Vavuniya Campus
International Research Symposium 2019

"Innovative Excellence for Tomorrow"

EXTENDED ABSTRACTS

1st October 2019

VAVUNIYA CAMPUS OF THE UNIVERSITY OF JAFFNA
SRI LANKA

VAVUNIYA CAMPUS INTERNATIONAL RESEARCH SYMPOSIUM-2019 (VCIRS-2019)

"Innovative Excellence for tomorrow"

1st October 2019

EXTENDED ABSTRACTS

Vavuniya Campus of the University of Jaffna, Sri Lanka

2019

Published by:

Vavuniya Campus of the University of Jaffna,
Park Road,
Vavuniya,
Sri Lanka.
TP: +94 77 236 9240, +94 77 658 8699
E-mail: vcirs2019@vau.jfn.ac.lk
Website: http://www.vau.jfn.ac.lk/vcirs2019/

ISSN: 1800-4911

Suggested Citation:

Subajana, J., (Ed.) (2019). Symposium proceedings of Vavuniya Campus Research Symposium 2019, Vavuniya, Sri Lanka: Vavuniya Campus of the University of Jaffna, 151p.

Organizing Committee

Chair: Dr. T. Mangaleswaran
Convener: Dr. S. Wijeyamohan
Secretary: Ms. K. Piranavamalar

Members

Ms. J. Subajana
Dr. S. Devaisy
Mr. T. Thilaganathan
Mr. T. Jeyamugan
Ms. S. Subaramya
Ms. N. Lojenaa
Mr. T. Selvamalai
Ms. K. Kajanthy
Mr. B. Balathas
Mr. S. Niththiyanantham

Editorial Board

Chief Editor

Ms. Subajana Jeyaseelan

Co-Editors

Ms. N. Lojenaa
Ms. S. Subaramya
Ms. A. Ann Sinthusha

Cover-Page Design

Ms. W. A. S. C. Perera

Panel of Reviewers

Name	Affiliation
Prof. T. Madhujith	University of Peradeniya
Prof. B. Nimalathasan	University of Jaffna
Prof. F. Hanziya Abdul Rauf	South Eastern University of Sri Lanka
Asst. Prof. Anang Hudaya Muhamad	Higher Colleges of Technology - UAE
Dr. (Ms.) L. Pradheeban	University of Jaffna
Dr. (Ms.) S. Devaisy	Vavuniya Campus
Dr. (Ms.) A. Nanthakumaran	Vavuniya Campus
Dr. (Ms.) J. Nimalan	Vavuniya Campus
Dr. (Ms.) K. Kalainathan	Vavuniya Campus
Dr. (Ms.) Y. Rathiranee	University of Jaffna
Dr. (Ms.) S. Shanmugathas	University of Jaffna
Dr. A. Rukshan	Vavuniya Campus
Dr. H. D. Dharshani Bandupriya	University of Colombo
Dr. J. Robinson	University of Jaffna
Dr. K. Pakeerathan	University of Jaffna
Dr. K. Thabotharan	University of Jaffna
Dr. Lishanthi Jeyawardena	University of Sri Jayewardenepura
Dr. N. Kengatharan	University of Jaffna
Dr. P. Pratheepkanth	University of Jaffna
Dr. R. A. Ratnasiri	Wayamba University of Sri Lanka
Dr. S. Rajumesh	University of Jaffna
Dr. S. Vasantharuba	University of Jaffna
Dr. S. Wijeyamohan	Vavuniya Campus
Dr. Senaka Amarakeerthy	University of Sri Jayewardenepura
Dr. Shashinie M. Thenabadu	University of Colombo
Dr. Shriram D. Raut	Punyashlok Ahilyadevi Solapur University
Dr. Swarnapali	Rajarata University of Sri Lanka
Dr. T. Ketheesan	University of Jaffna
Dr. Konara M. Dissanayake	Wayamba University of Sri Lanka
Dr. Y. Nanthagopan,	Vavuniya Campus
Mr. A. E. S. Patrick	Vavuniya Campus
Mr. A. Thayaparan	Vavuniya Campus
Mr. B. Yogarajah	Vavuniya Campus
Mr. C. Larojan	Vavuniya Campus
Mr. L. Mayuran	University of Jaffna
Mr. S. Thirugnanasampanthar	Vavuniya Campus
Mr. J. Aloy Niresh	Vavuniya Campus
Mr. T. Pratheepan	Vavuniya Campus
Ms. A. Dhanushanthini	University of Colombo
Ms. K. Nishanthan	University of Jaffna
Ms. Paulina M.G. Phillip	Vavuniya Campus
Ms. Sanjeewani Nanayakkara	University of Ruhuna
Ms. V. Sathana	University of Jaffna
Ms. M. W. A. C. R Wijesinghe	University of Colombo School of Computing

Message from the Competent Authority of the University of Jaffna

It is my great pleasure and honour to express this message to the second International Research Symposium Vavuniya Campus proudly conducts. I am delighted that Vavuniya Campus has its own potentiality and rapid growth logistically and academically and, also, a gateway for the research development for young academics. Their efforts have been the driving force of the research and development. Most importantly, the theme of the symposium **"Innovative Excellence for Tomorrow"** itself indicates the indispensability of innovation in this digital world and simultaneously it suits well to the era of the modern world. Particularly, I believe that presentations of this symposium will focus on some of the vital development issues of the nation, and provide motivation for further research in the identified area. The change of world is beyond everyone's expectation and imagination and remarkably creating new opportunities and challenges for the universities. In this scenario, we all must toil together and march towards innovation in all our academic accomplishments. Regardless of materialistic mind-sets, let us devote sincerely to reach our cherished mission and vision. I appreciate the enthusiastic and hard work of a number of colleagues of Vavuniya Campus. Therefore, as the Competent Authority of the University of Jaffna, I am extremely happy and proud of being part of this academic institution. I congratulate Vavunya Campus for its constant and continuous growth and performance throughout the decades.
Wish you a very good luck!

Prof. K. Kandasamy
Competent Authority
University of Jaffna, Sri Lanka.

Message from the Rector of the Vavuniya Campus

It is my immense pleasure to welcome all of you to the Vavuniya Campus International Research Symposium (VCIRS)-2019, to be held at Vavuniya Campus of the University of Jaffna on "**Innovative Excellence for Tomorrow".** The VCIRS provides a platform for sprouting and well-experienced academics and other professionals in research. The purpose of VCIRS is to promote discussions of research and relevant activities in the dynamic streams. This conference received research papers on the above theme all over the universities in our country and abroad. Also, this symposium aims at increasing the synergy between academic and industry professionals working in this area. The papers received in this international conference were rigorously reviewed by the highly qualified academic community. According to the review results, the program committee members have selected twenty-five out of forty high quality papers to be presented in this conference. The conference is furnished by the participation of an illustrious keynote speaker with a proven track record of research in the focused theme. I greatly appreciate and admire the support, effort, commitment and hard work from the VCIRS Committee members, staff of Vavuniya Campus. Finally, I also would like to take opportunity to thank all the external reviewers and contributing authors for producing high quality papers. We look forward to the exciting day of insightful presentations, discussions, and sharing of technical ideas with knowledge seekers.

'Research is what I'm doing when I don't know what I'm doing.' -Wernher von Braun

Dr. T. Mangaleswaran
Rector
Vavuniya Campus
01-10-2019.

Message from the Convener of the VCIRS 2019

"Innovative Excellence for Tomorrow" is the theme for the VCIRS -2019. How far the innovations have taken us today? Is it towards reality or disaster? This is a critical question to answer.

Medical innovations have increased modern human's average life time by almost 25 years in last 100 years. With the available technology and ground-breaking innovations in the field of medical science, it is easy to predict that in another 25 years time the average life time of human would be further increased by another 25 years. This means by 2050 the average life time of a human being would be simply 100 years or more. Yes, it is a great service to the mankind.

Leo Baekeland would not have thought that his innovation would be a disaster 100 years later when he invented Bakelite, the first real synthetic, mass-produced plastic. Recent finding by Canadian scientists revealed that premium tea bags release billions of micro plastics particles in your tea. Today the oceans around the world have been contaminated with micro plastics. Invention of plastic would have definitely been an "Innovative Excellence for Tomorrow" 100 years ago. Today, 100 year later, our organizing committee, with great difficulties and efforts, holds this International Research Symposium with "zero plastic" concept with the theme "Innovative Excellence for Tomorrow".

When innovations lead the man to explore the universe looking for "extra-terrestrial lives" a bird species, Dusky Seaside Sparrow (*Ammodramus maritimus nigrescens)* has become locally extinct in 1987 in the same place from where the rockets are blasted into the space.

Ever increasing human population is the root cause for many of the environmental issues such as extinction, habitat destruction, pollution and so on. While most of the medical innovations are very important on the humanitarian grounds, such as innovations leading to increasing the life expectancy for human, it should not end up in the lines of innovation of plastic.

Today, a camera developed in the MIT which can capture the movement of light is old news. In future more of these excellent innovations are going to happen. Then, hopefully, the problems created by earlier innovations will be solved. We have to remember that the Earth is alone in this Universe and its resources are limited.

Dr. S. Wijeyamohan
Senior Lecturer
Department of Bio-science
Vavuniya Camps of the University of Jaffna
Kurumankadu
Vavuniya

Adjunct Faculty, Missouri State University

Keynote Speaker

ENVIRONMENTAL CHANGES AND RANGE EXPANSION OF MOSQUITOES: EMERGING CHALLENGERS IN THE CONTROL OF MOSQUITO-BORNE DISEASES

Prof. S. N. Surendran
Department of Zoology, Faculty of Science, University of Jaffna, Jaffna

Mosquitoes are the vectors of major human diseases such as dengue and malaria. Mosquito-borne diseases are of public health concern in Sri Lanka. The mosquito vectors of human diseases co-exist and have co-evolved with humans over a long period of time. However, anthropogenic activities in the form of the rapid growth in human population and the associated expansion in agricultural activity and greater urbanization have created environmental changes that have had a marked impact on biology of mosquito vectors. Mosquito vectors are undergoing atypical adaptation to these changing environment and thus expand their range to invade new territories. This poses a threat of spreading vector-borne diseases to new areas and territories. Adaptation of mosquito vectors to the new habitats created by anthropogenic activities will be discussed in the lecture in the context of its potential for increasing disease transmission rates.

Keynote Speaker

NATURAL RESOURCE MANAGEMENT & CONFLICTS - FACILITATING CHANGE THROUGH CITIZENS DIALOGUE

Hans Peter Hansen
Senior Researcher, Aarhus University, Department of Bioscience, DK-8410 Rønde, Denmark
email: hph@bios.au.dk phone: + 45 93508675

Human-wildlife conflicts is an inherent and unavoidable part of nature conservation all over the world. Modern nature conservation paradigms often classes with the needs, values and cultural practices of the people and communities affected by the regulation, challenging the legitimacy and efficiency of governmental agencies and institutions. In my research, I explore the constructive potential by the active involvement and empowerment of local citizens within Natural Resource Management in general, and wildlife management in particular. Based on the experiences from one of my recent research projects, the Danish Wolf Dialogue Project I will put human-wildlife conflicts into a sociopolitical perspective and reflect on the potential of change through processes of citizens' dialogue.

Table of contents

Tracks

- Accounting & Finance
- Business Economics
- Business Management
- Hospitality Management
- Computing & Information Science
- Environmental Science
- English Literature & Linguistics

Accounting
&
Finance

ID - 13

BOARD GENDER DOMINATED SECTORS AND FINANCIAL PERFORMANCE IN SRI LANKA

Hameed, Z[1], Senavirathna, N[1], Weerasooriya S[1], Yasarathna, D[1] and Jayathilaka, R[1]
Faculty of Business, Sri Lanka Institute of Information Technology, Malabe, Sri Lanka.

Abstract

The purpose of this study is to identify the relationship between percentage of women on board and firm financial performance. In order to investigate this relationship, the gender composition of corporate boards of the 20 sectors classified by the Colombo Stock Exchange (CSE) is compared against its financial performances using Return on Assets (ROA) as a proxy. Data collected was analyzed using Pearson correlation technique. The results revealed new insights: The percentage of women directors in Information and Investment sectors has both a positive and significant correlation with the ROA. Moreover, the Information sector has the strongest positive relationship between the women director's percentage and ROA, while the Telecommunication sector has the strongest negative relationship.

Keywords*:* Women directors, financial performance, Colombo stock exchange

Introduction

The underrepresentation of women in the boardroom has gained substantial attention in the developed economies among a large number of researchers and policymakers in the recent years. This is regardless of the fact that female participation in the labour force and population of women in the world at large have both increased. Abundant literature indicates the impact of women directors on the financial performances of firms in the European Union (EU) and United States (US) [1,2]. Moreover, the financial crises and corporate scandals such as Lehman Brothers, Enron and WorldCom increased the concern for gender composition in corporate boards, whether it occurred because of the male domination in the banking industry. In the recent past too, many researches in developed economies have presented evidence on how gender diversity in boards have influenced financial performance. In top corporate firms in Europe, many senior positions and directorships are held by men while women hold only a few such positions although a large number of women join the labour force every year[3]. A study conducted by Adams & Feirreira[2] asserted that gender diversity in boards have a positive impact on the firm performance. Firms with more female directors or boards which have a high level of gender diversity tend to be overlooked. A similar study conducted in Spain; which is one of the countries with the highest quota for women on board, revealed that the presence of women directors alone has no impact on firm value. The positive impact is identified only in firms which have a diversified board[4].Results of a study conducted on board characteristics in the Sri Lankan context by Priya & Nimalathasan[5] on Hotels sector of the CSE revealed that the suggested number of women directors and those who are internal directors are significantly correlated with ROA.

Significant amount of evidence supports this research issue encountered in developed countries. A study by Liu[6] revealed that studies were mainly focused on firms in developed nations. As a result, it becomes evident that currently a research gap exists, due to lack of

insights with regards to addressing a similar issue in a developing economy, such as Sri Lanka. Therefore, it is evident that there is a growing concern to identify if the presence of female directors has any relationship between the financial performances of a firm. The main objective of this study is to identify the relationship between percentages of women directors in the CSE classified sectors and their financial performance. The significance of this study is to showcase the role of women on board and the importance of a well-diversified board. This study overcomes limitations of existing Sri Lankan literature by considering all the listed firms in the CSE during the period of 2012 to 2018, whereas previous researchers have either selected only a sample of the listed firms or selected a particular sector among the 20 sectors available. The seven-year time duration taken for this study is also comparatively higher than that taken in the similar studies conducted in the Sri Lankan context.

Methodology

This study uses panel data of public listed companies in the Colombo Stock Exchange (CSE) over the period of 2012 – 2018. This research is referred to as the panel or longitudinal study, since data has been collected over a period of seven years. In comparison to simple cross-sectional data, panel data have the ability to provide a more accurate analysis, while being appropriate for controlling unobservable heterogeneity and omitting variable biases[4]. Currently, the CSE has 297 companies representing 20 business sectors. However, after excluding unavailable data, the sample consists of 281 companies with 1,865 observations. Data collected was analyzed using descriptive statistics and Pearson correlation.

Results and Discussion

Percentage of female directors in the 20 sectors classified by the CSE was initially identified prior to finding the correlation between their financial performances. The findings reveal new insights on the presence of women directors in the sectors of CSE as depicted in Figure 1. The distribution of female directors varies from one industry to another. Participation of women on board is relatively high in the Textile, Telecommunication, Land and Beverage industries whereas the Construction, Chemical and Plantation sectors have the least percentage of female directors on boards. Moreover, the Oil sector has no female directors on board.

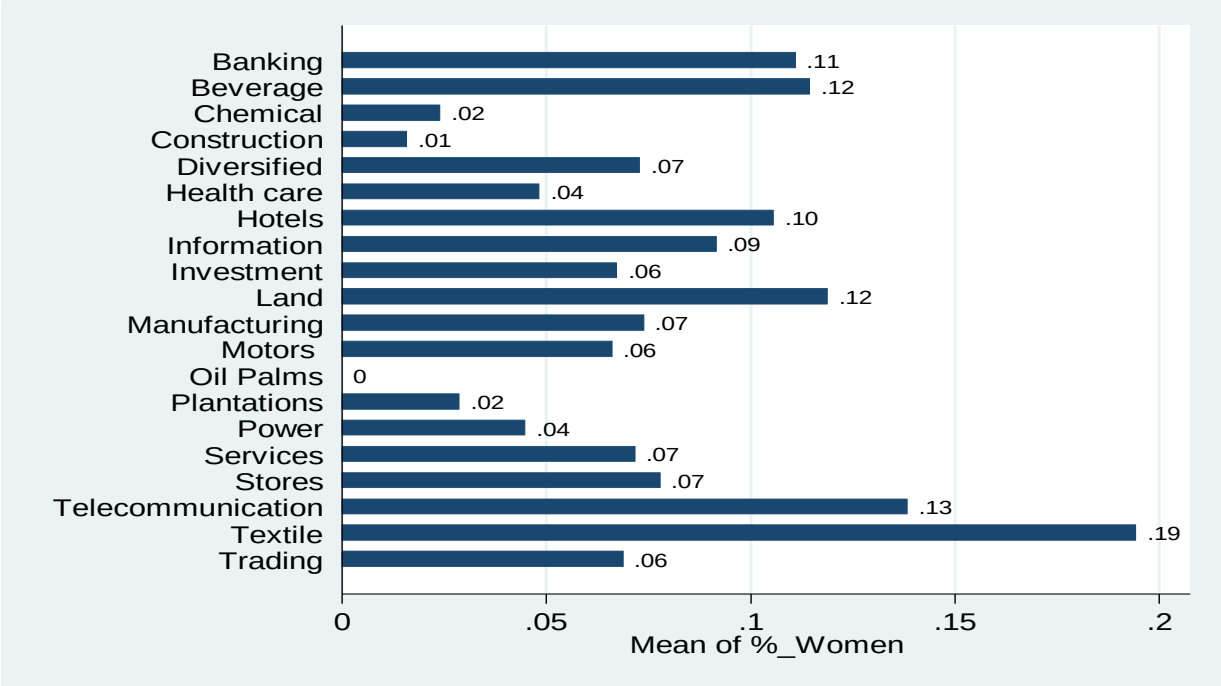


Figure 1. The percentage of women directors in the sectors classified by the CSE.

Table 1. Correlation between ROA and percentage of women directors representing the 20 sectors in the CSE.

CSE classified sectors	*ROA*	*Observations*
Banking	-0.0213	420
Beverage	-0.1979**	139
Chemical	0.1104	53
Construction	-0.0623	28
Diversified	0.0110	120
Health	-0.0005	39
Hotels	0.0455	228
Information	0.7435**	9
Investment	0.2634**	63
Land	-0.1116	104
Manufacturing	-0.0294	250
Motors	-0.2188	42
Oil	-	35
Plantation	0.1259	120
Power	-0.1194	57
Service	0.2103	56
Stores	-0.2399	28
Telecommunication	-0.8796***	13
Textile	0.4257	7
Trading	-0.1693	54

Note: ** Significance at the 5% level. *** Significance at the 1% level.

This study employed ROA as a proxy for financial performance since it is considered as a widely used financial performance indicator[6]. This ratio can be calculated as net income divided by total assets. The Pearson correlation between ROA and the percentage of women directors in the CSE classified sectors is illustrated in Table 1. Accordingly, results suggested that Information and Investment sectors are positively and significantly correlated with ROA, which is the measurement of firm's financial performance. Moreover, the Information sector has the strongest positive relationship between the women percentage on board and ROA with a coefficient of 0.7435. Strength of the relationship is lower in the Investment sector relative to the Information sector, since the coefficient is 0.2634.

On the contrary, Beverage and Telecommunication sectors reported significant negative relationship between percentage of women in the director board and ROA. Among these sectors, Telecommunication indicates the strongest negative relationship between the women percentage in the director board and ROA, with the highest negative coefficient of -0.8796. A similar study conducted by Pasaribu[7] in the United Kingdom (UK) revealed reasons so as to why these sectors have more female directors. He stated that firms are more likely to appoint female directors if these are into consumer-based industries such as retail, media, personal and household goods and healthcare sectors.

Conclusion

This study contributes new evidence on the relationship between board gender dominated sectors and firm financial performance in Sri Lanka. It has taken into consideration data of all the listed companies to provide a comprehensive picture on aspects of pertaining to board gender diversity in Sri Lanka. Similar studies conducted in Sri Lanka to date, were based on a sample of companies listed in the CSE. According to this study, new findings indicate that: Textile, Telecommunication, Beverage, Land, Banking and Hotel sectors have the highest percentage of female directors on board, while Construction, Chemical and Plantation sectors have the least.

Firms in many developed economies, such as in the EU and in US have compulsory gender quotas to comply and implement when determining its board gender composition. In contrast, Sri Lanka is a developing economy and has no such mandatory gender quotas to be adhered to. Therefore, the significance of the presence of women on board is still a topic that lacks awareness and with limited interest. Women in Asian countries such as Sri Lanka are still confined to family roles and invisible barriers tend to prevent them from climbing up the corporate ladder. Even in Sri Lanka, the gender composition in the corporate boards shows the extent to which women are underrepresented in boards. Therefore, the findings of this study will be much important to women of Sri Lanka, corporate boards and policy makers such as United Nations Women. The reason is being that these stakeholders are keen in ensuring rights of women and also in the process of implementing gender inclusive policies. These findings will also be vital to encourage women participation in senior positions and corporate boards. It is evident from these results, that women too have an ability to drive the financial performance of various sectors in Sri Lanka.

Reference

1. Green C.P. & Homroy S.Female directors, board committees and firm performance. *European Economic Review*.(14/12/2017)."Available from:"http://www.sciencedirect.com/science/article/pii/S0014292117302234 (28th June 2019)
2. Adams R.B. & Feirreira D.Women in the boardroom and their impact on governance and performance. *Journal of Financial Economics*.(04/08/2009)."Available from:"http://personal.lse.ac.uk/FERREIRD/gender.pdf (28th June 2019)
3. Christiansen L., Lin H., Pereira J., Topalova P. & Turk R.Gender Diversity in Senior Positions and Firm Performance: Evidence from Europe. *Periodical Gender Diversity in Senior Positions and Firm Performance: Evidence from Europe*.(03/2016)."Available from:"https://www.imf.org/external/pubs/ft/wp/2016/wp1650.pdf (18th July 2019)
4. Campbell K. & Mínguez-Vera A.Gender Diversity in the Boardroom and Firm Financial Performance. *Journal of Business Ethics*.(12/12/2007)."Available from:"https://link.springer.com/article/10.1007%2Fs10551-007-9630-y (28th June 2019)
5. Priya K. & Nimalathasan B.Board of directors' characteristics and financial performance: a case study of selected hotels and restaurants in Sri Lanka. *Merit Research Journal*. 2014, Vol.1(2) 20
6. Liu Y., Wei Z. & Xie F.Do women directors improve firm performance in China? *Journal of Corporate Finance*. 2014, Vol.28(C)
7. Pasaribu P.Female Directors and Firm Performance: Evidence from UK Listed Firms. *Gadjah Mada International Journal of Busines*.(08/2017)."Available from:"https://www.researchgate.net/publication/319251816_Female_Directors_and_Firm_Performance_Evidence_from_UK_Listed_Firms (9th July 2019)

ID - 17

DISCLOSURE OF CORPORATE SOCIAL RESPONSIBILITY IN TOURISM INDUSTRY, SRI LANKA

D. R. M. Weerasinghe[1], G. P. T. D. Pathirana[1], C. M. Rajapaksha[1], R. A. K. R. Perera[1], S. Kaneshwaren[1], N. Nagendrakumar[2], L. M. H. De Silva[3]

[1]*Undergraduate Candidate, Business School, Sri Lankan Institute of Information Technology, Malabe, Sri Lanka.*

[2]*Supervisor, Business School, Sri Lankan Institute of Information Technology, Malabe, Sri Lanka.*

[3]*Co-supervisor, Business School, Sri Lankan Institute of Information Technology, Malabe, Sri Lanka.*

Abstract

Studies that concentrate on the trend of Corporate Social Responsibility (CSR) disclosure in the Sri Lankan context, particularly in the hotel industry, are hardly found. The present study, therefore, aims to identify the trend in CSR disclosure of the tourism industry in Sri Lanka for the period from 2014 to 2018. A mixed approach of content and thematic analysis was employed in analyzing ten selected publicly quoted companies in the hotels and travels industry. The results of the study reinforce the tourism sector the pattern and the trend of CSR disclosure in heading towards effective strategic decisions. The study concludes that the growth of CSR disclosure in the hotel industry is not consistent.

Keywords: Sri Lanka, Tourism Industry, Corporate, Social Responsibility

Introduction

Today, the tourism industry is the third largest foreign exchange earner in Sri Lanka [1]. The industry has shown an upsurge in growth after the end of the civil war in 2009. Tourist arrivals have increased from 447,890 in 2009 to 2,333,796 in 2018[1,2]. Sri Lankan Tourism Development Authority (SLTDA) plans to double these numbers by 2020. Nevertheless, the interest of the community to engage in the tourism industry has rapidly increased due to this upsurge in growth after the civil war. It is mainly due to the expectations of the society and the possible consequences such an industry can have on the community. Maintaining a strong relationship between the community and the tourism industry is vital since it is the fundamental of building the country's image among tourists. As a result, if the community is disgruntled with the tourism establishments that will lead to loss of reputation in the world tourism [3]. Hence, CSR allows organizations to counteract this pressure from society while creating a sustainable future for the hotel industry. Damayanthi and Rajapakse[4], record that there is a growing trend in CSR activities reported by listed corporations. Furthermore, studies have shown that organizations by unique differentiation of CSR activities have tried to compete among themselves [5].

However, a recent study by Wijesinghe[6], argues that, the authentic disclosure level of CSR activities is low though a positive incremental trend is observed as a whole in Sri Lanka. Having said from the literature it is evident that many studies are conducted in other sectors except the few in tourism though the same is highly focused in other countries. Furthermore,

a knowledge gap was identified due to lack of research conducted in the tourism industry focusing on its CSR disclosure trend in recent years. Hence this research aimed to answer the question of what the trend of CSR disclosure in the tourism industry of Sri Lanka is. Accordingly, this research attempted to identify the trend of CSR disclosure in the tourism industry over the past five years and also, focused on exploring the importance given by firms on different dimensions of CSR.

Methodology

Current study employees a sample of ten publicly quoted hotel corporations listed under hotels and travels sector. Systematic sampling was adapted to avoid biasness towards firms with high market capitalization. Only firms which had released annual reports for the period of 2014 – 2018 were considered during sample selection. Annual reports for the period of 2014-2018 were used to derive CSR related information of selected firms. Preliminary work was to develop a checklist of keywords based on past literature. A checklist was developed with items relating to five dimensions of CSR, *viz.* community, employee relations, environment, product quality and diversity. The five dimensions included 190 keywords. By using the keywords in the checklist, a content analysis was carried out. It was found, searching the keywords at once would not serve the purpose. Secondly, the theoretical thematic analysis by Braun & Clarke[7] approach was adopted to deepen the analysis further. Under thematic analysis, CSR related information, which was not identified under the content analysis, were categorized into 62 CSR sub-themes. These themes and sub-themes were derived from the previously developed checklist of CSR items. A set of decision rules was developed to maintain consistency among all fifty annual reports when deriving CSR related information. Repetition of keywords and sub-themes in annual reports were counted and converted into Nila Units, introduced by Nuzula & Kato[8] to measure the level of CSR performance by each firm. Nila unit is calculated by dividing the total number CSR related keywords by the total number of words in the considered document.

$$Nila\ Unit = \frac{Number\ of\ CSRness\ words}{Total\ number\ of\ words\ in\ one\ document} \times 100$$

Average Nila Unit Percentage (ANUP) for each period was then calculated by dividing the total of Nila units for each period by the total number of considered firms in order to identify how the trend of CSR disclosure has behaved during the considered period.

Results

From the year 2014-2018, ANUP has shown an increment of 24.05%. However, the average annual growth rate of ANUP during the period is only 5.54%. On the other hand, annual growth rates of ANUP fluctuated between 13.77% to 1.35% show an inconsistent growth during the period. From the point of dimensions of CSR, “employee relation” and “community” hold an average importance in disclosure of 37% and 23% respectively during the period. “Environment” and “Product quality” dimensions hold an average importance of 19% and 16% respectively, while diversity being at only 6%.

Discussion

Based on the findings of the study, it was observed that there is a positive but slight incremental trend of CSR disclosure based on ANUP. Though the overall growth between 2014-2018 is 24.05%, which may seem attractive, the annual average growth rate is only 5.54%. It shows rather slow growth in the level of CSR disclosure during the period. Furthermore, inconsistency in annual growth rates was observed during the period. From 2015 to 2016, the annual growth rate has dropped from 13.77% to 4.18%. In 2017, this growth rate again decreased to 1.35% but increased up to 3.27% in 2018. Though there is an overall upward trend during the period, this inconsistency in annual growth makes it difficult to ensure that this trend will continue in the coming years as well.

Furthermore, it was found that, by 2018, only six out of ten firms have adopted a reporting structure that separately discusses on CSR and Sustainability matters. It was also noticed that most of the firms have repeatedly engaged in the same CSR initiatives and disclosed a similar level of information in consecutive years. Thus, it shows a lack of effort among companies to increase CSR commitments and could be the underlying reasons for slow growth in CSR disclosure. In some cases, annual reports only consisted of the financial aspect of the entity, and hardly any CSR related information was disclosed. A similar argument is made by Wijesinghe[9], stating that most financial reports contain financial and corporate information intending to satisfy shareholder needs. Wijesinghe[9] further argues that the primary objective of Sri Lanka companies is to maximize shareholder wealth instead of satisfying stakeholders as a whole.

Focusing the dimensions, it was observed that the highest emphasis by firms is given on disclosing employee related information. During the period, an average of 37% of disclosed CSR information relates to employee relations. Such a result can be expected as tourism is a high labor-intensive industry. Higher daily customer interaction could be another underlying reason for hotels to give such emphasis on their human capital. Providing high-quality service in-order to decrease customer churn rate by pooling skilled labour within the organization could be a motive for such focus. Firms may also be motivated to disclose information regarding their human capital as a mean of building confidence in shareholders which could especially be true for a firm operating in the tourism industry.

Moreover, it is observed that dimensions such as “community” and “environment” are also given a higher level of emphasis when disclosing CSR information. It is evident that significant efforts were put by most selected hotel firms to minimize the adverse effects of their operations on nature and community. However, it is still an undeniable fact that these initiatives may be strategically placed to benefit the firm itself. Most environmental initiatives taken by the firms can be linked with reducing energy costs and counteracting legal pressure. Some community outreach programs are carried out to develop strategic and harmonious relationships with local groups as a mean to avoid volatile situations.

From the findings of the study, it is evident that diversity is the least emphasized dimension, with an average importance in disclosure of only 6%. It was noticed that, though most firms discuss gender, ethnicity and racial equality, there is hardly any emphasis on factors such as employment of disabled and special interest groups. It raises the question of whether the

definition of equality within the Sri Lankan context is still limited to such a narrow scope. This can be considered as an area that requires more attention and future research.

Agreeing it is not the part of this paper, with the recent incident of the Easter Sunday attack, a decline in the identified CSR disclosure trend can be expected. Due to low occupancy rates, some hotels are forced to reduce their service rates to a level as low as 50%. Impact on financial performance due to such, will force firms to be more vigilant on their cost patterns. Hence, even the firms performing well in CSR may withhold from such activities as a mean of protecting profit margins. On the other hand, to counteract the current situation in the country, firms may focus more on improving their product quality and being innovative in providing higher security measures. Hence, the current average importance in disclosure of product quality, which is 16%, can be expected to increase in the future.

Conclusion

Findings of the study reveal that there is a slight increment in the trend of CSR disclosure in the tourism industry. Further, it was found that a significant proportion of disclosed CSR information relates to dimensions such as employee relations, community, and environment. It was observed that, though there is a positive increment in the level of disclosure, annual growth of the trend is problematic. As cited by Fernando[10], based on results of a survey conducted in 2004 by an international NGO named International Alert, reiterates that most companies lack strategy and policy in conducting CSR and also lacks a clear direction as to what and how to contribute to the society. As final remarks, in a global context, CSR is considered as a part of annual reports and financial statements, instead of voluntary activity[6]. As a result, it is recommended to exaggerate more effort by governing bodies of the country to foster the disclosure of CSR deeply rooted as the culture of the Sri Lankan firms.

Reference

1. SLTDA, (2017). *Annual Statistical Report*. [online] Sri Lanka: Sri Lankan Tourism Development Authority, 15,89. Available at: http://www.sltda.lk/node/763 [Accessed 3 Mar. 2019].
2. SLTDA, (2018). *Monthly tourist arrivals reports*. [online] Available at: http://www.sltda.lk/node/757 [Accessed 2 Mar. 2019].
3. SLTDA, (2019). *Community relations*. [online] Available at: https://www.sltda.lk/community_relations [Accessed 1 Jul. 2019].
4. Damayanthi, D. G. and Rajapakse, R. M. R. B. (2011). Factors leading to CSR reporting: a case from manufacturing sector in Sri Lanka. In: *International Conference on Business Management and Finance*. [online] Colombo: University of Colombo, 198-202. Available at: http://archive.cmb.ac.lk:8080/research/bitstream/70130/511/1/sample%20proceedings final%20(dragged)%202.pdf [Accessed 6 Mar. 2019].
5. Beddewela, E. & Herzig, C.,Corporate social reporting by MNCs' subsidiaries in Sri Lanka. *Accounting Forum*. 2019, 37(2) 135.
6. Wijesinghe, K. N. and Senaratne, S. (2011). Impact of disclosure of corporate social responsibility on corporate financial performance in bank, finance and insurance sector in Sri Lanka. In: *International Conference on Business and Information*.

[online] Kelaniya: University of Kelaniya, 1-18. Available at: http://fcms.kln.ac.lk/ICBI2011/ICBI%20CD/ICBI%202011/Papers/A&F%20141.pdf [Accessed 1 Jul. 2019].

7. Braun, V. & Clarke, V.,Using thematic analysis in psychology. *Qualitative Research in Psychology*. 2006, 3(2) 77.
8. Nuzula, N. F. & Kato, M.,Quantitative relations between corporate social responsibility activity and share price: introducing “Nila” unit. *Research Journal of International Studies*. 2010, (17) 146.
9. Wijesinghe, K. N.,Current context of disclosure of corporate social responsibility in Sri Lanka. *Procedia Economics and Finance*. 2012, 2 171.
10. Fernando, M.,Corporate social responsibility in the wake of the Asian tsunami: a comparative case study of two Sri Lankan companies. *European Management Journal*. 2007, 25(1) 1.

ID - 20

IMPACT OF FIRM SPECIFIC FACTORS ON CAPITAL STRUCTURE: EVIDENCE FROM LISTEDCOMPANIES IN COLOMBO STOCK EXCHANGE OF SRI LANKA

S. Kasthury [1], S Anandasayanan [2]
[1]*Student, Department of Financial Management, University of Jaffna*
[2]*Senior Lecturer, Department of Financial Management, University of Jaffna*

Abstract

Capital structure is one of the most controversial topics in the world of corporate finance. This study attempts to identify the factors affecting the capital structure and to what extent they impact on the capital structure. To analyze this, the researchers selected a sample of 100 listed companies in CSE for 6 years from 2013 to 2018 using stratified random sampling technique. The determinants of leverage represented by the variables namely Profitability, Tangibility, Size, Liquidity and Sales Growth Rate were independent variables. In addition, Total Debt to Total Assets was employed as dependent variable. The study was analyzed using the statistical tools Descriptive Statistics, Correlation Analysis, Pooled Ordinary Least Square Regression, Fixed Effect and Random Effect. The findings reflected Profitability and Liquidity have significant negative impact on leverage at the same time Tangibility, Firm Size, Sales Growth Rate have significant positive impact on leverage.

Keywords: Capital Structure, Profitability, Tangibility, Size, Liquidity, Sales Growth Rate

Introduction

Capital structure is one of the noteworthy and debatable matters in financial management. This has drawn special attention among the researchers for prolonged period it is because the decisions on capital structure directly or indirectly have effect in managing finance especially in maximization of wealth of investors. Also, there are several factors influencing the capital structure adversely or favorably while making decisions on seeking for the sources of finance. Unless the decision planned carefully, the firm may fail to maximize the shareholder's wealth at efficient cost. Therefore, considerable attention has to be taken while determining the optimal capital structure.

The mixture of different sources of financing is known as capital structure which comprises mainly of debt capital and equity capital (Pandey, 2009). The theory of capital structure was emerged by Modigliani and Miller in 1958 putting forward an opinion that capital structure does not affect the firm value under assumptions of efficient market conditions. Furthermore, other three conflicting theories were developed namely trade off theory (Modigliani and Miller, 1964), agency theory (Jensen and Meckling, 1976) and pecking order theory (Myers and Majluf, 1984). Various factors such as profitability, tangibility, firm size, growth opportunities, business risk, firm age etc play important role in determining the composition of capital structure of an organization. However, the nature of influencing and impact may vary from country to country, industry to industry depending on the economic situation. Thus, the researchers have intended to undertake study on the determinants of capital structure for 100 listed companies for 6 years from 2013 to 2018.

Research Problem

There are plenty of studies conducted by the foreign researchers on identifying the determinants of capital structure. (M'ng, Rahman and Sannacy, 2017; Acaravci, 2015). More than these, several researchers from Sri Lanka had also undertaken studies on determinants of capital structure (Vijayakumaran and Sunitha, 2011; Hassan and Safeena, 2015; Anadasayanan and Subramaniam, 2013). But the findings of these studies differ in terms of either industry or period. Also, the impact of the determinants of leverage on capital structure is bit conflicting especially variables carrying significant or insignificant impact, positive or negative impact and the empirical evidences are proved only in specific sector. Vijayakumaran and Sunitha (2011) had concluded that firm size has positive and significant impact on leverage on the other hand Thusyanthi and Yogendrarajah (2015) proved that there is a significant negative impact of firm size on debt to equity. Similarly, there are conflicting results between the firm specific factors and capital structure. So, the research problem is "To what extent the firm specific factors impact on capital structure of listed companies in Sri Lanka?"

Literature Review

Empirical Evidence

This section explains about the previous researches undertaken relating to capital structure. In a study conducted on Determinants of capital structure for 112 companies for the period from 1997 to 2005, it is proved that the profitability and growth has negative relationship with the leverage where as firm size positively related with the leverage (Jahfer, 2009). The pecking order theory is quite adapted by Sri Lankan listed companies as the firm size has significant and positive impact on capital structure and profitability negatively significantly impact on capital structure (Vijayakumaran et al., 2011). Yogendrarajah and Thanabalasingham (2011) had investigated on the determinants of capital structure for the listed manufacturing companies covering the period of 2005 to 2009. It has been concluded that profitability has a low impact on capital structure except tangibility and asset turnover.

Sangeetha and Sivathaasan (2013) have proved that use of debt financing is low in the context of Sri Lankan companies in a research on Factors determining capital structure. In addition they have concluded the factors such as profitability, growth and firm size significantly impact on capital structure. Sri Lankan companies under banks, finance and insurance industry adapts the trade off, pecking order and agency theory in various occasions (Sritharan, 2014). In their analysis, tangibility is negatively impact on short term and total debt ratios which is supporting the agency theory. And pecking order theory is highlighted by the negative impact of profitability on leverage.

In a research on Determinants of leverage of Sri Lankan listed manufacturing companies, Vijeyaratnam and Anandasayanan (2015) emphasized that profitability and non debt tax shield were possessing significant relationship with leverage and tangibility was not significantly related to leverage. Also, Hassan et al. (2015) proved liquidity and profitability has significant negative correlation with Long Term Debt ratio in study factors determining capital structure of listed companies in CSE.

.

Research Questions

The researchers have formulated the following questions to answer them through the study conducted. They are:

1. What are the factors determining the capital structure of listed companies in Sri Lanka?

Research Objectives

The objective of the study is listed as follows:

1. To identify the factors determining on capital structure of listed companies in Sri Lanka

Hypotheses Testing

The hypotheses developed for testing are as follows:

H1 - Determinants of capital structure has significant impact on Total Debt to Total Assets.

H1a – Profitability has significant impact on Total Debt to Total Assets.
H1b - Tangibility has significant impact on Total Debt to Total Assets.
H1c – Firm Size has significant impact on Total Debt to Total Assets.
H1d – Liquidity has significant impact on Total Debt to Total Assets.
H1e – Sales Growth Rate has significant impact on Total Debt to Total Assets.

Conceptual Framework

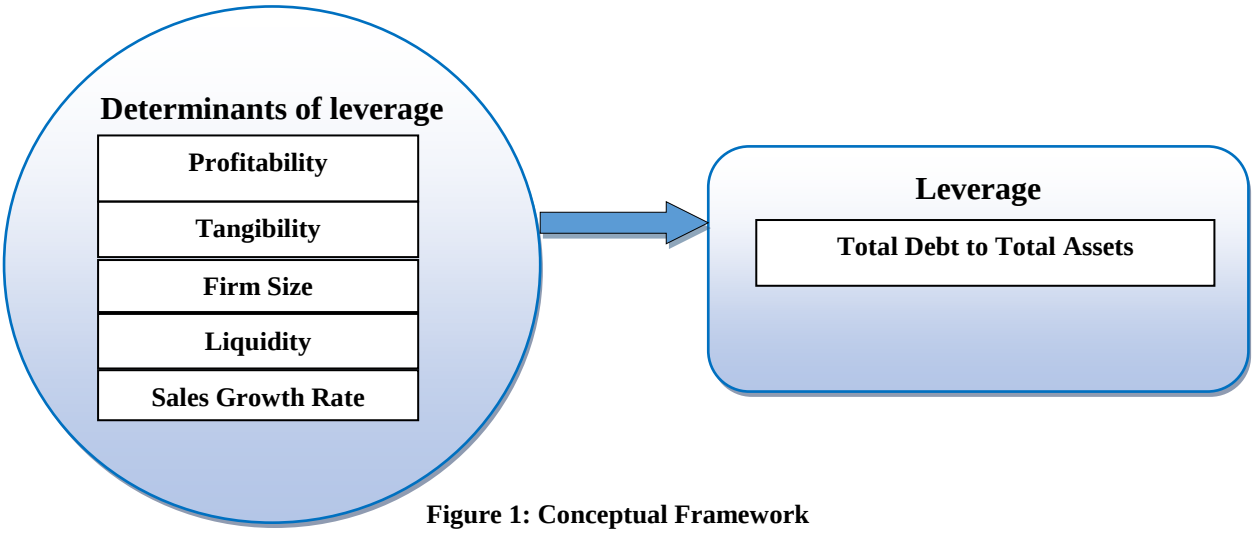


Figure 1: Conceptual Framework

Source: Deduced from the literature

Research Methodology

There are 297 companies listed in Colombo Stock Exchange of Sri Lanka representing 20 sectors. Out of these, the researcher has chosen 100 companies out of 16 sectors using Random Stratified Sampling method. Due to unavailability of data for some companies for few years, the Stratified Sampling method was employed to extract data for 100 listed companies for 6 years period from 2013 to 2018. Also, it is common the other researchers have conducted the study for specific sector only.

