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Organoleptic evaluation and assessment of glycemic index of formulated low GI mix and recipes for type II diabetes

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Abstract
Diabetes mellitus is very common now a day, small modification in the diet can helps to controls high blood sugar levels. This study delivers the importance of fibre by adding whole grain, millets with pulses to formulate a mix for type II diabetes. The objective of the study is to formulate a low glycemic index mix of three variations by using roasting processing then evaluate organoleptic and their glycemic index checked. The mix-I variations were selected as they have high score of acceptability (4.40) and low glycemic index value (GI value- 51.94± 1.60) compare to other two mixes. From Mix-I five recipes such as Adai, Chapathi, Dosa, Dhokla and Idiyappam were formulated and their sensory and glycemic index and glycemic load were checked. The overall acceptability for Adai was 4.4±0.81, Chapathi 4.9±0.30, Dhokla 3.6±0.67, Dosa 3.6±0.81 and for Idiyappam 3.6±0.67. The mean GI and GL value for Adai (GI 46.53±2.34, GL 18.68), Chapathi (GI 50.32±1.78, GL 20.20), Dosa (GI 45.60±2.58, GL 18.30), Dhokla (GI 40.99±1.47, GL 16.45) and for Idiyappam (GI 50.32±1.78, GL 20.02), respectively.

Keywords: diabetes mellitus, millets, glycemic index, glycemic load, organoleptic evaluation, roasting, recipes

Introduction

Diabetes develops in every ten seconds in two individual world-wide and two individual die of diabetes related conditions every 10 seconds according to International Diabetes Federation, 2007. In India the increasing trend of epidemiological transition is taking place in most of the states with decrease in communicable disease and increase in chronic non- communicable diseases that has resulted in more than 50 % of total death in India (Thangappan, 2010). In recent years, People are dependent on fast foods which contain minimal amount of dietary fibre. The American Diabetic association 2007 recommends that individuals with diabetes mellitus increase the amount of dietary fibre in their diet in order to reduce blood sugar levels. Millets have been reported to be rich sources of dietary fibre which is present in the soluble and insoluble forms and is proven to play an important role in the prevention of metabolic diseases like diabetes mellitus, due to its low glycemic index and antioxidant activity (Hathan and Prasanna, 2011) [8].

Pearl millets *(Pennisetum glaucum*) and Barnyard millet *(Echinochloa frumentacaea)* have been reported to be beneficial for type 2 diabetes mellitus especially the dehulled varieties as the glycemic index for dehulled millets is 50.0 and heat treated was 41.0 (Ugare *et, al* 2011) [6]. Bengal Gram (*Cicer Arietinum*) Each cup of kala chana provides 13 g of dietary fibre and yellow maize 8.1 g of fibre. A high-fibre diet lowers cholesterol levels and helps regulate blood sugar levels in individuals with diabetes (Natalia Stein, 2018, United Nation Food and Agriculture Organization, 2017)) [9]. Cowpea (*Vigna Unguiculata)* The low glycemic index of cowpea is attributed to the action of resistant starch and dietary fibre which attenuate insulin responses and reduce hunger (Oboh, 2010) [5].

Diet based on carbohydrate food that are more slowly digestible, absorbed and metabolized (low GI diet) have been associated with a reduced risk of type II diabetes (Pankaj Modi, 2011) [4].

The glycemic index of a food is defined as the incremental area under the two-hour blood glucose response curve (AUC) following a 12-hour fast and ingestion of a food with a certain quantity of available carbohydrate (usually 50 g). The AUC of the test food is divided by the AUC of the standard (either glucose or white bread, giving two different definitions) and multiplied by 100. The average GI value is calculated from data collected in 10 human subjects. Both the standard and test food must contain an equal amount of available carbohydrate. The result gives a relative ranking for each tested food (Glycemic Research Institute, 2018) [10].

So, the present study is to formulate a low glycemic index mix and different recipes from the mix for type II diabetes with the following objectives:

Objectives

The objective of the study is

- To formulate low glycemic index mix
- To formulate different recipes from the selected low GI mix
- To evaluate organoleptic and glycemic index of the formulated recipes

Methodology

Selection and Procurement of Raw Materials

The raw materials selected for the study are whole wheat, pearl millets, barnyard millets, yellow maize, bengal gram and cowpea. The above ingredients are selected for product development because they are high in fibre and possess low glycemic index values. All the ingredients like whole wheat,

yellow maize, pearl millet, barnyard millet, bengal gram and cowpea are of grade-1 quality have been purchased from the markets of Coimbatore (Kalapatti). The grains have been hand sorted to remove all the dirt and foreign materials. Grains were subjected to processing such as sorting, cleaning, and grading before being finally processed to further steps.

Processing of Raw Materials

Food processing is the transformation of raw materials, by physical or chemical means into food, or of food into other forms. It is widely accepted because it is a simple and inexpensive way of traditional processing technique and is an effective method of achieving desirable changes in the composition of millets, pulses and grains.

