Chapter-3

A Literary Investigation on Ayurveda and Siddha Approach to Prevent and Control Diabetes Mellitus Upgrading Meal Pattern W.S.R. to Traditional Rice Verities

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Abstract

Diabetes mellitus is a metabolic disorder characterized by impaired action or secretion of insulin or both. It is predicted further upsurge of hyperglycemia in near future with increased mortality due to emerging complications such as cancer, cardio vascular, kidney diseases and dementia. Even though the food portion and calory consumption is measured well and meal plans are introduced according to the food and nutrition regulations which has uplifted with modern sciences international diabetes federation says there is a growing impact of diabetes across the world. In allopathy medicine some commonly used drugs are introduced, expecting enhancement of secretion or action of insulin but those are given with timely increasing dose. That means the amount or quality of insulin may have hidden controversial effect in expecting results.

Therefore, this is the best era to identify the reasons, find solutions, do researches based on traditional knowledge and conventional system of medicines practiced in eastern world to protect the next generation from early diabetes.

This literature study was aimed to compile and review etiological factors of *prameha* explained in Ayurveda and siddha medicine and disseminate the knowledge to use in diabetic prevention. Further, attention of this research was focused to study the validity of traditional rice verities in the aspect of controlling diabetes. Owing to rice is consumed as the main meal in south Asia region.

The study was conducted based on the authentic texts of Ayurveda and Siddha medicine and research articles searched through recognized search engines for instance Google scholar and Pub Med., using relevant keywords.

Among the etiological factors explained in Ayurveda and siddha medicine many are modifiable risk factors. Disregarding them since ages seems the reason behind rapid outbreak of diabetes

Glycemic controls of 10 traditional rice varieties used in Sri Lanka also were assessed. Thirty articles which published in the period of 2000-2023 were used in this study. The results identified the effect of those in controlling hyperglycemia including appropriate processing and cooking method.

The study concluded that it is very much important uplifting meal pattern in the manner mentioned in ayurveda authentic texts with life style modification avoiding sedentary life style in prevention of DM. Further it shows the unpolished traditional rice varieties with red pericarp, has low GI, high amylose content with proper cooking method and it can be used as opposed to newly developed rice verities for main meal in aiming reduction of diabetes and its complications.

Keywords: Traditional rice verities, Diabetes, Sri Lanka, Glycemic index

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1. INTRODUCTION

Diabetes mellitus is a metabolic disorder characterized by impaired action or secretion of insulin or both, resulting hyperglycemia [1]. According to International Diabetes Federation, Worldwide, 537 million adults (20-79 years) are living with diabetes and it is nearly one in ten. this number is predicted to rise to 643 million by 2030 and 783 million by 2045. It also states that over 3 in 4 adults with diabetes live in low- and middle-income countries. and in the past 3 decades the prevalence of type 2 diabetes has risen dramatically in countries of all income levels Diabetes is responsible for 6.7 million deaths in 2021, and that is one in every 5seconds. Diabetes has accounted for 966 billion USD in health expenditure and it is 316% increase over the last 15 years [2].

Apart from the above-mentioned economic burden diabetes is a major cause of blindness, kidney failure, heart attacks, stroke and lower limb amputation. According to the WHO official web page in 2019 kidney disease due to diabetes caused an estimated 2 million deaths.

When observing this remarkable global health problem, health care professionals should pay more attention on preventive measures than finding out new medications. Because this has an Outbreak even though it is a non-communicable disease.

Further recent studies on Diabetes mellitus emphasize its complications such as retinopathy, foot ulcer, nephropathy and neuropathy affecting whole system of body and increasing the mortality from vascular disease. Except vascular diseases cancer and dementia also have become the leading causes of death at present [3] [4]. The health system considers early screening and long term follow up within the system as its management combined with supportive lifestyle and dietary changes.

When observing this remarkable global health problem, health care professionals should pay more attention on preventive measures to prevent a diabetes mellitus Outbreak in future.

When critically investigate the causative factors of *prameha* explained in Ayurveda authentic, it is observed that there is close relationship between them and modern life style including food habits and behavioral pattern.

Before technical and technological revolutions, we had hard physical exercises in day today life, and never had excessive calorie burning burden in lives. But people are not updated with them in the aspect of health. Especially conventional knowledge regarding food habits and the medical systems based

on eastern philosophies has not been taken into consideration in this regard. Even though the calorie consumption of a person is measured gender wise, age wise and according to the health state until the end point, and the knowledge regarding the accurate number of calories with definite amount of food category in modern society this problem of diabetic is rapidly increasing.

Rice is the main meal of Sri Lanka. People in Sri Lanka cultivate varieties of rice for their consumption and for trading. In ancient times those were limited to traditional verities which escape them from number of non-communicable diseases.

Therefore, this is the best era to identify the reasons, find solutions, conduct studies based on traditional and conventional system of medicines for protecting the next generation from early diabetes. In allopathic medicine, some drugs introduced expecting enhancement of secretion and action of insulin, had to increased its dose time to time that means the amount or quality of insulin may have hidden controversial effect in expecting results.

Thousands of years ago in the medical systems like ayurveda which based on eastern philosophies have been explained *madhu meha* under *prameha roga* introducing significant etiological basis which are very important to taken into consideration in modern era. Number of modifiable risk factors could be identified to aware the society to uplift their meal pattern. Present is the precise time to popular them among the people with acceptable evidences in aiming to discard suffering from diabetes.

Research Question

Diabetes mellitus is a massive public health issue which represent 10.5% recognized adult population [20-79yrs] of globally while almost half unaware that they are living with diabetes by 2021. In south Asia this was 8.8.%. It is rapidly increasing among the society causing remarkable death and disability rate as well.

Thousands of years ago in ayurveda authentic, the ancient rishis have explained some precautions to prevent this. Etiological factors, pathology, symptoms and management principles are there but as an un disseminate hidden knowledge or with a limited population who obtained that knowledge as a medical science. Definitely it has positive impact in controlling diabetes mellitus outbreak if we can take necessary steps to transfer this knowledge towards the general public as a long-term policy plan.

Rice is the main meal of south Asian region. Traditional rice verities used by ancient civilians help to protect their health from NCDs including diabetes and cancer. It is beneficial to study the relationship among these facts and made suggestion to researches and implementing disseminating programs and action plans to overcome the problem of diabetes.

2. AIM AND OBJECTIVE

General Objective

To aware the community in aiming to control the diabetes mellitus outbreak in future generation.