The study was analyzed using the secondary data and the data had been collected from annual financial statements of companies listed in Colombo Stock Exchange of Sri Lanka. The statistical techniques such as Descriptive Statistics, Correlation Analysis, Ordinary Least Squares Regression, Fixed Effect, Random Effect and Variance Inflation Factor were used to analyze the data.

$$TD\_TA = \beta_0 + \beta_1 PROF + \beta_2 TANG + \beta_3 SIZE + \beta_4 LIQ + \beta 5 SGR + \varepsilon$$

where,

β0	-	Constant variable
β1, β2, β3	-	Coefficient of variables
ε	-	Error

Table 1. Variables and measurement

Abbreviations	Variable	Measurement
TD_TA	Total Debt to Total Assets	Total Debt / Total Assets
PROF	Profitability	Profit Before Tax / Total Assets
TANG	Tangibility	Tangible Fixed Assets / Total Assets
SIZE	Firm Size	Logarithm of Sales
LIQ	Liquidity	Current Assets / Current Liabilities
SGR	Sales Growth Rate	Percentage change in sales

Results and Discussions

Table 2. Descriptive Statistics

	TD_TA	PROF	TANG	SIZE	LIQ	GROWTH
Mean	0.353061	0.079598	0.658529	20.75116	4.693721	2.05E+10
Median	0.337087	0.071181	0.690155	20.74073	1.458270	7.890839
Maximum	1.326374	0.739935	0.999323	25.86484	114.1067	1.05E+12
Minimum	0.003028	-0.216100	0.046129	9.210340	0.020905	-8.268431
Std. Dev.	0.231152	0.092007	0.227552	2.035401	11.58702	1.08E+11

Source: Surveyed Results

Based on the above output, the mean value of Total Debt to Total Assets, Profitability, Tangibility, Firm Size, Liquidity and Sales Growth Rate are 0.353061, 0.079598, 0.658529, 20.75116, 4.693721 and 2.05 respectively. This reflects the average leverage is low which means listed companies in Sri Lanka are quite rarely financed by debt capital. Also, the average profitability is 7.9%.

Table 3. Correlation matrix

	TD_TA	PROF	TANG	SIZE	LIQ	SGR
TD_TA	1.00000					

PROF	-0.117829	1.00000				
	0.0038	-----				
TANG	-0.253148	0.04838	1.00000			
	0.0000	0.2366	-----			
SIZE	0.317097	0.13801	-0.20560	1.00000		
	0.0000	0.0007	0.0000	-----		
LIQ	-0.379844	0.03666	-0.04595	-0.15422	1.00000	
	0.0000	0.3700	0.2611	0.0001	-----	
SGR	0.069217	0.00093	-0.04387	0.03848	0.06597	1.00000
	0.0903	0.9818	0.2833	0.3467	0.1064	-----

Source: Surveyed Results

The above Table 3 represents the Pearson's correlation matrix of dependent and independent variables. The Profitability, Tangibility and Liquidity are negatively and significantly correlated with the Total Debt to Total Assets. On the other hand, Firm Size and Sales Growth Rate have positive relationship which is statistically significant at 95% and 90% confidence level respectively. All the independent variables except Sales Growth Rate possess significant relationship with Total Debt to Total Assets at 95% confidence level since the p value is less than 0.05.

Table 4. Ordinary Pooled Ordinary Least Square

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.000420	0.094417	-0.004449	0.9965
PROF	-0.318842	0.088649	-3.596671	0.0003
TANG	-0.215327	0.036346	-5.924388	0.0000
SIZE	0.026529	0.004149	6.394234	0.0000
LIQ	-0.007058	0.000707	-9.977324	0.0000
SGR	1.60E-13	7.49E-14	2.131568	0.0335
R-squared				0.282231
Adjusted R-squared				0.276189
F-statistic				46.71286
Prob(F-statistic)				0.000000
Durbin-Watson stat				0.809131

Source: Surveyed Results

Table 5. Fixed Effect

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.034124	0.197790	-0.172528	0.8631
PROF	-0.181500	0.065936	-2.752671	0.0061
TANG	0.131314	0.048551	2.704665	0.0071
SIZE	0.015491	0.009416	1.645090	0.1006
LIQ	-0.003018	0.000572	-5.278384	0.0000
SGR	3.83E-13	1.61E-13	2.374390	0.0180
R-squared				0.825244
Adjusted R-squared				0.788527
F-statistic				22.47611
Prob(F-statistic)				0.000000
Durbin-Watson stat				2.133087

Source: Surveyed Results

Table 6: Random Effect

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.175319	0.138174	-1.268826	0.2050
PROF	-0.201374	0.064028	-3.145070	0.0017
TANG	0.015645	0.041699	0.375176	0.7077
SIZE	0.026367	0.006354	4.149605	0.0000
LIQ	-0.003820	0.000546	-7.001643	0.0000
SGR	2.38E-13	1.14E-13	2.088339	0.0372
R-squared				0.122482
Adjusted R-squared				0.115095
F-statistic				16.58182
Prob(F-statistic)				0.000000
Durbin-Watson stat				1.761022

Source: Surveyed Results

Table 7. Hausman Test

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	31.627498	5	0.0000

Source: Surveyed Results

The above tables Table 4, Table 5 and Table 6 depict the regression of Pooled Ordinary Least Square, Fixed effect and Random Effect respectively. Based on the Pooled Ordinary Least Square, Fixed effect and Random Effect models, Profitability and Liquidity negatively impact on Total Debt to Total Assets possessing statistically significant at 95% confidence level. Whereas Firm Size and Sales Growth Rate positively impact on the Total Debt to Total Assets as per the Pooled OLS. But, the Firm Size does not significantly impact on Total Debt to Total Assets in Fixed Effect Model and Tangibility does not impact on Total Debt to Total Assets in Random Effect Model. However, according to the Hausman test carried out, the Fixed Effect is appropriate model as the probability value of Chi square is less than 0.05.

In respect to the Fixed Effect model, R^2 is 0.8252 which reveals 82.52% variation in the Total Debt to Total Assets is explained by the variation in the determinants of leverage. Additionally, the value of F statistic is 22.48 and its probability value is less than 0.05 proving the overall model is best and significant at 95% confidence level. Also, the Durbin Watson value is closer to two which indicates there is no auto correlation issue.

Conclusion

This study examines the determinants of capital structure of 100 listed companies in Colombo Stock Exchange of Sri Lanka from 2013 to 2018. With reference to the fixed effect, the findings revealed there is a negative impact of Profitability on leverage and the impact is significant at 5% which is consistent with the findings of Dissanayake (2015), Gamini (2008), Vijeyaratnam et al. (2015), Anandasayanan et al. (2013), Hassan et al. (2015) and Thusyanthi et al. (2015). Also, Liquidity negatively and significantly impact on leverage and matches the findings of Dissanayake (2015) and Hassan et al. (2015). Firm Size does not significantly influence the leverage and corresponds with Hassan et al. (2015). Moreover, all the hypotheses are accepted except H1c.

Reference

1. Acaravci, S. K. The determinants of capital structure: Evidence from the Turkish manufacturing sector. *International Journal of Economics and Financial Issues*.2015, 5(1) 158.
2. Ajanthan, A., Determinants of capital structure: Evidence from hotel and restaurant companies in Sri Lanka. *International journal of Scientific and research publications.*2013, 3(6) 1.
3. Anandasayanan, S., Subramaniam, V. A., Srirangan, A.,&Raveeswaran, M., The Determinants of Leverage of the Listed Companies in Sri Lanka: An Empirical Study.*International Journal of Research in Commerce & Management.* 2013, 3(6) 1.
4. Dissanayake, T. D. S. H., & Fernando.C. S. P. K., Determinants Of capital Structure: Evidence From Sri Lanka. 2015.
5. Gamini, L. P. S., Determinants of capital structure– A case in Sri Lanka. *Journal of Humanities and Social Sciences*. 2008, 4 38 .
6. Hassan& Safeena, M.G., Factors determining capital structure: an analysis of listed companies in the Colombo Stock Exchange in Sri Lanka. 2015.
7. Jahfer, A., Determinants of Capital Structure in Sri Lanka: An Empirical Study.*Annamalai International Journal of Business Studies & Research*. 2009, 1(1) 23.
8. Jensen, C., &Meckling, H., Theory of the firm: Managerial behavior, agency costs and ownership structure.*Journal of financial economics*. 1976, 3(4) 305.
9. M'ng, J. C. P., Rahman, M., & Sannacy, S. The determinants of capital structure: Evidence from public listed companies in Malaysia, Singapore and Thailand. *Cogent Economics & Finance*.2017, *5*(1).
10. Modigliani, F., &Miller, H., The cost of capital, corporation finance and the theory of investment.*The American.* 1958, 3.
11. Modigliani, F., &Miller, H.,Corporate income taxes and the cost of capital: A Correlation.*The American.* 1964,53 433.

12. Myers, C., and Majluf, S., Corporate financing and investment decisions when firms have information that investors do not have.*Journal of financial economics*. 1984, 13(2) 187.
13. Pandey, I. M.,*Financial management*.New Delhi: Vikas Publishing House PVT Ltd, 2005.
14. Pratheepan, T., & Yatiwella, W.B. The determinants of capital structure: Evidence from selected listed companies in Sri Lanka. *International Journal of Economics and Finance*.2016, 8(2).
15. Sangeetha, M., & Sivathaasan, N., Factors determining capital structure: a case study of listed companies in Sri Lanka.*Research Journal of Finance and Accounting*. 2013, 4(6) 236.
16. Sritharan, V., Determinants of capital structure-a study of listed banks finance & insurance companies in Colombo Stock Exchange in Sri Lanka. *International Journal of Economics, Commerce and Management*.2014, 2(10) 72.
17. Thusyanthi, R., & Yogendrarajah, R., Determinants of Capital Structure: Evidence from Listed Manufacturing Companies in Sri Lanka. 2015.
18. Vijayakumaran, R., &Sunitha, V., Determinants of capital structure in Sri Lanka: Evidence from panel data. *Proceedings of the international conference of Sri Ram Institute of Management Studies, India*. 2011, 295.
19. Vijeyaratnam, H., & Anandasayanan, S., The Determinants of Leverage of Sri Lankan Manufacturing Companies Listed on Colombo Stock Exchange. *Research Journal of Finance and Accounting*.2015, 6(5).
20. Yogendrarajah, R., & Thanabalasingham, S. Determinants of Capital Structure: A Study of Listed Manufacturing Companies of Colombo Stock Exchange (CSE), Sri Lanka. *Financial Information and Strategies. 2011*.

ID - 37

IMPACT OF OWNERSHIP AND BOARD STRUCTURE ON CORPORATE SOCIAL RESPONSIBILITY DISCLOSURE OF LISTED COMMERCIAL BANKS OF SRI LANKA

Mithushana.R[1], Johnathan Kevin S.P.T [2], Vijayakumaran R[3]
Department of Financial Management, Faculty of Management Studies and Commerce, University of Jaffna.
Department of Financial Management, Faculty of Management Studies and Commerce, University of Jaffna.
Department of Financial Management, Faculty of Management Studies and Commerce, University of Jaffna.

Abstract

The purpose of this study is to examine the relationship between corporate social responsibility (CSR) disclosure and ownership and board structure in domestic licensed commercial banks in Sri Lanka. Ownership and board structure have been identified as independent variables and CSR disclosure identified as the dependent variable in this study. The researcher selected 11 high performance domestic licensed commercial banks as a sample for a period of six years starting from 2012 to 2017. Based on the analysis results, there is a significant, positive impact between CSR disclosure and institutional ownership and foreign investors has a significant negative impact on CSR disclosure. Further managerial ownership has insignificant impact on CSR disclosure. Also board structure does not show a significant impact on CSR disclosure in listed licensed commercial banks in Sri Lanka. Researcher concludes that different ownerships have different impacts on the bank's CSR reporting.

Keywords: Board Structure, Commercial Banks, Corporate Social Responsibility, Ownership Structure.

Introduction

CSR has gained momentum as a new concept regarding the social impact of business enterprises and has become a popular notion among stakeholders, such as managers, investors, creditors, suppliers, customers, employees and policy makers. Several issues in this regard, such as pollution, resource depletion, waste, product quality and safety and the rights and the status of the workers, have become the focal aspects of this growing attention (Gray, Owen and Maunders 1987). Firms are expected to behave in a socially responsible manner while, at the same time, generating value for investors. Today the banking industry is considered as one of the key contributing sectors behind economic solidity and growth, and it is highly observable to public evaluation. So general public now has high expectations of the government and private sector for responsible behavior. With the recent corporate scandals and corruption have indicated that over-focusing on financial results while disregarding other aspects of business has produced failures. Thus, CSR refers to finding a balance between the financial and non-financial goals of corporations, while acting in the best interest of society as a whole.

Problem Statement

The results of impact of ownership and board structure on CSR Disclosure on past studies have been mixed. Some researchers have been identified a negative relationship between CSR and profitability. As well as some researchers conclude that there are no any relationships between these two variables. As examples Wright and Ferris (1997) discovered a negative relationship, Tsoutsoura (2004) reported a positive relationship, while Teoh, Welch and Wazzan (1999) found no relationship between CSR and financial performance. Therefore it's better to understand the actual situation of the Sri Lankan banking industry. This measured how CSR practices effect on reporting of the banks of the same financial year and how it affects the next financial year.

Research Question

Does the ownership and board structure have an impact on CSR reporting of listed commercial banks in Sri Lanka?

Objectives

The primary objective of the study is to examine the impact of ownership and board structure on CSR reporting of listed banks in Sri Lanka.

Literature Review

As to Gray, Owen and Adams (1996) define CSR reporting disclosure is as the process of communicating the social and environmental effects of organizations' actions such as economic, to relevant interest groups within society and to society at large. When considering the CSR disclosures, most of the entities disclose the CSR activities for various purposes. According to Damayanthi and Rajapaksha (2011), there are two reasons company motivating the CSR disclosures. First one is creating authenticity through reporting the quality and reputation of its products and operations, being a communication media, stay away from stakeholder challenges, proactively winning the assurance of stakeholders, informing the stakeholders on organizational changes and changing the perception of the public reflecting the legitimization through the factors leading to CSR reporting. Second, CSR reporting is due to: requirement to ensure the competitive position in the industry, maintain the trend in the industry, the influence by the professional bodies which provide guidelines, the organizational growth and its' profitability, influence of leaders on CSR reporting, and the impact of organization specific culture reflecting the institutionalization through the factors leading to CSR reporting.

Financial institutes are exclusive in many ways and the retail services provide to firms role in facilitating economic activity for corporations. Those firms are also unique in how they have altered over the last few decades. When considering the Sri Lankan economy, the service sector plays vital role and high portion support from banking and financial institutions. The finance sector had become so important to the Sri Lankan economy; problems within the finance sector can impact so many other aspects of the economy. Studying the factors that can impact the finance sector is of critical importance. According to Damayanthi and Rajapaksha (2011), there is an increment trend to report on listed companies in Sri Lanka and

$$\text{CSR Index} = \boldsymbol{\beta 0} + \boldsymbol{\beta 1}\text{MOWti} + \boldsymbol{\beta 2}\text{IOWti} + \boldsymbol{\beta 3}\text{FOWti} + \boldsymbol{\beta 4}\text{BRDSIZti} + \boldsymbol{\beta 5}\text{INDRMEMti} + \boldsymbol{\beta 6}\text{FEMDRMEMti} + \boldsymbol{\beta 7}\text{BSIZti} + \boldsymbol{\beta 8}\text{PRFTti} + \boldsymbol{\beta 9}\text{LEVti} + \boldsymbol{\varepsilon ti}$$

that in the banking and finance, insurance, plantation, food and beverage and tobacco sector the CSR reporting is most common.

Methodology

This research study focuses on inferential research design to identify the impact of ownership and board structure on CSR in listed banks in Sri Lanka. By conducting this research study, researcher is going to identify the relationship in between CSR reporting disclosure and CSR proxies with the different type of ownership of shareholders and board structure. EViews 8 software used to analyze statistical data of the research. Based on the variables following regression equation is derived by the researcher.

When those variable applied to regressions those are formulated as follows,
Where,

β0 – Intercept

MOW – Managerial Ownership

IOW - Institutional Ownership

FOW – Foreign Ownership

BRDSIZ - Board size

INDRMEM - Independent directors

FEMDRMEM - Female directors

BSIZ - Bank size

PRFT – Profitability

LEV - Leverage

E – Error term

Hypotheses

H1a = There is a significant relationship between MOW and CSR

H1b = There is a significant relationship between IOW and CSR

H1c = There is a significant relationship between FOW and CSR

Results

Table 01. Descriptive Analysis

	BRDSIZ	FEMDRMEM	FOW	INDRMEM	IOW	MOW	BSIZ	LEV	PRFT	CSR
Mean	10.64	2.12	16.40	5.32	55.36	1.35	8.55	1.15	0.14	0.76
Median	11.00	2.00	17.90	5.00	75.78	0.04	8.54	0.78	0.15	0.80
Maximum	15.00	4.00	36.70	10.00	92.79	15.02	9.30	5.18	0.34	0.91
Minimum	7.00	0.00	0.00	0.00	0.00	0.00	7.50	0.00	0.00	0.43
Std. Dev.	1.99	1.076	12.63	1.69	34.80	3.66	0.44	1.25	0.06	0.14
Skewness	-0.10	0.21	-0.07	-0.46	-0.78	3.28	-0.29	1.44	0.14	-0.98
Kurtosis	1.95	1.86	1.56	5.11	1.87	12.48	2.31	4.33	3.98	2.77
Jarque-Bera	3.06	3.94	5.58	14.28	9.97	355.46	2.21	26.91	2.82	10.41
Probability	0.21	0.14	0.06	0.000794	0.0068	0.00	0.33	0.00	0.24	0.01
Sum	681.0	136.00	1049.96	341.00	3543.42	86.51	546.98	74.00	9.43	48.87
Sum Sq. Dev.	250.73	73.00	10050.48	180.11	76302.12	845.59	12.70	99.79	0.24	1.25
Observations	64	64	64	64	64	64	64	64	64	64

The data shows that the mean of the FOW is 16% with the standard deviation of 13% also the FOW ranges approximately from 37% (Maximum) to 0% (Minimum). The data also shows that, nearly (55.37%) of the sample firms owned by institutional investors which means most of the shares held by the Institutions. The Managers have the ownership nearly 1.35% (average) and the maximum Managerial Ownership rate is 15% whereas the lowest recorded managerial ownership is 0%. The mean of the Dependent Variable CSR Index is 76% and the maximum value of the CSR Index is 91% while the lowest is 43%.

Table.02 Correlation Analysis

Correlation										
Probability	BRDSIZ	FEMDRME	FOW	INDRMEM	IOW	MOW	BSIZ	LEV	PRFT	CSR
BRDSIZ	1.000									

FEMDRME	0.3687	1.000								
	0.003	-----								
FOW	0.228	0.213	1.000							
	0.069	0.092	-----							
INDRMEM	0.294	0.343	0.282	1.000						
	0.018	0.006	0.024	-----						
IOW	0.202	0.287	0.721	0.356	1.000					
	0.110	0.021	0.000	0.004	-----					
MOW	0.255	0.277	0.014	0.081	0.150	1.000				
	0.042	0.027	0.915	0.524	0.238	-----				
BSIZ	-0.544	0.126	-0.070	-0.059	-0.170	-0.040	1.000			
	0.000	0.319	0.584	0.645	0.178	0.754	-----			
LEV	-0.248	0.023	0.048	-0.075	-0.036	0.007	0.136	1.000		
	0.048	0.860	0.709	0.556	0.778	0.958	0.286	-----		
PRFT	-0.348	-0.049	-0.105	-0.235	-0.244	-0.106	0.467	-0.068	1.000	

	0.005	0.700	0.411	0.061	0.052	0.4041	0.000	0.594	-----	
CSR	-0.307	0.125	0.384	0.073	0.637	-0.053	0.277	0.204	0.068	1.000
	0.013	0.324	0.002	0.566	0.000	0.677	0.027	0.107	0.594	-----

Based on the results BRDSIZ has negative relationship with CSR Index (-0.307490) and which is statistically significant with CSR Index at 5% level. The FEMDRMEM has positive relationship with CSR Index (0.125309) but it is not statistically significant. The Independent Directors INDRMEM has positive relationship with CSR Index (0.073068) but it is not significant.

Then FOW has positive relationship with CSR Index (0.384444) and also significant with CSR Index at 1% level. IOW has strong positive relationship with the CSR Index (0.637327) and also it is statistically significant with the Dependent Variable at 1%. MOW has negative relationship with CSR Index. (0.053167) and it is not statistically significant.

Except BSIZ and MOW other all variables have positive relationship with the CSR Index. IOW has the strongest relationship with CSR Index among all the variables.

Table 03: Regression Analysis

Dependent Variable: CSR_INDEX

Method: Least Squares

Date: 06/26/19 Time: 10:07

Sample: 1 66

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.052401	0.338975	0.154586	0.8777
BOARD_SIZE	-0.013354	0.008436	-1.582919	0.1193
FEMAL_DIRECTORS	0.000261	0.012857	0.020263	0.9839
FOREIGN	-0.002280	0.001314	-1.735245	0.0884
INDEPENDENT_DIRECTORS	-0.008033	0.007296	-1.101103	0.2757
INSITUTIONAL	0.003802	0.000503	7.554248	0.0000
MANAGERIAL	-0.004582	0.003173	-1.443802	0.1546
BANK_SIZE	0.080162	0.034609	2.316223	0.0244
LEVERAGE	0.018286	0.009233	1.980487	0.0528
PROFITABILITY	0.151939	0.210387	0.722189	0.4733

R-squared	0.687030	Durbin-Watson stat	1.055047
Adjusted R-squared	0.634869		
F-statistic	13.17120		
Prob(F-statistic)	0.000000		

Based on the results, it is observed that institutional ownership shows a significant impact over CSR disclosure since the p value of this being 0.0000. Also foreign ownership shows a significant impact on CSR disclosure at 90% confidence level, since the p value is 0.0884. Other independent variable not shows a significant impact over CSR disclosure on commercial banks of Sri Lanka since the p values became 0.1546 of managerial ownership. R squared indicates that 69% of influence over dependent variable is caused by the independent variables used in the particular study. And F statistic results shows that the model fits perfectly to the study since the value became 0.0000.

Conclusion

The main objective of this study was to find out the impact of ownership and board structure on banks' CSR disclosure. According to the result of the regression analysis researcher found that there is a significant relationship between institutional and foreign ownership and CSR disclosure of banks. Findings of this study are consistent with Merve et al. (2015), Muttakin et al. (2015), and Panicker (2017).

The regression model shows that institutional ownership has a significant positive impact on CSR disclosure. This finding is consistent with Shleifer and Vishny (1997), Schnatterly et al. (2008), Graves and Waddock (1994) Teoh and Shiu (1990).It means if there is an increase in the institutional ownership the CSR disclosure will also be increased. Normally the institutional owners concentrate on long term performance because they cannot easily sell the shares. Since the CSR investments are mostly realized in long term, so the institutional owners would be more supportive to CSR. The results state that there is a negative significant relationship between foreign ownership and CSR disclosure. This significant indicates any increase in the foreign ownership will result reduction in the CSR disclosure. This finding is consistent with Fitri et al. (2017). Then the model shows that there is a negative insignificant relationship between managerial ownership and CSR disclosure. It indicates that any changes in the managerial ownership do not impose impact on CSR disclosure. This finding is consistent with Swandari and Sadikin (2016). Therefore, based on the study, it can be concluded that the institutional ownership and foreign ownership shows a significant impact on banks' CSR disclose in listed licensed commercial banks in Sri Lanka.

Reference

1. Damayanthi, D. G., & Rajapakse, R. M. R. B. (2011). Factors Leading To CSR Reporting: A Case From Manufacturing Sector In Sri Lanka.

2. Graves, S. B., & Waddock, S. A. (1994). Institutional owners and corporate social performance. Academy of Management journal, 37(4), 1034-1046.

3. Gray, R., Owen, D., & Maunders, K. (1987). Corporate social reporting: Accounting and accountability. Prentice-Hall International.

4. Muttakin, M. B., & Subramaniam, N. (2015). Firm ownership and board characteristics: do they matter for corporate social responsibility disclosure of Indian companies?. Sustainability Accounting, Management and Policy Journal, 6(2), 138-165.

5.Panicker, V. S. (2017). Ownership and corporate social responsibility in Indian firms. Social Responsibility Journal, 13(4), 714-727.

6. Schnatterly, K., Shaw, K. W., & Jennings, W. W. (2008). Information advantages of large institutional owners. Strategic Management Journal, 29(2), 219-227.

7. Shleifer, A., & Vishny, R. W. (1997). A survey of corporate governance. The journal of finance, 52(2), 737-783.

8.Teoh, H. Y., & Shiu, G. Y. (1990). Attitudes towards corporate social responsibility and perceived importance of social responsibility information characteristics in a decision context. Journal of Business Ethics, 9(1), 71-77.

9.Tsoutsoura, Margarita. "Corporate social responsibility and financial performance." (2004).

10.Wright, P., & Ferris, S. P. (1997). Agency conflict and corporate strategy: The effect of divestment on corporate value. Strategic management journal, 18(1), 77-83.

ID - 42

FACTORS AFFECTING TO THE CSE INVESTOR'S PERCEPTION: A CASE OF NORTH CENTRAL PROVINCE

JMN Wijekumara[1], DMT Madhushanka[2]
Faculty of Management Studies, Rajarata University of Sri Lanka

Abstract

The aim of this study is to identify the factors that affect to the perception of investors for investing in Colombo Stock Exchange special reference to the North Central Province.In the present study, three independent variables and one dependent variable are considered. A sample size of sixty individual investors was drawn from the population of North Central Province's individual investors by using stratified random sampling method. The structured questionnaire was used to collect the data and the study used descriptive analysis, correlation analysis and regression analysis as the analytical tools. Result of the study revealed that socioeconomic status and savings have significant impact on perception of investors and awareness has insignificant impact on perception of investors for investing Colombo Stock Exchange. These results are implied to encourage investors and financial analyst to investing Colombo Stock Exchange by identifying factors that affected to their perception.

Keywords: Socioeconomic status, Awareness, Savings, Colombo Stock Exchange

Introduction

Investment and savings are very imperative to all countries for their economy. There are many causes affect for savings and investment. Colombo Stock Exchange is one of most widespread stock exchange in South Asia, and it is providing a fully automated trading platform for Sri Lankan investor. It has opened to investors for their transactions since 1985 but evolution of the share trading began 1895. Colombo Stock Exchange is a systematized market for buying and selling securities. The debentures, shares issued by public listed companies. Now stock market has branches over the Sri Lanka in Kandy, Jaffna, Negombo, Matara, Kurunegala, Anuradhapura and Ratnapura. Hence it's more advantageous to the rural area people to diversify their assets.

Past studies show that many factors affected on the investor's perception when investing. For example, Bhavani & Shetty (2017) studied that impact of demographics and perceptions of investors on investment avenues and they identified that individual investor's investment choice depends on the demographic variables and the perception of investors.

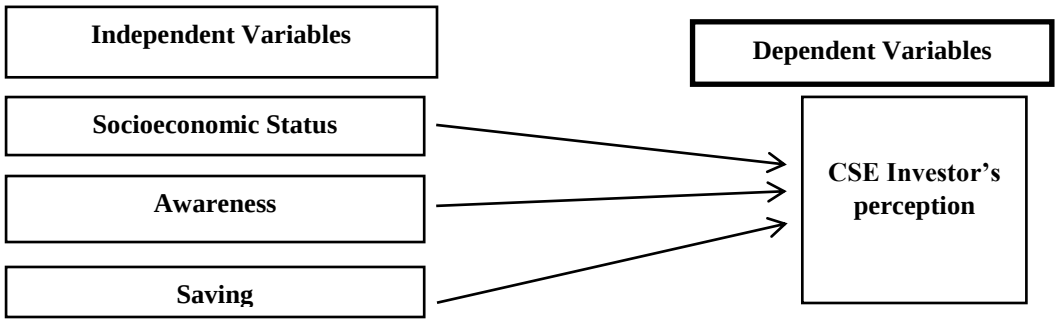
When compared to other developed countries, the researches regarding behavioral finance is therefore by considering all the above issues, researcher identified unfilled gap regarding the investor perception on Stock Market Investment. As a main objective, researcher observed the factors that affect to the perception of investors for investing in Colombo Stock Exchange and sub objectives are;

1. To examine the impact of socioeconomic status on perception of investors for investing in Colombo stock Exchange.
2. To examine the impact of awareness on perception of investors for investing in Colombo Stock Exchange.
3. To examine the impact of savings on perception of investors for investing in Colombo Stock Exchange.

Methodology

Conceptual Framework

Figure 1 Conceptual Framework



Population and Sample

Population

The population of this study consists of individual investors in North Central Province. According to CSE data, 4525 investors have been registered in Colombo Stock Exchange from North Central Province. But actively participation very close to 300 from registered investors.

Sample

The target group of this study consists of 60 of individual investors who are investing in Colombo Stock Exchange in North Central Province. Stratified Random Sampling technique was used to select respondent over the North Central Province.

Method of Data Collection

The primary data were collected by issuing questionnaire for 60 investors in North Central Province. Investors were selected randomly as sample from above province. Structured Questionnaire was distributed to the sample to get information.

Data Analysis & Presentation

Reliability Analysis

Table 2. Reliability Statistic

Cronbrach's Alpha	Variable	No of Item
0.726	Socioeconomic Status (SES)	05
0.785	Awareness (AWS)	05
0.801	Savings (SAV)	06
0.768	Perception of Investors for Investin CSE (PICE)	06

Regression Analysis

Table 5. Regression Analysis Model

Model	R	R Squared	Adjusted Square	Std. Error of tl Estimate	Significance
1	0.528[a]	0.279	0.240	0.296	0.000

a. Predictors: (Constant), AWS, SAV, SES

Table 6. Coefficients Model

Model	Unstandardized Coefficient		Standardized Coeffic	t	Sig.
	B	Std. Erro	Beta		
(Constant)	3.281	0.537		6.108	0.000
SES	0.407	0.092	0.537	4.442	0.000
AWS	0.60	0.088	0.078	0.680	0.499
SAV	-0.211	0.76	-0.333	-2.763	0.008

Conclusion

This study investigated the factors influencing on the perception of investors for investing in Colombo Stock Exchange. On behalf of the research questions, three objectives were established and three hypotheses were formulated to achieve those research objectives. According to the results, there is a significant impact of socioeconomic status on perception of investors for investing Colombo Stock exchange. As a result, there is a significant impact of socioeconomic status on perception of investors for investing in Colombo Stock Exchange. Therefore, H1 is accepted. There is a significant impact of awareness on perception of investors for investing Colombo Stock exchange. According to the result, there is insignificant impact of awareness on perception of investors for investing in Colombo Stock exchange. Therefore, H2 is rejected. There is a significant impact of savings on perception of investors for investing Colombo Stock exchange. The result highlights that there is a significant impact of savings on perception of investors for investing in Colombo Stock exchange. Therefore, H3 is accepted.

Reference

1. Bhavani , G & Shetty, K (2017), Impact of Demographics and Perceptions of Investors on Investment Avenues, Accounting and Finance Research, Vol. 6, No. 2; 2017
2. Bhuvanneswari (2004) A Study on Investor’s Perception towards Equity/Tax Saving Mutual Funds. CARE Journal of Applied Research 18-21
3. Das, S. K. (2012). Small investor’s behavior on stock selection decision: A case of Guwahati stock exchange. International Journal of Advanced Research in Management and Social Sciences, 1(2), pp59–78
4. Geetha, S.N., Vimala, K. (2014), Perception of household individual investors towards selected financial investment avenues. Procedia Economics and Finance 11, 360-374.

5. Lokhande, M.A. “A study of investment awareness and pattern of savings and investment by rural investors”, Indian journal of finance, Vol. 9, No.,7, pp. 22-46, 2015
6. Kumarasinghe P.J and Jayasinghe (2016). A comparative Study on the Determinants of Household Saving in the Colombo Stock Exchange. 13th International Conference on Business Management (ICBM) University of Sri Jayawardenapura, Sri Lanka.
7. Pandian, P., & Jeyanthi, Q. (2017). Stock Market Volatility in Indian Stock Exchanges . Retrieved January 22 , 2014, from indiastat.com
8. Ponnamperuma, C.J.2013. Factors influencing investor behaviour: The case of Colombo Stock Exchange, unpublished MBA thesis of university of Sri Jeyawardenapura
9. Sadiq, M.N., and Ishaq, H.M.2014. The effect of demographic factors on the behaviour of investors during the choice of investment: Evidence from twin cities of Pakistan. Global Journal of management and Business Research, vol. 14, no.3, pp. 47-56.

Business Economics

ID - 19

HOUSEHOLD INCOME AND HEALTHCARE EXPENDITURE IN SRI LANKA

Cader.I[1], Dilrukshi.M[1], Senanayake.K[1], Welgama.M[1]

[1] *Undergraduate, Department of Business Management, University of Sri Lanka Institute of Information Technology, New Kandy Road-Malabe*

Abstract

Health can be recognizing as a main factor, which directly governs the overall economy and development of a nation. This article reviews the household healthcare expenditures using demographic characteristic of the household. Even though a number of studies have examined on this subject in Sri Lanka, Their expenditure patterns and household characteristics are not separately analyze based on recent data. This paper expects to bridge that knowledge gap. This study use Sri Lankan household income and expenditure survey of 2016(HIES). Our result findings demonstrated that a person living in urban area would spend higher health expenses in all health categories compare to rural and estate sector. When comparing gender, female spends more on healthcare in every considered factor and over 60 years old spends extra on healthcare compared to other age groups. This study further confirms that age and gender of the household are closely associated with healthcare expenditure.

Keywords: household, healthcare expenditure, HIES, Sri Lanka

Introduction

Better health is important for happiness and well-being of humans. Populations with healthy lifestyles live longer which makes an important contribution to economic progress. This study is expecting to evaluate household income and healthcare expenditure in Sri Lanka.

Government of Sri Lanka provides free health services to its citizens, as a national priority for decades. Despite this free service, households still spend considerably on their health care. The empirical analysis is based on the Household Income and Expenditure Survey (HIES) 2016 from the Department of Census and Statistic (DCS). Accordingly, the mean monthly total household expenditure was Rs.54,999.00. Per month, the mean non-food expenditure was Rs.35,885.00 of that the health expenses was Rs.1,695.34 (3.08%).Therefore this research explores the problem of spending considerable amount for healthcare expenditure. Moreover, this study investigate further healthcare categories taking to an account.

Past researchers have identified that the people who are in age sixty and more than that have spent six times higher in average than person under age eighteen on healthcare (Martin, Whittle, Levit, Won, & Hinman, 2002).In Denmark literature has mentioned that maintaining income equality supports to minimize health inequality(Dorling, 2015). Health can vary with the age or gender variations (Furnee, Groot, & Pfann, 2011). Nutrition requirements, immunity, exposure to diseases can change with the age or gender. A research conducted in Bangladesh identified that women record more complaints than men in self-recorded health problems(Kabir et al., 2006).Even though there has been few compressive study done on this subject in Sri Lanka, their expenditure patterns and household characteristics are not separately analyze based on recent data. This study aims to bridge that gap. The main

objective of this study is to investigate social economic and demographic characteristics of household on different health expenses categories.

Methodology

This study is based on secondary data gathered through the HIES 2016 from the DCS which includes 21,756 households. HIES 2016 survey comprise 11 healthcare categories and this study grouped those into 7 healthcare categories. Namely, spend on private medical practices, purchase of pharmaceutical products, fees to private nursing, fees to medical lab, consultation fees, spend on spectacles and hearing aids and other health expenses.

Furthermore HIES 2016 includes Household socio economic and demographic characteristics such as age group, gender and marital status. Data were use to analyzed by using average values of different demographic characteristics among the different health expenditure categories.

Results

Table 1: illustrates that seven different ways of spending money on personal health care by sectors and provinces.

Table 1: Mean per capita healthcare expenditure by sectors and provinces

	C1	C2	C3	C4	C5	C6	C7
Sector							
Urban	163.6	220.4	69.9	41.1	36.3	10.8	42.6
Rural	151.6	95.1	82.0	39.9	25.3	4.8	17.6
Estate	81.1	23.4	1.5	6.4	4.7	0.0	2.3
Province							
Western	209.2	221.1	113.0	52.1	31.4	7.3	33.3
Central	147.0	89.6	66.1	28.9	21.7	6.3	33.5
Southern	160.0	148.9	65.8	49.7	42.0	6.8	15.0
Northern	46.5	33.3	242.1	21.8	9.1	1.3	4.8
Eastern	94.8	25.1	15.4	24.3	8.8	0.5	2.6
North-west	177.6	116.0	38.3	66.0	39.2	12.4	46.4
North-central	148.1	51.8	25.2	19.2	17.0	3.1	4.6
Uva	78.7	41.6	13.4	17.2	17.5	1.8	9.2
Sabaragamuva	172.3	60.7	11.1	28.3	26.4	4.0	7.8

Source: Authors demonstration based on HIES 2016.

Note: C1 -Spend on private medical practices, C2 - Spend on Purchase of pharmaceutical products, C3 - Spend on Private nursing, C4 - Spend on Medical labs, C5 - Spend on Consultation fee, C6 - Spend on Spectacles and hearing aids, C7 - Spend on Other medical expenses.

Table 1 illustrates that the highest spend on private nursing are in rural sector while all other are in urban sector. This is due to nursing is easier in rural area. In addition, expenses on private medical practices and purchase on pharmaceutical products are high in Western province.It is explainable as western province is the capital of Sri Lanka and has the highest population density and widely available private medical practices. However Highest spend on consultation fee has recorded in Southern and highest spend on private nursing has recorded in Northern Province.

Table 2: Household demographic characteristics on different healthcare expenditure categories

	C1	C2	C3	C4	C5	C6	C7
Age level							
0-10	134	67	100	22	21	2	11
11-20	110	78	26	27	16	5	20
21-30	141	106	80	41	24	5	28
31-40	131	89	98	32	25	5	14
41-50	155	103	42	34	20	4.7	21
51-60	178	138	89	54	28	4.4	24
60+	214	224	94	66	47	12.4	31
Gender							
Male	141.3	109.7	77.12	37.5	25.4	5.1	19.7
Female	158.2	114.91	75.6	39.6	27.1	5.9	22.2
Marital status							
Never married	133.7	87.1	67.9	29.9	21.3	4.6	19.2
Married	160.5	127.4	83.5	44.9	29	5.5	22.1
Widowed	182.4	161.9	74.8	51.1	36.5	12.3	20.3
Divorced	151.6	169.3	306.6	32.3	30.2	1.17	21.1
Separated	154.1	121.3	21.4	23.9	22.9	1.1	50.9

Source: Authors demonstration based on HIES 2016.

Note: C1 -Spend on private medical practices, C2 - Spend on Purchase of pharmaceutical products, C3 - Spend on Private nursing, C4 - Spend on Medical labs, C5 - Spend on Consultation fee, C6 - Spend on Spectacles and hearing aids, C7 - Spend on Other medical expenses.

As can be seen from the Table 2 illustrates demographic variables on different heath expenses categories. Our results indicate that the spending on private nursing is high for the participants below 10years old. Senior citizens over 65 years old spends extra on healthcare compared to other age groups because getting old itself makes a person more vulnerable for diseases and it is difficult to recover from illnesses. However based on gender variable females spends the most on all the healthcare expenses except private nursing. According to the marital status of household widowed participants spends extra on private medical practices, medical labs, consultation fee, spectacles, hearing aids, and divorced participants more spend on pharmaceutical products and private nursing.

Discussion and Conclusion

This study investigates the household's demographic factors on different healthcare expenditure categories. The findings of this study demonstrated that a person living in urban area would spend higher health expenses in all health categories compare to rural and estate sector. When considering overall spending of each province, Northern Province has showed highest increment for spending on private nursing. When comparing gender, female spends more on healthcare in every considered factor and over 60 years old spends extra on healthcare compared to other age groups. This study further confirms that the over 60 year elderly people spend more out of pocket healthcare expenditure. Hence, it is important to paid more attention to elderly people when formulating health policies. Therefore, this research study provides the opportunity to both government and policy makers to investigate on health expenditure and well-being for all people in Sri Lanka.

Reference

1.Dorling, D. (2015). The mother of underlying causes - economic ranking and health inequality. *Social Science Medicine, 128*, 327-330. doi:10.1016/j.socscimed.2015.01.008

2.Furnee, C. A., Groot, W., & Pfann, G. A. (2011). Health and income: a meta-analysis to explore cross-country, gender and age differences. *European journal of public health, 21*(6), 775-780. doi:10.1093/eurpub/ckq166

3.Kabir, Z. N., Ferdous, T., Cederholm, T., Khanam, M. A., Streatfied, K., & Wahlin, Å. (2006). Mini Nutritional Assessment of rural elderly people in Bangladesh: the impact of demographic, socio-economic and health factors. *Public Health Nutrition, 9*(8), 968-974. doi:10.1017/phn2006990

4.Martin, A., Whittle, L., Levit, K., Won, G., & Hinman, L. (2002). Health Care Spending During 1991–1998: A Fifty-State Review. *Health Affairs, 21*(4), 112-126. doi:10.1377/hlthaff.21.4.112

Business Management

ID-03

IMPACT OF MARKETING MIX STRATEGIES ON THE COMPETITIVENESSOF SRI LANKAN CRICKET CLUBS

M.S.A. Lufry[1], A. L. K. R. Fernando[2]
[1, 2]*Department of Sports Science, Faculty of Applied Sciences, University of Sri Jayewardenepura*
msahamed99@gmail.com[1], kevin@sjp.ac.lk[2]

Abstract

Many cricket clubs now develop a more sophisticated marketing mix to enhance clubs' competitive advantages. This study investigates the impact of the marketing mix strategies on the competitiveness of Sri Lankan Cricket Clubs. The unit of analysis was cricket clubs and the disproportionate stratified sampling method was adopted in selecting the study sample of 40 clubs. Measurement scales were developed using empirical studies in the study domain. A questionnaire was adopted as the data collection instrument after assessing the internal consistency through a reliability analysis. Data analysis was carried out using SPSS 20.0 version and hypotheses were established and tested with Spearmen correlation. Excluding the people variable, there were strong and moderate correlations between each of the marketing mix variables namely product, price, place, promotion, physical evidence, and process and the competitiveness. Hence, it is recommended to implement marketing programmes with high attention on the 7 P's variables, excluding people, to increase clubs competitiveness.

Keywords: Competitiveness, Marketing mix, Sri Lankan Cricket clubs, 7P's.

Background of the Study

Competition is ubiquitous. There is competition in business, in sports, in entertainment, in politics, and even in private lives. Especially, businesses can only survive, if they remain competitive. In order to become and stay successful, businesses have to become more resourceful, and/or lower the price, invents improvements, and offer better service [1]. Sports, subtracting all its health aspects, as in its core are also considered as businesses, and therefore underlie the same competition as any other business. As a business, any sports organization will compete for members, sponsors, resources, fans, facilities, local, national, and international recognition [2]. For Sri Lankan cricket clubs, the competition consists with primarily in recruiting the most talented players to their club, and to achieve a high ranking. Competitiveness in business can be measured in several ways. It can be measured in market share, in the visibility of the club, in price flexibility, or in meeting the unique needs of the target market [3]. Michael Porter [4] analysed the competitiveness of a business and developed his theory of the five forces which influence Marketing. This study analysed the effect of marketing mix strategies on enhancing the competitiveness of Cricket clubs in Sri Lanka.

Problem Statement

Presently, almost all the Cricket clubs in Sri Lanka are operating with an intense competition. Therefore, these Cricket clubs are adopting different marketing strategies in developing competitive advantages over other competing clubs. While the paper focuses on the original four Ps of marketing strategy (product, price, place and promotion), it has been extended to

include another three Ps (physical evidence, process and people) commonly applied in service marketing. The service marketing driven strategies enhance competitiveness more in these service oriented sports clubs. Therefore, this study examines 'What is the impact of marketing mix strategies on competitiveness of Sri Lankan Cricket Clubs?'

Major Objective of the Study

The major objective of the study is to examine the impact of the marketing mix strategies adopted by cricket clubs in Sri Lanka to enhance clubs.

