

Glycemic Index of Kulakara and Mapillai Samba Rice Flakes

M.Nivethitha

(16PFN012)

Thesis submitted to

Avinashilingam Institute for Home Science and Higher Education for

Women,Coimbatore-641043

In Partial Fulfilment of the Requirement for the

Degree of Master of Science in Food Science and Nutrition

April ,2018

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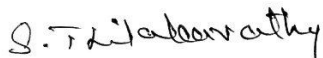
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Signature of the supervisor



Signature of the Head of the Department

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LIST OF CONTENTS

CHAPTER NO.	TITLE	PAGE NO.
	LIST OF TABLES	
	LIST OF FIGURES	
	LIST OF PLATES	
	LIST OF APPENDICES	
I	INTRODUCTION	1
II	REVIEW OF LITERATURE 1. Rice flakes-History and culinary uses 2. Health Benefits of Rice flakes 3. Glycemic Index and its benefits	7
III	METHODOLOGY 1. Selection of Ingredients. 2. Organoleptic Evaluation of the developed recipes out of different rice flakes.	18

	<p>3.Determination of the glycemic index of different rice flakes.</p> <p>4.Nutrient analysis of Rice Flakes.</p> <p>5.Calculation of the nutritive value of developed recipes.</p>	
IV	RESULTS AND DISCUSSION	42
	<p>1. Sensory evaluation of the developed recipes.</p> <p>2. Nutrient content of rice flakes.</p> <p>3. Determination of the glycemic index of the different rice flakes.</p> <p>4. Calculation of the nutritive value of developed recipes.</p>	
V	SUMMARY AND CONCLUSION	65
	BIBLIOGRAPHY	72
	ANNEXURES	72

LIST OF TABLES

TABLE NO.	TITLE	PAGE NO.
I	Composition of ingredients of Aval Dosa	23
II	Composition of ingredients of Aval Upma	24
III	Composition of ingredients of Aval Paniyaram	25
IV	Composition of ingredients of Aval Jeera Pepper Rice	26
V	Composition of ingredients of Aval Kesari	27
VI	Composition of ingredients of Aval Pakoda	28
VII	Composition of ingredients of Aval Cutlet	29
VIII	Composition of ingredients of Sweet Aval	30
IX	Mean Acceptability Scores of Aval Dosa	42
X	Mean Acceptability Scores of Aval Upma	43
XI	Mean Acceptability Scores of Aval Jeera Pepper Rice	44
XII	Mean Acceptability Scores of Aval Paniyaram	45
XIII	Mean Acceptability Scores of Aval Kesari	46
XIV	Mean Acceptability Scores of Aval Pakoda	47
XV	Mean Acceptability Scores of Aval Cutlet	48
XVI	Mean Acceptability Scores of Sweet Aval	49

XVII	Nutrient Content of Rice Flakes	51
XVIII	Mean Blood Glucose Levels	52
XIX	Fasting and Post prandial blood glucose levels	53
XX	Glycemic Index Value	55
XXI	Nutrient Value of Developed Recipes	59

LIST OF FIGURES

FIGURE NO.	TITLE	PAGE NO.
I.	Research Design	41
II.	Overall Acceptability of Breakfast Recipes	61
III.	Overall Acceptability of Snacks Recipes	63
IV.	Glycemic Index Of Riice Flakes	64

LIST OF PLATES

PLATE NO.	TITLE	PAGE NO.
I	Breakfast Recipes with Rice Flakes	31
II	Snacks Recipes with Rice Flakes	32
III	Drawing of blood sample	35

LIST OF ANNEXURES

ANNEXURE NO.	TITLE	PAGE NO.
I	Ethical clearance certificate by institutional Human Ethical committee	77
II	Standard Recipes	78
III	Score card for evaluation	85
IV	Nutrient Analysis	86
V	G.I Values-Mapillai Samba Flakes	93
VI	G.I Values-Milled Flakes	94
VII	G.I Values-Kulakara Flakes	95

I.INTRODUCTION

Rice (*Oryza sativa* L.) is the basic food for two-thirds of the world population and is the most important cereal crop cultivated in the world and consumed as staple food for more than half the world's population. Rice is the major food grain of the world and it is the principle cereal consumed in India and other parts of Asia (Desikacharar *et al.*, 2012).

Paddy (*oryza sativa* L.) is one of the major staple food cereal crops of the world. The whole grain has higher percentage of vitamins, minerals and fiber (Chen *et al.*, 2013).

Flaked rice (Avalakki, Poha), puffed or expanded rice (Puri, Murrura, Muri) and popped rice (Nel, Puri) are the important pre-cooked rice products. Flaked rice is obtained after soaking, roasting and flaking processes of paddy to variable thickness. Flaked rice is having high dietary fiber, minerals and oryzanol content than milled rice and is mainly responsible for providing benefits of reduction in blood cholesterol, coronary heart diseases and celiac diseases (Shiv kumar *et al.*, 2017).

Flaked rice is partially cooked and having gelatinized starch granule is either roasted or fried for its use in the development of various snacks (Prasad *et al.*, 2017).

Rice meets most of the requirements of a good and healthy food and is the only cereal that is eaten as a whole grain, and according to Ayurvedic concepts, the whole grain is more easily digested than flour (Ahuja *et al.*,2014)

'Rice flakes' or 'flattened rice' or 'beaten rice', is a popular processed rice product used as a breakfast cereal, a substitute for cereal in weaning foods and a snack food. About one-fifth of the rice produced is converted into flakes. Paddy production in the world is 660 million tonnes, out of which India produces around 144.6 million tonnes.

About 14.46 million tonnes (10% of production) are being utilized for the production of rice products like popped, expanded and flaked rice (Narasimha *et al.*,2012).

Flaked or beaten rice is a very popular traditional product in India and other rice consuming countries.

Rice based (ORS) Oral Rehydration Solutions are now preferred over glucose based ORS, and have been included in WHO programs (Gore *et al.*,2012)

White rice and red black rices are considered more nutritious, have been found to be rich in iron, zinc, and minerals and possess antioxidant properties. The parboiled red rice have lower glycemic index than white rice, and have been recommended for diabetics (Hettiarachchi *et al.*, 2012).

Though rice contains high levels of complex carbohydrates and is categorized as a high glycemic index food along with bread, many traditional varieties have been reported to have a low glycemic index (Rhoades *et al.*, 2011).

Roasting and flaking of paddy are responsible for partial gelatinization of the starch granule that gets ruptured even at low water absorption resulting in lower swelling power of roasted and flaked rice compared to brown rice. The flaked rice is easily digestible and serve as nutritionally rich traditional food item with improved nutritional attributes (Corree *et al.*, 2014).

Roasting is one of the traditional cooking method comprising high temperature and short time heat exposure having some roasting medium like sand. During roasting starch granules are gelatinized therefore, a part of its retrograded, which ultimately transform into resistant starch. These resistant starches that acts a source of dietary fiber, lower blood cholesterol level, glycemic index (GI) and ultimately controls diabetes (Sharma *et al.*.,2016).

The resistant starch as prebiotic helps in maintaining gut health to prevent the risk for the onset of colon cancer. Starch digestibility after dry heat, parboiling and flaking followed by roasting reduces glycemic index. Flaked rice and parboiled rice has been reported to be having lower glycemic index than raw rice. Roasted flaked rice and

puffed rice may further increase the dietary fiber and pass the digestive tract to be considered as pre-biotic foods (Vijayalakshmi *et al.*, 2013).

Rice flake is the husked rice which is flattened into flat light dry flakes. These flakes of rice swell when added to liquid, whether hot or cold, as they absorb water, milk or any other liquids. The thicknesses of these flakes vary between almost translucently thin (the more expensive varieties) to nearly four times thicker than a normal rice grain. These are also known as POHA. It is a fast moving consumer item and generally eaten as breakfast item. Generally the beaten rice is a popular food for all kinds of human living in India. Most people use this as a raw food in ancient times which is very easy to produce and prepare at home (Anantachar *et al.*, 2013).

Rice flakes are the most common breakfast cereal used all over the country round the year. Rice flakes is locally known by many names like aval, avalakki, poha, chivda and beaten rice, which are prepared from paddy and has been claimed as a good source of protein, fat and carbohydrate. And it is also one of the main breakfast items in the states of Maharashtra, Madhya Pradesh, Karnataka, Rajasthan and Gujarat.

The production level of this rice product is not known exactly, but it has been indicated that about 10%total rice production is utilized for flaked rice, expanded rice and popped rice (Sulochana *et al.*,2014).

It can be fried with spices and chilly to make hot and tasty food item or milk or curd is mixed with it and then eaten. It is also used in large quantities for making 'Chevda' (a farsan item) and many caterers use it for thickness of gravy. Since it is made from paddy, it is easily digestible. Most of its preparations can be made at a short notice and hence bulk of the households, stores it on regular basis. With proper storage, its shelf life is 2-3 months. This is a common product and can be produced anywhere in the country. Now the people are making different kinds of recipes with this by adding sweetness or spices. This is rich in fiber and carbohydrate and can be consumed even by those suffering from diabetes, high blood pressure etc.

The process of parboiling, puffing, and flaking causes alteration in nutrient content of rice grain. Rice can be flaked to different degree of thickness following a process of soaking paddy in hot water and roller pressing. Flaked rice can be eaten as such or used in preparation of other rice based snacks or other culinary items (Prakash *et al.*,2013).

In order to re-introduce rice flakes, value addition in terms of flavor and taste will aid in consuming rice flakes as a major cereal breakfast. Rice flakes represent a perfect food vehicle for fortification (Durgadevi *et al.*2017).

Rice flakes is considered to be a great meal option for diabetics as it promotes slow release of sugar into the blood stream. Carbohydrates are the major source of energy in a bowl of poha. The carbohydrates are needed to help our body store energy, and perform various other functions. Mixed vegetables can be added to rice flakes to make it rich in vitamins, minerals and fibre. (www.allaboutdiabetes.net).

There are varied metabolic responses to different starches. These differences in postprandial physiological outcome are attributed to various factors such as dietary fiber content of food, food-processing methods(such as polishing of grains, grinding, extrusion under pressure and cooking by different methods like baking, roasting, steaming,etc.),other food components such as anti-nutrients (phytates, tannins, lectins, etc.)that retard the amylase activity and the chemical nature of starchy polysaccharides, eg amylase or amylopectin, all of which might affect the rate of digestion. Understanding the role of these factors can be of help in identifying foods for their suitability for inclusion in a diabetic diet. The rice flakes or convenience foods which is commonly used as breakfast item by many parts of India and 30g serving of rice flakes can provide 3.6% of the total energy requirements (Crapo *et al.*,1977).

The ability of a food item to raise the blood sugar is measured in terms of glycemic index. Glycemic index depends on the composition of food item, form of the food item –mashed, raw, boiled, cooking method, applied to the food, processing applied to the food source presence of antinutrients like fibre, type of fibre-soluble or

insoluble phytates, tannins, lecithins, alone or carbohydrate with fat, addition of salt and complex items(Sharma *et al.*, 2013).

Glycemic index is the level at which the blood glucose rises on consumption of a particular food. Foods which are absorbed slowly raise the blood sugar levels slowly and have a low glycemic index. Whereas, foods which are absorbed fast, raise the blood sugar levels fast and have a high glycemic index. Glycemic index of the food is very important for a diabetic. Rice with high amylose content is reported to raise blood glucose less than rice with higher amylopectin content. (www.canadian diabetics association).

Diets with low Glycemic index value improve the prevention of coronary heart disease in diabetic and healthy subjects. In obese or overweight individuals, low Glycemic Index meals increase satiety and facilitate the control of food intake. Selecting low Glycemic index has also demonstrated benefits for healthy persons in terms of post prandial glucose and lipid metabolism. The glycemic index of foods is the result of several parameters which must be considered while making food choices. These perverse metabolic effects result in hyperinsulinism leading to obesity, diabetes and many cardiovascular illnesses (Urszula *et al.*, 2013).

Low glycemic index diets may reduce post prandial glycemia, the ability of individuals to maintain these diets long term has not been established. The concept of glycemic index (GI) emerged as a physiological basis for ranking carbohydrate foods according to the blood glucose response they produce on ingestion, and was introduced by Jenkins *et al.*, (1981). Few foods, traditionally consumed by the Indian population, have been tested for their glycemic response (Dilawari *et al.*, 1981, Akhar *et al.*, 1987 and Mani *et al.*,1990) have studied the glycemic response to cereals and a few legumes and dhals (dhals are dehusked and split legumes). The rice flakes or convenience foods which is commonly used as breakfast item by many parts of India and 30 g serving of rice flakes can provide 3.6% of the total energy requirements.

Further, information regarding the Glycemic Index of rice flakes is scanty. Hence, the present study was planned to determine the GI of three types of rice flakes that are important in the diet of Indians.

Hence, with this background the objectives of the present study was framed as follows:

- To determine the glycemic index of milled rice flakes, kulakara and mapillai samba flakes.
- Development of recipes with rice flakes
- Calculate the nutritive value of developed recipes.
- Analyze the nutrient content in the rice flakes.

II. REVIEW OF LITERATURE

The review of literature pertaining to the present study on “**Glycemic Index of Kulakara and Mapillai Samba Rice Flakes**” is presented under the following headings:

- A. Rice flakes-History and culinary uses
- B. Health Benefits of Rice flakes
- C. Glycemic Index and its benefits

A. Rice flakes-History and culinary uses

Flattened rice, commonly known as Chura (also called beaten rice not to be confused with Poha a North Indian dish prepared using flat rice) is rice which is flattened into flat, light, dry flakes. These flakes of rice swell when added to liquid, whether hot or cold, they absorb water, milk or any other liquids. The thickness of these flakes vary between almost translucently thin (the more expensive varieties) to nearly four times thicker than a normal rice grain. This easily digestible form of raw rice is very popular across India, Nepal and Bangladesh and is normally used to prepare snacks or light and easy fast food in a variety of Indian cuisine style (www.riceflakes.com).

Poha can be eaten raw by immersing it in plain water or milk, with salt and sugar to taste or lightly fried in oil with nuts, raisins, cardamoms, and other spices. The lightly

fried variety is a standard breakfast in Malwa region (surrounding Ujjain and Indore) of Madhya Pradesh. It can be reconstituted with hot water to make a porridge or paste, depending on the proportion of water added. In villages, particularly in Chhattisgarh, flattened rice is also eaten raw by mixing with jaggery. Flattened rice can be viewed as a convenience food and is very similar to bread in usage.

Rice flakes a paddy product is also popularly known as Poha. Rice flakes, Poha rice or Flattened Rice are known by the other names also like pressed rice, flattened rice or flaked rice. Poha may be precisely described as one of world's first ever "fast foods". The highest quality of poha (rice flakes) is one that is paper thin and translucent and is also a bit more expensive.

Normally eaten as a breakfast item, Poha (rice flakes) can be fried with chilly and spices to make a tasty dish or can be eaten with curd or made into a sweet dessert also (healthy breakfast). It is used to make a farsan product called Chevda, Poha or rice flakes are used to thicken gravy. An easily digestible product, the Rice Flakes preparations can be cooked even at short notice and this product is an available easy item.

Poha or rice flake can be stored for a long time like two to three months under proper storage conditions. Rice flakes are available in most Asian markets and come in different thickness. Rice flakes are essentially the parboiled rice made flat and thin by applying pressure to partially cooked rice. With uneven edges, the extremely light flakes have a rough texture. Having a bland taste and no particular aroma, rice flakes can be cooked as a soft preparation or crunchy (www.rice-flakes-history.com)

Flattened rice (also called beaten rice) is a dehusked rice which is flattened into flat light dry flakes. They are mostly famously known as Pohe in Malwa region, also they are considered to be originated in the Malwa region itself. These flakes of rice swell when added to liquid, whether hot or cold, as they absorb water, milk or any other liquids. The thickness of these flakes varies between almost translucently thin to nearly four times thicker than normal rice grain (www.flattenedrice-low-cost-food).

It can be taken in different forms-raw, fried, with curd or milk and therefore mass appeal. Beaten rice is made from paddy and is popular in all parts of India. People of all age groups from all sections like it and thus it is a mass consumption time. It is used in households, restaurants, roadside dhabas and other eateries, hostels and so on. Beaten rice can be produced anywhere in the North-East region of the country.

Poha is nothing but rice that has been parboiled, rolled, flattened and then dried to produce flakes. The flakes come in different thickness depending on the pressure used in the flattening process. Rice flakes are small, very light, about 2 mm long, flat and grayish white in colour. They have uneven edges and a rough texture. Rice flakes have no particular aroma and a bland gentle taste .Depending on the method of cooking, they can be soft or crunchy. The flakes are capable of absorbing a large volume of liquid when used in various recipes, and hence imbibe flavors well. They are very popular in sin cooking, but in Western countries they are more often used commercially in the production of cereals and rice snacks (<http://pohahealthbenefits.html>).

The rice flakes come in different thicknesses depending on the pressure used in the flattening process. Thick poha does not get mushy soon on soaking like the thin variety of poha.