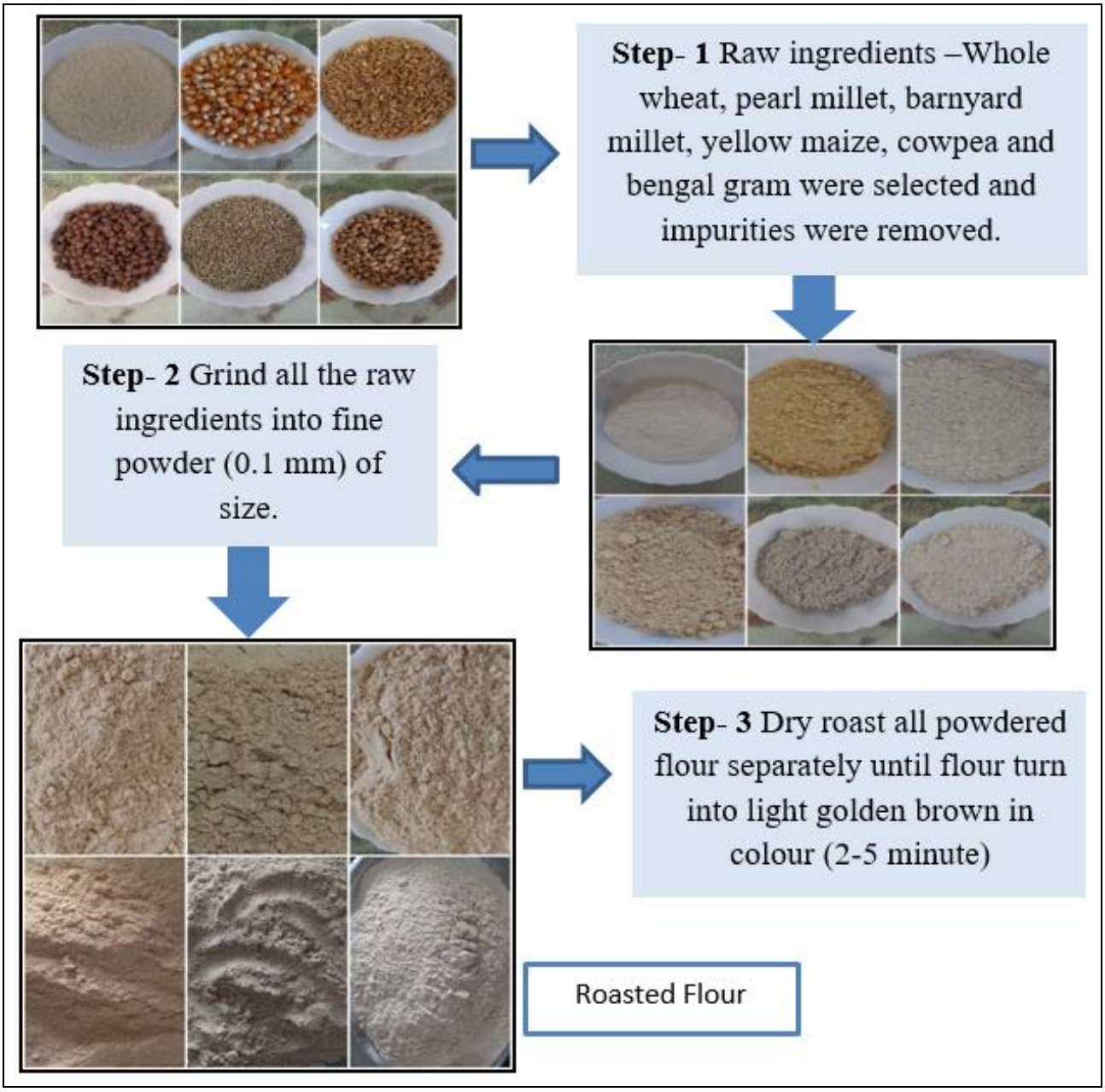
For this study, the processing roasting was selected

Roasting

All raw ingredients were cleaned for residue, stones and other impurities. These were then separately ground to a fine powder (0.1 mm) of size in a flour mill Coimbatore, After that, all flour was separately dry roasted in a pan at a low flame till the flour turned into light golden brown in colour. The quantity of the ingredients after processing the yield will be noted. The roasted flour timing is given in the Table-I

Table 1: The Time Taken for Roasting Flour

Flour	Quantity-Gms	Timing- Minutes
Whole Wheat	1000	5
Yellow Maize	1000	4.5
Barnyard Millet	1000	4.0
Pearl Millet	1000	4.5
Bengal Gram	500	2.5
Cowpea	500	2.0



Standardisation of mix

Plate I: The Processing Flow Chart for Roasted Mix Flour

Table 2: Standardization of Roasted Mix Flour

Ingredients	*RM I (g)	*RM II (g)	*RM III (g)
Whole wheat flour	500	500	500
Yellow maize flour	100	200	100
Pearl Millet	100	100	200
Barnyard millet	200	100	100
Bengal gram flour	50	50	50
Cowpea flour	50	50	50

*RM- Roasted Mix

Preparation of Pasta by Formulated Mix

Pasta is chosen as the product to be prepared for each of the variations above.