Specific Objective

- To investigate the etiological factors, pathogenesis, symptoms and management principles of Diabetes mellitus mentioned in main Ayurveda and siddha authentic texts.
- To identify the modern research findings on traditional rice varieties against Diabetes mellitus for introducing effective main meal modification.
- To logically present food pattern and lifestyle changes to control diabetes mellitus based on ayurveda and siddha theories.
- To encourage the research communities to plan qualitative and prospective researches to prove the findings.
- To aware the general public and draw attention of policy makers to implement disseminating programs and action plans in aiming to get rid of the heavy burden of diabetes

3. METHOD

A literature review was conducted based on the authentic texts of Ayurveda and Siddha medicine and articles searched through recognized search engines such as Google scholar and Pub Med using the relevant keywords

Investigating explanations mentioned in main selected authentic compendiums of Ayurveda and siddha medicine regarding etiology, pathology, symptoms and management on *prameha roga* resembling it with diabetes mellitus.

Observing food and lifestyle changes suggested in those for prevention and curing the ailment and analyzed them.

Examining modern research findings and data regarding traditional rice varieties against diabetes mellitus. In that aspect thirty articles which published in the period of 2000-2023 were used in the study. Then, critically investigated the selected number of traditional rice varieties used in Sri Lanka for glycemic control.

Presenting suggestions for upgrading meal pattern accordingly the ayurveda and siddha etiology and main meal modification with traditional rice varieties for prevention and curing the diabetes.

4. LITERATURE REVIEW

Literature Review

According to the ayurveda *madhumeha*/diabetes is a complicated end stage of 20 *prameha roga*. When it becomes *madhu meha* it is incurable and taken as a complicated stage of basic *prameha roga* which has not been treating properly. And *prameha* comes under serious ailments category (*maharoga*) in ayurveda explanations.

Nutrition of the food we taken /*Sara bhaga* becomes seven *dhathus* /tissues of the body at the end of proper metabolism/ action of 13 types of *Agni* [digestive capacity and metabolism up to the cellular level]. All hormonal and enzymic activities identified by modern physiology is representing by the actions of *Agni*. In Sanskrit language we have a hollow organ/*aashaya* produced *Agni* and we call it *agnyasha (Agni+aashaya)* this organ is called pancreas in modern anatomy, which is responsible for the production of insulin that directly related with controlling blood glucose levels.

In *prameha, Sara bhaga* of *ahara rasa* (essence of digested food) excrete from the body through the channels having tiny openings, without proper metabolism.

When the *Agni* process which responsible for creation of proper *dhathus*/tissues is not going in the correct manner additional liquid matters are produced as waste products. Consistency of urine also could be changed, because some solid matters also left with urine which results due to improper metabolism (*aavila muthrata*) The Sanskrit word '*prameha*' defines extra discharges with urine. In this instance urine volume and frequency also expected to be high (*prabhutha muthrata*). Therefore, wasting body tissues and reducing body strength can be cased due to *prameha* according to ayurveda. (Deteriorative illness)

When appearing signs and symptoms Susruta and Vagbhata explain increasing volume and frequency of urine with the changes of composition of urine, while Charaka has been observing bodily changes than them in urine.

Causative factors are as follows; [Cha/chi/6/4]

Aasyasukham swapnasukham dadhini gramyodakaanuparasah payaansi Nawaannapanan gidavaikrruthamchaprmeha hethuh kaphakruchcha sarwam

Over indulgence in the pleasure of sedentary habits, excess sleep, curds, soup of the meat of domesticated and aquatic animals and animals inhabiting marshi land milk and its preparations, freshly harvested food articles and drinks productions of sugurcane/jaggery and all kapha aggravating factors are responsible for the causation of *prameha*.

Accoding to the *doshic* involvement and pathogenesis it is explained 20 types of *prameha* in Ayurveda as 10 *kaphaja* and curable, 6 *pittja* and palliable and 4 *vataja* which is incurable and cause complications. And further it is said if not treated properly other *prameha*s also can go to incurable stage of *vataja prameha*. Some acharyas consider madhumeha [disease named due to passing urine similar to bee honey having sweet taste] which resembles in diabetes mellitus in modern medicine is also a one in 4 *vataja prameha*.

But currently we identified this disease with the presence of sugar in blood or urine. By that we passed the curable stage /types of *prameha*. At that time sages/clinicians have explained *purwa rupa* / premonitory signs and symptoms to identify them at previous stages before developing it into madhumeha/ diabetes mellitus as follows. (cha/chi/6/13-14)

Sweating, body odor, flabbiness of the body, liking for constantly lying on the bed, sitting, sleeping and leading an easy life, a feeling as if the cardiac region is covered with extraneous material, exudation of excreta from eyes, tongue, and ears, corpulence of the body, excessive growth of hair and nails, liking for cold things, dryness of throat, and palate, sweet taste in the mouth, burning sensation in hands and legs, and swarming of ants on the urine.

Collecting waste particles in body organs, rough feeling of teeth even some times after brushing, changing odor of mouth and body, thirsty, extra smoothness of skin, sweet taste in mouth, increasing nail and hair growth rate, etc. also explained by other acharyas even as premonitory symptoms.

Samprapthi/ Pathogenesis [cha/chi/6/5]

Aggravated *kapha* vitiated *medas/*fat tissues, *mansa/*muscle tissues and *kleda/*fluidity located in *vasti/*the bladder, cause kapha dominant types of *prameha*. When those elements are vitiated by aggravated *pitta* due to hot things, it leads to *pitta* dominant *prameha*.

The difficult thing is when having those two doshas in diminished state, *vayu* get aggravated and draws tissue elements like *ojas*/essence of *sapthadhatu*[seven body tissues], majja/bone marrow and *lasika*/body fluids into urinary tract causing *vata* dominant *prameha*.

When involving causative factors harmfully enhancing sweet/*madhura* and sour/*amla* taste/*rasa* and smooth/*snigdha*, cold/*sheetha*, sticky/*pichchila*, heavy/*guru* and discharging/*abhshyandi guna*/qualities in the body.

In *prameha*, first *Rasa vriddhi* (specially *madura/*sweet, *amla/*sour taste) ---*kapha* vitiation---changes of normal qualities of *rakta dhatu---mansa* and *medo vriddhi* abnormally----it effects on *shukra dhatu* as first enhancing / *shukra vriddhi*, then changed/*vipareetha*, atlast *dushitha* /vitiating. According to the body constitution of the patient he may get obese first and then emaciated or vice versa. Weaken ligaments cause loosen muscles which has less strength. That is because of sub tissue formation accordingly *dhatu paripachana* process. (cha/chi/15-grahani) this results abnormally enhancing breast milk (sub tissue of rasa dhatu) rate of nail and hair growth become high (waste product of *mansa dhatu* and sub tissues of *asthi dhatu*) this process completely explain increase sweating with bad odor, loosen muscles which has less tone, increasing fat store, reducing sexual strength, enhancing fluidity in the body etc….. but *asthi dhatu* is emaciated. [cha/chi 15]

Due to association of *prameha nidana*/etiology, basically *Agni* is decreasing, and then increasing finally chronic changes of *Agni* is taken place.

Vata and pitta dosha qualities are hidden and they showed kapha qualities instead.

