

# GLOBAL ACADEMIC RESEARCH INSTITUTE

COLOMBO, SRI LANKA



## PROCEEDINGS

### GARI MULTIDISCIPLINARY SYMPOSIUM 2022

On 21<sup>st</sup> October 2022

in Oxford, United Kingdom

ISSN 2659-2193 (Online)

ISBN 978-624-6068-08-0

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Edited by Global Academic Research Institute Publication Department

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84 Pages

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## **About GARI**

Global Academic Research Institute (GARI) is an International Scientific Research Conference Organizer in collaboration with International Universities & Institutions. GARI has brought together leading academic and industry experts from the global community who process diverse experience and expertise in verity of scholarly or scientific disciplines. We established on 2010 as independent service provider then wider range of experience GARI became a powerful arm of scientific research conference organizer in the industry.

## **PREFACE**

Global Academic Research Institute is proud to present GARI MULTIDISCIPLINARY SYMPOSIUM 2022 which is a series of successful research symposium. The Inaugural Session and the Technical Sessions were conducted in 21<sup>st</sup> October 2022 in Oxford, United Kingdom; 11<sup>th</sup> November 2022 in Singapore and 16<sup>th</sup> December 2022 in Colombo, Sri Lanka. The conference was organized into different disciplines which empirical, conceptual and methodological papers were received from academics, practitioners and public policy makers were accepted paying austere attention to the academic standards of the papers. To maintain consistency, authors were prescribed to follow the academic writing format of the GARI Publishers. The reviewing process was apparently transparent where papers underwent a double blinded review process by eminent subject specialists in respective areas. Thus, refereed full papers selected to be presented at the conference were published here. We do not assume any responsibility for any errors or omissions in the research papers which rests solely with the authors.

Special thank goes to Key note addresses & Co-chairs made by Professor R.M.G Rajapakse (Imperial College of Science, Technology and Medicine, London), Senior Professor of Chemistry and Research Supervisor (University of Peradeniya, Sri Lanka); Coordinator of the M.Sc. Programme in Nanoscience and Nanotechnology (PGIS University of Peradeniya, Sri Lanka); Mr. Manoharan Kesavan (Faculty of Technology, Wayamba University of Sri Lanka); Dr. S.A.D.H.N. Suraweera (Faculty of Social Sciences, University of Kelaniya); Dr. P.G.R.N.I. Pussella (Faculty of Geomatics, Sabaragamuwa University); Dr. Vijitha Paheerathan (Unit of Siddha Medicine, Trincomalee Campus Eastern University); Dr. Jeevani Dahanayake (Institute of Indigenous Medicine, University of Colombo); Sampath Priyankara (Universidade dos Açores, Portugal). The organizing committee special Appreciation Online Research Publications Partner NLSL's National Digital Library and Repository in Sri Lanka, an International Academic Affiliation with Jagadguru Kripalu University - India, Department of Community Medicine, Mysore Medical College and Research Institute - India, International Federation for Fitness Health, Physical Education & Iron Games - Saudi Arabia, Australasian Institute of Ayurvedic Studies - Australia, Kathmandu School of Law – Nepal, Noble School of Business, India.

Journal Partner as GARI Publishers and GARI International Journal of Multidisciplinary Research, all other GARI affiliated academic partners, Further the support given by GARI Tours as Travel partner, Official Creative Partner Sameera Artco & MICE official Partner Sri Lanka Convention Bureau. The conference committee expresses deep gratitude to the panel of reviewers for the priceless service rendered. Finally, the committee extends sincere thanks to the presenters and participants for the valuable contribution and active participation.

Conference Committee  
**GMS 2022**

## GARI AFFILIATIONS

<< Couleur-Espace-Culture >> Association 1901 – France



Our Association aims to devote itself to the fields of art, architecture, urban planning to defend visual ecology and the harmony of colors in the environment. The different fields and domains concerned, the theoretical and methodological development as well as the practical bases of environmental projects, are at the center of the professional interest of the activities of the Association CEC Couleur-Espace-Culture.

National Digital Library and Repository – Sri Lanka



The National Library is mainly research and a reference library and it is the main library and information Centre in Sri Lanka. It intends to provide library resources as well as information to all Sri Lankans through the National Library. Powers and responsibilities of the National Library were clearly spelled out for the first time and this was a fulfillment of a long-felt need. It has become a herculean task to organize and introduce this new institution to the country and to the general public.

Jagadguru Kripalu University - India



Jagadguru Shree Kripaluji Maharaj envisioned a university that not only provides quality education but also aims at all-round personality development of the students, turning them into leaders in their chosen fields. The faculty at JKU are experts in their respective fields, with an

intense desire to teach and guide the students to success. Regular interactions with industry leaders and opportunities to be part of various conferences and seminars broaden the students' horizons.

#### Kathmandu School of Law – Nepal



Kathmandu School of Law, established in 2000 AD as an affiliate of Purbanchal University, is a community-based, non-profit academic institution that upholds its unrestrained commitment for a pragmatic, research-based and community responsive legal education in the country. It was conceptualized within the ambit of non-profit movement dedicated to serve the need of an academically sound and functionally feasible legal education in Nepal.

#### Australasian Institute of Ayurvedic Studies – Australia



The Australasian Institute of Ayurvedic Studies is synonymous with quality and authentic education in Ayurveda. The Institute was founded in 1999 in Auckland, New Zealand and is proud to be the only training Institute in Australasia offering recognized Ayurvedic qualifications in both Australia and New Zealand.

#### International Federation for Fitness Health, Physical Education & Iron Games - Saudi Arabia



IFFPHPEIG was established in year 1995. It is one of the largest upcoming federation around the world. The Federation was established by the Honorary President Dr. Kaukab Azeem

#### Noble School of Business - India



Noble Institution will be a learning community that is focused on developing youngsters who will become leaders in an era of global competitiveness and technological advancements.

#### Vision Factory - Spain



Our company is inspired by a modern vision, driven by mission and supported by values. We have made our vision, mission and values visible here for you

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## **A PARADIGM SHIFT IN AFRICAN INDIGENOUS MUSICAL PRACTICES**

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### ***ABSTRACT***

Indigenous musical practices in traditional settings typically have a symbolic purpose in cultures worldwide. Indigenous musical performances place great importance on the connection of the performance to sociocultural issues, which often reflect the underlying values of the society and range from everyday activities to essential ideas and beliefs that shape a people's culture. Additionally, indigenous musical performances provide a potent acculturative conduit through which new members learn values and skills shared by the group. Thus, in African societies, indigenous musical practices have a significant role in culture, arts, and the education of indigenous communities as they influence people's thoughts and actions. Lately, African indigenous musical practices have evolved, and new performance practice trends are emerging. Modern musical ensembles now arrange and perform indigenous music and dance, and concert venues no longer view them as diabolic and out of place. This paper traces these new paradigm shifts among the Urhobo people in Southern Nigeria through fieldwork employing interviews, observation, and oral history, supported by a literature review. The findings from this research were analysed using descriptive qualitative methods. The paper suggests ways to harness these paradigm shifts and trends to be better used in the cultural development of African communities.

Keywords: African indigenous musical practices, paradigm shifts, indigenous music, African music and dance

# WOMEN IN CONFLICT AND POST-CONFLICT SITUATION: UNDERSTANDING INDIA'S NORTHEAST

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## **ABSTRACT**

Women in India, be it in the north, in the south, in the west or in the east or in the eastern most part of the country is not free from different types of harassment, gender prejudice or gender bias in different spheres of life. Coming to Northeast India, ever since decolonization this part of the country has been facing violent agitations, separatist insurgencies and different kinds of ethnic conflicts which has led to huge bloodshed. States in this region have dynamic societies and are modernizing in varying degrees of response, stress and stability. It is regarded that women in Northeast India enjoy a better position in the society particularly the tribal women compared to other counter parts in the rest of the country in the absence of social evils like dowry, infanticide etc. However, we cannot deny the fact that women in Northeast face various social and economic implications of constant conflicts, illiteracy, poverty, landlessness, poor health, alcoholism, drugs, broken homes, domestic violence, discrimination of democratic participation in decision making, traditional institutions at the cost of customary laws, discouragement of participation in electoral politics etc. Drawing on the case studies from the ethnic conflicts in Northeast India, it will seek to provide a holistic gendered analysis of the agency, identity and sufferings of women during conflict and post-conflict scenario. The study is based on descriptive and analytical methodology. The paper while primarily qualitative in nature will employ certain degree of quantitative methods whenever necessary. While review of literature has shown existence of literature on subjects related to women in conflict generally, there is a serious lack of substantive body of literature as far as narratives on the plight of women in Northeast India is concerned. As such, it is incumbent on the study to carry out extensive interactions with those who have been directly affected by the various conflicts in Northeast India.

Keywords: Conflict, Women, Northeast India

## WHEN THE LAW IS SILENT: HATE CRIME PROSECUTION AND IMPLICIT BIAS IN LAW ENFORCEMENT AGENCIES

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### **ABSTRACT**

Hate crime legislation and institutional developments are often seen as panacea against the phenomenon, moreover as judicial objectivity and the unbiased application of the law is rarely questioned. A look into hate crime prosecution patterns can reveal that implicit bias can affect impartial judicial decision-making. This study aims to investigate the prosecution of anti-Semitic hate crimes in Romania and looks to uncover possible explanations for the persistence of antisemitism within the society by the way the law is applied in the field. We present the results of an original survey designed to empirically test whether implicit bias among prosecutors can lead to either an undetected anti-Semitism or a spike in anti-Semitic violence.

Keywords: implicit bias, hate crimes, antisemitism, law enforcement, Romanian judiciary

# WHY PEACE ACCORDS DOESN'T LEAD TO ORDER IN NORTHEAST INDIA? POTENTIAL AND LIMITATIONS OF BODO AGREEMENTS

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*India*

## **ABSTRACT**

The postcolonial Indian State has faced several challenges pertaining to political violence with minority groups in Northeast India. Works by Sanjay Baruah (2005), S. Bhaumik (2009) and Udayon Misra (2017) have highlighted the multiple ways in which political violence has engulfed and contained Northeast India. Despite signing multiple agreements with ethnic leaders, peace and durability continue to elude India's northeast. This paper critically reviews the peace accords conducted by the Indian government with the Bodo insurgent groups of Assam. Drawing on ethnographic fieldwork conducted for six months in 2021 and discourse analysis of peace accords signed between the Indian Union and Bodo leaders in 1993, 2003 and 2020, this paper makes three interrelated points. First, peace accords provide a veneer of legitimacy to the Indian State, while the real issues of recognition and redistribution are neglected. Second, fissures of ethnic identity and land rights within the Bodo tribal movement are complicated. Misunderstanding of the critical factor has led to limitations of peace accords, engendering newer dynamics of post-agreement conflict. Third, this paper argues that peace accords signed by the Indian State are limited in scope and potential. The frequent spillover post-agreement violence in other Northeast regions attests to this fact. In the conclusion, this paper highlights certain recommendations for durable peace and restitution in the region.

Keywords: bodo, insurgency, peace accords, conflict, recognition

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## PROCEEDINGS

### GARI MULTIDISCIPLINARY SYMPOSIUM 2022

On 11<sup>th</sup> November 2022

in Singapore

# IS IT GOOD TO DO THE DIGITAL TRANSFORMATION? THE ROLE OF A FIRM'S VALUE CO-CREATION

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## ABSTRACT

This research examines whether every industry is amenable to digital transformation, using the real estate brokerage industry as an example. In the context of the rapid development of modern technology, more and more industries have added digital technology to make digital changes, and more scholars are discussing issues related to digitalization, including digital transformation. This research will use the real estate brokerage industry to conduct research in the form of a questionnaire survey to discuss the positive impact of digitalization on value co-creation and digital transformation and the role of value co-creation between them. In this study, we use digital-related issues in the real estate brokerage industry to make contributions to the future development of the real estate brokerage industry.

Keywords: Digital transformation, value co-creation, real estate brokerage industry

## INTRODUCTION

With the progress of the times, the development of technology, and the advent of the digital age, our lives are becoming more and more convenient, and the way of trading and interacting in the market is becoming more and more different. In the past, customers who wanted to know product information could only rely on the introduction of product suppliers. Through the new functions and

new applications brought about by these digital technologies, many different changes will be brought about, from the manufacturing process, inventory management, and logistics management of suppliers on the production side, to the service methods provided to customers and the resulting consumer experience on the customer side will be very different from the past, bringing a new transformation (Markovitch & Willmott, 2014). Recently, digitization and digital transformation have become increasingly popular, and it is often regarded as the future trend of enterprises. However, this raises the question of whether a digital transformation is essential and whether each industry is really suitable for digital transformation. This research will revolve around our central theme, whether every industry is ideal for digital transformation. Under such a theme, we will first discuss whether the value co-creation between stakeholders brought about by the digitalization change will stimulate the industry's digital transformation. This study will use the real estate brokerage industry as an example to explore how integrating resources in the industry and the value co-creation brought about by interaction with customers bring about digital transformation.

## LITERATURE REVIEW

**Digitalization and Digital Transformation**



Digitalization uses digital technology based on the combination of information, machine power, and intelligent connected machines. It might affect the competition between industries and also increase customer value. Digitalization has changed the auditing services market. Customers need the new services within digitalization. Point out in the study that service intelligence, occupational identity, and service climate change the front-line workers how they provide the services. And also found the differentiation between some specific industries (Pemer, 2021). The process of digitalization requires the combination of past knowledge and new technologies (Markovitch & Willmott, 2014). However, the focus of digital transformation is not on "digital" but on "transformation," but the use of digital technology to change the business model of companies in the sales market (Gandhi et al., 2018). Therefore, digital transformation is to adjust an enterprise's human resources, organization, process, culture, and business model—the company's ability to adapt to the market. The digital environment pervades business and everyday life, and the digitization of businesses can help grow the economy and remain competitive (Matzler et al., 2018). Digital transformation is recognized as one of the major trends changing society and business models (Tihinen et al., 2016), using digital technology to redefine organizational strategies for enterprises, evaluate their services, adjust service quality in a timely manner, re-draw improvement plans and create new service models to enhance customer experience, increase turnover, and Brand Loyalty. However, in digital technology, the technology relies on data and information, which are different. Only processed data can show the difference in information (Gandhi et al., 2018), and digital information can be read by digital technology. To assist the organization in

making decisions. Digital transformation is a process that combines digital technology with existing business models (Warner & Wäger, 2019). From business processes, value propositions, customer experience, and digital culture to a complete transformation, it becomes a susceptible one centered on customer value and experience. It constantly updates and transforms the organization (Vial, 2019). Each industry has a different focus and sequence. In industries that rarely interact with customers, organizations may first transform the level of operational processes and simplify organizational management and department-to-department business by integrating digital technology. New technologies make engineering processes more efficient, etc. Digital transformation can create a work environment where employees can be more productive in their daily work life (Albukhitan, 2020). Enterprise collaboration tools are a good example. When these tools are fully utilized, the time savings and productivity gains are almost immeasurable.

### **Value Co-Creation**

In the past, the traditional view of the value creation process is to exclude consumers and only assume that the enterprise itself is the value creator (Prahalad & Ramaswamy, 2004). In this model, value is only unilaterally created by the enterprise, manufactures products and services, and decides what value to provide to consumers. This process forms a complete value chain, and manufacturers offer these values. They are produced in the course of a product or service. Ramirez (1999) put forward the view of value co-creation, which is to change the role of value creation. He believes that customers should be produced by mutual interaction with enterprises, allowing customers to interact with enterprises. This relationship is called value co-creation. Prahalad and Ramaswamy (2004) pointed out that the

interaction between consumers and enterprises is an emerging model of co-creation, and the generation of value is not only in the stage of currency transaction but occurs in every stage of the value chain. The research of Grisse mann and Stokburger-Sauer (2012) pointed out that the cocreation of value between enterprises and customers will improve both financial performance and non-financial performance. Because enterprises meet customer needs, customers are more willing to pay more for products and services, thus improving satisfaction. The value of even being willing to give back again. O'Cass and Ngo (2012) believed that enterprises could produce, integrate innovative products or services, and maintain relationships with each other, thus jointly creating value for customers. They are not only competitors but also partners and can improve corporate performance together. Neghina et al. (2014) propose that in-service interaction and value co-creation should be understood as a joint collaborative activity between service employees and customers, consisting of six dimensions corresponding to simpler joint actions: personalization, association, empowerment, ethics, development, and joint coordinate operations. Furthermore, Neghina et al. (2014) derive propositions about nine antecedents of value co-creation, labeled as communication, association, and understanding factors. For the first time, this paper provides a richer understanding of the concept of value co-creation through an analytical framework, which can drive future research and guide managers interested in implementing Service Advantage Logic (S-D Logic) principles within the companies in which they provide services.

### **Research Hypotheses**

Digital transformation involves an enterprise's digital level and technical capabilities. It creates new value based on

the impact of different levels of capabilities on the organization in various aspects (Morakanyane et al., 2017). Therefore, it is believed that digitalization in the real estate brokerage industry can affect the digital transformation of this industry. Based on the above, this study proposes the following hypotheses:

**H1: Digitization has a positive impact on digital transformation**

Çakıcı (2022) explores the impact of digital transformation and value co-creation processes in the research process, focusing on the role of digital agility in this context. It proves the interrelationship between digital transformation and value co-creation. Based on the above, this study, therefore, proposes the following hypothesis:

**H2: Digitization has a positive impact on value co-creation**

## ***METHODOLOGY***

This chapter explains the scale and questionnaire design, sample sampling method, and data source collection method used in this research to obtain relevant information to achieve the research goal. First, the research hypothesis and framework proposed by this study can be established based on the theories that have explained the research motivation and literature discussion above. According to the research framework established by this research, appropriate questionnaires are designed to explore variables and the relationship between the variables. This research will be conducted by means of a questionnaire survey. We will conduct the research based on the Taipei Real Estate Brokerage Association members and the Taoyuan Real Estate Brokerage Association. A total of 111 questionnaires were recovered. Among the 111 questionnaires collected, 12 were deleted

because the respondents were not managers, leaving a total of 99.

## RESULTS

### Research Hypotheses

The research mainly discusses three control variables: EMP, FP4n, and FP5n. Whether there is a significant correlation between the variables, use the statistical method of Pearson basis correlation to analyze. The analysis results are shown in the table, which is described as follows:

Table 1 Correlation analysis table

	Mean	S.D.	1	2	3	4	5
1. EMP	24.94	32.93					
2. FP4n	.15	.96	-.11				
3. FP5n	.30	.84	-.22*	.01			
4. Digitalization	5.09	1.18	.08	.12	-.01		
5. Value co-creation	5.72	.69	.21*	-.24*	-.14	.54**	
6. Digital transformation	5.25	.94	-.08	.28**	-.03	.56**	.40**

S.D. = Standard deviation \* p < 0.05, \*\*p < 0.01

Regression analysis was used to verify the hypotheses put forward by this study and the relationship between digitalization, value co-creation, and digital transformation.

