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Development of Nutri- Cereals Based Mahua (*Madhuca longifolia*) Laddoo

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ABSTRACT

Mahua flowers are one of the most significant non-timber forest products (NTFPs) in Chhattisgarh state, but a large portion of their production—between 80 and 90% is misapplied to the creation and sale of unhealthy alcoholic beverages there in order to generate more fast cash. According to information gathered from the tribal, the same mahua flowers were previously consumed by the tribal and other people as mahua laddoo. After developing for laddoos, their nutritive value was estimated, and sensory evaluations (of six parameters) were done through score card method. This mahua laddoos were with moisture content, protein, fat, carbohydrates, ash, crude fibre, total sugar and energy found to be 3.15% , 8.55%, 13.88%, 67.63%, 1.912% and 4.84% , 51.50% , 429.64 kcal respectively. Microbiological analysis acquired the standard plate count, coliform, yeast and mold count observed in nutri-cereals based Laddoo were found to be 2041,<10 and <10 respectively.

Keywords: *Mahua, Laddoo, Cereals, flowers*

INTRODUCTION

Mahua (Madhuca longifolia), a member of the sapotaceae family, is native to various parts of India, Sri Lanka, Myanmar, and Nepal. It is a multifunctional tree that satisfies the three basic needs of tribal people, namely food, fodder, and fuel (Patel et al., 2011). Mahua trees are widely distributed throughout India's states of Uttar Pradesh, Madhya Pradesh, Orissa, Jharkhand, Chhattisgarh, Andhra Pradesh, Maharashtra, Bihar, West Bengal, Karnataka, Gujarat, and Rajasthan. It is estimated that 45000 million tonnes of mahua flowers are produced annually, with each tree producing between 80 and 320 kg of mahua flowers on average. The most amazing mahua developing state is Madhya Pradesh, with an average trade volume of 5,730 metric tonnes and value of roughly 8.4 million Indian rupees. Mahua, rhododendron, kachnar, moringa, gulmohar, palash, and other such plants that are widely used traditionally and have the potential to be commercialised can be found in India. One of those plants, mahua, is taking up new space in the economic and ethnic lives of the indigenous people (Vishal et al., 2020).

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Mahua is a frost-resistant shrub that may flourish in India's dry tropical and subtropical forests at elevations between 1200 and 1800 metres. It needs a mean annual temperature between 2 and 46 degrees, mean annual rainfall between 550 and 1500 millimetres, and mean annual humidity between 40 and 90%. Mahua trees are exported from India to Australia and other Asian nations like Pakistan, Sri Lanka, and The Philippines. It can be found sporadically in semi-evergreen forests and on river banks in central India's pasturelands. The tree may grow in a wide range of soil types, however sandy soil is optimal for it. Additionally, it thrives on clayey, calcareous, shallow, and bouldery soils.

Evergreen mahua trees can reach heights of 70 feet. At the age of 8 to 15 years, the tree matures and starts producing fruit; it can continue to produce fruit for up to 60 years. A medium-sized to large deciduous tree that may grow to a height of 12 to 15 metres and has a short, holed, rounded, and shaded crown that can be found across India's green forest region. Cracked and fissured bark that is rough, thick, and black. On the other hand, the inner bark is dark crimson, and when cut, it pours a milky white sap. The leaves are elliptical in shape, 10–30 cm long, with sharp ends and strong nerves, and leathery on the underside and hairy underneath. Additionally, leaves have complete but waxy borders, are 7.5 to 23 cm long and 3.8 to 11.5 cm wide, and are fluorescently bright around branch ends (Verma et al., 2010).

One of the most significant non-timber forest produce (NTFP) is the mahua flower, which significantly impacts the national tribal economy. Mahua has a significant economic impact as evidenced by the fact that around 7.5 million people participate in the harvesting of mahua flowers, or nearly three-fourths of all tribal households in the nation. Mahua flowers are extremely important to tribal societies. They rely on it for their livelihood, as well as for their food and liquids. Additionally, they don't need to invest any money on this crop. Tribes typically exchange Mahua for everyday necessities like food, which have a much higher market value than the mahua itself.