In some of the treatment principles specially in Sri Lankan traditional medicine, to balance these changes in the body clinicians used medicines having qualities such as astringent/*kashaya*, bitter/t*hikta rasa/* taste and hot potency/*ushna virya* in nature.

Principles of management (cha/chi/6/15-17)

According to the Ancient sage Charka's explanations patients suffering from *prameha* are classified into two categories (cha/chi/6/10)

1. Obese and strong
2. Emaciated and weak

For first category, elimination therapy (*shodhana karma/ pancha karma*) is recommended while the second category is recommended nourishing therapy.

In elimination therapy the oileated patient should be given various recipes given in *kalpa sthana* in aiming to eliminating metabolic waste products through upward and downwards tracts. (*wamana*/emesis, *vireka*/laxative, *vasti*/enema.) after removing excess metabolic by products from the body, those patients also should be given *santharpana*/nourishment therapy.

Except these categories in *indriya sthana* sage Charaka explain inherited type of *prameha* as well. [cha/indr/9] There, it is explained as the changes happened in *bija*/spermatozoa or *bijabhaga*/chromosome or *bijabhagaawayawa*/ genes.

Sage Susrutha and Charaka both have explained incompatible food habits, and lifestyle which could be the etiology of *prameha.* (Cha/chi/ 07; Su/chi/11/12)

Sage Vagbhata in ashtanga hrudaya says as vitiation of *vata dosha* due to wasting of *pittadi dosha* (enzymes, hormones) and *dhatus* could be caused *prameha*.(ash/hr/nid/6/27)

When we associated etiological factors of *prameha* basically less hunger, and then excessive hunger eventually changeable hunger can be results.

In *dhatu paripachana* /metabolic process *dhathvagni/*metabolic power act on *dhathus/*tissues then results *upa-dhathu* and *mala/* waste products.

Kapha and rasa *vriddhi*/enhancing cause changes in identical qualities of *Rakta dhatu* and then *rakta dhatu* is vitiated. Harm fully enhance *mansa* and *medo dhatu. Asthi dhatu* is wasting but maajja dhatu also enhancing.

Due to deterioration of *pittadi dos*ha and dhatu can cause *vata* vitiation it also leads to *prameha* according to the vagbhata in Ashtanga hrudaya samhitha [ash/hr/ni/6/]

If the disease is longtime, having complications, having more discharges from the body openings, if having cysts and wounds, and if it is coming through the generation or if it is having with birth those *pramehas* are considered as

incurable. Most of the patients who suffering juvenile diabetes have been born with the disease.

Ayuveda Aspect

Table 5: Etiological factors, etiopathogenesis, symptoms and management principles of Diabetes mellitus in Ayurveda aspect

Etiological Factors	Constant day sleep, absence of physical activities, cold, unctuous, sweet, fatty foods and drinks [5], Sedentary habits, sleep, curd, soup of meat of domesticated and aquatic animals and animals inhabiting marshy land, milk preparations, freshly harvested food articles, freshly prepared alcoholic drinks Jaggery preparations (*kapha* aggravating factors) [6], Cold, sweet, sour, salt, fatty foods and drinks, hardly digestible foods, fresh grains, beer, meat of animals of marshy regions, sugarcane juice, molasses, milk, habit of always sitting at a place, sleeping without adopting suitable methods [7]
Symptoms	Burning sensation in palms and soles, unctuous, slimy skin, urine is sweet, bad in smell and white in colour, stupor, debility, profound thirst, dyspnea, more accumulation of dirt in the palate, throat, tongue and teeth, more growth of hairs and nails [5]' Sweating, emanation of foul smell from the body, flabbiness of the body, feel to be in bed constantly, exudation of excreta from eyes, tongue, ears, excessive growth of hair and nails, dryness of throat and palate, sweet taste in mouth, burning sensation in hands and legs, swarming of ants on the urine, desire to sweet [6]' Excessive perspiration, bad smell of body, looseness of the body parts, desire for the comfort of the bed, seat and sleep, thickness of heart, eyes, tongue and ears, stoutness of the body, excessive growth of hairs and nails, desire for cold things, dryness of throat and palate, sweet taste in mouth, burning sensation in palms and soles, swarming of ants towards the place of urinated [7]
Etiopathogenesis	*Vatha*, *Pitha* and *Kapha* which are not processed by heat properly mix with *medas* (fat tissue) expelled out along with urine [5], *Kapha* vitiated *medas*, *mamsa* and *kleda* located in *basti* (urinary tract) and *Pitha* vitiated elements along with aggravated *Vayu* draws the tissue elements in the body into urinary tract and expels out [6]. *Kapha, Pitha* and *Vatha*

	causes change in the nature of urine, cold, sweet, thread like urine, hot, foul smelly, red urine, frequent honey like urine respectively [7].
Management Principles	First category, elimination therapy (*shodhana karma/ pancha karma*) the second category is nourishing therapy. In elimination therapy the oileated patient should be given various recipes given in *kalpa sthana* in aiming to eliminating metabolic waste products through upward and downwards tracts. (*Wamana/*emesis, *vireka*/laxative, *vasti*/enema.) after removing excess metabolic by products from the body, those patients also should be given *santharpana*/nourishment therapy along with *pathiya ahara* and *vihara* [6]

Siddha Aspect

Madhu megam is considered as a condition described as the recurrent passage of urine beyond the normal level causing weakening and reduction of seven body *dhathus*. It is one of the 20 types of *Megam* (disease causing emaciation of body due to excess urine loss) in Siddha medicine [8]. *Madhu megam* is also known as *Neerizhivu, inippu neer* in Siddha medicine. It is correlated to Diabetes mellitus.

Table 6: Etiological factors, symptoms, and etiopathogenesis and management principles of Diabetes mellitus in Siddha aspect

Etiological Factors	Improper intake of milk, ghee, toddy and fish, excessive sexual indulgence, psychosomatic stress [8]
Symptoms	Large quantity of urine output at frequent intervals, burning and pain in urethra, dull pain in testis in male, urine becomes yellow with white sediments, pallor skin, body pain [8]
Etiopathogenesis	Recurrent passage of urine above than the normal resulting in weakening and reduction of seven *dhathus* in our body (tissues) [8].
Management Principles	Internal medicines and external medicines along with *pathiya apathiyam* [8]

Traditional Rice Varieties in Sri Lanka

With the development of technology in Agricultural industry in Sri Lanka, there are different categories of rice such as new improved, old improved and traditional varieties [9].