First, we need to understand the mediating effect of value co-creation between digitalization and digital transformation, which is tested through three steps of regression analysis. The first step dependent variable is digital transformation. The standardized coefficient  $\beta$  is .554, which shows a positive impact, and the T value is 6.730 and  $p < 0.001$ , indicating that very significant. Therefore, this study's hypothesis (H1) appears to be valid. In the second step, the dependent variable is digital transformation, and the independent variable is value co-creation. The standardized coefficient  $\beta$  is .573, which shows a positive effect; the T value is 7.207 and  $p < 0.001$ , which is very significant. Therefore, this study's hypothesis (H2) appears to be valid.

## CONCLUSION

In hypothesis H1, we concluded that digitalization positively impacts digital transformation. We can know the current level of digitalization in the real estate brokerage industry, including external

digitalization and internal digitalization. The way to deal with business cooperation, integration, and acquisition of market, customer information, etc., Internal digitalization is like the company's use of digitalization in internal management, cost control, and so on. These levels of digitization have a positive impact on the degree to which companies undergo digital transformation. In the study of Çakıcı (2022), the interrelationship between digital transformation and value co-creation was proved, and we deduced this hypothesis. We can know that it is not only digital transformation. Even if the company is currently only undergoing digital transformation, which includes the external and internal digitalization mentioned above, it can be positive for value co-creation to a certain extent. Influences In past studies, although some studies have used value co-creation as a mediating variable (Barile et al., 2021), studies have not regarded value co-creation as a mediating variable between digitalization and digital transformation. This study successfully verified value co-creation. Since this research is based on

the real estate brokerage industry, there is no way to know why other industries are or are not suitable for digital transformation. In future research, we can study more industries to understand the reasons why other industries are suitable or unsuitable for digital transformation, what is the reason that he is not suitable for digital transformation, or simply that the existing modern technology is not enough to support the digital transformation of the industry, or some ethics or national regulations make the industry unsuitable for digital transformation.

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## USING A SIMULATION IN BUSINESS EDUCATION DEVELOPMENT SESSIONS: PARTICIPANTS' PERCEPTIONS OF PEDAGOGICAL EFFECTIVENESS

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### **ABSTRACT**

This study is currently a work-in-progress paper. It explores the perceptions of managers on an executive education course regarding their learning through the use of a business simulation, utilising constructivist pedagogy. Traditional instructivist pedagogy has been described as being educator driven, with the educator setting the agenda, with little focus on open-ended explorations (Jackson, 2015). Jackson (ibid) goes further to promote constructivist pedagogy as being more appropriate to help learners acquire knowledge and understanding through active learning. The educator is a facilitator, with learners defining and exploring problems and goals, building and utilising learning relationships, creating a personalised learning ecology. This endorses the contentions of other literature contrasting instructivist with constructivist approaches (illustratively, Gerstein 2015, 2014; Thomas and Seeley Brown 2011). Within the constructivist approach is an emphasis on reflection, drawing upon work by Stenhouse (1975) and Schön (1983). The vehicle is a group of sixty middle managers from one company using the simulation for CPD (continuing professional development), seeking to convert from acquiring knowledge as a product to knowing as a process. The simulation immerses teams in the management of an airport, tasked to achieve/exceed key performance indicators. The data are student responses to a survey based on themes from learning literature and the aims of the simulation (n = 42, 70% response rate). Descriptive statistics, and inferential statistics are used to report data analysis and findings. The findings indicate that the aims of the simulation are attained and learners have benefited from their involvement in constructivist pedagogy.

Keywords: constructivism, instructivism, pedagogy, simulations, executive education

# A STUDY OF THE WATER AND LAND TRANSPORTATION NETWORK AROUND PROVINTIA CITY IN 17<sup>TH</sup> - CENTURY DUTCH FORMOSA

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## **ABSTRACT**

In 1624, the Dutch East India Company (VOC) came to Tayouan (present-day Tainan Anping) to establish Zeelandia city, and in the late 1640s, the Provintia City was developed in the Saccam area (present-day Tainan West Central Dist.) across the Taijiang inner sea. The former served as a port city for entrepot trade, linking Taiwan with other port cities in Asia through water and land transportation; the latter served as a major city for land development, linking Saccam area with surrounding indigenous villages through the waterway and land route; the two cities were also linked by the water and land transportation network, reflecting the flow of people and goods at that time. Therefore, this paper explores and reconstructs the water and land transportation network around Provintia City as the core. In addition to citing relevant research and historical documents, several important historical maps are analyzed, including the Map of the west coast of Formosa in 1636, the Kangxi Taiwan map in 1699-1719, and the Taiwan Baotu in 1904. This study has five steps. First, the location of several indigenous villages in Southern Taiwan is clarified; second, the coastline and river system in the region are examined; third, reconstruct the land route of Provintia City; fourth, reconstruct the waterway of Provintia City; finally, a scaled plan of the water and land transportation network was compiled and drawn. The research results will help to understand the geospatial structure of the 17th -century Dutch Formosa and the subsequent historical changes in Southern Taiwan.

Keywords: Dutch East India Company (VOC), Provintia City, Fort Provintia, Dutch Formosa, Water and Land Transportation Network

# COMMUNICATION TECHNOLOGIES AND THEIR INFLUENCE ON MENA REGION UPRISINGS

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## **ABSTRACT**

The social media is found to have obtained considerable attention from the media in recent years, especially after the popular revolutions and protests. People have started looking at the al media as a platform to efficiently execute and organise regimes. There exist several such upheavals which took place in recent years and have become revolutionary through social media networking platforms. Examples of popular revolutions include The Arab Spring and Occupy Wall Street moment. This study closely examines how social media has played a role in the revolutions of the Arab Spring. The Arab Spring revolutions of are always debated to have been popularised and upraised by social networking media. The revolution has also been claimed popularly as the 'Twitter revolution' and 'Facebook revolution' by cyber sceptics and cyber supporters. It is thus claimed that the internet and its tools and social media have facilitated the uprisings of the Arab Spring. This study thus examines the role of social media as a tool of empowerment or surveillance in protest movements concerning the revolution of the Arab Spring. The impacts of social media on revolutions and in causing social unrest are evaluated in the study. The study closely examines the extent to which Arab activists used social media networks such as Twitter, YouTube and Facebook as tools for generating and organising consciousness of political conditions of the region during the Arab uprisings of 2010. The capability of social media is said to have mesmerised the conventional media and the observers. The revolutions upraised by social media also seem to have been blocked from use by the governments at a particular stage to control the protests on the Arab streets. For the study, secondary data was gathered from several articles, books, journals, and websites and worked upon by various authors and researchers. The study also discusses the role of social media by examining the secondary data in the final section concluding how social media has played a significant role in empowering the Arab Spring revolutions.

Keywords: Arab spring, Communication technologies, democratic processes, public opinion, social media, Middle East region

**ASSESSMENT OF SUPPLIER ACCEPTANCE OF ELECTRONIC REVERSE  
AUCTIONING TOOLS IN PROCUREMENT, USING TECHNOLOGY  
ACCEPTANCE MODEL (TAM) – CASE OF SRI LANKA**

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**ABSTRACT**

Online reverse auctioning tools are being used in the industrial sourcing projects and activities as a strategic negotiating tool (Wu et al., 2021). Online Auctions, also known as Reverse Online Auctions, are defined as internet based, real-time and dynamic auctions between organizations and suppliers, where potential suppliers compete against each other in terms of price<sup>1</sup>. However, in most of the developing countries, electronic reverse auctions are considered as controversial sourcing tools, as those are being criticized on the potential impact it can create on buyer-supplier relationships<sup>2</sup>. This study aims to assess the level of acceptance of electronic reverse auctioning tools by suppliers, considering a case within a Sri Lankan diversified conglomerate. Empirical data with regard to user experience and perception on electronic reverse auctioning tools, has been collected from 27 suppliers. Sample consisted with experienced suppliers on using reverse auctioning tools, from various industry sectors such as water consumables, oil and lubricants, chemicals, stationery, linen, wines and spirits, chicken, freezers and coolers, solar panels, air conditioners and computers. Among the many models and frameworks introduced by scholars on testing user adoption of new technologies, the Technology Acceptance Model (TAM)<sup>3</sup> has been selected to conduct this study. This model has been enhanced by researchers to increase accuracy<sup>4</sup> and the latest TAM consists of two factors that can influence the behavioural intention to use (BIU) technology by the user namely, perceived usefulness (PU) and perceived ease of use (PEOU). Then a descriptive analysis was conducted using correlation analysis and hypothesis testing. Results of the study reveal that the suppliers of the given Sri Lankan conglomerate, have a significantly higher degree of acceptance for reverse auctioning tools, after evaluating their behavioural intention to use (BIU) and its correlation with PU and PEOU. In addition, it is proven that both PU and PEOU are impacted by external variables (demographics) related to supplier.

Keywords: Reverse Auctioning, E-procurement, Technology Acceptance Model

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# GLOBAL ACADEMIC RESEARCH INSTITUTE

COLOMBO, SRI LANKA



## PROCEEDINGS

### GARI MULTIDISCIPLINARY SYMPOSIUM 2022

On 16<sup>th</sup> December 2022

in Colombo, Sri Lanka

# CONCEPTUAL DESIGN FRAMEWORK FOR WEARABLE PRODUCT DESIGN

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## **ABSTRACT**

Design aesthetically pleasing yet functional wearable products for the dynamic human body is always challenging since traditional garment manufacturing techniques and virtual prototyping techniques are not adequate. On the other hand, how to develop aesthetically pleasing forms is a well-practiced subject in the field of industrial design. Current conceptual paper discusses on how to integrate form development principles which are used in the field of industrial design into the field of wearable product design in fashion. Rowena Reed Kostellow's work related to form-factor-related visual design principles was mainly selected as an appropriate source for the current study. This work gives a structure to analyze visual relationships of an abstract form composition. Accordingly, character of line, shape, form, space, forces of the composition were focused and how they work together in creating abstract relationships was explored. Iterative design process allows the continuous improvement of the design solution through the three steps of Design, Prototype and Evaluate in a cyclic manner. Current study adopted the iterative design process in order to develop the above design framework for wearable product design. Some forms have been developed based on Kostellow's principles while developing the framework itself. Those designs have been presented. The framework emphasizes the adaptation of a hybrid methodology where it applies both physical and virtual prototyping techniques. Accordingly, Digital 3D

prototyping, 3D printing, 3D scanning, physical clay modeling, physical fabric-based prototyping and virtual prototyping are recommended in the in the prototyping phase of the iterative design process in order to develop expressive and functional wearable product designs.

Keywords: Wearable products, Form development, iterative design process, design framework, hybrid prototyping

## **INTRODUCTION**

Wearable products are becoming popular in recent years especially due to the advancements of digital technologies which offer connectivity through internet of things and miniaturization of the physicality of them. Accordingly, wearable products are extending their range from traditional non-digital products such as fashion accessories, shoes and bags to digital or phygital products such as fitness trackers, gaming equipment and head mounted displays. Gemperle et al. (1998) explains wearability as the interaction between the object that being worn and the body it worn on. According to Dunne & Smyth (2007), wearability is the degree of comfort offered by the being worn object to the wearer. Term comfort is referred to as not only physiological but also psychological, social or emotional. Hence, designing a wearable product has additional set of concerns which goes beyond the traditional design concerns. Evidently, added volume of the product upon the human body should inter-play with natural movements of the human body at a seamless manner and offers

psychological, social and emotional comfort in addition to the physical comfort. Accordingly, current study presents a conceptual design framework for wearable product design.

Gemperle et al. (1998) tried to identify locations in the 3D human form where can facilitate to hold wearable objects without interfering fluid body motions. Presented guidelines related to design for wearing were successfully applied at a later study where they developed a wearable tactile display (Gemperle et al., 2001). Further, Zeagler (2017) reviewed Gemperle et al. (1998)'s guidelines according to today's wearable products in the world since the product portfolio shows a considerable difference between these two time periods. While accepting the design guidelines of Gemperle et al. (1998), Motti & Caine (2014) also came up with 20 human factors principles to follow in design for wearing. LaBat & Ryan's (2019) work also give a set of considerations for designing wearable products specially when it comes to body placements. While accepting these insightful approaches to the area of design for wearing, current study presents a conceptual framework in order to make the overall design process efficient and effective.

The scope of the current study has been limited to wearable products that change the natural body form significantly. This change could be the change that occurs due to the added volume of the wearable product or changes to the body formation due to the wearing product. For instance, wearing a pair of high heeled shoes or boots significantly changes the standing posture of the wearer by enhancing the lumber curvature. Moreover, wearing shoulder pads can give the wearer a masculine wider shoulder look. Further, these body form changes can affect the perception towards the wearer as well as how the wearer feels about him or herself. For instance, Lewis et al. (2017) embraced the hypothesis that the attractiveness

shown when a woman wears high heels mainly occurs due to the enhancement of the lumber curvature of the women. Hence, studying the interaction between the perception of human body form and how it changes according to the manipulation of natural human form seem to show an interesting as well as potential research direction. Thus, current study will develop a framework for developing various form factors which can be used in developing products for wearing.

## ***METHODOLOGY***

The study conducted as a practice-based design research. Overall study was built up believing the pragmatist worldview with evolutionary ontology and learn by doing epistemology (Purao, 2013). Iterative design process was used as an underline structure in developing the wearable design framework. The Iterative design process consists of three phases named as Design, Prototyping and Evaluation. Design ideas are supposed to transfer these phases in a cyclic manner during the process. Current paper presents only the conceptualization part of the design framework for wearable products where only the researcher conducted the practice mainly as a designer. Thus, designer's reflection was captured and used as inputs to the iterative design process in order to improve the design concept while defining the design framework.

Stage of prototyping in the iterative design process is supposed to take a hybrid approach where both physical and digital prototypes were created for testing. Testing also should be conducted both virtually and physically. Hybrid process assisted fast development of design ideas, hence, more refinements to the conceptual design framework. However, current study which was conducted to develop the framework used only sketch models for prototyping. Hence, further studies should be conducted with both physical and

virtual prototyping in order to validate the design framework.

### **Adopting iterative design process into the current study**

Traditional the form follows function hypothesis emphasizes the fact that exterior form of an object should follow its internal functionality in order to make the overall form factor effective as well as functionally optimized. Hence, it is recommended to consider this hypothesis at any design including design for wearing. However, when it comes to wearable products forms should follow not only the function of its own internal mechanism but also how the wearer's body functions. Hence, we propose to include two cycles of iteration: designing a device to reach its desired functionality and designing the device for the dynamic human body (see the figure 1).

### **Process of adopting Kostellow's form language in the context of current study**

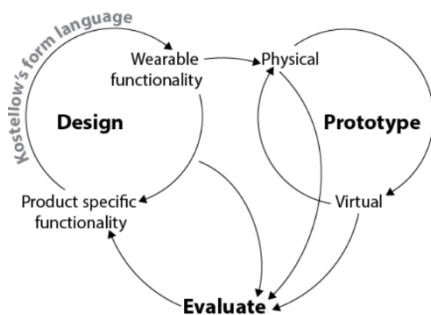
Akner-Koler's (2007) thesis and Hannah's (2002) work, which were both derived from the work of Rowena Reed Kostellow's work have been referred in the current study as a suggestion for designers to adopt in the process of wearable design in order to come up with expressive and functional forms for wearable designs. Kostellow's work is mainly about the structure of visual relationships. These visual relationships can be analyzed and constructed through practicing to see abstract relationships

within a composition. Moreover, Kostellow's form language emphasizes the character of line, shape, form, space, forces and how they work together while creating imaginary abstract relationships.

Kostellow positions individual forms which are in a composition at a hierarchy considering how dominant they are compared to others. Thus, there are three types of forms: dominant, sub-dominant and subordinate. Further, based on the orientation of an individual form, an imaginary axis can be seen which defines the direction of the expression of a form. This concept of axial movement is applicable not only to individual forms but also to collected forms in a composition. Accordingly, these concepts can be used to enhance the overall expression of a form composition.

In the context of the current study human body is considered as a composition of individual forms where torso is the dominant form and forms of hands, legs and the head are sub-dominant or subordinate to other forms. Moreover, axial movements can be drafted to define the directions of these overall form compositions (Wasala, 2021). Expressive characters can be achieved through manipulating the overall composition of body form with added forms of wearable products. Thus, the usage of Kostellow's form language in the current context makes the form-giving process more effective.

### **Conceptual design framework for wearable product design**

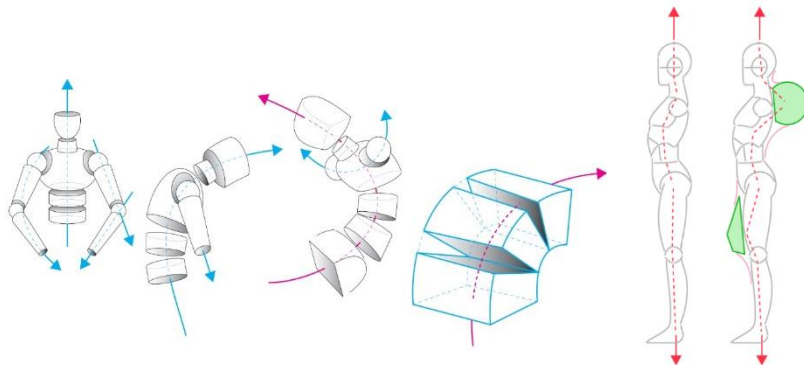


*Figure 1 - Conceptual design framework for wearable product design*

The conceptual design framework for wearable product designs (Figure 1) follows the underline structure of the iterative design process. Hence, it encourages the continues process of improvement. Moreover, the dedicated space for design constrained mainly by two functionality aspects of functionality related to the product which is being designed and the functionality related to wearability. The dedicated space of prototyping encourages both physical and virtual prototyping in order to reach the desired outcome earliest possible with minimum physical prototyping. Further, the dedicated space for evaluation receives input not only from the prototyping phase but also from the design phase in order to optimize the design process.

### **Application of the framework in the process of design for wearing**

Current study used the proposed conceptual design framework for wearable products to develop a wearable design while developing the framework itself (Figure 2). Accordingly, a space for an expressive backpack and exaggerated front trouser pockets were designed which changes the overall formation of the human body. First three images of Figure 2 show the imaginary line that can be drawn across the form of the human body and how the direction of this imaginary line changes based on the overall body posture and orientation (Wasala, 2021). Further, the form of the human body has been segmented based on their movement possibilities while keeping them connected to each other. Last two images of Figure 2 show how the imaginary axial line changes its direction when an external form attached to the body as potential wearable products.