Preparation of Pasta

The Pasta was prepared as per the three combinations of wheat, pearl millet, barnyard millets, yellow maize, bengal gram and cowpea in prescribed proportions in roasted flour. The weighed quantities of all the ingredients was taken together and then weighed amount of 1 kg of all roasted flour of different variations separately were feed into pasta making machine (Dolly Mini P3) the kneading operation was carried out for 30 minutes by slowing add the 200-220 ml of warm water. The roasted flour was extruded through the 10 mm diameter of the die into a rotini (Spiral) shape and cut into 4 cm lengths using a cutter attached to the pasta extruder. Depending on the shape of the final product, the cutter speed was adjusted to the optimal level (3 to 12 rpm). The extruded pasta was collected in a tray and dried at room temperature (27-28 °C) and then sundried for 3-4 days until the moisture content is reduced. Check the dried pasta by pressing it by hand if it is hard and crisp it means it is fully dried. The extruded pasta was then stored under ambient conditions (25-35º C) in airtight container at room temperature for further analysis. The flow chart of preparation of roasted mix flour pasta is given in Plate- III

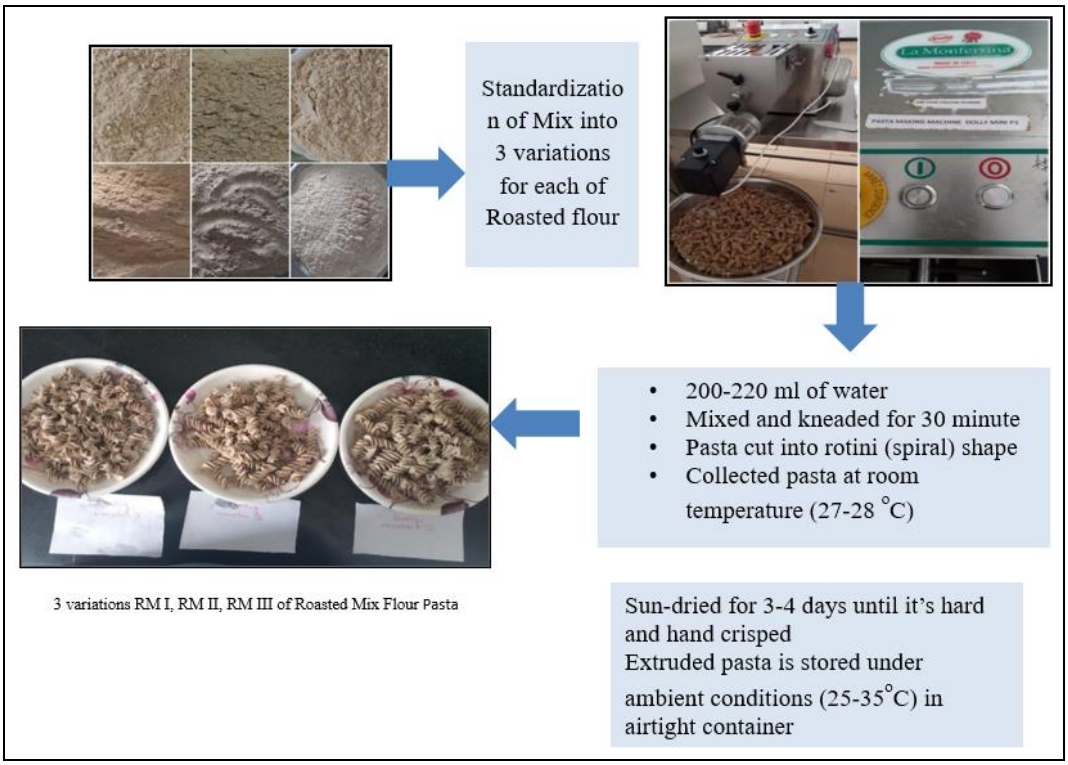


Plate II: Flow Chart of Preparation of Roasted Mix Flour Pasta

Organoleptic Evaluation of Pasta

Besides any food having high nutritional value, it is important that it must be acceptable to people by means of its good colour, flavour, taste and texture. When a food fulfils all these qualities positively, it becomes the most acceptable food product by consumer.

Cooking of Pasta

The three variation of formulated pasta by using roasted flour was taken for the preparation of cooking. Take 250 ml of water, boil it to 100ºc and then add 2 gms of salt and 25 g of pasta. Cook it for 5-6 minutes until the central core of pasta get disappeared. The pasta was subsequently drained using a stainless-steel sieve. The pasta was then served to the participants for organoleptic evaluation. The cooked pasta of three variations of each of roasted mixes flour is given in the Plate- III

Plate III: Three Variations of Roasted Pasta

Hence, the developed pasta of three variations was sensory evaluated by a panel of 30 subjects (male and female with their age between 20-40 yrs.) comprising of semi-trained panellist faculty and students of the Department of Food Science and Nutrition, Dr N.G.P Arts and Science College, Coimbatore for the sensory attributes like appearance, colour, texture, flavour and overall acceptability by using

score card. *After organoleptic evaluation, all three variations of pasta were subjected for the evaluation of glycemic index and glycemic load.*

Phase- 2

Evaluation of Glycemic Index and Glycemic Load

Ethical Approval

The study protocol was reviewed and approved by the Institutional Review Board under the approval number DAIRB_ TVL_21_05 having been approved by Dr Agarwal's Eye Hospital (Institutional Review Board), No-10 Bypass Road, Vannarpettai Tirunelveli 627003

Eligibility Criteria for Participation in the Study

30 normal subjects of the age group of 18-24 yrs. both males and females were chosen, having a height between 145-175 cm, weight between 45-75 kg and BMI between 18-24 kg / m² were randomly selected from Dr NGP Arts and Science College. The subjects were given general instruction to avoid feasts, heavy meals, fasting, medication and any form of physical exertion during the experimental study.