Specific Objectives

There are two specific objectives which are to identify strong and weak marketing mix variables in order to help managers and to help sports marketers understand the marketing mix's effectiveness in developing clubs' competitiveness. This facilitates club administrators to provide the cricket consumers with better service and to suggest new strategies from the marketing mix perspective to enhance the competitiveness through developing competitive advantages against competing clubs.

Conceptualization and Operationalization

Empirical studies reveal the impact of organizational marketing strategies on developing organizational competiveness with special reference to commercial sector. Studies specifically conducted adopting marketing mix in determining sports clubs competitiveness in Sri Lankan context is minimum. Therefore, the original conceptualization derived from a study with Kenyan tennis clubs explaining the impact of marketing mix strategies on developing competitiveness [5]. The same conceptualization was adapted and applied to Sri Lankan cricket context using seven independent marketing mix variables (product, prices, place, promotion, people, physical evidence, process) and one dependent variable (competitive advantage). Conceptual framework of this study is presented in Figure 1.

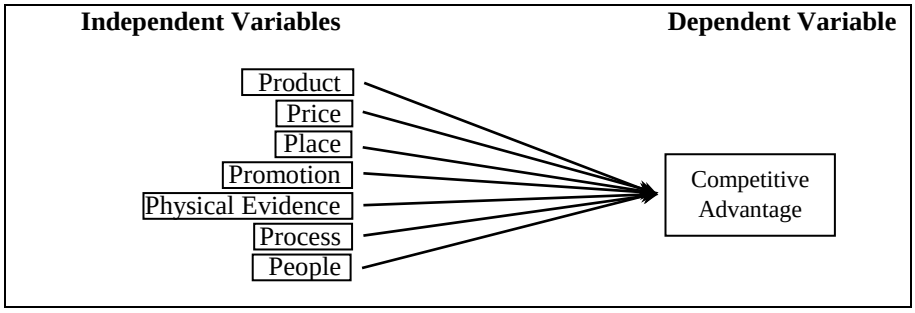


Figure 1. Conceptual Framework

All the study variables were operationalized using relevant dimensions based on empirical studies. Accordingly, the questionnaire was developed based on the empirical studies as the survey instrument.

Hypothesis Development

This study aims to investigate the impact of marketing mix strategies on Sri Lankan Cricket clubs' competitiveness. Therefore, present study aimed to investigate the correlation between each of the independent variables and the dependent variable. In the case of this study, the hypotheses are mainly concerned with the analysis of the correlation between the independent and dependent variables. In order to analyse the relationship between the seven components of the services marketing mix and competition, the research tested the following hypotheses:

H1: There is a relationship between product strategy and competitive advantage.
H2: There is a relationship between price strategy and competitive advantage.
H3: There is a relationship between place strategy and competitive advantage.
H4: There is a relationship between promotion strategy and competitive advantage.
H5: There is a relationship between physical strategy evidence and competitive advantage.
H6: There is a relationship between process strategy and competitive advantage.
H7: There is a relationship between people strategy and competitive advantage.

Methodology

A standard questionnaire [6,7]. was developed and sent to the presidents of the cricket clubs. Subsequently, interviews were set up and the data were collected. All the Cricket clubs registered under Sri Lanka Cricket Board are considered as the study population of this study. Out of 72 clubs, using Disproportionate Stratified Sampling (DSS) method, 40 clubs were selected as the study sample. This sampling method of was used since the sample size of each stratum did not necessarily correspond to the population size of the stratum.

Data Gathering Techniques

The presidents, vice presidents or marketers of the clubs were contacted and interviewed. Initially, the detailed questionnaire was provided to them via email, and officials were then contacted in person or by phone. First section of the questionnaire contained five items for each marketing strategy variables representing different dimensions. Respondents' responses were recorded on a five point Likert Scale. Second section of the questionnaire recorded the responses relevant to the competitive advantage which consisted of 8 items. Third section of the questionnaire was to collect demographic data about the responding cubs. Reports published by SLC, Cricket Cubs and websites were also used to collect required secondary data[8].While measuring the product strategy, emphasis was placed on the service design, the image of the product, extra services around the facilities and future developments. Price strategy was measured using the pricing policy and price reasonability. Place strategy looked at the location of the clubs, ability to attract customers, and whether the clubs should extend their presence beyond their location. Promotion was examined through the clubs' promotional activities' ability to reach their target customers. Physical evidence checked whether the physical environment left the customers with a positive impression. Process evaluated the complexity of the service and its delivery. People examined the relationship between the clubs and their customers. The Competitive Advantage determined the advantage that one club might have over others.

Data Analysis

Data were analysed using SPSS software 20.0 version. The first step was to clean the data and check for outliers and missing values. After cleaning data sheet, descriptive analysis was conducted. Thereafter, the reliability of each study variable was tested and normality of the data was checked. Since the study intends to examine how the marketing mix strategies influence the clubs' competitiveness. Finally seven hypotheses were tested using Spearmen correlation coefficient.

Results and Discussion

Table 1 provides the reliability statistics of al study variables and since Cronbach's Alpha values of all study variables are more than 0.7, all variables' measurement scales were considered as reliable.

Table 1. Reliability Statistics

Reliability Statistics	Product	Price	Place	Promotion	Physical Evidence	Process	People	Competitive Advantage
Cronbach's Alpha	0.843	0.921	0.704	0.773	0.798	0.729	0.886	0.901

Table 2 provides the correlation coefficients between each of the independent variable and the dependent variable of the study. Accordingly, except the people variable, all other marketing mix strategies are having a positive correlation with competiveness of Cricket clubs. Product, place strategy and promotion strategy show significant positive correlations with clubs' competitiveness where price strategy shows a moderate correlation.

Table 2. Correlation between marketing mix variables and competitive advantage

Marketing mix Variables	Product	Price	Place	Promotion	Physical Evidence	Process	People
Correlation Coefficient	0.617	0.438	0.768	0.605	0.381	0.172	-0.193
Sig. (2-tailed)	0.000	0.005	0.000	0.000	0.015	0.028	0.393

Conclusion and Recommendations

Conclusion

The highest number of cricket clubs is located in a relatively small area of the country along the Western and South-Western Coast. The greatest numbers of clubs employ very few people. Over the last half century more community-based cricket clubs have come into existence. With the exception of people, there is a strong correlation between the marketing mix variables and the competitive advantage.

Recommendations

Recommendations were made for each of the correlated marketing strategies. Clubs' administrators should intensively study about more innovative and customized marketing programmes in terms of game experience itself, pricing, delivering game experience to spectators, promotion, physical evidence and resources of club premises and the overall process of the club. One way of expanding the base of cricket clubs in the areas that are

currently underserved might be to initiate and develop clubs within academic institutions. By expanding these clubs into the community, the potential for some public-private partnerships could also be created. Additionally, stronger school cricket teams would also create a larger pool of better cricket players to draw from. Another recommendation is the construction of larger cricket grounds and clubs which provide enough parking, good public transportation, and well-kept grounds. A properly maintained clubhouse and grounds as well as comfortable and well maintained seating areas will likely all contribute to the expansion of customer satisfaction within this marketing variable. It is likely that the introduction and development of special promotional campaigns in mass media and on social media would result in an increase in the customer-fan base. Especially the clubs which have good facilities should also consider using them for promotional activities outside of strictly cricket events.

Furthermore, a general recommendation utilizes more marketing research professionals in order to become more effective in marketing. Future research might apply this same concept to other sports. It would be recommended to expand the marketing mix to 9 P's, including program and performance, since this seems the most appropriate for sports businesses.

Limitations and Scope of the Study

The study considered only the cricket clubs registered under the SLC. Competiveness was measured considering the perceived competitive advantages of the clubs. There may be other factors also which affect clubs' competiveness other than marketing mix strategies.

The study was limited by only testing for the competitive advantage. More evaluation of the demographic data is also necessary, and more research is recommended which is not limited to clubs registered under the SLC. Furthermore, study variables can be operationalized using more dimensions compared to the present study.

Reference

1. Ford, D. & Håkansson, H., *Competition in Business Networks,* 2013"Available from:"https://www.researchgate.net/publication/259090029_Competition_in_business_networks(Accessed Date: 18/07/2018)

2. Da Silva, E. C. & Las Casas, A. L., Sports Marketing Plan: An Alternative Framework for Sports Club. *Article in International Journal of Marketing Studies* 2017"Available from:" https://www.researchgate.net/publication/318764714_Sports_Marketing_Plan_An_Alternative_Framework_for_Sports_Club (Accessed Date: 12/10/2018)

3. Muchohi, J. N., *Marketing Mix Strategies Adopted by Tennis Affiliated Organizations to enhance Competitiveness*(M.Sc) "Thesis", University of Nairobi, 2015. "Available from:"http://erepository.uonbi.ac.ke/handle/11295/94333 (Accessed Date: 17/06/2018)

4. Porter, M. E., *Competitive Strategy*. New York, Free Press, 1985. "Available from:"https://www.albany.edu/~gs149266/Porter%20(1985)%20-%20chapter%201.pdf (Accessed Date: 18/07/2018)

6. Sreenivas, T., Srinivasarao, B., & SrinivasaRao, U., "An Analysis of Marketing Mix in Hospitals." *International Journal of Advanced Research in Management and Social Sciences.* 2013.Available from:"http://www.garph.co.uk/IJARMSS/Apr2013/17.pdf (Accessed Date: 12/10/2018)

7. Al-Debi, H. A. & Mustafa, A., *The Impact Of Services Marketing Mix 7P's in Competitive Advantage To Five Stars Hotels.* The Clute Institute International Academic ConferenceOrlando, Florida, USA. 2014Available from:"https://www.zuj.edu.jo/wp-content/staff-research/economic/dr.hameed-al-taee/2.pdf (Accessed Date: 18/10/2018)

8.SriLankaCricket, *Sri Lanka Cricket Board*. 2018. Available from:"https://www.srilankacricket.lk\wp-content\uploads" [Accessed September 2018].

ID - 06

FACTORS AFFECTING ON OPERATIONAL EFFICIENCY

A.K.D.N. Dilshani[1], S.M.N. Praveeni, J.A.A.N. Fernando[1]
[1]*Wayamba University of Sri Lanka*

Abstract

Even though, the topic operational efficiency has gained more attention and interest, it is still under researched and the related knowledge also limited. Most organizations often suffer due to operational inefficiency and high wastage which arise mainly in operations. Particular manufacturing plant where the researchers have given the consideration facing continuous efficiency drop downs during recent past. Therefore, this study was done to identify the factors affecting on operational efficiency. Theoretically, it was revealed that human, organizational and technological variables significantly affect operational efficiency, and they were integrated into the research model. The views were collected through a structured questionnaire & the views of the respondents were evaluated individually to find out proper outcome. To analyze data, Explanatory Factor Analysis (EFA) was used. Research revealed that operational efficiency is significantly determined by human factor, organizational factor and technological factor.

Keywords: operational efficiency, garment manufacturing organization, human factors, organizational factors, technological factors

Introduction

The global apparel industry has seen remarkable changes in the past few years and it is now always on a lookout for cheap source of garment production. As per the Global Textile and Apparel Industry's vision in 2015, is expected to reach US$805bn by 2015 from US$650bn in 2010. At present few countries like Bangladesh, Thailand, Cambodia, Sri Lanka and Pakistan contribute major share in foreign earnings of their country from Textile and Clothing trade, though their share in the world market is not very significant.

Sri Lanka's apparel industry began to grow significantly in the 1980s because of its open economic policy as well as the trade and investment friendly environment. From end of the 20th century apparel, export industry became more important contributor to Sri Lanka's economy. It becomes second only relatively to the dollars brought in by the foreign employment. Over the past four decades it became the money revolving industry with a remarkable strength of 40% of all exports. Solely this industry ventures through private sector into the international market (Beamish, 2013).

Even though apparel industries contribute to such a considerable advancement, there is still need for the development. Over the last ten years there has been a great concern regarding the competitiveness of this industry. The reason for this is that the textile and clothing sector has experienced the most turbulent chapter in its history with respect to the competition from low wage countries, the advance in technology, the development of new production plants, the rapid progress in information technology, and the increasing demand for variety. To sustain in the competitive market, it is required to cater the products at the required quality standard and within minimum lead-time with on time delivery by improving Operational efficiency. In this manner improving operational efficiency is one of the companies' top objectives. Companies

indeed try to improve operational efficiency (Adams, 2004). To do this, the production department needs to perform at the planned level and at required standards. In this effort, single minute drop of production is monitored and recorded as it is very important. The management is eager to look into the issues that drop production because such drop may convert sea cargo into air cargo in order to ensure on time delivery, but at double the cost. Waste is a common barrier which is facing all the apparel industries caused to reduce the profit.

In terms of profit maximization, organization needs to follow optimum utilization of resource with achieving the maximum possible productivity and continuously searching for the improvements even though there are slight impacts to the overall cost involvement and everybody within the organization are encouraged to gain the maximum productivity. This can not only be achieved by the employees work at their best and there should be appropriate methods, tools and skills have to be established and those elements have to be updated periodically to cope with the changing world. Therefore, the employers and management cannot ignore the appropriate operations, methods, skills and tools to identify and implement in attaining the organizational set goals.

Based on the information gathered from the selected organization it has explained that before moving into key performance information system (KPI), they have recorded considerable in-efficiency percentage. Even though KPI has implemented in the factory the improvements have been limited to a certain extent. By moving deeply in to the problematic situation currently existing in the company, the company has taken several steps to overcome that. Even if the company has taken such steps to overcome this crisis, no any considerable improvement can be observed. So, the company is in an issue of identifying the exact reasons for the continuous efficiency failures. Accordingly, this research was conducted to evaluate the factors that are affected on the operational inefficiency.

Literature Review

In a business context, operational efficiency can be defined as the ratio between outputs gained from the business and an input to run a business operation. When improving operation efficiency, the output to input ratio improves. Operation efficiency is often achieved by streaming a company's core process in order to more effectively respond to continually changing market force in a cost-effective manner (Hillier, 2012). Operational efficiency underpins the companies' most basic strategic goals. Improving customer satisfaction and increasing shareholder value both depend on achieving operational efficiency. Therefore, improving operational efficiency is one of the companies' top objectives.

Factors affecting operational efficiency

Human factors

Job Mismatch: The incompatibility or the existence of a weak "match" between the characteristics of workplaces (skills required, competences etc.) and the characteristics (skills, level of education and localization preferences) of job seekers (Becker, 1985)

Competency: Competency is the capability to consistently apply a set of related knowledge, skills and abilities to successfully perform critical job functions or tasks in a defined role or work setting (Collins 2000).

Fatigue: Fatigue affects everyone regardless of skill, knowledge, and training. It influences directly on many people's physical and mental abilities needed to carry out even simple task (Pasupathy & Barker, 2012).

Attitudes: Employee attitudes directed towards the high performance of work place and further positive attitude will be a one of the major reason for the organizational success and the operational success (Bartel, 2004).

Organizational Factors

Supervision: When a company has poor supervision, there is not enough responsibility for taking action for the prevention of problems, mistakes, accidents, and injuries (Bridger, 2008).

Training & Development: If there is no proper training procedures, Operations may not able to conduct properly and it will be a reason for low performance of employees and efficiency of operations will go down (Bertola, 2004).

Job Security Job security and employment protection legislation makes use of partial and general equilibrium in dynamic models (Bertola, 1990).

Augment A poorly conceived layout can also result in congestion, prohibitive material handling cost, increased accidents, and decreased inventory space (Banjoko, 2002).

Technological Factors

Maintenance: Operational Efficiency represents the life-cycle, cost-effective mix of preventive, predictive, and reliability-centered maintenance technologies, coupled with equipment calibration, tracking, and computerized maintenance management capabilities – all targeting reliability, safety, occupant comfort, and system efficiency (Sullivan et.al, 2007).

Research & Development: R&D is critical to advancing energy efficiency by promoting the creation, development, and commercialization of new, energy-efficient technologies and practices (Herring & Roy, 2007).

Process Management: The application of knowledge, skills, tools, techniques and systems to define, visualize, measure, control, report and improve processes with the goal to meet customer requirements profitably (Forbes & Ahmed, 2010).

Methodology

As related in the review of the literature, it has been identified that human factor, organizational factor and technological factor are major determinants of operational efficiency. Accordingly, they were integrated into a research model. Following figure shows the conceptual framework of the study.

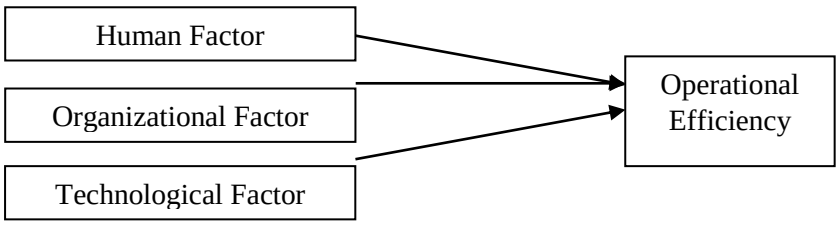


Figure 1: Conceptual Framework

Survey methodology was used because most data are descriptive and primary one. The population for this study included all line leaders of planning, production, and cutting departments in the selected organization and it included 71 respondents.

Data was obtained through administering questionnaire which was structured and designed on a five point likert scale. To increase the speed of the data collection rate and response rate, researchers first communicated with the line leaders in particular departments and delivered questionnaires by hand. First part of the questionnaire was designed to find the demographic information of the respondent. Second part consisted with the questions relating to factors affecting on operational efficiency. 60 respondents submitted the completed questionnaires with respond rate of 84.5%. Cronbach's Alpha value for all tested variables exceeded 0.7 which indicated reliability of questionnaire is in satisfactory level. The aim of the study was explained to respondents and they were assured of the privacy of their information. Gathered data were analyzed using confirmatory factor analysis method. The primary condition to use the factor analysis is the adequate sample. There must be adequate sample and sphericity in this research and it checked using Kaiser - Meyer Olkin measurement and it was 0.655. It is higher than the value of 0.5 and considered that the sample is adequate for this research study. The sphericity is there because of the Bartlett's test of sphericity is significant there.

Findings

Using principle component method, researchers got the extraction values and every single indicator has the higher values which are higher than the 0.3 value. So, the communities complete the required condition. In here there are 03 indicators which are removed from the communities table because of they do not fulfill that required condition. Varimax method has been used for the rotation by the researchers and the coefficient display format has sorted by size and the absolute value is below the 0.3. The rotation Varimax method has been selected and used by the researchers and the coefficient display format has sorted by size and the absolute value below 0.5.

Table1. Rotated Component Matrix

	Component		
	1	2	3
Training & Development3	.725		
Training & Development2	.705		
Advancement1	.697		
Augment 2	.686		
Supervision1	.654		
Supervision3	.644		
Readiness 1	.596		
Training & Development1	.584		.506
Supervision4	.559		
Competencies2	.536		
Job Security1	.522		
Attitude1	.505		
Fatigue 1		.735	
Fatigue 3		.664	
Attitude3		.630	
Job Mismatch1		.627	

Process 1	.613	
Supervision 2	.599	
Fatigue 2	.537	
Competencies 1	.506	
Competencies 3	.501	
Research & Development1		.853
Maintenance 1		.738
Research & Development2		.550
Augment 4		.525
Maintenance 2		.510
Attitude 2		

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 9 iterations.

According to the rotated component matrix table 1, it is understandable that the questions are grouped in to 3 components. 26 out of 34 questions were determined the factors affecting on operational efficiency and 8 questions may not determine any variable shown in the conceptual framework. 8 out of 14 questions in organizational factors are more relevant to the human factor. Likewise, some questions are categorized in to variables as above rotated component matrix which has the similarities for the particular variables.

According to the human factor, it has been identified that training and development, advancement, augment, supervision, readiness, competencies, job security, attitude and job mismatch are deciding operational efficiency. According to the organizational factor, it has been identified that fatigue, attitude, job mismatch, process, supervision, competencies are deciding operational efficiency. According to the technological factor, it has been identified research and development, maintenance and augment are deciding operational efficiency.

Conclusion and Recommendations

According to research findings, it was revealed that company has followed better procedures to handle the employee, in order to improve efficiency of the employees. Even though the mean value shows positive impact, company should give more attention.

Management should try to create a readiness for change. It depends on creating a felt for change. Hence this is an organizational level change, can use sensitize organizations to pressure for change, reveal discrepancies between current and desired one and convey credible positive expectations for the change to generate sufficient dissatisfaction to produce change.

Regarding the organizational factors, respondents have provided their opinion remaining under agree aspect. This reflects that the organizational factor is considerably perfect in the company. Therefore, it required to improve that keeping the same level or more than that. Management should be follow work life balancing programs which is become the trend of the present business world. To get the maximum efficiency through the organizational factors management should implement good training programs and motivational programs which help employees for mind relaxing

In terms of technological factors, results revealed that it is significant on operational efficiency. Therefore, it is need to follow some development for the technology, and then can achieve best results. As we are in IT era, nobody can retain the customers only satisfying

them, should delight them. For an example before 10 or 15 years' technology development may very much lower than present world and in that time management expect to sell the product at high cost. Because there was less competition. But with the competitive and fast technological development, not to earn high profit but to survive, management should sell the products at low cost with high quality. Therefore, management should always look for the new technology adaption to reduce cost of production. Then the management may able to improve operational efficiency through the determinant of technological factors.

Reference

1. Adams, C. A. (2004). The ethical, social and environmental reporting-performance portrayal gap. *Accounting, Auditing & Accountability Journal*, *17*(5), 731-757.
2. Banjoko, S. A. (2002). Human Resource Management: An Expository Approach. Lagos: Pumark Nigeria Ltd.
3. Bartel, A. P. (2004). Human resource management and organizational performance: Evidence from retail banking. *ILR Review*, *57*(2), 181-203.
4. Beamish, P. (2013). *Multinational joint ventures in developing countries (RLE International Business)*. Routledge.
5. Becker, G. S. (1985). Human capital, effort, and the sexual division of labor. *Journal of labor economics*, *3*(1, Part 2), S33-S58.
6. Bertola, G. (1990). Job security, employment and wages. *European economic review*, *34*(4), 851-879.
7. Bertola, G. (2004). A pure theory of job security and labour income risk. *The Review of Economic Studies*, *71*(1), 43-61.
8. Bridger, R. (2008). *Introduction to ergonomics*. Crc Press.3rd edition.
9. Collins, D. B., Lowe, J. S., & Arnett, C. R. (2000). High-performance leadership at the organization level. *Advances in Developing Human Resources*, *2*(2), 18-46.
10. Forbes, L. H., & Ahmed, S. M. (2010). *Modern construction: lean project delivery and integrated practices*. CRC press.
11. Herring, H., & Roy, R. (2007). Technological innovation, energy efficient design and the rebound effect. *Technovation*, *27*(4), 194-203.
12. Hillier, F. S. (2012). *Introduction to operations research*. Tata McGraw-Hill Education.
13. Pasupathy, K. S., & Barker, L. M. (2012). Impact of fatigue on performance in registered nurses: Data mining and implications for practice. *Journal for Healthcare Quality*, *34*(5), 22-30.
14. Sako, M. (1992). *Price, quality and trust: Inter-firm relations in Britain and Japan* (No. 18). Cambridge University Press.\
14. Sullivan, R. C., Guazzotti, S. A., Sodeman, D. A., Tang, Y., Carmichael, G. R., & Prather, K. A. (2007). Mineral dust is a sink for chlorine in the marine boundary layer. *Atmospheric Environment*, *41*(34), 7166-7179.

ID - 15

SOCIO-DEMOGRAPHIC CHARACTERISTICS OF RECREATIONAL ACTIVITIES: EVIDENCE FROM EASTERN PROVINCE.

Hashan Rathnayaka[1], Pramuditha Geethanjana[1], Udani Gamage[1], Hiranya Karunarathne[1], Ruwan Jayathilaka[2].
[1]*Undergraduate candidate, Department of Business Management, Faculty of Business, Sri Lanka Institute of Information Technology, Malabe, Sri Lanka.*
[1] *Senior Lecturer (Higher Grade), Department of Business Management, Faculty of Business, Sri Lanka Institute of Information Technology, Malabe, Sri Lanka.*

Abstract

Socio-demographic characteristics of individuals in Eastern province of Sri Lanka are an important area to study to formulate better policies for businessmen who are interested in recreational activities in the country. The study used annual sample of 21,756 households that covered all 25 districts in the country, based on data from the provincial and district level. This research suggests to investigate the determinantsof socio-demographic characteristics of households on spending on recreational activities. As such, itutilized the methods of descriptive statistics chi-squaredistribution to derive quantitative data and information in a meaningful way. The study adopted cross-sectional statistics to create distribution pyramids and diagrams to highlight the socio-demographic characteristics of people in the Eastern province. The results and finding revealed that most spending on recreation activities are done by the Male Headed households (MHHs) than the Female Headed households (FHHs) in the Eastern province. It is respectively 78.63 percent and 21.37 percent.

Keywords: Socio-demographic characteristics, recreational activities, Eastern province.

Introduction

The leisure and entertainment sector of the economy of countries with a high standard of living is rapidly expanding in business activities such as marketing, financing, research and developing, and manufacturing. The purpose of this study is to investigate the determinantsof socio-demographic characteristics of households on spending on recreational activities. Statistics report by the Department of Census and Statistics (DCS) indicates that the mean monthly income was Rs.62, 237, while the mean monthly household expenditure on recreational activities was only Rs.908 (2.5% of total non-food expenditure).

Past literature has much focused on how socio-demographic characteristics can affect the spending on recreational activities. AS stated by [1] which analyzed the relationship between income and leisure time physical activities (LAPA) indicate that there is a known relationship between lower socioeconomic status and lower leisure time physical activities. The study considered about a person's all non-leisure time physical activities and socio-demographic characteristics and the result. Furthermore, the research that is done by [2] to analyze the various demographic, socioeconomic and psychological characteristics on people's expenditures on recreation activities in Greece revealed that there is a strong relationship between demographic, socioeconomic and psychological factors and Greece household's expenditures patterns in recreation activities.However, no comprehensive study on this subject has been conducted to date in Sri Lanka. Although the DCS captures household expenditure on recreations, their expenditure patterns are not separately analyzed based on household income, socio-economic and demographic characteristics. As such, the study

addresses this research gap, by highlighting the significance of recreational activities with in-depth insights.

The importance of this study can be listed as,

1. The analysis is centered around spending on recreational activities by people from the Eastern province, and critical studies have not been conducted on the aforementioned subject in this particular area
2. Mean per capita income of Eastern province is less than the other provinces in Sri Lanka, thus the findings will be useful for other business ventures as well

Methodology

Data are gathered from the HIES and analyzed by descriptive statistics and chi square statistical techniques.

Results

Table 1. Distribution of 'spent' and 'not spent' on recreational activities by sector, province.

		Spent on Recreation %	Not spent on Recreation%	Mean per capita income. (Rs.)
Sri Lanka		56.19	43.81	16,377
Sector				
	Urban	58.23	41.77	22,297
	Rural	55.69	44.31	15,508
	Estate	57.4	42.6	8,566
Province				
	Western	62.9	37.1	21,665
	Central	59.28	40.72	13,729
	Southern	70.52	29.48	15,730
	Northern	55.27	44.73	11,384
	Eastern	21.68	78.32	11,259
	North Western	58.29	41.71	16,671
	North Central	41.99	58.01	16,567
	Uva	63.48	36.52	13,867
	Sabaragamuwa	49.02	50.98	13,157

Source: Calculated from HIES 2016 data[3].

Based on the data of the DCS the study analyses how socio-demographic characteristics affect recreation, entertainment, cultural and religious activities of households. Table 1 clearly indicates that there is a Province-wise household variation in spending on recreation activities. As indicated, 56.19 per cent of the individuals spent on recreational activities from Sri Lanka while 43.81 per cent are not spending. The higher degree of spending on recreational activities was 70.52 per cent recorded in the Southern province. However, Eastern province recorded a lower extent for spend on recreation activities which is 21.68 per cent. The difference significant at $p<0.01$ level and it investigate that the sector wise spend and not spend on recreational activities are differ from spend or not spend on recreational activities in the province wise.

Table 2. Distribution of 'spent' and 'not spent' on recreational activities by district in eastern province.

	Spent on Recreation %	Not spent on Recreation %	Total
Eastern	21.68	78.32	7490
Batticaloa	11.22	88.78	2593
Ampara	26.67	73.33	2981
Trincomalee	28.08	71.92	1916

Source: Calculated from HIES 2016 data[3].

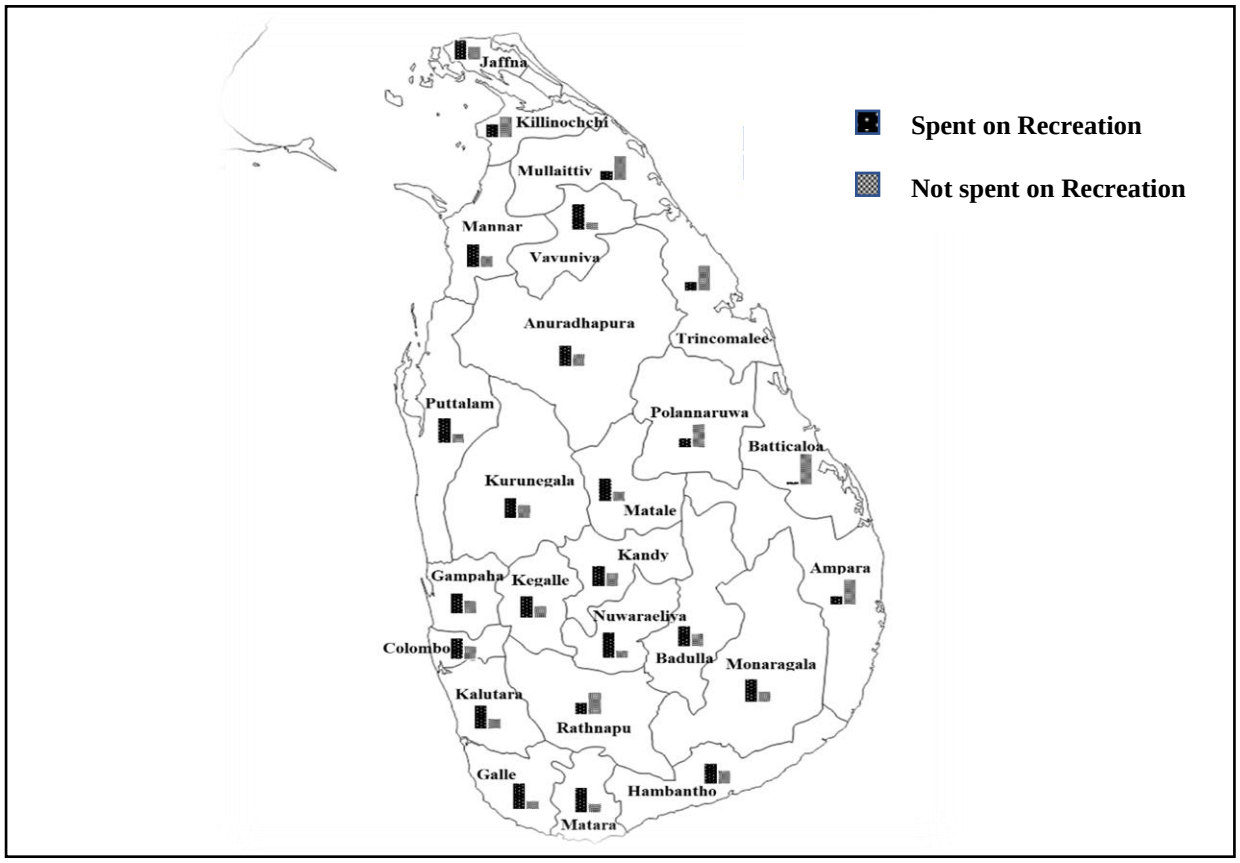


Figure 1. Distribution of 'spent' and 'not spent' on recreational activities by district
Source: Authors' compilation based on HIES 2016[3]

Eastern province comprises of Batticaloa, Ampara and Trincomalee districts. . Trincomalee district recorded the most noteworthy extent spend for recreation activities (28.08 per cent). Relatively Batticaloa district shows the lowest proportion that spend on recreational activities (11.22 per cent). The total number of MHHs have spent 78.63 percent on recreational activities in the Eastern province while FHHs are only 21.37 per cent. (Table 2 and Figure 1)

Table 3. Distribution of recreational activities by gender in Eastern province.

	CDVF	BNM	LB	EP	AMD	Sports	PA	Toys	MRTV	SG	CSTVP	AE
Eastern												
Male %	7.9	19.1	12.6	9.5	-	0.7	1.9	5.6	5.6	22	12	3.3
Female %	18.8	13.4	11.6	8	0.9	0.9	0.9	8	6.3	19	8.9	3.6
Batticaloa												
Male %	26.2	3.1	4.6	4.6	-	-	6.2	3.1	26.2	11	11	4.6
Female %	50	-	-	3.3	-	-	3.3	3.3	23.3	6.7	3.3	6.7
Ampara												
Male %	2.9	23.1	13.9	11.3	-	0.4	0.4	5.9	0.8	29	10	2.1
Female %	4.9	22	12.2	12.2	-	-	-	-	-	29	17	2.4
Trincomalee												
Male %	7.9	19.7	14.2	8.7	-	1.6	2.4	6.3	3.9	16	15	4.7
Female %	10.8	16.2	21.6	8.1	2.7	2.7	-	21.6	-	8.1	5.4	2.7

Source: Calculated from HIES 2016 data[3].

Table 3 displays 12 recreational exercises, a significant number of MHHs in Eastern province spent on the SG (22.3 per cent from the total recreational activities) while FHHs spent a higher number on both CDVF category and SG (18.8 per cent from the total recreation). It is evident that in Ampara both MHHs and FHHs spent the highest percentage on the same recreational activity (SG). However, both MHHs and FHHs are not spending on the same recreation activity in the other two districts. Furthermore, it was found that MHHs in Batticaloa district represent the highest rate on both MRTV and CDVF, and a significant percentage of the FHHs spent on CDVF. In Trincomalee district, both MHHs and FHHs are inclined to spend on different recreational activities than the other two districts. The study uncovers that the FHHs spend a lot on lotteries and betting (21.6 per cent), and the same rate is spent on toys. It indicates that there is a strategically significant at $p<0.01$ level are differing in both Trincomalee and Ampara district for the spend and not spend on CDVF.

Age sex distribution

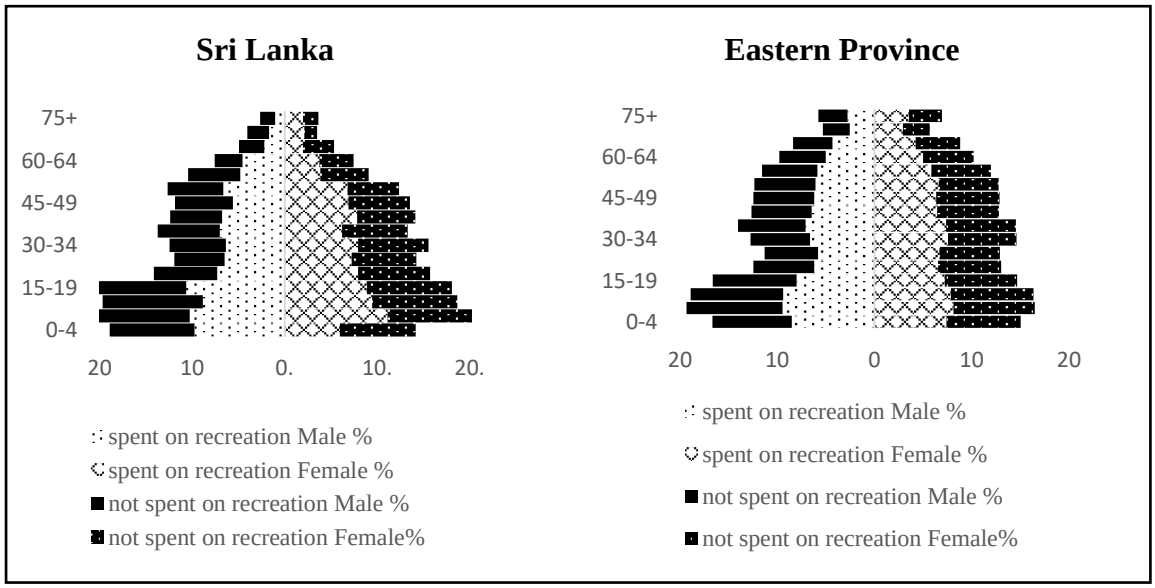


Figure 2. Age sex distribution of 'spent' and 'not spent' on Sri Lanka and Eastern province.
Source: Calculated from HIES 2016 data[3] .

The demographic characteristics of the individuals 'spent' and 'non-spent' on recreational activities could be understood by using a population pyramid. It graphically represents of the age and sex composition of a specific population.

As shown in the Figure 2, shape of the age-sex pyramids differs in both male and female individuals. In the Eastern province age-sex distribution is closer to the shape of a pyramid. However, the shape of the age-sex distribution of the Sri Lanka is slightly different. The pyramid clearly indicates that there is a higher proportion of 'non-spending' individuals than the individuals who spent on recreational activities. It is noticeable that the number of individuals who spent on recreational activities in the age groups of 15-19 and below are considerably higher (7.43 to 9.44 per cent) in both female and male individuals. Conversely, the number persons in the age groups of 60 and above are relatively lower. One significant aspect is that the number of FHHs who spent on recreation in the age group of 0-4 are considerably lower than the male headed households (5.96 and 9.75 per cent) and age groups of 5-9 and 15-19 are recorded the higher degree of spend on recreations among the other age groups. However, it decreases when the age groups are more mature. This difference is statistically significant at $p<0.01$ level and thus it suggests that the age of spend and not spend of FHHs are relatively differ from the age of spend and non-spend MHHs. The highest proportion of age 30-34 population is in the spend on recreational FHHs and considerably higher proportion of age 40-44 population is also in the spend on recreational FHHs in Sri Lanka.

Ethnicity

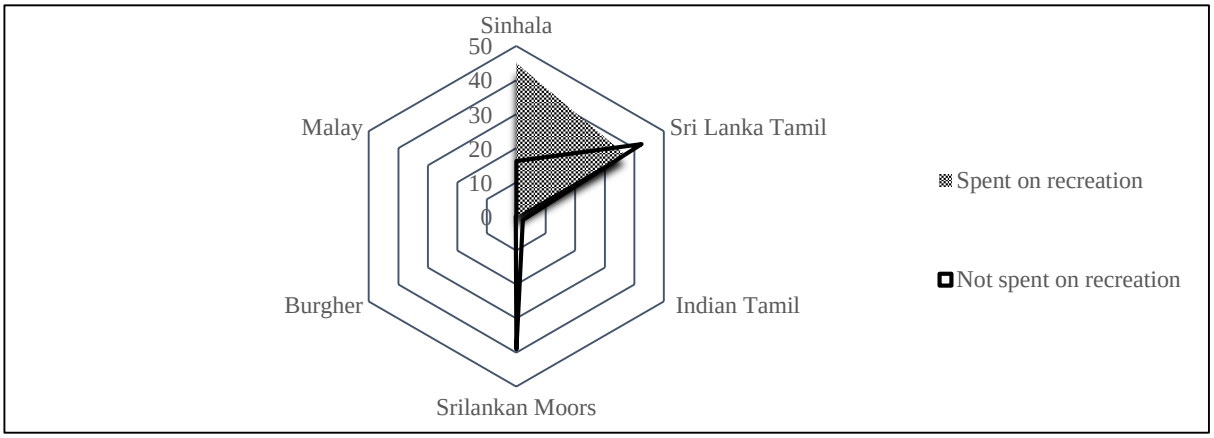


Figure 3. Ethnicity distribution of eastern province.
Source: Calculated data from HIES 2016[3].

The ethnicity of the 'spent' and 'non-spent' on recreational activities are presented in figure 3. It confirms that a majority of the head of the households who spend on recreational activities are Sinhalese which is 45.04 per cent. While Burgher demonstrate the lowest proportion, which is 0.25 per cent. Malay and Indian Tamils are hardly spending on recreational activities.

Conclusion

The socio-demographic characteristics of the 'spent' and 'non-spent' on recreational activities indicate that Trincomalee district has the most noteworthy amount of spending on recreational activities (28.08 per cent) in the Eastern province. Moreover, this study clearly highlights that highest proportion spent on recreational activities are by children and it decreases in mature. One of the significant finding with regard to ethnic groups in Eastern province is that a higher number of the head of the households who are spent on recreational activities are Sinhalese, while Malay and Indian Tamils rarely spending.

The facts and figures presented in this paper uncovers that individuals' spending on recreational activities vary based on their demographic characteristics. Therefore, it is important to identify the socio-demographic characteristics of individuals in Eastern province to formulate better policies for the businessmen who are interested on recreational activities in Sri Lanka.

Reference

1. Kakinami, L., R. Wissa, R. Khan, G. Paradis, T. A. Barnett, and L. Gauvin, *The association between income and leisure-time physical activity is moderated by utilitarian lifestyles: A nationally representative US population (NHANES 1999-2014).* Prev Med, 2018. 113(2): p. 147-152.
2. Kostakis, I., S. Papadaki, and A. Marketos, *Greek Consumers' Expenditure on Recreation Activities during Difficult Times.* Journal of Tourism and Recreation, 2014. 1(1): p. 12-20.
3. DCS. *Household Income and Expenditure Survey* 2016 [cited 2019 15th February]; Available from: http://www.statistics.gov.lk/HIES/HIES2016/HIES2016_FinalReport.pdf.

ID - 27

FACTORS AFFECTING JOB SATISFACTION OF NON-COMMISSIONED OFFICERS IN SRI LANKA MILITARY ACADEMY

Romita De Silva[1]
Advanced Technological Institute (ATI)

Abstract

Job satisfaction plays a significiant role to retain an effective employees. Satisfied employees are adherence towards their work which lead to improve their performance. The sucess of an organisation is highly depends on the performance of the employees. Military service is one of the most stressful jobs which needs to perform duty at any time and at any risk situation based on the demand. Consequently, retaining productive officers in long term is one of the main challenges faced by many military organisations. Premature retirement among Non - commissioned officers (NCOs) in Sri Lankan army (SLA) is high, although SLA invest huge money for recruitment, induction, training, career development, maintenance and retention of those officers. Therefore, its effects to the operational effectiveness in the field. The purpose of the study is to investigate the factors which affect job satisfaction and to measure the level of job satisfaction among the NCOs in Sri Lanka Military Academy (SLMA). 320 Non - Commissioned officers were selected as sample of the study. Questionnaires were distributed in Sinhala language among the selected participants. A multiple linear regression analysis was carried out to analyse the collected data. The findings of the study reveal that pay, benefits, relationship with supervisor, communication are significant, where p values are less than 0.05. And also reveal that there is a positive relationship between these factors and job satisfaction. Further, respondents were dissatisfied on pay and relationship with supervisors. Management should give more attention on the factors such as pay, benefits, relationship with supervisor, over workload, work pressure and operating procedures in order to increase job satisfaction level of NCOs which lead to reduce turnover and absenteeism.

Keywords: Job satisfaction, Military personnel, Non - commissioned officers (NCOs) and Premature retirement

Introduction

Job satisfaction is the feeling of wellbeing of employees about the job. Satisfying employees' need in an organisation is prime necessity in order to retain employees which is directly proportional to turnover and absenteeism. Thus, understanding employees' preference is important in order to satisfy their need. Apparently, the level of employees' performance and commitment towards the work are highly influenced if the employees are satisfied by the internal and external environment of the organization. Military service is one of the most stressful jobs which considered as 24 hours service. Military personnel need to perform duty at any time and at any risk situation based on the demand. Non - commissioned officers (NCOs) of Sri Lanka army play a significant role in both peace and war time. Nation's security and peace is highly dependent on the military personnel. As a result, it is needed to build a strong-armed force in order to protect and keep peace in a nation. Therefore, it is necessary to understand the preferences of military personnel to satisfy their needs. There are variety of factors that can influence on a person's job satisfaction. Some of these factors which influence among the NCOs can be mentioned as pay, benefits, promotion, job

description, training opportunities, working condition, workplace relationship, communication and rule and regulation.