*Figure 2 - Identifying axial movements in human form (Wasala, 2021) and applying extra volumes in a way that it alters the overall movement of the body form*

## **DISCUSSION**

Works such as Gemperle et al. (1998), Motti & Caine (2014), Zeagler (2017) and LaBat & Ryan's (2019) look into developing guidelines for wearable product designs specially related to placements of the human body which facilitate external forms as products. The

current research has been carried out agreeing to those guidelines. Even though these guidelines seem to be obvious, applying them and designing wearable product forms seems to be challenging. Hence, current research brought a conceptual design framework for wearable product design by integrating Kostellow's visual form analysis language, hybrid prototyping methods and iterative design

process. The framework was developed through a practice-based approach while experimenting with adding external forms to the natural form of the human body. How the imaginary axis of the form composition changes according to the overall final form which comes after adding external forms were explored. However, more experiments need to be conducted with physical and virtual prototyping as suggested by the framework. Lewis et al. (2017) showed that wearing high heel shoes can lead to more attractive body forms due to the enhancement of lumbar curvature of the wearer. Similar explorations also need to be conducted in relation to the current study specially on changes of the natural form of the human body and how it affects the perception. These types of experiments can be used to validate the proposed conceptual framework.

## CONCLUSION

Other than usual wearable products such as fashion accessories, shoes and bags more and more wearable products are coming to people's everyday life due to the advancement of digital technologies. Designing wearable products gives more challenges than designing static objects since, externally added physical forms could interfere the dynamic fluid body movements of the wearer. A conceptual design framework for wearable product design has been presented in this paper to help designers to ease the process of designing. The method presented in Kostellow's work related to the analysis of different form compositions was integrated in the iterative design process in addition to the hybrid prototyping method. Even though, initial testing of the design framework shows it as a promising solution to wearable product design methodology, more testing and validations are needed. Testing with experienced designers in expert interview sessions and

co-discovery sessions can be identify as future research directions in order to firmly establish the proposed conceptual design framework. Finally, the study should extend to explore the expressive aspects of manipulated forms of human body in the same way which was conducted by Lewis et al. (2017) on high heeled shoes and increased the attractiveness.

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# CURRENT TRENDS IN METROLOGY FOR INDUSTRIAL DEVELOPMENT AND DIGITAL CALIBRATION SYSTEMS

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## **ABSTRACT**

It is mandatory to facilitate international trade through reducing rejects and removing technical barriers to trade (TBT) to resolve the current economic crisis and increasing the production capacity improving quality of export products in developing countries. Therefore used international standards which help to improve industrial measurement process through satisfying requirements for measurement processes and measuring equipment metrological characteristic to customer metrological requirement[1]. Mass, Dimension, Temperature, volume, pressure and flow measurements are critical in manufacturing and production sector for accurate positioning of sensors for transmitting actual data for management system and for making the required quality output. Digital development is a decision not a choice for integrated economic and industrial development for a comprehensive and sustainable development for generations. The world wide national metrology institutes mainly PTB, Germany working with digital transformation in metrology in machine readable version and introduced DCC Syntax[2]. We provide internationally traceable metrology facilities through accredited calibration certificates according to ISO 17025:2017[3] in hardcopy and focus to implement Digital calibration system. Digitization used to fulfill the high demand for calibration in the process from customer request to issuing calibration certificate. Calibration report preparation

and reviewing arranged to do in softcopy in MS excel to reduce paperwork and resources. Single page human readable digital calibration certificate were programmed in MS Excel and saved as PDF with electronic signature in mass laboratory to deliver customer in shared folder maintaining data security aspects. This electronic human-readable version is similar as the current (non-digitalized) calibration certificate and it reduce handling, storage, retrieval time and more efficient than the analog version in hardcopy. Each Single page auto generated standard weight calibration certificate with unique identification numbers contain conventional mass value with international traceability and uncertainty according to OIML 111-1 standard[4]. Calibration measurement capability(CMC) or the best realizable uncertainty for E2 class standard weights is 2 $\mu$ g for 1mg standard weight, 0.02 mg for 50g, etc. Calibrated results of weights can be transferred upto 35 weights in one page data analysis form then referred calibration results reported in 2nd Page. If necessary it has the capacity to extend even more number of weights received from Customers. Report preparation and reviewing time has reduced significantly. Electronic copies make secure data transmission with loyal customer. Digital calibration certificate in machine readable version is also in experimental basis to convert from excel version. The correction factors given in report should be used for measurement process or measuring



equipment and should confirm it to customer metrological requirement specified in their procedures. If there is deviation customer should correct or repair or replace their equipment. The implementation of DCC is crucial for the quality infrastructure in industrial internet of things (IIOT) and sensor networks to meet the challenges in digital era going with this year theme for world metrology day 'metrology in digital era', which needs an international effort and coordination to achieve sustainable development.

Keywords: Metrological confirmation, Weight calibration, Human readable digital calibration certificate

## **INTRODUCTION**

Metrology is science of measurement and its application. It has three major streams in scientific metrology, legal metrology and industrial Metrology. The objective is to focus on industrial metrology concerned with application of measurement to manufacturing and other processes and their use in society, ensuring the suitability of measurement instruments, their calibration and quality control. Calibration is the process of comparing the test equipment/instrument or the value of a material measure against reference value of a measurement standard with uncertainties under specified conditions. In the process of calibration of an instrument or material measure, the test item either adjusted or correction factors are determined. It establishes a relation between the quantity values with measurement uncertainties provided by measurement standards and corresponding unknown device with associated measurement uncertainties under specified conditions. Metrological Traceability is the value of a measurement standard or measuring instrument can be determined by an unbroken chain of comparisons with a series of higher level

standards with stated uncertainties. Metrological Traceability guarantees international consistency and comparability, significantly reducing technical barriers to trade (TBT's). It is mandatory to reduce technical barriers to trade (TBT) and rejects at international market to resolve current economic crisis and increasing the production capacity improving quality of export products of the local industries.

Mass, Dimension, Temperature, volume and flow measurements are critical in manufacturing and production sector for accurate positioning of sensors for transmitting actual data for information management system and for making the required quality output. It is intended to utilize international standards to meet requirements for measurement processes and measuring equipment metrological characteristic (MEMC) to customer metrological requirement (CMR) [1] to improve industrial measurement process since industry and society face issues on traceability and calibration in more broader view metrological confirmation of measuring equipment. The International Bureau of Weights and Measures (BIPM) established by Article 1 of the Metre Convention, signed on 20 May 1875 providing the basis for a single, coherent system of measurements and Operates under the authority of the International Committee of Weights and Measures (CIPM). The international system of units in 1960 define 7 base SI units with meter, kilogram, second, Ampere, Kelvin, mole and candela. Its definitions redefined in 2020 to realize by independent national and come into inter lab comparisons. The world wide national metrology institutes mainly PTB, Germany working with digital transformation in metrology in machine readable version and introduce DCC Syntax [2]. Internationally traceable metrology facilities provided through accredited and non accredited calibration

certificates according to ISO 17025:2017[3] to the local and foreign customers. Accredited calibration certificate have third party attestation for technical competency and traceability to ISO 17025: 2017 standard. Non-accredited calibration reports given without ILAC MRA logo and accreditation body logo, with traceability to reference standard by direct comparison or with international guidelines.

## METHODOLOGY

The process from customer request to issuing calibration certificate plans to be digitized in the digital era to fulfill the high demand for calibration and issue calibration certificate. Reference standards used for calibration with uncertainty fulfilling the ISO 17025:2017 standard; General requirements for the competence of testing and calibration laboratories ensure the standardized process of operation. When receiving customer request, the request form will be shared in separate folder in 'google' drive to input the calibration request details, then after preparation of the invoice, it will

be shared in drive and after payment, final report will be shared in 'google' drive folder to access by the customer. In the calibration laboratory providing digital calibration answer is planned for last phase due to limited resources. Calibration report preparation and reviewing arranged to do in softcopy in MS excel to reduce paperwork and resources. Even handling, storage, retrieval is efficient with digital systems than the analog version in hardcopy.

Reference weights of classes E1,E2,F1,F2,M1,..and OIML111-part 1 international recommendation[4] used for standard/industrial weights calibration by Direct comparison double substitution method[5]. The test weight is compared against one or more reference weights of nominally equal value and the following cycle of weighing is performed: Load the reference weight R and obtain reading r1, Replace R by the test weight, T and obtain reading t1, Add a sensitivity weight and obtain reading t2 , Replace T by R and obtain reading r2. Calculated the conventional mass( $m_{ct}$ ) of the test weight using the equation;

$$m_{ct} = m_{cr} + \frac{m_{cs}(t_1 + t_2 - r_1 - r_2)}{2(r_2 - r_1)} + m_{cr}C \quad \text{where} \quad C = (\rho_a - 1.2) \left[ \frac{1}{\rho_t} - \frac{1}{\rho_r} \right]$$

The term C in equation (1) represents the buoyancy correction.

if  $|C| \leq \frac{1}{3} \frac{U}{m_o}$  the term  $m_{cr}C$  can be omitted. U - Expanded uncertainty of the test weight,  
 $m_o$  - Nominal mass of the test weight

Repeated the above cycle several times and recorded the data

$$\text{Average conventional mass for n cycles } (m_{ct}) = \bar{m}_{ct} = \frac{\sum m_{ct}}{n}$$

$m_{ct}$  - Conventional mass of the test weight,  $m_{cr}$  - Conventional mass of the reference weight,

$m_{cs}$  - Conventional mass of the sensitivity weight,

$\rho_t$  - Density of the test weight,  $\rho_r$  - Density of the reference weight,  $\rho_a$  - Air density

MS excel used to auto generated final data sheet to review and auto generated human readable digital calibration

certificate. It saved in google drive folder for easy access to work from home and finally after reviewing saved as PDF with

electronic signature or take print in security papers if necessary in mass laboratory to deliver customer, maintaining data security aspects. Auto generated calibration certificate issued with unique identification number and contain conventional mass value with international traceability and uncertainty as given in annexure 1. Calibration measurement capability or the realizable best measurement capability achieved to E2 class standard weights was 2µg for 1mg standard weight, 0.02 mg for 50g, etc. Number of weights can be combined upto 35 weights in single report then calibration results report in 2nd Page, Report preparation and reviewing time has reduced significantly. If necessary it has the capacity to extend even more. Electronic copies make secure data transmission with loyal customer. This human-readable version is similar to the current (non-digitalized) calibration certificate. Correction values given in calibration certificates should be used for measurement process in measuring equipments. Converting this human readable calibration certificate to machine readable version in Excel is in progress using 'python', but still no customer requirement for the machine readable version certificate.

## **CONCLUSION AND RECOMMENDATION**

Human readable calibration certificate in electronic or digital form is successfully done to any number of weights to produce the calibration certificate with minimum time. Calibration is far beyond a just calibration report, The correction factors given in report should be used for measurement process or measuring equipment and should confirm it to customer metrological requirement specified in standard procedures. If there is deviation customer should correct or

repair or replace their equipment. Development in industrial sector can be catalyzed by introducing digital calibration certificate, since then calibration laboratory will transfer the calibrated data directly to the machines to improve the efficiency and effectiveness of the measurement processes. Metrological confirmation of measuring equipment satisfying customer metrological requirement in industrial processes, will help to minimize rejects and remove technical barriers to trade facilitating international trade in developing countries. It's very important to come together and discuss how to implement digitalization tools, since it's crucial for the quality infrastructure in digital environment. It's a pleasure to take initiating steps to introduce digital calibration systems to meet the challenges in digital era, going with this year theme for world metrology day 'metrology in digital era'. Finally lot more to do for implementation of digital transformation with traceability in metrology in industrial internet of things(IIoT) and sensor networks. This needs an international effort and coordination to achieve sustainable development goals.

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Annexure 1  
Calibration Certificate of Standard Weights

Issued by .....

	Certificate No:	SS-	
Reference No	C2201111-1		
Customer	XXXXXXXXXXXXXX		
Address	XXXXXXXXXXXXXXXXXX		
Description	Standard Weight set	Accuracy class:	F1
Capacity/Range	1mg and 50g	No of weights:	2
Serial No	A1289387	ID No:	W-001
Manufacture	Ohaus		
Received Condition	No visual damage		
Request Date	2022 August 10	Calibration Date	2022 September 4
Location of calibration	Mass Laboratory		
Temperature	23 ± 0.5 ° C	Relative Humidity	50 ± 10%
Reference standards and Traceability			

Set of weights of accuracy class E2 (Eqp No MA00X) traceable to Primary standards maintained at DKD, Germany to the International system of units (our reference xxxx) Auxiliary Equipments used

Comparator Mettler AT1005                      1000g                      0.01 mg

Calibration Results

Nominal value	Conventional mass value (g)	Deviation (g)	Expanded Uncertainty U (g)
1mg	0.000995	0.000005	0.000003
50g	50.000597	0.000597	0.000026

The measurement results can be varied ± U

UNCERTAINTY:

The reported expanded uncertainty of measurement is based as the standard uncertainty of measurement multiplied by a coverage factor k=2, corresponding to a coverage probability of approximately 95%. The standard uncertainty of measurement has been determined in accordance with Guide to the expression of uncertainty in measurement (GUM-JCGM 100: 2008)

Customer obliged to recalibrate the weights at appropriate intervals

Authorized by	Test Performed by
xxxxxxx	xxxxxxx
Authorized Signatory	Research Scientist
Senior Research Scientist	
2022 October 5	

# **ELECTROCHEMICAL PERFORMANCE OF ANODE MATERIALS, DEVELOPED FROM SRI LANKAN NATURAL VEIN GRAPHITE, IN RECHARGEABLE LITHIUM-ION BATTERIES**

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## **ABSTRACT**

Graphite is presently the most common anode material used for rechargeable Lithium Ion Batteries (LIB). However, further development of graphite as a more stable and high-capacity anode material is crucial to face the growing high demand exists for LIB in the battery market. In this study, Sri Lankan vein graphite was developed for LIB anode by introducing acid-leaching purification followed by surface modification. Then, coin cells were assembled in an argon-filled glove box with anode electrode fabricated from the developed graphite, lithium foils as reference and counter electrodes with non-aqueous electrolyte of 1M LiPF<sub>6</sub> in ethylene carbonate and dimethyl carbonate (1:1 wt %). Galvanostatic charge-discharge testings performed on the cells showed a significant high initial specific discharge capacity of 399.6 mAhg<sup>-1</sup> while maintaining high Coulombic efficiency of around 99 % over 50 cycles. More importantly, the resultant smooth cyclic voltammograms having a sharp anodic peak (delithiation) at 0.452 V and a cathodic peak (lithiation) at 0.459 V endorse for a greater intercalation and de-intercalation of lithium ions with the developed graphite anode material. Furthermore, the resultant electrochemical impedance spectroscopy shows an interestingly low charge transfer resistance at the electrolyte/electrode interface. It implies that our introduced purification and modification to graphite in this study have greatly supported to enhance the charge transfer together with improved reversible capacity and cycling stability. Consequently, it reveals the capability of our introduced purification and modification processes to develop Sri Lankan vein graphite as a more stable and high-capacity anode material for rechargeable lithium-ion batteries.

Keywords: Sri Lankan vein graphite, electrochemical performance, purification, modification

# STUDY ON QUASI-STATIC PRESSURE OF TNT INTERNAL EXPLOSION IN CONFINED SPACES

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## **ABSTRACT**

Afterburning-effect accompanies the explosion of TNT explosion. To accurately analyze and study the quasi-static pressure characteristics of TNT explosion in confined space, using AUTODYN finite element software to numerically simulate the explosion of TNT explosives of different masses in a confined space, and through parameter settings, The afterburning-effect of detonation products produced by TNT explosion is considered. The quasi-static pressure values of TNT explosives with the different masses of TNT in the confined space are obtained. Through dimensional analysis, it is concluded that the ratio of the confined space volume to explosive charge is the main factor affecting quasi-static pressure. And conclude by fitting the numerical simulation results that the functional relationship between quasi-static pressure value and charge volume ratio of confined space Within the scope of

$2.79\text{kg/m}^3 \leq W/V \leq 27.9\text{kg/m}^3$ , the maximum relative deviation between the calculated value and the test value is 10.5%, which can be used to predict the quasi-static pressure peak value of TNT explosion in a confined space.

Keywords: TNT, quasi-static pressure, numerical simulation, mass-space volume, dimensional analysis

## **INSTRUCTION**

The explosion energy release of explosives in confined space differs from

that in free space. After the explosion of explosives in the confined space, the shock wave pressure is reflected in the confined space due to space restrictions during the propagation process. At this time, the pressure load in the confined space is composed of the initial reflected shock wave and several subsequent reflected and oscillating superimposed shock waves (CAI,2019). After the blast shock wave stage ends, relatively stable, slow change and prolonged quasi-static pressure will be formed inside it, causing more severe damage to the target in the confined space. Quasi-static pressure is an essential characteristic parameter of the total energy of explosives (WANG et al., 2020). The research on quasi-static pressure of explosion in confined space is of great significance for evaluating explosive power and structural protection design. The source of quasi-static pressure is mainly the detonation products and the expansion of the gas with increased temperature caused by the explosion heat in the confined space, which is constrained by the space (WANG et al.,2012; ZHANG et al.,2018). When TNT explosive explodes in a confined space, the subsequent combustion effect supported by oxygen has an important influence on the formation of quasistatic pressure and its peak value (LI et al.,2020; JIN et al.,2013). When numerically simulating the explosion in a confined space, to better analyze the explosion shock wave and quasi-static pressure load in the confined space, it is necessary to consider the

energy released by the combustion effect (KONG et al.,2019). Domestic and foreign researchers have done much research on quasi-static pressure load. T.P.E. David (David,1996.) and R.J. Lee (LEE et al.,2010) established the evaluation method of explosive internal explosion effect based on quasi-static pressure; Some scholars have studied the quasi-static pressure load characteristics of explosion in confined spaces by conducting explosion tests and numerical simulation methods and obtained that the mass /space volume ratio  $W/V$  is the main factor determining the quasi-static pressure, and used relevant test data to fit the quasi-static pressure calculation formula (ZHANG et al.,2019;XU,2019; XU, 2019). At present, the research on quasi-static pressure mainly focuses on numerical simulation. However, in numerical simulation of explosions in confined spaces, the afterburning effect release energy of explosives is often ignored, which leads to some errors in the results. The calculation formulas of quasi-

static pressure obtained are quite different, and the application scope is small. The quasi-static pressure of TNT explosives in a confined space is studied by numerical simulation.

## METHODOLOGY

Explosion in a confined space is a fluid structure coupling problem. The AUTODYN nonlinear dynamics analysis software's ALE algorithm is selected to simulate the explosion process of TNT explosion in a closed container. The total dimension of the closed container is  $100\text{mm} \times 100\text{mm} \times 300\text{mm}$ , the thickness is 10mm, and The volume of the explosion cavity is  $80\text{mm} \times 80\text{mm} \times 280\text{mm}$ . Choose 5g, 10g, 15g, 25g, 35g, and 50g TNT explosives of different masses to explode inside, and set the explosive position as the centre of the closed container. The numerical simulation model is shown in Figure 1.

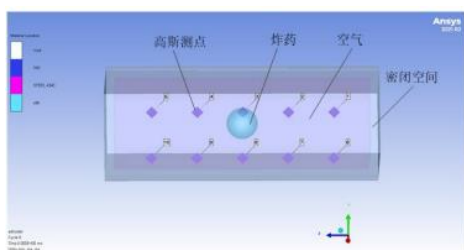


Figure 1 Numerical simulation model

The material of the closed container is steel 4340. Its constitutive model is defined by the Johnson-Cook model, the failure model of material is Johnson-Cook, and set its related parameters. The air material model is simplified as a non-dense ideal gas, and the shock wave expansion is assumed to be an adiabatic process. LINEAR POLYNOMIAL expresses the equation of the state of air material.

