DEVELOPMENT - STANDARDIZATION AND GLYCEMIC INDEX TESTING OF THE MADUVA CHOCO MIX

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ABSTRACT

The glycemic index is a relative ranking of carbohydrate in foods according to how they affect blood glucose levels. Carbohydrates with a low GI value are more slowly digested, absorbed and metabolised and cause a lower and slower rise in blood glucose and therefore usually," insulin levels. Palm sugar is a sweetener derived from any variety of palm tree while sugars from different palms may have slightly different compositions; all are processed similarly and can be used interchangeably. Compared to many other sweeteners, palm sugar has a relatively low impact on blood glucose levels and is more appropriate for diabetes. For comparison, regular table sugar has a glycemic index value of 68, honey is rated at 55, and palm sugar is rated at 35. Furthermore, compared to brown sugar and table sugar, palm sugar is higher in potassium, magnesium, zinc, iron, nitrogen and sodium. But, just because palm sugar impacts blood glucose comparatively less, does not mean that there should not be limits on its consumption. Eating excessive amounts of palm sugar at a time would raise blood glucose levels too high, so moderation is the key. Hence, a product was developed along with the ingredients, ragi flour, palm sugar, cocoa powder and milk powder. The developed product was preservative free instant premix, which had low glycemic index than normal sugar.

Keywords: *Ragi; Low-Glycemic index; Palm sugar,;Cocopowder; Milk powder; Product development; Standardization*

1. Introduction

The finger millet commonly known as ragi and mandua in India is one of the minor cereals originating in Ethiopia, but is widely grown in several regions of India and Africa. In India, Karnataka is the main producer of finger millet and accounts for 58% of its global production. Production, in the world, finger millet occupies the fourth place in importance among millets (Pallavi et al., 2016).

The finger millet grain is germinating the seed. This process is also known as the malting

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process and is very common. When the fingers of millet germinate, the enzymes are activated, which transfer the starches to other carbohydrates such as sugars.

The millet finger has a good malting activity. Malted millet finger can be used as a substrate to produce, for example, gluten-free beer or easily digested baby foods (National Research Council, 1996).

Ragi is a good source of nutrition for growing children, pregnant women, the elderly and patients. Ragi is considered an ideal food for diabetics, also because of its low sugar content and the slow release of glucose / sugar in the body (Lakshmi and Sumathi, 2002). The millet finger serves as an ideal low-calorie diet for all age groups, especially growing babies and pregnant women (Subastri et al., 2015).

The millet finger contains an amino acid tryptophan that reduces appetite and helps keep weight in control. FM is digested at a slower rate, therefore avoiding excessive caloric intake (Chandrasekhar et al., 2010).

Palm sugar is a sweetener derived from any variety of palm. Palm palm (Borassus spp.) Is grown in Asia. The sugar palm (Arenga pinnata) is native to the coastal and tropical regions of Asia. The sap used to produce palm sugar is known in India as gur. Palm sugar is produced by boiling the collected sap until it thickens. Palm sugar is an ingredient in sweet and savory dishes that are used throughout Asia.

(https://en.wikipedia.org/wiki/Palm_sugar).

Palm sugar is a low-glycemic crystalline sweetener, rich in nutrients, which has a taste, dissolves and melts almost exactly like sugar, but is completely natural and unrefined. Naturally brown and naturally rich in several key vitamins, minerals and phytonutrients, which include potassium, zinc, iron and vitamins B1, B2, B3 and B6. Palm sugar is not a calorie-free sweetener. It has calories like any carbohydrate, but because of its relatively low glycemic index, its calories are absorbed into the bloodstream at a significantly slower rate than regular refined sugar. It has a glycemic index of 35. By comparison, the GI of honey is 55 to 60, and high fructose corn syrup (HFCS) is 62. Maltodextrin, a common powder often added to many sweeteners, it has an IG of 105 (https: //iskconnews.org/why-organic-palm-sugar-is-the-next-big-thing-in-natural-sweeteners).

Cocoa solids are a mixture of many substances that remain after extracting the cocoa butter from the cocoa beans. When sold as a final product, it can also be called cocoa powder or cocoa powder. The cocoa powder has a light brown color and a removable pH of 5.3 to 5.8 (Miller et al., 2008).

Cocoa powder contains several minerals, including calcium, copper, magnesium, phosphorus, potassium, sodium and zinc. All these minerals are found in larger amounts in cocoa powder than cocoa butter or cocoa liquor (Steinberg et al., 2003).