Mahua flowers contain a good amount of Vitamin C, which is responsible for its antioxidant activity. Flowers are a good source of carotene, which is a precursor to vitamin A, as well as minerals like calcium and phosphorus. Mahua flowers' therapeutic characteristics, including their anti-helminthic, antibacterial, analgesic, hepatoprotective, antioxidant, and anticancer effects, have also been the subject of numerous investigations. Mahua flowers are well renowned for their excellent nutritional value and lowering sugar content. Flowers from the plant are edible. The corolla, also known as mahua blossoms, is a sugar-rich flower that also contains a significant number of vitamins and minerals (Singh et al., 2005)

Mahua flower can be used as a food ingredient for biscuits, cakes, laddus, candies, bars, jams, jellies, sauces, and other baked goods in addition to making liquor. Mahua oil is utilised as cooking oil in some Indian tribal regions and for producing laundry soaps and detergents. (Vinita et al., 2018)

Nowadays, medicinal and aromatic plants are important to the global economy. These plants are prime source of secondary metabolites which are used as food, medicine etc. Various parts of plant like roots, fruit, leaves and bark are used in food and medicine. (Kathuria & Singh, 2015). One of the traditional medicinal plant loaded with nutrients is mahua (Madhuca longifolia). Maduca, often known as the butternut or mahua forest tree. Mahua is a very nutritious tree that may also be used as a herbal remedy to treat various diseases. Mahua's photochemistry study revealed that it contains a lot of sugar, vitamins, proteins, alkaloids, phenolic compounds, and other nutrients. Mahua flowers can be used as a food ingredient to make biscuits, cakes, Laddoos, candies, bars, jams, jellies, sauces, and more, in addition to being used to make whisky. (Sinha et al., 2017). Mahua has significant amounts of calcium, phosphorus, and vitamins A and C. Mahua seeds are loaded with not just

energy giving carbohydrates, but also essential fatty acids like linoleic and arachidonic. Mahua is said to help increase milk production and secretion in lactating mothers (Mishra & Padhan, 2013).

Pregnancy and lactation are two stages of life when an adult woman's nutritional needs are increased. During her nine months of pregnancy, she has the duty to assist the fetus's internal growth, and subsequently, when the baby is born, she has the duty to maintain its exterior growth. A good diet is essential for the expecting and nursing mother since the growth requirements are critical at the start of life. A satisfactory diet during pregnancy will ensure a good store of nutrients or satisfactory breastfeeding. The quantity and quality of milk released are both affected by inadequate nutrition during lactation. (Ramadas et al., 2011).

Wheat is a grass widely cultivated for its seed, a cereal grain which is a worldwide staple food. The genus Tritium includes numerous types of wheat, with common wheat being the most extensively cultivated. (T. aestivum). Wheat is cultivated as second crop after paddy harvest in the Chhattisgarh state as well as in many parts of the country. Late harvesting of kharif paddy (main crop of the area) delays the sowing of wheat in the state. Winter is short in the state (about 80-90 days) & normally the day (max.) temperature rises gradually after the third week of January and reaches a higher rate of increasing trends after 20th February. Wheat is grown in India on 33.61 Mha and produces of 106.21mt with a national average yield of 3160 kg/ha during 2019-20 (Anonymous, 2020a). The wheat crop requires favourable winter for about 100-110 days for producing its potential yields. Since wheat output is severely reduced above the optimum temperature (22–24°C), agricultural research continues to place a high priority on developing heat-tolerant wheat varieties. In Chhattisgarh, 50% of the wheat is planted after the first week of December and suffers from heat stress, which drastically reduces yields. Wheat that is planted late experiences severe yield losses that might reach 40–50%. Heat stress has already been shown to have a substantial impact on lowering wheat production and quality. In India, heat stress is a significant barrier to wheat productivity. In comparison to the national productivity of 29 qt/ha, the state's wheat productivity is about 12.50 qt ha-1 (Agrawal et al., 2007).

Millets are minor cereals of the grass family, Poaceae. They are annual cereal grasses with small seeds, many of which are adapted to hot and dry conditions, and are distinguished by their capacity to flourish in less fertile soil. Millets include sorghum (Jowar), pearl millet (Bajra), finger millet (Ragi), foxtail millet (Kakum), proso millet (Chena), little millet (Kutki), kodo millet (Kodon), barnyard millet (Sanwa), and brown top millet. Ragi or finger millet (Eleusine coracana L.) is one of the common millets in several regions of India. It has historically been a significant millet staple food in portions of eastern and central Africa and India, where it is also known as Koracan and by other names in Africa. (FAO, 1995). To make beverages, porridge, idli (an Indian fermented steamed cake), dosa (an Indian fermented pan cake), and roti, finger millet was traditionally ground, malted, and fermented in India (unleavened flat bread) (Malathi & Nirmalakumari, 2007).