The JWL equation of state describes TNT

JWL equation has some limitations in describing TNT, a highly harmful oxygen explosive. The energy released by the afterburning effect of detonation products is not considered in the setting of the above parameters, so it needs to be supplemented and corrected. In AUTODYN analysis software, the afterburning effect shall be considered. It can be realized by adding additional

energy based on the JWL equation. Select the Additional Energy item in the Additional Option (Beta) of the material parameter panel of TNT to add extra energy.

Considering the instability of the peak and trough pressure values of the pressure curve in the quasi-static pressure stage, the average value of this stage is taken as the quasi-static pressure value in this paper takes the average value of this stage as quasi-static pressure value.

## RESULT

Table 1 Quasi-static pressure value in confined space

m/kg	5	10	15	25	35	50
m/V/(kg•m <sup>3</sup> )	2.79	5.58	8.37	13.956	19.53	27.9
P/kPa	2157.4	4284.8	6354.5	10572	14751	20960

According to the numerical simulation in the previous section, the quasi-static pressure peak value of TNT explosives with different qualities exploding in a confined space is obtained by fitting

$$P_q = 0.781 \left( \frac{W}{V} \right)^{0.9883} (2.79 \text{ kg / m}^3 \leq \frac{W}{V} \leq 27.9 \text{ kg / m}^3)$$

The goodness of fit  $R^2=0.998$ . The comparison results between the quasi-static pressure test values of explosion in confined spaces in literature [12] and literature [3] and the calculated values in (6) are shown in the table2.

Table2 Comparison between test value and calculated value

m/V/(kg•m <sup>3</sup> )	test value /MPa	calculated value /MPa	Relative deviation /%
3.84	3.3	2.95	10.5
6.46	4.8	4.94	2.8
8.87	6.48	6.75	4.2
17.69	12.58	13.36	6.2

## DISCUSSION

Figure 2 shows the pressure curve of a 10gTNT explosive explosion in a confined space. It can be seen from the figure that the pressure load change in the confined space is mainly divided into two stages. The first stage is the high-frequency shock wave pressure. Because the shock wave is constrained by the space structure in the propagation process, multiple reflections and superimposition occur in the confined space, and numerous pressure peaks appear in the shock wave load stage. It can

be seen from the partial view in the following figure that at the end of the shock wave pressure loading phase, the pressure peak value has increased, which is caused by the afterburning effect of the TNT explosion. After that, the pressure load in the confined space enters the second stage - the quasi-static pressure load stage. The pressure curve no longer attenuates with the change of time. The pressure peak value tends to be stable and lasts for a long time.



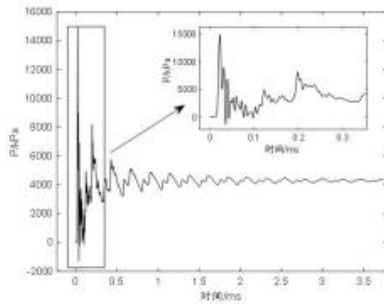


Figure 2 10gTNT Explosion pressure time curve

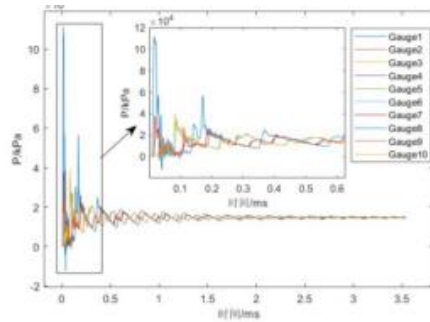


Figure 3 Pressure Curve of Gauss Points in 25gTNT Explosion Confined Space

Figure 3 shows the pressure curve of each Gauss measuring point when a 35gTNT explosive explodes in a confined space. It can be seen from the figure that in the stage of shock wave pressure loading, due to the different distances between each measuring point and the explosion centre, the peak value of shock wave overpressure decreases with the increase of the explosion centre distance. With the end of the process of reflection and superposition of the shock wave pressure in the confined space, the quasi-

static pressure reaches the peak value, the pressure in the confined space tends to be stable and evenly distributed, and the quasi-static pressure values of each measuring point are equal. To obtain a universal calculation method of TNT explosion quasi-static pressure peak value in a confined space, a dimensional analysis of the quasi-static pressure in a confined space is carried out. TNT explodes in a confined space, and there are many factors affecting the quasi-static pressure peak value, mainly

including the mass of TNT  $W$ ; TNT explosive density  $\rho_e$ ; Energy released by unit mass explosion  $E$ ; Expansion index of explosion products  $\gamma_e$ ; Initial air pressure in confined space  $P_a$ ; Initial air density  $\rho_a$ ; air adiabatic index  $\gamma_a$ ; Confined space volume  $V$ ;  $P_q$  stands for quasi-static pressure value, it can be expressed as a function of physical quantity:

$$P_q = \psi(W, \rho_e, E, \gamma_e, P_a, \rho_a, \gamma_a; V) \quad (2)$$

According to the  $\Pi$  theorem and dimensionality analysis, we get the following results:

$$P_q = \phi(V/W) \quad (3)$$

## CONCLUSIONS

When the TNT explosive explodes in a confined space, the rise of quasi-static pressure is accompanied by multiple shock wave reflections. At the end of the shock wave pressure reflection, the combustion effect of detonation products releases a certain amount of energy, and the quasi-static pressure reaches the peak value for a long time; The quasi-static

pressure load is uniformly distributed in the confined space, and the quasi-static pressure at different locations is approximately equal. Through dimensional analysis, it is proved that the ratio of enclosed space volume to explosive charge is the main factor determining the quasi-static pressure. Through numerical simulation, the quasi-

static pressure peak value of TNT explosives with different qualities exploding in the confined space is. The functional relationship between the quasi-static pressure value and the charge volume ratio of the confined space within the range. Within its application scope, the

maximum relative deviation between the calculated value and the test value is 10.5%, which can be used to predict the quasi-static pressure peak value of the TNT explosion in a confined space

$2.79\text{kg} / \text{m}^3 \leq W / V \leq 27.9\text{kg} / \text{m}^3$ . It is obtained through data fitting.

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# TRI-TRANSITION METAL OXIDE CATHODE MATERIALS WITH CHEAPER ALKALINE METAL ADDITIVES FOR LITHIUM-ION RECHARGEABLE BATTERIES

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## ABSTRACT

Layered tri-transition metal oxides, specially  $\text{LiNi}_{1/3}\text{Co}_{1/3}\text{Mn}_{1/3}\text{O}_2$  (NMC 333), have become a promising cathode electrode material in the rechargeable Lithium-Ion Battery (LIB). The electrochemical performances of NMC 333, mainly depend on its crystallographic structural properties including lattice parameters, dislocation density ( $\delta$ ), and lattice strain. In this study, the Pechini method, which is a low-cost wet chemical technique, was used for synthesizing  $\text{K}^+$  doped  $\text{Li}_{1-x}\text{K}_x\text{Ni}_{1/3}\text{Mn}_{1/3}\text{Co}_{1/3}\text{O}_2$ , ( $x = 0, 0.04, 0.08$ ) materials. The crystallographic structural properties of the synthesized materials were characterized using X-ray diffraction (XRD). In the refinement of XRD data, the reliability factor of  $\chi^2$  and Rwp were found to be less than 3 with weighted factors of less than 10%, confirming an acceptable refinement. XRD confirmed the formation of a single-phase layered hexagonal  $\alpha\text{-NaFeO}_2$  structure (R-3m space group) without any impurity phase for all prepared materials.  $\text{Li}_{0.96}\text{K}_{0.04}\text{Ni}_{1/3}\text{Mn}_{1/3}\text{Co}_{1/3}\text{O}_2$  showed the optimum crystallographic properties with a better splitting of the (006)/(102) and (108)/(110) peaks. The crystallite size of  $\text{Li}_{1-x}\text{K}_x\text{Ni}_{1/3}\text{Mn}_{1/3}\text{Co}_{1/3}\text{O}_2$ , (%) materials were 77.4 nm, 128.38 nm, and 122.6 nm for  $x = 0.00, 0.04,$  and  $0.08$  nm respectively. Scanning Electron Microscopy of synthesized materials showed sponge-like agglomerates, with well-defined compact and larger primary particles. The peaks observed at 479 and 596  $\text{cm}^{-1}$  in Raman spectroscopy could be assigned to Raman-active species  $\text{E}_g$  and  $\text{A}_{1g}$  modes for  $\text{Li}_{1-x}\text{K}_x\text{Ni}_{1/3}\text{Mn}_{1/3}\text{Co}_{1/3}\text{O}_2$ , ( $x = 0, 0.04, 0.08$ ) materials. Altogether, this study reveals that the addition of  $\text{K}^+$  by substituting  $\text{Li}^+$  improves the structural stability hence the potentiality of NMC 333 materials for the cathode of LIB.

Keywords: NMC materials, Na doping, K doping, Li-ion battery, Pechini method

# DEVELOPMENT OF SRI LANKAN VEIN QUARTZ, THROUGH PURIFICATION AND MODIFICATION, FOR THE ANODE APPLICATION OF RECHARGEABLE LITHIUM-ION BATTERIES

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## ABSTRACT

Silicon and its oxidative derivatives have been identified as a promising anode material for lithium-ion batteries (LIB) due to volumetric energy, high power density, and long cycle life. However, high cost, volume expansion during lithium intercalation, and low electrical conductivity limit its practical applications. Therefore, this study aimed to develop cheaper and greener anode material using Vein Quartz (VQ) from Sri Lanka. VQ was ball milled and acid leached to obtain high-purity quartz and modified further with a pyrolysis technique. The X-ray diffraction phase analysis performed on this developed quartz reveals the existence of only the signature crystalline structure and its fingerprint phases without any minority phase. Raman spectroscopy analysis conducted on developed VQ also reveals the presence of the signature crystalline structure. Coin cells were assembled in an argon-filled glove box with the developed VQ anode electrodes, Li-foil as the reference and counter electrodes, and the non-aqueous electrolyte of 1M LiPF<sub>6</sub> in ethylene carbonate and dimethyl carbonate (1:1 wt %). The cyclic-voltammograms obtained on LIB half-cells assembled with anode electrodes fabricated from developed quartz reveals a stable and reversible reduction and oxidation during charging and discharging. Finally, Electrochemical impedance spectroscopy analysis exhibited improved electrical conductivity. Altogether, this study reveals the potentiality of developing Sri Lankan vein quartz for the anode application in rechargeable lithium-ion batteries.

Keywords: Sri Lankan vein quartz, lithium-ion rechargeable battery, electrochemical analysis

# REMOTE CALIBRATION MODEL FOR TEMPERATURE AND ELECTRICAL INSTRUMENTS IN INDUSTRY THROUGH EMERGING TECHNOLOGIES

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## **ABSTRACT**

International standards in electrical and temperature metrology can be used for calibration of equipment in industry to meet requirements for measurement processes and measuring equipment metrological characteristic (MEMC) to customer metrological requirement (CMR) [1] to improve industrial measurement process. Internationally competitive calibration services with traceability provided to local and foreign customers through analog calibration certificates but need arise in digital era to do it remotely as an example for industrial internet of things sensors (IIOT). Temperature indicator/simulator calibration done according to EURAMET cg-11 [2] where the electrical stimuli used for the temperature indicator or simulator calibration. Instrument accuracy stay within specification only if calibration/adjustment performed at regular interval or at extended interval by analyzing previous calibration data according to OIML D10 guideline [3]. Multimeters and electrical measuring devices can be calibrated at laboratory according to EURAMET cg-15 [4]. It's about unit under test value direct comparison with the reference standard values at defined percentages to cover the range of operation. Also it has the provision to use the method for capacitance and frequency. Also we could extend method for inductance, direct comparison with the appropriate reference standard with traceability certificates.

Currently calibration devices need to be taken to calibration laboratory or onsite calibration arranged, which will not be feasible in next decade with industry 4.0 environment. So to survive in the business, developing remote calibration applications are crucial using remote interfaces and data communication methods. For that recalibration of instruments done according to EURAMET guidelines mentioned above using RS232 remote interface, wireless sensor networks and software application separately purchased from manufacture or calibration provider. The user plug in the device and remote program directs to apply a series of shorts, opens, voltage, current, and resistance to input the test calibration equipments/device. Then software obtain the test meter reading with in short period of time reducing cost, time, human error and energy. Internet of things (IOT) platform or additional software can be developed using remote panels in Lab view. 'Thingspeak.com' IOT platform used with digital thermometer for data acquisition to IOT to view from remote location. The correction factors in calibration certificates should be used for measurement process or measuring equipment and should confirm it to customer metrological requirement specified in their procedures. If there is deviation customer should correct/replace their equipment to ensure the quality of their products to compete in international trade and achieve sustainable development goals. Remote calibration model for direct

comparison is universal can be implemented successfully since transducers are developing for conversion of physical quantities and electrical signal and vice versa in wireless sensor networks. More over developing digital reference system for digital SI units is to be done. Digital development is a decision not a choice for integrated economic and industrial development for a comprehensive and sustainable development for generations.

Keywords: Temperature and Electrical devices, Digital/remote calibration, uncertainty

## ***INTRODUCTION***

The International Bureau of Weights and Measures (BIPM) established by Article 1 of the Metre Convention, signed on 20 May 1875 provide the basis for a single, coherent system of measurements and Operates under the authority of the International Committee of Weights and Measures (CIPM). The international system of units define 7 base SI units with meter, kilogram, second, Ampere, Kelvin, mole and candela in 1960. It's redefined in 2020 related to known constants like avagadro number, plank constant, electronic charge etc to realize by independent nationals and then join for BIPM or regional inter lab comparisons. Industrial metrology concerned with application of measurement to manufacturing and other processes and their use in society, ensuring the suitability of measurement instruments, their calibration and quality control. Calibration is the process of comparing the test equipment/instrument or the value of a material measure against reference value of a measurement standard with uncertainties under specified conditions. In the process of calibration of an instrument or material measure, the test item either adjusted or correction factors

are determined. Metrological Traceability gives the value of a measurement standard determined by an unbroken chain of comparisons with a series of higher level standards with stated uncertainties. Metrological Traceability guarantees international consistency and comparability, significantly reducing technical barriers to trade (TBT).

It is intended to utilize international standards in electrical and temperature metrology to meet requirements for measurement processes and measuring equipment metrological characteristic(MEMC) to customer metrological requirement (CMR)[1] to ensures that measuring equipment and measurement processes are fit for their intended use and is important in achieving product quality objectives and managing the risk of incorrect measurement results. Metrological characteristic is distinguishing feature which can influence the results of measurement. Metrological confirmation is set of operations required to ensure that measuring equipment conforms to the requirements for its intended use [1]. Self-calibration/ auto-calibration is internal calibration process of an instrument, with the aim of improving its accuracy. Adjustment of a measuring system is set of operations carried out on a measuring system to provide prescribed indications corresponding to given quantity to be measured. Depending on the instrument, the adjustment can be performed by physical adjustment of internal components or via the instrument's firmware. Accredited calibration services have third party attestation for technical competency and traceability to ISO 17025:2017 standard; General requirements for the competence of testing and calibration laboratories ensure the standardized process of operation. Non-accredited calibration does not have third part attestation and reports given without ILAC MRA and accreditation body logo,

with traceability to reference standard by direct comparison.

Temperature indicator operates by converting the electrical signal received from a sensor in to an equivalent readout in temperature units. The calibration principle is based on the verification of this conversion process by simulation / replacement of the output of the sensor by appropriate electrical stimuli and calibrated according to EURAMET cg-11[2]. Fluke bench type digital multimeter available with the RS232 remote interface for calibration. It is user friendly to field precision measurements in automation systems, portable and adjustment or calibration required to maintain traceability and accuracy at desired interval or when meter verification test indicate it is out of tolerance. Instrument

accuracy stay within specification only if adjustment performed at regular interval[3]. Electrical measuring equipment can be calibrated at laboratory according to EURAMET cg-15[4] for that it need to be taken to calibration laboratory. So to survive in the business, developing remote calibration applications is must using remote data communication methods, wireless networks like wi-fi etc to work from remote desktop to give required reference values and obtain the test meter reading with in short period of time reducing cost, time and energy. Figure 1 elaborates the connection between industrial real world production optimization and virtual optimization plan. It was evolved with sensor data, central database cloud computing, digital twin to facilitate industry 4.0

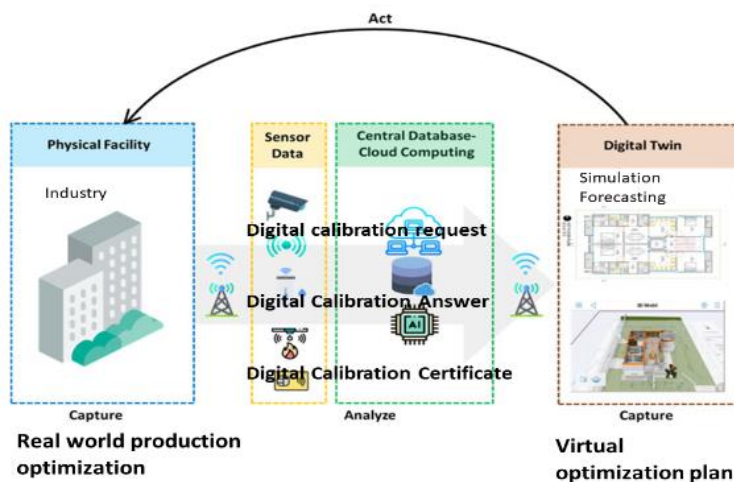


Figure 1

The International System of Units (SI) providing confidence in the accuracy and global comparability of measurements needed for international trade, manufacturing, human health and safety, protection of the environment, global climate studies and scientific research through the international quality infrastructure. Maintaining this

confidence in the accuracy and global comparability of measurements will require the creation and adoption of a full digital representation of the SI, including robust, unambiguous, and machine-actionable digital representations of units of measurement and of measurement results and uncertainties [5].

## METHODOLOGY

Main focus here is to develop model to provide digital calibration answer with remote calibration. EURAMET reference guidelines and fluke multi product calibrator used for calibration with uncertainty fulfilling the ISO 17025:2017 standard. Calibration report preparation and reviewing arranged to do in softcopy to reduce paperwork and resources. Even handling, storage, retrieval is efficient with digital systems than the analog version in hardcopy.