Inclusion Criteria

- All participated subjects must be healthy male or females, non- pregnant, non- lactating women.
- They should not be suffering from any chronic diseases.
- They do not have any food allergy or food intolerance.
- They should not be on any medications that affects glucose tolerance test (Excluding oral contraceptives)

Exclusion Criteria

- Age should not be less than 20 years and greater than 60 years old.
- Known history of diabetes mellitus or on insulin to treat diabetes and related conditions.
- Participants using any medication like steroids, protease inhibitors or antipsychotics etc. that would interfere with the digestion and absorption of nutrients.
- Participants with any known history of hepatitis, heart and renal disease, AIDs or any other serious complications that may interfere with glucose metabolism.

Consent Form

Potential participants were given an overview of the purpose of the research and the procedure of the test. All willing participants were asked to fill it and sign the consent form prior to the blood test.

Reference Food

Glucose powder (Glucon D, India) was purchased from a local pharmacy in Nehru Nagar, Coimbatore and used as a standard/reference food for this study. Fifty grams (50g) of glucose was measured using a kitchen scale (Health Sense India Model No- Ks-33) and diluted into 250 ml of water.

Test Food

80g of uncooked pasta from roasted mix flour which contain 50g of carbohydrate to be cooked and used as a test food.

Estimation of Glycemic Index and Glycemic Load

To calculate Glycemic Index and Glycemic Load, 10 non-diabetic subjects are selected. Day one, the blood sugar levels after 12 hr. of overnight fasting was recorded. To check the Glycemic index of the developed pasta of each three variations of roasting was estimated through a scientific approach to determining the glucose response in healthy subjects through the meal tolerance test. The experiments were conducted in the Department of Food Science and Nutrition, Dr N.G.P Arts and Science College, Coimbatore.

10 healthy subjects were chosen and all the subjects were informed beforehand about the experiment and subjects were asked not to smoke, consume alcohol or undertake any vigorous physical activity and their voluntary consents were taken before conducting the experiment. On the first day 50 g of glucose (glucose monohydrate) dissolved in 200 ml water was used as a reference food. Glucon D (glucose powder) was purchased from a local pharmacy shop in Nehru Nagar, Coimbatore were given to the participants and their blood glucose levels were checked at the interval of 0, 30, 60, 90, 120 and 150 mins by using glucometer. The kit contains lancets (fine needles), a pen, test strips and a glucometer). The next day, the same steps were repeated for the same subjects, the subjects were made to eat the boiled pasta containing 50g of carbohydrates (i.e., 80g of uncooked pasta). The blood glucose levels were checked at the interval of 0, 30, 60, 90, 120 and 150 mins using a glucometer.

Calculation of Glycemic Index and Glycemic Load

The glycemic index is calculated using Incremental Area under the Curve (IAUC) of the blood glucose response curve. The area under the curve is calculated by the formula:

$$L = \frac{\Delta 30t}{2} + \Delta 60t + \frac{(\Delta 30 - \Delta 60)t}{2} + \Delta 90t + \frac{(\Delta 60 - \Delta 90)t}{2} + \Delta 120t + \frac{(\Delta 90 - \Delta 120)t}{2} + \Delta 150t + \frac{(\Delta 120 - \Delta 150)t}{2}$$

Note

L = Incremental Area under the Curve

T = Time interval of blood taking (30 min)

Δ30 = the blood difference of glucose level 30 min after fasting

Δ60 = the blood difference of glucose level 60 min after fasting

Δ90 = the blood difference of glucose level 90 min after fasting

Δ120 = the blood difference of glucose level 120 min after fasting

Δ150 = the blood difference of glucose level 150 min after fasting

$$Glycemic\ Index = \frac{Area\ under\ the\ test\ food\ curve * 100}{Area\ under\ the\ reference\ food}$$

The GI is a ranking of foods based on how quickly they raise blood glucose levels. The reference foods such as glucose have a GI of 100.

Foods with carbohydrates that are digested, absorbed and utilized quickly are referred to as high glycemic index food (GI≥70). Those absorbed moderately (56-69) are referred to

as medium GI foods while those that are digested, absorbed and utilized slowly are referred to as low GI (GI≤ 55) food.
The Glycemic load represents the product of the GI and the total available carbohydrate content in a specified portion of food divided by 100.
From the Glycemic Index, we calculate the Glycemic Load.

$$Glycemic\ Load = \frac{Glycemic\ Index\ * Available\ Carbohydrate}{100}$$

The Glycemic load of ≥ 20 is high a glycemic load while 11≤ GL ≤19 (both inclusive) is medium and a glycemic load of ≤ 10 is very low.

The pasta of low glycemic index value from roasted mix flour will be chosen for product development.

Phase-III Product Developments of Selected Roasting Mix

Ingredients and equipment used for product formation
The roasted mix was used for recipes formulation by using following ingredients. Whole wheat, barnyard millet, pearl millet, maize, cowpea, bengal gram. Onion, oil, salt, green chillies, low-fat curd, and mustard seeds were purchased from the local market of Nehru Nagar, Coimbatore at the time of preparation of recipes (Products). Tawa, ladle, stainless steel strainer, knives, kadai, dhokla steamer stand, idiyappam maker, rolling pin and board, non-stick pan, spatula, tongs and other crockery dishes and butter paper were used for the study during the preparation of recipes (product). Liquid petroleum gas (LPG) was used as a heating source. A Gas stove (HP India) was used during the preparation of products. The stove knob was kept at medium flame during the preparation of recipes.

