

Studies on Development of Nutritionally Enriched Banana Flour Ladoo

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Abstract— Food based approaches are recognized as an essential part of an urgently needed more comprehensive strategy for improving nutrition by increasing the availability and consumption to combat nutrient deficiencies. Banana flour ladoo was developed and standardized largely for the children, adolescence and lactating mothers. The present study is carried out to develop a nutritionally enriched banana ladoo. The banana flour ladoo was composed of banana flour, pearl millet, flax seed, Moringa powder, palm jaggery and desi cow ghee. Banana flour was taken in the form of three different compositions and control form (50%, 60%, 70% and 100%) & analyzed for sensory physio-chemical, textural and color analysis. The results obtained that banana flour ladoo with treatment 3 (70 % of banana flour, 15 % of pearl millet flour, 13 % of flax seed powder, 2% of Moringa powder, 80% palm jaggery and 20% of desi cow ghee) is more acceptable and nutritious compared to treatment -1, treatment -2 and control (banana flour). It has protein content of 11.34 grams, carbohydrates 97.24, moisture 3.5 and ash 4%. The hardness of banana flour ladoo treatment 3 is 60 g which is lowest value compared to other treatments. The treatments of banana flour ladoos are packed in LDPE pouches and stored at room temperature (27°C). Hence it may be recommended that banana flour ladoo could be a healthy value added product and overcome from certain nutrient deficiency.

Keywords— Flour Ladoo, Palm Jaggery, banana, Millet, flax seed.

I. INTRODUCTION

India is the largest producer of bananas in the world with a production of 297 lakh metric tonnes on 8.4 lakh hectares of land according to an estimate, 290 lakh metric tonnes (97%) is consumed domestically, while another 5 lakh metric tonnes or so is lost due to bananas perishability. The majority of banana exports from India are to west Asian and north African countries like UAE, Bahrain, Egypt, Saudi Arabia, Qatar and Iran. The banana variety that grown in Kadapa district is Grand Nain. These are banana cultivars of *Musa acuminata*. It is one of the most commonly Cavendish banana cultivar group. It is also known as the Chiquita banana because it is the main product of Chiquita brands international. Banana fruits are the major source of energy-producing carbohydrates, potassium, vitamin-b6, vitamin c, dietary fibre, antioxidants and minerals such as potassium, magnesium, sodium and phosphorus. Bananas have no fat, cholesterol or salts and therefore make an excellent food rich in nutritional substances and ideal as a snack for both children and adults. Palm Jaggery also known as Taad Gud (Taar Gur) in Hindi and Karuppatti It was originally made from the sugary sap of the Palmyra Palm. The taste of the Palm Jaggery which is made from the coconut juice has a chocolate-like taste which makes it a great substitute to refined sugar Palm Jaggery which is made from Palm tree extract has a number of minerals and vitamins. They have a large number of medicinal properties, which also acts as a healthy and natural sweetener. Palm Jaggery is an incomparable substitute of refined sugar. When comparing it to the refined sugar, the nutrient of palm jaggery remains in it even after the manufacturing process is completed. Palm Jaggery intensifies the taste of many dishes in India because it provides both sweet and savoury flavour. The leaves of the *Moringa oleifera* tree are very nutritious. They can be consumed fresh, cooked or dried. Since dried Moringa leaves retain their nutrient content, it is possible to convert them into leaf powder. Moringa Leaf Powder is an excellent nutritional supplement and can be added to any dish. Moringa contains high amount of vitamins, calcium, iron, potassium, antioxidants and all essential