Cocoa powder is rich in flavonoids, a subset of polyphenols. The amount of flavonoids

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depends on the amount of processing and manufacturing that cocoa powder undergoes. The alkalization, also known as Dutch processing, causes its flavonoid content to be substantially reduced (Jeffery Hurst et al., 2011).

Milk powder contains all the twenty-one standard amino acids, the building blocks of proteins, and are rich in soluble vitamins and minerals. According to USAID, typical average amounts of the main nutrients in non-reconstituted non-fat milk powder are (by weight) 36% protein, 52% carbohydrate (predominantly lactose), 1.3% calcium, and 1.8% potassium. Whole milk powder, on the other hand, contains on average 25-27% of proteins, 36-38% of carbohydrates, 26-40% of fat and 5-7% of ashes (minerals). In Canada, milk powder should contain added vitamin D in an amount such that a reasonable daily intake of milk provides between 300 and 400 International Units (IU) of vitamin D. (https://en.wikipedia.org/wiki / Milk powder)

There is a need to develop the healthy and nutritious products for Children (Sireesha & Kusuma, 2014a: 2014b) Adolescents, Adults and all the population groups. Because majority are suffering with micronutrient deficiencies (Sireesha & Kusuma, 2015: Sireesha & Rajani, 2015; Sireesha et al., 2017: Sarada et al., 2017), to mitigate this deficiencies, there is a need to develop nutrient quality denced foods like instant muffin mix enriched with calcium (Niharika etal., 2020), mulberry products (Sireesha & Kanaka Vidya Sri, 2020) like that.

In this context, the present study was planned to develop foods based on ragi, palm sugar, cocoa powder and milk powder. These four foods are rich sources of nutrients. Based on this, the four foods were selected for product development.

2. Materials and Methods

The detailed protocols used for the development of the Maduva Choco Mix is follows. Fig.1 shows the research design.The basic ingredients required for the development of premix mix were ragi, palm sugar, cocoa powder, and milk powder are procured from the super market.

2.1. Processingof Ingredients

Preparation of ragi powder

1. Take ragi in a vessel and wash it by rubbing well with your hands.
2. Then soak the ragi in clean water for 12 hours. The colour of the ragi will be changed after soaking.
3. Then drain the water completely. Transfer the drained ragi to a clean white cloth or cheese cloth for sprouting.
4. After 12 hours, open the cloth carefully. You could see the tiny sprouts in ragi.
5. In the next step the sprouted ragi is pressure cooked for 5 minutes. After cooking cooled for few minutes and then spread in the plate in a thin layer and then sun dried

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6. Take the dried ragi to a dry mixer jar and blend it to a smooth powder. Sieve the powder well. Cool it down and store in an air tight container.

2.2. Standardization

The premix powder variations were made with different proportions of ragi flour, palm sugar, cocoa powder and milk powder. The trail which was scored the maximum score through sensory evaluation was considered as the standard sample. Mix all the ingredients (ragi flour, palm sugar powder, cocoa powder, milk powder) in a mixer and mix it for few seconds for perfect mixing of all the ingredients equally. After mixing of the premix sieve the product with the help of a muslin cloth which helps in obtaining very fine powder. Table 1 shows the premix standardisation compositions.