Culinary Uses

Rice flakes are very easy to cook and can make a meal in five minutes. First wash the beaten rice in water and then soak for 10 minutes. Strain a using a strainer and use as required to make sweet or savory snacks .Poha made from rice flakes, is an easy to cook, light and nutritious snack that is often had for breakfast or brunch. Poha also makes a wonderful supper or a potluck dish. It can also be toasted and seasoned to make chivwda. Rice flakes can be used for preparing soft-cooked, energy-packed weaning food. Rice flakes are used to make creamy puddings and savory bakes too. Poha may be eaten raw like cereals, mixed with milk or yoghurt and fruit, or boiled like oatmeal. Add poha to your gravies, it will act like corn flour to thicken the food ([www.natureloc-benefitsofrice flakes](http://www.natureloc-benefitsofriceflakes)).

Raw or slightly toasted beaten rice can be mixed with jaggery and grated coconut, allowed to stand for a few minutes to soak in the flavours and then served. This is often made as a quick neivedhya, when no elaborate sweets or foods have been prepared for offering to God after puja. Beaten rice can be used to make a variant of the famous curd rice or bagalabath so popular in south India. Soak the beaten rice in water and drain. Mix curd and salt to it and serve with mango or lime pickle. Add poha to your gravies, it will act like corn flour to thicken the food.

Poha patties can also be made by soaking poha and binding it with potatoes, chillies and coriander. Roast it or fry it, and enjoy with mint chutney or ketchup. An exquisite snack can be prepared by immersing the rice flakes in cold water, drying them, and then preparing it like a pulao with nuts, raisins, black pepper, green chillies, salt and sugar to taste. When one is down with fever or an upset tummy, some rice flakes can be immersed in bowl of water, flavoured with lime juice, salt, sugar and a little black pepper, to make a comfort food (www.taraladhal.com culinary uses).

Processing of rice flakes:

Puffing or popping of cereals is an old traditional practice of cooking grain to be used as snack or breakfast cereal either plain or with some spices/salt/sweeteners. Starch is the main carbohydrate in human nutrition and offers a range of desired technological properties. The nutritional quality of starch strongly depends on starch structure and on its processing (Lehmann *et al.*, 2010).

a. Flaking

At the household level, flaked rice is traditionally produced by hand pounding the soaked and roasted paddy using a pestle and mortar. At the cottage level and larger processing units, roasted paddy is collected in bamboo baskets and fed into an edge runner in 1-2 kg batches. It is then flaked for 15-60 sec, depending on the quality of flaked rice. Thin flaked rice is obtained from longer running times i.e., for 60 seconds (Narasimha *et al.*, 2010).

Edge runner are batch type flaking machines with the capacity to flake 50,100 and 140k/hr of paddy .In edge runners, the paddy is pressed in between the body of the edge runner and the flaking roller. The husk and bran come out through the perforated mesh at the base of the edge runner. The remaining husk parts and bran that continue along with the flaked rice are cleaned by manual winnowing or by using a shieve shaker (Shanakara *et al.* , 2009).

The flaked rice obtained from the edge runner is again pressed and flattened in roller flakes to further reduce the thickness. The roasted paddy is polished and then fed in between the rollers, in which it is pressed and flattened. The reduction in thickness is accomplished by passing the paddy through the set of rollers in sequence and pressing the flakes for further flattening. The gap between the two rollers is maintained by pressure. In medium and large scale industries, different types of flakes are produced. the end products are categorized according to the thickness of the flakes (Ananthachar *et al.* , 2009).

b. Sieving and packing

The flaked rice is sieved in a sieve shaker in order to separate small, broken, powdered material and lumps. The graded flaked rice is collected in heaps and turned from time until cool. The thick flaked rice requires drying in order to reduce the moisture content before packing. After, this he flaked rice is packed directly into gunnies or in polyethylene bags inserted in gunnies. The shelf life of the thick type of flaked rice is less than the medium and thin types as it contains more moisture and undergoes less polish than the other grades (Ghose *et al.*, 2010).

c. Roasting

Roasting which can be performed with or without sand, is a strenuous, labor intensive and costly manual operation that requires skill and fine judgment to determine the appropriate termination point .Even a slight shift from the optimal roasting conditions may entail loss of yield caused by puffing of grains during roasting or breakage during flaking due to under roasting (Shankara *et al.*, 2011).

In medium and large scale industries, roasting is usually performed by continuous roasters using a sand medium. The partial gelatinization of soaked paddy is achieved from roasting at 110-180°C for 10-60sec. The soaked paddy is fed to the roaster by means of belt conveyors or by manually feeding the hopper. A medium scale processor may have one such roaster and five edge runners (Sulochana *et al.*, 2009).

Mechanical roasters are available as batch types or continuous types. The roasters are operated either by electricity, roaster consists of a circular heating coil over which a circular iron pan is mounted inside the metallic cover. Roasting is performed in batches with 8-10 kg of soaked paddy at about 200°C. The completion of roasting is indicated by the initiation of a popping sound of the roasted grains, after which the roasted paddy is discharged with a lever.

The continuous type roasters are modified gram roasters. The roasters consists of outer and inner horizontal cylindrical drums. The inner drum is equipped with helical ribs to provide forward movement of the paddy and sand. As the paddy travels through the roaster, the moisture content is reduced by 8-12%. A mesh assembly is arranged such that the sand is sieved out and returned back towards the mouth of the roaster by means of helical ribs facing in the reverse direction. The roaster itself is heated by furnaces, using either husks, sawdust or furnace oil. The roaster and furnace are built with insulation fire bricks (Vidhyalakshmi *et al.*, 2011).

d. Sieving and Conditioning

At the cottage level, the roasted paddy is fed to the flakers, whereas, in medium and large scale systems it is moistened and conditioned to obtain different types of flakes such as thick (~1mm), medium (0.6mm), thin (0.55-0.33mm). For the larger processors that operate the continuous type of roasters, the sand roasted paddy is sieved in order to remove the adhering sand and impurities, such as awns. After sieving the roasted paddy is fed directly onto a screw conveyor, where the addition of water takes place at the beginning of the conveyor and uniform mixing occurs as it travels through the conveyor. The amount of water added varies widely, mostly depending on the type of flaked rice processed, i.e., thin or thick (Pillai *et al.*, 2012).

B. Health Benefits of Rice flakes:

Utilization of rice and dhal for food is still mostly confined as staple for as raw form in day today life. Because of partly non availability of these grains in ready to eat forms. Rice is a distinctive crop due to its colourless, soft, taste, low sodium levels ,easy edible carbohydrates and hypoallergenic properties(Muna Howefah *et al* .,2014).

The health benefits of rice flakes include its ability to provide instant energy, regulate and improve bowel movements, stabilize blood sugar levels, and slow down the aging process. It also plays a role in providing vitamin B1 to the human body. Other benefits include its ability to aid in skin care, boost metabolism, aid in digestion, reduce high blood pressure, help in weight loss, boost the immune system, and provide protection against dysentery and heart disease (Amanda *et al* .,2011).

Rice flakes can prevent iron deficiency or anaemia as it contains 20mg of iron in every 100 raw rice flakes. Sufficient iron helps the body to form haemoglobin that carries oxygen to body cells and also builds immunity. For additional benefits, rice flakes will keep you supplied with energy and it will stave off hunger cravings(Jenkins *et al.*, 2013).

Beaten rice a lactose –free, fat-free and is a heart –friendly food. It is a good source of 11 essential vitamins and minerals including iron. As the flakes are usually pounded using an iron mortar and pestle, the process boosts the iron content. Poha is considered to be a great meal option for diabetics as it improves slow release of sugar into the blood stream. It also keeps you full for longer time. Carbohydrates are the major source of energy in a bowl of poha. This makes it a perfect breakfast option. It can be eaten for snack too in the place of unhealthy option such as chips and biscuits ([www.healthliving.natureloc.com/aval-beaten rice](http://www.healthliving.natureloc.com/aval-beaten-rice)).

Rice flakes made from waxy rice were evaluated for their nutritional and sensory characteristics. Dietary fiber, protein, and phytate content were highest for rice flakes harvested at 100 days. A nutrient comparison of the 100-day rice flakes versus commercial oats showed that commercial oats had higher nutrient value for crude protein, crude fat, ash, crude fiber, dietary fiber, and calcium. The rice flakes on the

other hand, have lower phytate content. In terms of percent nutrient adequacy, rice flakes are comparable to commercial oats in meeting the recommended daily allowances of adults. A 30 g serving of rice flakes alone can provide 3.96% of the total energy requirements (Kcalories) per day for males and 6.42% protein for females. Rice flakes likewise contribute 14.0% of the total dietary fiber recommended in a day. Thus, when eaten as a snack food or consumed several times a day would mean that the recommended daily allowances of the individual could be met. Rice flake and its products are locally available at a cheaper price compared to other cereal-based products in the market (www.natureloc.com).

Eating poha regularly can prevent iron deficiency or anaemia. Softened poha is also a great way to add dietary iron when an infant is weaned from breastmilk. Sufficient iron helps the body to form haemoglobin that carries oxygen to body cells and also builds immunity. Carbohydrates are needed to help our body store energy, and perform various other functions. Poha is considered to be a great meal option for diabetics as it promotes slow release of sugar into the blood stream. It also keeps you full for longer time (www.healthbenefits-riceflakes).

Poha is the beaten rice flakes. In this process the parboiled rice are beaten up and then dries for 2 days. In this whole process fermentation takes place which enriches the poha with vitamin B and probiotic bacteria. It is a very good breakfast. We can take it also in lunch or even as a snack. It is full of iron thus works as a healthy breakfast for anemic persons. we can increase the amount of iron in poha by adding sprouts in it. Absorption of iron can be increased by squeezing lemon juice on poha before serving. It is called a complete meal. (www.healthsite.com.health benefits)

Rice flakes can be eaten either cold or mixed with yoghurt or hot milk and fruit or simply boiled like oatmeal. Poha patties are another tasty treat and can be made by soaking poha and then binding it with chillies, potatoes, and coriander. Roast the patties or simply fry them.

C. Glycemic Index and its benefits

The concept of glycemic index (GI) emerged as a physiological basis for ranking carbohydrate foods according to the blood glucose response they produce on ingestion, and was introduced by (Jenkins *et al.*, 2014). Few foods, traditionally consumed by the Indian population, have been tested for their glycemic response (Dilawari *et al.*, 1981, Akhar *et al.*, 2013 and Mani *et al.*, 2011) studied the glycemic response to cereals and a few legumes and dhals (dhals are dehusked and split legumes).The diet of the rural/tribal population of India is predominantly cereals and millets (coarse cereals) which provide 80%of the total energy. Further, Information regarding the GI of millet-based foods is scanty (Scazzina *et al.* , 2013).

The glycemic index is a characteristic of foods that more and more people are looking at when making food choices. For people suffering from diabetes, heart disease or obesity, adding low glycemic index food to the diet may be beneficial (Brand *et al.* , 2012).

In its simplest terms, the glycemic index measures how fast food is broken down in the upper gastrointestinal tract. The rate of breakdown can be monitored by measuring blood glucose levels after an individual food has been eaten (Riccardi *et al.*, 2009).

The glycemic index is a value assigned to foods based on the increasing blood glucose levels. Foods high on the glycemic index release glucose rapidly. Low GI foods tend to foster weight loss, while foods high on the GI scale help with energy recovery after exercise, or to offset hypoglycemia (www.glycemicindex.com).

Foods with a low glycemic index are considered to be healthier because they produce a lower and slower rise in blood glucose.This affects how much insulin the body has to produce during the metabolism of the food sugars, and ultimately affects how much fat is stored in the body. As a group, pulses (peas, chick peas and lentils)and legumes(bean)have low glycemic indexes because of the type of carbohydrate (sugars)they contain. Beans and pulses are often added to the diet as good sources of protein that are low in fat. Because of their low glycemic index, adding beans and pulses to the diet may also have other health benefits (Metsger *et al.*, 2011).

There are varied metabolic responses to different starches. These differences in postprandial physiological outcome are attributed to various factors such as dietary fibre content of food-processing methods (such as polishing of grains, grinding, extrusion under pressure and cooking by different methods like baking, roasting, steaming, etc.), other food components such as anti-nutrients (phytates, tannins, lectins, etc.) that retard the amylase activity and the chemical nature of starchy polysaccharides, eg amylose or amylopectin, all of which might affect the rate of digestion. Understanding the role of these factors can be of help in identifying foods for their suitability for inclusion in a diabetic diet (Pignonee *et al.*, 2011).

Clinical trials and research has shown that diets with low Glycemic Index improves glycemic control in Diabetes, increased insulin sensitivity and cell function, reduce food consumption and body weight influence memory and may reduce serum cholesterol. As we grapple with a slew of lifestyle diseases, it might be pertinent to re-evaluate our food choices. Millets are consumed as whole grain foods, in their unpolished state. Rice and wheat on the other hand not only lose out on their nutritional value while being polished but are also high on the Glycemic Index. Millets release a lesser percentage of glucose and over a longer period of time, thus lowering the risk of diabetes (Parulkar *et al.*, 2009).

Slama *et al.*, 2012 stated that a glycemic index food has also demonstrated benefits for healthy persons in terms of post prandial glucose and lipid metabolism. Ellioett *et al.*, 2010) reported that consuming a low Glycemic food decreases the risk for complication in diabetes.

Parks *et al.*, 2010 revealed the relationship between the Glycemic Index of a food and indicators of a food's Glycemic Index and that food's ability to stimulate lipogenesis in humans. (Schwingshack *et al.*, 2014) revealed that consuming low GI foods has an effect on parameters of Obesity and obesity related disorders.

Diets with low glycemic Index value improve the prevention of coronary heart disease in diabetic and healthy subjects. In obese or overweight individuals, low-Glycemic Index meals increases satiety and facilitate the control of food intake.

Selecting low Glycemic Index foods has also demonstrated benefits for healthy persons in terms of post-prandial glucose and lipid metabolism (Urszula *et al.*, 2012).

The glycemic Index of foods is the result of several parameters must be considered while making food choices. By disregarding these scientific notions, discovered during the past 20 years, traditional diets have allowed the food industry to develop suspect botanic varieties as well as industrial processing cooking and conservation technologies, which contribute to indirectly hiking postprandial glycemia to alarming levels for consumers of modern foods. These perverse metabolic effects result in hyperinsulinism leading to obesity, diabetes and many cardiovascular diseases (Chinnaswamy *et al.*, 2010)

Small adjustments in dietary intake with regard to the GI may yield significant results. When both subjects and providers recognize this and educate them, those different carbohydrates may have different effects on blood glucose levels and this can result only with effective dietary changes that not only will improve glycemic control but also provides long term health benefits (Daniel *et al.*, 2010).

The glycemic index is a characteristic of foods that more and more people are looking at when making food choices. For people suffering from diabetes, heart disease or obesity, adding low glycemic index food to the diet may be beneficial. In its simplest terms, the glycemic index measures how fast food is broken down in the upper gastrointestinal tract. The rate of breakdown can be monitored by measuring blood glucose levels after an individual food has been eaten. Foods with a low glycemic index are considered to be heal their because they produce a lower and slower rise in blood glucose. This affects how much insulin the body has to produce during the metabolism of the food sugars, and ultimately affects how much fat is stored in the body. As a group, pulses (peas, chick peas and lentils)and legumes (beans) have low glycemic indexes because of the type of carbohydrates (sugars) they contain beans and pulses are often added o the diet as good sources of protein that are low in fat. Because of their low glycemic index, adding beans and pulses to the diet may also have other health benefits (Beans and pulses are low glycemic index foods 2008).

III. METHODOLOGY

The methodology pertaining to the study “**Glycemic Index of Kulakara and Mapillai Samba Rice Flakes**” was carried out under the following headings:

- A. Selection of Ingredients
- B. Organoleptic Evaluation of the developed recipes out of different rice flakes
- C. Determination of the glycemic index of different rice flakes
- D. Nutrient Analysis of Rice Flakes
- E. Statistical analysis and interpretation of data

A. Selection of ingredients

The ingredients selected are mapillai samba rice flakes and kulakara rice flakes. Rice flakes or flattened rice or beaten rice is a popular processed rice product used as a breakfast cereal, a substitute for cereal in weaning foods and a snack food. About one fifth of the rice produced is converted into rice flakes. Paddy production in the world is 660 million tones, out of which India produces around 144.6 million tones. About 14.46 million tones (10% of production) are being utilized for the production of rice products like popped, expanded and flaked rice. Flaked or beaten rice is a very popular traditional product in India and other rice consuming countries.

Rice Flakes or Flattened rice, commonly known as Chura, is rice which is flattened into flat, light, dry flakes. Flaked rice is a major product in India and it is also one of the main breakfast item in the states of Maharashtra, Madhyapradesh, Karnataka, Gujarat and Rajasthan (Sulochana *et al.*, 2017) .Rice flakes are prepared from paddy. It is a fast moving consumer item and generally eaten as breakfast item (Global Agri system Rice Flakes *et al.*, 2017).

In order to re-introduce rice flakes, value addition in terms of flavor and taste will aid in consuming rice flakes as a major cereal product. Rice flakes represent a perfect food vehicle for fortification (Durgadevi *et al.*, 2017).Rice flakes was considered to be a great meal option for diabetics as it promotes slow release of sugar into the blood stream. It also keeps full for longer time functions. Carbohydrates are the main source of energy in a bowl of rice flakes. The carbohydrates are needed to help our body store energy, and perform various other functions (Natureloc *et al.*, 2018).