Temperature indicator/simulator calibration done according to EURAMET cg-11[2], where the electrical simulation used for the temperature calibration. The calibration principle is based on the verification of the conversion(electrical signal in to equivalent temperature) process by simulation or replacement of the output of the sensor by appropriate electrical stimuli. Digital thermometer calibration system for remote data acquisition of calibration data through thingspeak.com used. EURAMET cg-15 guideline used with multifunctional measuring instruments with digital reading for the measurement of the quantities: DC voltage, AC voltage (low frequency), DC current, AC current (low frequency), resistance, Capacitance, Frequency. The guidelines also be applied

point

Uncertainties are calculated in accordance with the methods laid down in "Guide to Expression of uncertainty in measurement (GUM) JCGM 100:2008". Example: Type A uncertainties component is  $U_7$ , Type B uncertainties components are from  $U_{10}$  to  $U_6$

- $U_1$  - Reference thermometer Calibration uncertainty. Take the value given in the calibration certificate and divide it by the appropriate factor (if  $k=2$  is given, then divide by 2).
- $U_2$  - Resolution of the Reference thermometer display value divided by  $2\sqrt{3}$
- $U_3$  - Accuracy of the reference thermometer (selected from values given in simulator 741B as the reference) divided by  $\sqrt{3}$
- $U_4$  - Probe calibration uncertainty as given in the calibration certificate divided by the appropriate factor (if  $k=2$  is given, then divide by 2).
- $U_5$  - Drift of the thermocouple divided by  $\sqrt{3}$
- $U_6$  - Resolution of the test temperature controller. Consider it as a rectangular distribution
- $U_7$  - Scatter of results(type A): Take the highest standard deviation of the mean divided by  $\sqrt{n}$

$$\text{Combined uncertainty } U_c = \sqrt{\sum_{i=1}^7 U_i^2}$$

$$\text{Expanded uncertainty } U_{95} = 2 * U_c, \text{ for Coverage factor } k = 2$$

Calibration measurement capability or the realizable best measurement uncertainty get from those expanded

to digital instruments that are able to measure only some of the quantities mentioned above[4]. It's about direct comparison with the reference standard values at appropriate percentages to cover the range of operation. Therefore we could extend method for inductance also if we have the appropriate reference standard to be used during calibration. The automatic calibration facility modeled to provide using RS 232 remote interface, the user plug in the device and remote program directs to apply a series of shorts, opens, voltage, current, and resistance to input the test calibration equipments/device. At each step software makes necessary calculation to bring meter into specification and record in calibration certificate. Similarly temperature indicator calibration reference voltages and resistances provided through remote interface to the temperature device and output is taken from software and transfer to certificate.

Calibration correction for temperature indicators/controllers given by the following equation,

$C = (T_0 - T) + (Z_f - Z_i)$  , Where,  $T_0$  = Temperature indicated in the Reference Standard

$T$  = Temperature of the test controller/indicator,  $Z_f$  = Final zero point,  $Z_i$  = Initial zero

uncertainty values. For calibration of electrical measuring instruments DC and AC voltage upto 1000V uncertainty is



4 $\mu$ V/V and 0.1mV/V, For DC/AC current 20A uncertainty is 0.2mA/A and 0.8mA/A. For calibration of simulators uncertainty in voltage is 1.6 $\mu$ V, Resistance 1.2 M $\Omega$ , Current 1 $\mu$ A. The human-readable version or Electronic copies make secure data transmission and increase process efficiency. Correction values given in calibration certificates should apply for measurement process in measuring equipments. After the calibration, the MEMC are compared to the CMR before confirming the equipment for its intended use. the reported error of indication of the measuring equipment would be compared to the maximum permissible error specified as a CMR. If the error is smaller than the maximum permissible error, then the equipment complies and confirmed for use. If the error is greater, action should be taken to remove the nonconformity or the customer should be informed that the equipment cannot be confirmed. Recalibration interval decide by customer with trend analysis, statistical process or other methods.

## **CONCLUSION AND RECOMMENDATION**

Industrial temperature indicator/controller/simulator or electrical devices calibration model can be concluded to provide reference voltages, resistances through remote interface to the temperature indicator/controller or the electrical device and output is taken from software and Type A and type B uncertainty components were calculated separately and take the combined uncertainty and then expanded uncertainty according to GUM guidelines and prepare the calibration report in softcopy which can reduce report preparation and reviewing time and human errors. Human readable calibration certificate in electronic or digital form is far beyond a

just calibration report, The correction factors given in report should be used for measurement process or measuring equipment and should confirm it to customer metrological requirement specified in their procedures. If there is deviation customer should correct/ replace their equipment.

Customer may decide recalibration interval according to OIML D10 guideline to extend or reduce interval over time with trend analysis, statistical process or other methods analyzing the previous data. More over developing digital reference system for digital SI units is to be done. Development in industrial sector can be catalyzed by introducing digital calibration system, then calibration laboratory will transfer the calibrated data in machine readable version directly to the machines to improve the efficiency and effectiveness of the industrial measurement processes. Metrological confirmation of measuring equipment satisfying customer metrological requirement in industrial processes, will help to minimize rejects and remove technical barriers to trade facilitating international trade in developing countries. Finally long process ahead to go through the digital transformation in metrology for industrial internet of things (IIOT) and sensor networks to achieve sustainable development goals.

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## **ANODIC ELECTROCHEMICAL EXFOLIATION OF VEIN GRAPHITE IN AQUEOUS MAGNESIUM SULFATE ELECTROLYTE**

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### **ABSTRACT**

Anodic electrochemical exfoliation technique has the potential to produce exfoliated graphite through a cost-effective, simple and environmentally benign approach. This presents a study carried out on anodic electrochemical exfoliation of Sri Lankan vein graphite, in an aqueous medium with MgSO<sub>4</sub> as the electrolyte, to produce exfoliated graphite. In this study, a graphite rod cut from vein graphite was electrochemically treated using a Pt rod as the reference electrode and MgSO<sub>4</sub> as the electrolyte. Crystallographic and morphological analyses revealed an excessive volume increase in graphite layers caused by this exfoliation method. As a result, the sulfate anion could influence the migration of water molecules into the bulk of the graphite by allowing access to the graphite layers. Raman spectroscopic analysis showed that the defect density of the edge plane in graphite layers had increased from 0.48 to 1.38. Further, the particle size of the exfoliated graphite analyzed by the laser diffraction technique revealed a median particle size of 4592.9 nm with 1.197 of polydispersity index. Hence it indicates a highly oxidized and defective nature for this synthesized exfoliated graphite. Altogether, this study reveals the potentiality of producing exfoliated graphite from vein graphite, by this simple and cost-effective electrochemical exfoliation technique, with MgSO<sub>4</sub> as the electrolyte.

Keywords: vein graphite, electrochemical exfoliation, exfoliated graphite, magnesium sulfate

**DISTRIBUTION OF LEGISLATIVE POWERS UNDER MODELS OF UNITARY  
AND FEDERAL GOVERNMENT: A SYSTEMATIC INQUIRY ON  
CONSTITUTIONS OF INDIA AND SRI LANKA**

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**ABSTRACT**

There are established different models of the distribution of legislative power in India and Sri Lanka. At the same time, we can identify some similarities in the distribution of power in both constitutions. The principle of federalism is the distribution of powers among the federation and the federating units. There is a clean distribution of legislative powers between, federation and the federating units in a federal system. Further, the distribution of legislative powers between center and State is the most important characteristic of a federal Constitution. The Indian Constitution is modelled on the principle of federalism, though not of a classical example for pure federalism. In Sri Lanka the new Constitution, promulgated in 1978, provided for a unicameral Parliament with legislative power and an Executive President. The legislative body is entrusted with the power of legislating for the country while the executive is empowered by the Constitution to implement the legislation. The Sri Lankan Constitution is modeled on the principle of Unitary. Its distribution the governmental power between three different organs, Legislature, Executive and the Judiciary. Under 13th Constitutional amendment, the Provincial Council was established and provides legislative and executive powers at the provincial levels. Distributed the legislative power to the Parliament, Provincial Councils, and Local authorities. In doing so, this research aims to identify

the weaknesses of distribution of legislative power in Sri Lanka and to make recommendations for how to increase the distribution of legislative power in Sri Lanka.

Key words: Constitution, Devolution, Legislative

**INTRODUCTION**

This research deals with the distribution of legislative power in India and Sri Lanka. The main objective of this research is to make recommendations for how to increase the distribution of legislative power in Sri Lanka through analyzing comparative constitutional provisions of both Sri Lanka and India's constitutions. The sub objectives are, to examine whether India and Sri Lanka have a proper mechanism of distribution of legislative powers in their respective constitutions, to investigate the pros and cons of the different models of the distribution of legislative powers and their operation in different forms of governments of Unitary and Federal systems under both India and Sri Lanka's constitutions and to make recommendations for how to increase the distribution of legislative power in Sri Lanka.

**Research Problem**

This research engages in a comparison of the important aspects of the distribution of

legislative powers under federal form and distribution of legislative power under unitary form governments, namely, the 'distribution of legislative powers between two countries of India and Sri Lanka.

### **Research Questions**

1. Whether India and Sri Lanka have a proper mechanism of distribution of legislative powers in their respective constitutions?

2. What are the pros and cons of the different models of the distribution of legislative powers and their operation in different forms of governments of Unitary and Federal systems under both India and Sri Lanka's constitutions?

4. What recommendations can be made to increase the distribution of legislative power in Sri Lanka?

### **METHODOLOGY**

The researcher has relied on Doctrinal legal research. Under doctrinal legal research method, this research adopts two approaches, first a critical review of the literature, and second a comparative legal analysis. In the critical review of literature, this research examines primary and secondary sources such as judgments, principles and Acts, journal articles, books, magazines, and papers presented in seminars and conferences in dealing with both India and Sri Lanka. In the phase of comparative analysis, this research compares relevant constitutional provisions and judicial decisions of both India and Sri Lanka.

#### **Significance of the Research**

First, it is important to get a sense of comparative law and its methodology. The Constitution regulates the relationship between the government and the other legislative bodies to enact legislation to protect the peoples' rights. The Comparative Study of Constitutional provisions aims to understand the legal rules and patterns of such a country.

Especially, comparatively, study on legislative relations can get knowledge on regulations and rights of the people in a different culture. This study will be useful to the law-making bodies to restructure the distribution of legislative power in Sri Lanka.

### **CONCLUSION**

The 13th amendment of Constitution of 1978, which was introduced in the year 1987 established a second-tier government in Sri Lanka as Provincial Council. The Constitutional Amendments of 73rd and 74th in India first time introduced the Devolution of powers to grass steps of democracy namely Panchayat and Municipalities for India. These amendments enacted in 1992, seek to encourage local government by creating viable units of self-governance at the State, town, and the district levels. Both countries introduced of Devolution by Constitutional Amendments. But India devolved power to Local Bodies and Sri Lanka only devolved power to Provincial Councils from Central. Local Government in Sri Lanka derives their powers from Ordinance and Acts made by Minister or Provincial Councils. The Local Body of Government in India and Provincial Council in Sri Lanka are not totally sovereign bodies. On my view both of countries are not devolving all powers to local governments. In Sri Lanka the Provincial Councils are not a totally self-governing body. As well as the local governments of India also not a totally self-governs from the State. In India for resources, Panchayats depend mainly on grants from State Government and the Provincial Councils of Sri Lanka also depend on grants from national budget. The devolution of powers attempted by the 13th Amendment in Sri Lanka was done within the constraints of a Unitary State and a centralized Executive Presidency. These two aspects of the government do

not sit comfortably with concept of devolution.

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## **APPLICATION OF TECHNOLOGY INTO PROJECT MANAGEMENT PRACTICES**

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## **ABSTRACT**

Driven by emergent technological revolution, the primary purpose of this research is to explore the effect of technological transformation in the domain of project management and its potential opportunities for today's industrial and business entities. Moving from hydropower to steam power to electricity to electronics to internet and cyber space, technology has gradually evolved management theories in compared to 'Waves of Innovation'. Based on its key extracts, this paper aims to bridge the gap between technology and project management worlds by presenting an approach which industries can inherit in transforming their organizational project management practices into more tech savvy based. The research includes a comprehensive literature review carried out on six emerging technologies: AR/VR, Holography, AI, ML, IoT, 3D Printing and their impact over Project Management Key Knowledge Areas; covering potential sub-areas for technology integration, fitting technologies for each application followed by an analysis of their pros and cons. Strategically, this initiative forms a leading opportunity for industries to automate their lowerlevel routine tasks for effective direction of team efforts towards high level, more complex tasks including decision making and process analysis. However, the approach would also be highly controversial due to its ethical concerns in terms of cyber security and impact on existing employment models. Balancing between these two extremes involves establishing a clear set of principles and methodologies in terms of 'Strategic Organizational Transitioning' together with careful selection of technologies and its integration models based on positive Return on Investment followed by continuous employee encouragement and awareness.

Keywords: Project Management, Technology, Automation

**GENDER DISPARITIES AND OPPORTUNITY COST OF HOUSEHOLD LEVEL  
EDUCATION EXPENDITURE IN SRI LANKA WITH SPECIAL REFERENCE TO  
COLOMBO, BADULLA, KILINCHCHI AND HAMBANTOTA DISTRICTS**

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**ABSTRACT**

The total household level expenditure is shared by the households itself, public sector and voluntary organizations. Public and private expenses are complementary to each other and in the absence of either of them, it is likely to be an under allocation of resources for education. Majority of the Asian region civilians consider the gender when spending money on education. The objectives of this study are to assess the gender related disparities and to examine the household level opportunity cost of it educational expenses. This study has used the t Test to assess the gender related disparities and the descriptive statistics to examine the opportunity cost of education. Moreover, focused group interviews have used to gather data for the second objective. The main findings of the research illustrated that there is a statistically significant difference between male and female children on mean preschool expenses, households spend more on their male children preschool education expenses than that of female children in these four districts. In addition, there is no any such difference between male and female children on mean school level or higher studies expenses. According to the overall results of household level opportunity cost of education, it concluded that majority of the full time and the part time students did not receive the self-satisfaction or in other words the utility of consuming the higher education in their lives. The suggestion which is suggested by the researcher is implementing a new system for the full-time undergraduates to work at least 10 hours per week for their expenses.

Keywords: Gender Disparities, Educational Expenditure, and Opportunity cost

**A STUDY OF THE MANNER IN WHICH THE PAINTER “ASAI RASAI AH”  
DEPICTED THE LIFE AND SOCIAL CONDITIONS OF THE TAMIL  
COMMUNITY THROUGH HIS PAINTINGS**

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***ABSTRACT***

It is necessary to find out about the life of the Sri Lankan Tamil people and the distressing situations they faced and the way in which “Aasai Rasaiah” has come out through his paintings. This study is carried out with interpretive, psychological and sociological approaches. The hypothesis of this study is; He wanted to bring out the life style of the Tamil people especially the lay people, business methods, distressing conditions and the war environment of the people of the region through his paintings. This study includes the introduction and works of the painter and the ways of life of Tamils in his painting, the influence of the social environment issues on his landscape paintings. His landscape paintings often depict the environment of the plains, especially palm trees. Painting people involved in ordinary occupations and their lifestyles in Jaffna also highlights the social status of the Jaffna people. He has also shown the pains and migrations caused by war through his paintings. Through this, it is found that the Tamils, especially in the land of Jaffna, tried to reveal the social condition through painting. Through this, he left the traditions of the community or the region for the next generation to think about.

Keywords: Landscape, paintings, Tamil people

# CASE STUDY ON RECESSION AND ITS IMPACT ON TELECOMMUNICATIONS INDUSTRY

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## **ABSTRACT**

Telecommunications industry is becoming stagnated, with APAC region expects around 2% flat revenue growth till year 2025. In such time, Sri Lanka is currently facing an economic crisis with major economic indicators worsening on quarterly basis, indicating a Recession. The purpose of the study was to differentiate natural industry behavior of telco KPIs compared to behavior during a recession. Furthermore, this study focuses post-recession behavior of major telco KPIs and its relationship with economic KPIs to find applicability of outcomes to current Sri Lankan economic context while identifying threats and opportunities lies within next few years for the telecommunications business. The study has been conducted using historical KPI data obtained from 36 countries, 144 mobile operators over a 22-year span to identify recession periods and statistically analyze post-recession behaviors of KPIs. Hypothesis testing, correlation and regression analysis has been used to derive key outcomes of this study. Moreover, the study has been further extended to identify top and worst performed operators to analyze strategic actions taken during recession periods. The study yields several key findings including high significance of correlation between mobile connection and mobile revenue growth rates, percentage of mobile operators with 10% revenue drop after one and two years from recession while regression analysis shows high degree of significance between revenue growth with mobile connections, ARPU and inflation growth rates. Furthermore, the study explains how actively top and worst performed operators have participated in merges and acquisitions, new solution offerings, spectrum acquisitions and network collaborations.

Key words: Recession, Telecommunications, Revenue growth, Correlation, Hypothesis



# CAPACITY DEVELOPMENT OF SCHOOL COUNSELLORS IN FACILITATING TO RESOLVE PSYCHOLOGICAL PROBLEMS OF ADOLESCENTS

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## **ABSTRACT**

Adolescence is considered the transitional period of lifespan development. This period is full of changes and challenges for any adolescent. Adolescence is a crucial period for developing social and emotional habits important for mental well-being. These include adopting healthy sleep patterns; exercising regularly; developing coping, problem-solving, and interpersonal skills; and learning to manage emotions. Protective and supportive environments in the family, at school, and in the wider community are important. School counsellors should play a major role in facilitating to help adolescents to solve their problems. Therefore, school counsellors should be trained to address the problems faced by adolescents. The objectives of the study were to identify psychological problems faced by adolescents, find out the reasons for psychological problems of adolescents, study to what extent the school counsellors facilitate the adolescents to resolve their problems, Plan and launch awareness and training workshops to develop the skills of the school counsellors in facilitating adolescents. The students in grade 11 classes in Sinhala medium government schools in the Western province were the target population. The stratified random sampling method was utilized to select the school counsellors and adolescents. The sample comprised 398 adolescents (male=198 and female = 200) and 18 school counsellors. A survey Questionnaire and interviews were administered to collect data. The data were analyzed using SPSS. This study revealed that the prevalence of psychological problems significantly differed between girls and boys ( $p < 0.001$ ), with girls having a higher prevalence. The most prevalent psychological issue for both groups is examination stress. Therefore, the school counsellors were trained based on the most prevalent issue.

