

Development of Nutritional Granola Bites Incorporated with Kamarkas (Flame of Forest) and Lotus Seeds (*Nelumbinis semen*) to Treat PCOS

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Abstract

Polycystic Ovarian Syndrome (PCOS), a common endocrine condition, results from hormonal imbalance and is associated with risks such as diabetes, obesity, hypertension, insulin resistance, dyslipidemia, and cardiovascular disease. This study focuses on developing nutritional granola bites as an organic intervention for PCOS management. Unlike conventional medications, these granola bites are formulated with natural ingredients rich in bioactive compounds that address hormonal imbalances and improve overall health. The formulation incorporates nuts (almonds, cashews, pistachios, walnuts) and seeds (sesame, pumpkin, flax, sunflower), they include omega-3 fatty acids and lignans. These compounds reduce androgen levels, regulate estrogen, promote ovulation, and combat inflammation. Additional ingredients include kamarkas (rich in kenotannic acid for menstrual regulation), lotus seeds (high in magnesium for glucose regulation), and dates (fiber-rich to manage insulin resistance). The granola bites underwent comprehensive analysis for their nutritional and functional properties. Proximate composition revealed moisture ($13\pm0.02\%$), protein ($8.75\pm0.03\%$), ash ($2\pm0.04\%$), fat ($6\pm0.01\%$), fiber ($19\pm0.08\%$), and carbohydrate content ($51.25\pm1.71\%$). Other analyses showed a pH of 5.59 ± 0.01 , total soluble solids of $8.0\pm0.03^\circ\text{Brix}$, and color values ($L48\pm1.71$, $a10.5\pm0.02$, $b^*28.3\pm0.08$). The granola bites demonstrated antioxidant potential with DPPH radical scavenging activity (70 ± 2.36), total phenolic content (0.721 ± 0.008 mgGAE/g), and flavonoid content (0.49 ± 0.008 mgQAE/g). Consumption of six 5-gram bites daily helps reduce hormonal imbalances and regulate menstrual cycles. These granola bites offer a sustainable, functional food solution to manage PCOS symptoms, showcasing their potential as a natural therapeutic aid in improving women's reproductive health.

Keywords: PCOS, granola bites, hormonal imbalance, inflammation, nutritional deficiency, omega-3.

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INTRODUCTION

Poly cystic ovarian syndrome (PCOS) is viewed as an endocrine condition caused by hormonal disparity . It occurs in 5-18% of females who are at the age of reproductive and is becoming a major communal wellbeing complication throughout the world(S. Naveed, Ghayas, & Hameed, 2015). This disorder outlines symptoms like menstrual instability, an ovulatory infertility, and hyperandrogenism(Dilshad, Ismail, Naveed, Usmanhane, & Sarwar, 2016). Nuts are enriched with MUFA and PUFA (monounsaturated and polyunsaturated fatty acids), that are beneficial in curing PCOS . Walnuts are nutrient-dense, rich in PUFA- linoleic acid (LA) and α -linoleic acid (ALA) and several phytochemical nutrients i.e. protein, minerals, melatonin, polyphenol, protein, fiber, and arginine, which are correlated with reduction in cardiovascular (CVD) risk factors and other health problems

like cancer, PCOS, cognitive functions. Due to its cardio protective effect, consumption of walnut aids in improving blood lipid. It also improves central obesity and endocrine effects in PCOS women .Almonds are rich in protein, vitamin E, vitamin B2 (riboflavin), 30% MUFA and 12% PUFA.Almonds also improve insulin resistance. Insulin resistance in combination with abdominal weight gain also decreases fertility in women (Alam, Asif, Naveed, & Usmanhane, 2016; Hussain, Naveed, Mujeeb, & Tariq, 2023).Both, cashew nuts and pistachio nuts comprises of excellent bioactive compounds such as tocopherols, unsaturated fatty acids mostly MUFA, polyphenols, fibers and phytonutrients.Fatty acids in these nuts ensure healthy hormone levels. As polycystic ovarian syndrome is related to insulin resistance, studies suggested that these nuts play their role in lowering blood glucose as they are low glycemic food having low carbohydrates (S. Naveed & Sadia, 2021).