Formulation of different recipes from selected Mix
The recipes prepared from the selected mix were Adai, Chapathi, Dhokla, Idiyappam, Dosa. Detailed methodology of the preparation and serving size of the different recipes from the selected mix is given below

Table 3

ADAI			
Ingredients	**Weight**	**Measure**	Take a bowl, add flour, and add salt, chopped onion and water. Mix all the mixture to make medium consistency batter. Spread ladleful of batter on a greased tawa (iron pan). Cook on slow fire on both sides. Cook the entire mixture this way. No. of Adai- Two
Mix Flour	80 gms	One cup	
Oil	1.25ml	¼ tsp.	
Salt	To taste	½ tsp.	
Onion	30 ms	1 small size	

Table 4

CHAPATHI			
Ingredients	**Weight**	**Measure**	Take a big bowl, add flour mix and add salt and water. Make dough. Divide the dough into balls and roll them into chapathi. Put one by one on hot tawa and let it remain for few seconds, till brown marks appears turn and pat with a piece of cloth to puff. No. of chapathi-Three
Mix Flour	80 gms	One cup	
Salt	To taste	½ tsp.	

Table 5

DOSA			
Ingredients	**Weight**	**Measure**	Take the mix and add salt and water. Keep the mix for 5-6 hours to ferment. Heat a tawa and smear with oil. Pour ladleful of the mixture, spread entirely and fry from both sides using less amount of oil. Cook the entire mixture this way. No. of Dosa –2
Mix Flour	80 gms	One cup	
Oil	1.25 ml	¼ tsp.	
Salt	To taste	½ tsp.	

Table 6

DHOKLA			
Ingredients	**Weight**	**Measure**	Take a big bowl; Make a batter of flour mix, salt, curd and water. Keep it aside to ferment for 5-6 hours depending on the weather. After adding soda bicarb mix well and pour into a greased disk. Sprinkle some red chilli powder over it. Steam the whole till set. Cool for few seconds, cut into small pieces and season with mustard seeds, red chilli and few curry leaves. No. of Dhokla pieces- Eight- Ten
Mix Flour	80 gms	One Cup	
Oil	1.25 ml	¼ tsp.	
Salt	To taste	½ tsp.	
Low fat curd	30 gms	2 tbsp.	
Mustard seeds	5 gms	1 tsp.	
Red chilli	2 nos.	½ tsp.	

Table 7

IDIYAPPAM			
Ingredients	**Weight**	**Measure**	First, add the ½ tsp of oil to the water and bring it to a rolling boil. Once the water starts to boil, turn off the flame. In a separate mixing bowl, add mix flour, salt and mix well. Add about ¾ cup of hot water to the flour, stir with a spatula. Now continue to add the water little by little to the flour and mix well until a soft, smooth and non-sticky dough is formed. Once you are able to handle the dough by hand, knead it nicely for 1-2 mins. Grease the inside portion of idiyappam press. Grease your palm with oil, take a portion of the dough, smoothen it out in your palm and fill it in the press. Similarly, grease the steamer plate. Gently press
Mix Flour	80 gms	One cup	
Oil	1.25 ml	¼ tsp.	
Salt	To taste	½ tsp.	
Water	100 ml	2 cups	

	the idiyappam dough in a circular motion onto the steamer plate. Steam the idiyappam for about 5 mins, until cooked through. Let the idiyappam top cool down a bit, before gently removing from the steamer plate and transferring to a serving plate.

Consumer Acceptance of Formulated Recipes

The selected variations of roasted mix was taken for formulations of different recipes and check the consumer acceptance through sensory evaluation test on 30 household women belongs to 20-30 years of age in Coimbatore District by using score card 1-5 rating scale for colour, taste, texture, Flavour and overall acceptability.

Assessment of Glycemic Index and Glycemic Load of Formulated Recipes

Each of the recipes was evaluated for glycemic index. 10 normal subjects randomly in the age group of 25-35 and with the normal BMI-18-24 were selected for the determination of glycemic index by glucose tolerance test. The purpose of the study was explained to each of the subjects and consent to participate in the study was taken. The subjects were explained not to take any medication, avoid smoking and not be involved in any physical activity during the period of study. Glucose tolerance tests were carried out on overnight fasted subjects with a glucose load of 50g. It was done by adopting the following steps. On the first day, the fasting blood glucose of subjects was measured with 50g of glucose dissolved in 200 ml of water. The measurements were taken after 0, 30, 60, 90, 120, and 150 mins using a glucometer. On the second day, the fasting blood glucose was again measured for the same subjects. Then recipes containing 50g of carbohydrate (i.e. 80 g) along with 200 ml of water were given to the subjects. The formulated recipes were to be eaten within 10-15 mins. The blood glucose was measured at 0, 30, 60, 90, 120, 150 mins by using a glucometer. Blood samples were drawn using the finger prick method. Blood glucose was analysed by the glucose oxidase method. The Area under the curve (AUC) for glucose and for recipes was calculated. The Same processes were repeated for each of the recipes to calculate their glycemic index and then glycemic load.