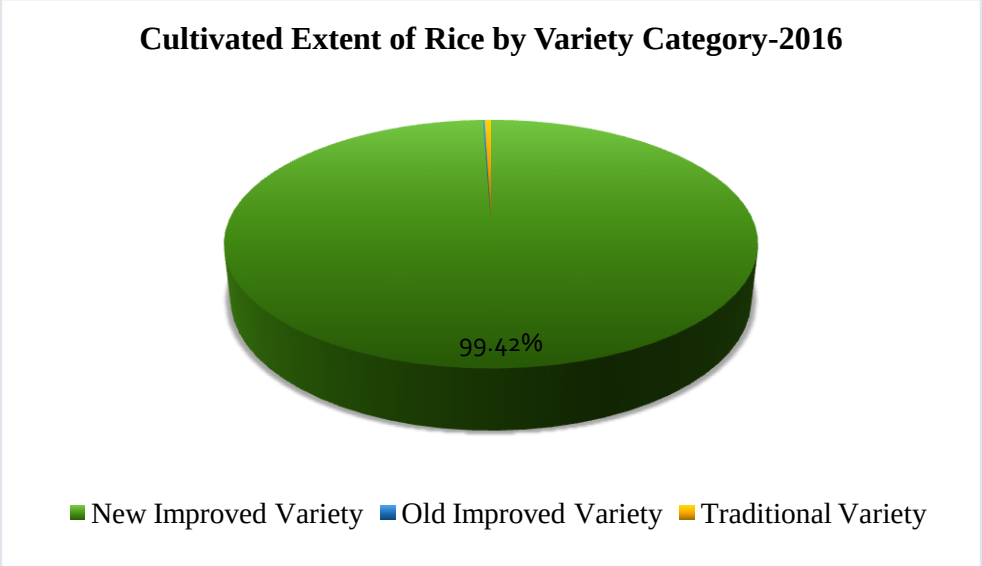

Figure 11: Cultivated Extent of Rice by Variety Category-2016 [9]

However, the new improved rice varieties are dominant, Sri Lanka still maintains the collection of 3000 traditional rice varieties with 400 remaining popular for its nutritional and medicinal value among local people [10] .

Traditional Rice Varieties

Table 7: The list of Traditional Rice Varieties in Sri Lanka

Rice Varieties Mentioned in Traditional/ Ayurveda Medicine	Action	Rice Varieties Mentioned in Siddha Medicine	Action
Black Heenati	Treatment of Snake Poisoning, Diarrhea, Diabetes	Kaar Arisi	
Red Heenati	Hepatitis	Manakkathai,	Wounds and Poisioning
Thavulu Heenati	Convalescing Patients With Problem in Digestive System	Eerkku Samba	Increase Pitham
Beheth Heenati	Snake Bite	Puzhugu Samba	Relieves Thirst and Provide Strength
White Heenati		Kaivarai Samba	Strengthen Body
Murungakayan	Expecting Mothers, Good for Growth of Fetus	Kallundai Samba	Strengthen Body

Pachchaperumal	**Control Diabetes**	Kundach Samba	Relieves Thirst
Maa Wee	Orthopedic Treatments	Malligai Samba	**Cures Prameham**
Baala Maa Wee	Gangrene, Jaundice	Mani Samba	Cures Excess Urination
Suwandel	Aphrodisiac	Korai Samba	**Cures Prameham**
El-Wee	Easy Digestion Prescribed Foe Expecting Mothers And Infants	Vaalan	
		Karunkuravai	
		Senj Samba	
		Iluppaipoo Samba	
		Valaithadi Samba	
		Kurunch Samba	
		Milagu Samba	
		Seeraga Samba	
		Kaalan Samba	
		Mai Samba	
		Kodai Samba	
		Kaadai Samba	
		Kunrimani Samba	
		Annamazhagi	

Dietary Recommendation for Diabetes Mellitus: Carbohydrate in diabetes management includes carbohydrates from fruits, vegetables, whole grains, legumes and low-fat milk. Glycemic control is achieved by carbohydrate counting, exchanges or experienced- based estimation strategies [11].

1. **The Glycemic Index And Load:** Glycemic index is a relative measure of the incremental glucose response per gram of carbohydrate and their ability to influence postprandial glycemia [12] [13] . Glycemic load is obtained by multiplying glycemic index by the amount of carbohydrate of overall diet [12]. They are additional benefit in glycemic control [11]. Replacing high glycemic index carbohydrates with low glycemic index forms improve glycemic control in diabetes type 2 patients and educe hypoglycemic episodes in persons treated with insulin [12].

   Glycemic index is classified as high (GI> 69), medium (GI= 56-69) and low (GI< 56) [14]

2. **Fiber:** Increased intake of fiber containing foods such as legumes, fiber rich cereals, fruits, vegetables and whole grain a product is recommended for people with diabetes and fiber rich cereals more than 5g/serving is considered good for health [11]. Fiber rich foods generally have low glycemic index, but not all the foods with low glycemic index essentially have high fiber content [12]. Dietary fiber can be classified as soluble and insoluble dietary fiber [15] 50g/day

3. **Resistant-Starch/High-Amylose Foods:** It is starch physically enclosed within intact cell structures as in modify glycemic response, prevent hypoglycemia and reduce hyperglycemia [11].

   Amylose content is classified as waxy (0-5%), very low (5-12%), low (12-20%), intermediate (20-25%) and high (25-33%) [16].

   Dietary Fat and Cholesterol in Diabetes Management: Limiting saturated fatty acids (less than 7% of total calories), Tran's fatty acids and cholesterol (less than 200 mg/ day) intake to prevent from the risk of Cardio vascular disease (CVD) [11].

   Protein in Diabetes Management: The dietary intake of protein for individuals with diabetes is similar to that of the general public and should be less than 20% of energy intake [11].

   Micronutrients in Diabetes Management: The diabetes patients should aware about the micronutrient's requirement from natural sources and balanced diet as the deficiencies may lead to uncontrolled diabetes. Scientific evidences of the micronutrients on glycemic control are lack [11].

4. **Anti-oxidants in Diabetes Management:** Even though, anti-oxidants such as Vitamin C and E are considered to reduce the oxidative stress in diabetes, sufficient scientific evidences are unavailable [11].

5. RESULTS AND DISCUSSION

Ayurveda says '*sankshepathah kriya yogo nidanam parivarjanam'* that means in shortly against a disease the best thing to do is refraining from causative factors. When *prameha* become incurable stage of *madhu meha* it only become manageable with life time medicine, according to the modern medical system/allopathy also the situation is same. In this regard it is very much beneficial to know the etiological factors explained in these medical systems. Modern medical sciences identifying this with the rising up of blood or urine sugar levels or amount of blood glucose attached to hemoglobin. They

advise some modifiable risk factors like food habits and behavioral pattern but any patient cannot be without life time medication for controlling to avoid serious complications on other systemic functions of the body or death.

Ayurveda authentic explain definite *nidana*/etiological factors to avoid and even some premonitory symptoms of *prameha* to gets the life towards the correct path if having any of them before it becomes *madhu meha* which considered as incurable.

According to the sage charka as mentioned in literature review as *asya sukham swapna sukham*… we should avoid sedentary lifestyle, in the ancient time before technological development people are having very active life style in their day today life if we missed it with modern technological equipment in hectic competitive life battle, and we should compensate it with additional physical exercise.