Pumpkin seeds contain important fatty acids belongs to the omega-3 and omega-6 groups. It has been established that estrogen hormone plays an important role in the menstrual cycle, reproduction, bone density inflection, and cholesterol movement throughout the body. Pumpkin seeds have a higher level of phytoestrogen, a polyphenol with estrogenic characteristics (Yang & Chen, 2024). Phytoestrogens are the primary factor in inhibiting cardiovascular output and lowering total cholesterol. Flaxseed, often known as linseed, is rich in α -linolic acid, omega-3 fatty acids, protein, fiber, and lignans. According to research, ingesting 30 g of flaxseed every day for four months helps to reduce testosterone levels, which is advantageous in the treatment of PCOS. Sunflower seed (*Helianthus annuus* L.) includes protein, fiber, vitamins (especially E), selenium, copper, zinc, folate, iron, and lignin. Magnesium, Selenium and vitamin E can reduce insulin resistance and enhance progesterone levels in PCOS patients. (Ali, Daniyal, Ismailov, Usmanghani, & Naveed, 2016). Date is best known for their nutritional, medicinal and functional properties. It provides high source of energy as the flesh of dates are enrich with sugar, mainly fructose and sucrose and low in fats and proteins., It may maintain the blood sugar levels, manage your body weight and reduce menopausal symptoms. Thus, it may help to stabilize the symptoms of PCOS. Kamarkas (flame of forest) is a herb used as medicine as it contains phytochemicals that help in preventing and treating PCOS. It also maintains the levels of glucose in your blood; help in preventing the diabetes so that directly lower the risk of PCOS (S. Naveed, Kauser, Shahid, & Farooqui, 2014). The main component of kamarkas is kenotannic acid that helps in regulating menstrual cycle and treating hormonal imbalance. Lotus seeds are low calorie; high fiber foods maintain blood sugar level and promote feeling of fullness which may be beneficial for women having PCOS struggling with weight management and insulin resistance (S. Naveed, Hameed, & Jaffery, 2014). Oats contain high levels of minerals, fiber and vitamins, such as B vitamins. The fibers in oats provide feeling of satiety for longer period by slowing down digestion, thus cause to eat less, which

benefit women having PCOS. The soluble dietary fibers in oats also help lowers cholesterol and sugar level thus improves insulin resistance. PCOS patients have low level of progesterone. Vitamin B in oats help increase progesterone level. Jaggery is used as a natural sweetener. The jaggery are rich in calcium, phosphorus, magnesium, potassium, iron, copper, zinc, folic acid and B-complex, that helps balance hormone and regulate blood flow. Since healthy snacks are in continuous demand and consumers are paying more attention towards their health and fitness, these granola bites are excellent replacement to those highly caloric meals. In this research paper, seeds and nuts are used to develop granola bites as they provide numerous nutrients and benefits to tackle with PCOS issues. On contrast lotus seed, kamarkas, oats and dates are utilized to develop this product which provides specific health benefits. These granola bites promote seed cycling as they contain all those essential seeds which are an effective cure for PCOS. All these ingredients aid in weight loss, proper hormonal functioning, reducing blood glucose and serve as key markers to insulin resistance. The primary goal of our investigation is to use organic ingredients as an excellent replacement of highly dosage medicines to treat PCOS and to promote use of healthy snack options. (Ghauri, Qamar, & Naveed, 2021)

MATERIALS AND METHODS

Procurement of raw materials

The composition of nutritional granola bites consists of a rich blend of seeds, nuts, jaggery, dates, and kamarkas, all sourced locally from the Karachi. The chemicals used for testing were high-quality products from Merck, Germany, and were procured by Jinnah University for Women. The recipe's foundation is 51% of oats, complemented by 2% each of lotus seeds, kamarkas, flax seeds, almonds, walnuts, cashews, pistachios, sunflower seeds, sesame seeds, and pumpkin seeds. To enhance sweetness naturally, the recipe incorporates 30% of jaggery and dates, respectively resulting in a nutritious and flavorful blend (Qamar, Naveed, Faizi, & Sana, 2021).