Results

The result of the formulated three variations of pasta

The texture, colour, and taste are the important features for admissibility

Table 8: Mean of Organoleptic Evaluation of Roasted Mix-I, Mix-II and Mix-III Pasta

Roasted	Mix I		Mix II		Mix III	
	Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Deviation
Appearance	4.37	0.615	4.00	0.788	4.13	0.776
Taste	4.00	0.695	3.73	0.640	3.97	0.718
Flavour	4.00	0.695	3.67	0.711	3.90	0.662
Texture	4.13	0.819	4.00	0.587	4.13	0.681
Overall	4.40	0.563	3.80	0.664	4.20	0.610

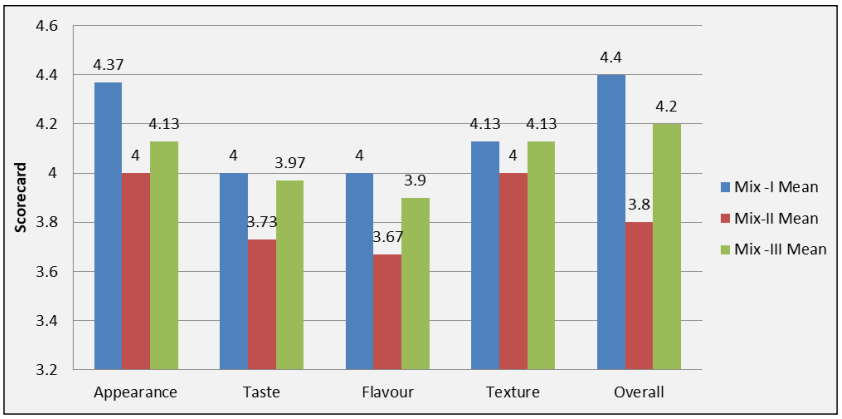


Fig 1: Mean Organoleptic Evaluation of Roasted flour Pasta Mix-I, Mix-II, Mix-III

Table 9: Mean of Organoleptic Evaluation of Roasted Mix Pasta (ANOVA)

Organoleptic evaluation	Sources of variation	Sum of Squares	df	Mean Square	F	P
Appearance	Between 5Groups	2.067	2	1.033	1.936	0.150
	Within Groups	46.433	87	0.534		
	Total	48.500	89			
Taste	Between Groups	1.267	2	0.633	1.349	0.265
	Within Groups	40.833	87	0.469		
	Total	42.100	89			
Flavour	Between Groups	1.756	2	0.878	1.846	0.164
	Within Groups	41.367	87	0.475		
	Total	43.122	89			
Texture	Between Groups	0.356	2	0.178	0.360	0.699
	Within Groups	42.933	87	0.493		
	Total	43.289	89			
Overall	Between Groups	5.600	2	2.800	7.427	0.001
	Within Groups	32.800	87	0.377		
	Total	38.400	89			

Table 10: Glycemic Index of Roasted Flour of Mix- I, Mix –II, Mix –III

Roasted Mix Flour –I			Roasted Mix flour –II			Roasted Mix flour- III		
Sl no.	Participants	GI	Sl.no.	Participants	GI	Sl. No	Participants	GI
1.	Participant-1	54.00	1.	Participant-1	57.86	1.	Particpant-1	57.08
2.	Participant-2	49.28	2.	Participant-2	60.212	2.	Particpant-2	57.55
3.	Participant-3	52.47	3.	Participant-3	58.61	3.	Particpant-3	57.04
4.	Participant-4	52.11	4.	Participant-4	59.46	4.	Particpant-4	60.55
5.	Participant-5	52.10	5.	Participant-5	54.61	5.	Particpant-5	59.62
6.	Participant-6	53.22	6.	Participant-6	56.49	6.	Particpant-6	56.43
7.	Participant-7	53.01	7.	Participant-7	59.77	7.	Particpant-7	61.86
8.	Participant-8	50.00	8.	Participant-8	52.60	8.	Particpant-8	56.80
9.	Participant-9	53.16	9.	Participant-9	59.54	9.	Particpant-9	56.57
10.	Participant-10	50.09	10.	Participant-10	57.37	10.	Particpant-10	56.13
Mean Glycemic index		51.94	Mean Glycemic Index		58.05	Mean Glycemic Index		57.96
Std. Deviation		1.60	Std. deviation		1.80	Std. deviation		1.98
Available Carbohydrate		40.15			40.16			41.16
Glycemic Load		20.85			23.32			23.85
p- value		0.9327			0.9978			0.9963
Null hypothesis at 10%, 5% and 1 % Significance		Don't Reject			Don't Reject			Don't Reject