Research Problem

Sri Lanka Military Academy (SLMA) is the main institute of Sri Lanka Army (SLA) where the officer cadets are recruited and trained for the work forces. Non - commissioned officers (NCOs) take a vital role in order to train and support the new officer cadets, national security, counter-terrorism, protecting borders from illegal activity, peacekeeping operations and helping communities affected by natural disasters. For these reasons, SLA invest a lot of money on NCOs in terms of induction, training, career development, maintenance and retention in the military service. As per SLA annual performance report 2016, SLA invest Rs 11,880,729.00 for battalion and special infantry operation training which is Sri Lanka India joint training known as Mitra Shakti training held at regimental headquarters in Sri Lanka. Although a lot of investment, it has been experienced that premature retirement and absenteeism rate among NCOs in SLA is high. In 2017 & 2018 absenteeism rate of SLA were 6.5 % and 4.8% and it has been increased by 6.5% at present. Retaining officers in long term is one of the main challenges faced by the SLA.Consequently, job dissatisfaction has been repeatedly identified as the main reason why NCOs leave their jobs. There is a problem of attrition and the increasing dissatisfaction rate among the NCOs in SLA [5]. Therefore, it is necessary to develop a clear understanding of the factors that caused job dissatisfaction among the NCOs in SLA. The problem statement of the study is "*which are the factors affecting job satisfaction of NCOs in SLMA"*.

Research Question

1. What are the factorswhich affect job satisfactions of non-commissioned officers?
2. What is the level of job satisfaction of non-commissioned officers?

Objectives of the Study

1. To determine the factors which affect job satisfaction of non-commissioned officers
2. To measure the level of job satisfaction of non-commissioned officers

Theoretical and Empirical Evidence

Job satisfaction refers to an individual's general attitudes and perceptions toward his or her employment [8]. Job satisfaction can be an important predictor of work behaviours such as organizational commitment, absenteeism, turnover, and motivation and employee relation. The concept of job satisfaction is important for an organization in two reasons. Firstly, job satisfaction can be an indicator for someone's general and mental well-being. Secondly, job satisfaction leads to improve employee's performance and consequently more committed towards the organization [1]. Factors which lead to job satisfaction are salary, communication with co - workers, training and health and safety at workplace [4]. Job dissatisfaction may lead to frustration, aggression, psychological withdrawal, poor physical health and shortened the life span of employees [7]. Older personnel in the military have demonstrated a greater job satisfaction as compared to the young soldiers [7]. Indian armed forces are facing a 'battle on two fronts. First, failing to attract bright youngsters to join the forces and second, the serving officers are seeking for premature retirement [3]. Affect theory postulate that

satisfaction is determined by a discrepancy between what a person wants in a job and what he/she has in a job [6]. According to Hygiene Two Factor theory, it revealed that hygiene factors such as company policy, supervision, relationship, working conditions and salary do not create much satisfaction to employees even though these factors are present at the workplace [2].

Methodology

The population of the study was all the non-commissioned officers working in Infantry, Support, Service and Special Forces in SLMA. The sample size of the study was 320 Non-Commissioned officers. Researchers used stratified sampling method to divide the population into separate strata based on the officers' ranks and their units of work comparatively. In this study, the researcher has considered, job satisfaction as dependent variable which is measured through job characteristics and organisational characteristics as main indicators. And relationship, task status and extrinsic factors are considered as independent variables which are measured through pay, benefits, promotion, contingent rewards, relationship with supervisor, relationship with co-workers, operating procedures, communication, responsibilities, over workload, work pressure and training. Questionnaires were distributed in Sinhala language among all the randomly selected participants as a primary data collection of the study. Cronbach's alpha value of .867 and .796 shows that questionnaire used for job satisfaction is reliable.

Results and Discussion

All participants were males. Out of 320 respondents, majority (46 %) of the respondents were completed ordinary level (O/L) examination and 41% were completed grade 8 examination and 13% were above the ordinary level.

Multiple linear regression analysis

Table 1. Coefficients of regression analysis

Model		Un-standardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.139	.144		.963	.336
	Pay	.053	.043	.064	1.256	0.013
	Benefits	.057	.543	.763	3.313	0.048
	Promotion	.080	.046	.096	1.719	0.087
	Contingent Rewards	.342	0.56	.754	2.453	0.54
	Relationship with Supervisor	.509	.056	.509	9.074	0.000
	Relationship with co workers	.362	.058	.643	6.973	0.147
	Operating Procedures	-.067	.053	-.055	-1.256	0.210
	Communication	.148	.063	.129	2.364	0.019
	Responsibilities	.073	0.48	.478	1.468	0.054
	Over Workload	-.149	.039	-.151	-3.814	0.098
	Work pressure	-.352	.056	-.342	-4.861	0.654
	Training	.685	.047	.063	2.872	0.724
a. Dependent Variable: Job Satisfaction						

A multiple linear regression analysis was carried out in order to measure the significant levels and also to find out the impact of the considered factors on NCOs' Job Satisfaction. Based on the analysis, pay, benefits, relationship with supervisor, communication are significant, where p values are less than 0.05. It also revealed that how many units of job satisfaction increases for a single unit increase in each factor. Findings of the study show that 1point increases on pay, benefits, promotion, contingent rewards, relationship with supervisor, relationship with co-workers, communication, responsibilities, training correspond to .053, .057, .080, .342, .509, .362, .148, .073, and .685 increases on the job satisfaction. However, operating procedures,over workload and work pressure have a negative relationship with job satisfaction. One point increase on these factors lead to decreases job satisfaction by -.067, -.149 and -.352. Basedon this analysis, the model has developed as:
Job satisfaction (y) = .139+ (.053 x pay) + (.057x benefits) + (.080 x promotion) + (.342 x contingent rewards) + (.509 x relationship with supervisor) + (.362 x relationship with co-workers) + (-.067x operating procedures) + (.148 x communication) + (.073 x responsibilities) + (-.149 x over workload) + (-.352 x work pressure) + (.685 x training)

Level of job satisfaction of ncos

Table 2. Level of job satisfaction of NCOs

Factors	Level of satisfaction
Pay	2.10
Benefits	2.84
Promotion	3.86
Contingent Rewards	3.90
Relationship with Supervisor	1.83
Relationship with Co workers	4.97
Operating Procedures	3.46
Communication	3.13
Responsibilities	3.51
Over Workload	2.86
Work pressure	3.42
Training	3.62

According to table no. 2, findings of the study reveal that respondents were dissatisfied on pay and relationship with supervisor which fall in the range of 1.80 to 2.59 (dissatisfied). Furthermore, in Infantry unit, it is evident that only 23 officers out of 120 were satisfied with the pay. It finds from the study that 61 % of respondents were unhappy with the relationship with their supervisor in support unit. Consequently, in Service and Special Forces units, 56% and 65% of respondents shows that they were unhappy with the relationship with supervisors. Nevertheless, respondents are satisfied on promotion, contingent rewards, responsibilities, operating procedures, work pressure, training and relationship with co – workers.

Conclusion and Recommendations

The findings of the study highlight that pay, benefits, relationship with supervisor, communication are statistically significant factors affecting job satisfaction of NCOs in SLMA. Consequently, pay, benefits, promotion, contingent rewards, relationship with supervisor, relationship with co-workers, communication, responsibilities, training have

positive relationship with the job satisfaction. It also demonstrates that officers are dissatisfied on pay and relationship with supervisor. It suggests that decision makers should give more attention on the factors such as pay, benefits, relationship with supervisor, over workload, work pressure and operating procedures in order to satisfy the need of NCOs. Management should develop strategies as implementing performance-based pay system, improving benefits and recreational programmes and building healthy work relationship at workplace. Further, researchers recommended that to organise more workshops on career development, work pressure and managing secondary duties without effecting on the primary duties.

Reference

1.Arnold, J., Cooper, C.L., Robertson, I.T. (1998) Work psychology: Understanding human behaviour in the workplace. 3rd Ed. London, Pearson Education: Prentice Hall.

2.Herzberg, F. (1959) Hygiene two factors theory of motivation [Blog post]. Retrieved from:http://managementstudyguide.com/herzbergs-theory-motivation.htm

3.Jaiswal, R.K., Satyabhusan Dash, S., Sharma, J.K., Mishra, A., Kar, S. (2015) Antecedents of turnover intentions of officers in the Indian military: A conceptual framework. *Vikalpa: The journal for Decision Makers.* 40(2): 145–16.

4.Jhajharia, P., Gupta, H (2015) A study of employee satisfaction and its impact on employee retention in retail sector: *IOSR Journal of Business and Management (IOSR -JBM)* . Vol.17.No. 7

5. Lekamge, B.J.,Silva, R., (2010) Job satisfaction of commissioned officers in volunteer force in Sri Lanka army. Master thesis, Institute of Personnel Management (IPM), Sri Lanka.

6.Locke, E. A. (1976) Range of affect theory. In *Wikipedia.* Retrieved on September 6, 2017, from: https://en.wikipedia.org/wiki/Job_satisfaction#Models_.28methods.29

7.Montgomery, L. J., (2007) Perceived control and locus of control in active duty military members : *A comparison of late enrolees with early enrolees*. *Ph.D.* Thesis, Philadelphia College of Osteopathic Medicine.

8.Robbins, S.P. (2000). Organizational behavior. (9th ed) New Jersey. Prentice Hall.

ID - 33

DISCLOSURE PRACTICES OF CORPORATE SOCIAL RESPONSIBILITY AND FIRM FINANCIAL PERFORMANCE: A STUDY OF LISTED BANKS IN SRI LANKA.

Panuja E[1], Arulvel K[2]

[1,2]Department of Accounting, Faculty of Management Studies & Commerce, University of Jaffna, Sri Lanka

Abstract

This study examines the disclosure practices of Corporate Social Responsibility (CSR) and firm financial performance of listed banks in Sri Lanka over the period of 2013-2017. A population of all 13 banks listed under Bank, Finance, and Insurance sector of CSE Sri Lanka was studied. The study made use of secondary data gathered from annual reports of banks. The data is analyzed by correlation and regression analysis using STATA (version 12) package. The result of regression analysis suggests that disclosure practices of corporate social responsibility significantly affect the Return on assets (ROA) of banks. And also disclosure practices of corporate social responsibility does not significantly affect Tobin's Q. Correlation analysis indicates that disclosure practices of corporate social responsibility have significant negative relationship with ROA while Tobin's Q has an insignificant positive relationship.

Keywords: Disclosure Practices of Corporate Social Responsibility, Return on assets (ROA), Tobin's Q.

1. Introduction

1.1Background of the study

At present, the business bodies cannot ignore the society, and the society cannot exist without business bodies in its own right. Therefore, there is a mutual relationship between business bodies and the society. Hence, the interdependence of the firm and the society can be beneficial for both business entities and the society as a whole. So, the managers of the companies should try to play an increasingly active role in the society, which is called "Corporate Social Responsibility" (Sandra A. Waddock and Samuel B. Graves, 1997).

There was not a clear relationship between CSR studies on financial performance. Peloza, (2009) reviewed 128 studies on CSR and financial performance and reported that 75 studies (about 58.6 percent) found a positive association between CSR and financial performance, 34 studies (about 26.7 percent) found a mixed or neutral association, and 19 studies (about 14.7 percent) found a negative association. Some researchers have denoted the inconsistency in results to be caused by differences in selecting methodologies, approaches and selection of variables (Kohers, 2002).

1.2 Research objectives

- To identify the association between the disclosure practices of CSR and firm financial performance of listed banks in Sri Lanka.
- To examine the impact of disclosure practices of CSR on firm financial performance of listed banks in Sri Lanka.

2. Literature Review

The previous empirical papers on the relationship between CSR activities and firm performance can be divided into qualitative and quantitative studies. The qualitative studies have often focused on the relationship between CSR and the firm's competitiveness, which in turn implies an increased financial performance. The quantitative studies on the other hand have mainly been conducted as either regression studies or event studies, which often have led to inconclusive results (Camelia-Daniela Hategan, Nicoleta Sirghi, Ruxandra-Ioana Curea-Pitorac, 2018). For example, Aupperle, (1985) and McWilliams & Siegel (2000) found that there is a neutral relation between socially-responsible activities and profitability, while Waddock and Graves (1997) found that CSR activities result in an improvement in firm performance. Negative correlations have also been found, however those have not been as common (Alessandra Distefano, Vincenzo Pisano, Marco Galvagno, 2016). Most of the critique pointed towards these studies has been related to the inconsistency of variables and methodology used in the research (Weber, 2008; McWilliams & Siegel, 2000). It has also been discussed whether there are missing factors in previous research and that this deficiency may lead to misleading results. Examples could be cultural differences of CSR importance, industry differences, and the causality between CSR and financial performance, or if a correlation actually is dependent on a hidden variable, such as R&D or advertising (Sang Jun Cho, Chune Young Chung, Jason Young, 2018).

There was little empirical evidence of previous research in banking industry in addition to manufacturing industry in Sri Lanka. Much of prior research in this area has concentrated on developed countries. Past research has shown inconsistencies results obtained by different researchers. Studies assessing the effects of CSR disclosures in a developing economy context are scant and less clear.

3. Methodology

3.1Research Methods

The quantitative research approach is employed to find out the findings of this research study. The study is related with secondary data collection. In this research the researcher collect data from the annual reports of related banks published during the year 2013 to 2017 is mainly used to collect information regarding CSR disclosures by each company. Population of the research includes all the 13 banks listed in CSE under bank, finance and insurance sector from 2013 to 2017.

3.2 Building Hypothesis

H_1: There is a significant association between disclosure practices of CSR and Financial performance.

H_1 a: There is a significant association between disclosure practices of CSR and ROA.
H_1 b: There is a significant association between disclosure practices of CSR and Tobin's Q.

H_2: There is a significant impact of disclosure practices of CSR on Financial performance.
H_2 a: There is a significant impact of disclosure practices of CSR on ROA.
H_2 b: There is a significant impact of disclosure practices of CSR on Tobin's Q.

3.3 Conceptualization

Figure 3.1 Conceptualization

3.4 Operationalization

Table 3.1 operationalization

Key concept	Variable	Indicators	Measurement
Disclosure practices of CSR	CSR index	• Community Involvement • Human resources • Products and customers • Environment (Kilic, 2015)	$\sum_{j=1} rj \div n$ rj =1 if the j item is disclosed rj =0 if the item is not disclosed n= No of items
Financial Performance	Return on assets (ROA)	Its indicates how much profit a firm generates with its total assets (Simionescu, 2014).	$ROA = \frac{\text{Profit after tax}}{\text{Total assets}}$
	Tobin's Q	Tobin's Q indicates stock market value perception of current and future company earnings and growth potential (Wang, 2014).	Tobin's Q $= \frac{EMV + DEBT}{\text{Total assets}}$ Description: EMV : Equity Market Value = closing price of fiscal year end X number of outstanding shares) DEBT : Total Debt at end of fiscal year

4. Data Presentation and Analysis

4.1Correlation Analysis

According to table 4.2 The correlation results between CSR disclosure and ROA shows -0.3377 a negative correlation and a P-value is 0.0059, this means at 95% confidence level, the P-value of 0.0059 less that than 0.05, therefore, there is significant strong negative correlation between CSR disclosure and the ROA of the listed banks in Sri Lanka

The correlation results between CSR disclosure and Tobin's Q show a positive correlation of 0.0796 between the listed banks, the results showed a P-value of 0.5287, this means at 95% confidence level, the P-value of is more than 0.05 Therefore there is an insignificant positive correlation between CSR disclosure and Tobin's Q of the listed banks.

Table 4.2 Results of Correlation Analysis

	CSR	ROA	Tobin's Q
CSR	1.0000		
ROA	-0.3377**	1.0000	
	0.0059		
Tobin's Q	0.0796	0.2017	1.0000
	0.5287	0.1071	

Source: STATA Output.
* indicates a correlation significant at 95%

4.2 Regression Analysis

4.2.1Results of regression analysis: Disclosure practices of CSR and ROA

According to table 4.3 R square variables is 0.1141. This means that 11% of the variation in ROA is explained by the independent variable disclosure practices of CSR. P value is 0.0059 which is lower than 0.05. It shows that there is a significant impact of disclosure practices of CSR reporting on ROA. Adjusted r^2 value is 0.1000, which means that disclosure practices of CSR impact only by 10% on firm financial performance and remaining 90% are determined by other factors.

Table4.3 Results of panel regression Analysis

ROA	Coefficient	Std. Err	t	P>|t|
CSR	-32.3202	11.34876	-2.85	0.006
Cons	1.975974	0.278563	7.09	0.000
Number of obs	0. 00807	R-squared		0.1141
F(1, 63)	8.11	Adj R-squared		0.1000
Prob > F	0.0059	Root MSE		0. 807

Source: STATA Output

4.2.2Results of regression analysis: Disclosure practices of CSR and Tobin's Q

Table 4.4 shows that R^2 value is 0.0063 which means that there is a variance of 6% in the variation in Tobin's Q is explained by the independent variable disclosure practices of CSR. And also indicated that p value is 0.5287 which is higher than 0.05. It shows that there is an insignificant impact of disclosure practices of CSR on firm financial performance. The adjusted R^2 value is -0.0094 which means that disclosure practices of CSR impact only by -0.9 % on firm financial performance and the impact is insignificant.

Table 4. 4 Results of panel regression Analysis

Tobin's Q	Coefficient	Std. Err	t	P>|t|
CSR	0.7533407	1.189029	0.63	0.529
Cons	0.0923758	0.0291855	3.17	0.002
Number of obs	65	R-squared		0.0063
F(1, 63)	0.40	Adj R-squared		-0.0094
Prob > F	0.5287	Root MSE		0. 08459

Source: STATA Output

5. Conclusion and Recommendation

There is a significant association between and disclosure practices of CSR and accounting based sort term financial performances (ROA), There is an insignificant association between and disclosure practices of CSR and investment based long term financial performances (Tobin's Q). Hence, it can be concluded that there is asignificant association between disclosure practices of CSR and firm accounting based short term financial performance of listed banks in Sri Lanka and there is an insignificant association between disclosure practices of CSR and firm investment based long term financial performance of listed banks in Sri Lanka.

There is a significant impact of disclosure practices of CSR on accounting based short term financial performances (ROA). There is an insignificant association between and disclosure practices of CSR and investment based long term financial performances (Tobin's Q). Hence, it can be concluded that there is asignificant impact of disclosure practices of CSR and firm accounting based short term financial performance of listed banks in Sri Lankaand there is an insignificant impact of disclosure practices of CSR on firm investment based long term financial performance of listed banks in Sri Lanka.

Reference

1. Alessandra Distefano, Vincenzo Pisano, Marco Galvagno. (2016). The Effect of Negative Corporate Social Responsibility On Consumers' Attitudes Toward Waste Treatment Facilities.

2.Camelia-Daniela Hategan, Nicoleta Sirghi, Ruxandra-Ioana Curea-Pitorac. (2018). Doing Well or Doing Good: The Relationship.

CSE. (2018, March 8). Retrieved from Colombo stock exchange: http://www.cse.lk/home/market

3.Dam, L., & Scholtens, B. (2012). Does Ownership Type Matter for Corporate Social Responsibility? *Corporate Governance: An International Review*, 233–252.

4.Dorasamy, N. (2013). Corporate Social Responsibility and Ethical Banking for Developing Economies.

Hospitality Management

ID - 48

COMPARATIVE ANALYSIS OF CUSTOMER LIKING TOWARDS THE TASTE OF STEVIA AND SUGAR-MADE COOKIES

M. Thashneem Thaqseen Bhanu[1], Sivaram R[2]
Research Scholar, Ramaiah University of Applied Sciences, Bangalore, India
riverintheheaven@gmail.com, +91-9845415356
Hospitality and Events Management, PES University, Bangalore, India
sivaramr@pes.edu, +91-9629606955

Abstract

Stevia, the substitute for sugar contains very less calories. The reason for the growth of interest in using stevia is because it helps people with diabetes in managing their blood sugar levels. The health benefits of stevia are more as the demand for the same as sugar substitute is increasing day by day. A group of 50 respondents participated in blind tasting of sugar-made and stevia-made cookies. The liking of respondents toward stevia –made cookies were examined in comparison to sugar-made cookies. The recorded liking of respondents were analysed statistically using various statistical tools with the help of Minitab ’18 software. The results proved that the respondents liked sugar-made cookies more than stevia-made cookies. Further analysis to find out the reason which made sugar-made cookies to taste better was done through qualitative interviews with 20 respondents who participated in the blind tasting. The results of the qualitative interview was analysed in Nvivo software to get a visualization of the interview conducted. The results proved that stevia-made sugar was not liked because it was bitter, hard and leaves the palate cold after tasting, on the other hand, sugar-made cookies were liked by the respondents as the respondents were used with the taste of sugar for years and the cookie made out of sugar seems to be a taste which they are used to, soft, crunchy and mouth melting. In nut shell, the results proved that the awareness of stevia sugar and its health benefits were lesser among the respondents and the paper therefore, suggests more awareness on health benefits of stevia and a lifestyle change for a valid reason, which would further help to maintain a healthy lifestyle. The limitation of the paper being time and budget constraint which therefore involved a smaller sample size and the respondents belong to one city, that is, Bangalore and thus the results cannot be generalized.

Keywords: Stevia, Sensory analysis, Stevia Vs Sugar, Healthier substitute for sugar, Healthy lifestyle

Introduction (Literature Review)

Consuming sugar sweetened items may be one of the cause of obesity [1]. According to [2], there has been a huge diabetic population in the last decade in India. Stevia is the new emerging alternative source of calorie free sweetener having no carbohydrate and fat [3] and it is plant that is grown wildly in Brazil and Paraguay [4][5]. Due to high demand for natural sweeteners the plant is cultivated in different parts of India, namely, Rajasthan, Kerala, Punjab, Orrisa and Maharashtra [2]. World Health Organization has recommended a limit on stevia, that is, not more than 1.8 milligrams per pound per day. Stevia sweeteners help in boosting nutritional quality by cutting down calories [6]. Several studies proved the health

benefits of stevia, [7] states the effect on anti –inflammatory and anti- cancer property of stevia. This might be due to the presence of polyphenol content and antioxidant activity in stevia [8][9]. Stevia has no calories and thus doesn't affect the sugar levels in blood, which makes stevia an option for people who suffer with diabetes [10]. Stevia is proved to help in lowering blood pressure, strengthening the heart and other antimicrobial activities, yet sweetener is the main use of stevia [11]. There is no evidence on effects of using stevia during pregnancy or lactation [12]. The major issue in stevia is its bitter taste and few feel it tastes like cough syrup or a chemical [13]. The measure of 25gm of stevia to the basic recipe was proven to be highly acceptable by diabetics [14]. The taste of stevia was also proven to be accepted and its use can aid in diabetics and for weight loss [15]. As various studies have scientifically proven the health benefits of stevia and stevia being a new taste in the market the acceptability of its taste becomes the big question. With this regards, this paper attempts to understand the customer liking towards stevia-made product in comparison with the sugar-made product. This paper would also analyse the reason for the disliking of the taste of stevia and the tendency of change to a new taste for a good reason, that is, the health benefit of stevia. The justification to this research is that this study would identify the liking of stevia's taste when used in baking in comparison to sugar and would analyse the reason behind the liking of disliking of the taste which would further be helpful to create awareness on a healthy substitute of sugar.

Methodology

The study involved both quantitative and qualitative methods of research. The study examined the liking of customers towards stevia – made cookies in comparison with sugar-made cookies. Two types of cookies were baked and used for sensory analysis, namely, butter cookies and choco-chip cookies. Each type of cookie was made with sugar and stevia. The study involved 50 respondents for the blind tasting of cookies. Each respondent was given 4 cookies each to taste and record their preferences, that is, 1 sugar-made butter cookie, 1 stevia-made butter cookie, 1 sugar-made choco-chip cookie and 1 stevia made choco-chip cookie. A measure of 57 grams and 120 grams of castor sugar was used per butter cookie and choco-chip cookie respectively. The measure of stevia powder was 0.57 grams and 1.2 grams per cookie [14]. The quantitative data of liking of customers were statistically analysed with tools like one-way Anova and t –test using Minitab'18. The qualitative part of the research involved 20 respondents who took part in blind tasting and a qualitative interview was done to get an in-depth understanding of liking or disliking of the taste of cookies in comparison with stevia and sugar-made cookies. The interview data was analysed using Nvivo 12 software to get a visualization of the conducted interviews.

Results and Findings

The respondents who participated in the blind tasting mostly were in the age group of 26 – 35 years as they constituted 40% of the overall respondents (p value = 0.002). The respondents involved in the blind tasting, 62% of them were male and 38% were female respondents (p value = 0.08).

Fifty six percentage (56%) of the respondents stating that they are 'Very Probable' to go for a healthier substitute for sugar, followed by that 36% are 'Somewhat Probable'. The statistical

analysis proves that the taste of stevia-made cookie is being least liked, with 58% of the respondents stating the taste to be 'Poor' and only 2% say the taste is 'Excellent'. This difference among the group has been proved significant with a p value of 0.00 (p value < alpha value). Same way, the customer liking was more toward sugar-made cookies as 44% of the respondents mentioning the taste as 'Excellent' and 36% stating 'Good'. Thus the null hypothesis has been rejected (p value = 0.00). A comparative analysis (t –test) was done between sugar and stevia made butter cookies which rejected the null hypothesis with a p value lesser than alpha value (0.00) and proves a significant difference among the group. The respondents showed more liking toward sugar-made butter cookie when compared with stevia-made butter cookie. 88% of the respondents liked sugar-made butter cookie whereas only 12% liked the taste of stevia –made butter cookie.

The next analysis was done for the choco-chip cookies where the respondents showed a lesser liking toward stevia-made choco-chip cookie as the p value is 0.00 and the null hypothesis being rejected and there exists a significant difference among the group. 61% of the respondents felt the taste of stevia-made cookie is 'Poor' and only 12% stated it has 'Excellent'. However, the sugar –made choco-chip cookie the analysis proves higher liking of consumers toward sugar –made choco-chip cookies with lesser p value of 0.00 proving a significant difference among the group. The. 48% of the respondents felt the cookie's taste to be 'Excellent' and only 1% felt it to be 'Poor' in taste. The comparative analysis (t-test) proves a significant difference among the group and thus the null hypothesis is being rejected. The results prove that, the taste sugar-made choco-chip cookie (88%) was more liked by the respondents when compared with stevia-made choco-chip cookies (12%).

Qualitative Analysis

As a part of qualitative analysis of the study, 20 respondents who participated in the blind tasting of cookies were interviewed to understand the reason behind liking or disliking of the taste of sugar-made and stevia-made cookies. Figure 1, illustrates the visualization of the interviews conducted.

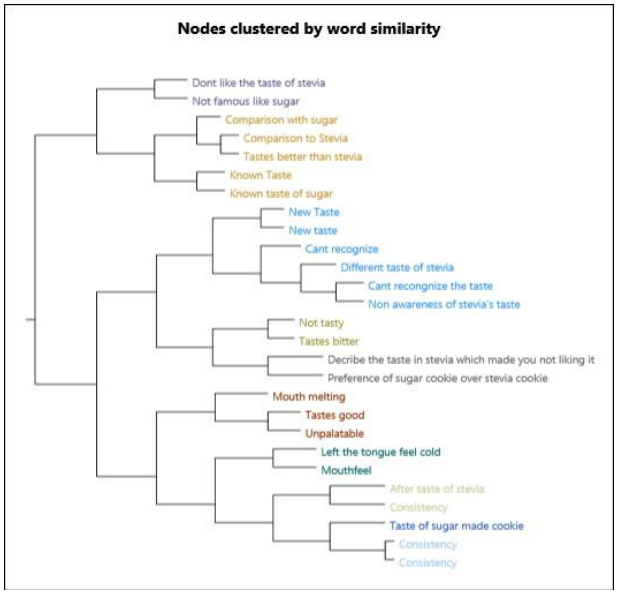


Figure 1. Node Cluster by Word Similarity

According to Figure 1, the visualization of the interviews conducted prove that stevia-made cookies are not liked by the respondents when compared to sugar-made cookies because taste of stevia is new to them and they feel that stevia is not famous like sugar. The known taste of sugar has dominated and thus became a reason for disliking of stevia. Moreover, the taste of sugar was found to be better than stevia. Some of the respondents were not able to recognize the taste of sugar due to lack of awareness of stevia. All the respondents felt that stevia-made cookies were bitter in taste which made the stevia cookies unpalatable. In respect to the aftertaste of stevia-made cookies the respondents stated that the cookie left the tongue feel cold. The respondents also felt that the consistency of stevia-made cookies was not good as it was hard and wasn't crunchy enough. Wherein, the taste of sugar-made cookies was to be more liked by the respondents as they were used with the known taste of sugar, the cookie was soft and crunchy with a good after taste.

Conclusion

In comparison with other studies which focused on analysing the health benefits of stevia and the sensory analysis of stevia, this study focuses in analysing the taste of cookies baked using stevia sugar. The study involved a taste comparison between sugar-made and stevia-made cookies and checked the liking of the respondents. Two types of cookies were used for the research work, namely, butter cookies and choco-chip cookies. The study involved 50 respondents, that is, 31 men and 19 women, who blind tasted the cookies and recorded their feedback. According to the statistically analysed data the taste of the sugar-made cookies were liked more compared to stevia-made cookies in case of both types of cookies. Though the liking towards the taste of stevia make cookies were rated poor, according to Table 3, more than half of the respondents (56%) were 'very probable' in changing to a better sugar substitute for health reasons (p value = 0.00). Moreover, the exists a significant, positive, medium correlation (r = 0.41, p value = 0.00) between rate of probability of change and liking of stevia-made butter cookies and a positive, weak correlation with stevia-made choco-chip cookies (r = 0.14, p value = 0.00). The correlation proves that more the probability in opting a healthier substitute for sugar, more would be the customer's liking of the taste of stevia- made products. The study involved qualitative interviews conducted with 20 respondents who participated in the blind tasting to understand the reason behind the liking or disliking of the cookies. To get a visualization of the interviews conducted was done with the help of Nvivo software. According to the interview the sugar-made cookies were liked by the respondents because they are familiar with the taste, crunchy consistency of the cookie and a pleasant after taste. The respondents didn't like the taste of stevia-made cookies because it was the taste was bitter, hard, the after taste left the palate chill. The respondents also stated that they weren't aware of the taste of stevia sugar and so few weren't able to recognise the taste. This emphasis the need for creating awareness about stevia sugar and the health benefits of it to the consumers. As more respondents (56%) are ready to change to a healthier substitute of sugar an awareness [16] to help them to choose stevia sugar which would help in weight loss [17], controlling blood sugar levels [18]and the ailments due to the presence of antioxidant properties and phenolic content in stevia [9]. In nut shell, as the previous studies mentioned about the scientific benefits of stevia, to add on to the literature, this study has analysed the reason behind disliking of the taste of stevia. As more than of the respondents were ready to change to a sugar substitute for health reasons, the results of the study

emphasis in creating awareness among consumers about stevia. The limitation of the study is the small sample size and the study was restricted with the residents of Bangalore due to time and financial constraints. According to the proven results, more respondents are most probable to opt the healthier substitute for sugar and lack of awareness being an obstacle, a future study can be done on blind tasting of stevia–made cookies after 20 minutes conceptual training on the benefits of stevia.

Reference

[1] S. D. Anton *et al.*, "Effects of stevia , aspartame , and sucrose on food intake , satiety , and postprandial glucose and insulin levels §," *Appetite*, vol. 55, no. 1, pp. 37–43, 2010.

[2] S. K. Goyal and R. K. Goyal, "Stevia (Stevia rebaudiana) a bio-sweetener : a review," vol. 61, no. February, pp. 1–10, 2010.

[3] S. D. Singh and G. P. Rao, "S t e v i a 9 T h e H e r b a l Sugar of 21 st C e n t u r y," vol. 7, no. l, pp. 17–24, 2005.

[4] B. Prideaux and M. Thompson, "Developing a food and wine segmentation and classifying destinations on the basis of their food and wine sectors," in *Advances in Hospitality and Leisure*, vol. 5, Emerald Group Publishing Limited, 2009, pp. 163–183.

[5] N. K. Verma and P. Panda, "A study on Stevia Rebaudiana : A review," pp. 1–6, 2018.

[6] A. Boileau, J. C. Fry, and R. Murray, "A new calorie-free sugar substitute from the leaf of the stevia plant arrives in the UK," pp. 47–50, 2012.

[7] L. Taylor, "The Healing Power of Natural Herbs. Garden City Park," 2005.

[8] A. Usha, "Nutrient composition of cultivated stevia leaves and the infl uence of polyphenols and plant pigments on sensory and antioxidant properties of leaf extracts," vol. 47, no. February, pp. 27–33, 2010.

[9] A. Rao, Galla Narsing ; Rao, Pamidighantam Prabhakar; Balaswamy, Karakala ; Satyanarayana, "Antioxidant Activity of Stevia (Stevia rebaudiana L .) Leaf Powder and A Commercial Stevioside Powder," *J. Food Pharm. Sci.*, vol. 2, pp. 32–38, 2014.

[10] C. Republic, S. Agriculture, and C. Agriculture, "Determination of Stevioside in Plant Material and Fruit Teas," pp. 383–388, 2001.

[11] B. Ahmed, M. Hossain, R. Islam, A. K. Saha, and A. Mandal, "a review on natural sweetener plant – stevia having medicinal and commercial importance izvještaj o biljci stevia , prirodnom zasla đ iva č u , ljekovite i komercijalne važnosti," pp. 75–92.

[12] M. Gupta, Reshu; Yadav, Vidushi; Rastogi, "a review on importance of natural sweetener, a zero calorie plant – stevia - having medicinal and commercial importance," *Int. J. FOOD Nutr. Sci.*, vol. 3, no. 3, 2014.

[13] C. Hellfritsch, A. Brockho, F. Sta, W. Meyerhof, and T. Hofmann, "Human Psychometric and Taste Receptor Responses to Steviol Glycosides," 2012.

[14] V. Agarwal, A. Kochhar, R. Sachdeva, V. Agarwal, A. Kochhar, and R. Sachdeva,

"Studies on Ethno-Medicine Sensory and Nutritional Evaluation of Sweet Milk Products Prepared Using Stevia Powder for Diabetics Sensory and Nutritional Evaluation of Sweet Milk Products," vol. 5070, 2017.

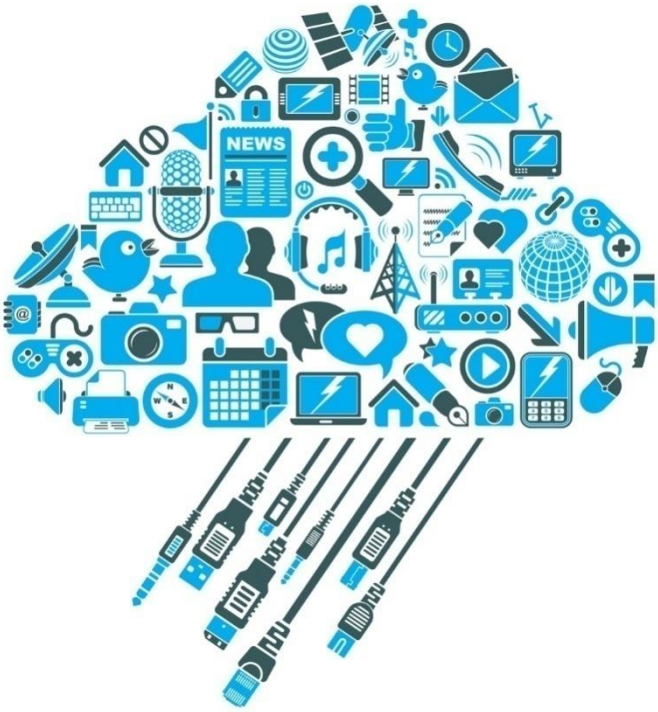
[15] R. Mogra and V. Dashora, "Exploring the Use of Stevia rebaudiana as a Sweetener in Comparison with Other Sweeteners Exploring the Use of Stevia rebaudiana as a Sweetener in Comparison with Other Sweeteners," vol. 9274, 2017.

[16] N. H. Kamarulzaman, K. Jamal, and G. Vijayan, "Journal of Food Products Marketing Will Consumers Purchase Stevia as a Sugar Substitute ?: An Exploratory Study on Consumer Acceptance Will Consumers Purchase Stevia as a Sugar Substitute ?: An Exploratory Study," no. November 2014, pp. 37–41.

[17] M. . Sumon, M.H.; Mostofa, M; Jahan, M.S; Kayesh, M.E.H; Haque, "Comparative efficacy of powdered form of stevia (," vol. 6, pp. 211–215, 2008.

[18] M. A. A. Gasmalla, "Stevia rebaudiana Bertoni : An alternative Sugar Replacer and Its Application in Food Industry," 2014.

Computing
&
Information Science



ID - 02

ETHICAL, LEGAL AND SOCIAL ISSUES IN BIOINFORMATICS APPLICATIONS

S. Jayanitha, T. Kartheeswaran
Department of Physical Science, Faculty of Applied Science,
Vavuniya Campus, University of Jaffna.

Abstract

Bioinformatics is the use of computing for acquisition, management, organization, storage and analysis of biological data. The introduction of various bioinformatics applications plays a leading role in the health sector in recent years. Though, the bioinformatics applications possess many advantages, each application makes some ethical, legal and social issues in the community. This study analyses applications of Bioinformatics in forensic databases with DNA fingerprinting, Biological weapons with genetic engineering, Pharmacogenomics, Personalized medicine and Detection of mutation with NGS through critically assessing available literature. The ethical, legal and social issues are arising due to the computational analysis of genetic data which reveal some personal hidden information about individuals. Because the result may reveal some ugly and bitter truth which cannot be accepted in the society sometimes. The privacy is the most concern as most of the Bioinformatics applications are dealing with genes which is specific and private to each individual. Each bioinformatics application should be proven as safe and secure as those input data and the results are considered as more sensitive and private. This study proposes some healthy practices and policies to reduce the above mentioned non-technical impacts.

Keywords: Bioinformatics, gene profiling, ethical issues

Introduction

Advancement in computational technologies are improved massively in this decade. Several scientific dreams became true due to these massive technological changes in computing as well as Biology. Further, considering Biology, there were several hidden and unknown facts are revealed by applying computational algorithms. The growth of data science such as Bigdata analysis, Data Mining and Pattern Recognition are contributed a lot in the Biological domain. This advancement leads to a new discipline called Bioinformatics where modification to both computing and Biology has been done. Bioinformatics includes variety of applications and each contributes a lot to health sector in many ways such as treatment techniques, monitoring, predicting etc. However, there are many issues may arise due to the social, cultural, ethical bindings of mankind. It is easy to know about the physical and mental behavior of individuals if we have some computational pipeline and his/her genetic data. This may expose of confidential medical information or other details that could potentially harm the particular individual. This study has been undertaken in order to figure out the ethical, legal and social issues as a result of bioinformatics applications in health industries and to suggest some solutions to reduce the impacts up to some extent.

Methodology

This study has been carried out through analyzing five bioinformatics applications through critically reviewing the existing literature. Also, YouTube videos and some online documents submitted by the scientists and biologists regarding the influence of Information Technology and issues possessed on the functioning of these Bioinformatics applications were analyzed in terms of ethical and cultural issues and also possible solutions. The most widely used ten bioinformatics applications are DNA and protein sequencing, Protein Modelling, Evolutionary Studies, Pharmacogenomics, Genetic Engineering and Biological weapons, Personalized medicine with IBM Watson, Detection of mutation using NGS, use of genomics with NGS, Forensic databases with DNA fingerprinting and Proteomic technology according to survey done by Deniz and Canduri [1]. A survey was done in order to figure out the commonly used applications among the ten applications mentioned above. There were 120 questionnaires were circulated and 100 valid questionnaires were got responded. The results are shown in Figure 1.

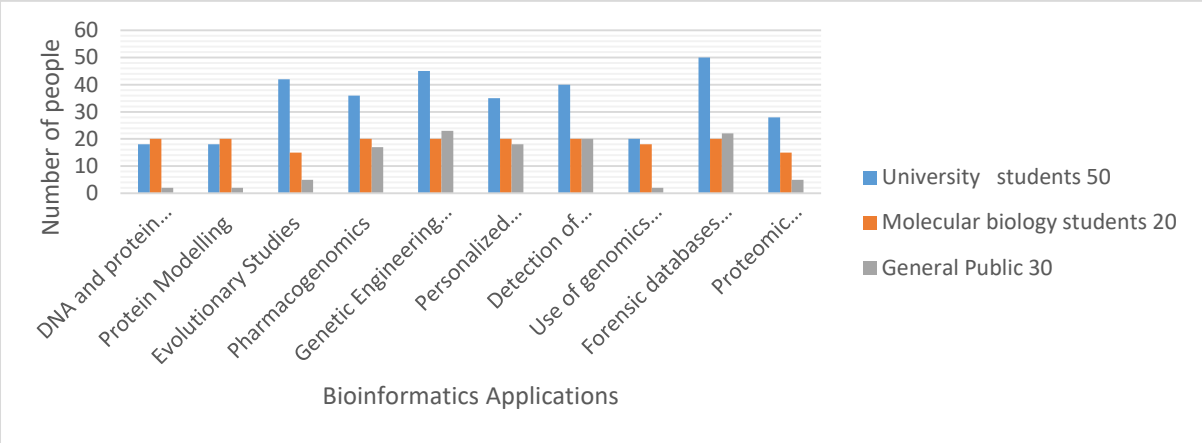


Figure 1: The result of survey

The rest analysis has been carried out with the selected five applications based on the results of the survey to analyze the ethical, legal and social issues caused by applying advanced technology. The selected five applications among the ten discussed by Diniz and Canduri [1] are Forensic databases with DNA fingerprinting, Genetic Engineering and Biological weapons, Pharmacogenomics, Personalized medicine and Detection of mutation using NGS. The information collected regarding the role of IT in each of the above-mentioned bioinformatics application based on literature are described below. The information collected regarding the role of IT in each of the above-mentioned bioinformatics application based on literatures are mentioned below.

Forensic databases with DNA fingerprinting

DNAforensics is a branch of forensic science that focuses on the use of genetic material in criminal investigation. It is first made its way into the courts in 1986, when police in England asked molecular biologist *Alec Jeffreys*, who had begun investigating the use of DNA for forensics, to use DNA to verify the confession of a 17-year-old boy in two rape-murders in the English Midlands[2]. The software tools used under DNA fingerprinting are, GelJ, and

automatic DNA Diagnosis for 1D Gel Electrophoresis images using Bio-image processing technique (GELect).

Genetic engineering and biological weapons

The basic principle of genetic engineering is gene transfer. Many foods consumed today are either genetically modified whole foods, or contain ingredients derived from gene modification technology. Billions of dollars in U.S. food exports are realized from sales of GM seeds and crops. [3]The principal concern seemed to be the fear of a public health disaster because there is a risk of some genetically superpowered microorganism may be accidentally released into general public [4]. Biological weapons are designed to spread disease among people, plants, and animals through the introduction of toxins and microorganisms such as viruses and bacteria. [5] In the bioweapon industry, genetic engineering can be used to manipulate genes to create new pathogenic characteristics aimed at enhancing the efficacy of the weapon through increased survivability, infectivity, virulence, and drug resistance. While the positive societal implications of improved biotechnology are apparent, the “black biology” of bioweapon development may be one of the gravest threats we will face in near future.