Development of nutritional granola bites

The preparation of nutritional granola bites involves several meticulous steps to ensure quality and safety. Initially, all ingredients are accurately weighed and thoroughly washed to eliminate any dirt or foreign particles. After washing, the materials are allowed to air dry at room temperature. Subsequently, the nuts, seeds, and oats are individually roasted over low heat to enhance their flavors (Nagarajan, Jacob, Mufti, Rajesh, & Dube, 2025). Dates are blended into a semi-solid consistency, and jaggery is melted separately. Each ingredient is then chopped to achieve a uniform particle size. In a mixing bowl, the chopped nuts, seeds, kamarkas, oats, blended dates, and melted jaggery are combined and mixed thoroughly to form a homogeneous mixture (Farooqi et al., 2024). This mixture is shaped into equal-sized portions and placed on a greased baking tray. Granola bites are baked in a preheated oven at 150°C for 15 minutes. Once baked, they are cooled to room temperature and kept in an airtight container to preserve freshness.

Roximate analysis

Moisture content

Moisture content of granola bites was determined according to standard procedure. The 3 g sample was then taken in dish and was spread uniformly. The dish with sample was then placed in the oven and dried for 4 h at 105 °C. The dish and dried sample were then reweighed. Moisture content was then calculated by using the formula:

$$\text{Moisture (\%)} = \frac{\text{Wt of sample before}}{\text{Wt of sample after}} \times 100$$

Protein content

Protein content was analyzed using the Kjeldahl method as outlined by method no 46-30 AACC. Approximately 2 g of sample was digested in a clean digestion tube with one digestion tablet and 30 mL of concentrated H₂SO₄. The mixture was gently heated for about 45 minutes and then further digested until a pale-green solution was obtained. After cooling, the digest was quantitatively transferred to a 250 mL volumetric flask and diluted to volume with distilled water.

During distillation, liberated ammonia was trapped in a 4% boric acid solution containing methyl red indicator. The distillation was continued until the indicator shifted from red to yellow. The collected distillate was subsequently titrated with 0.1 N H₂SO₄, using the appearance of a light-pink color as the endpoint. The amount of sulfuric acid used was recorded. To quantify total protein, the following formula was used to compute total nitrogen content which was then multiplied by a factor (6.38).

$$\text{Nitrogen (\%)} = \frac{\text{H}_2\text{SO}_4 \text{ (ml)} \times 250 \times 0.0014}{\text{Sample wt.} \times \text{digested sample vol. (digested)} \times 100}$$

Ash content

Ash content of granola bites was determined according to standard procedure (method no. 08-01 AACC, 2010). The pre-weighed crucible was taken and 5 g sample was placed in it. Crucible was then placed in a muffle furnace for direct burning at 550-600 °C for 5-6 hours until only white, gruesome, gloomy and miserable ash remained. After cooling in desiccator, the crucible was weighed. The equation below was used to determine the amount of ash:

$$\text{Ash (\%)} = \frac{\text{Wt of ash (g)}}{\text{Wt of sample (g)} \times 100}$$

Fat Content

Fat content was assessed using the Soxhlet extraction (method NO 30-25 AACC 2010). Approximately 2 g of sample was placed in an extraction thimble and inserted into the Soxhlet apparatus. A pre-dried 250 mL round-bottom flask was cooled in a desiccator, weighed, and filled with 80 mL of analytical-grade hexane. The flask was attached to the Soxhlet unit, and the extraction was carried out under reflux for 5 hours with controlled heating to avoid solvent loss. After completion, the solvent was evaporated, and the flask containing the extracted lipids was dried in an oven at 105 °C for 3 hours, cooled in a desiccator, and reweighed to determine fat content. The formula below was used to determine the amount of fat:

$$\text{Fat (\%)} = \frac{\text{Wt of sample before fat extraction} - \text{Wt of sample after fat extraction}}{\text{Original wt of sample}} \times 100$$

Carbohydrate content

The obtained value represents the sample's % carbohydrate constituent.

$NFE = 100 - (\% \text{ Moisture} + \% \text{ Ash} + \% \text{ Crude protein} + \% \text{ Fat} + \% \text{ Crude fiber})$

Analytical characterization

Color

Color is measured in three dimensions, the L (lightness), a* (red intensity), and b* (yellow intensity) using a digital colorimeter. According to CIE LAB system, spectral reflectance used as calibration mode, observation at an angle of 108 and illuminant D65.

pH

pH of the samples of granola bar is determined by using digital pH meter (Sadler and Murphy, 2010). 5 g sample was taken in a beaker and mix it with 20 mL distilled water. An electrode tip of pH meter was rinsed with distilled water. An electrode was then immersed in the sample. The results were recorded when reading became stable.

