



Development and Evaluation of Nutrient Rich Mixed Seed Laddu

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ABSTRACT: Mixed seed laddu is an snack which is prepared by different types of seeds namely Pumpkin seeds, Sunflower seeds, Watermelon seeds, Flax seeds, Chia seeds, almonds, cashew, pasta, jowar flour for better health benefits , these seeds are Nutritionally rich foods , This study focuses on the development of mixed seed laddu—a nutrient-dense snack composed of various seeds including pumpkin, sunflower, watermelon, flax, chia, as well as almonds, cashew, and pistachio. The aim was to create a nutritionally rich product by varying seed proportions and analyzing its sensory attributes and shelf-life stability. Three formulations were tested: Sample A (30% RF, 10% PS, 10% WS, 15% SS, 10% CS, 10% FS, 15% OI), Sample B (25% RF, 10% PS, 15% WS, 15% SS, 5% CS, 15% FS, 5% OI), and Sample C (30% RF, 10% PS, 10% WS, 15% SS, 10% CS, 10% FS, 15% OI). Sensory evaluations conducted by a taste panel indicated that Sample A demonstrated superior organoleptic properties compared to the other formulations. Nutritional analysis revealed that Sample A contained 599 kcal/100g, with 73.8g carbohydrates, 9.5g fat, 4g protein, 1.4g dietary fiber, negligible sugar, and notable amounts of phosphorus (57.9 mg), calcium (28.2 mg), and iron (0.6 mg) per 100g. During a one-month storage period, the total viable and coliform counts increased slightly, from 1 to 2 and 1 to 1.5, respectively. However, no harmful bacteria (*E. coli*, *Salmonella*, or *Staphylococcus*) were detected at any time. Sensory scores for color, odor, and taste of Sample A decreased from 4.5 to 4.0, while the texture score remained constant at 4.0. The results indicate that Sample A is a high-quality, nutritious snack with good sensory attributes and acceptable shelf-life stability.

KEY WORDS: Mixed seeds, Microbial analysis, Nutritional rich, Sensory analysis.

INTRODUCTION

A Pumpkin seed also known in America as a pepita is the edible seed of a pumpkin or certain other cultivars of squash. The seeds are typically flat and oval with one axis of symmetry, have a outer husk and are light green in are grown only for their edible seed .the seeds are nutrient and calorie rich with an especially high content of fat particularly linoleic acid and oleic acid ,protein, dietary fiber, and numerous micronutrients. pumpkin seed refer either to the hulked kernel or un hulled whole seed, and most commonly refers to the roasted end product used as a snack. [Smith Bruce D , May 2020].

One of these foods is pumpkin seed oil, which has been used in culinary and traditional medicine, but recent data also show its use in the pharmaceutical and cosmetic industries. In addition, some sources refer to it as a potential functional food, mainly because it is obtained from pumpkin seeds, which contain many functional components.[El-Kalek et al 2011].

Sunflower seeds are harvested from the flower head of the sunflower plant. While the seed itself is encased in a black and white striped shell, sunflower seeds are white and have a tender texture. Known for their distinct nutty flavor and high nutritional value, you can eat the seeds raw, roasted, or incorporated into other dishes.[Poonam sachdev,sep 2022].

Among the different varieties of sunflowers, the Shamshiri variety is widely and commercially cultured in Iran. This variety has long black seeds with thin hulls that are detached from the kernel. The objective of this study was to determine some properties of this sunflower variety namely: size, thousand seeds mass, true density, bulk density, porosity, static coefficient of friction, angle of repose, fracture resistance, and impact damage.[Jafari, S., Khazaei ,2011].

Watermelon (*Citrullus lanatus*) a fruit crop, is a herbaceous creeping plant belonging to the family *Cucurbitaceae*. It is mainly propagated by seeds and thrives best in warm areas. It is a tropical plant and requires a lot of sunshine and high temperature of over 25°C for optimum growth. Watermelon thrives best in a drained fertile soil of fairly acidic nature. It can be grown along the coastal areas of Ghana, the forest zone and especially along river beds in the Northern Savannah ares [Tabiri, B. 2016]