amino acids in a good proportion which are the building blocks of protein. The dried powder Moringa leaves have high level of vitamin E, Beta-carotene. Beta-carotene most potent precursor of vitamin A. Drying the leaves assist to concentrate the nutrients, facilitate conservation and consumption. Flaxseed is the seed from the flax plant, an annual herb, which is a member of the Linaceae family. The whole flaxseed is flat and oval with pointed tips and contains a seed coat or true hull (also called testa), a thin endosperm, two embryos and an embryo axis. Every part of the linseed plant is utilized commercially, either directly or after processing. The shell yields good quality fiber having high mechanical properties and low density instead the seed provides oil rich in omega-3, digestible proteins and lignans; it is also use to manufacture paints, varnishes, linoleum, oilcloths, printing inks, soaps and numerous other products. Bajra (Pearl Millet) is an important crop in India and it is the largest producer of bajra in the world. Bajra is rich in proteins, vitamins and minerals like iron and calcium. It has high calorific value and hence it is grounded into flour and is used in making various products like Breads, Cookies, and Biscuits. Bajra consumption prevents anaemia and promotes a healthy nervous system. It helps to overcome acidity due to its alkaline nature. Hence, Bajra is used as ingredient for protein enrichment. It is good for digestion and has antibacterial, antifungal and antioxidant properties. Ghee contains 99-99.5 % fat and less than 0.5% moisture. Contains fat soluble vitamins (A, D, E, and K) and essential fatty acids. Cow ghee is preferable to buffalo ghee because it has carotene vitamin A which is good for eye and brain function buffalo ghee has more fats and calories as compared to cow ghee.

II. MATERIALS AND METHODS

The present study entitled “Development and Quality evaluation of Nutritionally Enriched Banana Flour Ladoo” was attempted to analyze the texture and appearance of the Banana flour ladoo enriched with Palm Jaggery. The fruits are graded in the farm based on size and shape. The Fruits were weighted and washed with tap water. Remove the peel of raw bananas and cut into slices using slicer. Dry the slices in cabinet dryer at 60°C for 24 hours. The whole grains of bajra were graded and roasted at 180°C. After cooling, the grains were milled to obtain bajra flour. The flax seed were graded and roasted at 180°C. After cooling, the seed were milled to obtain flax seed powder. The moringa leaves were washed and steam blanched for 80°C for 1 minute. The blanched leaves were dried in solar dryer for 12 hours. Different compositions were used for different treatments. The compositions of raw banana flour used are 50%, 60% and 70% for preparation of ladoo.

2.1 Estimation of Proteins:

Protein content of sample was quantified by the kjeldahl technique with a conversion factor of 6.25.

2.1.1 Estimation of total carbohydrates by anthrone method:

Acidic medium glucose is dehydrated to hydroxy methyl furfural. This compound forms with anthrone a green coloured product with an absorption max at 630 nm.

2.1.2 Estimation of ash:

To determine ash content, the sample of 2.5g was used to expose the sample in a muffle furnace by following Horwitz and Latimer (2005).

2.1.3 Estimation of moisture content:

The moisture content of the banana flour laddoo was determined based on dry basis (PFA). It is based on the separation of water from the food material and its measurements by the resulting loss in weight or by measurement of the amount of water separated. The removal of water can be accomplished by drying procedure. Take the weight of Petri dish with lid. Weigh about 5gms of each sample into the Petri dish and spread evenly for uniform drying. Leave the Petri dish in an oven at 130°C with the lid open for about 2 hours. Cool the Petri dish in a desiccator for 1-2 hours. Take the weight of the Petri dish. Repeat process of heating and cooling until a constant Weight is achieved.

2.1.4 Estimation of colour:

Banana flour ladoo was measured by a Hunter Lab Colour meter (M/s Colorflex, 45/0, Hunter Lab Reston, VA, USA). Before measuring sample colour, the instrument was calibrated using a standard white plate followed by a black plate as described in user manual.

Instrumental values L*, a* and b* indicate lightness, redness/ greenness, and yellowness/blueness, respectively.

2.2 Texture profile analysis:

Banana flour laddoo was instrumentally conducted using a Brookfield texture analyzer (Model CT3, Middleboro, USA). The instrument was designed with 10 kg load cell with different probes for measurement of textural properties of food products. A cylindrical probe of (diameter 4 mm cylindrical/TA44) was used with 5 mm target distance test conditions, one mm/s test and post-test speed with trigger load 7g. Texture Pro CT V1.6 software (M/s Brookfield Engineering Labs) was deployed to assess textural attributes.

2.3 Sensory evaluation:

The sensory attributes of developed banana flour laddoo were evaluated with expert panel members. After every sample scoring, laddoo samples were served to panel members with coded identities and tasted for organoleptic properties by rinsing tongue with purified water.

III. RESULTS AND DISCUSSION

3.1 Protein:

The protein contents of the sample were determined using kjeldhal method. The protein contents of banana flour laddoo were compared with the control and the results are expressed as the following table 1.