Finger millet is a rich source of carbohydrates and comprises of free sugars 1.04%, starch 65.5%, and non-starchy polysaccharides or dietary fibre 11.5%, 59.5–61.2% starch, 6.2–7.2% pentose's, 1.4–1.8% cellulose, and 0.04–0.6% lignin's. When compared to other millets like foxtail, tiny, kodo, and barnyard millet, brown rice, polished rice, and finger millet, finger millet's 11.5% dietary fibre level is significantly greater. However, finger millet has a dietary fibre level comparable to wheat and pearl millet. Amylose and amylopectin are components of finger millet starch. Compared to other millets like sorghum (24.0%), pearl (21.0%), proso (28.0%), foxtail (17.5%), and kodo (24.0%), finger millet starch has a lower amylase level (16.0%). (Shobana et al., 2013).

Sesame (Sesamum indicum L.), a herbaceous annual plant in the family Pedaliaceae and order tubiflorae, is grown for its edible seed, oil, and flavourful value. Due to its exceptional level of resistance to oxidation and rancidity, it is also known as gingelly, til, benne seed, and is referred to as the "Queen of Oilseeds" in popular culture. Sesamin, sesamolin, and tocopherol homologues, which are natural antioxidants rich in polyunsaturated fatty acids (PUFA), are found in 50–60% of the high-quality oil found in sesame seeds. Proteins, dietary lignin's, vitamins, calcium, and phosphorus are only a few of the macro- and micronutrients that are abundant in sesame. According to sesame's chemical makeup, the seed is a significant source of oil (44-58%), protein (18–25%), carbohydrate (13.5%), and ash (5%). The most revered oil in ayurveda is sesame oil, which has been used since the time of the Vedas. Sesame oil has a reputation as a sedative in Tibetan medicine and has been used for millennia in the Chinese medical system. It is also known for its therapeutic powers. Sesame is said to treat Tridoshas in ayurveda. (2014) Pathak et al.

The significance of mahua Laddoo to the residents of Chhattisgarh. Mahua Laddoo is a beloved Indian dessert that has a ball-like shape. The functional food ingredient "Mahua" is also a galactagogue ingredient, which is given to breastfeeding women to increase the amount of breast milk during the lactation phase. Laddoo, which is based on nutri-cereals, is made up of mixtures of various flours. A nutritionally-cereals-based mahua (Madhuca longifolia) Laddoo for lactating women has been developed in the current study project, taking into consideration the nutritional profiles of mahua flower, wheat, finger millet, and sesame seeds.

MATERIALS AND METHODS

Raw Ingredients:

- Dried Mahua flowers
- Wheat
- Finger millet
- sesame
- jaggery/ Sugar
- Ghee

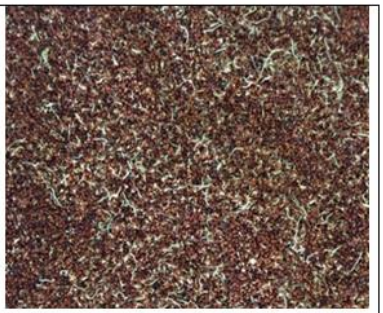
Formulation of Laddoo

Table Different ingredient with their levels for sample A and sample B

Ingredient	Sample A (Jaggery) Level (%)	Sample B (Sugar) Level (%)
Dried Mahuau Flower	12	12
Jaggery	21	-
Sugar	-	21
Wheat Flour	27	27
Finger Millet Flour	15	15
Sesame Seeds	10	10
Ghee	15	15

Dried Mahua Flower

Germinated & dried Wheat



Germinated and dried Ragi


Roasted Sesame Seeds


Mixing all Ingredients


Prepared Laddoo

COMPOSITIONAL ATTRIBUTES ANALYSIS

Raw ingredient samples and mahua flower enriched nutria-cereals based Laddoo were subjected to various compositional attribute tests as described below:

Prescribed protocols of AACC (AACC, 2000) and AOAC (AOAC, 2001) procedures were thoroughly followed.