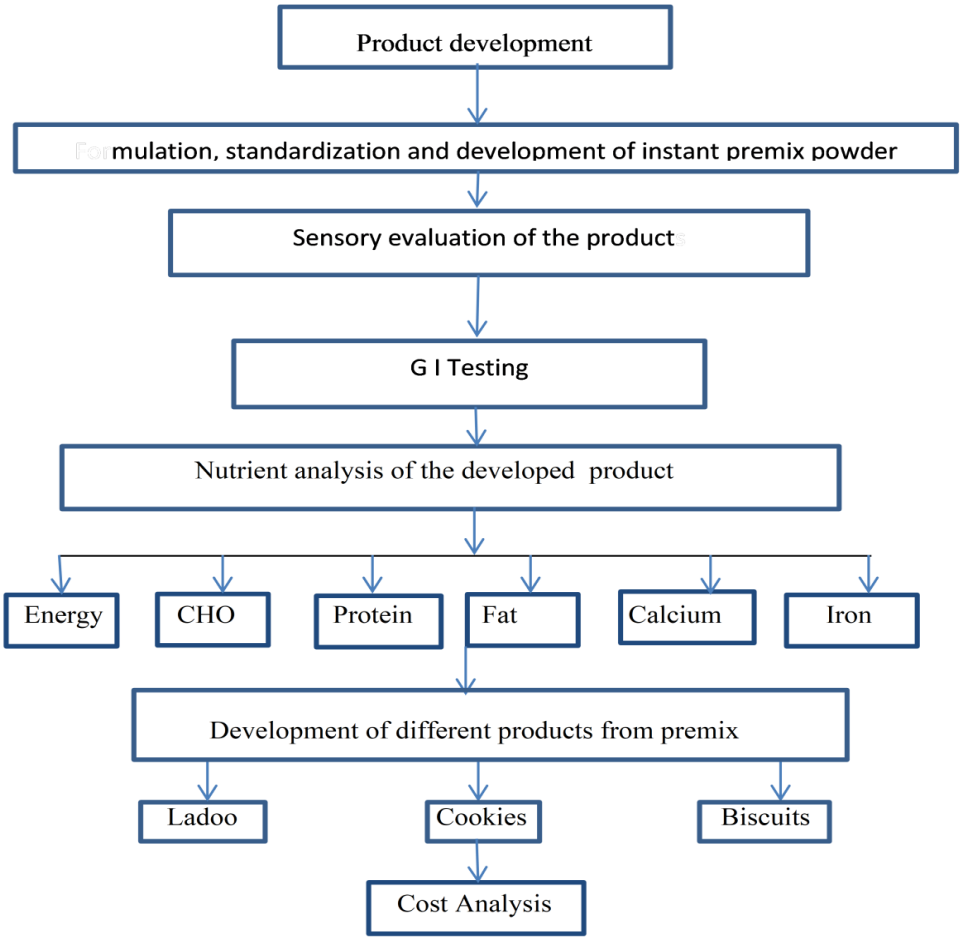

Fig -1 Research Design

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Table 1. Standardization of the premix

S.No.	Ingredients	V-1	V-2	V-3
1	Ragi flour(g)	**30**	**40**	**30**
2	Palm sugar(g)	**20**	**20**	**40**
3	Cocoa powder(g)	**40**	**26**	**20**
4	Milk powder(g)	**10**	**14**	**10**
	Total (g)	**100**	**100**	**100**

2.3. Sensory Evaluation- The quality parameters such as appearance, colour, taste, texture, flavour and over all acceptability were evaluated by panel of judges on a five point hedonic scale. Accepted product was processed for further development.

2.4. Method of Determining Glycaemic Index (GI)-Ten (10) normal subjects were selected to test GI in the morning after a 10-14h overnight fast. Fasting blood sample and after the test meal (60g) the blood samples were drawn at 30, 60, 90,120,190 minutes intervals. Capillary blood is obtained by finger-prick blood glucose determined with the glucometer. (AOAC, 1995)

Each test meal contains 50g available carbohydrate. Unavailable carbohydrates such as fructo-oligosaccharides, resistant starch and sugar alcohols are not included as available carbohydrate. Standardized product was supplemented to the subjects who were evaluated by the sensory panel members. Two types of products were prepared one is mixed with the palm sugar and another with the cane sugar. GI was tested in the same subjects in a week interval. This method is done to know the difference in the glycaemic index values between normal sugar and the palm sugar.

2.5. Nutrient Analysis- The analysis of the nutrients was done for the standardized product. The analysis was done and calculated based on the standard procedures.

3. Results and Discussion

The formulated product has been standardized by repeated trails in the laboratory and by checking the organoleptic characteristics through semi trained panelmembers.V-3 was the final product suggested by the panel members. The product can be consumed as ladoo, biscuits, milkshake, and cookies etc.

3.1. Nutrient Composition of Premix

Table 2 Shows the nutrient composition of premix (MADUVA CHOCO MIX) variations. The macronutrient content of the three variations was almost same except calcium and iron, these two nutrients was highest in the variation-3 than the two other variations.

The iron content was maximum for variation 3 (4.77mg) followed by variation 2 and 1 (3.36), (2.97) respectively.Variation-3 premix showed high iron value than the variation-1 and variation -2.Iron has its own importance role in the formation of haemoglobin and place an important role in transport of oxygen from the lungs to the tissues and of carbon dioxide from

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the cell to the lungs. Rich source if iron is from cereals, millets, pulses.