Pharmacogenomics

Pharmacogenomics is a discipline that aims to explain the inherited basis for differences in drug response between individuals. It is defined as the application of whole-genome technology for the prediction of the sensitivity or resistance of an individual’s disease to chemotherapy. Evaluation of the safety profile of medicines that are already on the market is also an important area in which Pharmacogenomics profiling can be used. Microarray or Biochip is the DNA microarrays which have been proven to be a state-of-the-art technique for high throughput comprehensive analysis of thousands of genes in parallel.

Personalized Medicine with IBM Watson

The ability to offer the right drug, the right patient, for the right disease, at the right time, with the right dose. Personalized medicine involves identifying the genetic information which paves way for the predictions to be made about a person's susceptibility. IBM Watson is cognitive computing applied to clinical decision support in personalized medicine. Personalized medicine has tremendous potential benefits for patients and healthcare providers, as well as for regulatory agencies and pharmaceutical and diagnostic companies, but the advancement of this innovative therapeutic strategy depends on identifying biomarkers functioning as companion diagnostics for the targeted drug.

Detection of Mutation with NGS

Detection of unknown mutations can involve sequencing of DNA, often in many patients. This has led to the development of methods to screen DNA for mutations as well as methods to detect mutations. Next Generation Sequencing is a high-speed sequencing technique. It generates a comprehensive molecular profile of a patient. It is a high throughput sequencing discovery of mutated genes that drive oncogenic phenotypes in tumors. Targeted

next-generation sequencing (NGS) provides a promising method for diagnostic purposes by enabling the simultaneous detection of multiple mutations in various genes in a single test.

Analyzed issues behind the above-mentioned bioinformatics applications based on literature reviews

Several countries nowadays maintain DNA banks of people who committed crimes. Unfortunately, there have been some cases when the DNA of people who were arrested but not convicted were accidentally entered into the database. In this case, DNA fingerprinting can be seen as a tool that violates the privacy of people and makes their personal information easily available to others. New organisms created by genetic engineering could present an ecological problem. The eagerness to increase crop products has resulted in the genetic manipulation of plants, which has raised much polemics ranging from political, ethical and social problems. One cannot predict the changes that genetically engineered species would make on the environment. In addition, many genetically engineered foods use microorganisms as donors whose allergenic potential are either unknown or untested. As well, genes from non-food sources and new gene combinations could trigger allergic reactions in some people, or exacerbate existing ones. [3] In the context of applications of genetic engineering in human life, misuse of this technology in the production of biological warfare or weapons is a biggest disadvantage. The creation of transgenic animals and plants promises many benefits, although it also raises critical questions about how far we should go in applying genetic engineering techniques. This raises political concerns and have been the subject of legislative hearings, regulatory actions and court deliberations. [6]. Recently, Jian-kui HE, a Chinese scientist, have created the first gene-edited babies, called Lulu and Nana, who are naturally immune to the human immunodeficiency virus (HIV). HE has used the CRISPR-Cas9 technique to modify the babies' germline gene. China's guidelines and regulations have banned germline genome editing on human embryos for clinical use because of scientific and ethical concerns. Jian-kui HE's human experimentation has not only violated these Chinese regulations, but also breached other ethical and regulatory norms. 122 Chinese scientists stated that while CRISPR-Cas involves serious off-target risks and associated ethical considerations, and so should not be used to produce genetically modified babies. So, this gene modification may bring little substantial benefit to the babies, while exposing them and their future generations to unknown and uncontrollable risks. [7]

Advancement in the use of individual pharmacogenomics profile makes privacy at risk. The U.S. Senate and the U.S. House of Representatives are attempting to pass the Genetic Information Nondiscrimination Act of 2007 in hopes of protecting individuals from genetic discrimination in terms of health insurance and employment. [8] If patients consult Watson directly then they may receive wrong diagnosis without ever being seen by a doctor. In this case, who is to be blamed? Malicious human interaction with Watson results in wrong output and individuals get to know wrong diagnosis about them and become depressed.

Results and Discussion

The figured-out bioinformatics applications are working under different technologies. Due to the Information Technology, each application performs fast and produce results within minutes. Up to some extent forensic science can violate people's privacy as it focuses on the use of genetic material in criminal investigation. This results in making the personal information of general public easily available to others. Just a small amount of human error

(such as exposing the sample to other substances or incorrectly identifying two samples as identical) can ruin the process or alter the results. The result will hardly affect the whole family of the particular individual. An accident in engineering the genetics of a virus or bacteria (for example could result in a stronger type), which could cause a serious epidemic when it released to outer environment. This could create problems ranging from minor medical problems, to death in human genetic engineering. An individual's privacy and confidentiality are at risk through the development of individual pharmacogenomics profiles which would become easy to access and sharable. Even a simple change in a gene will affect a whole generation as the behavior or the changes are inherited. Unlike western countries, we the Asian countries are tightly bound to cultural and social facts. Genetic and genomic information are sensitive by nature, if it leaked it will result in big social and cultural issue.

Recommendation and Conclusion

However, even though there are many advantages due to the advancement in Biology, there are possibilities to make some social issues which may collapse civilization structure and cultural aspects of a community as human are social animal. The analysis of the ethical, legal and social issues of the bioinformatics applications create an awareness among the general public who are using these applications for their easy and accurate results. Some proposed solutions are given below in order to reduce the ethical, social and legal issues.

1. Need to have stringent quality control checks in DNA fingerprinting labs worldwide.
2. Policies and practices related to patient data & privacy, must ensure appropriate consent.
3. New laws to prevent genetic discrimination by insurers and employers.
4. Researchers should evaluate the legitimacy of their work while handling with genetic engineering.
5. Existing technical and ethical guidelines should be refined and more rigorously enforced to guide and standardize relevant research and applications.
6. Conducting Awareness programs to general public.

Finally, whatever the advance technology there some impacts and issues, it can be managed if there are proper awareness, quality measures and regulation policies introduced by relevant authorities.

Bibliography

[1] W. J. S. D. F. Canduri, "Bioinformatics: an overview and its applications," in *Genetics and Molecular Research 16 (1): gmr16019645*, 2017.

[2] M. K. C. a. P. Sankar, "Forensics genetics and ethical, legal and social implications beyond the clinic," 2004.

[3] S. G. Uzogara*, "The impact of geneticmodification of human foods in the21st century: A review," *Biotechnology Advances 18*, pp. 179-206, 2000.

[4] T. H. Murray, "Ethical Issues in Genetic Engineering," *Social Research*, vol. 52, no. 3, Bioethics, 1985.

[5] J. v. A. ,. E. Hammond, "Genetic Engineering and biological weapons," 2003.

[6] R. H. Blank, "Politics and GeneticEngineering," *Politics and the Life Sciences*, pp. 81-85, 1992.

[7] Jing-ru LI, Simon WALKER, Jing-bao NIE, Xin-qing ZHANG, "Experiments that led to the first gene-edited babies: the ethical failings and the urgent need for better governance," Journal of Zhejiang University-SCIENCE B (Biomedicine & Biotechnology), pp. 32-38, 2019.

[8] J. C. Fletcher, "Moral problems and Ethical Issues in Propective Human Gene Therapy," *Symposium on Biomedical Ethics*, pp. 515-546, 1983.

ID - 23

Automated Identification of Polytene Chromosomes Banding Pattern using Image Processing Techniques

Niroshi J. [1], *Ananthakrishnan K* [2], *Ratnarajah N.* [1]
[1] *Department of Physical Science, Faculty of Applied Science, Vavuniya Campus of the University of Jaffna*
[2]*Computer Unit, University of Jaffna*

Abstract

An automated method has been developed to identify the dark bands and light-inter bands in the Polytene chromosomes microscopic images using the digital image processing algorithms. Polytene chromosomes are specific interphase large chromosomes which have alternation of dark bands and lighter inter bands morphology. Analysis of these banding patterns is very important in many structural and functional biological researches such as chromosomes mapping, identify small chromosome mutations, identify taxonomic species, and classify the sibling species.

The algorithm of banding pattern identification and analysis follows a step-by-step strategy and the overall system is modularized into three stages: preprocessing, segmentation and feature extraction. The preprocessing stage contains the techniques to prepare the image for segmentation; the techniques deal directly with the raw, possibly noisy, pixel values with de-noising and contrast adjustment. The segmentation stage finds and establishes outlines of specific dark/lighter-inter bands using rolling ball algorithm and automatic thresholding techniques. The feature extraction stage obtains semantics of the banding pattern and useful quantitative parameters from the segmented bands. In this work, some samples of straightened Polytene chromosome microscopic images were analyzed with satisfactory results.
.

Keywords: Polytene Chromosome, Banding Pattern, Rolling Ball

Introduction

Biological research immensely depends upon the correct identification of organisms. In addition, to develop essential tools for systematic analysis is highly useful in biological studies of diverse nature. This is very much true in the case of Polytene chromosome analysis because Polytene chromosomes are central objects for the analysis of many features of chromosome organization and the genome. Polytene chromosomes consist of thousands of DNA strands and are seen to have distinct dark and lighter banding patterns [1]. Polytene chromosome banding pattern analysis is a standard procedure to classify the species and other biological research purposes. Especially, Polytene chromosome banding pattern is widely used to identify sibling species in many species complexes [2]. Various features of the banding patterns of Polytene chromosomes were proposed and used for classification by the researchers manually [1,3]. Efficient automated object and pattern identification algorithms and software tools are becoming increasingly important in recent years as the difficulties in the manual methods. However, very limited studies have been published in the literature such as automate the classification of human chromosome [4], straighten human chromosome [5,6], and centromere and length detection in straightened human chromosome [7], as the quality of the microscopic images and the chromosome preparations are still in the developing stage.

An automated Polytene chromosome banding pattern identification system has been proposed here using microscopic image analysis techniques. To our knowledge, this is the first attempt to detect the bands and measure the bands in a Polytene chromosome automatically. To achieve this, image processing algorithms were placed at three levels. At the lowest level, methods deal with preparing the image for segmentation. In the middle level, algorithms are utilized low-level results for further means with background removing and bands segmentation. At the highest level, techniques attempt to extract the pattern and properties of bands.

Methodology

Data: A number of Polytene chromosome samples from various species prepared under the same conditions and straightened microscopic images is typically assumed to be in the white background an accurate representation of the chromosome [5].

Dark-Band Identification

The fully automated dark band identification consists of the following steps:
STEP 1 (Grayscale): The microscopic straighten colour Polytene chromosome images have been converted into grayscale images initially using Z=0.299 * R + 0.587 * G + 0.114 * B as acquired colour images are not suitable for image processing steps of band identification.
STEP 2 (De-noising and Smoothing): A Gaussian smoothing 2-D convolution operator algorithm [8] is applied on grey scale image to reduce image noise, smooth the image and preserve edges which is suitable for applying the rolling ball algorithm later. The degree of smoothing is determined by the standard deviation of the Gaussian, which was obtained using the training of some image samples in the identification.
STEP 3 (Complement): Smoothed image (I) has been transferred to complement of the image J (=255-I) as for finding the dark bands in the white background.
STEP 4 (Contrast Adjustment): The negative image from the previous step underwent a contrast adjustment procedure to boost the separation between the darkest and brightest areas of the image. The contrast adjustment intensity values were automatically defined from the histogram of the image.
STEP 5 (Background Removal): The background intensity level of images, on which the dark bands appear, is not uniform over an image and varies between images. Thus we must remove the background from the image before taking the thresholding for segmentation. Rolling ball algorithm [9] used here to find the image's smooth continuous background. Consider the 2D grayscale image from the previous step has a third (height) dimension defined by the intensity value at every point in the image. The radius of the "ball" was determined by experimenting with the sample images. The ball is moved along each scan line of the image and background is determined during the process. The identified background was subtracted from the image.
STEP 6 (Threshold): An automatic threshold is found for the filtered image using Otsu's method [10]. This threshold is applied to the image in order to separate the dark bands from the background.
STEP 7 (Morphological Operations): In this stage the binary morphological operations 'Dilation' and 'Erosion' are applied in the order to the segmented binary image to remove the small blobs in the background and to connect the breakdown band components together.
STEP 8 (Complement): The segmented bands have been reversed to appear the dark bands in the white background.

Lighter-Inter Band Identification

The fully automated lighter-inter band identification consists of the following step:
STEP 9: Combining the image from the STEP 8 of dark band identification and the original grey scale image, we first segmented the rest of the areas of the original image by taking out the identified dark band pixels. Each horizontal line the border pixels were removed comparing with the number of pixels in the average width of the chromosome.

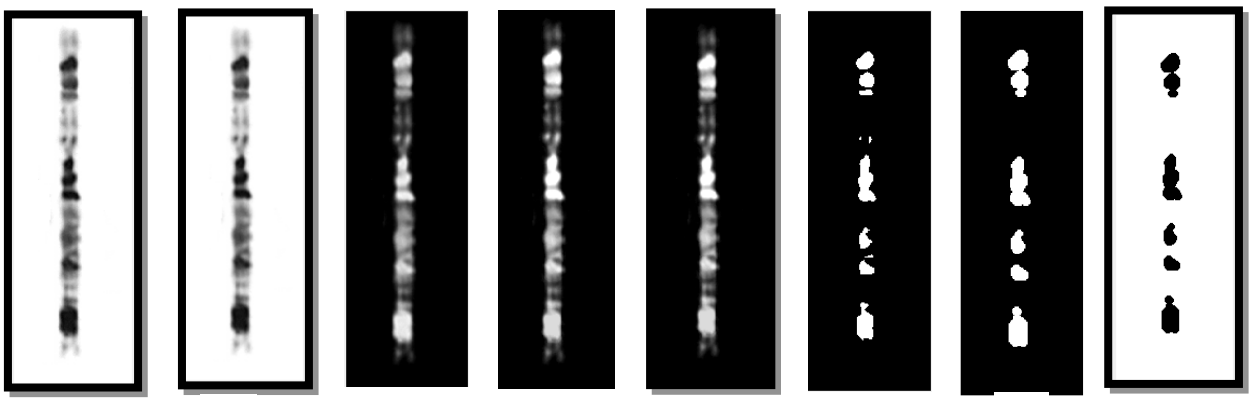
Combining Dark and Lighter-Inter Bands

Identified dark and light-inter bands were combined together for analyzing the band pattern and feature extraction. Each band is labeled according to the determined components. Band pattern is defined for the particular chromosome and quantitative values (area, height, and width) were measured for each band.

Results and Discussion

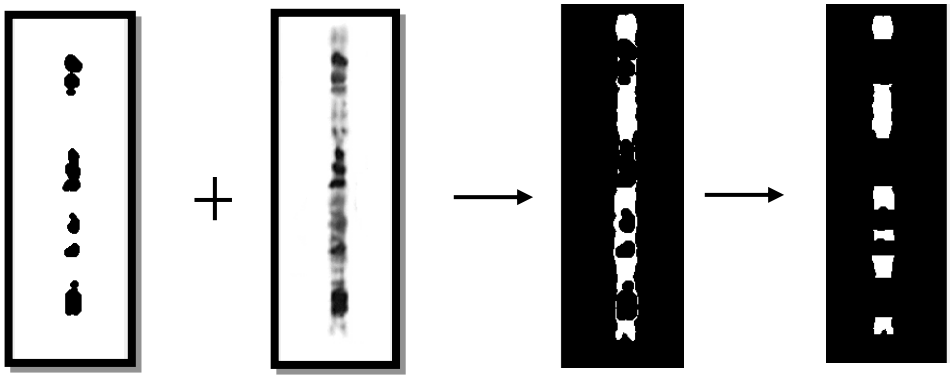
Dark Band Identification

The Figure 1 illustrates the dark band identification for a chromosome image described in the methodology section. Dark bands are extracted from the original image clearly and they are ready for the feature extraction step.



a b c d e f g h

Figure 1. Dark band identification (a) Original gray scale Polytene chromosome (Result of STEP 1) (b) Result of STEP 2 (c) Result of STEP 3 (d) Result of STEP 4 (e) Result of STEP 5 (f) Result of STEP 6 (g) Result of STEP 7 (h) Result of STEP 8



a b c d

Figure 2. Lighter-band identification (a) Dark bands from the STEP 8 (b) Grey scale image from the STEP 1 (c) Segmented the rest of the areas from the dark bands from the STEP 9 (d) Final lighter-inter bands

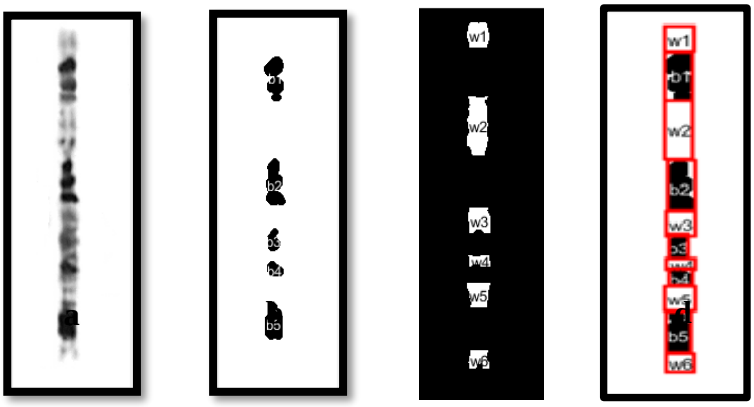
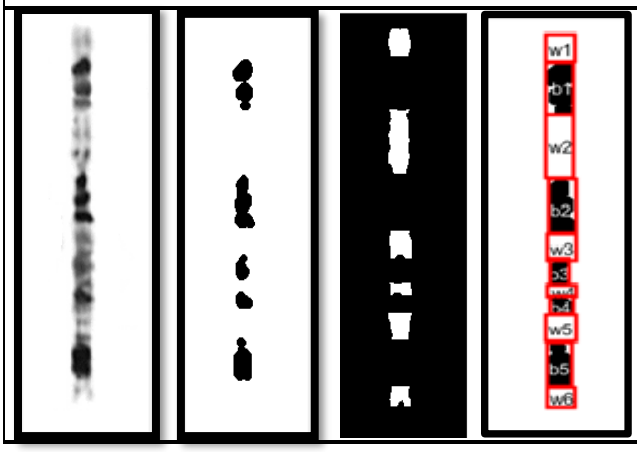
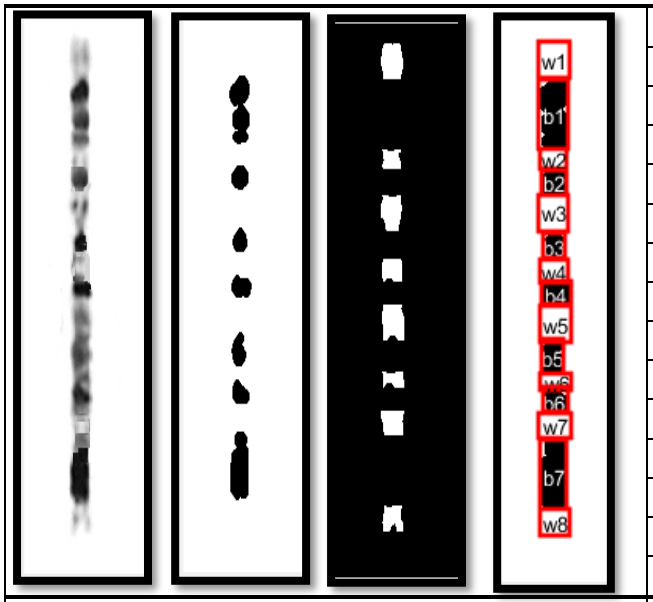


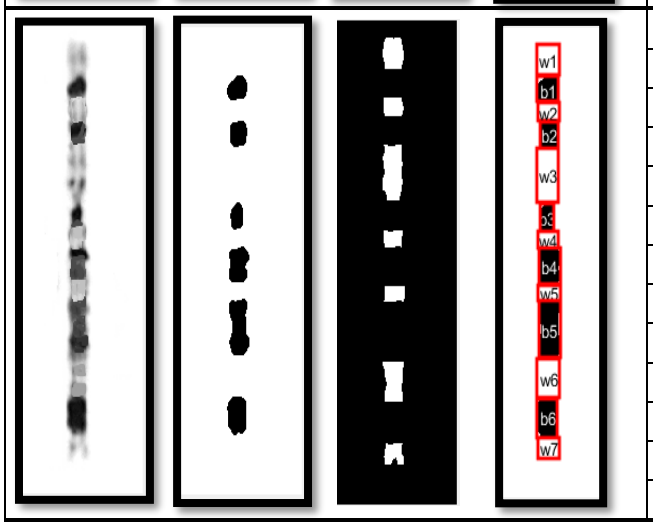
Figure 3. Combining ad labeling dark bands and lighter-inter bands (a) Grey image from the STEP 1 (b) Dark bands from the STEP 8 (c) Lighter-inter bands from the STEP 9. (d) Combined dark and lighter-inter bands.

Table 1. Banding patterns of three different chromosomes and the properties (Area, Height and Width in number of Pixels) of each dark band (b) and lighter-inter band (w).

Chromosomes	Bands	Area	Height	Width
	w1	390	22	20
	b1	521	41	19
	w2	821	51	19
	b2	560	35	17
	w3	360	21	20
	b3	197	21	19
	w4	165	10	21
	b4	172	14	13
	w5	392	22	20
	b5	466	43	16
	w6	247	16	19



w1	346	22	19
b1	575	42	19
w2	180	12	17
b2	178	15	16
w3	390	22	20
b3	158	15	14
w4	235	14	18
b4	206	14	19
w5	392	22	20
b5	191	21	14
w6	157	10	20
b6	206	15	16
w7	281	15	21
b7	606	42	17
w8	242	16	19



w1	390	22	20
b1	265	18	19
w2	226	13	19
b2	262	19	16
w3	640	39	19
b3	190	20	12
w4	203	12	18
b4	427	26	19
w5	195	11	20
b5	609	41	19
w6	470	28	20
b6	402	28	18
w7	231	15	19

Light Inter Band Identification

The Figure 2 illustrates the lighter inter band identification from the STEP 8 of the dark band identification algorithm as described in the methodology section and the original greyscale image. Lighter inter bands are segmented and they are ready for the feature extraction step.

Semantics of Dark and Light-Inter Bands

Combined dark bands and lighter-inter bands are labeled and identified the banding pattern of the chromosome, which is demonstrated in Figure 3. The complete process of three different species Polytene chromosomes and their banding pattern and their properties are shown in Table 1. The number of dark bands and lighter-inter bands are different in each chromosome and the size of the bands also vary for each band and chromosomes. The banding pattern and the properties are strongly related to their morphological and physiological similarities and differences.

Automatic segmentation of dark and light-inter bands of Polytene chromosome is described in this work and the results show very promising. In our future work, we have planned to straighten the curved Polytene chromosomes and taking more samples to be analyzed to classify the species.

Reference

1. Zhimulev, I.F; Koryakov, D. E (2009). "Polytene Chromosomes". Encyclopedia of Life Sciences (eLS). Chichester (UK): John Wiley & Sons, Inc. pp. 1–10.
2. S. Chaudhry, Neetu, S. Gupta, and J.S. Chhilar, 2005. “Salivary polytene chromosome mapping of Anopheles (Cellia) subpictus Grassi (Culicidae: Diptera)”, Genome 48: 241–246.
3. Singh, O. P. and W. E. Kalisch Electron Microscopic band-interband Pattern of Polythene Chromosomes in Drosophila nasuta albomicans II. Salivary gland chromosome 2L, Cytobios (UK) 68, 95-109
4. Kao, Jau & Chuang, Jen-Hui & Wang, Tsaipei. (2008). Chromosome classification based on the band profile similarity along approximate medial axis. Pattern Recognition. 41. 77-89.
5. Somasundaram, Devaraj & R. Vijay Kumar, V. (2014). Straightening of highly curved human chromosome for cytogenetic analysis. Measurement. 47. 880-892.
6. Javan Roshtkhari, Mehrsan & Setarehdan, Kamal. (2008). A novel algorithm for straightening highly curved images of human chromosome. Pattern Recognition Letters. 29. 1208-1217.
7. Jahani, Sahar & Setarehdan, Kamal. (2012). Centromere and Length Detection in Artificially Straightened Highly Curved Human Chromosomes. International Journal of Biological Engineering. 2. 56-61
8. Shapiro, L. G. & Stockman, G. C: "Computer Vision", page 137, 150. Prentice Hall, 2001
9. Stanley R. Sternberg:, Computer Volume: 16 , Issue: 1 Jan 1983 Biomedical Image Processing. 22-34
10. Nobuyuki Otsu (1979). "A threshold selection method from gray-level histograms". IEEE Trans. Sys., Man., Cyber. 9 (1): 62–66.

ID - 47

FREQUENCY SPECTRUM ANALYSIS OF MIXED-LINE RATE IN FLEXIBLE OPTICAL NETWORKS

S. Suthaharan[1], P. Rukshani[1], and C. Vanuja[1]
[1]*Department of Physical Science, Vavuniya Campus of the University of Jaffna, Sri Lanka*

Introduction

Optical networking is a promising solution of Internet growth since it uses wavelength division multiplexing technique [1]. The ever increasing demand for bandwidth is posing new challenges for transport network providers. A feasible solution to meet such challenge is to use optical networks with the aid of WDM technology. WDM is a multiplexing technique of data transmission in which it divides the huge transmission bandwidth available ona fiber into several non-overlapping wavelength channels and enables data transmission over these channels simultaneously [2]. WDM is mostly used for optical fiber communications to transmit data in several channels with slightly different wavelengths. WDM uses a multiplexer at the transmitter and a demultiplexer at the receiver to join the several signals together and to split them apart respectively. The channels in WDM are typically using 50 GHz or 100 GHz rigid grid spectrum spacing as specified by the International Telecommunication Union (ITU) [3]. For instance, 50 GHz fixed grid space is capable to transmit 100 Gbps based transmission rate and commercialized [4].

In our research study, we have focused on shared protection method in WDM optical networks. A single fiber consists of 4.4 THz total spectrum width which can be divided into 88 channels each of 50 GHz fixed grid [5]. Flexible optical networks (or Elastic optical networks (EON)) have recently been introduced to use the frequency spectrum more efficiently [4]. 12.5 GHz fine granular frequency slots or flexible grids are used for setting up lightpaths instead of using 50 GHz or 100 GHz fixed grid spacing in flexible optical networks [6].

Optical fiber has a risk of failure in terms of fiber-cut which causes loss of huge amount of data and therefore, the communication services can be interrupted. In survivability, the path through which transmission is actively realized is called working path or primary path whereas the path reserved for recovery is called backup path or secondary path. Protection is one of the approaches in survivability of optical networks in which pre-assigned backup paths are setup or reserved at the time of admitting a connection which are link-disjoint with their corresponding primary paths. Shared protection is one of the traditional protection methods in which backup resources can be shared by the backup paths or secondary paths.

Spectrum efficiency is the optimized use of spectrum so that the maximum amount of data can be transmitted with the fewest transmission errors. Spectrum efficiency can be computed by dividing the total traffic data rate by the total spectrum used in a particular network. The total traffic data rate can be computed by multiplying the data rate by the number of connections. The total spectrum will be the multiplication of the frequency used for a single wavelength and the total number of wavelengths used in a network [7].

To the best of our knowledge, this is the first paper that is investigating variation of the spectrum efficiency of traditional shared protection and flexible optical networks using

mixed-line rate(MLR) in various scenarios. Our findings are as follows. The spectrum efficiency of MLR is significantly varied, when applying traditional shared protection in EON. Unlike spectrum efficiency of MLR in dedicated protection, spectrum efficiency of MLR in shared protection method is considerably higher. Finally, spectrum efficiency in MLR using EON is significantly varied when compared to spectrum efficiency in MLR using WDM.

Methodology

The traditional shared protection in WDM usingflexible optical networks is illustrated in Figure 1, with a network topology of six network nodes and seven network links. Solid arrows denote working (W) path and dashed arrows denote secondary (S) paths. Working path W1 and its corresponding secondary path S1 are shown with their wavelength w1 for WDM and frequency slots f1. (Note that, working path and its secondary path can also use different frequency slots).

Suppose that a link failure, say, failure on A-B, configuration is required as S1 and S2 are sharing link C-D. (Note that W1 and S1 are link-disjoint). Therefore, after the proper configuration at network nodes C and D, backup traffic is rerouted.In Figure 1, a working path W1 (A->B) and W2 (E->F) are configured with frequency slotsf1 and f1 respectively at the time of connection establishment. In addition to that, secondary path S1 for working path W1 and secondary path S2 for working path W2 are reserved on link C->D with frequency slotsf1 and f1 respectively (note that, working path and its secondary path can also use different frequency slots). In case of component failure on link A->B, firstly, configuration at nodes A, C, D, and C will be done and traffic is rerouted through S1. Similarly, suppose that the failure on link E->F, configuration at nodes E, C, D, and F will be performed prior to rerouting the traffic through S2. This is because resources are shared by secondary paths S1 and S2 on link C->D. In thisscenario, the number of working path is limited to as one path as shortest path for working link, that is one hop from A->B and E->F. This is because to regulate the total spectrum used by the working path. However, three links that are A->C, C->D and D->B used for secondary path S1 and E->C,C->D, and D->F used for secondary path S2. Out of the three links, link C->D is shared by S1 and S2.Therefore, a single wavelength carries a higher data rate than a single frequency slot carries. For instance, 100Gbps data rate can be accommodated in a single wavelength, whereas, three frequency slotsare needed to accommodate the same data rate. Therefore, when considering MLR in both wavelengths and frequency slots vary from SLR which has the unique data rate throughout the entire connections establishment.

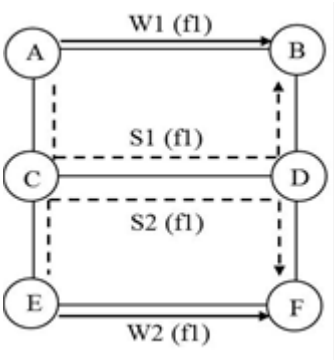


Figure 1. A scenario of traditional shared protection using flexible optical networks.

Results and Discussion

We simulate the traditional shared protection approach in flexible optical networks. To perform the experiment, we use NSFNET (14 nodes and 21 bidirectional links). We consider 352 frequency slots each of which consists of 12.5 GHz spacing. Various data rates such as 100Gbps, 400 Gbps and 1 Tbps are considered in both mixed-line rate and single-line rate with their appropriate bandwidths and follow the uniform distribution. Request arrival process followsPoisson distribution and holding time of requests follow exponential distribution with unit mean. Traffic requests arrive in dynamic network environment.

In this study, we consider shared protection in EON particularly, for MLR. This is because to measure the spectrum efficiency caused by both MLR and SLR in various scenarios. We select the Traffic bit rate ranges from 20 Tbps to 100 Tbps for all comparisons that are used to calculate spectrum efficiency. Such that they provide approximately the same spectrum efficiency (range). This helps us to find and compare the relative impact of the performance on different scenarios. Our performance study is considered in twofold. Firstly, we compare the MLR with different SLR for both shared anddedicated protection in EON, secondly, we compare the performance of the MLR for both shared and dedicated protection in WDM which are explained below.

Firstly, in Figure 2, MLR of shared protection in EON and each of the SLR in shared protection in EON are compared. In this comparison, MLR comparatively outperforms the SLR, particularly, of 100 Gbps and 400 Gbps whereas 1 Tbps performs the higher efficiency than the MLR. In addition, the comparison of MLR of shared protection in EON and MLR of dedicated protection in EON are performed as shown in Figure 3. This comparison is made because of identifying the performance of MLR in both dedicated and shared protection methods. In this comparison, it is obviously noticed that the spectrum efficiency is comparatively higher in shared protection method.

Secondly, we compare the MLR of shared protection in EON and MLR of shared protection in WDM as shown in Figure 4. This is because to compare the variation occurred between the EN and the WDM. In this comparison, MLR of shared protection in EON significantly has the higher spectrum efficiency than the MLR of shared protection in WDM. This can be observed due to the high spectral consumption occurred in WDM.

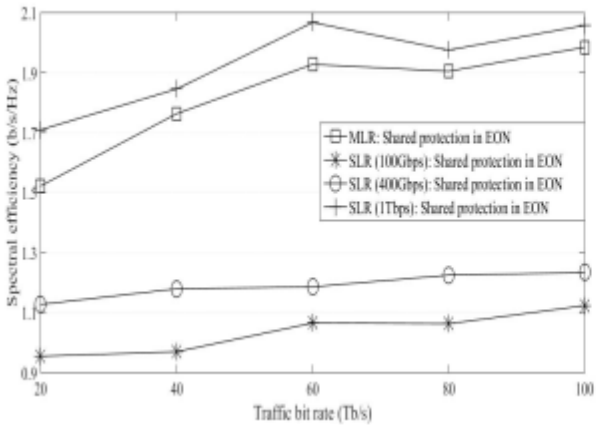


Figure 2. Shared EON (MLR vs. SLR).

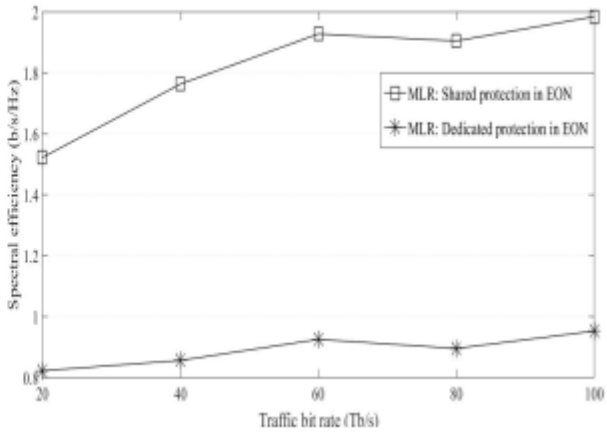


Figure 3. MLR EON (Shared vs. Dedicated).

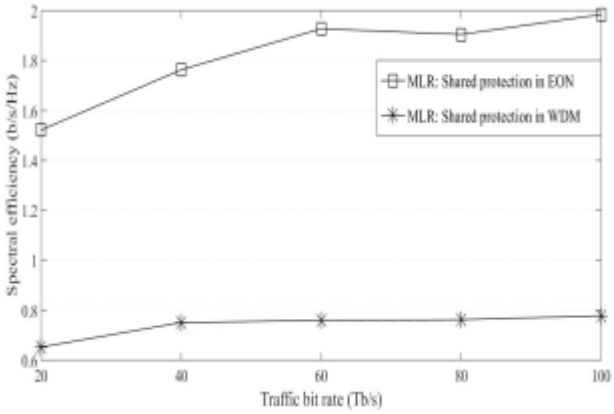


Figure 4. Shared MLR (EON vs. WDM).

In the performance study, we observe that, the spectrum efficiency in MLR is significantly considerable, when traditional shared protection in EON is applied. Further, spectrum efficiency in MLR outperforms in shared protection method, when compared it with dedicated protection method. Even though, spectrum efficiency in MLR using EON comparatively performs significant variation when compared to spectrum efficiency in MLR using WDM.

Conclusion

In this paper, we addressed the variation of spectrum efficiency for shared protection in flexible optical networks. We investigated the performance of various mixed-line rate (MLR) andTraffic bit rate in various scenarios. Our findings are as follows. Firstly, we observed that, the spectrum efficiency in MLR is significantly considerable while comparing the spectral efficiency of MLR for shared protection in EON and SLR for shared protection in EON. Secondly, the spectrum efficiency in MLR outperforms in shared protection method when MLRfor shared protection in EON and MLR dedicated protection in EON are compared. when compared it with dedicated protection method. Finally, the performance of MLR using EON is even higher when compared with MLR for shared protection in WDM.

Reference

[1] A. A. M. Saleh and J. M. Simmons, Technology and architecture to enable the explosive growth of the Internet, IEEE Communications Magazine,2011, 49(1), 126-132.
[2] A. K. Dutta, N. K. Dutta, and M. Fujiwara, WDM Technologies: Optical Networks, Elsevier Academic Press, 2004.
[3] ITU-T Recommendation G.694.1, Spectral grids for WDM applications: DWDM frequency grid. 2012.
[4] O. Gerstel et al., Elastic Optical Networking: A New Dawn for the Optical Layer?, IEEE Communications Magazine, 2012, 50(2), s12-s20.
[5] M. Liu, M. Tornatore and B. Mukherjee, Survivable Traffic grooming in Elastic Optical Networks-Shared Protection, Journal of Lightwave Technology, 2013, 31(6), 903-909.
[6] K. Christodoulopoulos, I. Tomkos, and E. Varvarigos, Elastic bandwidth allocation in flexible ofdm-based optical networks, Journal of Lightwave Technology, 2011, 29(9), 1354-1366.
[7] M. Jinno, et al., Spectrum-Efficient and Scalable Elastic Optical Path Network: Architecture, Benefits, and Enabling Technologies, IEEE Communications Magazine, 2009, 47(2), 66-73.

Environmental Science

ID - 25

DETERMINATION OF SUITABLE OSMOTIC SOLUTION CONCENTRATION AND TIME FOR OSMOTIC DEHYDRATION OF PAPAYA SLICES

Mahendranathan M.[1], Prasantha B. D. R.[2], Hettiarachchi D. N.[3].
Postgraduate Institute of Agriculture, University of Peradeniya, , Department of Food science and Technology,Faculty of Agriculture, University of Peradeniya, ,Food research unit,Department of Agriculture,Gannoruwa.

Abstract

Osmotic dehydration has been used as a long term preservation method for papaya slices. This study was done to determine suitable sugar concentration and time for osmotic dehydration of papaya. In this study papaya slices (50×50×5 mm) were blanched for three minutes, then pre weighed pieces were dipped into 40° Brix, 50° Brix, and 60° Brix sugar solutions for four hours and weighed every 30 minutes with 15 minutes interval manual agitation. Based on the rate of weight changes, suitable concentration of sugar solution was selected. During the process mean percentage weight loss of papaya were increased with time. Significant differences of mean weight loss of papaya were not observed in sugar concentrations 50° and 60° Brix. Whereas it showed significant difference with 40° Brix, while all other conditions were maintained constant. Due to case hardening effect and high cost of production 60° Brix was rejected. Result of this study proved that 50° Brix for four hours period is the suitable condition for the effective osmotic dehydration of papaya slices.

Key words: Osmotic dehydration, Papaya, sugar concentration

Introduction

The increased interest in and demand for organic products also affects the consumption of organic dried fruits. In recent past agriculture through production of dehydrated fruits and vegetables has captured a good market and became a good source of foreign exchange earnings. The annual growth of dried fruit import value of United Kingdom is significantly higher from developing countries than imports from other countries [1]. Dried fruit is mainly used as a snack for breakfast cereals, muesli, bakery products, dairy products and dessert.

Sri Lanka produces around 540,000 metric tons of fruits annually [2], but amount of postharvest loss is very high. Annually around 35-40% losses of fruits and vegetables occur under traditional distribution chain [3]. Annual loss of papaya is 40% [4]. This amount of postharvest losses occur due to the lack of appropriate packaging methods to transport from farm gate to the consumer, and the poor packaging storage methods transport facilities. Additionally, involvement of many middlemen such as retailers and whole sellers in the supply chain also contributes to these losses. Water removal from fruit and vegetables by drying is one of the oldest forms of food preservation known to man and is the most important process to preserve food [5]. Water, being one of the main food components, has a decisive direct influence on the quality and durability of food stuffs through its effect on many physicochemical and biological changes. Water removal is the main task while preserving food [6] reducing the moisture contents to a level, which allows safe storage over an extended period of time. Dried foods also present low storage and transportation cost when compared to the fresh ones [7].

Recently, osmotic dehydration has been introduced as a practical alternative preservation approach that is capable of producing a higher quality final product [8]. In osmotic dehydration, fresh produce is immersed in a hypertonic solution where the water content from the cells of the produce is transferred into the solution due to the relative differences in their solute concentrations [8]. In this processing, osmotic dehydration removes a desired portion of thewater from within the fresh produce resulting in a product of intermediate moisture content [9]. Simultaneously, a corresponding transfer of solid materials (normally sugar and/or salt) occurs from the solution into the product [8, 10]. In fruit osmotic dehydration treatment is use as pretreatment to reduce the quality loss of fresh fruits and increase the organoleptic properties. To use the osmotic dehydration as a pretreatment need to know about osmotic solution concentration and time duration that required to dip within that solution. Thus the whole objective of this research study is to determine the suitable osmotic solution concentration and time for osmotic dehydration of papaya slices.

Materials and Methods

This study was carried out at the food research unit, Department of Agriculture, Gannoruwa and laboratories of faculty of Agriculture Department of Food Science and Technology. Mature fresh Papaw (*Carica papaya*) was selected from local market for the experiment.

Osmotic Dehydration

Selected fruits were washed well with tap water to remove adhering extraneous material and peeled. Then the fruits were cut into five millimeter thickness pieces. The pieces were blanched using steam for three minutes. Those fruit pieces were pre weighed and dipped into different concentration of sugar solutions. Papaya dipped into 40 ^{o}Brix, 50 ^{o}Brix and 60 ^{o}Brix sugar solutions. Then fruit pieces were frequently weighed 30 minutes time intervals. Manual agitation was carried every 15 min interval throughout the test. Based on the rate of weight changes, suitable concentration of sugar solution and time period was selected.

Statistical Analysis

Data obtained for osmotic concentration selection was subjected to one way ANOVA using SPSS 22 statistical software package. Means were compared by least significant difference $P<0.05$.

Results and Discussion

Osmotic Dehydration

Concentration of osmotic agent t can influence on mass transfer kinetics. When fruit pieces were dipped into an osmotic solution, mean percentage weight loss of papaya and pineapple were increased with time, as shown in figure 1.1. All three concentrations of sugar solutions can be used to the purpose of moisture loss and solid gain. However sugar concentration of 50 ^{o} Brix and 60 ^{o} Brix did not show any significant difference ($p>0.05$) of mean weight loss of papaya, whereas it was shown significant difference with 40 ^{o}Brix, while all other conditions were maintained constant. Therefore 50 ^{o}Brix sugar solution was selected as the suitable osmotic concentration for further processing.