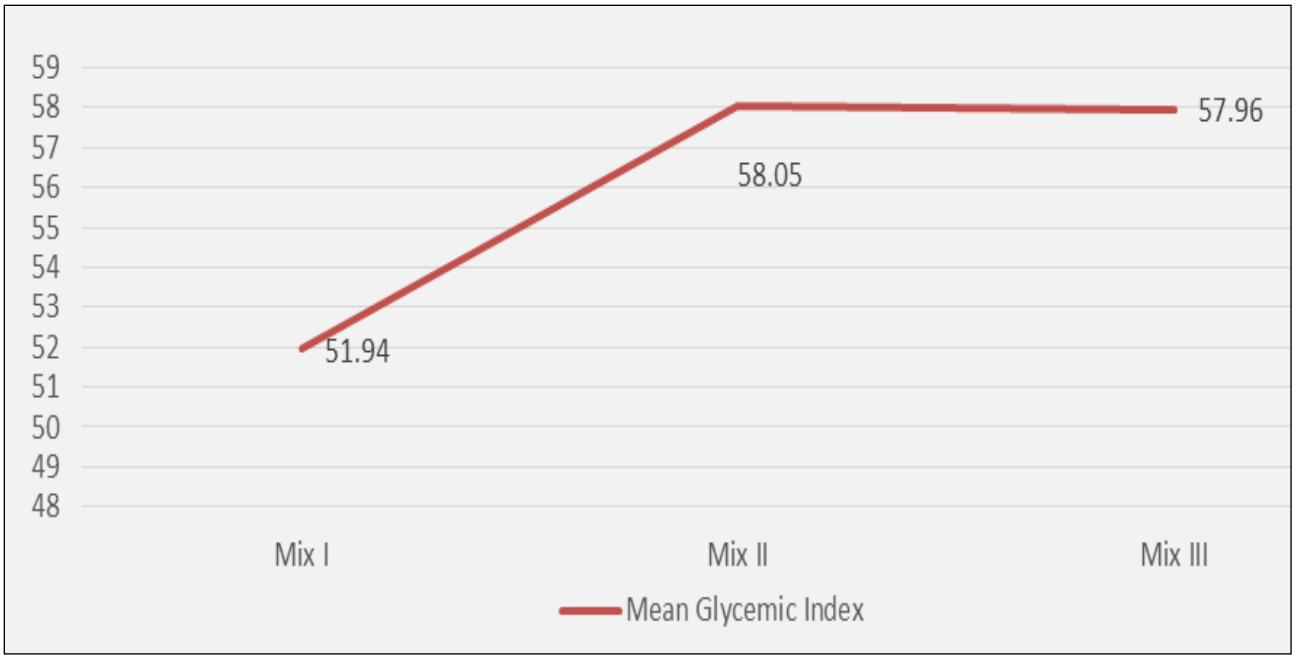


Fig 2: Mean Glycemic Index of Roasted Mix-I. Mix-II and Mix-III Pasta

The roasted RMIX-I was selected for further test (formulation of recipes) as has it possess high score of organoleptic evaluation and low glycemic index value.

Sensory Evaluation of formulated Recipes

Table 11: Mean of organoleptic evaluation of Roasted Mix-I formulated recipes

Roasted	Adai	Chapathi	Dhokla	Dosa	Idiyappam
	Mean and Std. Deviation	Mean and Std. Deviation	Mean and Std. Deviation	Mean and Std. Deviation	Mean and Std. Deviation
Appearance	4.5±0.68	5.0±0.0	3.6±0.67	4.3±0.79	3.6±0.67
Taste	4.4±0.81	4.9±0.30	3.6±0.67	4.1±0.84	3.6±0.67
Flavour	4.4±0.81	4.9±0.30	3.6±0.67	3.8±0.99	3.6±0.67
Texture	4.4±0.81	4.9±0.30	3.6±0.67	3.8±0.99	3.6±0.67
Overall Acceptability	4.4±0.81	4.9±0.30	3.6±0.67	3.6±0.81	3.6±0.67

Glycemic Index and Glycemic Load of Recipes

Table 12: Glycemic Index of Roasted Mix- I Flour – Adai, Chapathi, Dhokla, Idiyappam and Dosa

		Glycemic Index				
S. no	Participants	Adai	Chapathi	Dhokla	Idiyappam	Dosa
1.	Participant-1	46.16	46.16	40.26	46.16	48.86
2.	Participant-2	49.6	49.60	41.43	49.60	43.15
3.	Participant-3	46.53	50.48	42.90	50.48	44.63
4.	Participant-4	43.89	51.71	43.32	51.71	41.90
5.	Participant-5	45.66	51.12	39.32	51.12	49.96
6.	Participant-6	42.58	52.19	40.74	52.19	46.64
7.	Participant-7	49.2	48.68	40.93	48.68	47.68
8.	Participant-8	47.41	50.82	42.21	50.82	44.63
9.	Participant-9	45.16	51.30	39.74	51.30	44.25
10.	Participant-10	49.09	51.18	39.08	51.18	44.34
	Mean Glycemic Index	46.53	50.32	40.99	50.32	45.6
	Std. Deviation	2.34	1.78	1.47	1.78	2.58
	p-value	0.996	0.978	0.995	0.995	0.996
	Null Hypothesis at 10%, 5%, 1 % Significance	Don't Reject	Don't Reject	Don't Reject	Don't Reject	Don't Reject

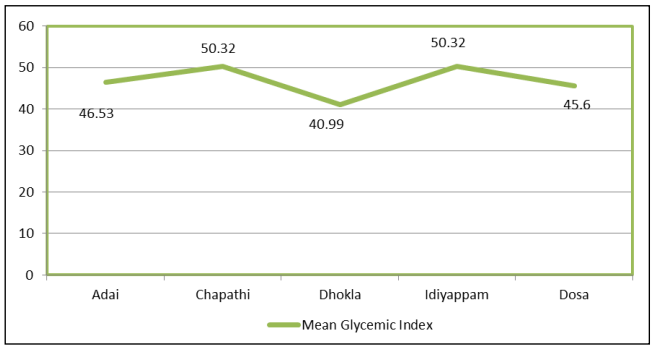


Fig 3: Mean Glycemic Index of Roasted Mix-I recipes

Table 13: Mean Glycemic Index and Glycemic Load of roasted Mix-I Recipes

Sl. No.	Recipes	Mean Roasted Glycemic Index	Available Carbohydrate	Glycemic Load
1	Adai	46.53	40.15	18.68
2	Chapathi	50.32	40.15	20.20
3	Dhokla	40.99	40.15	16.45
4	Idiyappam	50.32	40.15	20.02
5	Dosa	45.6	40.15	18.30