Table 2. Nutrient composition of premix (MADUVA CHOCO MIX) variations

S.no	Ingredients	Amount (gm)	Energy (kcal)	CHO (gm)	Protein (gm)	Fat (gm)	Ca (mg)	Iron (mg)
1	Variation-1	100	357.50	81.43	6.41	3.64	203.2	2.97
2	Variation-2	100	359.24	78.66	6.96	3.99	237.6	3.36
3	Variation-3	100	362.07	84.17	5.17	2.92	303.2	4.77

Table 3.Comparison of the laboratory analysed and calculated nutritive values of variation-3 premix

Nutrients	Analysed values	Calculated values
Energy(Kcal)	348.3	362.70
Carbohydrate(gm)	79.44	84.17
Protein (gm)	5.40	5.17
Fat (gm)	3.40	2.92
Calcium (mg)	201.10	303.20
Iron (mg)	2.90	4.77

Table 3shows the comparison of the laboratory analysed and calculated nutritive values of variation-3 premix. From the table no 3, it was observed that the analysed values of the variation-3 are decreased compared to the calculated values of the variation-3 from the (ICMR). These changes are due to some climatic changes in cultivation of the raw ingredients and some losses during the processing of the product and also due to some technical errors, changes are observed.

3.2. Organoleptic evaluation of prepared product - Quality is the ultimate criteria of the desirability of many food products food quality can be evaluated by sensory and objective methods. Sensory evaluation of food is important for accessing the acceptability of any product which in carried out any organoleptic tests. Sensory evaluation of food includes different senses like eyes (visual), nose (olfactory), ears (auditory), mouth (gustatory), touch (tactile), acceptability among beneficiaries is the ultimate criteria for different foods which have been proved to be a high quality. (Srilakshmi, 2016).

Table 4 depicts organoleptic evaluations and mean scores for the developed instant premix powders. There are several steps involved in a new product development among which taste panel stage is most. In taste panel stage various attributes of the product like appearance, colour, flavour, texture, and taste are judged by trained members. The attributes evaluated by panel members for pre-mix

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powder using Hedonic (5 point) rating scale include 1-very bad, 2- bad, 3- average,4-good,5-excellent

Table 4. Mean and SD values as obtained for the different attributes of premixes

S.No	Attributes	Instant premix Mean ± SD scores		
		Sample-1	Sample-2	Sample-3
1	Colour	4.1±0.5676	3.8±0.7888	4.2±0.6325
2	Flavour	3.6±0.6992	3.7±0.6749	4.3±0.8233
3	Texture	3.7±0.483	3.5±0.8498	4.1±0.3162
4	Taste	3.9±0.9944	3.7±0.6749	4.1±0.7379
5	Overall acceptability	3.8±1.0238	3.9±0.5676	4±0.8165

3.3. Glycemic Index Testing Results

The Glycaemic Index (GI) is a number associated with the carbohydrates in a particular type of food that indicates the effect of carbohydrates on a person's blood. The GI represents the rise in a person's blood sugar level two hours after consumption of the food. The glycaemic 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. DOSE- Each test meal contains 50g available carbohydrate. So each subject was supplemented with 60 gm of the product which contains 50gm of carbohydrate in the product.

The testing hours were after the 12 hours overnight fasting of the individual. Initially, first glucose levels should be taken i.e., Initial reading , after consuming the test meal the individuals glucose levels should be tested with the glucometer at regular intervals i.e., for first ½ hr , 1 hr, 1 &½ hr, 2hr, 2 &1/2hr.

Fig.2 represents palm sugar premix and normal sugar premix glycaemic index of the selected 10 subjects

Figure -2 depicts the difference between the GI values of the subject -1 supplemented with the palm

It was observed that 10 out of 7 subjects had the low GI of palm sugar premix compared to normal cane sugar premix. From the above results it was observed that subject-1, subject-5, and subject-9 has obtained the high GI value to the palm sugar product compared to normal cane sugar.