Keywords: School counsellor, psychological problems, Adolescents

# A STUDY OF THE IMMUNOMODULATORY EFFECT OF COMMON USING SPICES IN SRI LANKA

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## **ABSTRACT**

The immune system helps to defence the body from harmful invaders such as bacteria vires and other pathogens, cancers, infections, or other diseases were destroyed by immune modulators specific immune system modulators are monoclonal antibodies, cytokines, and vaccines. cytokines such as Interferons (INFs), interleukins, tumor necrosis factor (TNF- $\alpha$ ), nuclear factor kappa B (NF- $\kappa$ B), and cyclooxygenase (COX-1, COX-2). another important factor that affects the immune system is oxidative stress and which reduces the ability of an immune system to fight pathogens. A strong immune system helps to reduce harm to the body and it will help to protect our body from pandemic situations. Humans have faced different pandemic situations over recent years. beginning in December 2019. COVID-19 began appearing in human being the WHO decelerate more than half a million people infected and nearly 30,000 deaths. HIV/AIDS has also proven a global pandemic killing more than 36 million people. millions of people were victimized by other pandemics like flu, cholera, smallpox. for the achievement of the pandemic situation, good immunity of the persons is very important and it attacks pathogens and reduced the conditions of the disease. healthy life patterns and healthy food behavior reduced the accumulation of unwanted things in the body and enhance immunity.in Sri Lanka add many spices for their main meal times. some of them are cinnamon (Cinnamomum

zeylanicum), pepper (Piper nigrum), clove (Syzygium aromaticum), cardamom (Elettaria cardamomum), nutmeg (Myristica fragrant), turmeric (Curcuma longa). spices were derived from various parts such as leaves, flowers, fruits, buds, bark, and roots also. and has many uses like antioxidant, anti-inflammatory anti-diabetic activity, and many other benefits. according to Ayurveda texts spices is very effective for the nervous system, blood circulatory system, respiratory system, and excretory system like systems. Research problem- whether spices in Sri Lanka have effective immunomodulatory effects and can these spices will improve human autoimmune. **Aim** of this research is a scientific review of the selected spices and to find out their efficacy for the immune system. **Objectives** are to find out the phytochemicals of the spices, to find out the antioxidant effect, to identify immunomodulatory effects of the spices.

Key words: spices, immunomodulatory effect, interleukins, antioxidant effect, phytochemicals

## **METHODOLOGY**

Research is done as a systematic literature review by using the PRISMA (preferred reporting items of systematic review and meta-analysis) model. 109 research were identified in pub med and google scholar. 25 duplications, 8 non-English research were excluded other 76 types of research were included for screening among them 20 veterinary

research, microbiology genetics, and asymptomatic researches were excluded finally 36 types of research were included for this experiment.

## RESULTS

phytochemicals of the spices main phytochemicals of stem bark and roots of *Cinnamomum zeylanicum* are Cinnamaldehyde and camphor. cinnamaldehyde (68.95%), benzaldehyde (9.94%), and (E)-cinnamyl acetate (7.44%). Trans-cinnamaldehyde (49.9–62.8%) is the main phytochemical found in the bark essential oils. all of the research articles mentioned piperine is the main photochemical of *Piper nigrum*. others are Brachyamide B, Dihydro-piperidine, (2E,4E)-N-Eicosadienoyl-pyridine, N-trans-Feruloyltryamine, N-Formylpiperidine, Guineensine, pentadienoyl as piperidine, (2E,4E)-Nisobuty- ldecadienamid, isobutyl-eicosadienamid, Tricholein, Trichostachine, isobutyl-eicosatrienamid. the experiment reported eugenol (88.58%) as a major phytochemical in *Syzygium aromaticum* others are eugenol acetate (11.77%) and caryophyllene (6.85%). major components found from the *Elettaria cardamomum* are 1,8-cineole (45.6%),  $\alpha$ -terpinyl acetate (337%), sabinene (3.8%) and 4-terpinen-4-ol (2.4%). lignans, neolignans, phenylpropanoids, and terpenoids are the phytochemicals of *Myristica fragrans* among them mecelignan, mesodihydroguaiaretic acid, and myristicin are main. percentages of phytochemicals of *Curcuma longa* are aromatic-turmerone (24.4%), alpha-turmerone (20.5%) and beta-turmerone (11.1%).

immunomodulatory effect very least amount of research were found on in vitro studies of the immunomodulatory effect of *Cinnamomum zeylanicum*. some research

were done on mice lethality tests. cinnamon bark increased serum immunoglobulin levels, and increase neutrophil adhesion. cinnamaldehyde increases IL-1 $\beta$ , IL-6, IL-15, and IFN- $\gamma$  and has an effective immunomodulatory effect.

piperine of the *Piper nigrum* induced T cell proliferation and increase the secretion of IFN- $\gamma$ , IL-4, IL-17, and IL-2.

*Syzygium aromaticum* increases WBC production and macrophage cell clove extract shows IFN- $\gamma$  release and induction of IL-4, IL-10, and TGF- $\beta$  secretion according to this evidence clove extract were suppress the T cell cellular immunity and enhances the moral immune response.

*Elettaria cardamomum* enhances the proliferation of splenocytes, and splenocyte helps to enhance T helper (Th)1 cytokine. Conversely, Th2 cytokine release by splenocytes significantly enhances.

fresh nutmeg *Myristica fragrans* mace (aril part of the fruit) increases the production of T cell mitogen concanavalin A (con A) and it will inhibit the proliferation of splenocytes. response to con A IL-2, IL-4, and IFN- $\gamma$  production were inhibited.

curcumin reduced IL-1 $\beta$ , activates NF $\kappa$ B pathway and enhance the mRNA expression of IL-1 $\beta$ , IL-6, IL-12, IL-18 and TNF- $\alpha$ . according to some research, curcumin increases phagocytic activity within 75 min and *Curcuma longa* have the effect of increasing B cell volume also.

### Antioxidant effect

etheric, methanolic, and aqueous extracts of *Cinnamomum zeylanicum* presented 68%, 95.50%, and 87.5% of antioxidant effects respectively. which is done by the DPPH method.

piperic acids of *Piper nigrum* have a higher free radical scavenging effect than piperine ethanol extract of the clove buds (*Syzygium aromaticum*) showed remarkable scavenging activity (93%),

and eugenol was percent 71.56% antioxidant effect.

methanolic extract of cardamom powder (*Elettaria cardamomum*) has a significant free radical scavenging effect. 70% methanolic extract was present inhibition by  $90 \pm 0.7$  %. acetone extract ( $63.04 \pm 1.29\%$ ) of *Myristica fragrant* have highest free radical scavenging effect.

ethanolic extract of *Curcuma longa* has the highest free radical scavenging activity with the lowest 50% inhibitory concentration (IC50) (1.08  $\mu\text{g/mL}$ ).

## ***DISCUSSION***

according to the evidence of the results of the experiment selected spices have an effective immune modulatory effect. Interferon (IFN) can enhance the immune system and respond to cancer cells by increasing WBC *Cinnamomum zeylanicum*, *Piper nigrum*, *Syzygium aromaticum*, and *Myristica fragrans*, which have the effect of inhibiting IFN- $\gamma$  it is a pleiotropic cytokines important molecule for antitumor immunity it will reduce tumor formation. interleukins (ILs) are very effective cytokines for moral immunity, there are dozens of interleukins were percent in the human body and they have unique activities to do. IL-2 helps the production of WBC and boosts them. IL-2 can identify as a T-cell growth factor. *Piper nigrum* and *Myristica fragrans* increase the production of IL-2.

IL-1 $\beta$  is important for the response of molecules carried by the pathogen and it is very effective for the host response and resistance to the pathogen. IL-6 promotes

the host defense mechanism and it responded to infections and tissue injuries. IL-6 has an antiinflammation effect and immune response and has the effect of hematopoietic. it promotes the megakaryocyte maturation and increases the release of platelets. *Cinnamomum zeylanicum*, and *Curcuma longa* increasing the secretion of IL-1 $\beta$  and IL-6.

IL-4 helps to t cells to convert Th2 cells which help to B cells and promote the production of IgM to Ig G1 and Ig E. *Piper nigrum*, *Syzygium aromaticum*, and *Myristica fragrant* has the effect of increased IL-6. all the spices have the effect of free radical scavenging activity. and have a certain immune response.

## ***CONCLUSION***

according to the evidence of the experiments, phytochemicals of the spices have beneficial effects to increase the cytokines in the cell and it will respond in various ways to the immune system. by decreasing tumor growth, stimulating megakaryocytes, and promoting platelet production. and helps to produce T helper cells which are done a major role in the immune system. one major cause of reduced immunity is oxidative stress (toxins that accumulated in the body) free radical scavenging activity of these species promotes immunity in the body. this experiment will reveal the volubility of the spices and suggest doing laboratory experiments to find out the phytochemicals aqueous extracts of these spices further studies.

## REMISSION OF TYPE 2 DIABETES MELLITUS WITH AYURVED TREATMENT: RETROSPECTIVE COHORT STUDY

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### ABSTRACT

The prevalence rate of Diabetes Mellitus (DM) in India is around 10 %, i.e. every 10th adult in India is suffering from DM. Thus, there is a constant need for better treatments for management of Diabetes Mellitus. The present study aimed to assess the role of Comprehensive Diabetes Care (CDC) program as an adjunct therapy to standard antidiabetic medication in patients with Diabetes Mellitus. Method: This retrospective cohort study was conducted in 42 patients having long history of Type 2 DM ( $HbA1c \geq 6.5\%$ ) with mean age  $57.91 \pm 12.05$  yrs. Treatment plan included CDC therapy (60-75 mins) consisting of Panchkarmas viz Snehana (Azadirechta Indica in sesame oil), Swedana (Dashmool Kadha), and Basti (Gudmaar + Haridra + Yashtimadhu) along with 800 k/cal PRAMEHA diet for 12 weeks. Patients' glycemc parameters Hba1c and anthropometric parameters such as Weight and Body Mass Index (BMI) along with tapering of concomitant medications were monitored for 12 weeks, after 12 weeks all 42 participants advised for diagnostic OGTT (oral glucose tolerance test). Result: On 12<sup>th</sup> week, there was reduction in their mean HbA1C (%) from  $7.80 \pm 1.73$  to  $6.17 \pm 0.65$  which was highly statistically significant ( $p < 0.05$ ). Their mean weight (kg) as compared to day 1 was  $70.35 \pm 13.16$  significantly reduced to  $64.81 \pm 10.75$ , wherein ( $p < 0.05$ ) and BMI ( $kg/m^2$ ) as compared to day 1 was  $27.40 \pm 4.10$  to  $26.64 \pm 6.47$  at day 90 wherein ( $p = 0.48$ ). Out of 42, 17(40.48%) patients were found to be GTT negative and 14(33.33%) patients had impaired glucose tolerance and 11(26.19%) were positive for OGTT at 1st attempt, there was significant reduction in dependency on allopathic drugs, at the end of study period. Conclusions: In 12 weeks, overall, 10% of weight reduction and Hba1c correction without OHA support observed, Remission of T2DM is possible with Ayurved, CDC therapy successfully helped to correct glucose metabolism in more than 73% T2DM in 40% complete remission was observed, 26.19% are showed correction in Hba1c but glucose metabolism is still compromised.

Keywords: Type 2 Diabetes Mellitus, Oral Glucose Tolerance test (OGTT), Comprehensive Diabetes Care (CDC) program

# IMPORTANCE AND THERAPEUTICAL VALUE OF TRADITIONAL FOOD - PASGORASA IN HUMAN GROWTH AND WEALTH DEVELOPMENT - REVIEW

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## **INTRODUCTION**

Panchamahabhuta Prithvi, Ap, Teja, Vayu and akasha the components of the universe. All the living and non-living being composed of the panchamahabhuta. Panchamahabhuta has ingested with food nourishes respective tissue elements in the body. Amidst tharayo upasthambha sub pillars of the ayurveda ahara is the best medicine. Ahara and vihara which are congenial to the body channels, constitution and strength of human body considered as Pathya (Wholesome) and which is non congenial is termed as Apathya (Unwholesome). Prevention and curative aspects of Ayurveda revolve around the main theme of pathya ahara and vihara. Main dietary guidelines in terms of appropriate food and combinations of food have been mentioned. Food system which has a long tradition would never be changed immediately. Research study of National Botanical Research Institute on this subject “Our hospitality during festival and other special occasion had included the subtle thought of providing necessary vitamins, contented balanced food and shad rasas according to season. Traditional food systems are certainly a good option, which can overcome emergencies of food insecurity such as famines and droughts or unprecedented occurrences such as COVID 19 pandemic. Traditional foods allow the witnessing and practice of historically inherited cultural expressions. Traditional food systems of indigenous peoples can be defined to items

that are from the local, natural environment that are culturally acceptable. It includes the sociocultural meanings, acquisition/ processing techniques, use, composition and nutritional consequences for the people using the food. Traditional food knowledge includes improved food security, individual and community capacity building and promotion of biocultural diversity. Ayurveda said that Sarvam Dhruvayani Pantha Bhothikam, human body and all its edible testing this. To support this “Non Aushadhi Bhutam Jagath Kinchith Dravyam Upalabhyathae”. As per ayurveda the gorasas like ksheera, grutha, dadhi. Not as ahara but also aushadha. Charaka Samhitha Suthrasthana 27 has classified foods and drinks. That chapter is called annapaanavidhi adhyaya. That chapter explained that fruits, milk, dairy products, various types and qualities of vegetables, oils, grains etc. Milk and dairy products considered as Gorasa varga under this milk, curd, ghee, cream and butter milk. Traditional village setting, milking cows and few calves are considered essential for the sustainable life that ensures good nutritional values of family status and neighbours who can afford to buy excess milk. Ghee is obtained from the cream by removing water the remaining non-fat solids and fat develop characteristic flavour and texture. Buffalo milk converted into curd for consumption. Curdling of heated buffalo milk is by coagulation of milk protein. Buffalo milk has high total solids content compared

with cow's milk and produces a firmer curd. Curd accompanied with treacle traditional dessert. Whey fraction of buttermilk(moru) makes a beverage. There are lot of traditional foods available. But pasgorasa is very familiar and significance among our people. There are lot of therapeutic effects present. According to ayurveda milk has rasayna and promoting the ojas. Curd has brumhana and balavardhana. Creams improves female and male reproductive system. Fresh butter helps in digestion and stimulant of cardio tonic. Cow ghee improves memory, intellect, digestion and semen. Old ghee useful in nerve disorder.

#### Objective

To use the Pasgorasa traditional food in daily routine to prevent the disease and using and analyse the significance of the Pasgorasa preparing Pasgorasa traditional method because modern agribusiness practices affecting dairy products. To get

high nutritional value should use this traditional food.

### **METHODOLOGY**

#### Primary data collection

The study of this literature was primarily based on the main three texts which are (Vruhatthree) Caraka Samhita, Susruta Samhitha and Ashtangahrdaya Samhita

#### Secondary data collection

Data of concerned information were retrieved from various sources such as web-based database searches and published papers.

#### Data analysis

All the compiled literary materials were critically investigated and rearranged of present study. Finally comparative analysis was given using charts and pictures.

### **RESULT**

Rasa Panchaka	<i>Go Ksheera</i>	<i>Go Dadhi</i>	<i>Go Ghritha</i>	<i>Go Takra</i>	<i>Go Navanita</i>
Rasa	Madhura	Madhura/Amla	Madhura	Madhura, Amla	Madhura, Amla, Kashaya
Guna	Snigdha, Pichila, Guru, Manda, Alpaabhish ayandi(Susruta)	Snigdha, Guru, Ushana, Abhish ayandi	Snigdha, Mrudu	Snigdha, Pichila, Guru, Manda, Alpaabhishayan di (Susruta)	Laghu, Sukumar, Samgrahi
Veerya	Seeta	Ushna	Seeta	Ushna	Sheeta
Vipaka	Madhura	Amla	Madhura	Madhura	Madhura

Properties of Go Rasa according to classical texts

#### 1. Navaneeta – Butter

संग्राहि दीपनं हृद्यं नवनीतं नवोद्धृतम्।

ग्रहण्यशीविकारघ्नमर्दितारुचिनाशनम्॥ Cha.Samhitha-27

It has samgrahi (Stool adhering properties), Deepanam (Improve digestive capacity), Hridya (Cordial or pleasant to heart) and diminishes the symptoms like Grahani(Inflammatory disease of bowel), Arsha(Hemorrhoids), Ardita(Facial Paralysis) and Aruchi(Nausea and Vomiting)

### 2. Dadhi – Curd

रोचनं दीपनं वृष्यं स्नेहनं बलवर्धनम् |  
पाकेऽम्लमुष्णं वातघ्नं मङ्गल्यं बृहणं दधि | |२२५| |  
पीनसे चातिसारे च शीतके विषमज्वरे |  
अरुचौ मूत्रकृच्छ्रे च कार्श्ये च दधि शस्यते | |२२६| |  
शरद्वीष्मवसन्तेषु प्रायशो दधि गर्हितम् |  
रक्तपित्तकफोत्सेषु विकारेष्वहितं च तत् | |२२७| |  
rocaṇam dīpanam vṛṣyam snehanam balavardhanam |  
pāke'mlamuṣṇam vātagnam maṅgalyam bṛṃhaṇam dadhi | |225| |  
pīnase cātisāre ca śītake viṣamajvare |  
arucāu mūtrakṛcchre ca kārśye ca dadhi śasyate | |226| |  
śaradgrīṣmavasanteṣu prāyaśo dadhi garhitam |

Cha.Sam-27

It has rochana(Improves taste, appetizer), Deepana(Improves digestion strength), Vrushya(aphrodisiac), Snehana(Imparts oiliness), Balavardhana(Improves strength and immunity), Amla vipaka(Sour taste conversion after digestion), Ushana(Hot), Vataghna(Balances Vata),Mangalya(Auspicious), Brumhana(Improves nourishment).