TABLE 1
PROTEIN VALUES FOR DEVELOPED BANANA FLOUR LADDOO

S. No	Particulars	Protein content (gm)
1	Control (100% BF)	4.76
2	Treatment – 1 (50% BF)	12.47
3	Treatment – 2 (60% BF)	11.82
4	Treatment – 3 (70% BF)	11.34

3.2 Carbohydrates:

The carbohydrate content of the sample was determined by using Anthrone method. The carbohydrate contents of banana flour laddoo were compared with the control and the results are expressed as the following table 2. Treatment 3 showed highest value than other treatment banana flour laddoos, which is recommendable for better carbohydrate content.

TABLE 2
CARBOHYDRATE VALUES FOR DEVELOPED BANANA FLOUR LADDOO

S. No	Particulars	Carbohydrate Content (grams)
1	Control	88.28
2	Treatment – 1 (50% BF)	80.07
3	Treatment – 2 (60% BF)	94.92
4	Treatment – 3 (70% BF)	97.24

3.3 Ash Content:

The ash content of the sample were determined by using Muffle furnace. The ash contents of banana flour laddoo were compared with the control and the results are expressed as the following table 3. Treatment 3 showed highest value than other treatment banana flour laddoos, which is recommendable for better minerals.

TABLE 3
ASH VALUES FOR DEVELOPED BANANA FLOUR LADOO

S. No	Particulars	Ash content (%)
1	Control	2%
2	Treatment – 1 (50% BF)	3.50%
3	Treatment – 2 (60% BF)	1.50%
4	Treatment – 3 (70% BF)	4.10%

3.4 Moisture Content:

Determination of moisture content is the most important and fundamental analysis that can be performed on a food product. Moisture content of developed banana flour ladoo were compared with control and the results are expressed as the following fig 1. Treatment 3 sample showed lowest value than other treatment banana flour ladoos, which is recommendable for better shelf life.

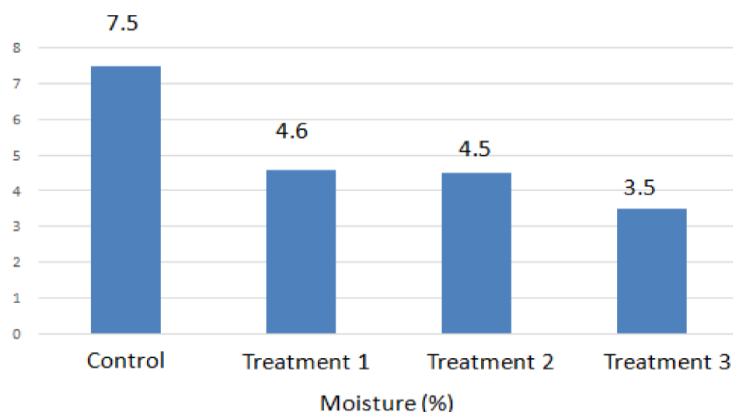


FIGURE 1: Moisture content of Banana flour ladoo

3.5 Colour:

The Colour values of the developed banana flour ladoos are presented in the following table 4. With the increase in the proportion of green banana flour, a decrease in whiteness was observed by Mabogo *et al.* (2021). Treatment 3 was shown better colour compared to other treatments.

TABLE 4
COLOUR VALUES FOR DEVELOPED BANANA FLOUR LADOO

S.No	Particulars	L*	a*	b*	ΔE^*
1	Control	73.3	3.54	15.1	313.84
2	Treatment – 1 (50% Banana flour)	45.3	3.69	25.62	715.3
3	Treatment – 2 (60% Banana flour)	55.64	2.61	24.67	671
4	Treatment – 3 (70% Banana flour)	53.05	4.37	25.21	707.67

3.6 Texture Profile Analysis:

Textural profile of food product indicates various attributes which are beneficial in design of any food formulation. Hardness of banana flour ladoo is one of the important attribute of which governs biting difficulty by consumer. The order of hardness in increasing order is T3>T2>T1>Control. The values are shown in table 5 and figures 2, 3, 4 and 5.