Poha is considered to be a great meal option for diabetics as it promotes slow release of sugar into the blood stream. Carbohydrates are the main source of energy in a bowl of poha and mixed vegetables can be added to rice flakes to make it rich in vitamins, minerals, and fibre. Aval is considered to be great meal option for diabetics as it promotes slow release of sugar into the blood stream (www.allboutdiabetes.com).

Varieties of Rice Flakes

Mapillai Samba Rice Flakes

Mapillai samba is a native variety of rice grown in Tamilnadu, that is well suited to organic farming because it hardly demands little or no fertilizers or pesticides. The word “mapillai” means “bridegroom”. It was a virtue for every Tamil man to prove his strength and valor. The origin of its name can be found in Tamil folklore which has it that traditionally, on his wedding day a bridegroom (mapillai) was required to lift a heavy rock as a show of his strength and virility. To help boost his energy before the task, this rice was cooked and fed to the new son-in-law. Mapillai Samba can be cooked as plain rice, ground into flour or made into idli, dosa, upma and pongal. Mapillai samba rice is a

good source of iron and zinc. Iron contributes to the production of myoglobin and haemoglobin. It also contains pro-anthocyanins which help to reduce cholesterol.

Kudaivazhai Kullakara

The value of indigenous varieties to act as insurance during times of distress and calamities was dramatically illustrated during the 2004 tsunami in Tamil Nadu, when thousands of hectares of land under paddy were under sea water for a brief period along the coast of Nagapattinam district. This rendered the soil saline and no high-yielding or modern paddy varieties could be cultivated. However, an excellent solution was provided by the use of an indigenous paddy variety called *Kalarpalai* (literally meaning a variety that grows in *kalar* – salty soil). This variety not only withstands soil salinity, it is also resistant to pests and diseases and provided an excellent solution to tsunami-affected farmers. During this period, it was found that even *Kalanamak*, an indigenous variety from northern India known to perform well in saline soil, could also be cultivated in these areas. There are also references to the nutritional and therapeutic properties of indigenous varieties of paddy (Surekha *et al.*, 2017) .

B. Organoleptic Evaluation of the recipes developed out of different rice flakes

Sensory evaluation is a scientific discipline that applies principles of experimental design and statistical analysis to the use of human senses sight, smell, taste, touch and hearing for the purposes of evaluating consumer products. The discipline requires panels of human assessors, on whom the products are tested, and recording the responses made by them. By applying statistical techniques to the results it is possible to make inferences and insights about the products under test. A score card reflects the characteristics features of the food product such as appearance, colour, flavor, texture and taste (Kaun *et al.*, 2006).

The scientific discipline used to evoke measure analyze and interpret human reactions to those characteristics as food as they are perceived by the senses of color, taste ,texture and flavor (Murano *et al.*, 2003).

In the present study, recipes were prepared out of Mapillai samba rice flakes and kulakara flakes. The recipes prepared were Aval Kesari ,Aval Pakoda, Aval cutlet, Aval sweet, Aval Dosa, Aval Paniyaram, Aval upma,and Aval Pepper Jeera Rice, were evaluated for its acceptability by tasting panel comprising of 9 members.

Hedonic rating relates to pleasure or unpleasurable experiences. The hedonic rating test was used to measure the consumers acceptability of food products. One to four samples are served to the panelist at one session. The panelist were asked to rate the acceptability of the product on a scale, using nine points ranging from like extremely to dislike extremely. Scales with different ranges and other experience phrases could also be used. The results were analyzed for preference with data from large untrained panels (srilakshmi *et al.*, 2011).

Formulation of score card

The score card was identified as the best tool for conducting organoleptic evaluation, a nine point hedonic rating scale were formulated, presented and used for conduction of organoleptic evaluation. A table utilizing the hedonic ratings ranging from unacceptable to very acceptable is relatively easy to construct. The acceptability of the recipes was tested through organoleptic evaluation. The overall acceptability scores obtained through the organoleptic evaluation were analyzed statistically (Powell *et al.*, 2009).

The score card (9 point Hedonic scale) was used for evaluating the attributes like color, flavor, taste, texture, and overall acceptability. The score card used for the organoleptic evaluation of prepared recipes is presented in Appendix-II

Appearance

The size, shape, color, temperature and surface texture all play an important part in helping to determine the first reaction to a food. Appearance can be judged by the eye. Surface characteristics of food products contribute to the appearance .In addition to size and shape, wholeness and pattern can also be an important appearance factor.

Appearance plays an important role in sensory evaluation of foods (Avantina Sharma *et al.*, 2010).

Colour

Colour plays an important role in many foods. In addition to giving pleasure, the colour of food is associated with other attributes. Colour is one of the most important image features because it contains the basic human vision. Colour significantly affects the consumer perception of quality (Cardello *et al.*, 2010).

Flavor

The flavor of food has three components odor, taste and composite of sensation known as mouth feel. A substance which produces odour must be volatile and the molecules of the substance must come in contact with receptors in the epithelium of the olfactory organ. The volatility of aromas is related to the temperature of food (Lawless *et al.*, 2012).

Texture

Texture is a sensory manifestation of structure and mechanical properties of food. The textural characteristics are crisp or crunchy, tender, smooth and juicy. Certain characteristics like hard and soft may be right for some products. It can be characterized by how the food feels on the tongue coarse or fine coarse texture crystalline products are said to be grainy (Melligar *et al.*, 2011) .

Taste

Taste is also a highly individual aspect because fundamental taste preferences may be a result of biological factor, which account for innate preference for sweet tastes and aversion for bitter taste. However it is not only consumer biological aspects that influence the sense of taste but the environment and cultural influence as well (stone and sidel *et al.*, 2010).

Standard recipes were prepared out of mapillai samba, kullakara rice flakes and compared with the standard milled rice flakes. In breakfast recipes Aval Dosa,

Paniyaram, Uppuma and Pepper Jeera rice was prepared. In snacks preparation Cutlet, Kesari, Pakoda and Sweet Aval was prepared. The ingredients used and the ratio is presented in the following table:

Table I presents the composition of ingredients used in breakfast recipe Aval Dosa

TABLE - I

COMPOSITION OF INGREDIENTS FOR DOSA

Ingredients (g)	Milled Flakes	Mapillai Samba Flakes	Kulakara Flakes
RiceFlakes	100	100	100
Rice	50	50	50
Blackgram dhal	50	50	50
Oil(ml)	5	5	5
Water(ml)	50	50	50

For the preparation of dosa, first soak the rice in the water for 1 hour, soak the black gram dhal for ½ hour, soak poha for 10 minutes and grind separately. Mix all the ground ingredients, then add little amount of salt to the mixture and add water to get dosa consistency. Heat a tava, pour the batter, spread add oil and cook .Once cooked turn over the dosa the other side is also cooked and gets a golden brown color.

Table II presents the composition of ingredients used in breakfast recipe Aval Upma

TABLE – II
COMPOSITION OF INGREDIENTS FOR UPMA

Ingredients (g)	Milled Flakes	Mapillai Samba Flakes	Kulakara Flakes
RiceFlakes	100	100	100
Mustard seeds	5	5	5
Turmeric powder	5	2	3
Red chilli (Nos)	4	4	4
Curry leaves	2	2	2
Corriander leaves	2	2	2

Bengal gramdhal	20	20	20
Oil(ml)	10	5	5
Salt	10	5	5

For the preparation of upma, Soak the poha, for 5-10 minutes and drain the water. Heat a pan, add oil, then add mustard seeds and spliter ,then add Bengal gram dhal, curry leaves and coriander leaves, onions and red chilli till it is fried well. Then add the turmeric powder into the fried mixture. Then add the soaked and drained poha into it and mix it well. Finally add salt, mix well and serve hot.

Table III presents the composition of ingredients used in breakfast recipe Paniyaram

TABLE - III

COMPOSITION OF INGREDIENTS FOR PANIYARAM

Ingredients(g)	Milled Flakes	Mapillai Samba Flakes	Kulakara Flakes
Paniyaram batter	100	100	100
Rice Flakes	50	50	50
Jaggery	50	50	50
Salt	5	5	5
Cardamom	2	2	2
Oil(ml)	10	10	10

Take paniyaram batter in a large mixing bowl. Add the powdered jaggery, cardamom powder and rice flakes, mix well. Heat the paniyaram pan and grease the pan with little oil. Pour little batter into the each mould in the pan. Then cover and cook for 3 minutes. Turn the other side and cook till golden brown in colour. Once cooked, they were taken out and evaluated.

Table IV presents the composition of ingredients used in breakfast recipe Jeera Pepper Rice

TABLE - IV

COMPOSITION OF INGREDIENTS FOR JEERA PEPPER RICE

Ingredients (g)	Milled Rice	Mapillai Samba Rice Flakes	Kulakara Flakes
Rice Flakes	50	50	50
Mustard seeds	2	2	2
Black Pepper Powdered	10	10	10
Onion	10	10	10

Red chilli (Nos)	4	4	4
Cumin seeds	5	5	5
Salt	5	5	5
Oil(ml)	5	5	5

For the preparation of pepper rice, Wash the poha, and drain the water. In a pan add the oil then mustard seeds, cumin seeds, curry leaves, red chilli, onion and roast it. Then add the poha into the mixture. Add salt, powdered pepper and mix till it is uniformly mixed.

Table V presents the composition of ingredients used in snacks recipe Kesari

TABLE - V

COMPOSITION OF INGREDIENTS USED IN SNACKS RECIPE KESARI

Ingredients(g)	Milled Flakes	Mapillai Samba Flakes	Kulakara Flakes
Rice Flakes	50	50	50
Sugar	50	50	50
Ghee(ml)	10	10	10
Cardamom powder	2	2	2
Cashewnuts	5	5	5
Orange food color	1	1	1

Water(ml)	50	50	50
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For the preparation of kesari, Boil a cup of water in a pan. Then add the ground poha and keep stirring .Then add a pinch of kesari powder and mix it well. When it becomes thick, add sugar and 10ml of ghee. Then heat 5ml of ghee and fry cashew nuts till it becomes golden brown. Finally add cardamom powder and cashew in the kesari and remove from fire when it has the consistency of kesari.

Table VI presents the composition of ingredients used in snacks recipe Aval Pakoda

TABLE - VI

COMPOSITION OF INGREDIENTS USED IN SNACKS RECIPE AVAL PAKODA

Ingredients(g)	Milled Flakes	Mapillai Samba Flakes	Kulakara Flakes
Rice Flakes	50	50	50
Onion	20	20	20
Red chillipowder	5	5	5
Corriander leaves	2	2	2
Curry leaves	2	2	2
Salt	5	5	5
Water(ml)	As Required	As Required	As Required
Oil	for frying	for frying	for frying

In a bowl add poha, salt, red chilli powder, coriander leaves, curry leaves and chopped onions and mix well. Keep the mixture as such to set for 30 minutes. Water should not be added to the mixture as the moisture in the onions and curry leaves is sufficient. Then heat the oil in a kadai and deep fry making into small pakoda balls. in batches and fry till it turns golden brown.

Table VII presents the composition of ingredients used in snacks recipe Aval Cutlet

TABLE - VII

COMPOSITION OF INGREDIENTS USED IN SNACKS RECIPE AVAL CUTLET

Ingredients(g)	Milled Flakes	Mapillai Samba Flakes	Kulakara Flakes
Rice Flakes	10	10	10
Potato	20	20	20
Red chillipowder	5	5	5
Corriander leaves	2	2	2
Carrot	2	2	2
Oil(ml)	5	5	5
Onion	50	50	50
Salt	5	5	5
Garammamsala powder	5	5	5
Turmeric powder	5	5	5

For the preparation of cutlet, in a bowl, combine together soaked poha, grated potato, grated carrot, chillies and coriander leaves. Add all the spice powder, salt needed and thick curd/plain. Mix well. Divide the mixture equally and make smooth balls from it. Then flatten it to form patties. Heat a tawa, place the prepared patties and drizzle 1-2 tsp of oil around the patties. Cook both sides until golden brown on low heat.

Table VIII presents the composition of ingredients used in snacks recipe Sweet Aval

TABLE – VIII

COMPOSITION OF INGREDIENTS USED IN SNACKS RECIPE SWEET AVAL

Ingredients(g)	Milled Flakes	Mapillai Samba Flakes	Kulakara Flakes
Rice Flakes	50	50	50
Grated coconut	20	20	20
Sugar	20	20	20
Cardamom powder	5	5	5
Dates	10	10	10
Cashew	10	10	10
Roasted Bengal gram dhal powder	10	10	10
Warm Water(ml)	3-4	3-4	3-4
Raisins	10	10	10

Take the aval in a large mixing bowl, rinse in water, strain and then add 3-4 tsp of warm water .Mix the grated coconut, sugar or jiggery, cardamom powder and chopped dry nuts and raisins and also roasted Bengal gram dhal powder. Keep the mixture for 5 minutes, so that the flavor is blended well.



DOSA



JEERA PEPPER RICE

UPMA



PANIYARAM

Plate I

Breakfast recipes



CUTLET



SWEET AVAL



KESARI

I



PAKODA

Plate II

Snacks recipes

C. Determination of the glycemic index of rice flakes

The glycemic index is a number associated with the carbohydrates in a particular type of food that indicates the effect of these carbohydrates on a person's blood glucose called blood sugar level. A value of 100 represents the standard, an equivalent amount of pure glucose (Aljebhjo *et al.*, 2008).

The GI represents the rise in person's blood sugar level two hours after consumption of the food. The glycemic effects of foods depends on a number of factors, such as the type of carbohydrate, physical entrapment of the carbohydrate molecules

within the food, fat and protein content of the food and organic acids or their salts in the meal (www.glycemicindex.com).

The importance of glycemic index is, it helps to follow a meal plan that is tailored to personal preferences and lifestyles and helps achieve goals for blood glucose, cholesterol and triglycerides levels, blood pressure and weight management (www.betterhealth.vic.gov.au).

The glycemic index ranks carbohydrates based on their immediate blood glucose response

GI=glycemic quality

The glycemic index of the rice flakes were calculated by taking the average of the glycemic response of both the reference and test food at 30, 60, 90 and 120 minutes and a glycemic curve was constructed. The incremental area under blood glucose response curve was calculated. The Glycemic index value of each individual was calculated as:

$$\text{GI value for test food} = \frac{\text{Blood glucose area of the test food(50gm)}}{\text{Blood glucose area of the glucose/bread (50gm)}}$$

Thirty subjects were selected for evaluating the glycemic index and they were between 30-35years of age. These 30 subjects were divided into three groups of 10 in each group. The subjects who had fasting blood glucose level of 80-90mg/dl, and who did not have any complications were selected. Three days before the test period all the subjects were instructed to avoid sweet preparations and steroid containing drugs. On the fourth day fasting blood glucose was estimated and then all of them were served white bread (70g) providing 50g of Carbohydrate for breakfast.

Blood samples were collected every half an hour for two hours. Again after a wash out period of one week the food intake of the subjects was controlled for three days as before. On the fourth day, the fasting blood was drawn to estimate fasting blood glucose and then they were served the milled, kulakara and mapillai samba flakes upma

which was standardized. The recipe standardized was cooked and served to the subjects in a fixed test portion containing 50g digestible (available) carbohydrate. It was ascertained that the subjects did not leave any plate waste and took same length of time for consuming the breakfast served. The blood samples were collected at periodic intervals of 0, 30, 60, 90 & 120 minutes. Blood glucose levels of all the sample were estimated.



The standardised mapillai samba flakes upma was served to the subjects



Plate III

Drawing of blood sample

Determination of glycemic index

The Glycemic Index of the standardized recipes was calculated by taking the average of the glycemic response of both the reference and test food at 30,60,90 and 120 minutes and a glycemic curve was constructed. The incremental area under blood glucose response curve was calculated. The Glycemic Index value of each individual was calculated as:

$$\text{GI value for test food} = \frac{\text{Curve under test food}}{\text{Curve under reference food}}$$

Glycemic index is a number. It gives you an idea about how fast your body converts the carbs in a food into glucose. Two foods with the same amount of carbohydrates can have different glycemic index numbers.

The smaller the number, the less impact the food has on blood sugar.

- 55 or less = Low (good)
- 56- 69 = Medium
- 70 or higher = High (bad)

D. Nutrient Analysis of the rice flakes

Nutrient analysis refers to the process of determining the nutrient content of foods and food products. The process can be performed through a variety of certified methods. The following biochemical analysis were carried out to analyze the nutrient content of the rice flakes. Ash, Moisture, Energy, Protein, Crude fiber, Iron, Phosphorus, Calcium and Vitamin C of the rice flakes was determined.

The nutrient content of the mapillai samba rice flakes and kulakara rice flakes was analyzed in the Nutrition laboratory, Department of Food Science and Nutrition, Avinashilingam Institute For Homescience And Higher Education For Women, Coimabtoe. The principle followed for the analysed nutrients is as follows:

Moisture

Estimation of moisture is one of the most often performed determinations in food analysis. Moisture is lost when food is heated not much higher than the temperature of boiling water or by allowing to stand over dehydrating agent or by heating over vacuum.