The second important etiological factor is *dadhi*/curd, yogurt etc. and *payansi*/milk and milk products. When we search the past of our ancestors except the people who have special nutritional need like debilitating illnesses they haven't got used to consume dairy products similarly to the modern society. Nowadays since the birth until death people are addicted to use liquid milk packets, bottles, yogurts, milk powders and various other dairy products unnecessarily. They mostly consume them daily.

Even though some studies say there is no relation ship between bovine serum albumin and diabetes mellitus it seems that it is needed further studies to ensure it and other chemical compounds in dairy products with diabetes relevant to ayurveda etiology explained by sages.

The other causative factor is meat varieties and fish consumption, for each and every main and additional meal of human in the past not consisted with meat or fish. Even the animals used for meat or fish had their own natural habitat for food and behavioral pattern instead of artificial farming. Now with increasing of meat and fish consumption bred, fed and everything was doing artificially. Animals are injected various chemicals for illnesses, enhancing growth and as preservatives even after death etc. Though Ayurveda explains the benefits of meat of most of the animals which is suitable for human consumption those qualities cannot be expected from modern farming and fisheries in competitive society. Further ancient civilians didn't have sedentary life style too.

Then food items prepared by newly harvested grains, and rain water also restricted in *prameha nidana*, and all the products made or mixed with guda/sugarcane has mentioned as the last.

Therefore, decreasing regular and higher consumption of dairy products, fish and meat varieties, newly harvested grains and rain water as a beverage and sweets made with sugarcane is a must to prevent diabetes as modifiable food factors.

Sedentary lifestyle has been explained as the main behavioral factor.

Ayurveda has mentioned remarkable premonitory symptoms also to identify the ongoing pathology of *prameha* in the body identifying them and act accordingly for avoiding causative factor also very important in prevention. Eg. Bounding roughness and early nonhygienic feeling of teeth even after brushing, increasing nail and hair growth rate, burning sensation of foot and hand etc. Because when it comes to *madhumeha* [presence sweetness in urine or sugar] stage it is incurable according to sages. In this regard close observation on selfcare is very important to introduce towards modern society.

People who are having family history of diabetes mellitus should be more careful to avoid causative factors, paying special attention on premonitory symptoms mentioned above. Because in *charaka samhitha indriyasthana* it has clearly mentioned regarding genetic predisposition of *prameha*. but it is also coming under general management principles.

If the patient is strong enough to apply pancha karma therapy, and when kapha is enhancing vamana and if pitta is affecting prominently virechana is being done after *ama pachana/*prompting digestion and preoperative processes of pancha karma [*Snigdha* / oileation and *Sweda* /methods stimulating perspiration]. Then the patient should be nourished and rejenuvated.

If the patient is emaciated first should apply rejunavation and then *pancha karma* as *shodhana/*internal cleansing via both upper and lower tracks of the body.

But in Sri Lankan traditional medicine, medicinal materials which having opposite qualities of the *dosha dushya* state of pathogenesis of *prameha* is being used. It gives good results soon but can be rebuilt the disease within short period of time when associate causative factors.

Ayurveda as well as Sri Lankan traditional medicine together gives better results accordingly the clinical experience of practitioners.

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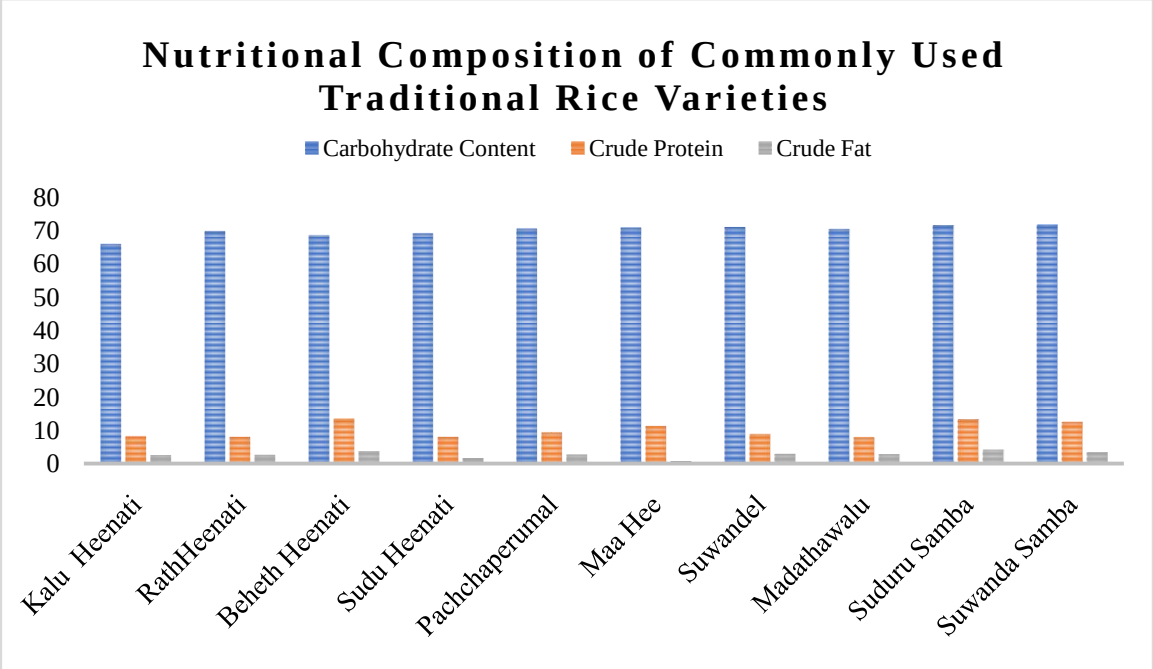

Figure 12: The Nutitional Composition of Selected Rice Varieties of Sri Lanka

Table 8: The Pericarp Colour, GI and Amylose Content of Selected Rice Varieties in Sri Lanka

Rice Varieties	Pericarp Colour	Glycemic Index (GI) Class	Amylose Content Class
Kalu Heenati	Red	Medium	High
Rath Heenati	Red	Medium	High
Beheth Heenati	Red	Low	High
Sudu Heenati	Red	Low	High
Pachchaperumal	Red	Low	High
Maa Wee	Red	Low	Intermediate
Suwandel	white	Low	Intermediate
Madathawalu	Red	Medium	High
Suduru Samba	white	Medium	Intermediate
Suwanda Samba	white	High	Low

