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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 percent 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 fiber, 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.

INTRODUCTION

Mahua (Madhuca longifolia) belongs to family sapotaceae and finds origin in different regions of India, Sri Lanka, Myanmar and Nepal. It is a multipurpose tree which fulfils three fundamental needs of tribal individuals i.e. Food, Fodder and Fuel (Patel et al., 2011). In India, large quantities of mahua trees are found in the states of Uttar Pradesh, Madhya Pradesh, Orissa, Jharkhand, Chhattisgarh, Andhra Pradesh, Maharashtra, Bihar, West Bengal, Karnataka, Gujarat, Rajasthan and the evaluated annual production of mahua flowers is 45000 Million tonnes during the yield of mahua flowers varies from 80-320 kg for every tree. Madhya Pradesh is the most astounding mahua developing state with average trade volume of 5,730 metric tonnes and worth about Indian rupees 8.4 million. India is known for wide diversity of such plants, which are utilized traditionally and have significance of being commercialized such as mahua, rhododendron, kachnar, moringa, gulmohar, palash, etc. Mahua is one of those plants which are occupying novel space in the ethnic as well as economical life of the traditional people (Vishal et al., 2020).

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Mahua is a frost resistant species that can grow in marginal areas of dry tropical and subtropical forests up to an altitude of 1200-1800 m, in India. It requires mean annual temperature of 2-46°C, mean annual rainfall ranging from 550-1500 mm and mean annual humidity from 40-90 percent. Mahua trees are distributed from India to other Asian countries like The Philippines, Pakistan, and Sri Lanka to Australia. It can be found scattered in pasture lands in central India, and on river banks in semi- evergreen forests. The tree grows on a wide variety of soils but thrives best on sandy soil. It also grows on shallow, boulder, clayey and calcareous soils.

Mahua is an evergreen tree that grows up to 70 feet tall. The tree grows and begins yielding fruit at the age of 8-15 years, and it can bear fruit for up to 60 years. A medium-sized to the big deciduous tree with a short, holed, rounded, and shaded crown found across India's green forest region up to an altitude of 1,200 meters and a height of 12 to 15 meters. Rough, thick, dark-coloured bark with fractures and fissures. The inner bark, on the other hand, is dark crimson and oozes a milky white sap when sliced. The leaves are elliptical in shape, leathery on the underside with a hairy underside, and 10-30 cm long, with pointy ends with strong nerves. Furthermore, leaves are epileptic or elliptic-oblong 7.5 to 23 cm into 3.8 to 11.5 cm with entire but waxy margins, fluorescent laboured near branch ends, (Verma et al., 2010).

Mahua flower is one of the most important non-timber forest produce (NTFP), playing a major role in the tribal economy of the country. The economic importance of mahua can be gauged from the fact that nearly three-fourth of entire tribal households in the country are involved in collection of mahua flower, which indicates approximately 7.5 million individuals are in this livelihood activity. The mahua flowers hold a special place in the lives of tribal communities. It is their source of livelihood; their food and drink also come from it. And it is a crop for which they do not have to spend any money. Tribe's generally barter mahua for daily grocery items, the value of which is considerably more than the actual value of mahua traded.

Mahua flowers contains a good amount of Vitamin-C which is responsible for its antioxidant activity. Flowers also contain a good amount of minerals such as calcium and phosphorus with a good amount of carotene which acts as a precursor of Vitamin-A. Several studies have also been done to study the medicinal properties of mahua flowers such as anti-helminthic, antibacterial, analgesic, hepatoprotective, antioxidant and anticancer. The high reducing sugar and nutritional content of mahua flowers and well known. The plant's flowers are tasty. 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 is not only used in preparation of liquor but can also utilized as a food ingredient for preparation of biscuit, cake, laddu, candy, bar, jam jelly, sauces etc. Mahua oil is used for manufacturer of laundry soaps and detergent, and also used as cooking oil in various tribal region of India. (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 and Singh, 2015). One

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of traditional medicinal plant loaded with nutrients is mahua (Madhuca longifolia). Maduca commonly known as mahua or butternut forest tree. Mahua is a highly nutritious tree and can also use as an herbal medicine for treatment of various disease. Phytochemistry study of mahua showed that it is rich in sugar, vitamin, protein, alkaloids, phenolic compounds etc. Mahua flower is not only used in preparation of liquor but can also utilized as a food ingredient for preparation of biscuit, cake, Laddoo, candy, bar, jam jelly, sauces etc (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 and Padhan, 2013).