Papaya 40 brix

Time (min)	Initial wgt	R1	wgt loss %	Initial wgt	R2	wgt loss %	Initial wgt	R3	wgt loss %	Mean wgt loss %	SD
0	93.57	93.57	0	91.21	91.21	0	93.41	93.41	0	0.00	0.00
30	93.57	93.42	0.160	91.21	91.01	0.219	93.41	93.32	0.096	0.16	0.06
60	93.57	93.31	0.277	91.21	90.69	0.570	93.41	93.03	0.406	0.42	0.15
90	93.57	92.44	1.207	91.21	90.3	0.997	93.41	92.31	1.177	1.13	0.11
120	93.57	92.02	1.656	91.21	88.94	2.488	93.41	91.62	1.916	2.02	0.43
150	93.57	90.5	3.280	91.21	88.25	3.245	93.41	91.14	2.430	2.99	0.48
180	93.57	90.03	3.783	91.21	86.77	4.867	93.41	89.29	4.410	4.35	0.54
210	93.57	88.66	5.247	91.21	86.08	5.624	93.41	88.99	4.731	5.20	0.45
240	93.57	87.75	6.219	91.21	85.12	6.676	93.41	85.93	8.007	6.97	0.93

Papaya 50 brix

Ti me (min)	Initial wgt	R1	wgt loss %	Initial wgt	R2	wgt loss %	Initial wgt	R3	wgt loss %	Mean wgt loss %	SD
0	96.75	96.75	0	89.3	89.3	0	93.41	93.41	0	0.00	0.00
30	96.75	95.14	1.664	89.3	87.38	2.150	93.41	91.29	2.269	2.03	0.32
60	96.75	92.11	4.795	89.3	83.58	6.405	93.41	87.47	6.359	5.85	0.92
90	96.75	90.27	6.697	89.3	81.93	8.253	93.41	86.07	7.857	7.60	0.81
120	96.75	88.71	8.310	89.3	80.11	10.291	93.41	84.61	9.420	9.34	0.99
150	96.75	87.92	9.126	89.3	78.39	12.217	93.41	81.31	12.953	11.43	2.03
180	96.75	86.13	10.976	89.3	75.43	15.531	93.41	79.03	15.394	13.97	2.59
210	96.75	85.2	11.937	89.3	73.31	17.905	93.41	78.49	15.972	15.27	3.05
240	96.75	84.06	13.116	89.3	73.28	17.939	93.41	77.3	17.246	16.10	2.61

Papaya 60 brix

Ti me (min)	Initial wgt	R1	wgt loss %	Initial wgt	R2	wgt loss %	Initial wgt	R3	wgt loss %	Mean wgt loss %	SD
0	90.15	90.15	0	88.41	88.41	0	91.7	91.7	0	0.00	0.00
30	90.15	87.9	2.495	88.41	84.59	4.320	91.7	87.72	4.340	3.72	1.06
60	90.15	84.19	6.611	88.41	81.98	7.272	91.7	81.21	11.439	8.44	2.62
90	90.15	82.53	8.452	88.41	79.24	10.372	91.7	80.02	12.737	10.52	2.15
120	90.15	80.56	10.637	88.41	77.35	12.509	91.7	77.31	15.692	12.95	2.56
150	90.15	78.33	13.111	88.41	74.41	15.835	91.7	72.49	20.948	16.63	3.98
180	90.15	76.57	15.063	88.41	71.27	19.386	91.7	71.13	22.431	18.96	3.70
210	90.15	75.36	16.405	88.41	69.5	21.388	91.7	68.33	25.485	21.09	4.55
240	90.15	72.88	19.156	88.41	69.4	21.502	91.7	67.4	26.499	22.39	3.75

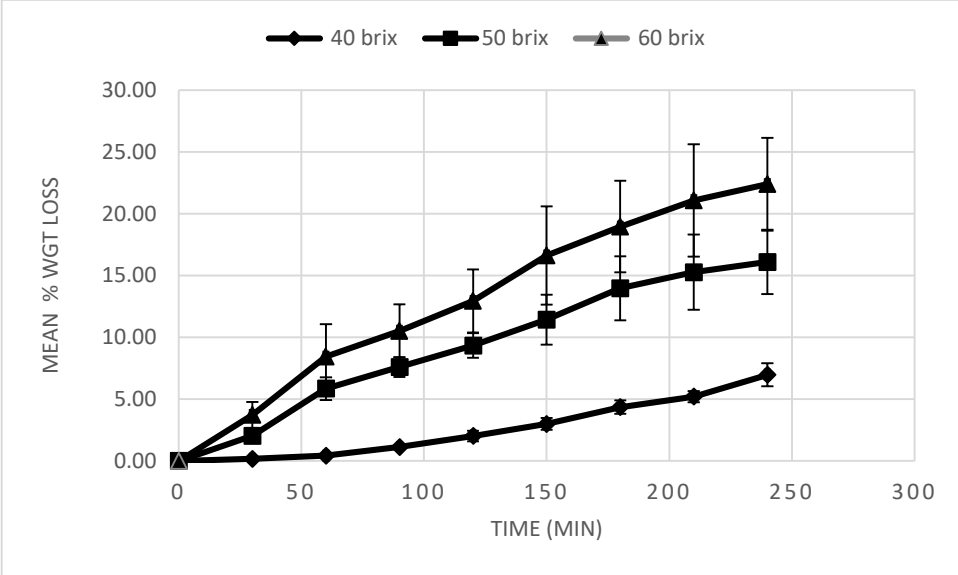


Figure 1.1 Mean percentage weight loss of papaya with time for osmotic dehydration process.

During extended osmotic treatment, the increase of solute concentrations in the fruits as a results of the increase in water loss and solid gain rates [11]. Increase the sucrose concentration enhances the water loss and solid gain throughout the diffusion period [12]. But if osmotic concentration of sugar solution increases above a limit, case hardening effect may become a brier for mass transfer [13], and also increase the cost of production due to the high amount of sugar requirement. Therefore 50 ^{o}Brix sugar solution was selected for the osmotic dehydration.

Conclusion

This study was found that 50° Brix sugar solution is the optimum concentration and four hours is the optimum time duration for osmotic dehydration of papaya slices. Further studies like sensory evaluation, keeping quality testing are essential to optimize the conditions.

Reference

1. CBI Market Survey (2005). The Eu Market For Dried Fruit Preserved. Preserved fruit and vegetables 1-22.

2. EDB (2013).Export Development Board Sri Lanka. Industry Capability Report Sri Lankan Fresh Fruit & Vegetable: 10

3. Heenkenda, H.M.S. 2013. Fruit production emerging economic sector in Sri Lanka. Retrieved December 21, 2017, from http://itfnet.org/Download/tfnetsymposium2015/11-SriLanka.pdf.

4. Nimal, D.A. 2102. Present Status, Issues and Future Trends in Fruit and Vegetable Handling, Distribution and Marketing in Sri Lanka. Retrieved December 21, 2017, from http://www.fruits.soton.ac.uk/files/2011/12/Srilanka-6-Slides-pdf.

5. Wasala1, W.M.C.B., Dissanayake, C.A.K., Dharmasena1, D.A.N., Gunawardane, C.R. and Dissanayake, T.M.R. (2014). Postharvest Losses, Current Issues and Demand for Postharvest Technologies for Loss Management in the Main Banana Supply Chains in Sri Lanka. *Journal of Postharvest Technology* 2 : 80-87.

6. Lenart, A. 1996. Osmo-convective drying of fruits and vegetables: technology and application. Drying Technology, 14, 391–413.

7. Okos, M.R., Narsimham, G., Singh, R.K. and Witnauer, A.C. (1992). Food dehydration. In D.R. Heldman & D.B.Lund (Eds.), Handbook of food engineering. New York: Marcel Dekker.

8. Rastogi, N.K., Angersbach, A. and Knorr, D. (2000), Synergistic effect of high hydrostatic pressure pretreatment and osmotic stress on mass transfer during osmotic dehydration. *Journal of Food Engineering* 45: 25-31.

9. Hawkes, J. and Fink, J.M.1978. Osmotic Concentration of Fruit Slices Prior to Dehydration. Food Processing Preservation 2: 265-267.

10. Tonon, R.V., Baroni, A.F. and Hubinges, M.D. (2007). Osmotic Dehydration of Tomato in Ternary Solutions: Influence of Process Variables on Mass Transfer Kinetics and an Evaluation of the Retention of Arytenoids. *Journal of Food Engineering* 82(4): 509-517.

11. Phisut, N. 2012. Mini review Factors affecting mass transfer during osmotic dehydration of fruits, *International Food Research Journal* 19: 7-18.

12. Falade, K.O. and Adelakun, A.T. 2007. Effect of prefreezing and solutes on mass transfer during osmotic dehydration and color of oven-dried African star apple during storage. *International Journal of Food Science and Technology* 42: 394-402.

13. Giraldo, G., Talens, P., Fito, P. and Chiralt, A. (2003). Influence of sucrose solution concentration on kinetics and yield during osmotic dehydration of mango. *Journal of Food Engineering* 58: 33-43.

ID-28

BIODIESEL PRODUCTION FROM *SARGASSUM*SPA SRI LANKAN MARINE FLORA AND OPTIMIZATION OF CONDITIONS FOR YIELD ENHANCEMENT

Mercy Nimal Fernando[1] and Kapilan Ranganathan[1]
Department of Botany, University of Jaffna, Jaffna, SriLanka
mercynisha24@gmail.coml

Abstract

Biodiesel production from natural resources has drawn global attention due to its cost effectiveness, eco friendliness and sustainability compared to the conventional fossil fuels. This work was aimed to select the best marine flora available in the Northern Sri Lankan sea to produce biodiesel and to optimize the conditions to produce higher yield. Five species of macro flora such as *Sargassum* sp, *Ulva fasiata*, *Turbinaria ornata*, *Gellidium* sp, *Thallasia* sp were collected from the coastal area of the Jaffna peninsula and washed thoroughly with water(mixed with NaOH) and dried under direct sun light. The organic solvents used to extract oil from marine plant species were n-Hexane and Di-ethyl Ether, while alkaline catalysts were used to convert the extracted oil into biodiesel via trans-esterification reaction. Higher oil quantity was obtained from *Sargassum* sp compared to other marine macro floral species, and it was selected for further studies. Optimum conditions for biodiesel production were identified as molar ratio of methanol to algae (4:1), catalyst amount in the reaction mixture (0.6%), reaction temperature (60°C) and reaction time (25minutes). When the optimum conditions were provided, the percentage of biodiesel production was significantly increased by 11.7-fold than the non-optimized conditions from *Sargassum* sp. Therefore, optimization of conditions during trans-esterification, significantly increased the biodiesel production from *Sargassum* sp.

Keywords: Biodiesel, Optimization, Oil extract, *Sargassum* sp, Trans-esterification

Introduction

Continued usage of petroleum sourced fuels is now widely recognized as unsustainable, because of depleting supplies. Contribution of the fossil fuels to the accumulation of carbon dioxide in the environment is significantly higher thus they lead to greenhouse effect. The cost of crude oil will continue to rise due to diminishing supply, therefore the production of fuels from alternate sources will be needed in the future decades. In this scenario, biodiesel could be considered as best alternative fuel due to its nontoxic and nature. Biodiesel has attracted attention during the past few years as a renewable and environmentally friendly fuel because of diminishing petroleum reserves and the deleterious environmental consequences of exhaust gases from petroleum diesel.

Biodiesel is the mono alkyl esters of long fatty acids, which is derived from trans-esterification of biological substances. The recent researches have proven that oil production from algae is clearly superior to that of terrestrial plants such as palm, grape seed, soybeans and has potential to completely displace fossil fuel (Abdel-moneim et al., 2010).Marine and freshwater algal species can contribute between 20-80% of the oil production by weight of

their dry mass (Georgogianni *et al*, 2007). Algae show much faster growth rates than terrestrial crops. The per unit area yield of oil from algae is estimated to be from 20,000 to 80,000L per acre per year. The use of algae as energy crops has potential benefits, due to their easy adaptability to growth conditions, the possibility of growing in adverse environments, either in fresh or marine waters avoiding the use of land. Furthermore, two thirds of earth's surface are covered with water, thus algae would truly be renewable option of great potential for global energy needs. Different algal species better suited for different types of biodiesel. Algal biofuels appear to be the only current renewable abundantly available, natural source that could meet the global demand for fuels (Abdel-moneim et al., 2010). There is a need to explore promising sources for biodiesel production and proper trans-esterification methods for the efficient biodiesel production. Therefore, this study was aimed to select the best marine flora available in the Northern Sri Lankan sea for the biodiesel production and to optimize the conditions to enhance the biodiesel yield.

Materials and Methods

Sources of algal species

Five species of macro algae such as *Sargassum* sp, *Ulva fasiata*, *Turbinaria ornata*, *Gellidium* sp, *Thallasia* sp.were collected from the sea and the coastal area of the Jaffna peninsula.

Pretreatment of algal species

The samples were washed thoroughly two to three times using tap water. Then they were spread directly under sun in a light area for one week to get dried biomass. The dried samples were ground separately, and the fine powder was passed through a 500-micron sieve to remove oversized particles.

Treatment with solvent

Treatment with hexane

Oils were obtained by extracting the algae (10grams) with hexane in a Soxhlet extractor for 9 hours. The extracted oil was separated by evaporating the solvent in a rotary evaporator at 45°C for 15mintues.

Treatment with di-ethyl ether

100 grams of fine powder of each algal sample were weighed and added in to 500ml brown bottle containing 200ml di- ethyl ether. The solution was covered and shaken every 30 minutes for six hours and allowed to stand for twenty-four hours in room temperature. Then it was shaken well and filtered through Buchner funnel suction pump using Whatsman (No1) paper.

Trans-esterification reaction

After filtration, the solvent was removed by evaporation using a rotary evaporator under reduced pressure and at a temperature below 35° C. About 3.3 grams crude extract was obtained and separated through the extraction process from 10grams of algal biomass sample. The extracted oil was converted into biodiesel through transesterification reaction in the presence of methanol. In this process triglycerides reacts with alcohols to form the fatty acid ester (biodiesel) and the glycerol. During this reaction the algal oil was allowed to react with the methanol in the presence of alkaline NaOH.

Optimized condtion for transesterification reaction

Effect of molar ratio of methanol to algae

Oil extraction experimental setup was done by *Sargassum* sps,optimized solvent ratio (hexane:diethylether;200:0),optimized algal biomass 100g, and allowed for optimized time period (24 hours). Following mol ratio methanol to algal biomass was added to opitimized transesterification reaction.(2:1,3:1,4:1,5:1,6:1,7:1).

Effect of catalyst amount

Oil extraction experimental setup was madewith*Sargassum* sps,with the optimized solvent ratio (hexane:diethylether;200:0), optimized algal biomass 100g and allowed for optimized time period (24 hours). Opitimied methanol to oil ratio 4:1 was added with the following catalyst amount(NaOH) respectively 0.3%,0.4%,0.5%,0.6%,0.7%,0.8% for transesterification reaction.

Effect of reaction temperature

Oil extraction experimental setup was madewith*Sargassum* sps,with the optimized solvent ratio (hexane:diethylether;200:0),optimized algal biomass 100g and allowed for optimized time period (24 hours) under optimized trasesterification reaction condition (molar ratio methanol to oil 4:1) with the optimized catalyst amount 0.7%(NaOH) were throught mixed using magnatic stirrer by various reaction time 5minutes to 30mintes(Khola and Ghazala, 2012) and that mixture was poured in to oil. This product was kept 35°Cto 60°C differnent temperature in a water bath.

Effect of reaction time

Oil extraction experimental setup was done with*Sargassum*sps,optimized solvent ratio (hexane:diethylether;200:0),optimized algal biomass 100g, allowed for optimized time period 24 hours,optimized trasesterification reaction condition molar ratio methanol to oil 4:1,optimized catalyst amont 0.7%(NaOH) were throught mixed using magnatic stirrer ,and the mixture was poured in to oil.this product was 60^{0}C with optimized temperature and allowing for 5minutes to 30minutes to reaction occurred in waterbath.

Biodiesel production after the optimization

The extracted oil was converted to biodiesel through trans-esterification reaction in the presence of methanol. The quality of biodiesel was assessed by measuring its properties such as flash point, viscosity, density, fire point and cloud point.

$$\text{Percentage of biodiesel yield} = \frac{\text{Biodiesel yield}}{\text{Oil used}} * 100$$

Biodiesel analysis

The quality of biodiesel was assessed by measuring its properties such as flash point, viscosity, density, fire point and cloud point.

Stastical analysis

All the experiments were done in triplicates. Statistical analyses were performed using Minitab 17.0 version. The data were analyzed using one way ANOVA. Tukey's multiple comparision test was used to determine significant difference at p _<0.05.

Results and Discussion

Effect of molar ratio of methanol to oil

The stoichiometric ratio for transesterification requires 3moles of alcohol and 1mole of triglyceride to yield three moles of fatty acid alkyl esters and one mole of glycerol. Significantly higher amount of biodiesel was obtained at 4:1 methanol to oil ratio than the non-optimized ratio (2:1). At higher molar ratio, the excess amount of oil promotes the forward reaction. When the range of methanol to oil ratio was 2:1 to 7:1, maximum yield was obtained (0.945%).

Effect of catalyst amount

When different amounts of catalyst (0.2,0.4,0.6,0.8,1.0%) were used, significantly higher amount of biodiesel production (0.93%) was obtained when 0.6%was used. The role of catalyst in transesterification reaction is very important. This reaction can be carried out with both, acid or alkali catalyst. However, using acidic catalyst has the disadvantages due to elevated rate of transesterification reaction and the reaction conditions are mild, consumption of methanol is significantly less, catalyst is less corrosive, and the acid catalyst process requires a high methanol to oil molar ratio and high acid catalyst concentration.

Effect of reaction temperature

The biodiesel production (after addition of methanol and alkali catalyst mixture to oil) at different temperatures ranging from 35°C to 70°C was given diesel yield. Maximum amount of biodiesel was produced in between 45°C to 60°C temperature range. Therefore, the temperature more likely gave a big effect for the yield produced. In this study, significantly higher biodiesel production was obtained at 60°Cwhich is in the agreement with the available literature. When the temperature was optimized as 60°C, biodiesel production was increased by 9.4 times(from0.1%-0.942%) than the non-optimized condition. The 70°C for the system temperature excess the boiling point of the methanol (64.7^{o}CAt 60oC biodiesel gives 0.942%

yield, gives the maximum amount for producing diesel because there is a limitation of methanol boiling point. Biodiesel reduce the amount methanol, because of forward reaction in transesterification reaction. so that the methanol become insufficient. At 70oC, yield will be decreased 1.809% because, higher temperature could accelerate the saponification of triglycerides and had a negative effect on the product yield.

Effect of reaction time

When the reaction time was kept at 25minutes, biodiesel yield was significantly increased by1.2 times than the non-optimized reaction time. All the optimized conditions indicated that the reaction time required for the optimization of the alkaline catalyst transesterification reaction depend not only in the reaction temperature, but also on the degree of mixing in the process.

Biodiesel analysis

The quality of biodiesel was assessed by measuring its properties such as flash point, viscosity, density, fire point and cloud point, as shown in Table 1. The higher flash point of biodiesel as compared to Petro diesel makes it safer. The other properties of biodiesel are also very close to petro diesel.

Table 1. Biodiesel analysis: Comparison of the biodiesel properties with the petro diesel

Properties	Petro diesel	Biodiesel
Flash point (^oC)	134	142
Fire point (^oC)	154	159
Cloud point (^oC)	4	3
Density (KgM^{-3})	865.2	867.3

Conclusion

When the extracted oil was converted into biodiesel via trans-esterification reaction, after the optimization of conditions, such as molar ratio of methanol to algae (4:1), catalyst amount (0.6%), reaction temperature (60°C) and reaction time (25minutes), the percentage of biodiesel produced was significantly increased by 11.7 times than the non-optimized conditions from *Sargassum* sp. Therefore, *Sargassum* sp brown macroalgae could be used as an efficient raw material for the biodiesel production, after the optimization of the conditions tested above.

Reference

1. Abdel-moneim,M.R.Afify, Emad .A.Shalaby and Sanaa M.M. shanab., Enhancement of biodiesel production from different species of algae., 2010; 416-421.
2. Georgogianni, K. G., Kontominas, M. G., Tegou, E., Avlonitis, D., Gergis,V. Biodiesel Production: Reaction and Process Parameters of AlkaliCatalyzed Transesterification of Waste Frying Oils. Energy & Fuels 2007; 21: 3023-3027.

ID - 30

QUALITY ANALYSIS OF THE WATER SUPPLIED FOR PUBLIC FROM COLLECTOR WELLS

Thilakshan Sandrasegaran and Ranganathan Kapilan
Department of Botany, University of Jaffna, Jaffna, Sri Lanka

Abstract

The study was aimed to determine the water quality of the collector wells in the Vallipuram area of the northern Sri Lanka and to determine the suitability of the water for domestic utilization. Because of the infection of well water by iron and coliform bacterial species in 2016, public water supply was temporarily stopped and after a complete sterilization and clean-up process using chlorination and integrated control methods only, the water supply restarted after six months. Since then, there had been no steps made to check the quality of the drinking water supplied to the public from these wells. Water samples (36) were collected from the four major water supply collector wells in both top, middle and bottom randomly in triplicates during the rainy season of 2018. Samples were analyzed for pH, Electrical conductivity (EC), Turbidity, Total iron, Colour, Coliform test and Bio chemical tests such as Indole production test, Methyl red test,Voges-Proskauer test, Oxidase test and Catalase test. The results were compared with WHO and SLS standards and it was concluded that all the water samples from the collector wells tested, did not have any contaminants thus the quality of those samples was good for drinking.Based on the biochemical and molecular analysis,the bacterial species presented in some water samples was identified as *Bacillus thuringiensis.* Exactly similar conclusion was reached when the same research study was repeated after 6 months from the earlier study and the values obtained for the physico chemical factors tested were not significantly different with that of the previous study. Therefore, water in all the collector wells could be used for domestic and sustainable agricultural purposes continuously in the future too.

Keywords: Collector wells,*E. coli*,physico-chemical, pH, salinity, water quality,

Introduction

Water plays an essential role in human life. Although statistics, the World Health Organization reports that approximately 35% of people were without access to safe drinking water (WHO, 2004). Ground water is the most important source of supply for drinking, irrigation and industrial purposes. Increasing population and its necessities have led to the deterioration of surface and sub-surface water (Basavaraj et al., 2015). Water is polluted on all the surfaces of earth. All metabolic and physiological activities and life processes of aquatic organisms are generally influenced by such polluted waste and hence, it is essential to analyze the physic-chemical characteristics of the drinking water (WHO, 2004). People in Jaffna Peninsula, depend mainly on ground water for their drinking and other domestic purposes as other water sources such as waterfalls and rivers are not available and fresh water ponds and rainfall are not sufficient. ManalkaduSand Dunes- Manalkadu village is a miniversion of a desert. Right at the town of Point Pedro begins the Manalkadu Sand dunes. The sparsely populated coastal stretch is punctured with isolated villages centeredaround avillage well. The acres ofsand dunesare also found covered with thick bush while beyond the dunes one can spot one of the most beautiful beaches of the Northern Province. Sand

dune, sand dune: Sand dunes are Jaffna lagoon of the northern Sri Lanka is surrounded by the densely populated Jaffna peninsula containing Palmyra palms, coconut plantations, and rice paddies. There are numerous fishing villages and some salt pans (Kapilan, 2015). The Jaffna lagoon is a shallow water body and has extensive mudflats, sea grass beds and some mangroves. Underground water quality of the coastal area of the lagoon is continuously degrading due to fishing related activities and dumping of garbage without proper management. The coastal areais widelyused for the fishing purposes and for small scale production of salt. Unoccupied land scare used as points todump garbage improperly. Most of the wells that are closer to sea are not used for publicconsumption becauseof thesalty nature (R Kapilan, 2015). Because of the infection of well water by iron and coliform bacterial species in 2016, public water supply was temporarily stopped and after a complete sterilization and clean-up process using chlorination and integrated control methods only, the water supply restarted after six months. Since then, there had been no steps made to check the quality of the drinking water supplied to the public from these wells. It was decided to analyses its ground water so that some remedies for improvement could be possible and sampling locations. However there is no recent scientific water quality analysis conducted for the collector wells to determine the water quality and to identify the potential pollutants. Vallipuram area was selected as an ideal place of the above mentioned situation. Therefore this study was aimed at determining the water quality of the collector wells in the Vallipuram area of the northern Sri Lanka and to determine the suitability of the water for domestic utilization.

Materials and Methods

Study area

This study was conducted in the Vallipuram costal area between August and September in 2018 and February and March in 2019.Collector wells are located in sand dunes. The location is rich in water and there are less hardness issues, less population density in the area so that anthropogenic is also very less.

Reagents and Chemicals

All the chemicals used in this study were of analytical grade and the standard methods were for the examination of water and its components (APHA, 1989).

Sampling method

Samples were collected and analysis was done by following “Standard method of analysis of water" from nine different spots of the each collector wells. Precautionary measures were adopted to minimize cross contamination of samples. Water samples were collected in sterilized screw-capped Durant bottles of one liter capacity and analyzed in laboratory for their biological and physic-chemical parameters. This was done carefully to avoid contact between the Walls of well, thus avoiding contamination of samples. Samples were labeled as collector well 1, 2, 3 and 4.

Water analysis

The collector wells were operated before the collection of the water samples. After the samples were collected, sample containers were kept in ice box and carried to Water board, Jaffna and later used for the physic-chemical analysis based on SLS and APHA guidelines The water quality parameter estimation and calibration of equipments were done using standard methods and techniques.

pH, Electrical conductivity, Turbidity, Total iron concentration and Colour

The pH of the water samples was measured by using digital pH meter. Electro conductivity was measured by the conductometry. Turbidity was measured by using Naphelo turbidity meter. Water samples were analyzed for total iron concentration. Total Iron was measured by the photometry (spectrophotometer) - Ferro Ver Method and used ferrous iron reagent powder pillows.The color of the samples was determined by the Hazen colour disk and lovibond comparator.

Physico-Chemical analysis

The various physico-chemical parameters were examined using the Standard Methods for the Examination of Water (APHA 1987)

Coliform test

After the chemical Analysis in the water board, the water samples were taken to the Department of Botany laboratory, University of Jaffna for the Coliform test and Bio chemical analysis. 10 ml of water from each samples were used to perform standard coliform test (Barrow and Feltham 1993, Fisher, 1975,Theivandrarajah, 1990).

Bio chemical analysis

Bacterial strains that were isolated from the water sample was subjected to variety of morphological and biochemical tests, as described in Bergey's Manual of Systematic Bacteriology (Bergey et al., 2001) and other methods (Barrow and Feltham 1993, Fisher, 1975, Theivandrarajah, 1990). Shape and arrangement of endospore were observed. under oil-immersion microscope after gram staining.Production of acid from different carbohydrates such asglucose, xylose and mannose were tested. Productionof urease, hemolysis of blood agar, indole test, nitratereduction test, decomposition of tyrosine, hydrolysis ofstarch, citrate utilization test and Voges-Proskauer (VP)test were done on the selected strain [34]. Growth of theselected strain was tested at 5, 15, 25, 35, 40, 45, 50,55 and 60°C at pH 9.0, and 100 rpm. Effect of differentconcentrations of NaCl on the growth of the selectedstrain was tested.

Characterization of the strain by molecular means

DNA was extracted from bacterial isolates by KIT method in Botany laboratory, and it was sent to Gene Tech to molecular analysis. Pure culture of the selected bacterial strain was grown overnight on Nutrient Broth and the DNA extraction was done using kit (QIAGEN Inc.Mississauga, ON, Canada) by Cell Lysis method and 16S rDNA was amplified by

Thermocyclerusing the primers, Forward: 5' AGAGTTTGATCCTGGCTCAG 3', Reverse: 5'TACCTTGTTACGACTT 3'. The amplified 16S rDNAPCR product was sequenced using automated sequencer. The Sequence Similarity Search was done for the 16S rDNA sequence using online search tool BLAST (http://www.ncbi.nlm.nih.gov/blast/). The unknown organism was identified using the maximum aligned sequence through BLAST.

Statistical analysis

Statistical analyses were performed using R2.15.3 (R Development Core Team, 2010). The data were analyzed using ANOVA. Determination of significant differences at $p \leq 0.05$ was estimated by performing Tukey's multiple comparison test.

Result and Discussion

pH, Electrical conductivity, Turbidity, Total iron concentration and Colour

The pH value of water sample in the study area ranged from 7.0 – 8.0. This shows the pH of the water sample was slightly alkaline. On an average, pH of all the samples was in desirable limits as prescribed for drinking water standards. Lime deposits below the soil, decaying Plant and Animal wastes, seasonal rain might have influenced in the observed pH value. The specific conductivity of water samples in the study varies between 1200 -2500 µ mho /cm. the maximum permissible limit of specific conductivity for drinking water is 3500µ mho /cm. however the average specific conductivity exceeds the permissible limit because of its high values during rainy season. In rainy season, due to the floods and rains water level in the well will increase and this will lead to increase in the amount of electrolytes.The turbidity of the water samples fell in the range of5.5 – 27 NTU. World health organization (WHO) prescribed the highest desirable limit is 5NTU and maximum permissible limit is 25 NTU(Kapilan, 2015). In most of the areas the water was very clear and the value of turbidity present was in the permissible limit. As all the water wells that were used for drinking were kept covered all the time there was a very less chance of substances reaching the water.Iron is one of the most abundant metals in the earth's crust. It is found in natural fresh waters at levels ranging from 0.5 to 50 mg/liter. Iron may also be present in drinking water as a result of the use of iron coagulants or the corrosion of steel and cast iron pipes during water distribution.Color in water is caused by minerals. Color can also be caused by industrial or municipal contaminations. Color is usually only a problem with surface water. But some ground waters containing iron or manganese can also have significant color levels. Color is classified as either true color or apparent color.True color is due to the colloidal organic compounds in the water. Apparent color is caused by colored suspended matter such as clay or iron precipitates in treatment applications.

Coliform count

There were no positive answers for the coliforms. Therefore, there were no coliform bacteria present in any of the water samples collected from Vallipuram wells.

Morphological Characteristics of the bacterial strain

Growth of the bacteria was observed in the agar media. Aloopful of bacteria was isolated on the same solidified medium, a pale yellow coloured growth was observed on the plates after an incubation of 24- 48 hours. Individual separate colonies were obtained. Since only one type of growth was observed hence, it could be concluded that is also possible to obtain the isolate as a pure culture.Gram Staining showed that gram positive rod shaped.

Microscopic Studies and Biochemical tests

Biochemical tests were carried out to confirm the genus of the strain and to identify the species. Since the strain produced O_2 from H_2O_2, it was concluded that the strain is a catalase producer. When tryptophan water medium was inoculated with the isolated strain and mixed with Kovc'sindole reagent, red colour ring was not observed. This indicated that strain cannot utilize tryptophan and produceindole. If the organism produces starch hydrolyzing enzymes it can be hydrolyze starch into mono saccharides. To check whether the organism has utilized starch, after the growth of the organism I_2 has to be added. If there is a blue colour formation, it indicates the production of starch hydrolyzing enzyme (Theivendrarajah, 1990). When the starch-agar medium was inoculated with the strain and I_2/KI was added after 48 hours of incubation, a blue colour was not formed. This indicated that the strain produce starch-hydrolyzing enzymes. Based on the biochemical tests performed, the genus of the strain isolated from the water sample was identified as *Bacillus* sp.

Final confirmation of species of identified strain *Bacillus sp*

Characteristics of the isolated bacterial strain were compared with other Bacterial species. If the character of strain is similar to the known species its score would be 1.if the character is not similar and variable, it would not get any score. Total score was counted, divided by total characteristics and it was multiplied by 100 and presented as a percentage. Based on these morphological findings and biochemical studies, the isolated strain got the highest score of 95% showing similarities with *Bacillus spp*. The strain showed clear characteristics of *Bacillus spp* than the other suspicious bacterial species. As the bacterial strain got the highest score, it was identified as *Bacillus spp*.

Characterization of the strain by molecular means

Based on the culture and morphology studies, the genus of the selected strain (B2) could be *Bacillus* since it showed positive results to the gram staining, spore formation, motility, catalase test and triple sugar iron agar test. The DNA from the isolated strain was isolated and the 16S rDNA was amplified and sequenced. The BLAST analysis of the strain using its 16S rDNA sequence data showed that strain CEL PTK1 had highest homology (100 %) with *Bacillus thuringiensis* (GenBank accession no AE017355).

Conclusion

This study reveals that all the values obtained for the water samples were within the permissible limit in all levels of all the collector wells, according to the WHO and SriLankan standards. The samples did not contain any pathological contaminants. The BLAST analysis of the isolated strain using its 16S rDNA sequence data showed that strain isolated from the wells had highest homology (100 %) with *Bacillus thuringiensis* (GenBank accession no AE017355). A periodical analysis needs to be done to make sure there are no more contaminants in the drinking water sample.

Reference

1. American public Health Association water Pollution Control board (1965). APHA, AWWA-WPCF, standard methods for examination of water and waste water, New York (USA), 6:74-92.
2. APHA (1989).Standard methods for the examination of water and wastewater (17thEdn) Washington, D.C.
3. Barrow GI, Feltham (1993), RKA. In: Cowan and Steel's Manual for the identification of medical bacteria, Ed Barrow,GI, Felthman RKA. Great Britain, University Press, Cambridge 1993; 51-93. ISBN 0521 326117.
4. B Basavaraj, L and G Vilas, D and Rathod, Vijayakumar. (2015). Study on ge netic vari abil ity and char ac ter inter-re la tion ship of qual ity and yield com po nents in tomato (*Solanum lycopersicum* L.). HortFlora Research Spectrum. 4. 108-115.
5. Bergey. D. H. and Holt, J. G. (1994). *Bergey's Manual of Determinative Bacteriology*. 9th edition. Williams and Wacket, Baltimore, Washington DC.
6. Fisher S. Endospore-forming rods and cocci: Family Bacillaceae. In: Bergey's Manual of Determinative Bacteriology, Ed. Buchanan RE, Gibbons NE, Cowan ST, Holt JG, Liston J, Murray RGE, Niven CF, Ravin AW, Stainer RY. Waverly Press, USA. 1975; pp. 529-550. ISBN 0-683-01117-08.
7. Kapilan.R (2015). Determination of Drinking Quality of Water near the Coastal Areas of JaffnaLagoon, Journal of progressive research in Biology, 2(1):32-36.
8. Laboratory Manual on Water analysis, National Environmental Engineering Research Institute, NEERS, Nagpur. (1991).
9. Theivendrarajah, K. (1990). Microbiology Laboratory Manual: Department of Botany, University of Jaffna, University Publication. 1-33.
10. World Health Organization (WHO), International standards of drinking water, world health organization, Geneva, (2004).

ID - 31

PRODUCTION OF SINGLE CELL PROTEIN FROM PINEAPPLE PEEL WASTE USING PALMYRAHTODDY YEAST

Thiviya. P[1], Kapilan. R[2] & Madhujith. T[3]
[1]*Department of Food Science & Technology, University of Peradeniya,*
[2]*Department of Botany, University of Jaffna.*

Abstract

The disposal of fruit waste into environment poses health hazard for living beings. And also protein deficiency is becoming a major problem with the fast growing world population. The bioconversion of fruit wastes into single cell protein production is an innovative and alternative way to this direction. Therefore, this study was aimed to produce single cell proteins from pineapple peel using palmyrah (*Borassus flabellifer*) toddy yeast under liquid state fermentation system. Pineapple peel was collected, cleaned, washed and blended and physiochemical properties such as Total Soluble Solid (TSS), pH, moisture content, protein, fat and ash content were determined in dry weight basis. The extract of pineapple peel was filtered and diluted to 10% and autoclaved. The sterilized pineapple peel extract kept in sterilized conical flask in triplicates and inoculated with natural palmyrah toddy yeast and allowed for fermentation at 100 rpm for 48 hrs. The sediment was collected by centrifugation and oven dried and the dry weight was measured and the protein content was determined by using Kjeldahl method. The protein content of peel was 6.9%±0.06, the TSS, pH, moisture, fat and ash content of pineapple peel were 10.8%, 3.69, 84.68%±0.85, 0.86%±0.088 and 4.50%±0.30 respectively. The mean cell bio mass was 0.940±0.053 gram cell mass per 100 mL substrate and the crude protein content was significantly increased to 49.7% from 6.9% (7.2 times, dry weight basis). Therefore, locally available pineapple peel waste could be a good source for the production of protein-rich cell biomass using fermentation by natural toddy yeast of palmyrah**.**

Keywords: Liquid state fermentation, Palmyrah toddy yeast, Pineapple peel, Single cell protein

Introduction

The disposal of fruit waste from fruit processing industry into environment can pose serious environmental pollution. Fruit waste might have a potential for recycling to get raw material or for bio conversion into useful product such as organic acid, methane, ethanol, SCP and enzyme. On the other hand increasing world deficiency of protein is becoming a major problem with the fast growing world population. It is important to focus on new, alternate and unconventional protein production in order to produce enough food and feed to meet the nutritional requirement. The single cell protein derived from the waste organic products has become more popular technology in recent days. Single cell protein (SCP) refers to the dead, dried microbial cell or total protein extracted from pure microbial cell culture (algae, bacteria, filamentous fungi, yeast) which grown on different carbon sources. Besides high protein content (about 60-82% of dry cell weight), SCP also contains fats, carbohydrates, nucleic acids, vitamins and minerals. SCP is rich in certain essential amino acids like lysine and methionine which are limiting in most plant and animal foods (1). Fruits which have a huge market potential, 30-40% of the harvest is lost at the postharvest stage due to improper

supply chain and value chain activities(2). In general the nonedible portion of fruits and vegetables such as peels, pods, seeds, skins, etc., are discarded during processing and it accounts for about 10–60% of the total weight of the fresh produce. Mainly pineapple are brought from other district into Jaffna Peninsula market (3) and the cultivation of pineapple has been initiated in chavakachcheri, Kaithady and Urumpirai(4). The increasing production of pineapple processed item in Sri Lanka, results in massive waste generation.

Microorganism utilizes the cheap and abundant agro waste to produce SCP thus, it can help to minimize the effect of organic waste disposal into the environment (5). Moreover, bioconversion of these waste materials to protein-rich food can reduce the cost of SCP production significantly (6).Various microorganisms are used for the production of SCP are bacteria (*Cellulomonas, Alcaligenes*, etc.), algae (*Spirulina, Chlorella*, etc.), molds (*Trichoderma, Fusarium, Rhizopus*, etc.) and yeast (*Candida, Saccharomyces*, etc.)(7). Yeast is suitable for SCP production because of its superior nutritional quality, high lysine content, larger size making them easier to harvest, low nucleic acid content and ability to grow on low pH (7). Moreover yeast and fungi are the most accepted and utilized microorganism for SCP production because of the long history of using in traditional fermentation (8).

The objective of this study was to determine the possibilities to produce SCP from the cheap and abundant pineapple peel waste using natural yeast from the palmyrah toddy**.** There have been very few literatures addressing the possibility of exploring different cost effective fruit wastes for SCP production. This study will focus on SCP production from cheap and abundant local pineapple peel waste, using natural yeast from the palmyrah toddy under Liquid State Fermentation (LSF) system.

Methodology

Collection of materials

Non-infected pineapple fruit wastes were collected from the local markets and processing industries located in Jaffna town, Sri Lanka. Palmyrah toddy was collected from the collection point of mature palm using sterile vessels in-order to use as the source of natural yeast, *Saccharomyces cerevisiae.*

Proximate analysis of pineapple peel

Cleaned and washed pineapple peel was weighed and the moisture, protein/ nitrogen content, fat, ash content were determined by AOAC (2006) methods.

Preparation of pineapple peel and produce SCP

The collected mass of pineapple peel was cleaned and washed using water. Then the cleaned peel was macerated using the blender into a slurry and filtered through the Whatman filter paper. The solid content and the pH of the extract were determined by using a refractometer (Abbe Refractometer) and the pH meter respectively (5). The extract was diluted to 10% using distilled water and sterilized in autoclave at 121ºC for 15 psi and 15 min. The 50 mL of sterilized peel substrate was transferred into pre-sterilized conical flask in triplicates under sterile condition. The sterilized media were inoculated with 5 mL of fresh palmyrah toddy sample ($(1.63\pm0.15)\times10^6$cells/mL) and allowed for fermentation under Liquid State

Fermentation (LSF) system at 100 rpm for 48 hr at 28ºC. After 48 hrs, sediment was centrifuged (4000 rpm for 20 min) and oven dried (50ºC for 16 hr) and the dry weight was measured. Protein content was determined on the basis of total nitrogen content (N×6.25) by using Kjeldahl method as per the protocol explained in AOAC, 2006 (9).

Results and Discussion

The mean pH and the total soluble solid values of the pineapple peel extract was 3.69 and 10.8% respectively. The result of the proximate analysis of the pineapple peel extract is presented in Table 1.

Table 1: Proximate analysis (dry weight basis) of pineapple peel waste.

Proximate composition	Amount w/w% (Mean ± SD)
Moisture %	84.68±0.85
Fat%	0.86± 0.09
Protein%	6.9± 0.1
Ash%	4.50± 0.30

The results of the chemical composition of peel established that it is a good nutrient source for yeast cell mass formation with the 6.9% protein content (10) and higher mineral content(11).

Yeast biomass produced after fermentation (Table 02) revealed that the mean cell bio mass was 0.940±0.053 gram cell mass per 100 mL pineapple peel substrate and the crude protein content was significantly increased to 49.7% from 6.9% (7.2 times, dry weight basis).

Table 2: Yeast biomass produced after fermentation from pineapple peel extract.

	Value (Mean ± SD)
Weight of Single cell colony (g)	0.047 ± 0.003
Per 100mL substrate (g)	0.940 ± 0.053
Crude protein (%)	49.7 ± 1.3

Previous studies used inorganic supplements (nitrogen, carbon and glucose sources) for the biomass production on waste materials(11). No such supplements were used to grow yeast culture on pineapple peel waste in this present study and therefore this process of SCP production extremely becomes cheaper. The above result established that pineapple peel extract and palmyah toddy yeast sample can be used to produce SCP. Additionally, it plays a vital role in waste management as waste materials (pineapple peel) are used as substrate (1). Studies on the possibilities of single cell protein production from various fruit peel waste as substrate using fresh palmyrah toddy yeast sample are under way.

Conclusion

Locally available pineapple peel waste can be a good source for the production of protein-rich cell biomass using fermentation by natural palmyrah toddy yeast and this biomass could be recommended as a food or feed after appropriate food quality testing. The crude protein content of the pineapple peel waste extract was significantly increased by 7.2 times after the fermentation by natural palmyrah toddy yeast.

Reference

1. Suman, G., Nupur, M., Anuradha, S., & Pradeep, B., Single Cell Protein Production: A Review. *International Jounal of Current Microbiology and Applied Science*. 2015, 251-262.
2. Institute of Post Havest Technology.,*Annual Report.* Institute of Post Havest Technology.2014.
3. **Dharmaratne, T.A.***An Overall Assessment of the Agricultural Marketing Systems in Northern Province of Sri Lanka.* Colombo 7: Hector Kobbekaduwa Agrarian Research and Training Institute. 2014, 169.
4. Ministry of Agriculture, Rural Economic Affairs, Irrigation and Fisheries and Aquatic Resources Development. Agricuture division. *National Program 2016-2018.* [Online] Date of Publication (15/12/2016).
5. Mensah, J. K., & Twumasi, P., Use of Pineapple Waste for Single Cell Protein (SCP) Production and the Effect of Substrate Concentration on the Yield. *Journal of Food Processing Engineering.* 2017, 40(3), 12478.
6. Mahan, K. M., Le, R., Wells, T., Anderson, S., Yuan, J. S., Stoklosa, R. J., Ragauskas, A. J., Production of Single Cell Protein from Agro-Waste Using Rhodococcus opacus. *Journal of Industrial Microbiology and Biotechnology.* 2018.
7. Nasseri, A., Rasoul-Amini, S., Morowvat, M., & Ghasemi, Y., Single Cell Protein; Production and Process. *American Jounal of Food Technology.* 2011, 6(2), 103-116.
8. Qiang, L., & Iong-zong, C. J. (2016). Advanced Materials and Energy Sustainability. Wuhan, Hubei, China: World Scientific Publishing Co. Pte. Ltd.
9. Sarathadevi, R., Kapilan, R., & Vasantharuba, S., Singe Cell Protein Production from Papaw and Banana Fruit Juices using Bakers's Yeast. *American- Eurasian Journal of Agricultural and Envionmental Sciences.*2018, 18(4), 168-172.
10. Dhanasekaran, D., Lawanya, S., Saha, S., Thajuddin, N., & Panneerselvam, A., Poduction of Single Cell Protein from Pineapple Waste. *Innovative Romanian Food Biotechnology.* 2011, 8, 26-31.
11. Mondal, A., Sengupta, S., Bho, J., & Bhattacharya, D., Utilization of Fruit Wastes in Producing Single Cell. *International Journal of Science, Environment and Technology.* 2012,1(5), 430 - 438.
12. Rehana, K., Induced Mutations in Microbes and Animals for Economic Benefit of Man. *Textbook of Biotechnology Volume-I Genetics and Molecular Biology*. 2010, (p. 272). Luxmy Publication.
13. Ugalde, U., & Castrillo, I. J.,Single Cell Proteins from Fungi and Yeasts.*Applied Mycology and Biotechnology.* 2002, 2, 123-149.
14. Ruvini, V., Jayamini, C., Roshini, R., & Wijesooriya, N.,Quality and Safety Issues in Fruit and Vegetable Supply Chains in Sri Lanka: A Review.*Hector Kobbekaduwa Agrarian Research and Training Institute*. 2018, 217.
15. Ali, S., Mushtaq, J., Nazir, F., & Sarfraz, H.,Production and Processing of Single Cell Protein (SCP) - A Review.*European Journal of Pharmaceutical and Medical Research.*2017, 4(7), 86-94.