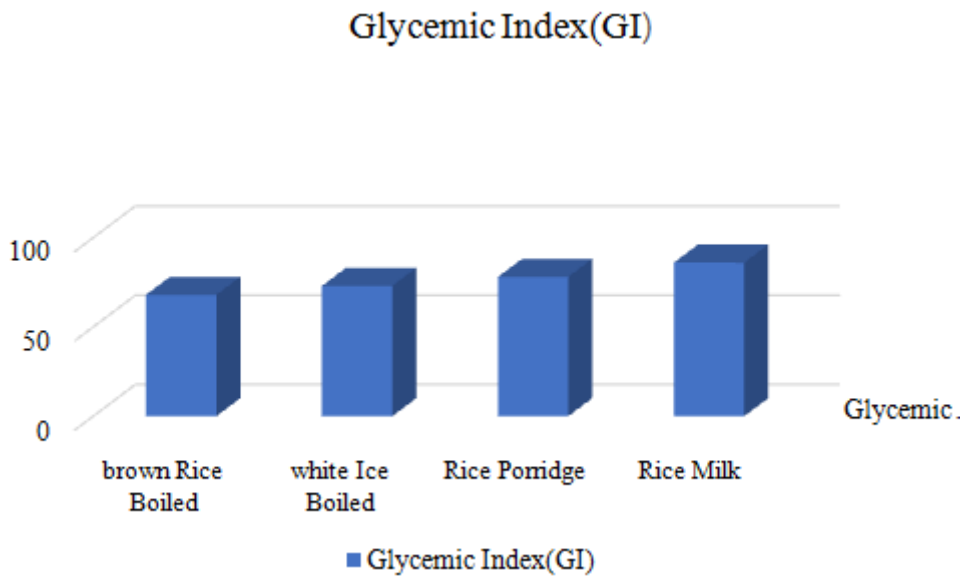

Figure 13: The Glycemic Index of Rice Based on Processing and Cooking Methods

Ayurveda is a medical system which established since thousands of years ago. Since that ancient era *prameha roga* in common and as its categories, had been identified with similar signs and symptoms of diabetes mellitus. It has mentioned in many authentic in ayurveda. But *prameha* had not become an outbreak at that period similarly to the present era.

The both Ayurveda and Siddha systems of medicine considers Diabetes mellitus with same name called "*Madhumeha*" with the characteristic feature of weakness of body with undue urine outflow. Excessive consumption of meat, fish, dairy products and food varieties made up from sugarcane and drinks, having foods difficult to digest, and fresh grains are considered as the etiological factors in Ayurveda aspect [5] [7] [8].

Dietary regimen in the management of *Madhumega* includes foods with spicy, astringent and bitter tastes, hot potency and dried in nature. Commonly grains and pulses are recommended but not just after harvesting. It is recommended to avoid sweet, sour, salty and cool, heavy, sweetened, soft, unctuous and viscous foods based on Siddha aspect [17] as well as in Ayurveda explanations. This explains the manner used in traditional Sri Lankan medicine introducing herbs having opposite qualities of involved *doshic* predisposition in the aliment.

The management for diabetes in Ayurveda and Siddha medicine include pharmacological and non-pharmacological aspects both. Dietary and behavioral modification recommended *pathya ahara* /food and *vihara*/behavior under the

category of pathya *apathyam* [6] [8].The modern science also emphasize the importance of adhering to Mediterranean diet and intake of whole grains to control hyperglycemia [18].

Rice being the staple food of Sri Lanka and the Mediterranean diet (a traditional diet type in mediterranean countries, characterized especially by a high consumption of vegetables and olive oil and moderate consumption of protein) recommended for diabetes is composed of daily consumption of non-refined cereals including brown rice [19], states the importance of rice in dietary management of diabetes. Further, the recent study on diabetes shows that the higher intake of cereal fibers is associated with lower risk of diabetes and replacing the food products made by wheat flour and potatoes with whole grains and minimally refined cereal products achieve in better glycemic control in patients with diabetes [12]. Hence the modification in the meal pattern by traditional rice variations in the management of diabetes is worthy. Traditional medicine knowledge in Sri Lanka believes the types of rice such as *kalu heenati* and *pachchaperumal* can definitely be used in the management of diabetes [20].

Glycemic Index (GI) and Amylose content/ Resistant Starch type 2 (RS) classification is considered as a tool to assess the glycemic control in prevention and treatment strategies of diabetes [21] [22] [23]. Studies declare that Low GI foods show potential benefits in the prevention and treatment of diabetes and its complication and the higher amylose content of the rice lowers the postprandial glycemic and insulinemic response [24] [25]. Consuming low GI diet with increased soluble fiber content is recommended and effective in diabetes type 2 patients [26] even not considering the carbohydrate content and energy intake.

Traditional and improved varieties of rice used in Sri Lanka but traditional varieties have very less consumption percentage when compared to new improved varieties [9]. The recent studies focus on traditional rice varieties reveal their anti-amylase and anti-glycation activities are detected high in bran extracts of traditional red varieties compared to improved varieties [27]. The study conducted to assess the RS content in traditional and improved rice varieties in Northern Province of Sri Lanka showed that the traditional varieties have higher RS content than improved varieties and recommend the traditional varieties such as *suwandel, pachchaperumal* to use in dietary management in diabetes [28]. The study conducted to investigate the prebiotic potential of traditional rice varieties with the prebiotic bacterium *Lactobacillus plantarum* inoculation, showed that the dietary fiber and RS content is higher in traditional rice varieties such as *suwandel, pachchaperumal, kalu heenati* and *madathawalu*, significantly higher in *kalu heenati* [29]. Assessent of GI shows that traditional rice varieties including *sudu heenati*, *madathawalu* and *pachchaperumal* are in low GI category [30].

The study conducted to screen invitro glycemic indices (GI) of four Sri Lankan porridges including traditional rice varieties such as *Madathawalu, Kalu heenati, Sudu heenati* showed high capability to inhibit α-amylase enzyme and effective for the prevention of diabetes and its complication with medium to low GI values [27]

Rice with red pericarp obtained significantly lower GI comparing with white pericarp [30]. Advancement in Technology produces high number of refined grains through milling and confiscating the outer bran and the germ portion of brown rice to obtain white rice. White rice is devoid of essential nutrients and contain high glycemic content leading to increase in postprandial glucose level and insulin demand whereas the whole grain foods improve insulin sensitivity with high fiber content [31] [32] [33].

The unpolished pigmented dark red rice contains high dietary fiber which reduces GI and is considered to have potential health benefits even though people prefer polished rice due to the characteristic roughness of red rice [34]. The experimental study on type 2 diabetes induced rats to assess the change in fasting blood glucose with white rice, brown rice and metformin intake over a 4 weeks intervention period showed that the 28% increase in white rice group, 3% reduction in metformin group while 9% reduction in brown rice group [35]

According to Siddha medicine, parboiled rice (*puzhungal arisi*) and old rice (*pazhamai arisi*) are suitable in any disease condition as *pathyam* where as new/raw rice (*pachai arisi*) is not suitable for any disease condition. Siddha literatures states that cooked parboiled rice (*puzhungal arisi annam*) is effective in diseases than cooked raw rice (*pachchai aisi annam*) [36].

Parboiled rice is better than raw rice and can be used as alternative to white rice or brown rice for diabetic individuals to control postprandial hyperglycemia with low GI. The high moisture, high resistant starch and low starch in cooked parboiled rice contribute to low GI. The postprandial glucose response and appetite assessment were positively significant in healthy and diabetic individual after ingestion of parboiled rice only [37] [38].