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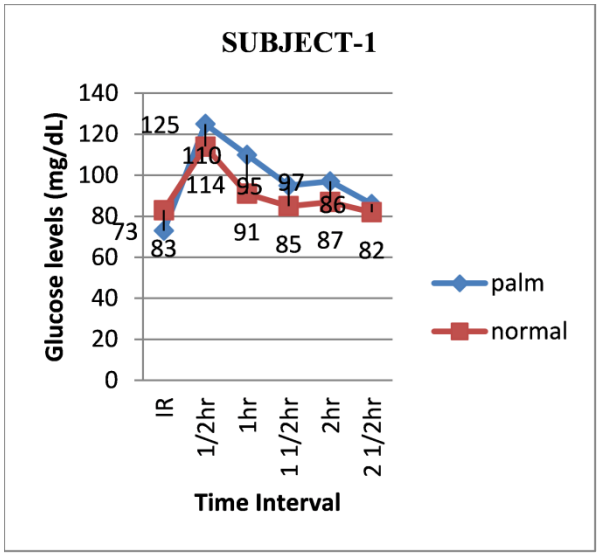

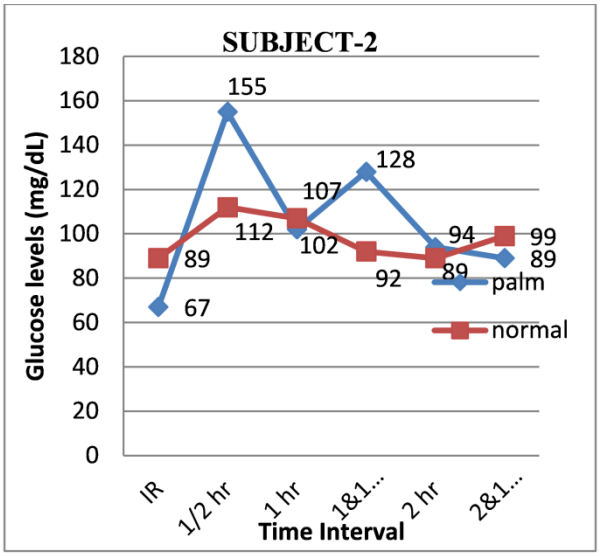

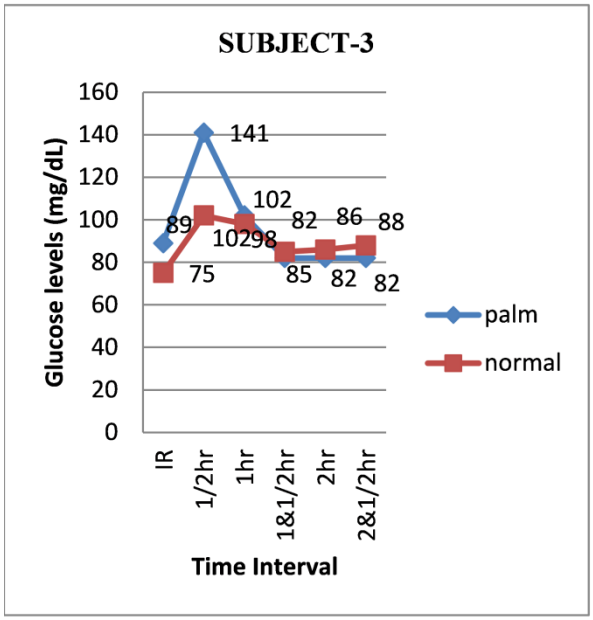