Pregnancy and lactation are two stages of life when an adult woman's nutritional needs are increased. She has the responsibility of supporting the growth of fetus internally during nine months of pregnancy and later externally by nursing the infant. Since the growth need at the commencement of life are crucial, good nutrition is a must for the expectant and nursing mother. A satisfactory diet during pregnancy will ensure a good store of nutrients or satisfactory breastfeeding. Inadequate nutrition during lactation is reflected on both the quality and quantity of milk secreted (Ramadas et al., 2011).

Wheat is a grass widely cultivated for its seed, a cereal grain which is a worldwide staple food. The many species of wheat together make up the genus Tritium; the most widely grown is common wheat (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 third week of January and reaches higher rate of increasing trends after 20th February. Wheat is grown in India on 33.61 Mha and produces of 106.21mt with national average yield of 3160 kg/ha during 2019-20 (Anonymous, 2020a).The wheat crop requires favorable winter for about 100-110 days for producing its potential yields. Therefore, the heat tolerant wheat variety is still one of the priorities of agricultural research, because above the optimum temperature (22-24°C) wheat yield is drastically affected. About 50 per cent of the wheat in Chhattisgarh is planted after first week of the December and suffer from heat stress resulting in significantly yield losses. Late planted wheat suffers drastic yield losses which may exceed to 40-50 per cent. It has already been established that heat stress can be a significant factor in reducing the yield and quality of wheat. Heat stress is a major challenge to wheat productivity in India. The productivity of wheat in the state is around 12.50 qt ha-1 which is far lower than the national productivity 29 qt ha-1 (Agrawal et al., 2007).

Millets are minor cereals of the grass family, Poaceae. They are small seeded, annual cereal grasses, many of which are adapted to tropical and arid climates and are characterized by their ability to survive 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 is also commonly known as Koracan in Srilanka and by different names in Africa and has traditionally been an important millet staple food in the parts of eastern and central Africa and India (FAO, 1995). Traditionally in India, finger millet was processed by methods such as grinding, malting, and fermentation for products like beverages, porridges, idli (Indian fermented steamed cake), dosa (Indian fermented pan cake), and roti (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 fiber 11.5%, 59.5–61.2% starch, 6.2–7.2% pentose's, 1.4–1.8% cellulose, and 0.04–0.6% lignins. The dietary fiber content of finger millet 11.5% is much higher than the fiber content of brown rice, polished rice, and all other millets such as foxtail, little, kodo, and barnyard millet. However, the dietary fiber content of finger millet is comparable to that of pearl millet and wheat. Finger millet starch comprises amylose and amylopectin. The amylase content of finger millet starch is lower 16% compared to the other millets such as sorghum 24.0%, pearl millet 21.0%, proso millet 28.2%, foxtail millet 17.5%, and kodo millet 24.0% (Shobana et al., 2013).

Sesame (Sesamum indicum L.) belonging to the order tubiflorae, family Pedaliaceae, is a herbaceous annual plant cultivated for its edible seed, oil and flavorsome value. It is also known as gingelly, til, benne seed and popularly as "Queen of Oilseeds" due to its high degree of resistance to oxidation and rancidity. Sesame seed contains 50-60% of high quality oil which is rich in polyunsaturated fatty acids (PUFA) and natural antioxidants, sesamin, sesamolin and tocopherol homologues Sesame is a rich source of macro and micro nutrients including proteins, dietary lignans, vitamins, calcium, phosphorous. The chemical composition of sesame shows that the seed is an important source of oil (44–58%), protein 18–25%, carbohydrate 13.5% and ash 5%. Sesame oil is known since Vedic times and is the most esteemed oil in ayurveda. Sesame oil is known for its healing properties and has a reputation as a sedative in Tibetan medicine and also used for millennia in Chinese system of medicine. In ayurveda, sesame is known to cure Tridoshas. (Pathak et al., 2014).