Good health is a challenge of modern-day living as the current civilization is plagued by several degenerative lifestyle diseases. With rapidly changing global health scenario and fast realization of the ill effects of uncontrolled food processing and overmedication; plant products have gained the well-deserved attention. Growing awareness about the role of diet and quest for wellness has fuelled interest in foods that can work like medicine. ‘Functional foods’ or ‘nutraceuticals’ are foods or dietary components that may provide a health benefit beyond basic nutrition. Functional foods deliver a health boost beyond what is expected from their traditional nutrient content. Functional attributes of many traditional foods are being discovered, while new food products are being developed with beneficial components. Flaxseed continues to surge forward in its recognition as a functional food, being rich in the essential omega-3 fatty acid, alpha linolenic acid and many phytochemicals. Flaxseed also provides dietary fibre and protein (lax primer) and was singled out as one of six nutraceuticals. Flaxseeds combined with an abundance of omega-3 fatty acids makes them an increasingly popular addition to the diets of many a health conscious consumer [Katare, 2012]

2. MATERIALS AND METHODS

2.1 Raw Materials

The raw materials selected for this study were Ragi flour, pumpkin seeds, watermelon seeds, sunflower seeds, flax seeds, chia seeds, dates, pink Himalayan salt, and ghee were purchased from the local market in Shapur Nagar, Hyderabad. The present study was carried out in Capital Degree and PG College, Hyderabad, Telangana, India.

2.2 Formulation of Mixed Seed Laddu

Prepare our product using ragi, pumpkin, peanut seeds, sunflower seeds, flax seeds, chia seeds, jaggery, sugar, dates and other ingredients.

Table 1: Formulation of Mixed Seed Laddu

Samples	Combinations
Sample - A	RF30%+PS10%+WS10%+SS15%+CS10%+FS10%+OI15%
Sample -B	RF25%+PS10%+WS15%+SS15%+CS5%+FS15%+OI15%
Sample - B	RF20%+PS15%+WS20%+SS10%+CS15%+FS5%+OI15%

RF-ragi flour, PS-pumpkin seeds, WS-water melon seeds, SS-sunflower seeds, CS-chia Seeds, FS-flax seeds, OI-other ingredients.

2.3 Method of preparing mixed seed laddu

Procurement of ingredients Soak all the seeds like pumpkin, water melon, sunflower, chia, and flax seeds along with dates Dry it for some time Now chop the dates in to small pieces Roast all the seed[mixed seeds like ps, ws, ss, cs, fs] Now grind the all the mixed seed Now take 10 ml of ghee for frying Now add the chopped dates of mix with ragi flour in to the kadai and fry it thoroughly for 3 min When it turn in to a fine paste kind of texture and mashy after 2 min add the grinded powdery and mix well and bind it well. Turn off the flame and bind the laddus..they are ready to serve.we can top them with some almonds .

2.4 Organoleptic Evaluation

The sensory evaluation was carried out for the prepared murukku samples using a 5-point hedonic scale with a panel of 20 judges considering the 6 parameters as Aroma, Appearance, Texture, Taste, Mouthfeel, and Overall acceptability.

2.5 Nutritional Evaluation

The nutritional evaluation of the best-selected sample was analyzed as follows

Table 2: Nutritional qualities and methods of the mixed seed laddu

NUTRIENT QUALITIES	METHODS
Energy	
Carbohydrate	CTL/SOP/FOOD/262-2014
Total fat	AOAC 20th Edn.2016, 920.39



Dietary fibre	AOAC 20th Edn.2016, 985.29
Protein	AOAC 20th Edn.2016, 986.25
Total Sugars	FSSAI Manual 2015-Beverages, Sugars, and Confectioneries
Calcium	IS 5949:1990 (RA.2003)
Magnesium	AOAC 20th Edn.2016, 999.11
Iron	AOAC 20th Edn.2016, 999.11

2.6 Antioxidant analysis of mixed seed laddu

The antioxidant activity of food sample laddu was evaluated using assays: DPPH (2,2-diphenyl-1-picrylhydrazyl), FRAP (Ferric Reducing Antioxidant Power), and ABTS (2,2'-azinobis(3-ethylbenzothiazoline-6-sulfonic acid)) assays. Each assay was conducted following standardized procedures.

Table 3: Antioxidant activity of the Laddu

Antioxidant activity	Units	Method
DPPH	ppm	Brand-Williams et al., 1995
FRAP	μmol Fe +2 /g	Benzie & Strain (1996)
ABTS	GAE/g	Re et al., 1999

2.7 Shelf-life Analysis of the mixed seed laddu

The selected mixed seed laddu sample was kept for one month of storage to know the shelf life by performing total viable bacteria, coliforms, E. coli, Salmonella, or Staphylococcus aureus, Yeast and Mould.

2.8 Statistical Analysis

Data obtained from sensory analysis were subjected to mean and standard deviation and it was statistically analyzed by one-way analysis of variance (ANOVA) by using a significance of 0.05.