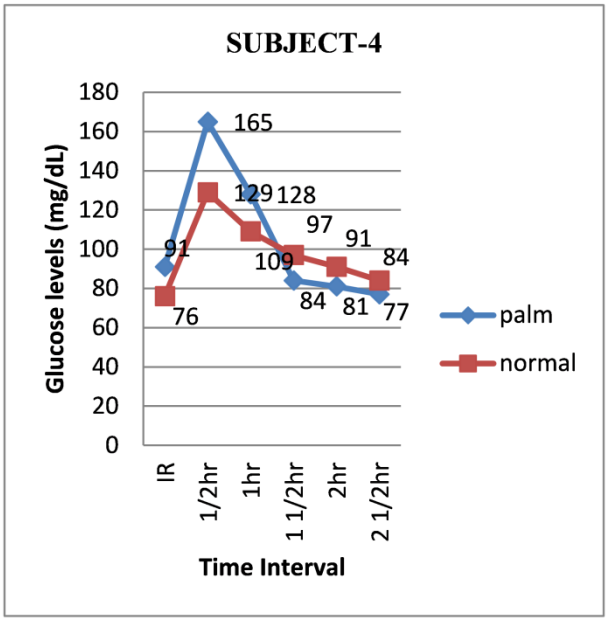

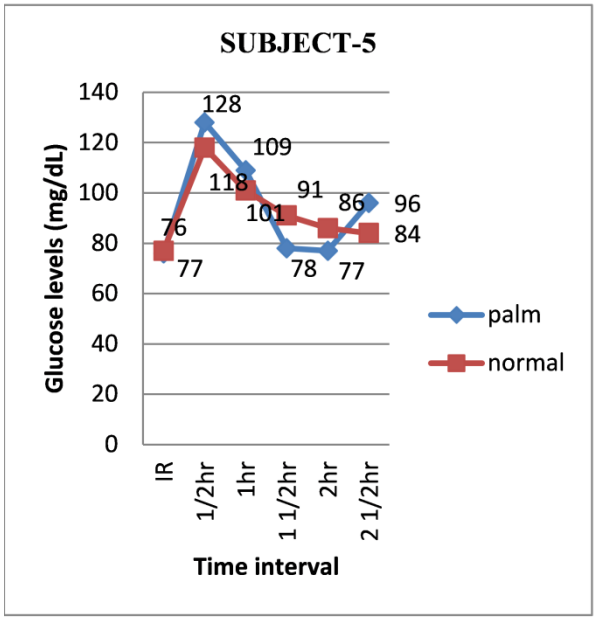

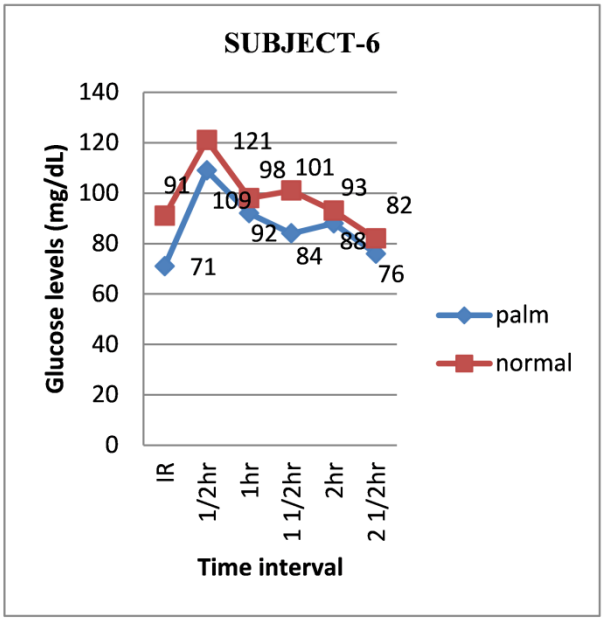

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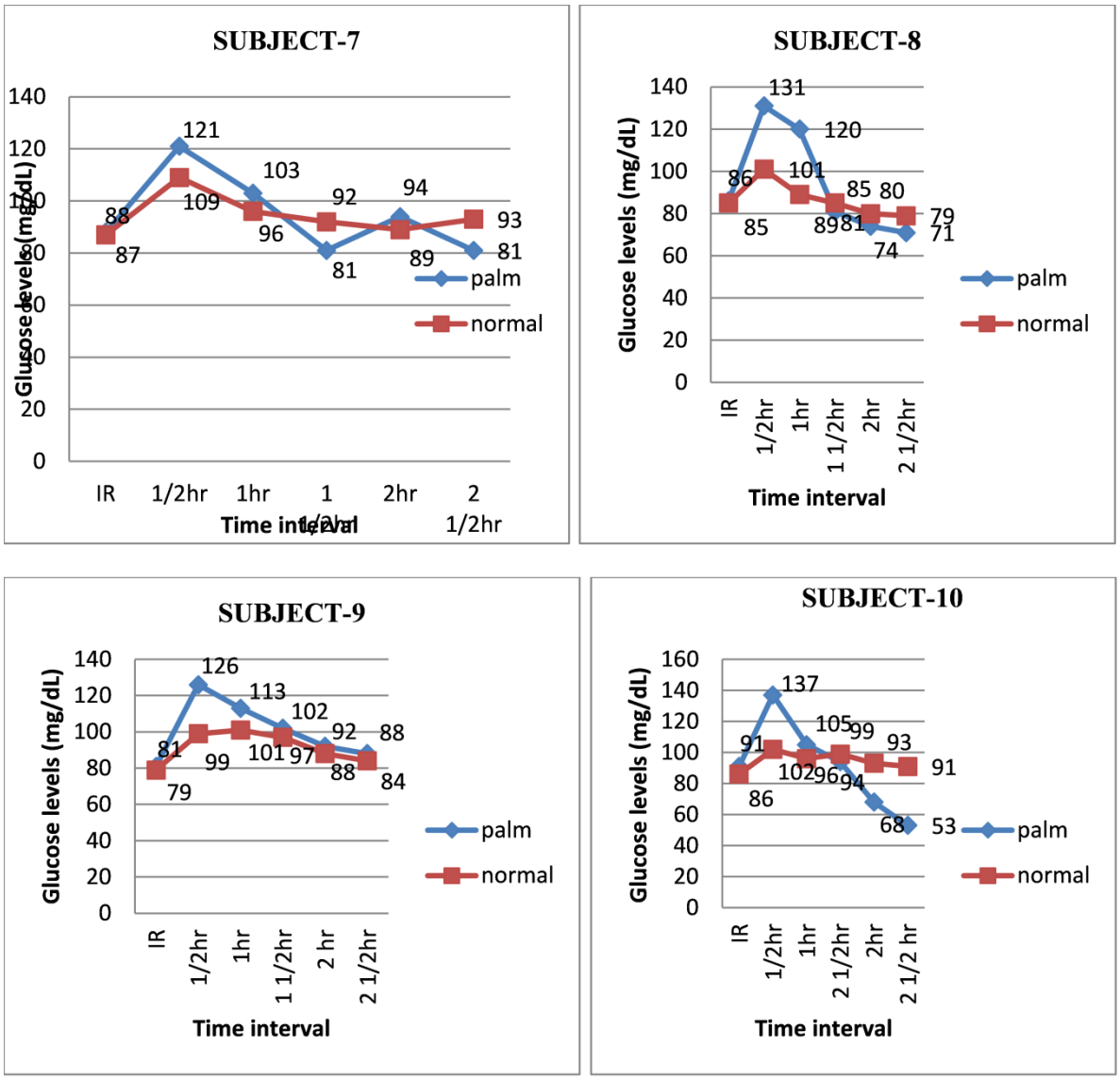