Physio-Chemical analysis:

1. Moisture content

The Moisture content was determined by A.O.A.C. (2000). In previously weighted Petridis; 5 g sample was taken and kept in a hot air oven set on 105± 1°C for 24 hours. Repeating the process of drying and cooling and weighted at 30 min interval, until a constant weight was attained then it was transferred to desiccators after cooling it was the moisture content was calculated using the following Formula:

$$\text{Moisture content, \% (db.)} = \frac{W_1 - W_2}{W_2} \times 100$$

Where,

W_1 = Initial sample weight, in grammes

W_2 = Sample final weight, in grammes

2. Fat Content

According to A.O.A.C. (2000), the fat content of the sample was estimated by the Soxhlet plus solvent/ fat extraction system. A beaker was first washed followed by cleaning and weighing. In the thimble, about 3 g of dried sample was weighted and transferred into the cellulose thimble. The thimble holders were kept along with the sample into the beaker and cover the top thimble with cotton because the petroleum ether was not evaporated. Pour 100 ml petroleum ether into the beaker and each beaker kept in the heating plate. The temperature was set at 75°C for 45 minutes and 150°C for 30 minutes in soxhlet's apparatus. The water tap was opened and the flow of water through the water condenser was ensured. The ether is then evaporated and flask with the residue dried in an oven temperature at 60°C, cooled in a desiccator and weight.

Calculation:

$$\text{Fat (\%)} = \frac{W_1 - W_2}{W} \times 100$$

Where,

W_1 = Wt. of beaker containing fat (g)

W_2 = Wt. of empty beaker (g)

W = Wt. of sample taken (g)

3. Protein Content

Nitrogen content of the sample was determined by kjeldhal method as given by A.O.A.C (2000) and protein content was calculated using conversion factor 6.25. The procedure is as follows: Take 0.5 g of weighed sample and transfer to the 500 ml kjeldhal digestion flask. Add to it 2 g of digestion mixture (K_2SO_4 & $CuSO_4$ in the ratio of 5:1). Take 10 ml H_2SO_4 solution pour in the sample. The sample was felt into all the tubes, but one tube was blank in which only the 10 ml H_2SO_4 was filled. Made by mixed indicator take 200 ml ethanol, methyl red 0.19 gm & bromocrysol 0.15 gm. Add 2.5 ml mixed indicator into the boric acid. Digest sample by heating flask till the sample turns light green or clear cool and make the volume to 100 ml by adding distilled water. Take this solution in a distillation flask, add to it 80- 85 ml of NaOH solution (40% w/v). The sample tube was put in the nitrogen analyser for 7 minutes with added distilled water. The liberated ammonia was collected in 100 ml beaker then boric acid with 2.5ml drops of

methyl red indicator was added. The sample tube was put in the nitrogen analyser for 7 minutes. Collect approximately 150ml of the distillate and titrate against with 0.1N HCL or H2SO 4 Till end point of pink colour was obtained.

Calculation:

$$\text{Protein (\%)} = \frac{1.4 \times \text{Titrated value} \times \text{Normality of acid}}{\text{Sample weight}}$$

The amount of protein was obtained by multiplying the nitrogen (%) with the appropriate Conversion factor (i.e.6.25) expressed on a percent basis.

4. Ash Content

According to A.O.A.C. (2000), the ash content was determined by the following procedure: First, clean the silica crucibles and weighted the empty silica crucible in the analytical weight balance. Take 3 gm sample and tare the silica crucibles followed by weighing. The sample was kept in the muffle furnace and the muffle furnace temperature was maintained at 550℃ for 3 hours until white ash is obtained. The sample was cooled down in the desiccators. The ash with crucible was weighted properly in the weighing balance.

$$\text{Ash content (\%)} = \frac{w_2 - w_1}{w} \times 100$$

Where,

w_1 = weight, in g of the empty dish

w_2= final weight in g of the dish with the ash

W = weight in g of the sample

5. Carbohydrate Content

Per cent carbohydrate content was determined by subtracting other constituents. Carbohydrate (per cent) = 100- (Moisture + Protein + Fat + Ash).