The importance of mahua Laddoo among the people in Chhattisgarh state. Mahua Laddoo is a ball shaped popular sweet in Indian subcontinent. Nutri-cereals based Laddoo is made up of mixes of different flours and functional food ingredient 'Mahua' is also a galactogogue ingredient, which is given to lactating women for increasing the breast milk during the lactating period. Keeping in view, the nutritional profile of mahua flower, wheat, finger millet and sesame seeds, an attempt has been made in the current research project to develop a nutri-cereals based mahua (Madhuca longifolia) Laddoo for lactating women.

MATERIALS AND METHODS

Raw Ingredients:

- Dried Mahua flowers
- Wheat

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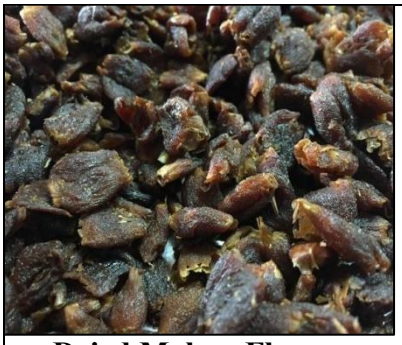
- Finger millet
- sesame
- jaggery/ Sugar
- Ghee

Formulation of Laddoo

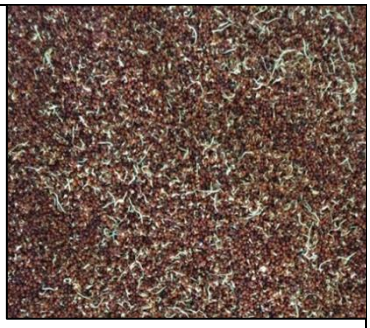
Table Different ingredient with their levels for sample A and sample B

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

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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.

Physico-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 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 a desiccators after cooling it was the moisture content was calculated using the following Formula:

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

Where,

W_1 = Initial weight of the sample, g

W_2 = Final weight of the sample, g

2. Fat Content

According to A.O.A.C. (2000) the fat content of 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 minute and 150°C for 30 minute 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 desiccators and weight.

Calculation:

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)

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3. Protein Content

Nitrogen content of 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 (K2SO4 & CuSO4 in the ratio of 5:1). Take 10 ml H2SO4 solution pour in the sample. The sample was felt into all the tube but one tube was blank in which only the 10 ml H2SO4 was fill. 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 minute 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:

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

Amount of protein was obtained by multiplying the nitrogen (%) with the appropriate Conversion factor (i.e.6.25) expressed on 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 into the muffle furnace and the muffle furnace temperature was maintained at 550℃ for 3 hour 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).

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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 Fiber

Crude fiber 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 fibra plus extraction unit. The crucible was properly sealed with the adapter rubber. In the fibra plus extractor, do not blank any place without crucible. Acid wash was done by pouring 150 ml of 1.25% H2SO4 into the fibra plus extractor from the top for each sample separately. When the sample preparation was complete then the switch on the fibra plus extraction unit was ON and set the initial temperature at 500°C. Tap water was allowed to flow slowly. After 45 minute boiling the sample, drain the acid and wash the sample with distilled water. During draining the knob should be vacuum mode. If draining is not effective then keep the knob in the pressure mode. The alkali wash process start in which pour the 150 ml of 1.25% NaOH into the fibra 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:

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

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. Filtration was done by using Whatman No.1 filter paper and excess leadions from the filtrate was removed by the addition of sodium oxalate crystals following by the filtration. The clear extract so obtained was then used for the estimation of free sugars. The total sugars and reducing sugars were estimated by method described in Ranganna (1986).

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9. Organoleptic Evaluation

Organoleptic testing involves the assessment of flavour, odour, appearance, and mouth feel of a product that individual experiences via the senses- including taste sight, smell and touch. The organoleptic testing of food products is essential in ensuring products comply with organisation and customer requirements.