3. RESULTS AND DISCUSSION

3.1 Organoleptic Evaluation

The organoleptic evaluation of the three samples was performed in IDA-Jeedimetla, Hyderabad. The data in the table-7 shows the average and the standard deviation of the sensory scores for different parameters. In the evaluation of appearance, Sample-A stood out with a visually appealing rating of 3.4 and a low standard deviation of 0.619, implying consistent agreement among evaluators. On the other hand, Sample B received a lower score of 2.245 and a larger standard deviation of 0.787, suggesting less uniformity in its appearance. Sample-C obtained a score of 2.5 with a standard deviation of 0.688, positioning it between the other two samples.

Table 4: Sensory parameters and Mean and Standard deviation of the different samples of mixed seed laddu

Parameter	SAMPLE-A	SAMPLE -B	SAMPLE -C
Aroma	2.55±0.861	2.155±0.579	2.25±0.665
Appearance	3.26±0.635	2.365±0.775	2.56±0.699
Taste	4.46±0.493	3.395±0.593	3.55±0.626
Texture	3.984±0.564	2.82±0.585	3.065±0.581
Mouth Feel	4.385±0.519	3.095±0.486	3.157±0.672
Over All Acceptability	4.45±0.54	3.395±0.589	3.34±0.667

NOTE: Score given as per five point Hedonic rating scale test.

In terms of texture, Sample-A received the highest rating of 3.978 with a small standard deviation of 0.575, indicating a pleasant and consistent texture. Sample B scored 2.92 with a comparable standard deviation of 0.577, suggesting moderate variability. Sample-C obtained a score of 3.085 with a standard deviation of 0.598, similar to Sample-B but slightly less consistent.

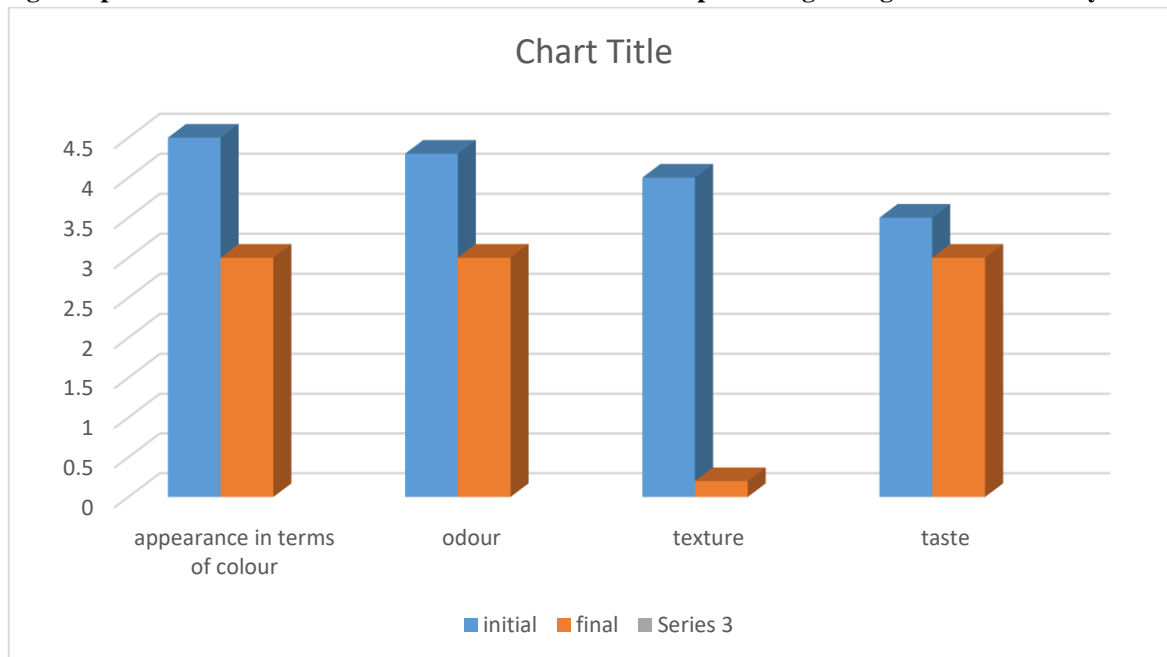


Regarding taste, Sample-A once again took the lead with a high score of 4.35 and a small standard deviation of 0.482, indicating a consistently favorable taste. Sample B scored 3.37 with a slightly larger standard deviation of 0.580. Sample-C received a score of 3.8 with a standard deviation of 0.622, falling between the other two samples.