6. Energy Value

The total energy in kilocalories/100 g was determined by following formula:

Kcal/100 g = 4×% protein + 9 × % fat + 4× % carbohydrate

7. Crude Fibre

Crude fibre was estimated by the procedure of A.O.A.C. (2000) first clean and wash the crucible with water and dry the crucible in oven for ½ hour. Take 2 gm. sample, transfer in the oven dried crucible then crucible was kept in the fibre plus extraction unit. The crucible was properly sealed with the adapter rubber. In the fibre plus extractor, do not blank any place without crucible. Acid wash was done by pouring 150 ml of 1.25% H2SO4 into the fibre plus extractor from the top for each sample separately. When the sample preparation was complete then the switch on the fibre plus extraction unit was ON and set the initial temperature at 500°C. Tap water was allowed to flow slowly. Drain the acid from the sample after 45 minutes of boiling it, then rinse it with distilled water. The knob should be in vacuum mode while draining. Keep the knob in the pressure mode if draining does not work. The alkali wash process start in which pour the 150 ml of 1.25% NaOH into the fibre plus extractor from the top for each sample after that, the same process was applied to the acid wash process. The acid wash and alkali wash process after that the sample was kept in the oven dryer for 100°C for ½ hour until the crucible was free from moisture. Cool the crucible sample to the desiccators after weighted the sample. The crucible was kept in the muffle furnace at 400°C for ashing purpose after that, the sample was cooled in desiccators and noted the reading.

Calculation:

$$\text{Crude fibre (\%)} = \frac{W_1 - W_2}{W} \times 100$$

Where,

W = Weight of sample, g

W_1= crucible weight before ashing, g

W_2= Crucible weight after ashing, g

8. Total Sugars and Reducing Sugars

Extraction of sugar was done by following standard AOAC procedure (AOAC2000). One gram ground sample was extracted twice with 50 ml of 80 per cent ethanol followed by complete extraction four times with 70 per cent ethanol by refluxing on a boiling water bath for 30 min. The extract was taken in 100 ml. The contents in the flasks were stirred occasionally in 100 ml volumetric flask and the volume was raised to about 98 ml with distilled water. 1 ml of lead acetate was added to remove proteins and made the volume to 100 ml. Whatman No. 1 filter paper was used for the filtration process, and excess lead ions

from the filtrate were eliminated by adding sodium oxalate crystals after the filtration. The estimate of free sugars was done using the clear extract that was thusly prepared. The total sugars and reducing sugars were estimated by the method described in Ranganna (1986).

9. Organoleptic Evaluation

The evaluation of a product's flavour, aroma, appearance, and mouth feel as experienced by the senses of taste, sight, smell, and touch is known as organoleptic testing. Food products must be organoleptically tested to ensure they meet organisation and customer criteria.

Nutri-cereals based mahua Laddoo was subjected to sensory evaluation soon after preparation from nine judges following the 9-point hedonic rating scale. Hedonic tests are based on the panellists' positive or negative experiences or an open admission of personal liking or disliking. The product was evaluated for appearance, texture, taste, flavour, mouth feel and overall acceptability by trained, semi-trained and untrained panellist.

Microbial Analysis

Total plate count: A technique for determining the total quantity of microorganisms (mould, yeast, and bacteria) in a substance is called total plate count (TPC). The dilution phase of the sample is where the research gets started, up to a dilution level of 10-5. Each 1 ml of the dilution sample was placed into a 15-20 ml petri plate to perform the microbial total analysis. The petri dish's sample is raised and frozen. Incubation is the last step, which involves placing a petri dish upside down in the incubator. 24-48 hours of incubation are spent at 36°C. The most recent computation and colony growth tracking.

Yeast and mould count: Total Yeast and Mold Counts (TYMC) are used to identify live yeast and mould species as well as to detect and measure fungal development on plant material. The amount of fungi is determined by counting the number of colony forming units (CFUs). The current maximum CFU limit for the state of Colorado is fewer than 10,000 CFUs.

RESULTS AND DISCUSSION

Statistical analysis of nutri-cereals based mahua Laddoo Jaggery sample (A).