Ash

By continuous heating the substance gets charred which can be used for the determination of minerals present.

Crude Fibre

The term crude fibre ordinarily meant in agriculture and food analysis is the given residue consisting largely of cellulose, that is left after other carbohydrates and proteins have been removed by successive treatment with boiling acids and alkalies. The crude fibre contained in this way is not cellulose but contains distinct properties of hemicelluloses and nitrogenous substances.

Protein

The given sample is digested with concentrated sulphuric acid in a macro kjeldhal flask when nitrogen converts to ammonium sulphate. Ammonia is liberated by the action of strong alkali in a macrokjeldhal steam distillation apparatus. This nitrogenous substance is converted to ammonium borate by absorbing 2% boric acid and is titrated against N/70 H₂SO₄. The volume of acid required to bring the test sample to the colour of the blank gives the acid equivalent to the ammonia.

Protein content of the food substance = nitrogen value \times 6.25

Iron

The food sample is oxidized with ignition or oxidation. Iron as ferric iron reacts with ammonium thiocyanate or with potassium thiocyanate to give ferric thiocyanate which is red in colour. The colour is a measure of the concentration is measured colorimetrically.

Phosphorus

When the ash solution is treated with ammonium molybdate, phosphomolybdic acid is formed phosphomolybdic acid is reduced by the addition of 1,2,4 amino naphthol sulphonic acid reagent to produce a blue color which is apparently a mixture of oxidizes

of molybdenum. The intensity of the colour developed is the measure of phosphorus present.

Vitamin C

Pipette out 5 ml of the working standard solution into a 100ml conical flask. Add 10 ml of 4 percent oxalic acid and titrate against the dye (V/1ml). End point is the appearance of the pink colour which persists for few minutes. The amount of the dye consumed is equivalent to the amount of ascorbic acid. Extract the sample (0.5-5g depending on the sample) in 4 percent oxalic acid and make upto a known volume 100 ml and centrifuge.



ESTIMATION OF FAT



ESTIMATION OF NITROGEN

FIGURE

NUTRIENT ANALYSIS OF RICE FLAKES

E. Statistical analysis and interpretation of data

The data obtained for sensory attributes of the developed recipes with two variations was analyzed statistically and interpreted. The data was consolidated and tabulated in which mean, standard deviation, and ANOVA were computed. The research design and protocol of the study was submitted for scrutinisation and approval to the Institutional Human Ethics Committee and Ethical Clearance approval was obtained. The Ref. No is AUW IHEC/FSN-17-18/XPD/10.

The methodology followed in the present study is represented in figure I

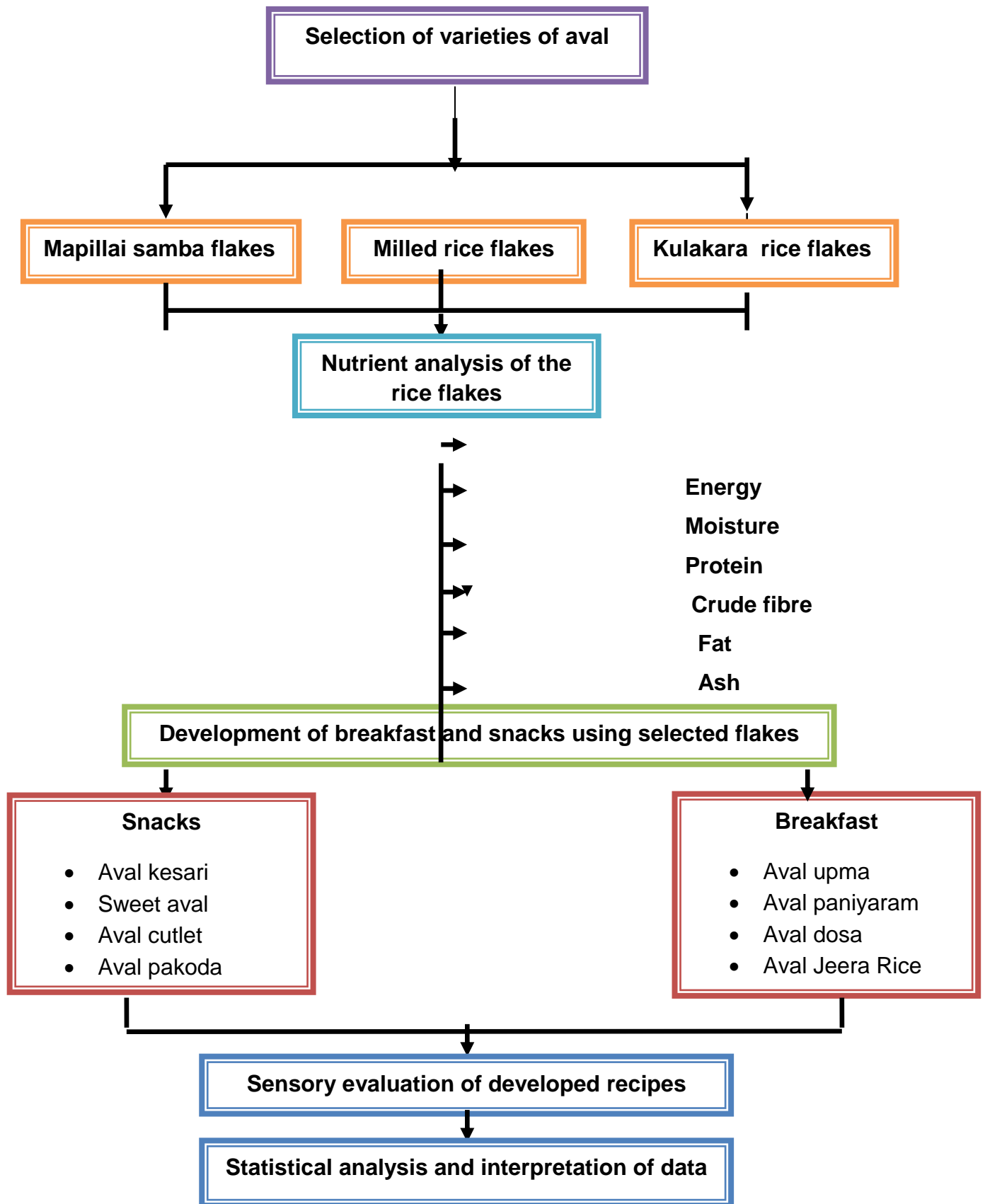


Figure-I Research design

IV. RESULTS AND DISCUSSION

The results and discussion of the study entitled “**Glycemic Index of Mapillai and Kulakara flakes**” is presented under the following heads:

- A. Sensory evaluation of the developed recipes
- B. Nutrient content of rice flakes
- C. Evaluation of the glycemic index of the different rice flakes
- D. Calculation of the nutritive value of developed recipes

A. Sensory evaluation of the developed recipes

Sensory evaluation is a scientific discipline that applies principles of experimental design and statistical analysis to the use of human senses sight, smell, taste, touch and odour for the purposes of evaluating the products. All the selected recipes were tried in the laboratory and subjected to sensory evaluation to evaluate its acceptability

Table IX represent the mean acceptability scores of Aval Dosa

TABLE-IX

MEAN ACCEPTABILITY SCORES OF DOSA

Variations	Appearance (Mean±SD)	Colour (Mean±SD)	Flavour (Mean±SD)	Texture (Mean±SD)	Taste (Mean±SD)	Over all acceptability (Mean±SD)
Milled Flakes	8.4±0.86	7.8±0.88	6.8±1.40	7.0±0.94	7.0±1.40	7±1.51
Kulakara flakes	7.3±1.31	7.2±1.30	7.3±1.29	7.0±1.25	7.3±1.29	7.0±1.32
Mapillai samba flakes	7.1±1.26	7.1±1.26	7.1±1.22	7.4±1.27	7.2±1.33	7±1.31

Dosa prepared from milled flakes scored the highest scores of 8.4 ± 0.86 for appearance followed by kulakara and mapillai with scores of 7.3 ± 1.31 and 7.1 ± 1.26 respectively. The colour of milled rice flakes scored highest score of 7.8 ± 0.88 followed by mapillai and kulakara rice flakes with scores of 7.7 ± 1.16 and 7.2 ± 1.30 respectively. The flavour of kulakara flakes scored the highest score of 7.3 ± 1.29 followed by mapillai flakes and milled rice flakes with scores of 7.1 ± 1.22 and 6.8 ± 1.40 respectively. The texture of mapillai flakes had the highest score of 7.4 ± 1.27 followed by kulakara and milled with scores of 7.0 ± 1.25 and 7.0 ± 0.94 respectively. Kulakara scored the highest score of 7.3 ± 1.29 for taste and the least scores of 7.0 ± 1.40 was obtained for milled rice flakes. The overall acceptability of the three flakes namely milled, mapillai and kulakara more 7.0 ± 1.51 , 7.0 ± 1.31 and 7.0 ± 1.32 respectively, and there was not much difference in the dosa recipe among the three flakes.

From the Table IX it is observed that the p value is greater than 0.05. Hence, the null hypothesis is accepted at 5% level of significance. (i.e.) there is no significant difference between the ranks of the various types of varieties in Aval Dosa.

Table X represents the mean acceptability scores of Aval Upma

TABLE-X

MEAN ACCEPTABILITY SCORES OF AVAL UPMA

Variations	Appearance (Mean±SD)	Colour (Mean±SD)	Flavour (Mean±SD)	Texture (Mean±SD)	Taste (Mean±SD)	Over all acceptability (Mean±SD)
Milled Flakes	7.6 ± 1.18	7.3 ± 1.29	7.5 ± 1.19	7.1 ± 1.34	7.8 ± 1.06	7.8 ± 1.41
Kulakara flakes	7.2 ± 1.29	6.9 ± 1.25	7.1 ± 1.14	7.0 ± 1.21	7.6 ± 0.96	7.3 ± 1.02
Mapillai samba flakes	7.1 ± 1.25	7 ± 1.25	6.9 ± 1.24	7.1 ± 1.30	7.5 ± 1.33	7.0 ± 1.27

The scores for upma prepared with different rice flakes with regard for appearance, milled flakes scored the highest of 7.6 ± 1.8 , followed by kulakara and mapillai samba with scores of 7.2 ± 1.29 and 7.1 ± 1.25 . With regard to colour, milled flakes had the highest score of 7.3 ± 1.29 followed by mapillai and kulakara with scores of 7.01 ± 1.25 and 6.93 ± 1.25 respectively. The flavor of milled flakes scored the highest score of 7.5 ± 1.19 followed by kulakara and mapillai with scores of 7.1 ± 1.14 and 6.9 ± 1.24 respectively. The texture of upma prepared from all the three flakes was similar with the average score of with regard to taste milled flakes scored the highest score of 7.8 ± 1.06 followed by kulakara and mapillai with scores of 7.6 ± 0.96 and 7.5 ± 1.33 respectively. The overall acceptability of milled flakes was highly acceptable with score of 7.8 ± 1.41 and the least scores was obtained for mapillai of 7.0 ± 1.27 .

From the Table X it is observed that the p value is less than 0.05. Hence, the null hypothesis is rejected at 5% level of significance. (i.e.) there is significant difference between the ranks of the various type of varieties in Aval upma.

Table XI represent the mean acceptability scores of Aval Jeera Pepper Rice

TABLE-XI

MEAN ACCEPTABILITY SCORES OF AVAL JEERA PEPPER RICE

Variations	Appearance (Mean±SD)	Colour (Mean±SD)	Flavour (Mean±SD)	Texture (Mean±SD)	Taste (Mean±SD)	Over all acceptability (Mean±SD)
Milled Flakes	6.7 ± 1.46	7.1 ± 1.25	7.2 ± 1.14	7.5 ± 1.25	6.3 ± 1.33	7.2 ± 1.38
Kulakara flakes	7.3 ± 1.37	7.0 ± 1.11	6.8 ± 1.16	1.0 ± 1.24	7.1 ± 1.29	7.1 ± 1.19
Mapillai samba flakes	8 ± 0.83	7.5 ± 0.93	7.3 ± 1.31	7.0 ± 1.15	7.2 ± 1.25	7.1 ± 1.21

The aval jeera rice prepared from mapillai flakes scored highest score of 8.0 ± 0.83 for appearance followed by kulakara and milled flakes with scores of 8.0 ± 0.83 for appearance followed by kulakara and milled flakes with scores of 8 ± 0.83 and 6.7 ± 1.46 respectively. With regard to the other organoleptic characteristics like flavour, colour, texture taste and overall acceptability, Aval jeera rice prepared from mapillai and kulakara has scores in the same range of 7.1 ± 1.00 and therefore there was not much difference in the acceptability among the two flakes. But jeera rice prepared out of milled flakes had an overall acceptability of 7.2 ± 1.38 .

From the Table XI it is observed that the p value is greater than 0.05. Hence, the null hypothesis is accepted at 5% level of significance. (i.e.) there is no significant difference between the ranks of the various type of varieties in Aval millagu jeera rice.

Table XII represent the mean acceptability scores of Aval Paniyaram

TABLE-XII

MEAN ACCEPTABILITY SCORES OF AVAL PANIYARAM

Variations	Appearance (Mean±SD)	Colour (Mean±SD)	Flavour (Mean±SD)	Texture (Mean±SD)	Taste (Mean±SD)	Over all acceptability (Mean±SD)
Milled Flakes	7.3±1.34	7.2±1.43	7.0±1.11	7.2±1.60	7.2±1.16	7.8±1.45
Kulakara flakes	7.1±1.29	7.2±1.36	7.6±1.19	7.4±1.22	7.3±1.26	7.4±1.10
Mapillai samba flakes	7.4±1.27	7.2±1.27	7.0±1.21	7.2±1.19	7.1±1.23	6.8±1.25

The aval paniyaram prepared from mapillai flakes scored the highest score of 7.4 ± 1.27 followed by milled and kulakara with scores of 7.3 ± 1.34 and 7.1 ± 1.29 respectively for appearance. The scores obtained for the three flakes with regard to the

colour and flavour of the paniyaram was almost same with minimum difference .The score ranged around 7.2 ± 1.00 for colour. With regard to the taste, kulakara flakes had the highest score of 7.3 ± 1.26 followed by milled and mapillai flakes with scores of 7.2 ± 1.16 and 7.1 ± 1.23 respectively. The texture of the kulakara had the highest score of 7.4 ± 1.22 followed by milled and mapillai with scores of 7.2 ± 1.60 and 7.2 ± 1.19 . The overall acceptability of milled flakes has the highest score of 7.8 ± 1.45 and the least will appeared the score of 6.86 ± 1.25 in mapillai samba flakes.

From the Table XII it is observed that the p value is greater than 0.05. Hence, the null hypothesis is accepted at 5% level of significance. (i.e.) there is no significant difference between the ranks of the various type of varieties in Aval paniyaram.

Table XIII represent the mean acceptability scores of Aval Kesari

TABLE-XIII

MEAN ACCEPTABILITY SCORES OF AVAL KESARI

Variations	Appearance (Mean±SD)	Colour (Mean±SD)	Flavour (Mean±SD)	Texture (Mean±SD)	Taste (Mean±SD)	Over all acceptability (Mean±SD)
Milled Flakes	8.3 ± 0.75	7.8 ± 1.04	8.1 ± 1.02	8.1 ± 0.87	7.9 ± 0.98	8.1 ± 0.88
Kulakara flakes	7.5 ± 1.43	7.2 ± 1.48	7.6 ± 1.15	7.1 ± 1.38	7.1 ± 1.26	7.1 ± 1.49
Mapillai samba flakes	7.1 ± 1.43	6.9 ± 1.44	7.2 ± 1.17	7.3 ± 1.29	7.2 ± 1.33	7.6 ± 1.22

The aval kesari prepared from milled flakes scored the highest score of 8.3 ± 0.75 for appearance followed by kulakara and mapillai flakes with scores of 7.5 ± 1.43 and 7.1 ± 1.43 respectively. With regard to the colour milled flakes scored the highest score of 7.8 ± 1.04 followed by kulakara and mapillai flakes with scores of 7.2 ± 1.48 and 6.9 ± 1.44 respectively. The texture of milled flakes scored the highest score of 8.1 ± 0.87

followed by mapillai and kulakara with scores of 7.3 ± 1.29 and 7.1 ± 1.38 respectively. The flavor of aval kesari prepared from milled, kulakara and mapillai were 8.1 ± 1.02 , 7.6 ± 1.15 and 7.2 ± 1.17 respectively. The flavor of milled flakes had the highest score of 8.1 ± 1.02 followed kulakara and mapillai with scores of 7.6 ± 1.15 and 7.2 ± 1.17 respectively. The milled flakes scored the highest score of 7.9 ± 0.98 for taste followed by mapillai and kulakara with scores of 7.2 ± 1.33 and 7.1 ± 1.26 respectively. The overall acceptability of milled flakes was highly acceptable with score of 8.1 ± 0.88 followed by mapillai and kulakara with scores of 7.6 ± 1.22 and 7.1 ± 1.49 .