### 3. Takra- Butter Milk

शोफार्शाग्रहणीदोषमूत्रग्रहोदरारुचौ |  
स्नेहव्यापदि पाण्डुत्वे तक्रं दद्याद्गरेषु च | |२२९| |  
śophāśograhaṇīdoṣamūtragrahadarārucau |  
snehavyāpadi pāṇḍutve takraṃ dadyādgareṣu ca | |229| |

Cha.Samhitha-27

Shopa (Odema), Arsha (Hemorrhoids), Grahani(Malabsorption, Irritable bowel syndrome), Mutragraha(Urine retention), Udara(Ascites), Aruchchi(Anorexia, Lack of interest in food), Snehavyapat, affliction with Gara type of poison, Pandu(Anemia, initial stage of liver disorders)

*Takram laghu Kashaya amlam deepanam kaphavatajit |  
Shopha udara arsha grahani dosha mootragraha aruchihi |  
pleeha gulma ghrityapat gara paandu aamayaan jayet ||* Ash.Hrd-Cha-5

According to Ashtanga hrdya it has laghu guna, Kashaya and amla rasa, agni deepanam and kapha and vatajit so these qualities help in amavata



Table 7: Therapeutic actions of Pasgorasa

Therapeutical Functions	<i>Ksheera</i>	<i>Dadhi</i>	<i>Navaneeta</i>	<i>Takra</i>	<i>Ghrita</i>
<i>Vata Rakta</i>	+				
<i>Sandhanam Vihitsya</i>	+				
<i>Yoni Sukra Pradosha</i>	+				
<i>Mutra Dosha</i>	+			+	
<i>Pradara Dosha</i>	+				
<i>Vatapitta Vikara</i>	+				
<i>Jeerna</i>	+				
<i>Jwara</i>	+			+	+
<i>Vishamajwara</i>					
<i>Amavata</i>				+	
<i>Ksheya</i>	+	+			
<i>Peenasa</i>		+			
<i>Atisara</i>		+		+	
<i>Mutra Krchchra</i>		+			
<i>Karshyam</i>		+			
<i>Unmada</i>					+
<i>Apasmara</i>					+
<i>Sirah shola</i>					+
<i>Visha</i>				+	+
<i>Sosa</i>					+
<i>Chardi</i>		+Vata		+	
<i>Pandu</i>				+	
<i>Sihoulya</i>				+	
<i>Grahanai</i>				+	
<i>Arsha</i>		+		+	
<i>Bhagandar</i>				+	
<i>Prameha</i>				+	
<i>Gulma</i>				+	
<i>Trushna</i>				+	
<i>Kushtha</i>				+	
<i>Shoth</i>				+	
<i>Kirimiroga</i>		+Pureeshaja		+	
<i>Raktapitta</i>		+			
<i>Vatajardroga</i>		+			
<i>Urusthambhana</i>		+			
<i>Rajyakshama</i>		+			
<i>Udara</i>		+			

Fig 1: Effect on Subjective Parameters according to Mann-Whitney's U test (2019). Effect of Godugdha (Cow Milk) as Rasayana- A Randomized Controlled Clinical Trail. According to modern view Nutritional analysis of Pasgorasa

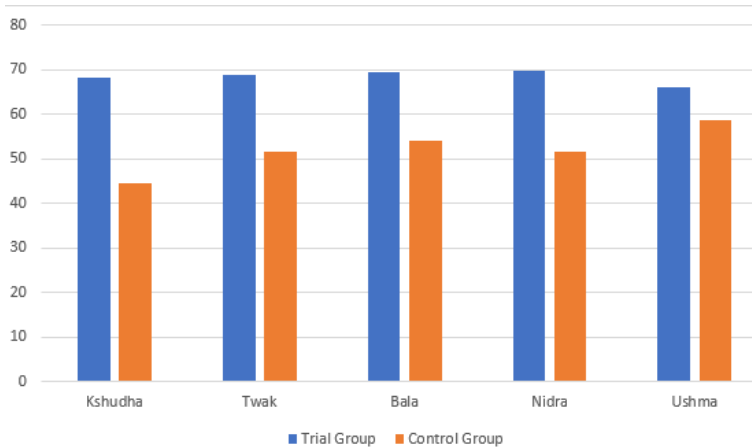


Table 9: Nutritional analysis

Nutrients	Curd	Butter Milk	Butter	Ghee
Calories	98kcal	40kcal	717kcal	130kcal
Carbohydrates	3.4g	10g	0.1g	
Proteins	11g	8g	0.9g	
Fats	3.5g	0.9g	81g	15g
Cholesterol	17mg	10mg		
Calcium	83mg	284mg	24mg	7.25mg
Iron	0.1mg	0.25mg	0.02mg	
Phosphorus	159mg		24mg	
Magnesium	12mg	2%		
Selenium	2.2mg		1.00µg	
Zinc	0.4mg		0.09mg	
Potassium	155mg	370mg	24mg	7.25mg
Sodium	46mg	260mg	11mg	
Vitamin A	99IU		2499IU	107.5mg
Vitamin C	0	130.00IU	7.00µg	3.20µg
Vitamin K	0.2µg			7.98µg
Vitamin B <sub>12</sub>	0.4µg		0.170µg	
Vitamin B <sub>2</sub>	0.2mg		0.034mg	0.007mg
Vitamin B <sub>6</sub>			0.003mg	0.026mg
Vitamin D	0.1µg	0%	0.90µg	1.40µg
Folic Acid	7µg		3.00µg	4.00

Source: Based on data from USDA National Nutrient Database for Standard Reference, Release 23 (2010)

## DISCUSSION

Ayurvedic texts are the ancient literature of scientifically proven things

with evidences and knowledge of those times which is mostly applicable to current era. Considering parameters chemical composition, centrifugations and other

investigation prove the facts of the given statements. Charaka Samhitha has mentioned that buffalo milk has more nutritional value rather than cow's milk. According to nutritional analysis of the milk has proved that ancient literature statement was true. Samhitha's quoted importance of Pasgorasa and impact on treating the diseases. Takra is used for various disease. According to Ashtanga hrdaya the features like laghu, deepana, kapha and vatajit these features help to treat amavata (Rheumatoid condition). Allopathic physicians recommending the takra (Buttermilk) for rheumatoid arthritis. Mann-Whitney's U test also showed effective of cow's milk compared to prepared Patanjali cow milk powder. Most significant effects present in cow's milk.

## CONCLUSION

Ayurveda clearly mention about consumption of milk and dairy product and traditional farming methods and native breeds can be used. With modern farming process and artificial ways of maintaining the cattle rises harmful effects on dairy product. Animal dairy is a great source of balanced minerals, possible to get calcium, magnesium, phosphorus, and protein. Modern agribusiness practices that affect dairy if that can't treat the diseases as per samhithas. To obtain therapeutic value get or prepare the Pasgorasa in traditional method. Powder milk has less significant compare to cow's milk freshly taken. To gain the benefit get the pasgorasa according to traditional method. Use of these traditional item is very rare and lack of consumption causes various diseases. It should be mandatory to

take pasgorasa routinely with our meal to prevent the diseases and rasayana basis.

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## **A STUDY OF THE USED OF SUBSTITUTE (PRATINIDHI DRAVYA) IN INDIGENOUS MEDICINE**

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### **ABSTRACT**

Ayurveda has given information about the possibility of using another substance in place of that substance in medicinal yoga when another substance is extinct or not available in abundance or when it is difficult to find it and the parameters used for that have also been indicated. The purpose of this study is to find out about the appropriateness of using other plants in place of the medicinal plants that is commonly used in traditional medicine. Methodology of the study is to identify the herbs that are used locally as substitutes mentioned in the Vegetable section of Ayurveda Pharmacopoeia in Sri Lanka. Botanical information on identified widely used substitute plants was collected and their Ayurvedic properties and medicinal uses were studied. According to the data obtained in the study, more than 387 herbs are included in Sri Lankan Ayurveda Pharmacopoeia, of which 347 plants are commonly used for medicine, and 54 plants are used as substitutes. 15 plants have been identified as the most used substitutes. The identified substitutes contain 05 plants of botanically similar families (33.3%), 03 different plant species of similar genera (20%), and 10 botanically dissimilar plants (66.7%) compared to Ayurvedic recommended plants. Also 05 plants containing similar properties (33.3%) mentioned in Ayurveda and 02 plants with different properties (13.3%) and 07 plants not mentioned in Ayurvedic properties (46.7%) are included. It was concluded that they do not show differences in clinical applications and quality and their longevity suggests that plants without the mentioned properties may be suitable for use.

Key words:- Pratinidhi Dravya, Substitute, Indigenous medicine

# AYURVEDA PERSPECTIVES OF MANAGEMENT OF PANDEMIC WITH CONCERNING DINACHARYA

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## **ABSTRACT**

“Epidemics” is a more complicated disease collection, which is defined as janapadodhwansa, aupasargika roga, māraka, janamāra, and āganthuja roga in Ayurveda classics. According to Ayurveda evidence, Adharmaya is the main causative factor of Epidemics. The most effective factors which are affected by epidemics are Vayu, Jala, Kala, and Desha. These factors are polluted due to unrighteous rules and people who became unrighteous. Not only in the present era but also in the ancient period, massive deaths were reported due to pandemics. Due to the unlimited number of people dying, a reasonable curiosity and a question arose to find a suitable solution for the current pandemic. The final destination of this review was studying preventive measures as well as treatment methods for pandemics. This literature review has been done with Charaka Samhita, Sushruta Samhita, Ashthangahrida Samhita, and research articles published from 2010 to 2020. Ayurveda classics mentioned suitable management procedures by using behavioral patterns, dietary regimens, and preventive measures for the prevention of pandemics. Data of the literature study revealed that people should be changed from their substandard daily routine to standard daily routine and follow a proper lifestyle to break the pandemics. Dinacharya, rithucharya, sadvritta, and achara rasayana inculcate discipline in a person and take on the right path and teach good health habits. As a therapeutic measure, vyadhikshamathwa is the main point of managing Epidemics. People

should have to be treated with Rasayana karma, ojowardhaka therapy, vajikarana therapy, lehana karma, and other Ayurvedic therapies of management. If a person can maintain the behavior correctly, that person can surely get longevity.

Keywords: Janapadhodhwansa, Dinacharya, Epidemic management

## **INTRODUCTION**

Epidemic disease is very clearly mentioned in Ayurveda as Janapadha roga, Aupasargika roga, Maraka, Janamara, and Aganthuja roga. There is much evidence that people were faced more severe epidemics in the past era as well as the current global pandemic of COVID-19. Not only that the scientists who have researched and experimented with Epidemic diseases have found that humans may face similar pandemics in the future. Gratifying to note that various vaccines have been developed to combat COVID-19. But all individuals are helpless in the face of the continuing global pandemic. And also the number of COVID deaths has increased day by day. Therefore, intend to study the treatment methods which are mentioned in Ayurveda for Epidemics. During data collection, a good example of shreds of evidence and curative methods were found in Ayurveda as well as Buddhist literature. Among them, Yukthivyapashraya chikitsa was the main method and in addition, Daiwavyapashraya chikitsa was mentioned. The main symptoms of these diseases are the simultaneous spread of a

large population suffering from the same symptoms. As Ayurveda had mentioned, Adharmaya (iniquity) is the main cause of Epidemics. The factors of Vayu, Jala, Kala, and Desha are polluted due to unrighteous rule and people becoming unrighteous. It is for this reason that a chapter of the Samhitas called Sadvrta is taught. And also lots of preventive measures has mentioned in Ayurveda classics to avoid such diseases. Such as procurement of medicine in their high potential phase or period well before the outbreak of the epidemic, improving the immunity and strengthening the body, moving to safe places away from the polluted environment/air/water, and so on. Ayurveda has widely mentioned Vyadhikshamathwa (the development of immunity) in individuals concerning epidemics. It can lead to longevity. It fulfills both the main objectives of Ayurveda “Swasthasyasāwastharakshana āthurasya wīkaraprashamaṇa”.

## **METHODOLOGY**

The nature of this research was a literature review. Mainly used Charaka samhitha, Susrutha samhitha, and Ashtangahruda samhitha as primary data sources. As secondary data, electronic databases including PubMed Scopus, Google Scholar, and Journals were explored for Ayurveda treatments for epidemics, and all retrieved articles were evaluated to achieve this. Data were collected only from journals published from 2010 to 2020. Only published articles were included in this review and unpublished works were excluded. Language restriction was performed and English articles were included. Recordings, magazines, newspapers, etc. were used. This research was based on the Ayurvedic management protocols and

preventive measures for Epidemic diseases. Referring to details of epidemic diseases according to Ayurveda, detailed modern views of epidemics, modern management, and preventive measure were excluded. The final destination of this research was review of the prevention and management of epidemics concerning Ayurveda.

The search terms were “epidemics with Ayurveda treatment”, “epidemic”, “pandemic”, “Janapada roga”, “Aupasargika roga”, “communicable diseases”, “Janapadodhwansa” and “Vyadhikshamathwa”. References of the final included articles were reviewed for relevant studies.

## **Research problem**

Pandemics have been uncontrollable in present era and the knowledge of Ayurveda Janapadodhwansa has not been focused critically which is a fact to be attentive.

## **RESULTS AND DISCUSSION**

The following literature review could be presented four main points to develop proper management for Epidemics. There are,

1. Preventive methods
2. Therapeutic approaches
3. Dietary regimens
4. Behavioral routine

Preventive measures mainly focused on dinacharya, rithucharya, achararasayana, and sadvrta. All three main classics and several research articles are recommended these four primordial methods are beneficial for the prevention of the epidemic. Among these main non-pharmacological treatment methods, dinacharya is the most applicable method for preventing the disease.

Table 1: The effects of dinacharya

Activity	Effect on dosha	Prevention of	Promotion of
Early rise	<i>Vatanulomana</i> <i>Kapha shamana</i>	Constipation Flatulence	<i>Ayu, Agni, Dhee,</i> <i>Dhritho, Smruti</i>
<i>Jala pana</i>	<i>Pitta shamana</i>	<i>Amlapitta</i>	Digestion, kidney function
<i>Shaucha, dhanta</i> <i>dhawana and jihva</i> <i>nirlekhana</i>	<i>Tridosha shamana</i>	<i>Mukha malinta,</i> <i>Durgandha, dantha</i> <i>roga, Mukha roga,</i> <i>Alasya, Angamarda</i>	<i>Dantha dhridruta,</i> <i>Mukha shuddhi, Jihva</i> <i>shuddhi, Bhojana</i>
<i>Jala neeti</i>	<i>Kapha shamana</i>	Whiting of hairs, wrinkles, cough	<i>Medha, Smriti</i> Eyesight
<i>Anjana</i>	<i>Akshigata dosha shaman</i>	<i>Timira, Stress on eyes</i>	Clarity of vision
<i>Nasya</i>	<i>Kapha shaman Vatanulomana</i>	<i>Urdhva jatrugata vikara</i>	Eyesight Voice Glow of face
<i>Nasya, Gandusha,</i> <i>Kavala</i>	<i>Kapha shaman</i>	<i>Durganthta, Arochaka,</i> Dryness of mouth, Dryness of lips, <i>Dant</i> <i>roga, Mukha roga</i>	Oral health
<i>Doompana</i>	<i>Urdhvajatrugata Kapha-vata</i> <i>roga</i>	Prevents disease above the clavicle	-
<i>Tambula sevana</i>	<i>Vata shaman</i>	<i>Hrid Roga</i>	Mental health
<i>Abhyanga</i>	<i>Vata shamana</i>	<i>Angamarda, Gilani,</i> <i>Sandhi Shool, Anidra</i>	Skin glow and softness, <i>Sarira</i> <i>dadhya , Samhanana</i>
<i>Vyayama/ shankramana</i>	<i>Tridosha shamana</i>	<i>Sandhi vata, Heart</i> disease, obesity	Lightness of body, Digestion, Strength Immunity
<i>Udvertana</i>	<i>Kapha nasaka</i>	Obesity, Compactness of body & skin	Skin compactness
<i>Snana ( Bath )</i>	<i>Tridosha shamana</i>	Skin disease, Prameha, Excessive sweating, Drowsiness Thirst, Burning	Improve digestion <i>Vrisya Aayushya</i> Strengthen energy <i>Utsaha, Bala</i>
Prayer	<i>Mansika dosha shamana</i>	Mental disorders anxiety	Mental health
Breakfast	<i>Pitta shamana</i>	<i>Amla pitta</i>	Agni, Utsaha
<i>Swadhyaya</i>	<i>Tridosha shamana</i>	<i>Bhaya, Glani, avasada</i>	Medha
<i>Sadvritta</i>	<i>Sharirika and mansika dosha</i> <i>shamana</i>	Lifestyle disorders Mental disorders	General health Mental health

(Kaushik, et al., 2018); (Murthy K. 2001)

All these dinacharyas give fruitful results. Accordingly, bhragma Murtha jagarana (waking up early morning) performs vatanulomana and kapha shamana. Therefore, constipation and flatulence are prevented. Also, ayu, agni, dhi, druthi, and smruthi are promoted. When a person wakes up early in the morning, the oxygen in the atmosphere easily and readily mixes up with hemoglobin to form oxy-hemoglobin, which nourishes the remote tissues rapidly. Exposure to bright light in the early morning causes the release of serotonin, which contributes to feelings of well-being, and happiness and keeps the person active and alert. Early in the morning, there is minimal pollution and the concentration of the mind is enhanced. Ushnodaka pāna is essential for maintaining urination and gastrointestinal function. Proper energy is developed throughout the body and enhances immunity. Mala tyaga is the evacuation of the waste of digested foods from the rectum. A healthy person should evacuate the natural urges properly. It is beneficial to increase digestive power and prevents various manifestations.

Netra prakshalana (washing eyes), applying nethra anjana prevents the eye diseases such as netrābhishandya, dantadhavana (tooth brushing), jihva nirlekhana (tongue cleaning), sneha gandusha and kavala dharana are most effective to cleanse the mouth and throat. Most effective activities for the manifestation of infections that are transmitted through the mouth. Applying nasya is effective to evacuate waste products and foreign materials from the nasal cavity. As well the olfactory nerve endings are stimulated by Nasya dravyas and send the message to the CNS to initiate normal physiological functions. Using dhupana gives more benefits. During the dhupana, drugs are lightened with fire, and CO<sub>2</sub> has released with smoke. The carbon atom in CO<sub>2</sub> tends to

stimulate the respiratory center located in the brain stem which may stimulate the normal physiological function of the respiratory system. Using abhyanga, the massage enhances the overall blood circulation and transports the potency of drugs to the desired part. As well triggers the acupuncture points and induces endorphins secretion. It shows an analgesic effect. The snana is good for strengthening the body and removing impurities from the body. Contagious diseases are subsided by bathing. Following the sandhyopasana contributes to mind relaxation, concentration, and cognition. It will cause to trigger natural immunity. (Kaushik, et al., 2018). Agnihotra (Homa) therapy is very simple, economic, and extremely effective in bacteriostatic effect. It cleans the atmosphere, boosts the immune system, and heals physical and mental ailments. Research proved that the smell of cow dung kills the bacteria of cholera and Tuberculosis/TB. The fumes of cow's ghee have the potential to lessen the effect of atomic radiation to a great extent. Unpolished whole brown rice should be used because a subtle energy structure is broken in broken rice. From Agnihotra in the atmosphere to detoxify, depollute, and eradicate bacteria and other microorganisms, which are the root cause of illness and disease. (Deogade, 2020)

## **CONCLUSION**

According to the studied information, it is clear that preventive measures are the main treatment for epidemic diseases in Ayurveda. It means that Ayurvedic treatments not only help to cure diseases but also help to avoid diseases and achieve uththama ayusha (a long life span). Therefore it always deals with the prevention of diseases. If people follow the proper dinacharya, rithucharya, sadvrutha, and achara rasayana they can be achieved a great healthy life throughout



their lifetime. If every individual can follow proper dinacharya, people would be able to prevent complication that comes with epidemic diseases. Shodhana and Rasayana therapy will be administered to epidemic diseases, it would be beneficial for preventing the recurrence of epidemic diseases. When the disease spreads throughout society, both ill and non-illness

persons can be protected by using drugs that are increasing the vyadhikshamathwa. As well as the proper following of dinacharya may help to improve vyadhikshamathwa as a non-pharmacological treatment.