After the statistical analysis of sensory evaluation of nutri-cereals based Mahua Laddoo (jaggery), the first important factors such as appearance and its mean, median, mode, Standard deviation, Kurtosis and Skewness was found to be 8.7,9,9,0.5,-1.7 and -0.9 respectively. Texture was determined to have mean, median, mode, standard deviation, kurtosis, and skewness values of 8.8, 9.9, 0.4, 0.7, and -1.6, respectively. Texture was the second crucial element. The average, median, mode, standard deviation, kurtosis, and skewness of the third most significant component, taste, were determined to be 8.9, 9.9, 0.3, 9.9, and -3, respectively. The average, median, mode, standard deviation, kurtosis, and skewness of the fourth critical element, flavour, were determined to be 8.3, 9, 9, 0.9, -1.1, and -0.8, respectively. Mouth feel was the fifth crucial element, and its mean, median, mode, SD, kurtosis, and skewness were found to be 8.7, 9.9, 0.5, -1.7, and -0.9, respectively. Overall acceptability, which was the sixth crucial element, had mean, median, mode, standard deviation, kurtosis, and skewness values of 8.7, 8.6, 9, 0.3, -2.1, and 0 correspondingly. The Statistical analysis of Nutri-cereals based mahua Laddoo Jaggery sample (A) data is shown in Table

Table 4.2 Statistical analysis of Nutri-cereals based mahua Laddoo Jaggery sample (A)

Jaggery sample (A)	Mean	median	mode	Normative deviation	Kurtosis	Skewness
Appearance	8.7	9	9	0.5	-1.7	-0.9
Texture	8.8	9	9	0.4	0.7	-1.6
Taste	8.9	9	9	0.3	9	-3
Flavour	8.3	9	9	0.9	-1.1	-0.8
Mouth feel	8.7	9	9	0.5	-1.7	-0.9
Overall acceptability	8.7	8.6	9	0.3	-2.1	0

Nutri-cereals-based Mahua Laddoo Sugar sample (B) statistical analysis

After the statistical analysis of sensory evaluation of nutri-cereals based Mahua Laddoo (jaggery), the first important factors such as appearance and its mean, median, mode, Normative deviation, Kurtosis and Skewness was found to be 8, 8,8 ,0.7, -0.3 and 0 respectively. The second important factors, was texture and its mean, median, mode, Normative deviation, Kurtosis and Skewness was found to be 7.8, 8, 8, 0.7, 0.7 and -1.6 respectively. The third important factors, was taste and its mean, median, mode, Normative deviation, Kurtosis and Skewness was found to be 7.8, 8, 8, 0.4, 0 and -0.3 respectively. The fourth important factors, was flavour and its mean, median, mode, Standard deviation, Kurtosis and Skewness was found to be 7.6, 8, 8, 1, -0.4 and -0.7 respectively. The fifth important factors, was mouth feel and its mean, median, mode, Standard deviation, Kurtosis and Skewness was found to be 7.9, 8, 8, 0.8, -1 and -0.2 respectively. Overall acceptability, which was the sixth crucial component, had the following mean, median, mode, standard deviation, kurtosis, and skewness values: 7.8, 7.4, 0.5, -0.3, and -0.6, respectively. The Statistical analysis of Nutri-cereals based mahua Laddoo Sugar (sample B) data is shown in **Table**

Sugar sample (B)	mean	median	mode	Normative deviation	kurtosis	Skewness
Appearance	8	8	8	0.7	-0.3	0
Texture	7.8	8	8	0.7	0.7	-1.6
Taste	7.8	8	8	0.4	0	-0.5
Flavour	7.6	8	8	1	-0.4	-0.7
Mouth feel	7.9	8	8	0.8	-1	0.2
Overall acceptability	7.8	8	7.4	0.5	-0.3	-0.6

Table Statistical analysis of Nutri-cereals based mahua Laddoo sugar sample (B)

Kurtosis: Kurtosis is a measure of whether the data are heavy-tailed or light- tailed relative to a normal distribution.