From the Table XIII it is observed that the p value is less than 0.05. Hence, the null hypothesis is rejected at 5% level of significance. (i.e.) there is significant difference between the ranks of the various type of varieties in Aval kesari.

Table XIV represent the mean acceptability scores of Aval Pakoda

TABLE-XIV

MEAN ACCEPTABILITY SCORES OF AVAL PAKODA

Variations	Appearance (Mean±SD)	Colour (Mean±SD)	Flavour (Mean±SD)	Texture (Mean±SD)	Taste (Mean±SD)	Over all acceptability (Mean±SD)
Milled Flakes	7.6 ± 1.16	8.1 ± 0.89	7.7 ± 1.11	7.8 ± 1.01	7.7 ± 1.08	7.6 ± 0.99
Kulakara flakes	7.3 ± 1.24	7.2 ± 1.31	7.4 ± 1.16	7.5 ± 1.25	7.2 ± 1.14	7.3 ± 1.21
Mapillai samba flakes	7.3 ± 1.26	7.2 ± 1.22	7.6 ± 1.09	7.6 ± 1.16	7.6 ± 1.12	7.1 ± 1.30

The pakoda prepared from milled flakes scored the highest score of 7.6 ± 1.16 followed by mapillai and kulakara with scores of 7.3 ± 1.26 and 7.3 ± 1.24 for appearance respectively. The colour of pakoda prepared from milled flakes had highest score of 8.1 ± 0.89 and the same score of 7.2 ± 1.22 was obtained for kulakara and mapillai flakes. With regard to texture milled flakes had the highest score of 7.8 ± 1.01 followed by

mapillai and kulakara with scores of 7.6 ± 1.16 and 7.5 ± 1.25 respectively. The flavor of milled flakes scored the highest score of 7.7 ± 1.11 followed by mapillai and kulakara with scores of 7.6 ± 1.09 and 7.4 ± 1.16 respectively. With regard to taste milled flakes had the highest score of 7.7 ± 1.08 followed by mapillai and kulakara with scores of 7.6 ± 1.12 and 7.2 ± 1.14 respectively. The overall acceptability of pakoda prepared from milled flakes was highly acceptable with score of 7.6 ± 0.99 followed by kulakara and mapillai with scores of 7.3 ± 1.21 and 7.1 ± 1.30 respectively.

From the Table XIV it is observed that the p value is less than 0.05. Hence, the null hypothesis is rejected at 5% level of significance. (i.e.) there is significant difference between the ranks of the various types of varieties in Aval pakoda.

Table XV represent the mean acceptability scores of Aval Cutlet

TABLE-XV

MEAN ACCEPTABILITY SCORES OF AVAL CUTLET

Variations	Appearance (Mean±SD)	Colour (Mean±SD)	Flavour (Mean±SD)	Texture (Mean±SD)	Taste (Mean±SD)	Over all acceptability (Mean±SD)
Milled Flakes	7.8±1.05	7.5±1.10	7±1.46	7.7±1.11	7.7±1.08	7.8±1.05
Kulakara flakes	7.4±1.24	7.5±1.22	7.3±1.21	7.4±1.19	7.1±1.35	7.4±1.19
Mapillai samba flakes	7.3±1.31	7.2±1.27	7.2±1.29	7.3±1.34	7.3±1.37	7.2±1.24

Cutlet prepared from milled flakes scored the highest score of 7.8 ± 1.05 for appearance followed by kulakara and mapillai with scores of 7.4 ± 1.24 and 7.3 ± 1.31 respectively. The colour of milled rice flakes scored highest score of 7.5 ± 1.10 followed by mapillai and kulakara rice flakes with scores of 7.2 ± 1.27 and 7.5 ± 1.22 respectively. The flavor of kulakara flakes scored the highest score of 7.3 ± 1.21 followed by mapillai

flakes and milled rice flakes with scores of 7.2 ± 1.29 and 7 ± 1.46 respectively. The texture of kulakara flakes had the highest score of 7.4 ± 1.19 followed by mapillai and milled with scores of 7.3 ± 1.34 and 7.7 ± 1.11 respectively. Milled flakes scored the highest score of 7.7 ± 1.08 for taste and the least score of 7.1 ± 1.35 was obtained for kulakara flakes. The overall acceptability of the three flakes namely milled, mapillai and kulakara were 7.8 ± 1.05 , 7.4 ± 1.19 and 7.2 ± 1.24 respectively and with regard to the overall acceptability milled flakes scored the highest and was highly acceptable.

From the Table XV it is observed that the p value is less than 0.05. Hence, the null hypothesis is rejected at 5% level of significance. (i.e.) there is significant difference between the ranks of the various types of varieties in Aval cutlet.

Table XVI represent the mean acceptability scores of Sweet Aval

TABLE-XVI

MEAN ACCEPTABILITY SCORES OF SWEET AVAL

Variations	Appearance (Mean±SD)	Colour (Mean±SD)	Flavour (Mean±SD)	Texture (Mean±SD)	Taste (Mean±SD)	Over all acceptability (Mean±SD)
Milled Flakes	7.6 ± 1.12	6.7 ± 1.35	7.3 ± 1.09	7.3 ± 1.20	7.1 ± 1.26	7.5 ± 1.25
Kulakara flakes	7.3 ± 1.21	7.2 ± 1.28	7.0 ± 1.31	7.3 ± 1.29	6.9 ± 1.37	7.3 ± 1.29
Mapillai samba flakes	7.5 ± 1.07	7.5 ± 1.19	7.6 ± 1.36	7.2 ± 1.36	7.3 ± 1.21	7.1 ± 1.34

Sweet poha prepared from milled flakes scored the highest score of 7.6 ± 1.12 for appearance followed by kulakara and mapillai with score of 7.5 ± 1.07 and 7.3 ± 1.21 . The colour of standard of mapillai scored highest score of 7.5 ± 1.19 followed by milled and kulakara rice flakes with scores of 6.7 ± 1.35 and 7.2 ± 1.28 . The flavor of mapillai flakes scored the highest score of 7.6 ± 1.24 followed by milled and kulakara flakes flakes with

scores of 7.3 ± 1.09 and 7.0 ± 1.31 . The texture of the kulakara flakes had the highest score of 7.3 ± 1.29 followed by mapillai and milled with score of 7.3 ± 1.20 and 7.2 ± 1.36 respectively. Mapillai flakes scored the highest score of 7.3 ± 1.21 for taste and the least score of 6.9 ± 1.37 was obtained for kulakara flakes. The overall acceptability of the three flakes namely milled, mapillai and kulakara were 7.5 ± 1.25 , 7.3 ± 1.29 and 7.1 ± 1.34 respectively.

From the Table XVI it is observed that the p value is less than 0.05. Hence, the null hypothesis is rejected at 5% level of significance. (i.e.) there is significant difference between the ranks of the various types of varieties in Sweet aval.

B.Nutrient content of rice flakes

Nutrient analysis refers to the process of determining the nutritional content of foods and food product. Nutrient content of food products are analyzed by qualitative and quantitative methods. Reagents are used as indicators to food substances for the presence of specific nutrients. The standard procedures are used to analyze the carbohydrate, protein, fat, vitamins and minerals.

Table XVII presents the data about the nutrients present in the three varieties of rice flakes.

TABLE- XVII

NUTRIENT CONTENT OF RICE FLAKES

NUTRIENTS	Kulakara flakes	Mapillai flakes	Milled flakes
Moisture(g)	12.2	12	11.6
Total ash(%)	6	7.6	5.22
Fat(g)	0.4	0.78	0.1
Protein(g)	7.22	8.7	0.1
Energy(k cal)	335.60	230.10	339.20
CHO(g)	74.20	71.05	75.82
Fibre	0.4	0.5	0.6

From the table it is evident that high amount of ash content (i.e) 7.6 percent obtained from mapillai samba rice flakes when compared to the other flakes. With regard to the moisture content kulakara flakes retained more moisture (i.e) 12.2 g followed by mapillai samba flakes 12 g, and least amount of moisture was present in milled flakes 11.6 g. The quantity of crude fibre present was almost same (i.e) it ranged from 0.4-0.6 g for all the different varieties of rice flakes. The energy content of the rice flakes was 339.20 for milled flakes, 335.60 for kulakara flakes and 230.10 for mapillai samba rice flakes. The amount of protein present in kulakara flakes is 7.22g for mapillai samba flakes 8.7g and 0.1g for milled flakes. The fat content present in mapillai samba flakes was 0.78 is the highest value and the least amount of fat present in milled flakes was 0.1g.

B.Evaluation of the glycemic index of the different rice flakes

A study by Thilakavathy *et al* (2007) on Glycemic Index for south Indian Breakfast recipes incorporating different sprouted pulse powders showed reduced post prandial blood glucose level when compared to white bread and standard recipes.

As detailed in methodology glycemic index of the selected recipes were evaluated by feeding the rice flakes upma to subjects in the age group of 30-35 years and the results are present and discussed as follows.

A. Mean blood glucose level

The mean blood glucose values of the groups of subjects who were administered white bread and then the test recipes were estimated every half an hour and the glycemic index was calculated. The mean blood glucose levels of the different groups estimated before and after two hours (post prandial) of administration of the test recipes are presented in Table. Appendix IV present the blood glucose values of individuals for every half an hour after feeding the rice flakes upma and white bread. Mean blood glucose levels of the subjects before and after the administration of test recipes for every half an hour.

TABLE-XVIII

MEAN BLOOD GLUCOSE LEVELS SUBJECTS BEFORE AND AFTER THE ADMINISTRATION OF TEST RECIPES

	Fasting	30mins	60mins	90mins	120mins
Bread	86.2±4.89	117.5±19.73	120.5±14.36	113.6±19.67	70.5±15.57
Kulakara	80.9±7.32	121.2±15.91	128.7±19.44	112.5±7.87	98±8.89
Mapillai	80±5.08	100.1±15.86	135±27.36	124.6±27.3	98.3±16.06
Milled flakes	76.5±6.21	100.1±20.58	150.6±18.25	104.5±13.65	96.5±8.27

Table XVIII shows the variation in the glycemic response of the recipe prepared from different rice flakes. With regard to kulakara the blood glucose level was 80.9±7.32, 121.2±15.01 and 128.7±19.44, 112.5±7.87 and 98.3±8.89 for fasting, 30, 60,

90 and 120 minutes respectively. With regard to Mapillai flakes the blood glucose level was 80 ± 5.08 , 100.1 ± 15.86 , 135 ± 27.36 , 124.6 ± 27.3 and 98.3 ± 16.06 for fasting, 30, 60, 90 and 120 minutes respectively. With regard to Milled flakes the blood glucose level was 76.5 ± 6.21 , 100.1 ± 20.58 , 150.6 ± 18.25 , 104.5 ± 13.65 and 96.5 ± 8.27 for fasting, 30, 60, 90 and 120 minutes respectively. With regard to bread the blood glucose level was 86.2 ± 4.89 , 117.5 ± 19.73 , 120.5 ± 14.36 , 113.6 ± 19.67 and 70.5 ± 15.57 for fasting, 30, 60, 90 and 120 minutes respectively.

Table XIX presents the data on the fasting and post prandial blood glucose levels

Table-XIX

BLOOD GLUCOSE LEVEL (mg/dl)

	Fasting Mean\pmSD	Post prandial Mean\pmSD	“T” value	“P” Value
Milled flakes	76.5\pm6.21	96.5\pm8.27	-4.977	.001*
Kulakara flakes	80.9\pm7.32	98\pm8.89	-6.900	.000*
Mapillai samba flakes	80\pm5.08	98.3\pm16.06	-3.528	.006**

***=Significant at 1% level**

****=Significant at 5% level**

It is evident from Table-XIX that the blood glucose values of the subjects before and after feeding the test food showed normal values between 70 and 100 mg/dl. The fasting and post prandial level for milled flakes was 76.5 ± 6.21 and 96.5 ± 8.27 while for kulakara flakes it was 80.9 ± 7.32 and 98 ± 8.89 and for mapillai samba flakes it was 80 ± 5.08 and 98.3 ± 16.06 respectively.

Glycemic Index

Glycemic Index (GI) is ranking foods on a scale from 0 to 100 according to the extent to which they raise blood glucose levels after they are consumed. Calculating the glycemic index was developed by Jenkins et al 1981 to assist diabetic patients in reducing post prandial blood glucose through diet. Low glycemic index foods, by virtue of their slow digestion and absorption produce gradual rise in blood glucose levels, and also reduce insulin levels and insulin resistance.

Among the three rice flakes kulakara rice flakes had the lowest glycemic index of 84.30 when compared to the standard milled which had a high Glycemic Index of 97.32 while mapillai samba rice flakes had a glycemic index of 90.01. Rice flakes prepared from the cereal rice has high G.I but compared to the traditional variety, mapillai and kulakara rice flakes are having low glycemic index

According to miller, 1994 on the basis of glycemic index glucose as 100, the glycemic index of breakfast cereals range from 43 to 90. Different studies quote different values for the same food at different times to the varying responses of individuals to influence the G.I markedly. In addition, particle size also plays an important role as the particle size decreases the glycemic index increases.

B. Determination of Glycemic Index

The glycemic index, or GI, measures how a carbohydrate-containing food raises blood glucose. Foods are ranked based on how they compare to a reference food — either glucose or white bread. A food with a high GI raises blood glucose more than a food with a medium or low GI.

Examples of carbohydrate-containing foods with a low GI include dried beans and legumes (like kidney beans and lentils), all non-starchy vegetables, some starchy vegetables like sweet potatoes, most fruit, and many whole grain breads and cereals (like barley, whole wheat bread, rye bread, and all-bran cereal).

Glycemic Index (GI) is ranking foods on a scale from 0 to 100 according to the extent to which they raise blood glucose levels after they are consumed. Calculating the glycemic index was developed by Jenkins et al 1981 to assist diabetic patients in reducing post prandial blood glucose through diet. Low glycemic index foods by virtue of their slow digestion and absorption produce gradual rise in blood glucose levels, and also reduce insulin levels and insulin resistance.

Hence the glycemic index of the three rice flakes were evaluated and calculated and is presented in Table XX and Figure

TABLE-XX

GLYCEMIC INDEX OF THREE RICE FLAKES

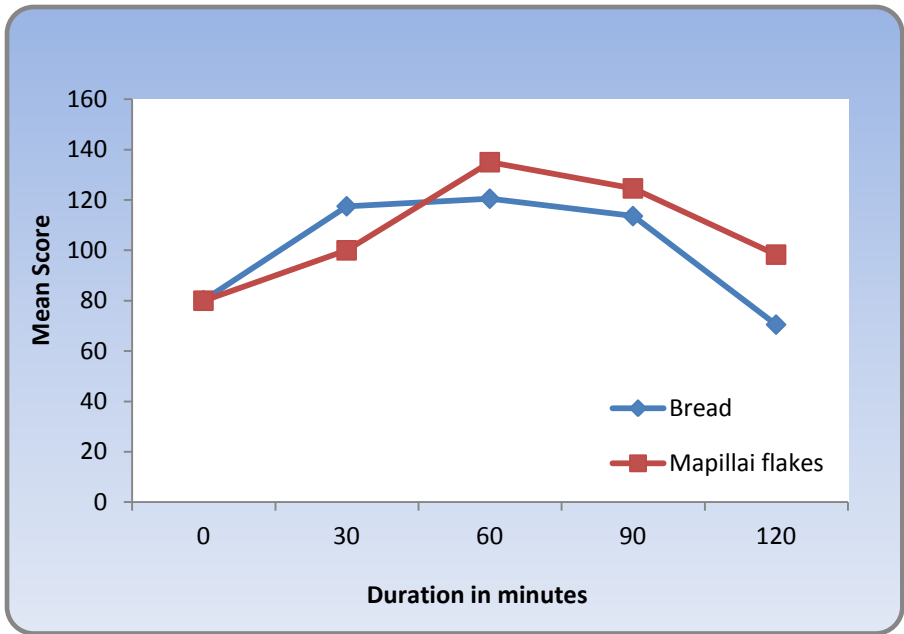
Varieties of Rice Flakes	GI VALUES
MILLED	97.3
KULAKARA	84.3
MAPILLAI	90.0

Among the three rice flakes Kulakara rice flakes had the lowest GI of 84.3 when compared to the standard Milled which had high GI of 97.3. While Mapillai samba rice flakes had a GI of 90.0. Rice flakes prepared from the cereal rice has high GI, but compared to traditional variety, Mapillai and Kulakara rice flakes are having Low GI.