Fig 2. GI value for the palm sugar and Normal sugar premix

3.4. Preparationof Various Products with the Premix (Maduva Choco Mix)

With the help of the premix various products like milk shake, biscuits, cookies, laddu etc. can be prepared.

3.4.1. Preparation of Milk Shake

Ingredients Premix: 10 gms

Milk: 100ml

Procedure 1.Take 100 ml of milk

2. Boil it

3. Cool to room temperature and transfer it to a blender.

4. Add 10 gms of premix in the blender.

5. Blend it well and serve cold.

3.4.2. Preparation of Cookies

Ingredients

Premix – 50 gms

Cold Butter-100 grams

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Baking powder -1 gm

Milk – 2 tbsp to knead the dough

Procedure

1. Sift the premix and baking powder together
2. Add the cold butter to the flour mixture and mix it with your hand
3. You will get a mixture that resembles breadcrumbs
4. Add one or two tablespoons of milk to make the dough softer.
5. Take care not to add more milk as the dough will become runny and cannot be used after that.
6. Roll the dough into a ball and refrigerate for half an hour.
7. After half an hour, divide the dough into small balls and flatten it on your palm to make round cookies.
8. Line a baking tray with aluminium foil. Place the cookies on the baking tray, and with help of fork, make 3-4 stripes on the cookies to ensure even baking.
9. Preheat the oven to 180 °C. Bake the cookies for 15-20 minutes a

3.4.3. Preparation of Ladoo:

Ingredient

Premix**:** 100gms

Powdered sugar: as per requirement

Ghee (Can use melted butter too) 30ml

Procedure

1. Add the premix, mix well with ladle. Also add the powdered sugar, and mix in thoroughly. Use a wire whisk to mix well too.
2. Heat up the ghee over a low flame in a different small sauce pan. If using butter, heat a similar quantity of butter for such time until you find the butter slowly changing hue to a pale gold.
3. Drizzle this hot ghee over the premix mixture. Mix again with ladle, and when it is of bearable heat, grab a fistful and compress using fingers to a round ball shape. The ladoo can be set aside to rest when it keeps its shape. It will harden on cooling. Finish off making ladoos with the rest of the mixture. Fig.3 shows the various products developed with the help of standardizes premix.

3.5. Yield of Powder

To know the yield of ragi powder the weights can be taken according to raw ingredients used. The weight of raw material and finally by taking weight of end yield of dried ragi powder. 500 gm. of raw ragi was taken and the total yield of the final ragi flour obtained was 350gm. The yield was reduced because of the very fine sieving of the flour.

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Fig.3 Different products developed from the Maduva Choco Mix

3.6. Packaging& Labelling

The role of packaging and labelling has become quite significant as it helps to grab the attention of the audience.