Recommended Dietary Allowance (RDA) for carbohydrate and protein for diabetic patients respectively are 130 g per day and 0.8 g per kg of body weight per day [12]. Hence it is necessary to consider the amount of rice intake.

The Ayurveda medicine commonly prescribes the rice as gruel of different types such as manda, *peya wilepi* (a medical drink prepared from rice used in controlling fever, anorexia, digestive problems and many other ailments and in many treatments protocols), *lunu kenda* (gruel prepared from rice adding

some salts without adding anything else or adding ginger and garlic) and *kola kenda* (gruel prepared from rice adding juices from various flora and coconut milk) for different ailments [20]. New Straits Times reports that a gruel having greater water to rice ratio, is healthier than steamed rice and the same amount of cooked rice which has higher number of calories and carbohydrate than gruel [39].

Siddha medicine considers warm (*atpasudukai annam*), properly cooked rice along with appropriate curries is suitable for all the type of body conditions and can be used as *pathiyam* other than hot cooked rice (*athisudukai annam*) as it causes excessive thirst. Partially cooked rice and over-cooked rice are not suitable for disease condition as they cause indigestion [36]. Over-cooking of rice also has higher GI value [40].

A senior dietician from Singapore states that the glycemic index of rice depends on methods of processing and cooking. More processed food disrupting the natural integrity of grain like refined rice, rice flour has higher GI whereas the less processing such as unrefined rice, and whole grains have lower GI. Similarly, cooking process also impact on the GI where the equal portion steamed rice and rice porridge, steamed rice has higher GI than porridge [40].

6. CONCLUSION

To prevent diabetes mellitus out break according to the ayurveda and siddha medical approach there should be a definite control in meat fish and dairy products consumption in future generation additionally to the sugar cane products and drinks. Avoiding newly harvested and refined grains also a matter. And it is advisable to get rid of from sedentary screen lives towards calory burning active life. The entire globe should pay attention to identified traditional rice varieties like suwandal, maavi, madathawaalu, heenati; pachchaperumal etc. comes under the common botanical name of *Oriza sativa*. Further harvesting and used them in main meal without artificial modifications. Further people should heed premonitory symptoms of *prameha* in self-care.

The literary study showed unpolished traditional rice varieties with red pericarp, low GI, high amylose content with adhering proper cooking method can be used as Mediterranean diet in the management of diabetes and its complications.

7. SUGGESTIONS

Researchers can do retrospective surveys to see the relationship between changed food habits and diabetes. Prospective qualitative works can be planned with the conclusion to study the truth of findings.

REFERENCES

[1] Srividya Kidampi, Shailendra B. Patel, "Diabetes mellitus consideration for Dentristry," *Clinical Dentristry,* vol. 139, no. 5, pp. 8-18, 2008.

[2] "IDF Diabetes Atlas," International Diabetes Federation, 2022.

[3] Z. K. A. A. Abraha L.D, "Glycemic control and diabetes complications among adult type 2 diabetic patients at public hospitals in Hadiya zone, Southern Ethiopia," *PLos One,* vol. 18, no. 3, 2023.

[4] Dunya T, Jonathan E.S, Diana , "The burden and risks of emerging complications of diabetes ellitus," *Nature reviews endocinology,* vol. 18, pp. 525-539, 2022.

[5] K.R.Srikanthamoorthy, "Sustrasthana and Nidana Sthana," in *Illustrated Susruta Samhita,* Chaukhambha Orientalia.

[6] P.V.Sharma, "Caraka Samhita," in *Chikitsasthana,* Chaukhambha orientalia, 2017.

[7] K. Lochan, Astanga Hrdaya of Vagbhata, New Delhi: Chaukhabha Publications, 2017.

[8] Markkalinganayanar, Yugi vaidhya sinthamani 800, Ezhumalaipillai, 1890.

[9] J.K.Galabada, B.G.C.A.Gamlath, S.G.Kaushalya, "Rice varietal distribution in Sri Lanka- 2016," Rice Research and Development Institute, Department of Agriculture, Ibbagamuwa, 2017.

[10] H.G.Amal Sudaraka Samarasinghe, Caroline Anastasia Fernando, Akila Randika Jayamaha, S.P. Nissanka, "Traditional rice varieties in Sri Lanka: A review on the nutritional values, medicinal properties and market potentials," *The 5th International Conference on Food, Nutrition, Health and Lifestyle,* 2023.

[11] "American Diabetes Association : Nutrition recommendations and Interventions for Diabetes," 31 january 2008. [Online]. Available: https://doi.org/10.2337/dc08-S061. [Accessed 6 march 2024].

[12] Walter Willet, Joann Manson, Simin Liu, "Glycemic index, glycemic load and risk of type 2 diabetes," *The American journal of clinical nutrition,* vol. 76, no. 1, pp. 274S-280S, 2002.

[13] Gabriele Riccardi, Angela A Rivellese, Rosalba Giacco, "Role of glycemic index and glycemic load in the healthy state, in prediabetes and in diabetes," *The American Journal of Clinical Nutrition,* vol. 87, no. 1, pp. 269S-274S, 2008.

[14] Brand-Miller J, Foster- Powell K, Wolever T.M.S, Colagiuri S, "The new glucose revolution: the authoritative guide to the glycemic index," *Marlowe and Compan,* pp. 3-15, 2002.

[15] Devinder D, Mona M, Hradesh R, Patil R.T, "Dietary fibres in food: a review," *Journal of Food Sci Tech,* vol. 49, no. 3, pp. 255-266, 2012.

[16] Bienvenido O.Juliana, "Rice starch properties and grain quality," *Denpun Kagaku,* vol. 39, no. 1, pp. 11-21, 1992.

[17] Thenmozhi, Panneerselvam, Lavanya, Amavasai et al.,, "An overview on Siddha

treatment guidelines for diabetes mellitus, a non-communicable disease," *Journal of Research in Siddha Medicine*, vol. 4, no. 2, pp. 46-53, 2021.

[18] Zahra M, Leila A, "How dietary patterns could have a role in prevention, progression, or management of diabetes mellitus Review on the current evidence," *Journal of Research in medical sciences* , vol. 17, no. 7, 2012.

[19] +/+lli, Anna Di Salle, .

[20] M. Seneviniwan, "Indigenous paddy varieties and traditional knowledge: econoic review," Colombo, 2010.

[21] Ain Esfahani, Julia M.W.W, Arash M, Korubua S,David J.A.J, Cyril W.C.K, "The glycemic index: physioloical significance," *Journal of Am Coll Nutrition,* pp. 439S-445S, 2009.

[22] Rakhi B, Salgotra R.K, Manmohan S, "Studies on correlation of amylose content and grain dimensions in Basmati rice (Oryza sativa L.)," *Electronic Journal of plant Breeding,* vol. 10, no. 2, pp. 364-369, 2019.