In the mouthfeel category, Sample-A obtained a high score of 4.385 with a standard deviation of 0.519, providing a pleasant sensation to evaluators with good consistency. Sample B received a lower score of 3.075 with a smaller standard deviation of 0.466, indicating moderate variability. Sample-C scored 3.17 with a larger standard deviation of 0.69, suggesting a less consistent mouthfeel compared to the other two samples.

In overall acceptability, both Sample-A and Sample-B obtained high scores of 4.55 and 3.290 respectively, with small standard deviations of 0.7 and 0.539, showing high consistency in terms of acceptability. Sample C received a score of 3.6 with a standard deviation of 0.666, placing it between the other two samples in terms of overall acceptability. Based on the above results, sample A acquired desirable organoleptic scores. Similar studies were conducted by *Indu Bhargavi et al (2023)* on the development of nutri-bars using millets and there was no significant change in the organoleptic properties from the 0th day to the 30th day of storage conditions. Chart-1 indicates the calculation of the ANOVA value, where the calculated P-value (0.046) was lesser than the significance value $[\alpha]$ (0.05) and the F-value (3.7855) is greater than the F-critical value (3.6823), therefore it is concluded that there was a significant difference between the samples. The result of the ANOVA indicates that the sensory attributes had a notable impact on the samples. According to the study conducted by *Laghima Arora et al (2023)*, there was a notable difference ($p < 0.05$) observed in the resistant starch levels between the product derived from foxtail millet and conventional cereal, except for kheer.

Chart-2 Organoleptic evaluation of the selected mixed seed laddu sample during storage from the 0th day to the 30th day



3.2 Nutritional Analysis of the Selected Mixed Seed Laddu

The Selected mixed seed laddu of Nutritional Analysis shown in the table-3. Selected mixed seed laddu sample had an energy content of 599Kcal/100g, 73.8g of carbohydrates, 9.5g of total fat, 4g of protein, 1.4g of dietary fiber, 11.2/100gm of moisture, 1.5g of ash, 9.8g of reducing sugar, 5.7g of non-reducing sugar. The presence of both types of sugars contributes to the sweetness and energy content of the laddu. Reducing sugars are involved in browning reactions and contribute to flavor, while non-reducing sugars are less reactive.



Table 5: Nutritional analysis of mixed seed laddu

Parameter	Result	Units
Energy	599	K.Cal
Carbohydrates	73.8	g/100g
Protein	4	g/100g
Fiber	1.4	g/100g
Fat	9.5	g/100g
Moisture	11.2	g/100g
Ash	1.5	g/100g
Reducing sugar	9.8	g/100g
Non reducing sugar	5.7	g/100g

The dry fruit laddu was prepared by *tarla dalal 2022* which contain all the dry fruits Energy of 167 kcal ,protein is3.1 gm , carbohydrates 17.8 gm, fiber 2.7gm and fat 9.5gm . Hence this mixed seed laddu presents a well-balanced nutritional profile with high energy and carbohydrate content, moderate fat, and protein levels, and beneficial fiber. Its composition makes it a nutritious snack option, particularly for those requiring a calorie-dense food with a mix of macronutrients and fiber.

Table 6: Mineral analysis of mixed seed laddu

PARAMETER	RESULT	Units
Calcium	28.2gm	mg/100gm
Phosphorus	57.9gm	mg/100gm
Iron	0.6gm	mg/100gm
Magnesium	34.8gm	mg/100gm

The selected mixed seed laddu of mineral analysis shown in (Table 6). selected mixed seed laddu had a calcium levels of 28.2 gm/100gm, 57.9gm of phosphorus, 0.6gm of iron, and 34.8gm of magnesium. The dry fruit laddu is prepared by *tarla dala 2022* which contain all the dry fruits contain minerals like sodium of 2.4 mg and with zero cholesterol. Its balanced mineral content, including calcium, phosphorus, iron, and magnesium, supports various physiological functions and contributes to a well-rounded diet.

Antioxidant Analysis for mixed seed laddu

The results showed significant antioxidant activity (Table 7), with a DPPH radical scavenging activity of mixed seed laddu contain 1277ppm, 9.795mol of FRAP, 0.92 GAE/GM of total phenolic content. This high level of scavenging activity indicates a strong capability of the laddu to neutralize free radicals, reflecting its potent antioxidant properties. The high levels of DPPH radical scavenging, substantial FRAP values, and significant total phenolic content collectively indicate that this snack is a valuable source of antioxidants. These findings support the potential of mixed seed laddu as a nutritious and health-promoting food product, leveraging the inherent antioxidant properties of its seed components.