TABLE 5
TEXTURE ANALYSIS VALUES OF DEVELOPED BANANA FLOUR LADOO

Samples	Hardness
Control	160
Treatment 1	90
Treatment 2	65
Treatment 3	60

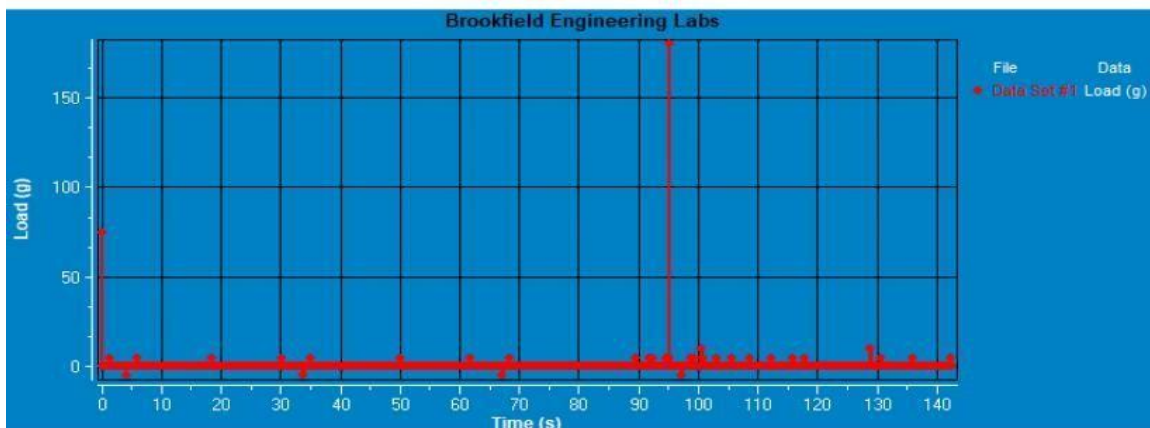


FIGURE 2: Texture profile analysis of control banana flour laddoo

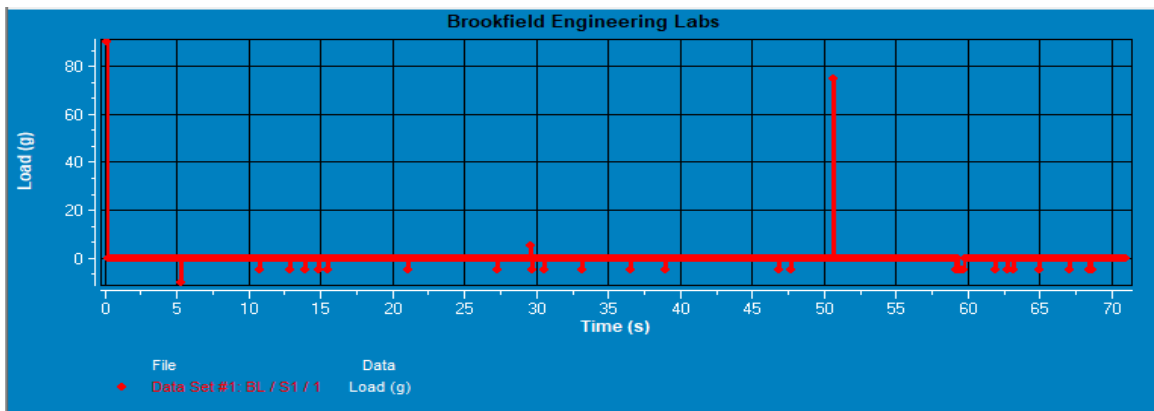


FIGURE 3: Texture profile analysis of Treatment – 1 banana flour laddoo

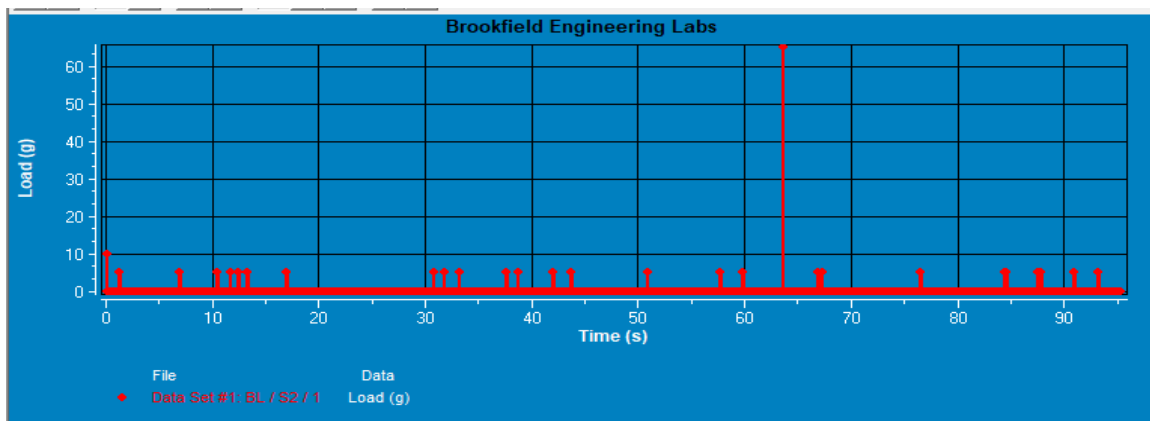


FIGURE 4: Texture profile analysis of Treatment – 2 banana flour laddoo

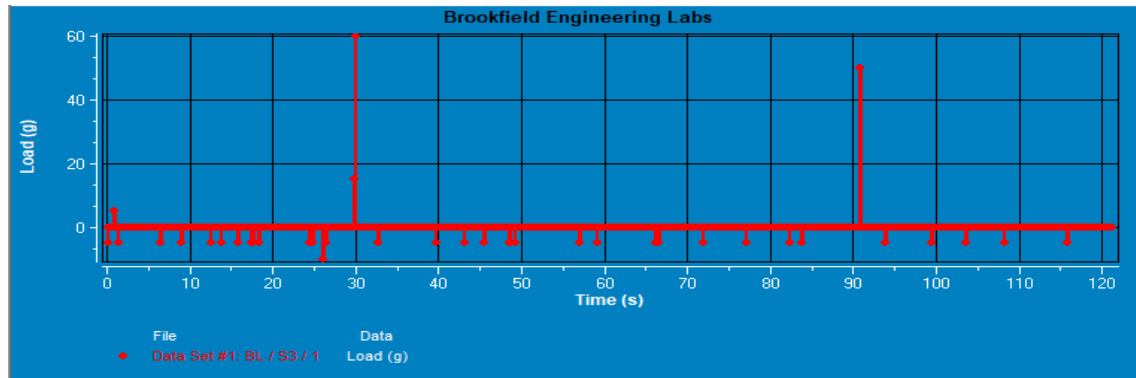


FIGURE 5: Texture profile analysis of Treatment – 3 banana flour laddoo

3.7 Sensory Evaluation:

The quality characteristics such as appearance, flavor, texture, taste and overall acceptability were analyzed by using the 9-point hedonic scale. The consumer acceptance of the banana flour laddoo had been evaluated by comparing the sample with control. The results are mentioned in table 6. Treatment 3 resulted good overall acceptability than other treatments banana laddos.

TABLE 6
SENSORY EVALUATION OF DEVELOPED BANANA FLOUR LADDOO

S. No	Criteria	Control	Treatment 1	Treatment 2	Treatment 3
1	Taste	5	6.1	6.9	7.5
2	Texture	6	6.3	6.8	7.8
3	Flavor	6.3	6.8	6.5	7.3
4	Appearance	5.5	6.4	7	7.4
5	Overall acceptability	5	6	6.7	7.3

IV. CONCLUSION

This development and quality evaluation of nutritionally enriched banana flour laddoo was to overcome the Nutrient deficiency. The banana flour laddoo was prepared by using three different treatments (T1, T2, and T3) along with control in the ratio of 50%, 60%, 70% & 100% and evaluated for protein carbohydrate, ash, moisture, color, texture profile analysis. It has protein content of 11.34 grams, carbohydrates 97.24, moisture 3.5 and ash 4%. The hardness of treatment 3 is 60 g. The treatments are packed in LDPE pouches and stored at room temperature (27°C). Sensory and microbial analyses were also conducted. Treatment – 3 was more nutritious as composition of banana flour: pearl millet: flax seed: Moringa powder: palm jaggery: (70:15:13:2:80) and desi cow ghee was more nutritious and acceptable. The cottage level processing industries may adopt this developed process technology of banana flour laddoo for income generation.

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