ID - 34

LEAF EXTRACT OF *BRYOPHYLLUM PINNATUM*: A POTENTIAL TENDERIZER FOR GOAT MEAT

Maathumai. S[1*], Kapilan . R[2], Arampath P.C[3]
[1]*Postgraduate Institute of Agriculture, University of Peradeniya, Sri Lanka.*
[2] *Department of Botany, Faculty of Science, University of Jaffna, Sri Lanka*
[3]*Department of Food Science & Technology, Faculty of Agriculture, University of Peradeniya, Sri Lanka.*

Abstract

Tenderness of the cooked goat (*Capra aegagrus hircus*) meat is one of the significant sensory attributes highly expected by the goat meat lovers in Sri Lanka. The leaf of *Bryophyllum pinnatum* is traditionally used as a meat tenderizer in Northern Province. The research objective was to determine the optimum concentration of *Bryophyllum pinnatum* leaf extract as a tenderizer for goat meat chunks. Aqueous extraction of *Bryophyllum pinnatum* leaves was obtained by boiling chopped leaves in distilled water at 40 ^{O} C for 24 hours. Goat meat chunks (50g) were treated with four levels of leaf concentrations (0.2, 0.4, 0.6 and 0.8 % w/v) and distilled water (control). The chunks were marinated at 4 ^{O} C for 24 hours and treated with salt (2% w/w) followed by thermal treatment at 121 ^{O} C for 15 minutes. pH and weight difference of the meat chucks were measured after thermal treatment. Sensory attributes of heat treated chunks were evaluated using Hedonic Scale (9 points) with 30 semi-trained panelists. pH value of meat chunks was significantly decreased with increasing concentration of leaf extract. While thermal yield of meat chunks increased significantly with increasing concentration. . Mean scores of sensory attributes, colour, flavor and juiciness of meat chunks did not show significant difference (n>0.05) compared to the control and increasing concentration of extract did not influence on them, but mean scores for overall acceptability and tenderness were higher than the control. Significantly highest mean scores for the overall acceptability values and tenderness were observed in 0.6 % and 0.8 % leaf extraction concentration than other treatments and both concentrations showed similar result in all the sensory attributes and thermal yield. In conclusion, 0.6 % (w/v) *Bryophyllum pinnatum* leaf extract was the optimum concentration for goat meat tenderization.

Introduction

The annual per capita consumption of goat meat in Sri Lanka in 2015 was about 0.09 kg (Department of Animal Production and Health, 2015). The total annual domestic production of mutton was 1350 MT in the year 2015 the balance requirement (350.33 MT) is imported (Department of Animal Production and Health, 2015). The annual per capita consumption of goat meat in Sri Lanka in 2015 was about 0.09 kg (Department of Animal Production and Health, 2015). The total annual domestic production of mutton was 1350 MT in the year 2015 the balance requirement (350.33 MT) is imported (Department of Animal Production and
Health, 2015).Goat meat is one of the most popular meat among the consumers in Sri Lanka. The statistics showed that annual per capita consumption of goat meat in Sri Lanka was about 0.09 kg in 2015 [1], while the total annual domestic production of mutton was 1350 mt in the year 2015 and the balance requirement (350.33 mt) is imported [1]. Consumer satisfaction is highly depends on meat quality. Among the various components of meat quality, the technological, nutritional, and sensory dimensions are much considered. The most crucial factor is tenderness and its variability. Improvement of tenderness has been done

by physical or chemical methods [2]. Blade tenderizer, hydrodynamic shockwave treatment are some examples for physical methods [3], whereas the chemical method employs addition of photolytic enzymes of plant or fungal origin. Papain, ficin, trypsin, bromalean, rhozyme are some examples for chemical tenderizers. Papain is the well-established tenderizer commonly used in industrial level. However Papain treated meat received higher tenderness with higher score for bitterness [4]. Abnormal flavor and bitter taste due to calcium chloride had been reported by Perez et al. (1998)[5].The leaf of *Bryophyllum pinnatum* is traditionally used as a meat tenderizer in Northern province. It has been an age old tradition. Even though traditionally used as a meat tenderizer, scientific proofs lack to support the fact. This study was to analyze the fact scientifically and tries to compare it with commercially available tenderizer. Since the leaf has numerous medicinal properties this will add value to the meat.

Methodology

Bryophyllum pinnatum leaves were collected and subjected to aqueous extraction (size reduced cleaned leaves were mixed with distilled water and kept at 40° C for 24 hours) and prepared in different concentrations (0.2 %, 0.4 %, 0.6 %, 0.8 % w/v%). 50g of goat meat chunks of same variety from same part were chosen and the pH and the initial weight of the meat chunks were measured. Then the chunks were allowed to marinate in different concentrations of *Bryophyllum* aqueous extraction at 4° C for 24 hours. One sample was allowed to marinate in distilled water as a control. Marinated chunks were taken out and 2% (w/w %) salt was added and set to autoclave at 121°C for 15 minutes. The pH and the final weight of the meat chunks were measured and sensory evaluation was conducted using Hedonic Scale (9 points) using 30 semi-trained panelists. All the data was analyzed by ONE – WAY ANOVA test using Minitab 17software.

Thermal processing yield

Thermal processing yield (YTP) was calculated according to equation:

$$YTP = mf / mi * 100$$

where: mf - final mass of the sample (after thermal treatment)
mi - initial mass of the sample (raw meat).

pH

pH was determined according to A.O.A.C. method (1980) [6], with a Trans bench top digital pH meter.

Results

Table 01: Thermal yield of the treated sample

Concentration (W/V %)	Raw weight (g)	cooked weight (g)	Thermal yield (%)
0.2	45.7	24.5	53.6^{b}
0.4	50.9	27	53.0^{d}
0.6	51.1	27.2	53.2^{c}
0.8	51.5	30.3	58.8^{a}
Control	53.2	27.3	51.3^{e}

Means sharing similar superscripts in a row are statistically non-significant ($p<0.05$)

Table 02. pH of the meat samples

Treatment Concentration	Initial pH of solution	meat pH after the treatment
0.2	6.85	6.59[b]
0.4	6.61	6.43[c]
0.6	6.15	6.34[d]
0.8	5.67	6.28[e]
Control	7.1	6.67[a]

Means sharing similar superscripts in a row are statistically non-significant ($p<0.05$)

Table 03: Sensory analysis results of the treated meat chunks

Treatment Concentration % w/v	Juiciness	Tenderness	Flavor	Color	Overall acceptance
Control	6.60 ± 1.79 [a]	5.15 ± 1.84 [c]	6.65 ± 0.36 [a]	5.90 ± 1.51 [a]	4.70 ± 1.72 [c]
0.2	5.90 ± 0.45 [a]	5.10 ± 1.59 [c]	6.75 ± 0.91 [a]	6.60 ± 1.57 [a]	6.30 ± 1.17 [b]
0.4	6.00 ± 1.84 [a]	6.20 ± 1.19 [b]	6.60 ± 1.05 [a]	6.45 ± 1.70 [a]	5.65 ± 1.75 [c]
0.6	7.00 ± 0.78 [a]	7.00 ± 1.08 [a]	6.80 ± 0.41 [a]	6.15 ± 1.72 [a]	7.45 ± 0.76 [a]
0.8	6.90 ± 0.71 [a]	7.75 ± 0.63 [a]	6.75 ± 1.12 [a]	5.95 ± 1.50 [a]	7.50 ± 0.89 [a]

Means sharing similar superscripts in a row are statistically non-significant ($p<0.05$)

Conclusion

The highest mean values were observed in 0.6 % and 0.8 % concentration of *Bryophyllum* leaf extract and those two values were not significantly differ thus, the lowest *Bryophyllum pinnatum* leaf extract concentration 0.6 % was considered as an optimum concentration to tenderize the goat meat. *Bryophyllum pinnatum* leaf extract showed strong tenderizing activity whereas the overall acceptability of the control is 4.70±1.72 and the treatment 0.6 % shows 7.45±0.76.

Reference

1. Department of Animal Production and Health. Administration Report, 2011. Department of Animal Production and Health; Gatambe, Sri Lanka:

2. Davis GW, Smith GC, Carpenter ZL. Effect of blade tenderization on storage life, retail case life and palatability of beef. J Food Sci. 1977;42:330–337. doi: 10.1111/j.1365-2621.1977.tb01492.x.

3. Kudachikar VB, Anjaneyulu ASR, Anna Anandh M, Lakshmanan V, Radha R, Mendiratta SK. Effect of blade tenderization and sodium bicarbonate on quality of buffalo rumen meat. J Food Sci Technol. 2007;44:437–439.

4. Gerelt B, Ikeuchi Y, Suzuki A. Meat tenderization by proteolytic enzymes after osmotic dehydration. Meat Sci. 2000;56:311–318. doi: 10.1016/S0309-1740(00)00060-7.

5. Perez et al., **1998**. World Rabbit Sci., 6 (special issue): 7ème Journées Rech. Cunicole, Lyon, 129-132

6. AOAC, 1980. Official method of Analysis, Thirteenth Edition, Washington DC.Association of Official Analytical Chemists.

ID-43

PURIFICATION AND CHARACTERIZATION OF BACTERIOCIN PRODUCED BY *Lactobacillus reuteri* AF182723, A STRAIN ISOLATED FROM TRADITIONALLY PREPARED CURD

Keerthini, Srikantha[1*], Kapilan, Ranganathan.[2] and Vasantharuba, Seevaratnam.[3]
[1]*Faculty of Technology, University of Jaffna.*
[2]*Department of Botany, Faculty of Science, University of Jaffna.*
[3]*Department of Agricultural Chemistry, Faculty of Agriculture, University of Jaffna*
keerthinisrikantha58@gmail.com

Abstract

Bacteriocins are antimicrobial peptides produced by diverse bacterial species that inhibit or kill other microorganisms. In the food industry bacteriocins have potential application as preservative. The bacteriocin obtained from fermented broth in a crude form that may contain lactic acid, acetic acid, H_2O_2 and other antimicrobial substances. Therefore, the objectives of the study were to purify the bacteriocin and to reveal the possibility of purified compound as biopreservative. Crude bacteriocin was produced by *Lactobacillus reuteri* AF182723 isolated from traditionally prepared curd in liquid fermentation system. When the crude bacteriocin was purified by sequential three step procedure involving ammonium sulfate fractional precipitation, cation exchange (SP Sepharose) chromatography and size exclusion (Sephadex G-100 column) chromatography, the specific activity (AU/mg) of the bacteriocin increased in each step of purification and it reached 6349.2AU/mg finally from 262.3 AU/mg with the purification fold of 24.206. When the purified bacteriocin was subjected to different temperature and pH treatments, it found stable over wide temperature range (45ºC - 75ºC) and pH range (3-7). When exposed to different enzymes, the purified bacteriocin showed resistant to catalase and amylase enzymes, but showed significantly higher sensitive to pepsin and proteinase K indicating that the antimicrobial substance was proteinaceous in nature. This study concluded that bacteriocin produced by *Lactobacillus reuteri* AF182723 could be used as a potential food biopreservative. Further safety studies should be done to recommend this potential bacteriocin as food biopreservative.

Keywords: Bacteriocin, Characterization, *Lactobacillus reuteri* AF182723**,** Purification

Introduction

Lactic acid bacteria (LAB) are widely used as starter culture. Antimicrobial peptides obtained from lactic acid bacteria named bacteriocin are used as biopreservatives in the food industry. Bacteriocinis are ribosomally synthesized primary metabolic peptide that exhibits inhibitory effect on food spoilage organisms[10].Use of bacteriocin obtained from LAB as biopreservative offers several advantages. They reduce the use of chemical preservatives and extension of heat treatments and not alter the food texture, flavor and aroma[3,9]. Therefore utilization of bacteriocin as biopreservative is highly advantageous. Purification and characterization of bacteriocin are important to check applicability of bacteriocin in food industry. In general bacteriocins are classified into four main classes according to their structural, genetic, and biochemical characteristics such as class I, class II,

class III and Class IV. Class I is small peptides with molecular weight < 10 kD. Class II bacteriocins are small (<10 kDa), heat-stable, non-modified peptides cationic, hydrophobic peptides. Class III is heat labile proteins and class IV is cyclicpeptides that required carbohydrate or lipid moieties for their activity[2]. Several researchers documented purification of heterogeneous nature of bacteriocins by different combination of strategies such as ammonium sulphate precipitation, ethanol precipitation, acetone precipitation, dialysis, cation exchange chromatography, RP-HPLC, ultra filtration and gel filtration[9].

Materials and Methods

Isolation and characterization of bacteriocin produced by *Lactobacillus reuteri* AF182723

Lactobacillus reuteri AF182723 was isolated from traditionally prepared curd sample by repeated streaking on MRS agar and identified by molecular studies and biochemical studies.

Production of crude bacteriocin

Production crude bacteriocin by *Lactobacillus reuteri* AF182723 was carried out by liquid fermentation. Composition of medium was maltose (20g/l), soy bean (30g/l) with substituted with 1% NaCl and mineral solution ($MnSO_4.4H_2O$-0.05g/l, $MgSO_4.7H_2O$-0.2g/l, K_2HPO_4-2g/l, $CH_3COONa.3H_2O$-5g/l, $(NH)_3C_6H_5O_7$-2g/l)at pH 5.5. *Lactobacillus reuteri* AF182723 was inoculated and initial inoculum level was maintained as 1.2×10^6cfu/ml and incubated at 30 ºC for 4 days.

Fractional purification by Ammonium sulphate

The fermented broth was centrifuged (13000 rpm, 15 min) and pH of supernatant was adjusted to 6.5. The supernatant was filtered through 0.45µm syringe filter**.** Antimicrobial peptide from crude extract was precipitated at different ammonium sulfate concentrations. Initially filter sterilized crude broth was saturated at 20% and centrifuged (13000 rpm, 15 min). The peptide precipitate was dissolved using 0.2 M sodium phosphate buffer and antibacterial activity assay was performed by using 24 hours old culture of *Enterococcus faecalis*as as the indicator organism. To find out which level of ammonium sulphate saturation leads to precipitation of bacteriocin, already 20% saturated supernatant was saturated again at 40% saturation. Saturated solution was centrifuged and dissolved by using 0.2 M sodium phosphate buffer and antibacterial activity was measured. These procedures were repeated at 60%, 80% & 100% saturation level.

Purification by cation exchange chromatography (SP Sepharose fast flow coloum)

Initially column (10.0 cm × 1.0 cm) was equilibrated with 20 mM phosphate buffer (pH 7.0). The sample (235µl of dissolved active fraction from ammonium sulphate fractional purification) was applied to column equilibrated with sodium phosphate buffer. Column was washed with 20 mM phosphate buffer and the absorbed substances were eluted from column with 20 mM sodium phosphate + 1 M NaCl (pH 7.0). The eluted fractions were collected at every five minutes interval and tested for antibacterial activity by agar well diffusion assay against *Enterococcus feacalis.* Protein concentration in each elution was determined by Bradford protein assay. The active fractions were pooled together and concentrated by 100%

ammonium sulphate. Ammonium sulphate precipitate was dissolved in sodium phosphate buffer and further purified by sephadex G-100.

Purification by size exclusion chromatography (Sephadex G-100 column)

Initially column was washed and equilibrated with 0.1M sodium phosphate buffer (pH 7.0) and 235µl of dissolved active fraction was loaded on column and allowed for 15 minutes. Elution was conducted by using 0.1M sodium phosphate buffer at pH 7.0. Eluted fractions were collected at every five minutes interval and assayed for presence of antimicrobial component by agar well diffusion assay. Protein concentration in each elution was determined by Bradford protein assay.

Determination of Protein concentration

Protein concentration of the supernatant, ammonium sulphate fraction and chromatographic elution were determined by the method of Bradford by using bovine serum albumin as the standard (Mæhre et al., 2018 and Kruger 2002)

Antimicrobial activity assay

Agar well diffusion assay was performed as antimicrobial activity assay to detect activity of bacteriocin. All ready solidified agar plate was seeded with 100µl of indicator organism (24 h old culture suspension of 6.0×108cfu/ml). Wells were prepared by using cork borer at 10mm diameter and 100 µl of crude bacteriocin/ purified bacteriocinwas added into the each wells and incubated at 37ºC for 24 hours. After 24 hours diameter of growth inhibition zone was measured by digital vernier caliper. *Enterococcus faecalis* was used as indicator organism. All the experiments were performed in triplicates. Bacteriocinactivity was expressed as arbitrary units (AU) per ml.

Effect of heat, pH and enzyme on purified bacteriocin

To determine the effect pH on bacteriocin activity, purified filter sterilized bacteriocin pH level was adjusted between 2- 10. Residual activity was treated bacteriocin solution was measured. To evaluate the effect heat on bacteriocin activity, purified filter sterilized bacteriocin was heated at 45ºC, 65ºC, 75ºC & 100ºC for 1 hour and 121º for 20 minutes. Residual activity was determined against control (purified bacteriocin without heat treatment). To evaluate the effect of enzymes, filter sterilized purified active fraction was incubated by following enzymes, Proteinase K, Catalase, Amylase at a final concentration of 0.1 mg/ml in 20 mmol/l phosphate buffer pH 7 and Pepsin at 0.1 mg /ml, 20 mmol/l of glycine HCl, pH 2. After 2 h of incubation at 37ºC, enzyme activity was stopped by heating at 100ºC for 5 min. Untreated samples were used as controls. The residual bacteriocin activity was determined by agar well diffusion assay against indicator strain *Enterococcus faecalis*.

Characterization of activity fraction

Preliminary tests in the analysis of an unknown organic compound

Purified bacteriocin was characterized. Initially preliminary tests for an unknown organic compound were carried out. Presence of alcohols, aldehydes, ketones, carboxylic acids, phenol, alkenes, esters and amines were tested.

Results and Discussion

Fractional purification by Ammonium sulphate

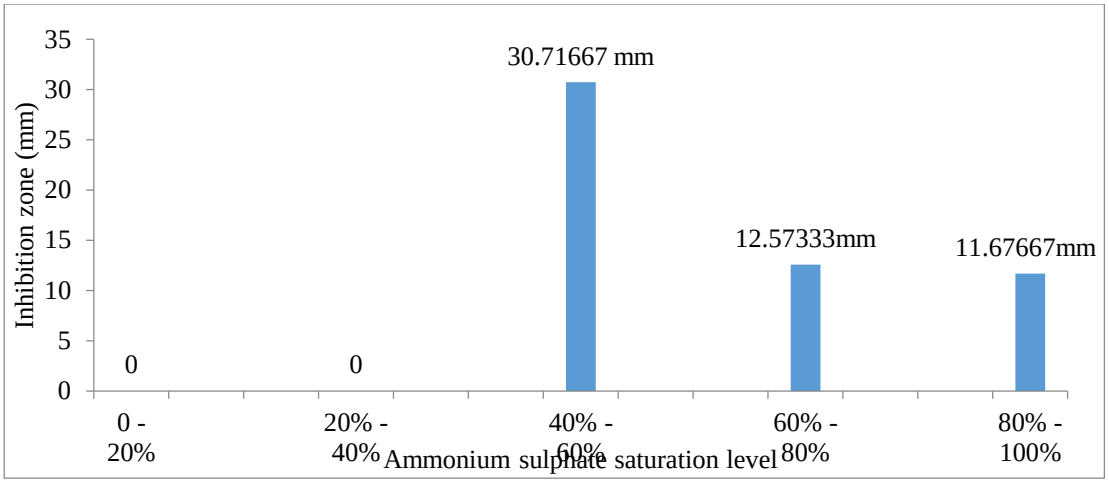


Figure 1. Inhibition zone obtained at different ammonium sulphate saturation level for *Lactobacillus reuteri* AF182723

Table 1. Antimicrobial activity of *Lactobacillus reuteri* AF182723 through purification profile

Purification steps	Volume (ml)	Activity unit (AU/ml)	Total activity (AU)	Protein (mg/ml)	Specific activity (AU/mg)	Purification fold
Culture supernatant	100 ml	320 AU/ml	32 000 AU	1.220 mg/ml	320/1.220 262.2950	1
Ammonium sulphateppt 40% - 100%	8 ml	2560 AU/ml	20480 AU	0.745 mg/ml	2560/0.745 3436.2416	13.1
SP sepharose fast flow	12 ml	160 AU/ml	1920 AU	0.029 mg/ml	160/0.029 5517.24	21.034
Sephadex G-100	24 ml	40AU/ml	960 AU	0.0063	40/0.0063 6349.206	24.206

Activity (AU/ml) = reciprocal of highest dilution with lowest observable inhibition zone (minimum observable inhibition zone = 12.00 mm), Total activity = (AU/ml) × Volume (ml), Specific activity (AU/mg) = Activity (AU/ml) / Protein concentration (mg/ml), Purification fold = Specific activity II / Specific activity I[1]

Previously bacteriocin from *Lactobacillus Viridescence* (NICM 2167) was purified in two steps involving ammonium sulphate precipitation followed by gel filtration using Sephadex G-100 increase purification fold to 4.69[8]. Purification of bacteriocin from *Lactobacillus plantarum*, by ammonium sulfate precipitation and gel filtration (Sephadex G-100 column) increase purification fold to 13.5[6]. Purification of bacteriocin from *E. faecium* M1M10 by ammonium sulphate, gel filtration, cation-exchange and hydrophobic-interaction chromatographies and reverse phase chromatography increase purification foldat 1397-fold [2]

Effect of heat, pH and heat on purified bacteriocin

Bacteriocin produced by *Lactobacillus reuteri* AF182723 was resistant to catalase and amylaseenzyme treatment. Purified bacteriocinwas found to be sensitive to pepsin and

proteinase k indicating that the antimicrobial substance was proteinaceous in nature.Purified bacteriocin was stable over wide range of pH (3-4) as well as temperature (45ºC - 75ºC).

Table 2. Effect of heat, pH and heat on purified bacteriocin from *Lactobacillus reuteri* AF182723

Treatment	Residual inhibitory activity
Catalase	40 AU/ml
Amylase	40 AU/ml
Pepsin	0
Proteinase K	0
pH 2	20 AU/ml
pH 3	40 AU/ml
pH 4	40 AU/ml
pH 5	40 AU/ml
pH 6	40 AU/ml
pH 7	40 AU/ml
pH 8	20 AU/ml
pH 9	20 AU/ml
pH 10	20 AU/ml
45ºC	40 AU/ml
65ºC	40 AU/ml
75ºC	40 AU/ml
100ºC	20 AU/ml
121º for 20 minutes	0

These results indicate that the bacteriocin produced by *Lactobacillus reuteri* AF182723could be used as biopreservative agent in acidic and thermal processed food stuff. Previously Soumya[7]*et al*., 2012 reported that supernatant produced by *Lactobacillus* was resistant to catalase treatment and found to be sensitive to temperature above 60ºC. It was stable between pH3 and 7 but sensitive to pH 9.Rattanachaikunsopon &Phumkhachorn [5]2006 stated that the bacteriocin produced by *Lactobacillus plantarum* N014 was sensitive to all proteolytic enzymes used in study, including papain, pepsin,pronase E, proteinase K, and trypsin, but was resistant to the other enzymes, such as α – amylase, lipase A, lysozyme, by 10, 20, or 30 min of boiling and autoclaved temperature. Inaddition to these findings, no change in antimicrobial activitywas detected when the culture supernatant was exposed to pH 2 to 10. However, exposing the culture supernatantto pH 1 and pH 11 to 14 eliminated antimicrobial activity.

Characterization of activity fraction

Preliminary tests in the analysis of an unknown organic compound

No changes were observed when add 2,4 DNP to test solution. Therefore acidified $K_2Cr_2O_7$ was added. Colour of acidified $K_2Cr_2O_7$(orange) was changed to green coloour.Because primary alcohols will beoxidised to aldehydes and the carboxylic acids, secondary alcohols will be oxidised to ketones.Tertiary alcohols cannot be oxidised by the dichromate ions. Dichromate ions ($Cr_2O_7^{2-}$) will be reduced Cr^{3+} ions (green). Therefore primary or secondary alcohol may be present. Again 2, 4 DNP was added, there was no

observation. It indicates that unknown purified solution may contain primary alcohol. No changes were observed when add $FeCl_3$ solution to unknown solution. But brown colour precipitate was observed after addition of $FeCl_3$ solution to already hydrolyzed unknown component by NaOH. These results indicate the presence of secondary amine in unknown purified component.

Conclusion

Purification of bacteriocin produced by *Lactobacillus reuteri* AF182723applied three steps procedure increase purification fold up to 24.206. The purified bacteriocin is highly heat stable, active at wide range of pH and degraded by gastrointestinal proteolytic enzyme. Therefore the bacteriocin from *Lactobacillus reuteri* AF182723 has highly potential applicability in food industry as biopreservative. Even though further safety studies should be done to recommend this bacterion as potential food biopreservative.

Reference

1. Adedire, A., Adegboye, O., & Osesusi A., Studies on the mode of action of bacteriocin produced by *Lactobacillusfermentum* CrT21: *International journal of science and research*. 2016. 5(3): 759-763.
2. Arbulu, S., Jiménez, J.J., Gútiez, L., Campanero, C., del Campo, R., Cintas, L.M., Herranz, C., & Hernández, P.E. Evaluation of bacteriocinogenic activity, safety traits and biotechnological potential of fecal lactic acid bacteria (LAB), isolated from Griffon Vultures (*Gyps fulvus* subsp. *fulvus*): *BMC microbiology*. 2016. *16*(1):228.
3. Campos, C.A., Castro, M.P., Rivas, F.P., & Schelegueda, L.L., Bacteriocins in food: evaluation of the factors affecting their effectiveness. Microbial pathogens and strategies for combating them: science, technology and education: *Formatex, Badajoz*. 2013. 994-1004.
4. Pingitore, E.V., Salvucci, E., & Nader-Macias, M.E. Different strategies for purification of antimicrobial peptide from Lactic Acid Bacteria (LAB): *Communicating current research and educational topics and trends in applied microbiology*, 2007.1:557-568.
5. Rattanachaikunsopon, P., & Phumkhachorn, P. Isolation and Preliminary Characterization of a Bacteriocin Produced by *Lactobacillus plantarum* N014 Isolated from Nham, a Traditional Thai Fermented Pork. *Journal of Food Protection*.2016. 69 :(8)1937–1943.
6. Sankar, N.R., Priyanka, V.D., Reddy, P.S., Rajanikanth, P., Kumar, V.K., & Indira, M. Purification and characterization of bacteriocin produced by *Lactobacillus plantarum* isolated from cow milk: *Int J Microbiol Res*, 2012.*3*(2):133-137.
7. Soumya, T. V., John, R., and Jose, S., Characterization of Bacteriocin Produced by *Lactobacillus* SP and Optimization of Cultural Conditions: *International Journal of Scientific and Research Publications*. 2012. 2(12): 1-8.
8. Sure, K.P., Kotnis, P.V., Bhagwat, P.K., Ranveer, R.C., Dandge, P.B., & Sahoo, A. K. Production and characterization of bacteriocin produced by Lactobacillus Viridescence (NICM 2167). *Brazilian Archives of Biology and Technology*. 2016. *59*.
9. Vuyst, L.D., & Leroy, F., Bacteriocins from Lactic Acid Bacteria: Production, Purification, and Food Applications: *J MolMicrobiol Biotechnol*. 2007.13:194–199.
10. Zacharof, M. P., & Lovitt, R. W., Bacteriocins Produced by Lactic Acid Bacteria, A Review Article:*ICBFS*, 2012. 2:50-56.

ID - 49

COMMUNITY STRUCTURE OF WATERBIRDS IN THADDUVANKODDY, KAPPUTHU AND NAGARKOVIL IN THE NORTHERN REGION OF SRI LANKA

G. Kandasamy[1*], D.K. Weerakoon[2], A. Sivaruban[1] and H.B. Jayasiri[3]
[1]*Department of Zoology, University of Jaffna, Sri Lanka*
[2]*Department of Zoology, University of Colombo, Sri Lanka,*
[3]*Ocean University of Sri Lanka, Crow Island, Colombo 15, Sri Lanka.*
[*] *vadhana.gk@gmail.com*

Abstract

Waterbirds use many kind of coastal wetlands including swamps, lagoons, estuaries, bays, mudflats and open beaches. The present study was conducted to assess the community structure of waterbird families in Thadduvankoddy, Kapputhu and Nagarkovil in Jaffna Peninsula. Three counting blocks in length of 500 m with open width was selected in each site and counting of birds was done once a month from December, 2016 to November, 2017. A total of 67 waterbird species representing 19 families were recorded in three sites (55 species in Thadduvankoddy, 59 in Kapputhu and 51 in Nagarkovil. The highest measures of species richness (59), mean density of waterbirds ±SE(24.72±3.33birds km^{-2}), Shannon-Wiener diversity (2.91), Pielou's evenness (0.72), Margalef richness (6.15) and Berger Parker dominance (0.27) indices were recorded in Kapputhu.Flamingos were the most dominant group of birds in all three sites (32.65%, 27.30 % and 29.05 % in Thadduvankoddy, Kapputhu and Nagarkovil respectively, followed by migrant ducks in Thadduvankoddy (30.54 %) and in Kapputhu (17.07). Cormorants and darters were the dominant group of birdsfollowed byflamingos in Nagarkovil. The two-way ANOVA revealed that the abundance of waterbirds significantly varied temporally among different months (p=0.05) in the three sites. That might be due to the migration of waterbirds and availability of water. The difference in waterbird species composition and the diversity indices could be due to the variation in habitat heterogeneity, availability of food and water resources. Thadduvankoddy provided habitat for wide array of waterbirds from October to March, 2017. Flamingos and ducks were the most dominant groups of birds in Thadduvankoddy. However, the site in Thadduvankoddygot completely dry from April to August, 2017 andit was a seasonal wetland during the rainy season. The availability of sufficient water level throughout the year makesKapputhu, an excellent habitat for wide variety of waterbirds especially flamingos and ducks.However, Thadduvankoddy got completely dry during dry season. Comparatively deeper water (>1 m) and dense mangroves in Nagarkovil provided suitable habitats for cormorants and darters for feeding and roosting. However, the drop in water level during dry season made the habitat suitable for wide array of waterbirds including flamingos. Thus, the findings revealed that community structure of waterbirdsdepend on temporal variation of water level and availability of sufficient water.

Keywords: Community structure, waterbirds, Northern wetlands

Introduction

Coastal wetlands are prominent habitats for many waterbirds. Waterbirds use many kind of coastal wetlands including swamps, lagoons, estuaries, bays, mudflats and open beaches. Knowledge on population and community structure of waterbirds and their habitats are necessary for conservation strategies [1]. Studies on waterbird communities are limited in Thadduvankoddy, Kapputhu and Nagarkovil, as these areas were inaccessible nearly for three decades due to the armed conflict [2,3,4,5]. Therefore, the present study will fill the gaps on ornithological studies in these coastal wetlands. The present study compared diversity and abundance of waterbird species among three different habitats, Thadduvankoddy, Kapputhu and Nagarkovil in the northern region of Sri Lanka, to determine species composition and community structure of waterbird families in the region.

Materials and Methods

The present study was carried out in three locations namely, Thadduvankoddy in the Kandavalai DSD (9 ^{0} 30’ 0” N, 80 ^{0} 25’ 0” E), Kapputhu in the Vadamaradchi South West DSD (9 ^{0} 44’ 09” N, 80 ^{0} 10’ 48” E), and Nagarkovil in the Vadamaradchi East DSD (9 ^{0} 36’ 00” N, 80 ^{0}17’ 00” E).

Figure 01. The three study sites, Thadduvankoddy, Kapputhu and Nagarkovi

The site in Thadduvankoddy is a marsh filled with water during rainy season, used by various resident and migrant waterbirds for feeding. This land got completely dry during dry season and the land wasused by public for walking as a short route to reach their village. Kapputhu can be described as salt marsh with mangroves. *Excoecaria agallocha* is the dominant mangrove species and *Lumnitzera racemosa* is common in Kapputhu[6]. Nagarkovil consists of dense mangroves. Recently, Nagarkovil has declared as a Nature Reserve by Department of Wildlife Conservation.

Bird counting was done once a month from December, 2016 to November, 2017. Three counting blocks in length of 500 m with open width along a transect line were selected for bird counting. Each block was separated at least by 500 m to avoid double counting as most were open areas. All the waterbirds were counted during dawn, noon and dusk on alternate months from 0600 h –1800 h to capture temporal variations by walking along the transect line[7]. Waterbird species were identified [8] and counted using binoculars (10 x 50) and spotting scope (60 x)a standard field guide.

Data Analysis

Diversity indices such as Shannon Diversity Index (H), Pielou Index (J), Margalef's Richness Index and Berger-Parker Dominance Index were used to compare the diversity and abundance of waterbirds in three study sites[9]. The relative abundance was compared for families of waterbirds recorded.Two-way ANOVA was also performed by using SPSS (21) to find out the variations in the diversity and abundance of birds in relation to time and space.

Results and Discussion

A total of 67 waterbird species, representing 19 families were recorded in three wetlands in Thadduvankoddy, Kapputhu and Nagarkovil in the northern region of Sri Lanka. Occurrence of 39 waterbird species in all three habitats indicated that these sites are suitable habitats of wide array of waterbird species. The recording of 55 species in Thadduvankoddy, 59 in Kapputhu and 51 in Nagarkovil showed that Kapputhu had attracted more waterbird species compared to Thadduvankoddy and Nagarkovil(Table 01). The difference in species composition and the diversity indices could be due to variation in habitat heterogeneity, availability of food and water resources.Habitat heterogeneity including, mangroves, marshlands and mudflats in Kapputhu make it a suitable habitat for waterbirds throughout the year.

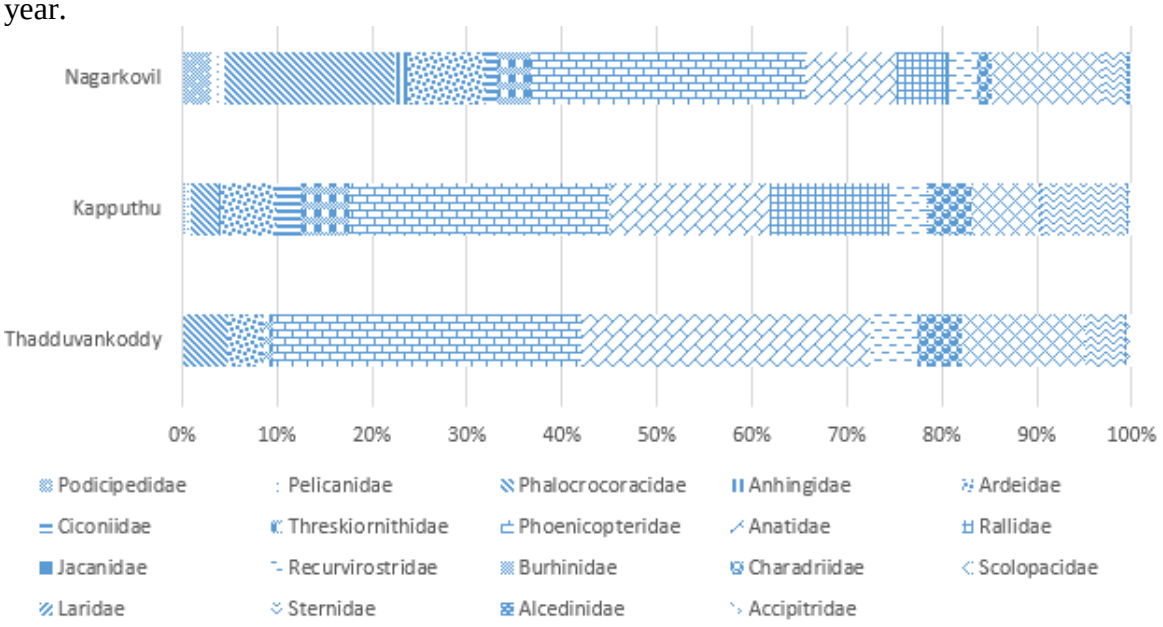


Figure 02: Composition of waterbird families (%) in three locations; Thadduvankoddy, Kapputhu and Nagarkovil.

Family Phoenicopteridae(represented by flamingos) was the most dominant family in all three sites (32.65%, 27.30 % and 29.05 % in Thadduvankoddy, Kapputhu and Nagarkovil respectively), followed by family Anatidae (represented by ducks)in Thadduvankoddy (30.54 %) and in Kapputhu (17.07%) (Figure 02). This could be due to the availability of sufficient water level in Thadduvankoddy and Kapputhu. Family Phalacrocoracidae (represented by cormorants and darters)was the dominant family next to Phoenicopteridae in Nagarkovil.

Table 01. Comparison of species richness, Mean density (birds /km^2) (square-root transformed) (±SE), and diversity, evenness, richness and dominance indices among three selected locations.

	Thadduvankoddy	Kapputhu	Nagarkovil
Species Richness	55	59	51
Mean density (birds/km^2) transformed (±SE)	20.27 (±3.98)	24.72 (±3.33)	22.48 (±2.66)
Shannon-Wiener diversity Index	2.46	2.91	2.68
Piolou's Evenness Index	0.61	0.72	0.69
Margalef richness Index	5.95	6.15	5.44
Berger Parker dominance Index	0.33	0.27	0.29

The two way ANOVA (Table 02) revealed that the abundance of waterbirds significantly varied temporally in different months (p=0.05) in the three sites due to the migration of waterbirds, availability of water and food. Water level in Thadduvankoddy eventually decreased and the study site in Thadduvankoddy turned completely dry during dry season and the land was used for public transportation. This was a seasonal wetland in Thadduvankoddy during the rainy season. However, sufficient water level was available for waterbirds throughout the year in Kapputhu. Presence of deep water (> 1 m) and dense mangroves makes the habitat suitable for diving waterbirds including cormorants and darters in Nagarkovil. These bird species use mangroves for roosting. When water level decrease to less than 1 m during dry season, this site in Nagarkovil was used by wide array of waterbirds. Flamingos were the most dominant during that period. Drying of the major wetlands in the region and the sufficient level of water in Nagarkovil (< 1 m) during June, July and August, 2017 might be reasons for the occurrence of flamingos and other waterbirds in Nagarkovil during such period.

Table 02. Summary of two-way ANOVA for total abundance of waterbirds among months and sites, and their interactions

Source	Degrees of freedom	F	Significance (<0.05)
Month	11	2.330	0.016
Site	2	0.417	0.661
Month * Site	22	1.524	0.093

Conclusion

The findings of this study revealed that Thadduvankoddy, Kapputhu and Nagarkovil are suitable habitats for many waterbirds. This might be due to the habitat heterogeneity and availability of food and water resources. Thadduvankoddy is a seasonal wetland during rainy season and provided suitable habitat for wide array of waterbirds. Flamingos and ducks were the most dominant in Thadduvankoddy. The site got completely dry during the dry season.The availability of sufficient water level throughout the year makes Kapputhu, an excellent habitat for wide variety of waterbirds throughout the year. Comparatively deeper water in Nagarkovil (>1 m) and dense mangroves in Nagarkovil provided suitable habitat for cormorants and darters for feeding and roosting. However, the drop in water level during June, July and August make the habitat suitable for wide array of waterbirds including flamingos. Thus, community structure of waterbirds depends on temporal variation of water level and availability of sufficient water.