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 pleasant/ unpleasant experiences of panellists or an honest expression of panellist's 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: Total Plate Count (TPC) is a method of estimating the total number of microorganisms (mold, yeast, bacteria) in a material. The research begins with dilution phase of the sample until it reaches 10-5 dilution. Microbial total analysis was done by taking each 1 ml of dilution sample and inserted into 15-20 ml petri dish. The sample in the petri dish is lifted to freeze. The final stage is incubation by inserting a petri dish in an upside position into the incubator. Incubation is carried out at 36°C for 24-48 hours. Last done calculation and recording colony growth.

Yeast and mould count: Total Yeast and Mold Counts (TYMC) are used to detect and quantify fungal growth on plant material, as well as to identify viable yeast and mould species. The number of colony forming units is used to calculate the amount of fungi (CFUs). The state of Colorado's current maximum CFU limit is less 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. The second important factors, was texture and its mean, median, mode, Standard deviation, Kurtosis and Skewness was found to be 8.8, 9, 9, 0.4, 0.7 and -1.6 respectively. The third important factors, was taste and its mean, median, mode, Standard deviation, Kurtosis and Skewness was found to be 8.9, 9, 9, 0.3, 9 and -3 respectively. The fourth important factors, was flavour and its mean, median, mode, Standard deviation, Kurtosis and Skewness was found to be 8.3, 9, 9, 0.9, -1.1 and -0.8 respectively. The fifth important factors, was mouth feel 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. The sixth important factors, was overall acceptability and its mean, median, mode, Standard deviation, Kurtosis and Skewness was found to be 8.7, 8.6, 9, 0.3, -2.1 and 0 respectively. The Statistical analysis of nutri-cereals based mahua Laddoo Jaggery sample (A) data is shown in Table

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Jaggery sample (A)	Mean	median	mode	Standard 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

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

Statistical analysis of nutri-cereals based mahua Laddoo Sugar sample (B).

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, 8,8 ,0.7,-0.3 and 0 respectively. The second important factors, was texture and its mean, median, mode, Standard 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, Standard 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. The sixth important factors, was overall acceptability and its mean, median, mode, Standard deviation, Kurtosis and Skewness was found to be 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	Standard 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 acceptibility	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.

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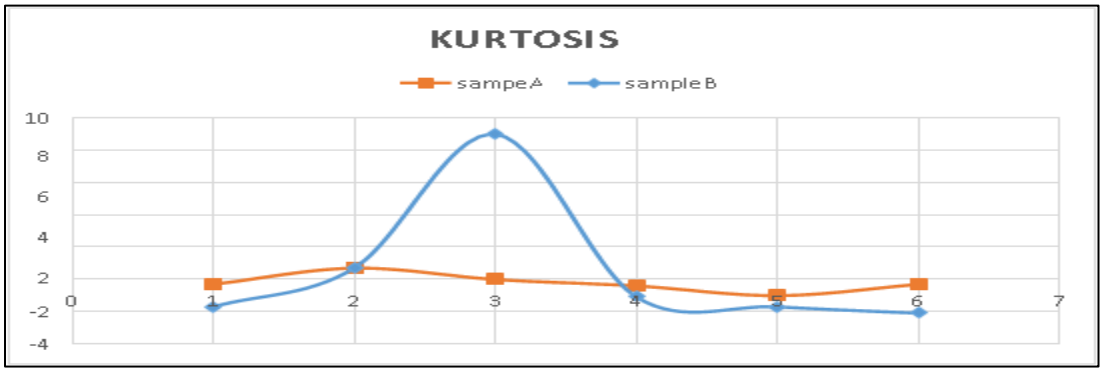

Fig Kurtosis based Visual consumer's Acceptability Score Profile for Sample A & Sample B

Skewness: Skewness is a measure of symmetry, or more precisely, the lack of symmetry. A distribution, or data set, is symmetric if it looks the same to the left and right of the center point.