Table 7: Antioxidant Activity of mixed seed laddu

Parameter	Result	Units
DPPH	1277	Ppm
FRAP	9.795	µmol
Total phenolic content	0.92	GAE/g



Microbial analysis of mixed seed Laddu

After a one-month storage period, the microbial analysis of the mixed seed laddu was re-evaluated to assess any changes in microbial quality (Table 8). The total viable count increased from 100 CFU/ml to 120 CFU/ml during the storage period. Although there was a slight increase in microbial load, the count remains relatively low. This minor increase suggests that while some microbial growth occurred, it is still within acceptable limits. The low total viable count indicates that the laddu's quality and safety are maintained, and the product has been effectively preserved. The absence of coliforms throughout the storage period confirms that the laddu remains free from fecal contamination and maintains high hygienic standards. E. coli was not detected at any point during the storage period. The continued absence of E. coli signifies that there was no contamination with this pathogen. The absence of Staphylococcus aureus throughout the storage period indicates that the laddu remains free from this pathogenic bacterium, which is crucial for preventing foodborne illnesses.

Meherunnahar et al (2023) foxtail millet noodles were stored for 6 months and the microbial load was within limits. Dr. Sarojini JK et al (2021) The ready-to-cook kodo millet pasta was stored for 3 months and there were significant changes in the pasta, the pasta became rancid after 3 months of storage.

Table 8: Microbial analysis of mixed seed laddu

Parameter	Result
Total viable count	100 CFU/ml
Coliform	Absent
E Coli	Absent
Staphylococcus aureus	Absent
Yeast and mould	Absent

The absence of yeast and mould even after a month of storage highlights the product's resistance to fungal contamination. results suggest that the storage conditions have been effective in preventing spoilage and maintaining the laddu's quality. the mixed seed laddu showed good microbial stability and safety even after one month of storage.

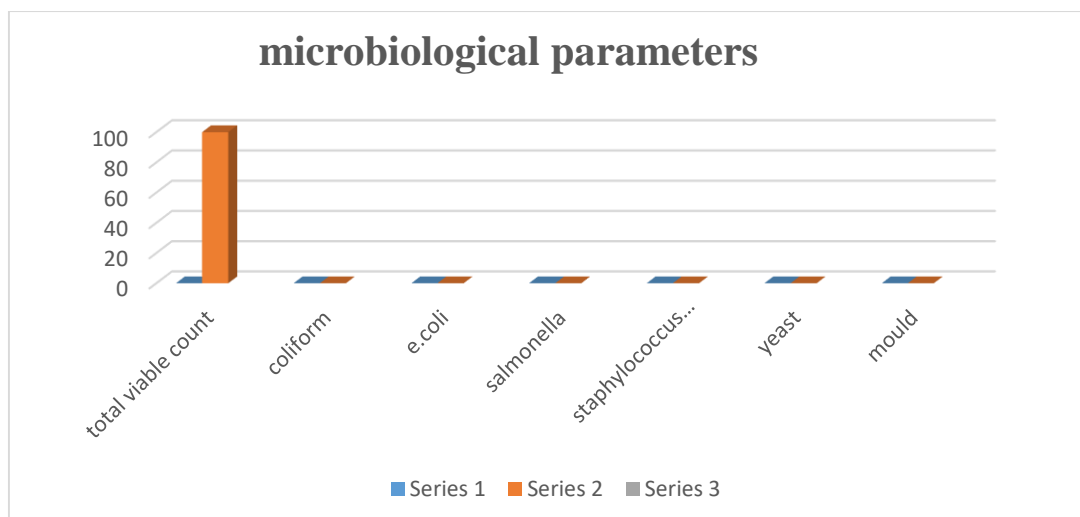


Chart-3 Microbiological parameters of the selected mixed seed laddu sample during storage

4. CONCLUSION

The study concluded that mixed seed laddu formulated with 75% with all the mixed seeds like pumpkin seeds, watermelon seeds, sunflower seeds, flax seeds, chia seeds, almonds and ragi flour, and 15% of other ingredients was highly acceptable in terms of organoleptic properties such as aroma, appearance, texture, taste, mouthfeel, and overall acceptability. The formulated mixed seed



laddu was also found to be highly nutritious and the formulated mixed seed laddu was good and within limits for a month. Hence, there is a scope for the development of mixed seed laddu using different type of mixed seeds and ragi.

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