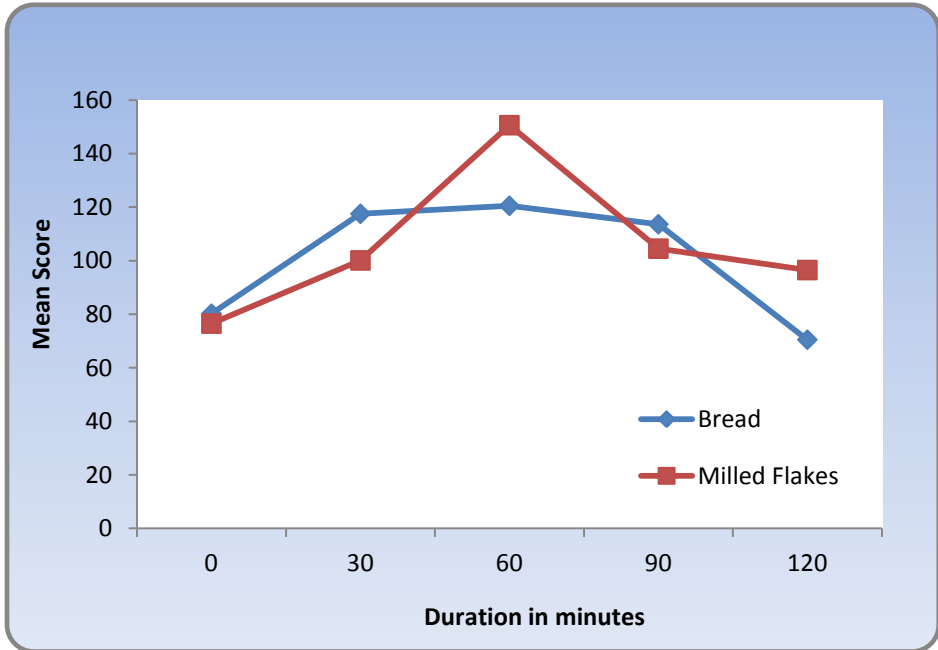
According to Miller, 1994 on the basis of GI of glucose as 100, the GI of breakfast cereals range from 43 to 90. Different studies quote different values for the same food at different times to the varying responses of individuals to influence the GI

markedly. In addition, particle size also plays an important role as the particle size decreases, GI increases.

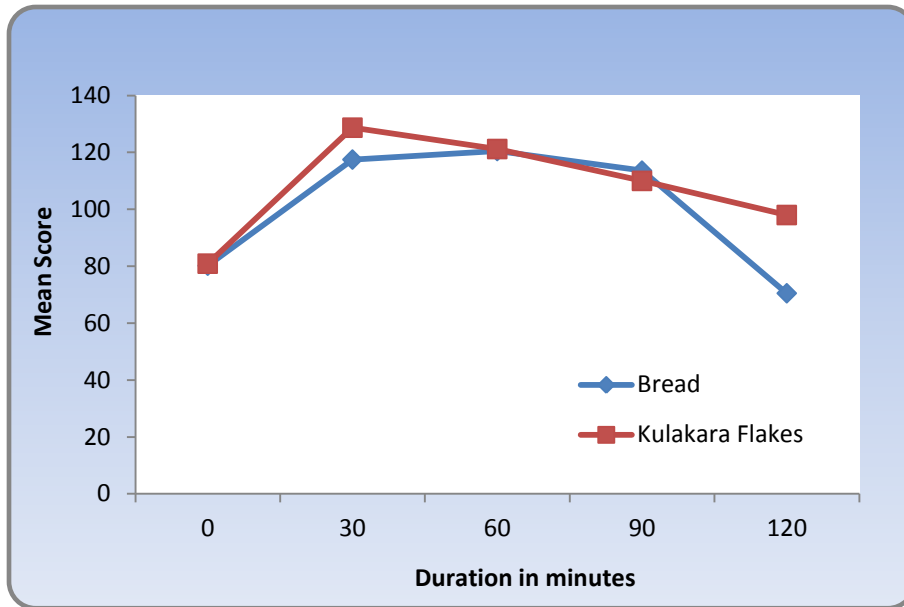
Similar results have been shown in the study by Thilakavathy and Muthuselvi., 2010 stating that millet incorporated chappathi registered low glycemic index compared to the standard chappathi which was due to the high fibre content of the millets.



Mapillai Samba Flakes



Milled Flakes



Kulakara Flakes

Figure

Glcemic index of milled, mappilai and kulakara flakes

D. Calculation of the nutritive value of developed recipes

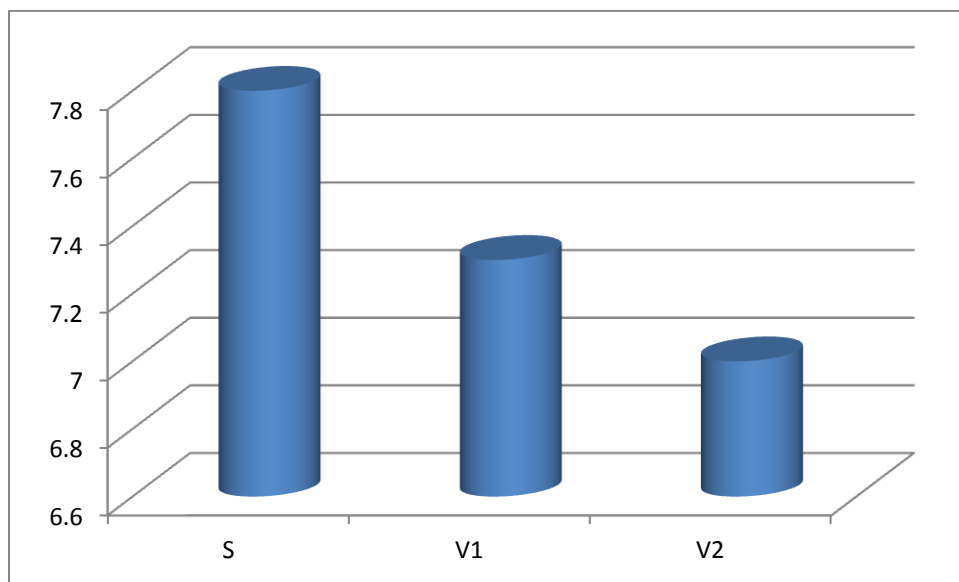
TABLE-XXI

NUTRITIVE VALUE OF DEVELOPED RECIPES

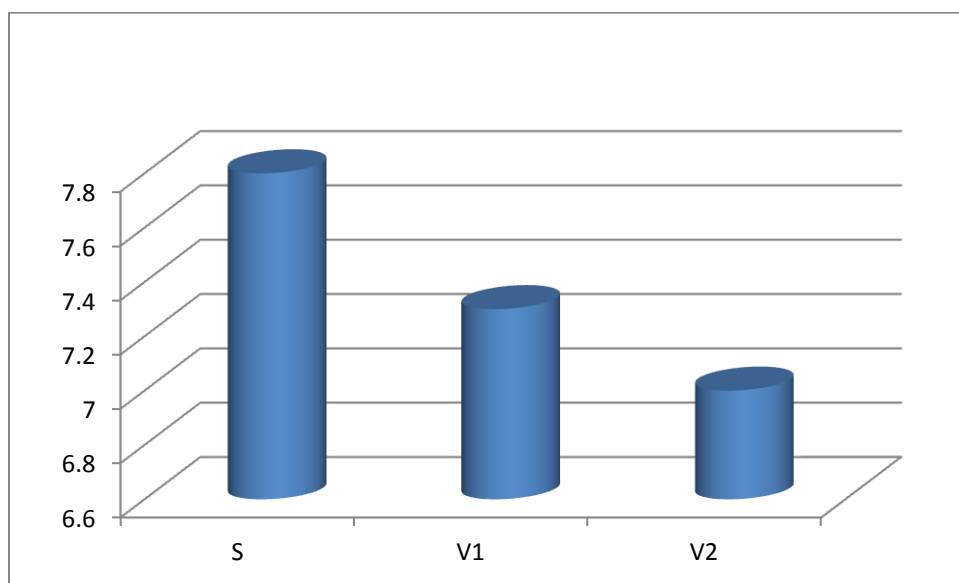
Nutrients	Aval Dosa	Aval Paniyaram	Aval Jeera Pepper Rice	Aval Upma	Aval Kesari	Aval Cutlet	Aval Pakoda	Aval Sweet
Carbohydrate(g)	25.24	44.30	40.32	44.6	37.42	27.73	18.2	53
Energy(k cal)	331	315	346	255	310	336	325	361
Protein(g)	5.05	3.03	4.00	5.04	4.09	3.2	5.3	4.0
Fat(g)	1.67	1.40	3.01	1.2	2.32	0.12	0.07	0.34
Dietary Fibre(g)	2.42	0.25	0.70	0.5	0.32	0.07	0.32	1.18
Iron(mg)	5.02	6.00	4.0	5.21	4.22	2.0	4.3	2.07
Calcium(mg)	20	30	10.0	15.6	32	20.1	25.2	30
Phosphorus(mg)	97.3	112	100	152	98	105	113	180

The nutritive value presented in the table is for the recipe standardized using 50 g of rice flakes. The carbohydrate level was high in paniyaram, upma, kesari and sweet aval which was 44.3, 44.6, 37.4 and 53 g respectively, when compared with the other recipes. All the recipes had calories in the range of 300-360 Kcal and this was reflected in the Glycemic Index levels also. The fat content varied depending on the recipe, with a little higher level in Kesari, Paniyaram and dosai where fat was added. As aval is rich in Iron, it is reflected in the recipes also where the iron level ranged from 4.2 mg to 60 mg. In the recipes calcium ranged from 10 mg to 30 mg.