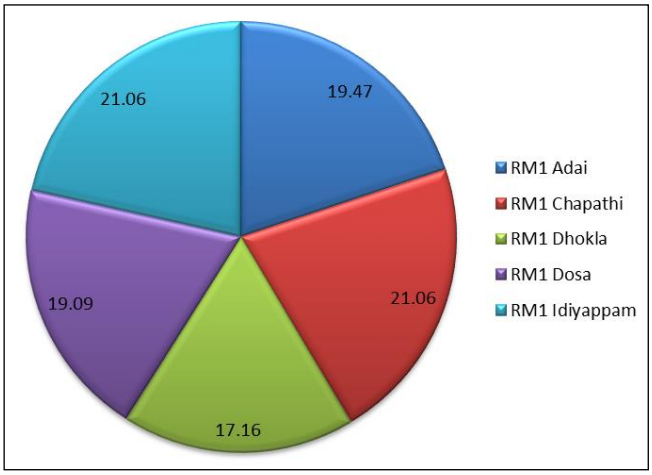


Fig 4: Glycemic Load of Roasted Mix-I recipes

Discussion

Table- I The time was taken for roasting of raw ingredients were 2 to 5 mins. The whole wheat flour were roasted for 5 mins, yellow maize for 4.5 mins, barnyard millet for 4 mins, pearl millet for 4.5 mins, Bengal gram for 2.5 mins and cowpea for 2 mins till they turns into golden brown in colour.

Table- II the composition of roasted mix flour, whole wheat flour in all three mixes is 500 g, but bengal gram and cowpea flour is 50 g. The remaining ingredients such as yellow maize, pearl millet and barnyard millets are in alternate proportion.

Table- III The mean and standard deviation for Mix I, Mix II, and Mix III in terms of appearance, flavour, texture, and overall acceptability after sprouting are displayed in Table III. In Mix I, the mean for appearance is 4.47, mean for taste and flavour is 4.03, mean for texture is 4.23 and for overall acceptability the mean is 4.40. In Mix II, the mean score for appearance is 3.97, the mean score for taste is 4.10, the mean score for flavour is 4.03, the mean score for texture is 4.07, and the mean score for overall acceptability is 4.17. In Mix III, the mean for appearance is 4.20, 3.97 for taste, 3.90 for flavour, 3.80 for texture, and 4.13 for overall acceptability.

Table- IV the findings of the ANOVA calculated to examine the acceptability of three combinations by sprouting are shown in Table III. The difference in means for appearance is statistically significant at 0.01. There is no further statistically significant information found.

Table V illustrate that the mean glycemic Index of roasted mix-I 51.94 ± 1.60, which comes under low glycemic index, the mean glycemic index of roasted mix flour-II is 58.05 ± 1.80 which comes under medium glycemic index and the mean glycemic index of roasted mix flour-III is 57.96 ± 1.98 which comes under medium glycemic index value respectively and glycemic load of roasted mix flour –I was 20.85 the glycemic load of roasted mix flour-II was 23.32 and the glycemic load of roasted mix flour-III was 23.85 respectively which comes under high glycemic load value. Since p-value > 0.05, the null hypothesis is correct and there is no difference in the mean glycemic index of the population.

Table- VI Illustrate that mean organoleptic evaluation of formulated recipes from selected mix. The Overall acceptability score for Adai is 4.4±0.81, Chapathi is 4.9±0.30, Dhokla is 3.6±0.67, Dosa is 3.6±0.81 and for Idiyappam is 3.6±0.67 respectively. It shows that the overall acceptability for Adai and Chapathi scores very good to good while Dhokla, Dosa and Idiyappam scores good to fair score.

Table VII illustrate that the mean glycemic index of roasted mix- I Adai-46.53± 2.34, Chapathi- 50.32±1.78, Dhokla-40.99±1.47, Idiyappam-50.32±1.78 and Dosa- 45.60±2.58 is which comes under low glycemic index value. Since p-value > 0.05, the null hypothesis is correct and there is no difference in the mean glycemic index of the population.

Table- VIII the table shows that the glycemic load for roasted Mix-I recipes Adai is 18.68, Chapathi is 20.20, Dhokla is 16.45, Dosa is 18.30 and Idiyappam is 20.02. The mean has been calculated over ten subjects. All the calculated glycemic indexes are in the range of low glycemic index for all recipes. The glycemic load for Adai, Dhokla, Dosa, shows medium glycemic load value while recipes like Chapathi and Idiyappam, slightly high glycemic load value.

Statistical Analysis

The final data was compiled and analysed using suitable statistical methods. The results were presented as descriptive statistics such as mean, standard deviation, ‘t’test, SPSS 20 Version and one way (ANOVA). A level of p-value <0.05 is considered as significant differences among the sample.

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Conclusion

The conclusion of the study is that small changes in the diet make huge differences in our health. This study delivers the importance of fibre enriched whole grains, millets with the

combination of pulses mix. The incorporation of whole cereals, millet and pulses improve the quality of food and low glycemic index response in seen formulated recipes from the low GI mix. Thereby this mix is helping the diabetic's subjects to maintain their blood sugar levels.

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