Total soluble solids

TSS in foods are determined by using refractometer. 5 g sample was taken in a beaker and mixed thoroughly with 20 mL distilled water. If solid particles still remain in the mixture, then filter it with cheese cloth. Put 2-3 drops of mixture on the prism of refractometer. Note the readings in degree brix.

Phytochemical analysis

DPPH Radical Inhibition Analysis

The antioxidant activity of granola bites was evaluated using the DPPH radical scavenging assay as described by Yu et al. (2002). A volume of 3 mL of sample extract was mixed with 1 mL of freshly prepared 0.004% DPPH solution in methanol and incubated in the dark for 30 min. The absorbance of the reaction mixture was recorded at 517 nm. Lower absorbance indicated stronger radical scavenging activity. BHT and ascorbic acid were used as reference antioxidants, while a blank solution without extract served as the

control. All measurements were performed in duplicate. The percentage DPPH inhibition was calculated using the standard formula:

$$\text{inhibition (\%)} = \frac{\text{Blank absorbance (A0)} - \text{Sample absorbance (A1)}}{\text{Blank Absorbance}} \times 100$$

Total flavonoids content (TFC)

Total flavonoid content of granola bites was quantified following the colorimetric method described by Hudz et al. (2019). Briefly, 5 g of sample was mixed with 5% NaNO₂ solution and 0.15 mL distilled water, followed by a 6 min incubation. Subsequently, 0.15 mL of 10% AlCl₃ solution was added and allowed to react for another 6 min. The mixture was then treated with 4% NaOH, and the volume was adjusted to 5 mL using methanol. After a 15 min incubation period, absorbance was recorded at 510 nm. Total flavonoid content was expressed as milligrams of quercetin equivalents per gram of dry sample, calculated using the following equation: $C = (c - V) / m$

Total phenolic content (TPC)

Total phenolic content was determined using the Folin–Ciocalteu colorimetric method as described by Hafiza et al. (2017). A standard calibration curve was prepared using gallic acid solutions (0.01–0.10 mg/mL), each mixed with 5 mL of ten-fold diluted Folin–Ciocalteu reagent and 4 mL of 20% sodium carbonate. After 1 h of incubation, absorbance was recorded at 750 nm and plotted against concentration to construct the standard curve. Total phenolic content was expressed as mg gallic acid equivalents per gram of dry sample and calculated using the following equation: $C = (c - V) / m$

Sensory evaluation

Granola bite sensory assessment was created according to consumer approval and preference.

It was done by trained panelists. It was carried out by using 9 points hedonic scale on color, appearance, texture, aroma, flavor, stickiness and overall acceptability. Samples were served in 3 sessions containing 2-3 samples in each session to the each panelist and in between asked the questions to the

panelist about granola bites taste, texture, aroma, color and stickiness and then rate the product.

Statistical Approach

To ensure the accuracy and repeatability of the findings, every analysis was carried out three times. Each test's data were statistically analyzed and presented as mean values together with the standard deviations that corresponded to them, providing data about the degree of consistency and variability. Statistical analyses were performed using Statistix 8.1 software, with results expressed as means and standard deviations to assess consistency and reliability

RESULTS AND DISCUSSION

Proximate analysis

Proximate composition of granola bites was determined through the physical and chemical analysis. The results obtained in these determinations are presented in Table 1. The results show higher concentration of moisture and protein as compared to the other proximal analysis of granola bite. The moisture obtained from sample is (13 ± 0.02) and protein is (8.75 ± 0.03). The values obtained are described on the basis of dry weight. The results of moisture and protein analyzed in the studies is closer to the observations (13.36%-13.50%) (D. Naveed & Siddiqui, 2025). The value for moisture and protein were 13.36%-13.50% and 9.91% to 10.08% respectively. Extreme levels of moisture content leads to oxidation-reduction, promotes microbial growth and enhance fungal growth. While the difference in protein content can be due to addition of almonds, which has good digestibility and good amino acid profile with essential amino acid. Ash content is a measure of a sample's mineral composition. In this study, the ash content was measured as $2 \pm 0.04\%$, as presented in Table 1. This value aligns closely with the findings reported by Ahmed et al. (2017), where the ash content ranged between 1.54% and 1.81%. The inclusion of nut is responsible for the minor fluctuation in ash content in the formulation, which are known to be excellent sources of minerals, thereby contributing to the higher mineral content in the sample.