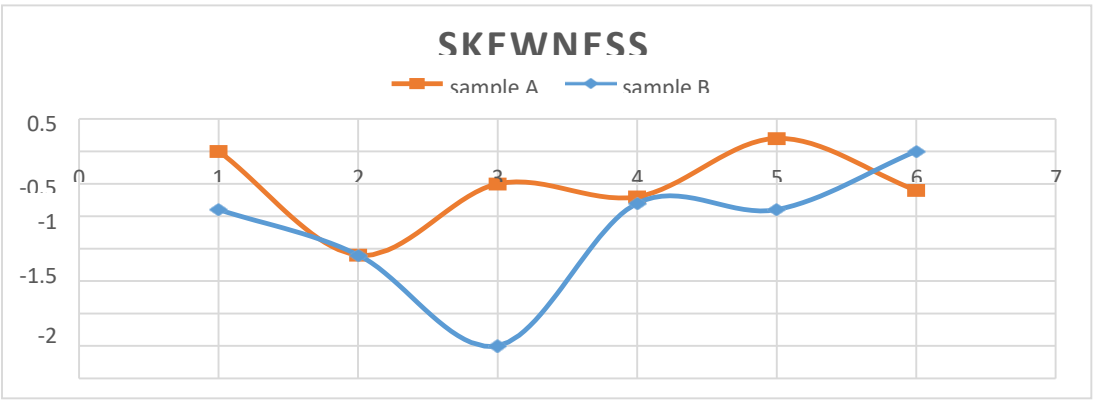

Fig Skewness based Visual consumer's Acceptability Score Profile for Sample A & SampleB

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 physico-chemical properties and microbiological studies and the results are presented in Table 4.4

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

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

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The result of physico-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 fiber, 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.

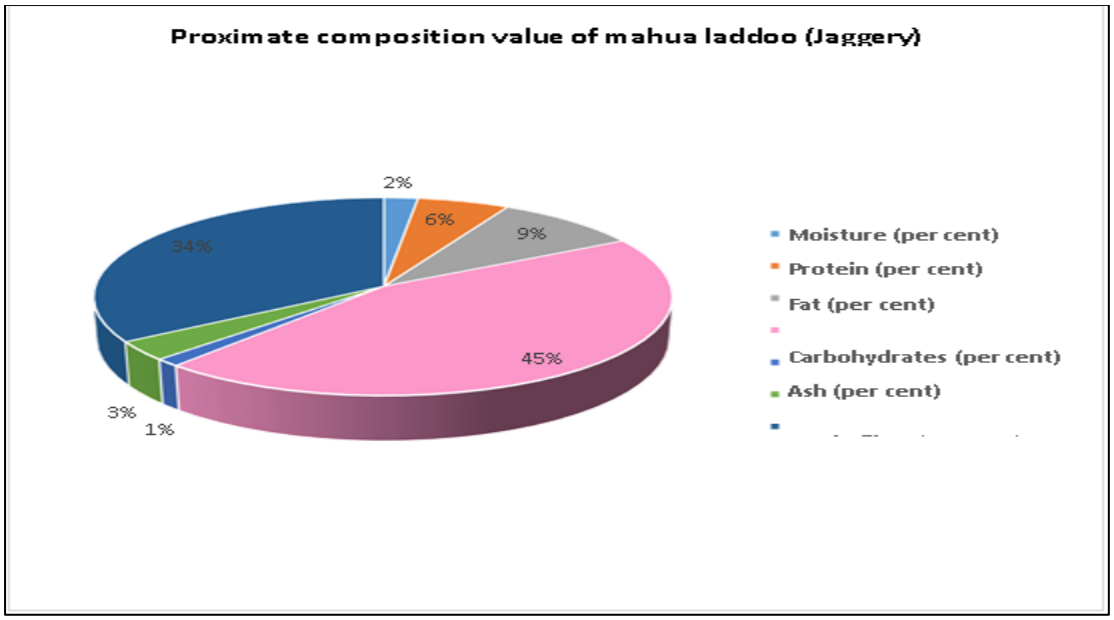

Fig Proximate composition value of nutri-cereals based mahua Laddoo (Jaggery)

Microbial Analysis of Nutri-cereals based mahua laddoo

The microbiological quality in terms of th 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 first phase, formulation for nutri cereal based mahua Laddoo was prepared with two variations with jaggery and sugar and

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analyzing the best sample and higher acceptability using score of 9-point hedonic scale. In second phase, statistical analysis, nutritional, physico-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 6% of the forward backword 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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