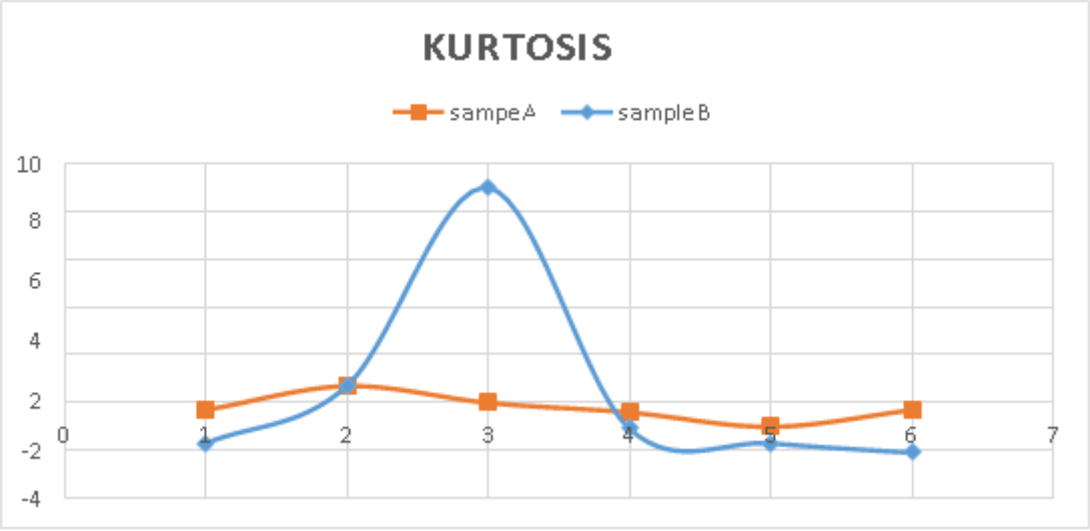


Fig Kurtosis based Visual consumer's Acceptability Score Profile for Sample A & Sample B

Skewness: A measure of symmetry, or more specifically, the absence of symmetry, is called skewness. If a distribution or data set appears the same to the left and right of the centre point, it is said to be symmetric.

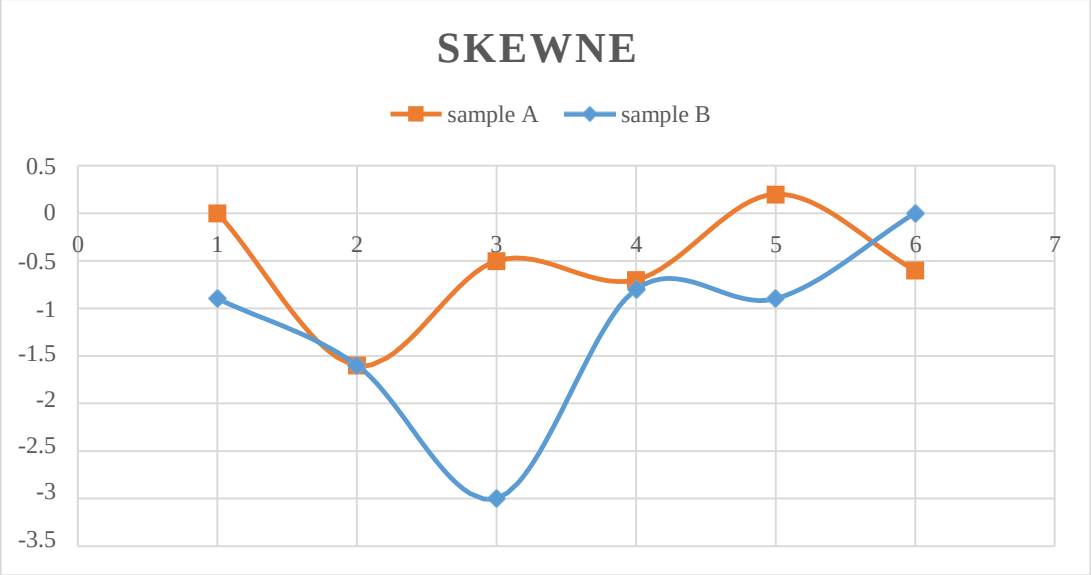


Fig Skewness based Visual consumer's Acceptability Score Profile for Sample A & Sample B

PROFILING OF NUTRI-CEREALS BASED MAHUA LADDOO

Composition of nutri-cereal based mahua laddoo

The final nutri-cereals based mahua Laddoo was prepared using optimized parameters. The product, so prepared was tested for physic-chemical properties and microbiological studies and the results are presented in Table 4.4

Table 4.4 Proximate composition of Nutri-cereals based Laddoo sample A (Jaggery)