The proximate carbohydrate content of granola bites, as shown in Table 1, was determined to be approximately 51.25%. The result shown is roughly equivalent to the results of literature where the carbohydrate content in granola prepared using a maize (*Zea mays*) and coconut (*Cocos nucifera*) blend ranged between 56.85% and 61.56%, with sample A exhibiting the lowest and sample D the highest values. The results of this research indicate that the carbohydrate composition of granola bites aligns with typical breakfast cereal formulations and does not negatively impact their energy values. Instead, it highlights their suitability as a nutritious energy source for consumers. The fiber content of the granola bite sample, as presented in Table 1, was measured at 19%. This value is lower than the range reported where fiber levels were noted to be between 26.76% and 29.65%. Since oats are known to greatly increase dietary and crude fiber levels in food products, fluctuations in ingredient composition may account for the change in fiber content. High fiber content has been widely recognized for its health benefits. As for fat content, the value obtained in Table 1 was almost similar to the range as mentioned in the study. The percentage of fat in granola bites was 6% while the range discussed in the research was between 6.43% and 10.34%. Fat provides a high level of calories that obtained from the ingredients used in the granola bites. Higher values of fat can cause rancidity which lead to unpleasant odor and flavor of the bites.

Physicochemical analysis

Table 2 presents the mean values for color, pH, and total soluble solids, highlighting critical quality parameters of the granola bites. Among these, color is a vital attribute influencing consumer acceptance or rejection of the product. The instrumental color analysis provided *L*, *a*, and *b* values, where *L* indicates lightness, *a* reflects red and orange tones, and *b* represents blue and yellow variations. Detailed results are shown in Table 2. When compared with other studies, significant differences in *L*, *a*, and *b* values were observed. For instance, cereal bars containing pineapple peel flour (Aparecida et al., 2016) showed *L* = 58.6, *a* = 6.12, and *b* = 34.19, whereas bars formulated with

pumpkin seed flour recorded $L = 57.28$, $a = 6.36$, and $b = 20.03$. These disparities can be addressed by the granola bits' and these cereal bars' different ingredient types and formulations. These differences highlight how particular ingredient selections affect the final product's appearance and nutritional value. The pH of nutritional granola bites was found to be 5.59 ± 0.016 as per Table 2. While comparing it with other variables as found in different studies, cereal bars containing pineapple peel flour has pH level 5.52 which shows slight difference due to acidic content in its peel. Cereal bars of pumpkin seed flour shows significant decrease in its pH values (5.2) due to the acidity index of pumpkin seeds. It indicates that nutritional granola bites possess stable shelf life and less susceptible to spoilage.

The value of total soluble solids of nutritional granola bites is found to be 8 °Brix. When multiple formulations are compared based on different studies, it is found that TSS value of cereal bars having pumpkin seed flour is 42-45 °Brix while those bars containing *pequi* almonds having TSS value 6-7 °Brix. This is probably due to the reason that pumpkin seeds are rich in soluble solids and organic acids. Increasing their concentration in cereal bars increases brix reading.

Phytochemical analysis

Results for antioxidant activity of granola bites incorporated with kamarkas and lotus seed have been listed in Table 3. The method is on the basis of reduction of alcoholic DPPH solution by the reaction. Antioxidants are chemicals that stop other compounds from oxidizing free radicals. Nuts and seeds are rich in antioxidants. There were five concentrations 2 g/mL, 4 g/mL, 6 g/mL, 8 g/mL and 10 g/mL, therefore, the scavenging activity observed shows a slight increase with concentrations. Highest antioxidant value was observed in highest concentration i.e. 10 g/mL containing 10 g of sample, whereas, the lowest antioxidant value in lowest concentration i.e. 2 g/mL containing 2 g of sample in 8 mL of solvent. The difference in readings of antioxidant activity is due to an increase in amount of sample. By increasing the quantities of nuts and seeds, the DPPH radical scavenging activity also increased, an increased antioxidant activity with increase

concentration of fruits and nuts. The antioxidant activity increases because of the presence of nuts and seeds. The potent antioxidant and anticancer activities of nuts are due to the additive and symbiotic actions of phytochemicals present in nuts.