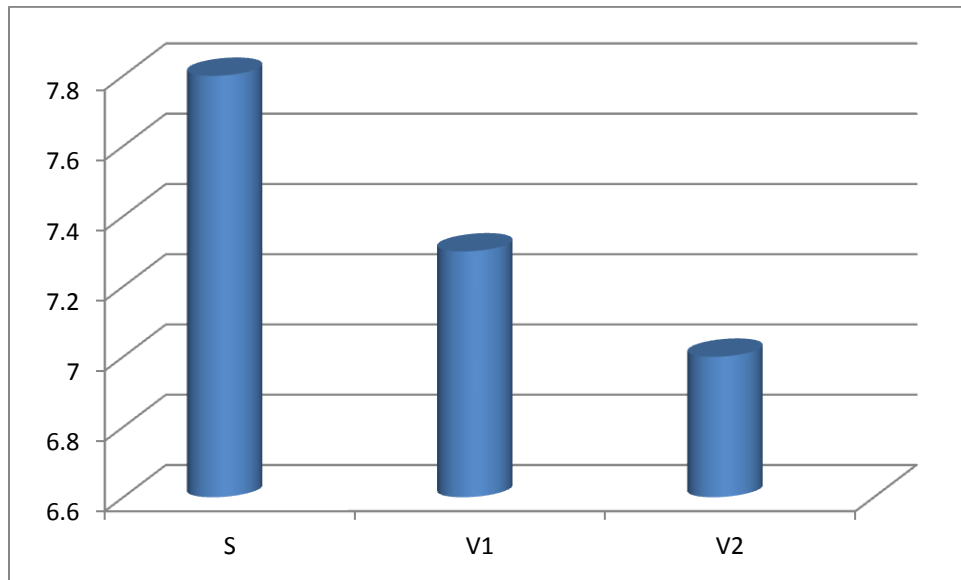
OVERALL ACCEPTABILITY OF DOSA



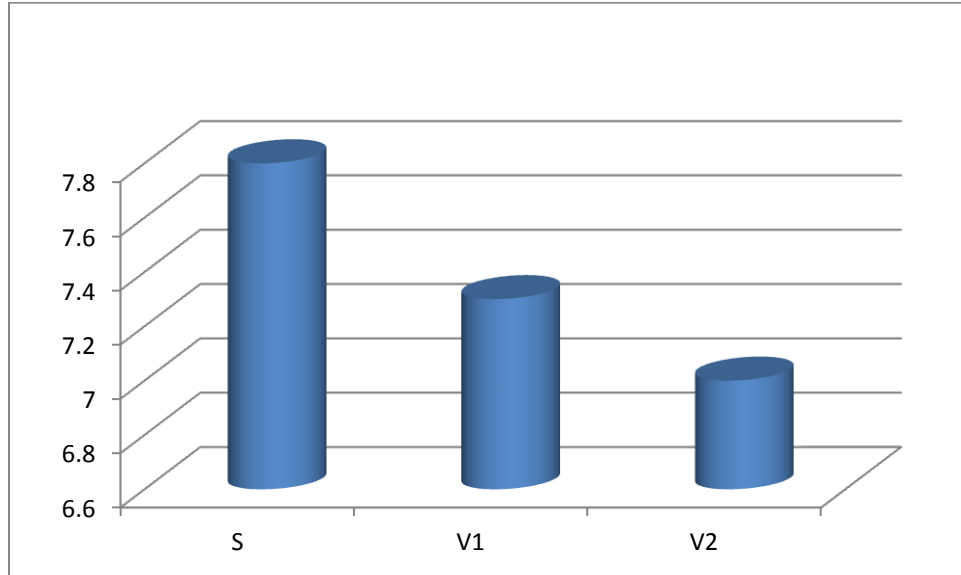
OVERALL ACCEPTABILITY OF PANIYARAM



OVERALL ACCEPTABILITY OF JEERA PEPPER RICE



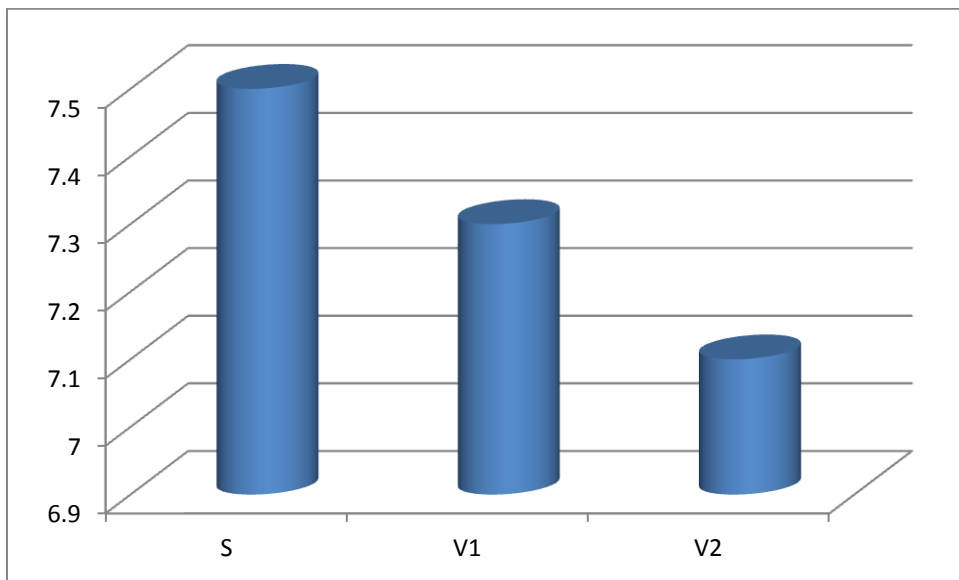
OVERALL ACCEPTABILITY OF UPMA



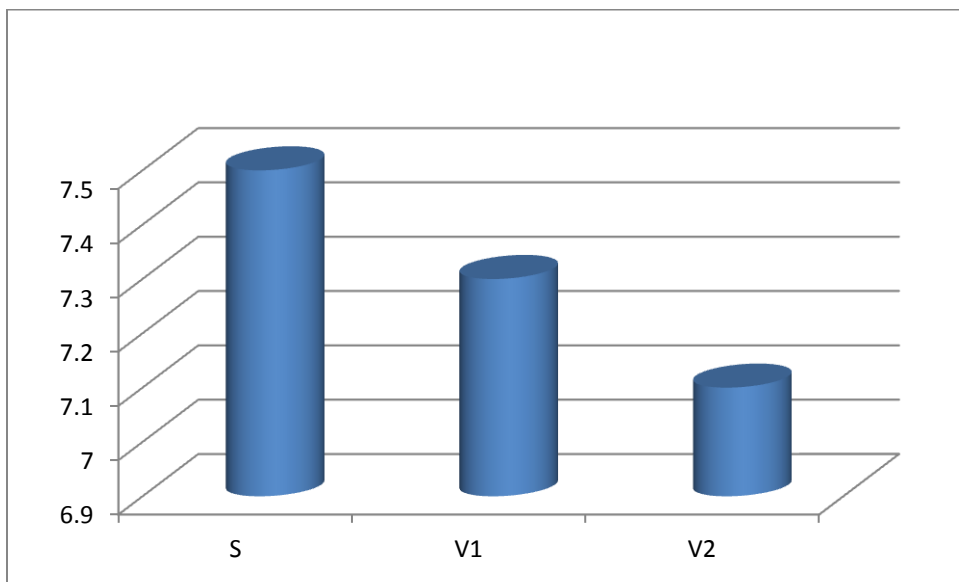
Figure

Overall acceptability of breakfast recipes

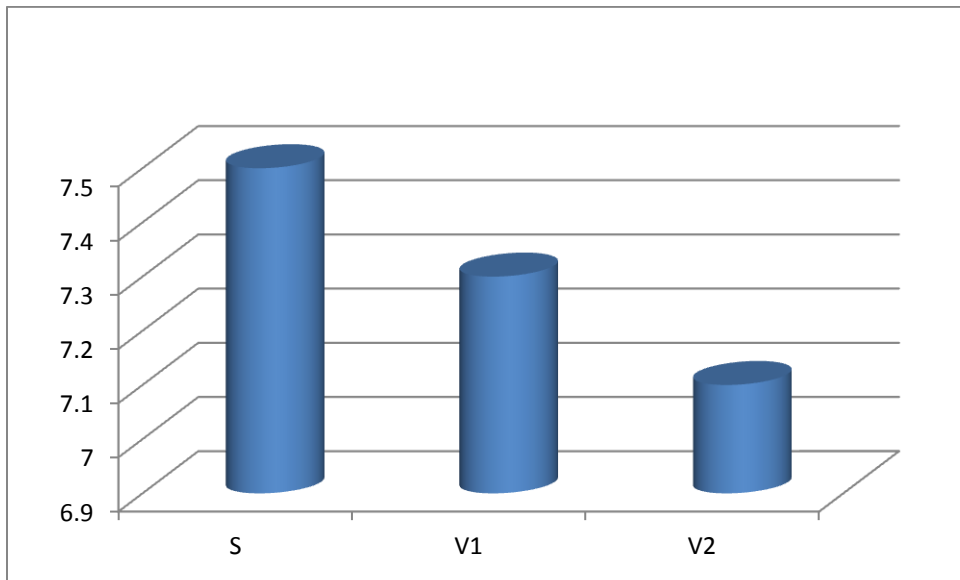
OVERALL ACCEPTABILITY OF CUTLET



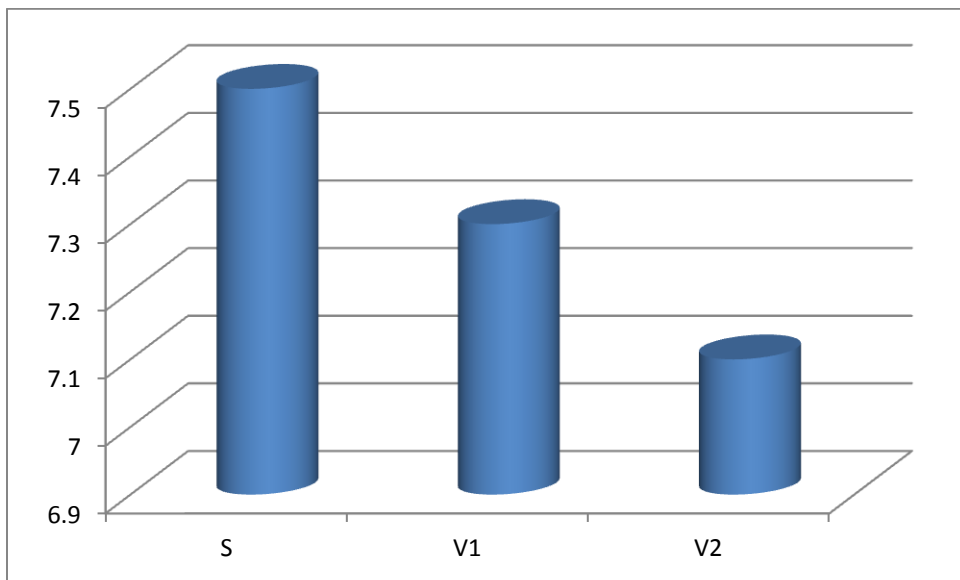
OVERALL ACCEPTABILITY OF PAKODA



OVERALL ACCEPTABILITY OF KESARI

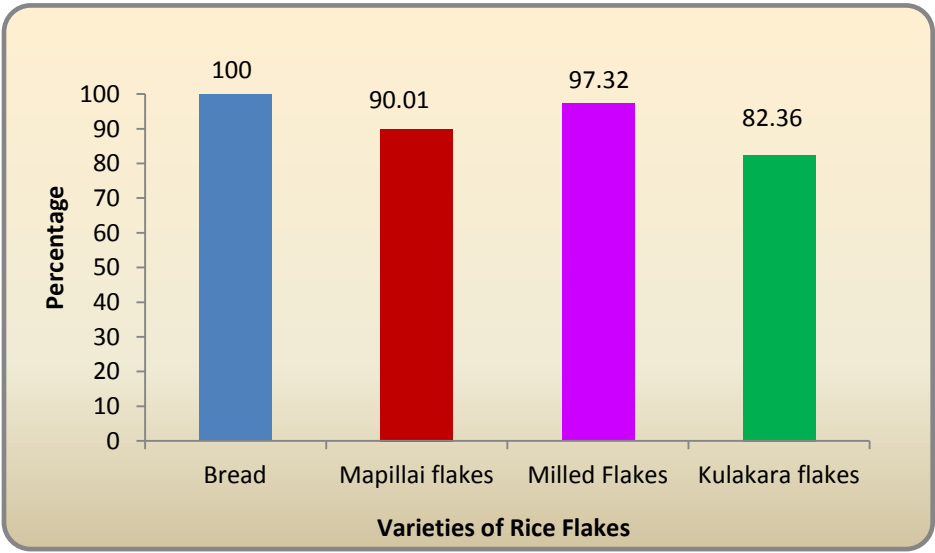


OVERALL ACCEPTABILITY OF SWEET POHA



Figure

Overall acceptability of snacks recipes



Figure

Glycemic index of rice flakes

V. SUMMARY AND CONCLUSION

Flaked rice (Avalakki, Poha), puffed or expanded rice (Puri, Murmura, Muri) and popped rice (Nel, Puri) are the important pre cooked rice products. Flaked rice is obtained after soaking, roasting and flaking processes of paddy to variable thickness. Flaked rice is having high dietary fiber, minerals and oryzanol content than milled rice and is mainly responsible for providing benefits of reduction in blood cholesterol, coronary heart diseases and celiac diseases (Shiv kumar *et al.*, 2017).

Roasting and flaking of paddy are responsible for partial gelatinization of the starch granule that gets ruptured even at low water absorption resulting in lower swelling power of roasted and flaked rice compared to brown rice. The flaked rice is easily digestible and serve as nutritionally rich traditional food item with improved nutritional attributes (Corree *et al.*, 2014).

Rice flakes are the most common breakfast cereal used all over the country round the year. Rice flakes is locally known by many names like aval, avalakki, poha, chivda and beaten rice, which are prepared from paddy and has been claimed as a good source of protein, fat and carbohydrate. And it is also one of the main breakfast items in the states of Maharashtra, Madhya Pradesh, Karnataka, Rajasthan and Gujarat.

Kulakara variety not only withstand soil salinity, it is also resistant to pests and diseases and provided an excellent solution to tsunami-affected farmers. . During this period, it was found that even *Kalanamak*, an indigenous variety from northern India known to perform well in saline soil, could also be cultivated in these areas. There are also references to the nutritional and therapeutic properties of indigenous varieties of paddy(Surekha *et al.*,2017) .

In the present study, recipes were prepared out of Mapillai samba rice flakes and kulakara flakes. The recipes prepared were Aval Kesari ,Aval Pakoda, Aval cutlet, Aval sweet, Aval Dosa, Aval Paniyaram, Aval upma,and Aval Pepper Jeera Rice, were evaluated for its acceptability by tasting panel comprising of 9 members.

The ability of a food item to raise the blood sugar is measured in terms of glycemic index. Glycemic index depends on the composition of food item, form of the food item –mashed, raw, boiled, cooking method, applied to the food, processing applied to the food source presence of anti nutrients like fibre, type of fibre-soluble or insoluble phytates, tannins, lecithins, alone or carbohydrate with fat, addition of salt and complex items(Sharma *et al.*, 2013).

Few foods, traditionally consumed by the Indian population, have been tested for their glycaemic response.(Dilawari et al 1981),Akhar et al.,1987 and Mani et al.,1990 have studied the glycaemic response to cereals and a few legumes and dals (dals are dehusked and split legumes). Further, information regarding the Glycemic Index of three types of rice flakes is scanty. Hence, the present study was planned to determine the GI that are important in the diet of Indians.

Hence, with this background the objectives of the present study was framed as follows:

- To determine the glycemic index of rice flakes.
- Development of recipes with rice flakes
- Calculate the nutritive value of developed recipes.
- Analyze the nutrient content in the rice flakes.
- Determine the glycemic index of milled rice flakes, kulakara and mapillai samba flakes.

The methodology pertaining to the study “ **Glycemic Index of Kulakara and Mapillai Samba Rice Flakes**” was carried out under the following headings:

- A. Selection of Ingredients
- B. Organoleptic Evaluation of the developed recipes out of different rice flakes
- C. Determination of the glycemic index of different rice flakes
- D. Nutrient Analysis of Rice Flakes
- E. Calculation of the nutritive value of developed recipes
- F. Statistical analysis and interpretation of data

Poha is considered to be a great meal option for diabetics as it promotes slow release of sugar into the blood stream. Carbohydrates are the main source of energy in a bowl of poha and mixed vegetables can be added to rice flakes to make it rich in vitamins, minerals, and fibre. Aval is considered to be great meal option for diabetics as it promotes slow release of sugar into the blood stream (www.allboutdiabetes.com).

Varieties of Rice Flakes

Mapillai Samba Rice Flakes

Mapillai samba is a native variety of rice grown in Tamilnadu, that is well suited to organic farming because it hardly demands little or no fertilizers or pesticides.

Mapillai Samba can be cooked as plain rice, ground into flour or made into idli, dosa, upma and pongal. Mapillai samba rice is a good source of iron and zinc. Iron contributes to the production of myoglobin and haemoglobin. It also contains proanthocyanins which help to reduce cholesterol.

Hedonic rating relates to pleasure or unpleasurable experiences. The hedonic rating test was used to measure the consumers acceptability of food products. One to four samples are served to the panelist at one session. The panelist were asked to rate the acceptability of the product on a scale ,using nine points ranging from like extremely to dislike extremely. Scales with different ranges and other experience phrases could also be used. The results were analyzed for preference with data from large untrained panels(*srilakshmi et al.,2011*).

The acceptability of the recipes was tested through organoleptic evaluation. The overall acceptability scores obtained through the organoleptic evaluation were analyzed statistically(*Powell et al., 2009*).

The score card(9 point Hedonic scale) was used for evaluating the attributes like color, flavor, taste, texture, and overall acceptability. The score card used for the organoleptic evaluation of prepared recipes.

Standard recipes were prepared out of mapillai samba, kullakara rice flakes and compared with the standard milled rice flakes. In breakfast recipes Aval Dosa, Paniyaram, Uppuma and Pepper Jeera rice was prepared. In snacks preparation Cutlet, Kesari, Pakoda and Sweet Aval was prepared.

The GI represents the rise in person's blood sugar level two hours after consumption of the food. The glycemic effects of foods depends on a number of factors, such as the type of carbohydrate, physical entrapment of the carbohydrate molecules within the food, fat and protein content of the food and organic acids or their salts in the meal.(www.glycemicindex.com)

Thirty subjects were selected for evaluating the glycemic index and they were between 30-35years of age. These 30 subjects were divided into three groups of 10 in each group. The subjects who had fasting blood glucose level of 80-90mg/dl, and who did not have any complications were selected. Three days before the test period all the subjects were instructed to avoid sweet preparations and steroid containing drugs. On the fourth day fasting blood glucose was estimated and then all of them were served white bread (70g) providing 50g of Carbohydrate for breakfast.

Blood samples were collected every half an hour for two hours. Again after a wash out period of one week the food intake of the subjects was controlled for three days as before. On the fourth day, the fasting blood was drawn to estimate fasting blood glucose and then they were served the milled, kulakara and mapillai samba flakes upma which was standardized. The recipe standardized was cooked and served to the subjects in a fixed test portion containing 50g digestible (available)carbohydrate. It was ascertained that the subjects did not leave any plate waste and took same length of time for consuming the breakfast served. The blood samples were collected at periodic intervals of 0,30,60,90&120 minutes. Blood glucose levels of all the sample were estimated.

Nutrient analysis refers to the process of determining the nutrient content of foods and food products. The process can be performed through a variety of certified methods. The following biochemical analysis were carried out to analyze the nutrient

content of the rice flakes. Ash, Moisture, Energy, Protein, Crude fiber, Iron, Phosphorus, Calcium and Vitamin C of the rice flakes was determined.

The data obtained for sensory attributes of the developed recipes with two variations was analyzed statistically and interpreted. The data was consolidated and tabulated in which mean, standard deviation, and ANOVA were computed.

The research design and protocol of the study was submitted for scrutinisation and approval to the Institutional Human Ethics Committee and Ethical Clearance approval was obtained. The Ref. No is

The results and discussion of the study entitled” **Glycemic Index of Mapillai and Kulakara flakes**” is presented under the following heads:

- A. Sensory evaluation of the developed recipes
- B. Nutrient content of rice flakes
- C. Determination of the glycemic index of the different rice flakes
- D. Calculation of the nutritive value of developed recipes

The overall acceptability of the three flakes namely milled, mapillai and kulakara more 7.0 ± 1.51 , 7.0 ± 1.31 and 7.0 ± 1.32 respectively, and there was not much difference in the dosa recipe among the three flakes.

The overall acceptability of milled flakes was highly acceptable with score of 7.8 ± 1.41 and the least scores was obtained for mapillai of 7.0 ± 1.27 .

The acceptability among the two flakes. But jeera rice prepared out of milled flakes had an overall acceptability of 7.2 ± 1.38

The overall acceptability of milled flakes has the highest score of 7.8 ± 1.45 and the least will appeared the score of 6.86 ± 1.25 in mapillai samba flakes .

The overall acceptability of milled flakes was highly acceptable with score of 8.1 ± 0.88 followed by mapillai and kulakara with scores of 7.6 ± 1.22 and 7.1 ± 1.49 .

The overall acceptability of pakoda prepared from milled flakes was highly acceptable with score of 7.6 ± 0.99 followed by kulakara and mapillai with scores of 7.3 ± 1.21 and 7.1 ± 1.30 respectively.

The overall acceptability of the three flakes namely milled, mapillai and kulakara were 7.8 ± 1.05 , 7.4 ± 1.19 and 7.2 ± 1.24 respectively and with regard to the overall acceptability, milled flakes scored the highest and was highly acceptable.

. The overall acceptability of the three flakes namely milled, mapillai and kulakara were 7.5 ± 1.25 , 7.3 ± 1.29 and 7.1 ± 1.34 respectively.

Nutrient content of food products are analyzed by qualitative and quantitative methods.

The standard procedures are used to analyze the carbohydrate, protein, fat, vitamins and minerals.

The quantity of crude fibre present was almost same (i.e) it ranged from 0.4-0.6g for all the different varieties of rice flakes. The energy content of the rice flakes was 339.20 for milled flakes, 335.60 for kulakara flakes and 230.10 for mapillai samba rice flakes. The amount of protein present in kulakara flakes is 7.22g, for mapillai samba flakes 8.7g and 0.1g for milled flakes. The fat content present in mapillai samba flakes was 0.78 is the highest value and the least amount of fat present in milled flakes was 0.1g.

The mean blood glucose values of the groups of subjects who were administered white bread and then the test recipes, were estimated every half an hour and the glycemic index was calculated.

With regard to kulakara the blood glucose level was 80.9 ± 7.32 , 121.2 ± 15.01 and 128.7 ± 19.44 , 112.5 ± 7.87 and 98.3 ± 8.89 for fasting, 30, 60, 90 and 120 mins. respectively. With regard to Mapillai flakes the blood glucose level was 80 ± 5.08 , 100.1 ± 15.86 , 135 ± 27.36 , 124.6 ± 27.3 and 98.3 ± 16.06 for fasting, 30, 60, 90, 120 mins respectively. With regard to Milled flakes the blood glucose level was 76.5 ± 6.21 , 100.1 ± 20.58 , 150.6 ± 18.25 , 104.5 ± 13.65 and 96.5 ± 8.27 for fasting, 30, 60, 90, 120 mins respectively.

With regard to bread the blood glucose level was 86.2 ± 4.89 , 117.5 ± 19.73 , 120.5 ± 14.36 , 113.6 ± 19.67 and 70.5 ± 15.57 for fasting, 30, 60, 90, 120 mins respectively.

Among the three rice flakes Kulakara rice flakes had the lowest GI of 84.3 when compared to the standard Milled which had high GI of 97.3. while Mapillai samba rice flakes had a GI of 90.0. Rice flakes prepared from the cereal rice has high GI, but compared to traditional variety, Mapillai and Kulakara rice flakes are having Low GI.

The nutritive value for the recipe standardized using 50 g of rice flakes is carbohydrate level was high in paniyaram, upma, kesari and sweet aval which was 44.3, 44.6, 37.4 and 53 g respectively, when compared with the other recipes. All the recipes had calories in the range of 300-360 Kcal and this was reflected in the Glycemic Index levels also. The fat content varied depending on the recipe, with a little higher level in Kesari, Paniyaram and dosai where fat was added. As aval is rich in Iron, it is reflected in the recipes also where the iron level ranged from 4.2 mg to 60 mg. In the recipes calcium ranged from 10 mg to 30 mg.