Parameters	Result per 100gm
Moisture (%)	3.15
Protein (%)	8.55
Fat (%)	13.88
Carbohydrates (%)	67.63
Ash (%)	1.912
Crude fibre (%)	4.84
Total sugar (%)	51.50
Energy (kcal)	429.64

The result of physic-chemical properties of nutri-cereals based Laddoo are presented in Table 4.4 Table shows that the value of moisture content, protein, fat, carbohydrates, ash, crude fibre, total sugar and energy found to be 3.15% , 8.55%, 13.88%, 67.63%, 1.912% and 4.84% , 51.50% , 429.64 kcal respectively.

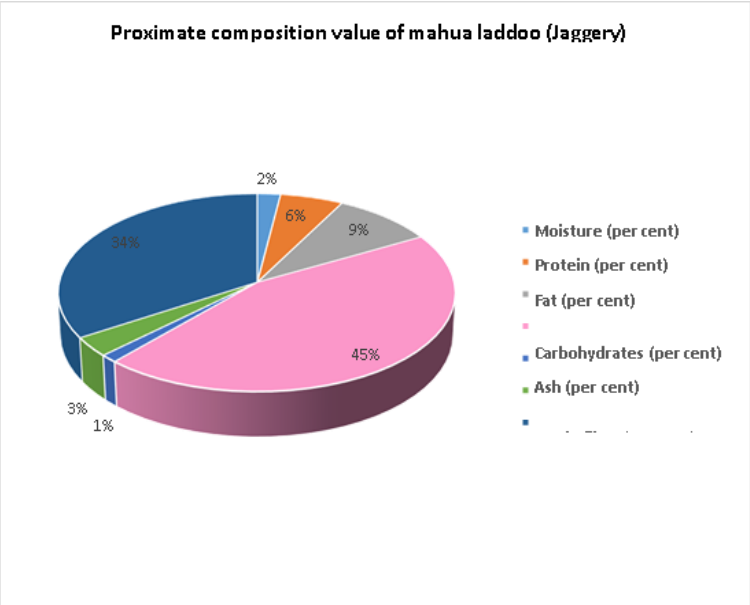


Fig Proximate composition value of Nutri-cereals based mahua Laddoo (Jaggery)

Microbial Analysis of Nutri-cereals based mahua laddoo

The microbiological quality in terms of the standard plate count, coliform count and yeast and mold count of optimized of Nutri-cereals based mahua laddoo was tested and there results are presented in Table 4.5

Microbiological analysis Parameters	Result
Standard plate count (log cfu/g)	2041
Coliform (log cfu/g)	<10
Yeast and Mold (logcfu/g)	<10

Table Microbiological analysis of Nutri-cereals based mahua Laddoo jaggery (Sample A)

Table. shows that ,the standard plate count, coliform, yeast and mold count observed in nutri- cereals based Laddoo were found to be 2041,<10 and <10 respectively.

CONCLUSION

The present investigation entitled, "Development of nutri-cereals based mahua (Madhuca longifolia) laddoo" was planned and conducted with an idea to prepare and to assess the proximate composition of laddoo. The study was carried out in the two phases. In the first phase, formulation for nutri cereal based mahua Laddoo was prepared with two variations with jaggery and sugar and analysing the best sample and higher acceptability using a score of 9-point hedonic scale. In the second phase, statistical analysis, nutritional, physic-chemical and microbiological characterization of developed Laddoo was carried out. The result of analysis of variance on the certain retained for the study involving the reducing drying rate to evaluate the effect of treatment on the product quality and the maximum drying rate and final time for the evolution of the process. the factor having the most effect on the variance of reducing temperature. The variance of maximum drying rate was explained by two factor variety. The microwave drying different factor on the variance of different retain criteria reducing *moring* leaves maximum drying rate duration of drying time. A small effect of 6% of the forward backward frequency of the conveyer and product shape.

The present investigation resulted in the development of a nutri-cereals based mahua laddoo based galactogoue product with highly acceptable quality attributes. In view of

the findings of the present study, it may be concluded that the nutri-cereals based mahua Laddoo developed under the study showed a nutritional profile which is highly suitable for lactating women. Also in terms of organoleptic quality, the product was found to be highly acceptable.

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