- Labelling and packaging can be used by marketers to encourage potential buyers to purchase the product.
- Packaging is also used for convenience and information transmission. Packages and labels communicate how to use, transport, recycle or dispose of the package or product.

Packing was done carefully to preserve the product for a long duration. Labelling of concerned product illustrate the necessary information needed to the consumer. Fig.4 shows the packaging and labelling of the developed product.

Packaging-Packaging was done carefully to preserve the product for a long duration, air tight food grade plastic were chosen for premix storage as it was the suitable materials to avoid moisture and external contamination.

Labelling-After packaging was done properly, the product was labelled with the following specifications.

Cost Evaluation- The term ‘cost’ means the amount of expenses incurred on or attributable to specified thing or activity. Cost evaluation was done by calculating the cost of ingredients used for preparation of premix powder and it also includes cost of packaging material and labour.

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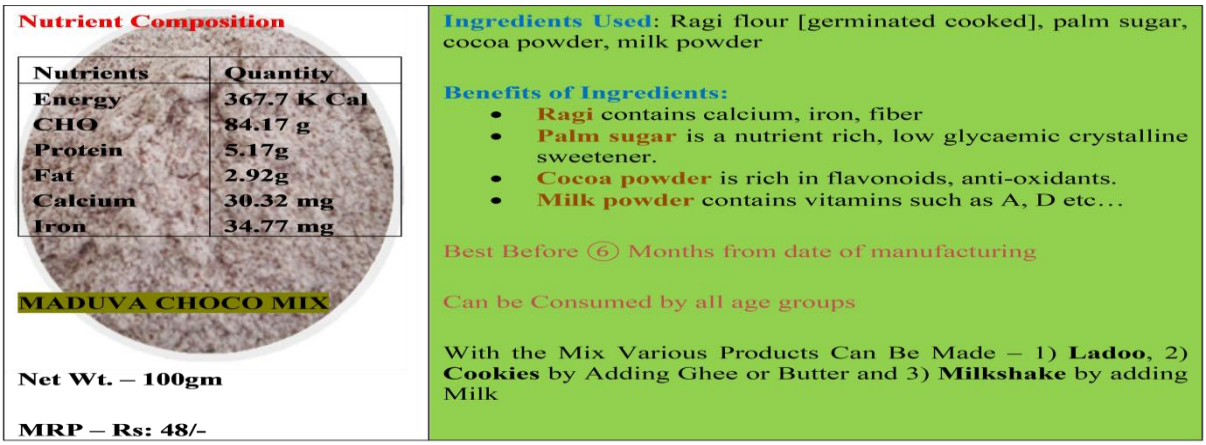

Figure .4 Labelling of the Maduva Choco Mix

3.7. List of costs considered for the cost analysis of premix.

Cost category	**Cost description**
Raw materials	Purchasing cost of raw material
Preproduction logistic cost	Transportation and storage cost
Production cost	Direct and indirect cost • Machine operating cost • Energy cost Packaging cost • Preventive outages
Post production logistic cost	Handling cost Transportation and storage cost

The cost was calculated for the variation 1, 2, and 3of the developed premix was calculated.

Table .5 Cost evaluations of different premix variations

Ingredients	**Variation-1**		**Variation-2**		**Variation-3**	
	Quantity (gm)	**Cost (Rs)**	**Quantity (gm)**	**Cost (Rs)**	**Quantity (gm)**	**Cost (Rs)**
Ragi	30	12	40	16	30	12
Palm sugar	20	8	20	8	40	16
Cocoa powder	40	30	26	18	20	15
MilkPowder	10	5	14	6.5	10	5
Cost	**100**	**55**	**100**	**48.5**	**100**	**48**

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Table -5 shows that cost evaluation of different variations .Almost all the products cost was similar with slight variations. The variation-3 was reasonable among the other variations and is nutritious when compared to other variations.

4. Conclusions

The research mainly focussed on to develop the low glycemic Maduva Choco Mix and testing the GI of the developed product with palm sugar and normal table sugar. In the results it was clear that majority of the subject's showed low glycemic index when they consumed the palm sugar Maduva Choco Mix compared with the normal table sugar Maduva Choco Mix. This mix was used to develop different products and also as such it is useful. This mix contains only natural ingredients, there was no addition of artificial preservatives, colouring agents, flavouring agents and stabilisers. So it was useful for infants, children, adults and old age persons. Nutritional composition wise also it was good.

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