[23] Jennifer E.P, Mingzhu C, Nunzia A, Gary F, "A comparison of the effects of resistant starch types on glycemic response in individual with type 2 diabetes or prediabetes: A systematic review and meta-analysis," *Front Nutrition,* vol. 10, 2023.

[24] Dario R, Alexandra J, Velimir B, Eva P, Klara J, Christopher F, Dominik R, Slaven K, Vladimir V, "Glycemic index in diabetes," *Coll Antropol,* vol. 35, no. 4, pp. 1363-1368, 2011.

[25] Masayuki Y, Mamiko W, Toshimi Y, Akiko N, Li Wang, Kuninori S, "Influence of rice with different amylose contents on postprandial glycemic response," *Journal of Rural Medicine,* vol. 2, no. 1, pp. 51-58, 2007.

[26] Dionysios Vlachos, Sofia Malisova, Fedon A.Lindberg, Georgia Karaniki, "Glycemic index or Glycemic load and dietary interventions for optimising postprandial hyperglycemia in patients with T2 Diabetes: A review," *Nutrients,* vol. 12, no. 6, 2020.

[27] Nadini T, Prashantha M, Sameera R.S,Pahan I.G, "Anti-diabetic and anti-cancer related health food properties of selected Sri Lankan traditional rice based porridges," *Journal of food science and technology,* vol. 59, no. 10, pp. 3745-3753, 2022.

[28] Printhajini P, Arasaratnam V, "Resistant starch of selected rice varieties of Sri Lanka," *Journal of Dry zone Agriculture,* vol. 6, 2020.

[29] Hettige K.D.T, Jayarathna G.E.D.A.M, Wijewardane R.M.N.A, "Prebiotic potential of resistant starches and dietary fibers of Sri Lankan Traditional rice varieties and its application in the food industry," *Journal of dry zone Agriculture,* vol. 6, no. 2, 2020.

[30] Rathnayake M, Hasini W.R, Jamburagoda G.S, "The in vivo glycemic response of different ice varieties in Sri Lanka," *Mal J Nutrition,* vol. 27, no. 3, pp. 495-504, 2021.

[31] Chidhambara Priya Dhashini K,Divya S, Umaaheswari S, "Rice and diabetes: A comprhensive review," *Ro J Diabetes Nutr Metab dis,* vol. 28, no. 4, 2021.

[32] S. Q, "White rice, brown riceand risk of type 2 diabetes in US men and women," *J Intern Med,* vol. 170, no. 11, pp. 961-969, 2010.

[33] Khosravi-boroujeni.H, "White rice consuption and CVD risk factors amon Iranian population," *J Health Population Nutrition,* vol. 31, pp. 252-261, 2013.

[34] Somaratne G.M, Prasantha B.D.R, Dunuwila G.R, Chandesekara A, Wijesinghe D.G.N.G, Gunasekara D.C.S, "Effect of polishing on glycemic index and anti-oxidant properties of red and white Basati rice," *Food chemistry,* vol. 237, pp. 716-723, 2017.

[35] Mustapha U.I, Maznah I, "Effects of Brown rice and white rice on expression of

xenobiotic metabolis genes in Type 2 Diabetic Rats," *International Journal of molecular sciences,* vol. 13, pp. 8597-8608, 2012.

[36] Pathartha Guna Sinthamani, Chennai: Indian medicine- Department of Homeopathy, 2007.

[37] Samar Hamad, Tasleem Zafar, Jiwan Sindhu, "Parboiled rice metabolism differs in Healthy and Diabetic individuals with similar improvement in glycemic response," *Nutrition,* vol. 47, 2017.

[38] Thennakoon T.P.A.U, Ekanayake S, "Sri Lankan traditional parboiled rice: A panacea for hyperglyceia," *Journal of pone,* vol. 22, 2022.

[39] K. Mustapha, "Eat healthy, the Malaysian way," New Straits Times, 2017.

[40] K. Adaikan, "Diabetes and glycemic index".*Diabetes.*

[41] S.Muthappan, S.D. Muralidass, E.Chinraji, M.Durairajan, "Concept and description of Madhumegam (Diabetes mellitus) in Siddha System of Medicine.," *International Journal of Research in Pharmaceutical sciences,* vol. 11, no. 2, pp. 1302-1304, 2020.

[42] Rannan Eliya R.P, Wijemunige N, Perera P, Kapuge Y, Gunawardana N, Sigera C, Jyatissa R, Herath H.M.M, Gamage A, Weerawardena N, Sivagnanam I, Dalpatadu S, Samarage S, Samarakoon U, Samaranayake N, Pullenayagam C, Perera B, "Prevalence of Diabetes and pre-diabetes in Sri Lanka: a new global hotspot estimatesfrom Sri Lanka Health and Ageing survey 2018/2019," *BMJ Open Diabetes Res Care,* vol. 11, no. 1, 2023.

[43] "National Diabetes Centre, Diabetes association of Sri Lanka," 2024. [Online]. Available: https://www.diabetessrilanka.org/lifestyle-modification/nutrition/. [Accessed 06 03 2024].

[44] Walimuni Kanchana, Kanchana Abeysekara, Srimal Premakuara G A, , "Physiochemical and nutritional properties of twenty three traditional rice(Oryza sativa L.) varieties of Sri Lanka," *Journal of Coastal Life Medicine,* vol. 5, no. 8, pp. 343-349, 2017.

[45] Ratnayake W.M.K.M, Karunarathna K.A.A.U, "Narratie review on Nutritional composition, antioxidant activity and healh benefits of Sri Lankan Traditional rice varieties," *Journal of Health sciences and innovative research,* vol. 4, no. 2, pp. 1-10, 2023.

[46] "Ceylon Digest," 25 January 2019. [Online]. Available: https://www.ceylondigest.com/traditional-rice-varieties-of-sri-lanka/. [Accessed 7 March 2024].

[47] P. B.D.R, "Glycemic index of fou traditional red pigmented rice," *Integr Food Nutr Metab,* vol. 5, 2018.

[48] Hafeel R.F, Bulugahapitiya V, "Variation in physiochemical properties and proximate composition of improved and traditional varieties of rice in Sri Lanka," *Journal of food and nutrition,* vol. 13, no. 1, pp. 19-32, 2020.

[49] Kanchana Abeysekara, Sudarshana Somasiri, Sirimal Premakumara G.A, Bentota A.P, "Cookin and eating quality traits of some Sri Lankan Traditional rice varieties across Yala and Maha seasons," *Tropical Agricultural Research,* vol. 20, pp. 168-176, 2008.

[50] Reni Sinthuja, Roshitha P.B.D, Achala H, "Comparative study of grain quality characteristics of some selected traditional and improved rice varieties in Sri Lanka: A review," *Sri Lanka Journal of Food and Agriculture,* vol. 7, no. 1, 2021.