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# A REVIEW ON IMMUNITY ENHANCING EFFECT OF "KAYAM HODDA" USED IN POSTNATAL PERIOD (PUERPERIUM)

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## ABSTRACT

Postpartum means the time after delivery of the child. This period is extended up to six weeks after delivery. 'Kayam Hodda' (KH) is mainly used to promote the health of puerperal women in this period. KH is a medicinal and nutritional traditional soup that has been given to postpartum women during puerperal period since ancient times in Traditional system of medicine in Sri Lanka. This research aims to review the effect of the immunity enhancing activity of KH. Ingredients used for KH vary depending on different regions of Sri Lanka. Data was gathered according to random sampling method from 26 Ayurvedic and Indigenous physicians and 60 people from all the districts of 9 provinces across Sri Lanka. The mostly used ingredients of KH were identified as Asafoetida, Fennel, Cumin, Turmeric, Cinnamon, Red chili, Black pepper, Coriander, Curry leaves, Garcinia, Ginger, Garlic, Bark of Moringa, Fenugreek and Common salt. 86.7% of herbal materials show Katurasa, 46.7% Tiktarasa and 33.3% Madhurarasa as the most predominant rasa. 86.7% of herbal materials show Laghuguna, 60% Thikshna, 53.3% Ruksha and 40% Snigdha guna. 66.7% of materials show Katuvipaka, 26.7% Madhuravipaka and 93.3% Ushnaveerya with 73.3% Kaphavatashamaka action. As modern pharmacological actions, the medicinal

and health potentials of herbals are mainly attributed to its Anti-inflammatory (73.3%), anti-oxidant (86.7%), anti-bacterial (60%), hepatoprotective activity (33.5%) and immunomodulatory properties which are helpful to strengthen the immunity of the mother during the puerperal period. The current study justifies the use of traditional folklore medicine KH which leads to further specified research.

Key words: Postpartum, Kayam Hodda, Immunity, Puerperal period

## INTRODUCTION

Traditional medicine is one of the most valuable medical systems in Sri Lanka. It has 3000 years back history. This knowledge is still preserved in rural society. Kayam Hodda is such an inimitable medicinal soup, used for puerperal woman in post natal period. Puerperal woman is the one after expulsion of the placenta and this time period up to six weeks thereafter is called as puerperal period. In Ayurveda it is termed as Sutika kaala and the woman is known as Sutika. The immune system of an individual is designed to defend against millions of bacteria, virus, fungi, toxins and parasites. The system is very complex, made up of several types of cells and proteins that have different functions to fight against foreign invaders.

## Aim

Aim of this research is to review the effect of immunity enhancing activity of "Kayam Hodda" used in traditional medicine (TM) in postnatal period (puerperium).

## Objectives

To identify the Ayurveda and modern pharmacological properties of ingredients of KH, the specific ingredients used in different recipes of KH and documentation of this disappearing valuable knowledge.

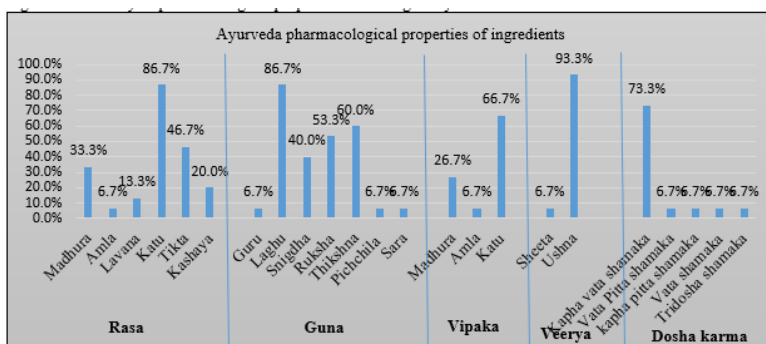
## METHODOLOGY

Recipes of KH were gathered according to random sampling method from 26

Ayurvedic and Indigenous physicians and 60 people from all districts of 9 provinces across Sri Lanka. Among those the mostly used 15 ingredients were selected to assess the effectiveness of immunity enhancing activity of KH according to Ayurveda and modern pharmacological properties and actions. The review was conducted by studying authentic books, web published research articles, reports on Google scholar, PubMed, Research gate and international research journals in Ayurveda and TM.

## RESULTS

Figure 1: Summary of pharmacological properties according to Ayurveda



According to the data analysis of Ayurveda pharmacodynamics properties of ingredients of KH 86.7% of herbal materials show Katu rasa, 46.7% show Tikta rasa, 33.3% show Madhura rasa as the predominant rasa. 86.7% of herbal materials show Laghu guna, 60% Thikshna guna, 53.3% Ruksha guna and 40% Snigdha guna, as well as 66.7% of materials show Katu vipaka, 26.7% Madhura vipak and 93.3% of materials show Ushna veerya. 73.3% of ingredients show Kaphavata shamaka action as their dosha karma.

Figure 2: Dosha karma of ingredients according to Ayurveda

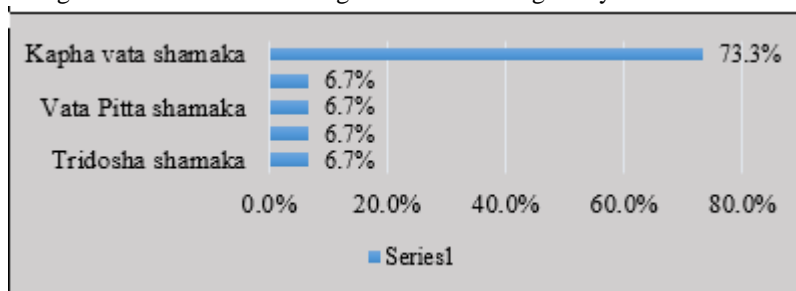
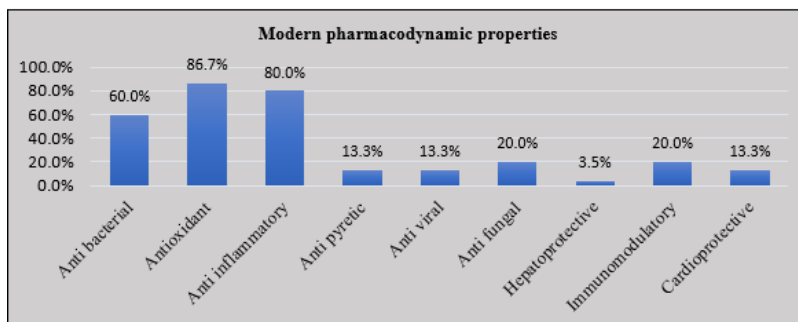


Figure 3: Modern pharmacological properties of ingredients



As modern pharmacological actions, the herbals are mainly attributed to its Anti-inflammatory (80%), anti-oxidant (86.7%) and antibacterial (60%) with 20% of immunomodulatory and hepatoprotective activity.

## DISCUSSION

According to Ayurveda the process of labour is initiated and controlled by Vata dosha. The fully stretched uterus is suddenly vacated after delivery thus filling with Vata dosha which means there is vitiation of Vata. So Vata shamana is important during postnatal period. Loss of body fluids and blood along with exhaustion during labour causes dhatu kshaya and reduction of immunity. Therefore puerperal woman becomes more prone to diseases and complications which is why she must be improved in immunity with cleansing of uterus which should be free of remnant parts of placenta to avoid further infections. According to evidence of Ayurveda pharmacodynamics properties of KH, it pacifies vitiated Vata dosha due to Madura rasa, Snigdha guna, Ushna veerya, and Madura vipaka. Having Laghu, Ruksha guna and Katu vipaka, it also pacifies vitiated Kapha dosha. Consequently the ingredients in KH show Kaphavata shamaka action. It helps to reduce pain and increase the immunity in Sutika. According to Ayurveda the Sleshma in its state of normalcy is known as the Bala (immunity). When Kapha is vitiated, it acts as a waste product in the body. Healthy Kapha dosha itself can be

considered as Ojas (immunity factor). When it is imbalanced, it causes diseases while it is balanced it helps to ward off diseases. KH balances both Vata and Kapha dosha and helps to improve immunity. According to modern pharmacological values, the medicinal and health potentials of herbals are mainly attributed to its Anti-inflammatory, anti-oxidant, anti-bacterial, hepatoprotective and immunomodulatory properties with their chemical compounds.

## CONCLUSION

According to the evidence found in this study it could be concluded that the "Kayam Hodda" consists with considerable effects for puerperal woman for enhancing immunity during post natal period. Further studies to determine the immunity enhancing effect of "Kayam Hodda" along with scientific studies are needed.

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# A LITERATURE REVIEW ON PHARMACOLOGICAL ACTIVITIES OF LEKHANIYA MAHAKASHAYA

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## **ABSTRACT**

Obesity is characterized by abnormal fat accumulation that impairs health. Ayurveda medicine recommended Lekhaniya action or scraping /corrosive action for obesity and medicinal plants mentioned in Lekhaniya mahakashaya have diverse pharmacological properties to reduce body weight. With this background, our intention is to summarize the literature on anti-obesity compounds mentioned in Lekhaniya Mahakashaya, discovered mechanisms and pharmacological actions of anti-obesity herbs in Ayurveda medicine. Literature searches were done regarding anti-obesity activities of the selected medicinal herbs in PubMed, PMC, and ScienceDirect. Furthermore, anti-obesity and hypo-lipidemic bioactive compounds of the selected herbs and their mechanisms were searched in some popular search engines like Google, Google Scholar, to gather secondary data. In this study revealed that *Picrorhiza kurroa* comprises choleric and cholegogue-purgative actions, *Curcuma longa* have the anti-adipogenesis potential, *C. rotundus* shown adipogenic activity, *Saussurea lappa*, *Iris germanica* and *Holoptelea integrifolia* have hypolipidemic activity, *Berberis aristata* changes in adipogenesis, *Acorus calamus* delayed intestinal absorption of dietary fat, *Aconitum heterophyllum* has hypolipidemic effect and block intestinal fat absorption, *Plumbago zeylanica* had been reduced the hypertrophy of adipocytes. All plants in Lekhaniya Mahakashaya have been exhibited

different anti-obesity mechanisms with different pharmacological pathways includes decrease lipid absorption, hypertrophy of adipocytes of the adipose tissues, delay or block intestinal fat absorption, inhibit pancreatic lipase activity, decreased pre-adipocyte differentiation and proliferation, decreased lipogenesis, and enhanced lipolysis.

Key words: Obesity, Lekhaniya Mahakashaya, pharmacological activities

## **INTRODUCTION**

Herbal medicine comprises its roots in all around the world and it involves the medicinal use of plants, animal products and minerals to treat disease and enhance general health and wellbeing (Sam, 2019). These ecofriendly and bio-friendly plant-based products are very helpful for the prevention and cure of different kind of human diseases (Marrelli, 2021). Obesity is described as an abnormal or excessive accumulation of fat that may have a detrimental effect on one's health that increases the risk of other diseases and health issues, including cardiovascular disease, diabetes, high blood pressure, and certain cancers. The body mass index (BMI) is a simple weight-for-height index that is frequently used to identify adult obesity (BMI  $\geq$  30) (Gunawardana et al., 2021).

Over the years, numerous medications have been used to prevent and treat obesity. Despite the seemingly

unescapable progression of this disease and the promising results of some drugs on lowering body weight and amendment of numerous cardiometabolic factors, the majority of approved and marketed anti-obesity drugs have been withdrawn from the market in recent years due to severe side effects (Kang and Park,2012). Ayurveda pharmaceuticals that have Lekhaniya action or scraping /corrosive action are recommended to reduce weight. With this background, our intention of this review is to summarize the literature on anti-obesity compounds mentioned in Lekhaniya Mahakashaya, discovered mechanisms and pharmacological actions of anti-obesity herbs in Ayurveda medicine.

## **METHODOLOGY**

Literature searches were done regarding anti-obesity activities of the medicinal herbs in PubMed, PMC, and ScienceDirect. Furthermore, anti-obesity and hypo-lipidemic bioactive compounds of the selected herbs and their mechanisms were searched in some popular search engines like Google, Google Scholar, to gather secondary data. All materials, regardless of sources, were reviewed, and the review framework was developed to represent the information available.

## **RESULTS AND DISCUSSION**

Generally, Ayurveda pharmaceuticals that have Lekhaniya action or scraping /corrosive action are recommended to reduce weight. Those medicines can reduce/prevent excessive accumulation of Kapha and medha by scraping action. The 4th chapter of Charaka Samhitha Sutrasthana mentioned 10 medicinal plants as Musthaka (Cyperus rotundus), Kushtha (Sausurea lappa),Haridra (Curcuma longa ), Daruharidra (Berberis aristata ), Vachaa (Acorus calamus),

Athivisha (Aconitum heterophyllum), Katukarohini (Picrorhiza kurroa), Chitraka (Plumbago zeylanica), Chirabilwa (Holoptelia integrifolia) and Haimawathi (Iris germanica) under Lekhaneya Dashakaya .

In 2016, Harshitha et al. discussed the useful for designing new formulations to treat Medodushti and its complications. Drugs that are Katu, Tikta, Kashaya in Rasa, possessing Ushna Virya, and Laghu Ruksha Guna are largely responsible for Medohara and Lekhaneeya activities (Harshitha et al., 2016). In 2012, Naresh proved that lekhaneya formulation yields better hypolipidaemic effect in medium dose and Lekhaniya Mahakashaya has got maximum depleting effect on serum low density lipids. Furthermore, he explained that one constituents of this formulation viz. Katuka (Picrorhiza kurroa) comprises choleric and cholegogue-purgative actions. Since, bile salts are required for absorption of fat and lipids from gut, their excretion would lead to decreased absorption of fat and lipids in the gut increasing fecal fat and bile salt contents. Subsequently, concentration of lipids in serum is decreased (Naresh, 2012). Curcuma longa had been reduced food intake and stimulation of sympathetic nervous system, resulting in thermogenesis and lipolysis through regulation of adipogenesis and lipolysis pathway in high-fat diet-induced obese rats (Ji Hye Kim et al, 2016). Also C. longa extract have the anti-adipogenesis potential on inhibiting the synthesis of triglycerides and cholesterol and lipid droplet formation in HepG2 cell as anti-obesity parameters better than curcumin (Budiman et al, 2015).

In 2021, Silva et al have been discovered most of Sri Lankan medicinal plants effectively attenuated the triglyceride (TG) content in adipocytes. C. rotundus which is coming under lekhaneya dashakaya inhibited lipid accumulation, suppressed adiposity and shown

adipogenic activity in the presence of the tested concentrations (Silva et al, 2021).

In 2020, Jayasena and Jayarathne revealed that *Sausurea lappa* came under *lekhaniya dashakaya* have been shown hypolipidemic activity and adipogenesis inhibition activity by reducing the fat absorption by bowels. Also, it increases the bowel mortality and reduces the time of fat absorption (Jayasena and Jayarathne, 2020). Hwang et al had been assessed the changes in adipogenesis-related protein expression in adipose tissue from mice using western blot analysis to clarify the mechanism underlying the anti-obesity effect of *Berberis aristata* (Hwang et al, 2009). In 2017, Athesh and Jothi had been observed pharmacological screening of anti-obesity potential of *Acorus calamus* in high fat cafeteria diet fed obese rats and they revealed that *Acorus calamus* delayed intestinal absorption of dietary fat due to the inhibition of pancreatic lipase activity, enhancement of antioxidant status mediated by the antioxidants such as flavones and activation of the leptin signaling pathway (Athesh and Jothi, 2017).

In 2012, Subash and Augustine had been observed that an increase in fecal fat content is also an indication of the hypolipidemic effect of *Aconitum heterophyllum*. Furthermore, the significant hypolipidemic effect of *A. heterophyllum* may be linked to its ability to inhibit HMGCR activity and block intestinal fat absorption. The increase in HDL-c may be linked to its ability to activate LCAT enzyme (Subash and Augustine, 2012). In histopathology studies revealed that *Plumbago zeylanica* had been reduced the hypertrophy of adipocytes of the adipose tissues of rats (Sarayu et al, 2019). In 2016 Gokaraju et al. had been disclosed the amelioration of certain biomarker molecules such as Peroxisome proliferator-activated receptor gamma (PPAR- $\gamma$ ), Adipose

Differentiation Related Protein (ADRP), CD36, Adipocyte Fatty-acid-Binding Protein (aP2/FABP-4/A-FABP), beta-3 Adrenergic Receptor ( $\beta$ 3AR), Leptin, Perilipin and Adiponectin by using the phytochemical components derived from *Holoptelea integrifolia* (Gokaraju et al, 2016). Results of the study evaluate the effects of ethanolic extract of *Iris germanica* on lipid profile of rats fed on a high-fat diet had been indicated that ethanolic extract of *Iris germanica* significantly lowered the lipid components especially, the cholesterol and triglycerides (Chaudhay et al, 2005).

## CONCLUSIONS

*Lekhaniya Mahakashaya* is a one of *mahakashayas* described in fourth chapter of *Sutrasthana* of *Charak Samhita* and includes ten plants taken in equal quantity for obesity reducing effect. In this study revealed that all plants exhibited different anti-obesity mechanisms that included decreased lipid absorption, hypertrophy of adipocytes of the adipose tissues, delay or block intestinal fat absorption, inhibit pancreatic lipase activity, decreased pre-adipocyte differentiation and proliferation, decreased lipogenesis, and enhanced lipolysis. Hence, more studies need to be focused on the bioactive constituents of the medicinal herbs for developing as anti-obesity drugs.

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## ENDOPHYTIC BACTERIA AS A THERAPEUTIC AGENT FOR ARTHRITIS

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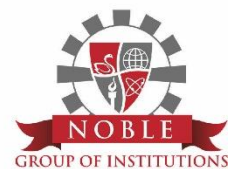
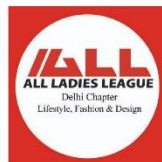
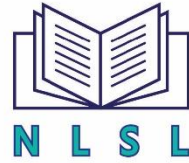
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### **ABSTRACT**

Endophytes are group of microorganisms specially bacteria and fungi, which colonize either in intra or intercellular spaces of plants. It is generally complete their part or entire life cycle in plants without causing any symptom of a disease. A single plant can be infected with diverse types of endophytes and importantly, they are reported to produce a number of novel metabolites that are promising, and useful sources to apply in the fields of agriculture, medicine, and industry. Among the medicinal plants, *Cissus quadrangularis* L. (Veldt grape/ Heeressa/ Pirandai) and *Cardiospermum halicacabum* (Balloon Vine/ Wel Penela/ Mudakattan) are used by common folk in India and Sri Lanka over the centuries for the treatment of arthritis. Arthritis is an inflammatory disease which has symptoms include pain, swelling, and destruction of cartilage and bone leading to permanent disability. This review is focused on the secondary metabolites obtained from the endophytes of *Cissus quadrangularis* and *Cardiospermum halicacabum* for the treatment of arthritis. The secondary metabolites produced by endophytes such as polyphenolics, triterpenoids, alkaloids, and flavonoids, could be used as an efficient candidate for drug development. Thus, these secondary metabolites might hold immense unexplored potential to treat arthritis and could manifest as an asset. There are various techniques to detect secondary metabolite from endophytic bacteria such as Nuclear magnetic resonance (NMR), Gas chromatography (GC), Liquid chromatography (LC), Cation-exchange high-performance liquid chromatography (CE) etc. Among those, Nuclear magnetic resonance (NMR) spectroscopy is a reliable method that frequently applied in metabolomics studies. Furthermore, identifying the endobacterial metabolic products and their medicinal value could be useful in treating arthritis. Therefore, identifying therapeutic compounds to treat arthritis will be a valuable resource for the future research.

Keywords: Arthritis, Endophytes, Secondary metabolites

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