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ANNEXURE-II

INSTITUTIONAL HUMAN ETHICS COMMITTEE



Avinashilingam

Institute for Home Science and Higher Education for Women

University

(Estd. u/s 3 of UGC Act 1956)

Chairman

Dr. S. Ramalingam
Principal, PSG Institute
of Medical Sciences
& Research, Coimbatore

Member Secretary

Dr.S.Uma Mageshwari
Associate Professor,
Department of Food Service
Management & Dietetics

Members

Dr. S. Kowsalya
Dr.P.R.Padma
Mr. K.Arulmoli (Legal Expert)
Dr. N.S. Rohini
Dr.A. Saraswathy
Mrs. V. Mangayarkarasi
Dr.Subhashini K. Sripathi
Mrs. S. Radha Devi
Dr.G.Victoria Naomi
Dr. Judith Justin
Dr.AnithaSubash

19th March 2018

To
Ms. M.Nivethitha
Department of Food Science and Nutrition
Avinashilingam Institute for Home Science and
Higher Education for Women
Coimbatore – 641 043

Dear Nivethitha,

Ref: Your proposal No. IHEC/17-18/FSN/10 "Glycemic Index of
Kulakara and Mapillai Samba Rice Flakes" submitted for
approval of the IHEC on 14th December.

The Institutional Human Ethics Committee of our University hereby
grants approval to your research proposal No. IHEC/17-18/FSN/10
"Glycemic Index of Kulakara and Mapillai Samba Rice Flakes"
submitted by you. The Approval number for the same is AUW/
IHEC/FSN -17-18/XPD/10.

We wish you all the best in your research endeavours.

Regards,

S. Uma Mageshwari
Dr.S.Uma Mageshwari
Member Secretary



ANNEXURE-II
SNACKS RECIPES

Aval kesari

Ingredients:

Aval-20g

Sugar-30g

Ghee-10ml

Cardamom-2pods

Water-50ml

Cashewnuts-5

Orange food color-a drop

Method:

- Boil a cup of water in a pan
- Then add the ground poha and keep stirring finely.
- Then add a pinch of kesari powder and mix it well.
- When it becomes thick, add sugar and 10ml of ghee.
- Then heat a 5ml of ghee and fry cashewnuts till it becomes golden brown.
- Finally add cardamom powder and cashew in the kesari in a correct consistency.

Aval Pakoda

Ingredients

Aval-50g

Big Onion-20g

Red chilli powder-5g

Green chilli-3nos

Corriander leaves chopped

Oil-20ml

Salt-to taste

Curryleaves-a pinch

Method

1.In a bowl add poha, salt, red chilli powder, coriander leaves, curry leaves and chopped onions and mix well.

2. Keep the mixture as such to set for 30 minutes.

3.Water should not be added to the mixture as the moisture in the onions and curry leaves is sufficient.

4.Then heat the oil in a kadai and deep fry making into small pakoda balls. in batches and fry till it turns golden brown.

Ingredients

Aval-10g

Potato-50g

Carrot-20g

Beans-20g

Corriander leaveschopped-10g

Garam masala powder-1/2 tsp

Turmeric powder-1/2 tsp

Red chilli powder -1/2tsp

Oil-5ml

Big onion-10g

Salt –to taste

Method

- 1.Take poha and rinse it with water and soak for 3-5mins.
- 2.Then boil the potato and mash it well.
- 3.Add the poha.
- 4.Heat a kadai,add oil and heat.
- 5.To the oil add chopped onions,and sauté till it gets cooked.
- 6.Finally add the poha,add turmeric powder,red chili powder,garam masala powder.
- 7.Mix everything till it becomes brown colour.
- 8.In the poha keep all the vegetables fried and then stuffed.Then heat a tava add oil,keep the poha on tava,till it becomes golden colour.

Aval Sweet

Ingredients

Aval-50g

Grated coconut -20g

Sugar-20g

Cardamom powder-5g

Dates-10g

Cashew-10g

Roasted Bengal gram powder-10g

Warm water-3-4tsp

Raisins-10g

Method

- 1.Take the aval in a large mixing bowl and add 3-4 tsp of warm water.
- 2.Mix the grated coconut, sugar or jiggery ,cardamom powder and chopped dry nuts and fruits and also Bengal gram powder.
- 3.To this mixture add aval and mix well and rest for5mins,so that the flavor is blended well.

Breakfast Recipes

Aval Dosa

Ingredients

Aval-50g

Rice-50g

Blackgramdhal-30g

Salt-to taste

Water-50ml

Method

- 1.Soak the rice in the water for 1 hour.
- 2.Soak the black gram dhal for ½ hour.
- 3.Soak poha for 10mins and grind separately,mix all the ground ingredients
- 4.Then grind rice,black gram dhal separately

5.Add salt to the mixture and then add water to get dosa consistency

6.In a tava,pour the batter spread it and add oil and cook

7.Once cooked turn over the dosa till the other side is also cooked and gets a golden brown colour.

Aval Upma

Ingredients

Aval-50g

Oil-5ml

Turmeric powder-2g

Red chilli-4nos

Curry leaves-2g

Corriander leaves-2g

Bengal gram dhal-10g

Salt-to taste

Mustard seeds-2g

Method

1.Soak the poha, for 5-10mins and drain the water.

2.Heat a pan, add oil, then add mustard seeds and spliiter onions, then add Bengal gram dhal, curry leaves and coriander leaves and red chilli till it is fried well.

3.Then add the turmeric powder into the fried mixture.

4.Then add the soaked and drained poha into it and mix it well.

5.Finally add salt mix well and serve hot.

Aval Millagu Jeera Rice

Ingredients

Aval-50g

Curry leaves-5g

Black pepper-10g

Cumin seeds-2g

Mustard seeds-1g

Oil-2ml

Salt –to taste

Red chilli-4nos

Onion-2g

Method

1.Wash the poha,and drain the water.

2.In a pan add the oil then mustard seeds, cumin seeds ,curry leaves, red chilli should be deeply fried.

3.Then add the poha into the mixture

4.Add salt and mix it to the mixture.

5.In the last, add finely powdered black peeper into poha rice and serve with chutney.

Sweet Paniyaram

Ingredients

Raw rice-50g

Aval-50g

Jaggery-powdered

Cardamom powder-2g

Method

1. Soak the rice and flakes separately for an hour .Don't add too much water.
2. Drain the water from rice and flakes. Then grind the rice flakes in a mixer without adding water.
3. Next add powdered jaggery and cardamom to the rice flakes batter and grain again.
4. Then heat the pan, add little ghee in the pan, then pour a batter in each paniyaram mould and add oil till it gets cooked.
5. Cook on both sides in a low of flam and serve hot.

SCORE CARD FOR SENSORY EVALUATION

Name:

Class:

Date:

Score card based on nine point hedonic scale

9	Like extremely
8	Like very much
7	Like moderately
6	Like slightly
5	Neither like nor dislike
4	Dislike slightly
3	Dislike moderately
2	Dislike very much
1	Dislike extremely

Variation	Appearance	Colour	Flavour	Texture	Taste	Overall acceptability
Milled Flakes(S)						
Kulakara Flakes(V1)						
Mapillai Samba Flakes(V2)						

ANNEXURE-IV

DETERMINATION OF ASH CONTENT

AIM:

To determine the ash content of the given food sample.

APPARATUS:

Porcelain crucible, Clay pipe triangle, Muffle furnace, Desiccator, Weighting balance, asbestos sheet.

PROCEDURE:

About 5g of the sample was weighed accurately into a tarred platinum or porcelain crucible (which had previously been heated to about 600°C and cooled). The crucible was then placed on a clay pipe triangle and heated over a low flame till all the material was completely charred, followed by heating in a muffle furnace for about 3-5 hours, at 600°C. The crucible was then cooled in a desiccator and weighed. To ensure completeness of ashing the crucible was again heated in a muffle furnace for half an hour, cooled and weighed. This was repeated till two consecutive weights were the same and the ash was almost white or grayish white in colour.

DETERMINATION OF MOISTURE CONTENT

AIM:

To determine the moisture content of the given food sample and calculate the percentage of moisture content.

APPARATUS:

Low flat-bottomed dishes, asbestos, analytical balance, weight box, tongs, desiccators and electric oven.

PROCEDURE:

Heated a pair of weighting bottles at 100°C in an oven labeled A and B. Placed on an asbestos sheet for 2 minutes and then transferred them to a desiccator where they remained for half an hour. Recorded their weights in an analytical balance. Repeated this procedure till two successive weights obtained were constant (with maximum difference of 0.0002g). Weighed definite amounts of food material (2g) in each dish and placed in an electric oven thermostatically controlled at 100-105°C. Heated for a stipulated time (2 hours), cooled in a desiccator for half an hour and weighed. This was also weighed till successive weighings showed no further loss.

ESTIMATION OF NITROGEN

AIM:

To determine the amount of nitrogen present in the given sample.

REAGENTS:

1. N/70 Sulphuric acid
2. 40% Sodium Hydroxide
3. 2% Boric acid (in warm water)
4. Digestion mixture:A mixture of copper sulphate and potassium sulphate in the ratio of 2:98
5. Concentrated Sulphuric acid
6. Mozazaga indicator: A mixture of bromocresol green and methyl red indicator in 95% alcohol in the ratio of 4:1 (80mg and 20 mg in 100 ml alcohol).

PROCEDURE:

0.5 g of the sample was taken into the digestion flask.To this added 15ml of concentrated sulphuric acid and a pinch of digestion mixture as a catalyst.Kept at boiling gently over a heating mantle.After digestion,the flask was cooled and the contents were transferred to a 100ml standard flask and made upto the mark with distilled water.The whole apparatus was washed with distilled water and allowed to back suck.10ml of boric acid was taken in a conical flask.A drop of indicator was well below the liquid.5ml of the diagedted blank was added into the distillation chamber through the funnel.Then added 10ml of 40%NaOH.Washed the funnel with 2 to 3ml of distilled water.Closed the tap and steam was generated.Steam entered the distillation chamber and drove all the ammonia which is inturn absorbed by boric acid.Solution was pinkish white in colour,turned blue.steam was passed for 5 min and then the conical flask was lowered and the tip of the condensor washed.The boric acid solution containing the liberated ammonia was titrated against N/70 H_2SO_4 .The end point was the appearance of pale permanent pink colour.Between each estimation,the apparatus was washed.The experiment was repeated to get concordant value

DETERMINATION OF FIBRE CONTENT

AIM:

To determine the fiber content of the given food sample.

APPARATUS:

Weighing balance, beaker, glass rod, funnel, mulin cloth, burner and wire gauze.

REAGENTS:

- ❖ 0.255N Sulphuric acid: 0.9 ml of sulphuric acid in 99.1 ml water.
- ❖ 0.313N Sodium hydroxide: 0.8g Sodium hydroxide in 99.2ml water.
- ❖ Ether.
- ❖ Alcohol.

PROCEDURE:

5g of the sample was weighed into a 500ml beaker and 200ml of boiling 0.255N sulphuric acid was added. The mixture was boiled for 30 minutes, keeping the volume constant by adding water at frequent intervals (a glass rod inserted in the beaker helps smooth stirring and boiling). At the end of the period, the mixture was filtered through a muslin cloth and the residue was washed with hot water till free from acid. The mixture was then transferred to a beaker containing 200ml of boiling 0.313N sodium hydroxide. After boiling for 30 minutes (keeping the volume constant as before) the mixture was filtered through a muslin cloth. The residue was washed with hot water till free from alkali followed by washing with some alcohol and ether. It was then transferred into a crucible, dried overnight at 80-100°C and weighed. The crucible was heated in a muffle furnace at 600°C for 2-3 hours. Cooled and weighed again. The difference in the weight represents the weight of the fibre.

ESTIMATION OF IRON

AIM:

To estimate the amount of iron present in 100g of the given food sample.

APPARATUS:

Volumetric flask, test tubes, klett, pipette.

REAGENTS:

1. Stock iron solution: Dissolved 0.0702g (70.2mg) of reagent grade crystalline ferrous ammonium sulphate (Mohr's salt) in 100 ml of water.
2. Working standard: Prepared a working standard solution in a 100ml volumetric flask by adding 10ml of the stock solution and diluted to the mark with distilled water.
3. Saturated potassium persulphate solution: Shook 7 to 8g of reagent grade potassium persulphate in 100ml of the water in a glass stoppered flask. The undissolved crystals settled to the bottom and compensated the loss by decomposition.
4. 3N Potassium thiocyanate: Dissolved 146g of reagent grade potassium thiocyanate in water and diluted to 500ml with water. Filtered if turbid. Added 20ml of pure acetone to improve the keeping quality. Deterioration will be evident from the rapid fermentation of a yellow colour in the blank. Stored in brown bottles.

PROCEDURE:

2g of the sample was ashed by ignition. When ashing has been completed 5ml of hydrochloric acid was added and made up to 100 ml in a volumetric flask. Took different aliquots of the standard solution (1ml – 5ml) corresponding to 10-50 gamma in a series of test tubes. 2ml of the unknown solution was taken in the test tube. Added 1ml of 30% H_2SO_4 , 1ml of potassium persulphate and 1.5ml of potassium thiocyanate to all test tubes. This was made up to 10ml with water. A blank was prepared by adding the reagents excepts the standard or the unknown solution. Allowed the colour to develop for 20 minutes and intensity was read at 530-540 μ filter in the colorimeter.

ESTIMATION OF PHOSPHORUS

AIM:

To estimate the amount of phosphorus present in the given sample.

APPARATUS:

Measuring cylinder, Klett, Test tubes, Pipette.

REAGENTS:

1. Molybdate solution No1: Dissolved 25g of reagent grade ammonium molybdate in about 200ml of water. In one litre volumetric flask 500ml of 10N sulphuric acid was added. The molybdate solution was added and was diluted with water to one litre. This solution is stable indefinitely.
2. Molybdate solution No.11: Dissolved 25g of reagent grade ammonium molybdate in about 200ml of water. In one litre volumetric flask, 300ml of 10N sulphuric acid was added and was diluted with water to one litre. This solution is stable indefinitely.
3. ANSA: 195ml of 15% sodium bisulphate solution was placed in a glass stoppered Cylinder. 0.5g of 1,2,4 ANSA (amino naphthol sulphonic acid) was added followed by 5ml of 20% sodium sulphite. Put the stopper and shook until the powder was dissolved. If the solution was not complete, added more sodium sulphite. 1 ml at a time with shaking but avoided excess. This solution was transferred to a brown glass bottle and stored in the refrigerator.
4. Stock standard phosphorus solution: 35.1 mg of pure potassium di-hydrogen phosphate is weighed and dissolved in water. Added 10ml of 10N sulphuric acid and made up to 100ml with water. 5ml of the solution contains 0.4mg of phosphorus. Prepared a working standard containing 8 gamma of phosphorus in 1ml of the solution by making up 5ml of the standard solution to 50ml with water.

PROCEDURE:

1 ml of the diluted ash (10ml of ash solution is diluted into 100ml) solution was taken in two test tubes. 1ml of molybdate II and 0.4 ml of 1,2,4 Amino naphthol sulphonic acid were added and the volume was made up to 10ml with distilled water. To 1ml, 2ml, 3ml, 4ml and 5ml of standard solution. 1ml of molybdate I

solution and 0.4ml of ANSA were added and made upto 10ml. All the tubes containing 10ml of the solution were mixed well and allowed to stand for 15 minutes. Simultaneously, a blank was prepared by mixing 8.6ml of water, 1ml of molybdate II and 0.4ml of ANSA. The colour developed was read in the colorimeter using red filter of wavelength 660 millimicrons.

GLYCEMIC INDEX VALUES

MAPILLAI SAMBA FLAKES

S.NO	NAME	Fasting	30mins	60	90	120
1.	Subhamathi	82	128	126	130	87
2.	Abirami.H	85	161	195	187	133
3.	Oviya.M	90	148	124	116	96
4.	Subhulakshmi.V	72	150	138	116	78
5.	Parimaladevi.P	83	151	153	99	91
6.	Pooja.A	82	124	126	104	94
7.	Sasikala	80	158	167	155	81
8.	Rajeswari	76	132	103	108	107
9.	Geetha	78	117	120	112	109
10.	Kavitha	77	125	118	110	102
		81	140.1	137.9	124.8	98.3

MILLED FLAKES

S.NO	NAME	Fasting	30mins	60mins	90mins	120mins
1.	Revathi	76	145	141	102	95
2.	Vimala	75	165	151	123	100
3.	Sudha.M	73	135	119	123	106
4.	Bebin.M	81	136	100	101	88
5.	Manjula.V	80	121	112	115	109
6.	Priya	94	123	106	106	111
7.	Prabhavathi.D	93	99	121	109	105
8.	Geetha.J	75	100	125	118	104
9.	Pooja	76	136	125	116	112
10.	Savitha.R	86	128	112	118	116
		80.9	128.8	120.2	113.1	104.6

KULAKARA FLAKES

S.NO	NAME	Fasting	30mins	60mins	90mins	120mins
1.	Revathi	76	140	141	102	90
2.	Vimala	74	164	151	123	100
3.	Sudha	73	134	118	123	106
4.	Bebin	81	135	101	101	88
5.	Manjula	80	121	110	115	108
6.	Priya	94	122	102	103	110
7.	Prabhavathi	92	97	120	109	102
8.	Geetha	75	100	120	115	102
9.	Pooja	76	135	125	116	112
10.	Suvitha.R	80	128	112	118	115
		80.9	121.2	128.7	110.0	98.0