Table 03: Status of waterbird species in the three study sites

	Family name	Common Name	Scientific Name	Resident / Migrant	NCS	GCS
1	Podicipedidae	Little Grebe	*Tachybaptus ruficollis*	R	LC	LC
2	Pelecanidae	Spot-billed Pelican	*Pelecanus philippensis*	R	LC	NT
3	Phalacrocoracidae	Indian Cormorant	*Phalacrocorax fuscicollis*	R	LC	LC
4	Phalacrocoracidae	Little Cormorant	*Phalacrocorax niger*	R	LC	LC
5	Anhingidae	Oriental Darter	*Anhinga melanogaster*	Uncommon R	LC	NT
6	Ardeidae	Grey Heron	*Ardea cinerea*	R	LC	LC
7	Ardeidae	Purple Heron	*Ardea purpurea*	R	LC	LC
8	Ardeidae	Great Egret	*Egretta alba*	R	LC	LC
9	Ardeidae	Intermediate Egret	*Ardea intermedia*	R	LC	LC
10	Ardeidae	Little Egret	*Egretta garzetta*	R	LC	LC
11	Ardeidae	Cattle Egret	*Ardea ibis*	R.M?	LC	LC
12	Ardeidae	Indian Pond Heron	*Ardeola grayii*	R	LC	LC
13	Ardeidae	Striated Heron	*Butorides striatus*	R	LC	LC
14	Ardeidae	Yellow Bittern	*Ixobrychus sinensis*	R,M	NT	LC
15	Ciconiidae	Painted Stork	*Mycteria leucocephala*	R	LC	NT
16	Ciconiidae	Asian Openbill	*Anastomus oscitans*	R	LC	LC
17	Threskiornithidae	Black-headed Ibis	*Threskiornis melanocephalus*	R	LC	NT
18	Threskiornithidae	Glossy Ibis	*Plegadis falcinellus*	M		LC
19	Threskiornithidae	Eurasian Spoonbill	*Platalea leucorodia*	R	LC	LC
20	Phoenicopteridae	Greater Flamingo	*Phoenicopterus roseus*	M		LC
21	Anatidae	Lesser Whistling Teal	*Dendrocygna javanica*	R	LC	LC
22	Anatidae	Eurasian Wigeon	*Anas penelope*	M		LC
23	Anatidae	Northern Shoveller	*Anas clypeata*	M		LC
24	Anatidae	Northern Pintail	*Anas acuta*	M		LC
25	Anatidae	Garganey	*Anas querquedula*	M		LC
26	Anatidae	Spot-billed Duck	*Anas poecilorhyncha*	R,M?	CR	LC
27	Rallidae	White-breasted Waterhen	*Amaurornis phoenicurus*	R	LC	LC
28	Rallidae	Purple Swamphen	*Porphyrio porphyrio*	R	LC	LC

29	Rallidae	Common coot	*Fulica atra*	R	LC	LC
30	Rallidae	Common Moorhen	*Gallinula chloropus*	R	LC	LC
31	Jacanidae	Pheasant-tailed Jacana	*Hydrophasianus chirurgus*	R	LC	LC
32	Recurvirostridae	Black-winged Stilt	*Himantopus himantopus*	R,M	LC	LC
33	Burhinidae	Great Thick-knee	*Esacus recurvirostris*	R	LC	LC
34	Charadriidae	Yellow-wattled Lapwing	*Vanellus malabaricus*	Uncommon R	LC	LC
35	Charadriidae	Red-wattled Lapwing	*Vanellus indicus*	R	LC	LC
36	Charadriidae	Asiatic Golden Plover	*Pluvialis fulva*	M		LC
37	Charadriidae	Common Ringed Plover	*Charadrius hiaticula*	M		LC
38	Charadriidae	Little Ringed Plover	*Charadrius dubius*	R,M	VU	LC
39	Charadriidae	Kentish Plover	*Charadrius alexandrinus*	R,M	VU	LC
40	Charadriidae	Monglian Plover	*Charadrius mongolus*	M		LC
41	Scolopacidae	Black-tailed Godwit	*Limosa limosa*	M		NT
42	Scolopacidae	Whimbrel	*Numenius phaeopus*	M		LC
43	Scolopacidae	Eurasian Curlew	*Numenius arquata*	M		NT
44	Scolopacidae	Common Redshank	*Tringa totanus*	M		LC
45	Scolopacidae	Common Greenshank	*Tringa nebularia*	M		LC
46	Scolopacidae	Green Sandpiper	*Tringa ochropus*	M		LC
47	Scolopacidae	Marsh Sandpiper	*Tringa stagnatilis*	M		LC
48	Scolopacidae	Wood Sandpiper	*Tringa glareola*	M		LC
49	Scolopacidae	Common Sandpiper	*Actitis hypoleucos*	M		LC
50	Scolopacidae	Pintail Snipe	*Gallinago stenura*	M		LC
51	Scolopacidae	Little Stint	*Calidris minuta*	M		LC
52	Scolopacidae	Curlew Sandpiper	*Calidris ferruginea*	M		NT
53	Laridae	Great Black-headed Gull	*Larus ichthyaetus*	M		LC
54	Laridae	Brown-headed Gull	*Larus brunnicephalus*	M		LC
55	Sternidae	Whiskered Tern	*Chlidonias hybridus*	M		LC
56	Sternidae	White-winged Tern	*Chlidonias leucopterus*	M		LC
57	Sternidae	Gull-billed Tern	*Sterna nilotica*	M,R	CR	LC
58	Sternidae	Caspian Tern	*Sterna caspia*	R,M	CR	LC
59	Sternidae	Little Tern	*Sterna albifrons*	R	VU	LC
60	Sternidae	Lesser-Crested Tern	*Sterna bengalensis*	M		LC
61	Sternidae	Great-crested Tern	*Sterna bergii*	R	NT	LC
62	Alcedinidae	Pied Kingfisher	*Ceryle rudis*	R	LC	LC
63	Alcedinidae	Common Kingfisher	*Alcedo atthis*	R	LC	LC
64	Alcedinidae	White-throated Kingfisher	*Halcyon smyrnensis*	R	LC	LC
65	Accipitridae	Brahminy Kite	*Haliastur indus*	R	LC	LC
66	Accipitridae	Black Kite	*Milvus migrans*	R	LC	LC
67	Accipitridae	White-bellied Fish Eagle	*Haliaeeetus leucogaster*	R	LC	LC

Reference

1. Hanski, I.A. & Gilpin, M.E. Metapopulation biology: ecology, genetics, and evolution. *San Diego, CA: Academic Press.* 1997.
2. Kandasamy G., Weerakoon, D. K., Sivaruban, A., & Jayasiri, H. B. Spatial variation of waterbirds in eight selected sites in the Northern Province of Sri Lanka, *Australasian Ornithology Conference* 2017a*:* 47.
3. Kandasamy G., Weerakoon, D. K., & Sivaruban, A. Spatial variation of waterbirds in Pallai and Thadduvankoddy in the Northern Province of Sri Lanka, *Third International Conference on Science, Engineering and Environment, SEE-USQ, 2017, Brisbane, Australia.* 2017b: 124-129.
4. Kandasamy, G., Weerakoon, D. K., & Sivaruban, A. Spatial variation of waterbirds in Kapputhu and Nagarkovil in the Jaffna Peninsula. Forty Years of Bird Research – Field Ornithology Group of Sri Lanka, *FOGSL symposium, Faculty of Science, University of Colombo.* 2017c.
5. Kandasamy, G., Weerakoon, D. K., Sivaruban, A., & Jayasiri, H. B. Diversity and Abundance of Waterbird communities in the Jaffna and Kilinochchi Districts: Where do we have to go from here? *Vingnanam Journal of Science*. 2019, 14 (1): 15-21.
6. Rajkumar, P., Wijesundara, C. S., & Ranawana, K. B. Distribution of mangrove species in Anthanathidal and Kapputhu areas in the Jaffna Peninsula, Sri Lanka. Page 8-8 *in*Proceeding of the International Symposium on Mangrove Ecosystems. 2018 of Seacology-Sudeesa Sri Lanka Mangrove Conservation Program. 2018.
7. Bibi, F., Ali, Z. Measurement of diversity indices of avian communities at Taunsa Barrage Wildlife Sanctuary, Pakistan. *Journal of Animal and Plant Sciences*. 2013. *23(2)*: 469-474.
8. Harrison, J, A. *A Field Guide to the Birds of Sri Lanka*. Oxford University Press, Oxford. 2011. 208 pp.
9. Magurran, A.E. *Measuring Biological Diversity.* Blackwell Publishing, Oxford, 2004: 256 pp.

English Literature
&
Linguistics

ID - 07

CAN WE BREAK THEIR SILENCE? EXPLORING THE CAUSES OF UNDERGRADUATES' RELUCTANCE IN SPEAKING IN ENGLISH IN AN ESL CLASSROOM

Shavindra Chandradasa
Faculty of Science, University of Ruhuna, Sri Lanka,
shavindrachandradasa@yahoo.com

Abstract

This study objects to find out the causes which discourage undergraduates in speaking in English. Psychological, linguistic and cultural factors were considered as the key components in conducting the research. Based on the related literature it was hypothesized that there was a negative relationship between psychological, linguistic and cultural factors and speaking in English. For the study 50 students were randomly selected from 108 students who followed the credit course unit, 'Speech and Communication Skills' in the University of Ruhuna, Faculty of Science and they were given a questionnaire. As the discourse aspect of the study is also important 10 students and five language teachers who voluntarily participated were also interviewed. The data was qualitatively and quantitatively analyzed. It was quantitatively analyzed using SPSS. The results revealed that all the three components negatively influence students in speaking in English. Nevertheless, in the context, psychological factors appeared to exercise more negative influence on the students than the other two factors. Among psychological factors lack of confidence was the biggest issue faced by most of the students. Regarding linguistic factors, lack of vocabulary and dealing with university subculture peer influence appeared to disappoint the students more in speaking in English. As possible solutions to overcome these issues, the teachers have to be more creative, passionate and need to create a very friendly classroom atmosphere. Not only that but also the students too should stop underestimating their capacity when they speak in English. Even the university also needs to start setting a good background for language learners introducing new speech course units and sound language bodies.

Keywords: Undergraduates, psychological factors, linguistic, university subculture, passionate

Introduction

In Sri Lanka English language is valued as a high form of linguistic capital to secure profit or distinction in the society (Ranwala, 2015). Thus, Regardless of class, caste, ethnicity or other social demarcations, there is a rush to learn English and acculturate oneself into "English" ways of doing things. The undergraduates who wish to be the harbingers of development and innovation are believed to be well equipped with English. Nevertheless, insufficient knowledge of English is identified as a serious difficulty that hampered undergraduates accomplishing the best out of their university education (Perera, 2013). This language constraint; inadequate access to English is able to shut off the undergraduates from vital comparative self-assessment of their work with international developments and standards (Atapattu, 2013). Language learning is not subject learning, it is overlearning and obtaining mastery over certain special skills. In this regard, one should be able to handle all major four skills. Being able to write, read and listen most of the undergraduates find it difficult to speak. Ability to speak is the most essential skill since it is the basic for communication

(Aungwatanakun, 1994 as cited in Oradee, 2012). However, it is the most difficult skill to acquire because it necessitates command of speech production sub-skills like vocabulary retrieval, choice of grammatical patterns, and sociocultural competence (as cited in Al-Roud, 2016). It is the skill that is neglected in classrooms. Though it is not a part of the examinations it demands a lot of practice and attention (Bashir, Azeem & Dogar, 2011). It is one of the productive skills as it is the ability to interact orally with others by sharing with them one's views and feelings (Haidara, 2016). According to Clifford, in spite of its importance, speaking skill has been neglected in many schools and universities due to more stress on grammar and negative teacher-student proportions (1987, in Leong & Ahmadi, 2016). Hence, English language communication is the most shared issue faced by many students. Once they lack the needed communication skills they cannot be considered as 'industry ready' (Ahmad, 2016). This is not novel to the Sri Lankan university context in which most of the second language learners hardly communicate in English inside and outside the classrooms. Accordingly, this study seeks to investigate and answer the questions as what are the factors which discourage undergraduates in speaking in English and what makes language teachers incapable of encouraging the students in enhancing their communicative competence.

Research Objectives

This study aims to achieve three main objectives respectively;

1. To examine the relationship of psychological, linguistic and cultural factors with speaking in English.
2. To identify the other hidden causes which demotivate second language learners in speaking in English.
3. To come out with new strategies to encourage the language learners to enhance their speaking abilities.

Methodology

The participants of the study were the students of the Faculty of Science, University of Ruhuna, Sri Lanka who followed the credit course unit, 'Speech and Communication Skills' and the language teachers who worked for the same faculty. 50 students were randomly selected from 108 students and they were given a questionnaire which included 15 questions under three segments; consisting five questions under each category of psychological factors, linguistic factors and cultural factors. Accordingly, Likert five point scale was followed (strongly agree 5 points, agree 4 points, neutral 3 points, disagree 2 points, strongly disagree 1 point). Further 10 students and five language teachers were also interviewed. The interviews were semi-structured and the interview questions were developed in line with the above mentioned three factors focusing on the related literature. The calculated data was qualitatively and quantitatively analyzed. To the quantitative analysis Statistic Package for Social Sciences (SPSS) was used. Mean and correlation of the data set was considered to verify the significance of the data. In the present study the Cronbach's Alpha was used for calculating the reliability and it turned to be 84% asserting that there is a high internal consistency between the acquired data. Further it was hypothesized that

H1There is a negative relationship between psychological factors and speak in English.
H2There is a negative relationship between linguistic factors and speak in English.
H3There is a negative relationship between cultural factors and speak in English.

Results and Discussions

Regarding the speaking ability of the sample populationonly an insignificant number of 8% was in the opinion that they have a good command in speaking in English. The majority of 50% was moderate and a large number of 30% was in the idea that their speaking ability was poor. Further the majority of 46% pointed that they sometimes speak in English whereas 34% reported that they speak in English rarely. 8% belongs to the hardly speaking category whereas just 12% (4% and 8% in total) was frequent speakers. The interviews revealed that the majority hardly speak in English inside the university and outside the university because there's no need. Even if they speak, that is only limited to the language classroom maximum two hours per week.

Factors which lead to undergraduates' reluctance in speaking in English were considered under the segments of psychological, linguistic and university culture. Thus it was evident that reluctance to speak in English has a social aspect, psychological aspect, linguistic aspect and a connection with instructor (Al-Roud, 2016). Mean and St. Deviation were measured in the analysis and the effect of mean value was categorized as lowest (1.00-1.49), low (1.50-2.49), moderate (2.50-3.49), high (3.50-4.49) and highest (4.50-5.00).

Table 3. Psychological Factors

Component	Mean	Standard deviation
Not afraid to make mistakes	2.02	1.186
Not shy	2.44	0.929
Not anxious	2.5	0.789
Confident	2	1.107
Motivated	3.16	0.738
Grand mean	2.424	0.62026

Regarding the psychological domain, the lowest mean of 2 was recorded under confidence. The grand mean is also recorded to be lower than 2.5 which is 2.424 with a deviation of just 0.62 indicating that psychological factors as a whole negatively influence students in speaking in English. The interviews revealed the students are scared to speak in English due to fear of making mistakes, negative evaluation of teachers and peers and as they afraid to lose face in front of the others.Their anxiety was situational. It was found that the students were in confusion that whether they could understand what others said and whether the others could understand what they said which was resulted in reducing their confidence. Thus, few students dominated the speaking atmosphere and the others have become passive learners. Despite their own weakness some students pointed that they did not feel like speaking as the lessons were a bit boring. They even revealed that their point of attending lecturers was just to keep up their attendance above 80% which was a prerequisite to sit for the examination. Hence, this is kind of Amotivation; a relative absence of motivation that is not caused by a lack of initial interest but rather by the individuals experiencing feelings of incompetence and helplessness with the activity (Soureshjani & Riahipur, 2012; Deci & Ryan, 1985).

Table 4. Linguistic Factors

Component	Mean	Standard deviation
Fluent in English	2.86	1.178
Have enough practice	2.44	1.013
Can Pronounce well & no vocabulary issues	1.92	1.158
Can understand what teacher says	3.66	1.042
Can concentrate on language activities	3.92	0.877
Grand mean	2.96	0.78142

Concerning the language related factors of the students it is clear that the issue remains with pronunciation and vocabulary with the low mean value of 1.92 and practice with the mean value of 2.44. Dealing with the grand mean of 2.99 it was moderate with adeviation of 0.78 which was below 1.

The interviews revealed that the students keep quiet because they are scared of mispronouncing and they can remember few words. Actually some of them were in the belief that mispronouncing will make their friend mock at them and it will damage their identity inside the university. Thus, they listen than speak. The teachers complained that even the most enthusiastic speaking exercises become unproductive as the majority of the students keep quiet and force two or three usual speakers in their groups to speak. Further the majority of the students always try to write and read than spontaneously speaking. The students seem to use their mother tongue, Sinhala in discussions as it is easy and comfortable in expressing their ideas. This goes in line with whatLeong & Ahmadi pointed (2017) highlighting Tuan & Mai (2015) that inhibition, lack of topical knowledge, low participation and mother tongue use are key issues in enhancing speaking skills.In Sri Lankan university context speaking is not tested. In following traditional teaching methods speaking is neglected giving more emphasis on writing and reading (Leong & Ahmadi, 2017; Richard & Rodgers, 2001).The issue seems to arise due to the non-English speaking academic atmosphere in pre-university rather than with the competence of the students (Farooqui, 2007; Chawdhury, 2001). Thus, it seems bit difficult to change the already prasticed learning habits of the students.

Table 5. Cultural Factors- (university sub-culture)

Component	Mean	Standard deviation
Speak as much as I can; accepted norm	3.38	0.697
I speak as my peers also speak	1.9	0.814
Speak in English is not showing off	3.06	1.185
Not afraid to look foolish in front of the others	1.88	1.062
Speak in English in communicating with peers inside the university	1.66	0.519
Grand mean	2.376	0.43263

With the lowest mean value of 1.6 it is clear that students hardly communicate in English with their peers. A low mean value of 1.8 recorded for the fact that students are scared to speak in English because; if mistakes occur it will damage their identity. However, with a low mean value of 1.9 the students rejected that they are tempt to speak in English simply because their friend also speak in English. Considering the grand mean of 2.37 with a

standard deviation of 0.43 it was found that university subculture discourages undergraduates in speaking in English.

During the interviews it was found that there is no culture outside the classroom which foster speaking in English. As the majority of the students believe that their English knowledge is poor they do not like to join with English Speaking clubs inside the university as they are scared to sound silly in front of the others. Peer group is a valuable asset of the university subculture. Thus, the students highlighted that it is a disadvantage if they speak in English inside the university as such a practice will be marked as showing off the western accent and upper class. This is also pointed by Haidara, (2016) indicating that speaking in English outside the classroom can have the possibility to be labeled as 'showing off'. It is peculiar. Further, during the interviews it was found that they have their own restricted language and jargon which is almost a fusion of English and Sinhala. Most of the English words are turned into Sinhala by changing a vowel or adding a vowel. Hence, cultural factors also seem to negatively influence the students in speaking in English.

The relationship between all the three factors and speaking in English were measured using the correlation and found that there was a negative relationship between all the factors and speaking in English. Therefore all the hypothesis have been proved.

Table 6. Correlation

	Speak in Eng.	Sig. (2-tailed)
Psychological factors	-.816	.000
Linguistic factors	-.731	.000
Cultural factors	-.450	.001

Analyzing the correlation it is obvious that all the r value significantly takes a minus value and sig. value is less than 0.05 indicating the negative relationship between speak in English and all the factors. Considering psychological factors r value is closer to one and it is -.816 which indicates that there is a strong negative relationship between psychological factors and speak in English. Next to that linguistic factors seem to discourage students whereas cultural factors also demotivate students though not much to a considerable extent.

Conclusions

The study proved that psychological, linguistic and cultural factors can discourage language learners in speaking in English. Among them psychological issues seem to be prominent. Among psychological factors lack of confidence, regarding linguistic factors poor vocabulary and pronunciation and considering cultural factors peers look more striking in demotivating students in speaking in English. To control the negative influence of such factors the language teachers can play a big role. They should create a non-threating speaking atmosphere, have to use modern technology in teaching with innovative and interesting teaching materials. It is their duty to understand each and every student and their level of performance. Sound feed backs, passionate teaching methods and interesting activities will let students speak more. On the other hand teachers only cannot turn a silent student to speak because that eagerness and energy should come within the students themselves. They should stop underestimating themselves, need not to think about their mistakes all the time and should take each and every opportunity to speak and practice more. As a support for the students and the teachers the university itself can be a good mechanism in helping students to

speak more. The university can introduce new credit courses based on speaking, can implement new language clubs and societies in case of building up a culture inside the university where students feel no hesitation to speak in English. Thus, it is hopefully believe that this study will provide more avenues for language researchers to find out more solutions for such issues.

Reference

1.Ahmad, R.S. "Importance of English communication skills", International Journal of Applied Research 2016; 2(3): 478-480, retrieved March, 16th, 2018 from https://www.researchgate.net/publication/318814564_A_Situational_Analysis_of_English_Language_Learning_among_Eastern_Indonesian_Students

2.Al-Roud, A.A. "Problems of English Speaking Skill that University Students Encounter from Their Perspectives", British Journal of Education, Society & Behavioural Science 18(3): 1-9, 2016, Article no.BJESBS.28404 ISSN: 2278-0998, retrieved January, 15th, 2018 from http://www.journalrepository.org/media/journals/BJESBS_21/2016/Oct/Roud1832016BJESBS28404_1.pdf

3.Atapattu, D."Higher Learning in Humanities and Social Sciences in Sri Lanka", Annual Academic Sessions, Faculty of Humanities and Social Science, University of Ruhuna, Matara, Sri Lanka, 2013.

4.Bashir, M. Azeem, M. and Doga, H.A., "Factor Effecting Students' English Speaking Skills" British Journal of Arts and Social Sciences, ISSN: 2046-9578, Vol.2 No.1 (2011), retrieved January, 15th, 2018 from http://www.bjournal.co.uk/paper/bjass_2_1/bjass_02_01_04.pdf

5.Farooqui, S. "Developing speaking skills of adult learners in private universities in Bangladesh: problems and solutions", Australian Journal of Adult Learning Volume 47, Number 1, April 2007, retrieved January, 15th, 2018 from https://files.eric.ed.gov/fulltext/EJ797591.pdf

6.Haidara, Y. "Psychological Factor Affecting English Speaking Performance for the English Learners in Indonesia" Universal Journal of Educational Research 4(7): 1501-1505, 2016, DOI: 10.13189/ujer.2016.040701, retrieved January, 15th, 2018 from http://www.asian-tefl.com/index.php/asiantefl/article/viewFile/14/pdf

7.Soureshjani, H.K. and Riahipour, P. "Demotivating Factors on English Speaking Skill: A Study of EFL Language Learners and Teachers' Attitudes", World Applied Sciences Journal 17 (3): 327-339, 2012 ISSN 1818-4952 © IDOSI Publications, 2012, retrievedJanuary, 15th, 2018 from https://pdfs.semanticscholar.org/0d96/6c599fcc295d5833b7b6aebfab0e419057f2.pdf

8.Leong, M. & Ahmadi M.H., "An Analysis of Factors Influencing Learners' English Speaking Skill", International Journal of Research in English Education, School of Educational Studies, Universiti Sains Malaysia, Malaysia, 2016, retrieved January, 15th, 2018, from https://ijreeonline.com/article-1-38-en.pdf

9.Oradee, T. "Developing Speaking Skills Using Three Communicative Activities (Discussion, Problem-Solving, and RolePlaying)", International Journal of Social Science and Humanity, Vol. 2, No. 6, November 2012, retrieved January, 15th, 2018 from

https://pdfs.semanticscholar.org/82b3/420141dd1dad4d260e29620b7b65e65e410a.pdf

10. Perera, R.N.A.M. "Problems Faced by Undergraduates in the Learning Environment; Some Evidences from a Sri Lankan University, retrieved September, 9th, 2014 from https://sljass.sljol.info/article/10.4038/sljass.v3i1.7129/galley/5513/download/

11. Ranwala, V.C. "Kaduwa; The Double Edge Sword", a study of post-colonial identity and language studies in Sri Lanka, 2015.

ID - 21

DIFFICULTIES FACED BY THE UNDERGRADUATES WHEN SPEAKING IN ENGLISH

Attanayake AMNR[1], Edirisinghe EMHJ[2]
[1] *Department of English Language Teaching, Wayamba University Of Sri Lanka, Kuliyapitiya, Sri Lanka*
[2] *Department of English Language Teaching, Wayamba University Of Sri Lanka, Kuliyapitiya, Sri Lanka*
nuwanrohith@yahoo.com

Abstract

Many English language learners frequently complain of their inability to communicate successfully and they face many difficulties when speaking in English. They also grumble that they can understand what is spoken but they cannot respond it. This study focuses on the difficulties faced by the undergraduates in oral communication in English. The study consisted of 40 first year students. The methodology employed was the analysis of data in pre and post-tests of speaking. Majority of the students had not followed any speaking lesson or had not had opportunities to speak in English in schools. The most frequent problems are the lack of sufficient vocabulary and confidence to speak because of their fear of making mistakes. The least problem was the difficulty in understanding questions. As an appropriate solution, one to one speaking sessions were introduced to build up their confidence to speak in English inside and outside the classroom effectively.

Keywords: Speaking ability, confidence, difficulties, oral communication

Introduction

Inability to communicate successfully in the target language in second language (L2) learning has been the complaint made by the learners of a L2. One among the many reasons to take into considerations might be the lack of confidence and anxiety about making errors as stated by Trent[1].Confidence helps learners to feel ready for life's experiences. When someone is confident, he or she is more likely to move forward with people and opportunities. Similarly, when people are lack of confidence that might be less likely to try new things or reach out to new people. If they fail at something at the first time, they might be less likely to try again**.** A lack of confidence can hold people back from reaching their success. Similarly, in second language learning, the self- confidence to use the target language plays a vital role in mastering the language. If the learners are lack of confidence to use the language, they will never try to move forward with the language.

Majority of the L2 learners do not have a good environment background to acquire and enhance English language from family, school, and friends especially when it comes to speaking skill. The only place for them to use the target language is the classroom. In this case the learners try to depend on their teachers because the teacher is the only available resource for them to communicate. These difficulties faced by them have made the students to remain in the low proficiency level in conversation. The main aim of L2 teaching and learning process is to enable the students to comprehend and produce the target language.

English has become the main language in business, and it has become almost essential for people to speak in English. English is the modern world language of media, education, technology, international

economic, tourism and scientific articles, and the internet that demands a sound knowledge of English especially of spoken English. While reading and listening are considered to be the two receptive skills in language learning and writing and speaking are the two productive skills necessary to be integrated in the development of effective communication. English has been the tool for education in the modern world and as a result, students are demanded to be able to improve the proficiency in English to continue their studies without barriers.

Of all the four macro English skills, speaking seems to be the most important skill required for communication. (Zaremba[2)].However, speaking for special communication usually occurs in contexts where speaking performance is conducted for an audience in differing circumstances. The principles of public speaking are also intertwined with the development of speaking for special communication. It is understood that any person without oral communication skills will suffer in this era of competition and may find it difficult to achieve a higher positions. Speaking is an interactive process of constructing meaning that involves producing and receiving and processing information (Burns & Joyce[3)].

The purpose of this research is to find out the problems faced by the learners when speaking in English and to find remedial solutions that can be practiced to improve the speaking skills of ESL students in the university. Without having any academic speaking experience in English before,it is understood that it takes more time for ESL students to adapt to speaking practices in the classroom. Moreover, due to ESL students' linguistic and cultural backgrounds, speaking tasks have become more demanding to be implemented successfully.

Research Methodology

Research Sample

Through random sampling procedure, 40 first year undergraduates (20 females&20 males) studying at the Faculty of Applied Sciences of the Wayamba university were selected for the present study.The study was descriptive in nature. A questionnaire was developed by reviewing the existing literature and through discussions with the experts in the field. The data were collected personally, tabulated in the form of counting frequencies and then analyzed through percentages.

Objectives

1. To find out the difficulties faced by the L2 learners when speaking in English.

2. To find out whether one to one speaking practices are helpful for the L2 learners to build up their confidence in oral communication.

Research Questions

1. What are the difficulties faced by the undergraduates while speaking in English?

2.Are one to one speaking practices helpful for the students to build up the confidence in oral communication?

Results and Discussions

Table 1. **Responses of students about their speaking ability in English**

Question	**Yes**		**No**	
	Female	Male	Female	Male
Shyness and fear in speaking	16 (40%)	21(52.5%)	2 (5%)	1 (2.5%)
Insufficient vocabulary to speak	16 (40%)	19 (47.5%)	2 (5%)	3 (7.5%)
Different exercises given for speaking ability	7 (17.5%)	5(12.5%)	12 (30%)	16 (40%)
Do not know how to speak correctly	13 (32.5%)	15 (37.5%)	5 (12.5%)	7 (17.5%)
I like English	15 (37.5%)	14 (35%)	6 (15%)	5 (12.5%)
Enough time for speaking ability	16 (40%)	18 (45%)	2 (5%)	4 (10%)
Students are the main cause for poor speaking	11 (27.5%)	7 (17.5%)	8 (20%)	14 (35%)
Teachers are main cause of for poor speaking	11 (27.5%)	13 (32.5%)	9 (22.5%)	7 (17.5%)
Regularly arranged activities	4 (10%)	1 (2.5%)	16 (40%)	19 (47.5%)
Speaking with class fellows and teachers	3 (7.5%)	1 (2.5%)	17 (42.5%)	19 (47.5%)

As depicted in table-1,the students are shy and afraid of speaking in English because they think that their class fellows will laugh at them or they think that it is a disgrace when mistakes are done when the speak in English. Majority of students37 (92.5%) said “YES” but 3 (7.5%) students said “NO” to the question. This can be ignored because vast majorities are of the view that they are humiliated by friends when they make mistakes. 35(87.5%) students claimed that they faced the problem of insufficient vocabulary to express their ideas to others while 5(12.5%) students disagree with the above idea and they were satisfied with their word power. However, this is a very few number.
28(70%) students replied negatively about the different exercises, tasks or opportunities given to them for improving their speaking ability.However,12(30%) students expressed that they had the diverse kinds of opportunities to do different exercises to develop their speaking ability. Regarding the accuracy of expressing ideas,28(70%) students agreed that they did not know how to speak correctly while 12(30%) knew how to express their ideas correctly. The remarkable point is that 29(72.5%) like to improve their English proficiency and11 (27.5)do not have positive attitudes to learn English. This is a considerable number.

In addition,34(85%)students are of the view that sufficient time was not given to practice activities for the improvement of speaking ability whereas 6(15%) students claim that they had a number of opportunities in this connection. In further discussions with students, some of them claimed that they had the chances to practice speaking only after entering the university.
18(45%) students replied that they themselves are responsible for the poor speaking ability, while 22(55%) students responded “NO” regarding this. 24(60%) students said that the teachers were responsible for this main cause of poor speaking ability because they paid their attention to teach grammar and writing skill. This should be paid serious attention. However, 16 (40%) are of the view that different activities such as group discussions and debating competitions, etc. were regularly being arranged by the teachers in their classes.5 (12.5%) students responded positively but a maximum number of students, 35(87.5%) responded negatively. Responding to the last question whether the students speak in the class in English with their teachers and fellow students, 4(10%) have said “yes”, while 36(90%) responded negatively in this regard.

Conclusion

Even though the students have already been learning English continuously for more than twelve years, it is understood that the majority of the students are shy and afraid to speak in English, thinking that their class fellows would laugh at them. The complaint made by many students is that enough time has not been given for the improvement of speaking ability in the classroom and their vocabulary level is insufficient to express their ideas to the others. In addition, different exercises or activities had not been given to them to improve the speaking ability. According to the collected data, some of students had the confidence to speak correctly.

However, it is worth expressing that both students and teachers are equally responsible for the poor speaking ability of the students. Different activities to provide opportunities to practice using the language such as group discussions, debates and competitions have not regularly been arranged in the classroom as expressed by a maximum number of the students.

English should be taught as a language as well as a subject. As the first step, the confidence to use the language should be improved. For such a purpose, ample of opportunities to speak in English should be supplied to the students in the classroom. Organizing one to one speaking sessions in the classroom is a good counteractive effort to build up confidence in the learners. In such activities, each student will get a chance to speak at least five to ten minutes a day individually with an instructor. Instructors can play the role of a facilitator. They avoid correcting the students at the beginning of speaking stages but help them in friendly manner in order to build up the confidence of the students. The students should be evaluated without students' knowledge and continuous proficiency tests can be conducted in order to examine the progress of the students. Students should be motivated, encouraged and appreciated during the activities for eradicating their shyness and fear to speak. Students should also be instructed to be positive in order to provide a friendly and conducive environment in the classroom. Linguistic skills such as vocabulary, grammatical structures, and pronunciations may be emphasized by the instructors during the speaking sessions without pointing out the mistakes done by the students.

In addition, the students should be supplied with opportunities to develop the habit of listening and reading in the classroom and they must be guided for that. To assess the language competency of students at various levels, viva-voce can be included as a compulsory part of the examination system.

Reference

1. Trent, J. (2009). Enhancing oral participation across the curriculum: Some lessons from the EAPclassroom. *Asian EFL Journal*, 11(1), 256-270 Retrieved from http://www.asian-efljournal.com/March_09-jt.php http://exchanges.state.gov/englishteaching/forumarchives/2009/09-47-1.html
2. Zaremba, A. J. (2006). *Speaking professionally*. Canada: Thompson South-Western activities.
3. Burns, A. & Joyce, H. (1997). "Focus on speaking". Sydney: National Center for English LanguageTeaching and Research.

ID - 40

TEACHERS' USE OF HYBRID LANGUAGE IN THE ESL GRAMMAR TEACHING CLASSROOM: SITUATIONS AND STUDENTS' ATTITUDES

Edirisinghe, E.M.H.J. [1], Edirisinghe, E.M.D.H. [2]

[1]*Department of English Language Teaching, Faculty of Business Studies and Finance, Wayamba University of Sri Lanka*

[2]*Department of English Language Teaching, Faculty of Business Studies and Finance, Wayamba University of Sri Lanka*

Abstract

The objective of this descriptive study is to look into the situations and attitudes of the undergraduates towards the teachers' use of Hybrid Language (HL) in the ESL grammar teaching classroom. HL is identified as one common practice used by the language teachers to tackle the communication difficulties while teaching English. It seems that the students bear different attitudes towards this practice. The present study employed grammar teaching classroom observations to identify the situations, student attitude questionnaires and also a focus group discussion with ten randomly selected students to investigate the students' attitudes towards the teachers' use of HL during the lessons. The findings reveal that the majority of the learners bear positive attitudes towards teachers' HL practices; however, there are also a very few negative sentiments. Based on the findings, it is concluded that the use of HL judiciously act as a facilitative tool for both teachers and students in the language teaching-learning process.

Keywords: English language, ELT, ESL classroom, Hybrid Language

Introduction

Background

Research studies have found out that the English proficiency levels of the undergraduates in Sri Lankan universities are very low. In addition, Samarakoon[1] points out that in general, most of the undergraduates come from rural backgrounds and they have very little exposure to the target language. Similarly, Edirisinghe[2] reveals that the English language proficiency of the undergraduates in Sri Lankan universities is at the UTEL 3 or 4 standards which are the basic levels of language proficiency. Due to this, much dependency on the teachers is visible especially in the ESL classrooms [3].Therefore, the learners cannot comprehend when the instructions are given only in English. Hence, the teachers employ various strategies to enhance the proficiency level of students in their teaching learning process. One such strategy is the use of HL for maximizing the language acquisition i.e.; instructors switch codes to Sinhala or Tamil as a means of facilitating the process of learning. The research findings of Makulloluwa[3] show that students'L1 is used for pedagogical, administrative and interactional purposes in the ESL classroom and those instructors teaching in lower proficiency levels use the HL practices in significant quantities as a strategy to accommodate student's low language proficiency and also as a strategy to create a less threatening classroom environment.

Especially, this practice is used as a pedagogical strategy by many teachers in Sri Lankan universities to ensure that the students understand what is taught especially when teaching grammar rules. Grammar is one of the basic skills in English Language that needs through understanding [4]. As stated by Attanayake[5], "With new policies being introduced to make English the medium of instruction in the education system, and with the awareness that there are challenges to face, it is our understanding that the analysis of the existing curricula and pedagogical strategies in relation to ELT in the Sri Lankan university system is of prime importance for improving undergraduate ELT in Sri Lanka".

Previous studies

According to the research studies of Samarakoon[1], Edirisinghe[2], Makullolwa[3,] Karunarathne[6]HL practice is often done in various situations in Sri Lankan ESL classrooms such as when explaining meanings of unfamiliar vocabulary, explaining language structures, in situations when invoking humor, to create a learner friendly environment, in situations that seems too difficult for them to handle in English and so on.

Spahiu[7] revealed that most of the teachers and students believed that it was necessary and acceptable to use native language in teaching. He points out that the arguments presented by the students to justify the use of the native language inside the classroom for teaching and learning ESL include:

- Native language gives a sense of security and helps feel less stressful.
- By being able to use both languages they are less confused.
- They feel the need to express their ideas and thoughts in their own language.
- They prefer translating difficult context and words.
- They feel necessary the teachers' use of native language in grammar explanations.

In the same vein, Edirsinghe[2] in his research study related to Sri Lankan University context, claims that the students confirmed that their teacher's use of HL is an effective teaching strategy which facilitates their learning. Majority of the students are of the view that the use of HL to illustrate complex grammar points helps them comprehend grammar rules better and more easily [4]. Most of the students participated in his study are of the view that the teacher's shift to L1 assisted them to follow the given instructions successfully as they are clearer to them. Further, they insist that the teacher's HL will assist them to understand the lesson content easily and clearly and avoid misunderstandings. Moreover, they say that HL helps them to be less stressed, more self-confident and relaxed in the classroom. In contrast to the above positive views, there were some negative attitudes as well towards this practice. For example, Parthasarathy[8]states thateven if the teacher uses English and L1 concurrently, it will not serve the purpose and will produce negative results. Hence, it is clear that there are heated arguments towards this practice.

Research Questions

The current study examined the situations and the attitudes of the students towards teachers' use of HL in the ESL grammar teaching classroom. It is important to expose the situations where the teachers use HL practices in the ESL classroom and the attitudes of the students regarding this use. In line with the objectives of the study, two research questions were presented:

1. What are the situations of the teachers' use of hybrid language in an ESL grammar teaching classroom?
2. What are the attitudes of the students towards the teachers' language hybridization between L1 and L2?

Methodology

The design of this study is descriptive in nature.

Data collecting instruments

This descriptive study employed three types of data collection tools; classroom observations, questionnaires and a focus group discussion to collect data from the sample. The data were collected using the above three tools in order to identify the situations and the attitudes regarding this use.

Data Analysis

A mixed-method approach was employed using both qualitative and quantitative data analysing techniques. Data gathered through observations and questionnaires were analysed both qualitatively and quantitatively where as data gathered through the discussion were analysed mainly qualitatively to meet the expected purposes of the study.

Classroom observations

Through the classroom observations, the particular situations of the teachers' use of HL were identified. They were coded under different categories in order to find out the amounts and the situations of using HL. The percentages of the occurrences were calculated and the findings are represented graphically.

Student attitude questionnaires

Focus group discussion

Students' responses were first summarized, categorized under emerging themes and then translated into English. The newly identified situations were also summarized and categorized.

The percentages of responses or the views given by the students for each statement were calculated and categorized under different situations. Answers given for the open ended question were also analyzed both qualitatively and quantitatively. The findings are illustrated in tables and bar graphs.

Participants

Student participants

Fifty-first-year science undergraduates were taken with average proficiency levels in English who take the English intensive course of the Faculty of Applied Sciences of the Wayamba University of Sri Lanka. Almost all the undergraduates of the class were Sinhalese.

Teacher participants

Two instructors of English from the Department of English Language Teaching of the Wayamba University of Sri Lanka were selected as per the convenience.

Results

It was identified that both teachers used HL practices in the following six situations when teaching grammar in their language classroom.

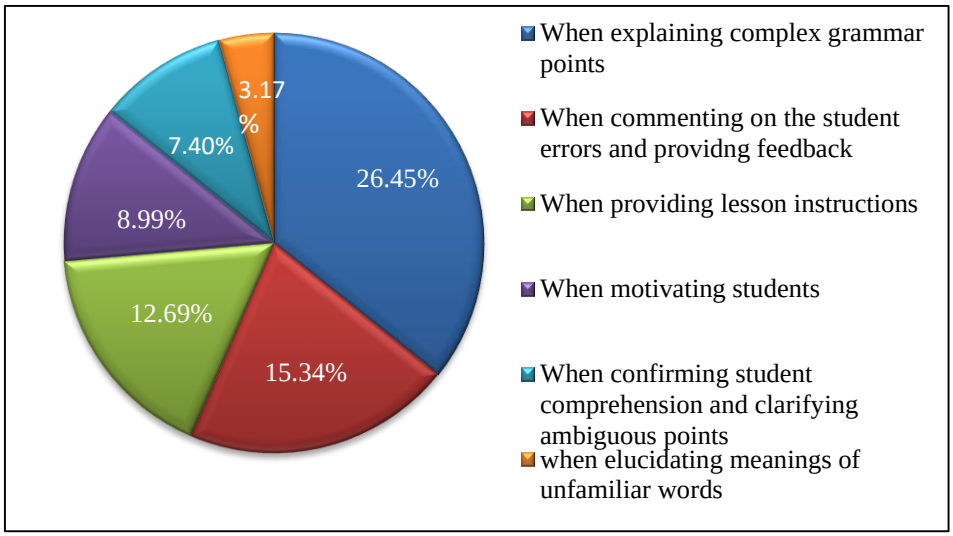


Figure 01. Situations and percentages of occurrences of HL.

Table 01. Percentage of preferences of the students for the identified situations.

Situation	Percentage of preference				
	Totally disagree	Disagree	Undecided	Agree	Totally agree
When explaining grammar points	0	0	8	30	62
When commenting on the student errors and providing feedback	0	4	18	44	34
When providing lesson instructions	0	6	10	64	20
When motivating students	6	12	30	28	24
When confirming student comprehension and clarifying ambiguous points	0	6	14	66	14
When elucidating the meanings of unfamiliar words	0	6	6	30	58

The above table shows the percentages of attitudes of the students towards the identified situations.

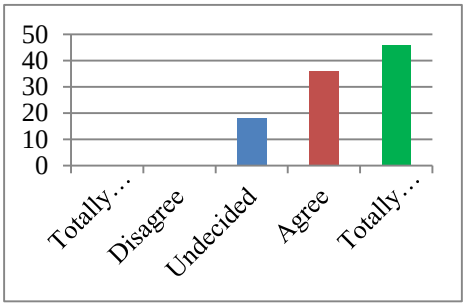


Figure 02. Attitudes of the students whether HL practice, a good teaching technique or not.

The above graph represents the attitudes of the students whether the HL practice is a favorable/effective technique to be employed in the language teaching-learning process.

Table 02. Students' other preferred areas for the use of HL.

Situation	Frequency	Percentage
1. Evaluation and feedback	20	40%
2. When outlining main facts after the lesson	16	32%
3. In comprehension exercises	12	24%
4. When exemplifying differences between L1 and L2 grammar	9	18%
5. In rapport building (making jokes/evoking humor, showing concern to students)	8	16%
6. Scaffolding and peer learning	7	14%
7. When giving instructions for assignments/projects and presentations and assigning and checking homework	5	10%
8. When elaborating the course/lesson objectives and transmitting lesson content before the lesson	5	10%
9. To talk about administrative information (course policies, announcements and deadlines, etc…)	3	6%
10. Classroom management	3	6%
11. To communicate with students outside the class	3	6%

The table given above presents the other preferred areas of the students where they like their teachers to employ HL.

Discussion

Research question 01- When do teachers use HL in the ESL grammar teaching classroom?

As shown in figure 01, both teachers used HL when explaining complex grammar points, commenting on student errors and providing feedback, giving lesson instructions, confirming student comprehension and clarifying ambiguous points, and when elucidating the meanings of unfamiliar words. In addition, they used HL practices to motivate the students during classroom activities in order to encourage the students and to build up their confidence to learn.

Research question 02- What are the attitudes of the students towards the teachers' use of HL?

According to the data represented in table 01, it is clear that the majority of the participants are in agreement that the teachers' use of HL in the identified situations facilitates their language learning.And they have expressed eleven other preferred areas that they expect their teacher to employ this technique as given in table 02. Further, figure 02 shows that it is viewed as a good teaching technique by the students.In addition, the study made an effort to find out the preferred amount of teaching time where HL should be used. The results indicate that no one had preferred the use of HL above 50% of the class time.Even in the focus group discussion students claimed that the HL practices are necessary only when the situation demands it. In short, excessive and haphazard use of HL practices should be minimized. Thus, the fair use of this teaching strategy should be permitted when and where it is necessary.

Conclusion

It was identified that the teachers use HL practices when teaching grammar in situations such as, when explaining complex grammar points, commenting on student errors and providing feedback, giving lesson instructions, motivating students, confirming student comprehension and clarifying ambiguous points, and also when elucidating the meanings of unfamiliar words. The students confirmed that the teachers' use of HL is an effective teaching strategy which eases their learning. Hence, it can be concluded that not even a single participant who involved in the study negate the idea of using this phenomenon in their language classroom. The results of this study too indicate that many of the undergraduates view this technique as a means of facilitating the teaching-learning process and also they view this as a tool which plays a crucially important role in the university grammar teaching classroom. Further, it can be concluded that the use of HL judiciously not only act as a facilitative tool for teachers in their teaching process but also act as a facilitative tool for students in their learning process as well. Also, it can and should be employed as a teaching strategy in the realm of language teaching.

Considering the limitations of this study, this study was only focused on the university level grammar teaching. The sample size is relatively small and it does not represent the whole population of ESL teachers and students in universities. Hence, the results cannot be generalizable. Further, the variables such as learners' different learning styles, Socio-cultural backgrounds, gender and attitudes to language and the teachers' teaching styles, personality and experience were not taken into consideration. Therefore, future research should consider using a wider sample and also may consider about the above aspects as well.

Reference

1. The Role Played by Code-switching in Sri Lanka. (n.d.). Retrieved from https://www.linkedin.com/pulse/role-played-code-switching-sri-lanka-saritha-samarakoon

2. Edirisinghe, H. (2016). *Teacher Code Switching: Functions and Impact on Students' Performance and Attitudes*. Masters level. Postgraduates Institute of English, The Open University of Sri Lanka.

3. Makulloluwa, E (2013). Code-switching by teachers in the second language classrooms. International Journal of Arts & Sciences.6(3). University Publications net.

4. Febriani, R. B. (2017). The Roles Of Language Shift In English Language Teaching. *Vision: Journal for Language and Foreign Language Learning,6*(1), 61. doi:10.21580/vjv6i11583

5. Attanayake, A. U. (2017). *Undergraduate ELT in Sri Lanka: Policy, practice and perspectives for South Asia*. Newcastle upon Tyne: Cambridge Scholars Publishing.

6. Karunarathne, I. M. (2009). Teaching of English: A Sociological study. New Delhi : A.P.H. Publishing Cooperation

7. Spahiu, I. (2013). Using Native Language in ESL Classroom. IJ-ELTS: International Journal of English Language & Translation Studies , 1(2).

8.Parthasarathy, R. (n.d.). The Use of the Mother Tongue in the ESL Classroom. Retrieved from https://www.academia.edu/4099631/The_Use_of_the_Mother_Tongue_in_the_ESL_Classroom

ISSN: 1800-4911