Results for total phenolic and flavonoid content of granola bites incorporated with kamarkas and lotus seeds have been listed in Table 4. Total phenolic content was determined by using Folin- Ciocalteu reagent in which gallic acid was used as standard. In our granola bites total phenolic content was found to be 0.721 mg/gm. By comparing it with other variables in different studies, gluten-free cereal bar made with quinoa had 0.51 mg/gm phenolic content which shows slight decreased phenolic content due to the less use of nuts and seeds. Colorimetric assay is used in determination of total flavonoid content in which quercetin was used as standard. In our granola bites total flavonoid content was found to be 0.49 mg/gm. While comparing it with other variables in different studies. It was found that oat bars having sunflower and pumpkin seeds showed increased flavonoid content (66.44 mg/gm and 70.26 mg/gm respectively) which are due to low temperature exposure and for a less time. As flavonoids are heat sensitive and can be degrade at slightly high temperatures resulting in the lowest flavonoid content in our granola bites.

Sensory evaluation

Sensory evaluation of nutritional granola bites found to be effective in evaluating color, appearance, texture, aroma, flavor, stickiness and overall acceptability of the bites by 3 semi- trained panelists. The results evaluated are compiled in table to elaborate difference of opinion drawn by panelists. It also helps in providing data related to the consumer preference towards nutritional granola bites. According to the hedonic scale, the panelists were permitted to provide readings. All parameters, however, displayed values between "slightly liked" and "like very much". The results evaluated are shown in the Table 5. The color value of the 1st panelist was 7.15 while the other 2 panelists gave similar readings i.e., 7.5. This range of values indicated that color of product is liked moderately among the panelists. This is due

to the reason that nutritional granola bites were prepared by baking which produces appealing golden brown color in resulting food product. When compared with other studies it is found that panelists gave color readings ranging from 6.2-7 to the cereal bars made from pineapple peel flour. Appearance is the key parameter that decides success of product. Here 2 panelists gave 7 score to appearance and one panelist gave score 7.5. Visual interest among the panelists was enhanced by the vibrant coating of nuts and seeds along with well bound cohesive bites structure gave it an appealing look.

The texture scores assigned by panelists to the granola bites were 7.5, 7.15, and 7, respectively. These scores reflect the product's desirable combination of crunchiness, crispiness, and chewiness, attributed to the inclusion of nuts, seeds, dates, jaggery, and kamarkas. It reported a texture score of 6.8 for nut granola bars, indicating a slight difference in textural attributes. As an instance, the hygroscopic properties of sweeteners like honey, corn syrup, and date palm fruit can make cereal bars harder and stickier, affecting the solid cohesiveness of the ingredients and requiring greater penetration forces during consumption. .Therefore, the choice and proportion of ingredients play a significant role in determining the textural characteristics of granola bars .The aroma scores assigned by panelists to the nutritional granola bites were 8, 7.25, and 7, respectively, indicating a favorable reception of the product's aromatic profile. This appealing aroma is attributed to the combination of roasted nuts, seeds, dates, jaggery, and kamarkas used during baking, which enhances the overall sensory experience. In comparison, a study reported aroma scores ranging from 6.06% to 7.40% for various granola bar formulations, suggesting that the granola bites in this study have a slightly higher aromatic appeal. These findings underscore the importance of ingredient selection and processing methods in developing granola bars with desirable sensory attributes .

Flavor scores given by panelists were 8, 7 and 7.5. As per panelists' comments, flavor of granola bites was mild, less sweet which makes it more appealing. The appealing

flavor is the outcome of multiple ingredients such as nuts, dry fruits and jaggery being natural sweetener. The blend of all these ingredients contributes to overall taste satisfaction to the consumers and panelists. Moreover, roasting also releases aroma that produce flavor compounds in a product. Nut granola bars possess flavor scores as 6.33-7.83 as per multiple panelists and treatments .Stickiness is another sensory attribute that is a kind of sub category of texture. Panelists gave stickiness scores as 7, 6.66 and 7. The stickiness of nutritional granola bites is mainly due to the binding ingredients used. These ingredients include jaggery and dates. Both these ingredients promote stickiness of product creating a cohesive structured product.

Overall acceptance scores perceived by 3 panelists were 7.43, 7.15 and 7.2, respectively. There is a slight difference of overall acceptance among panelists. This difference is due to the reason that panelist no 1 gave superlative scores to all attributes of sensory evaluation, followed by 3rd panelist and least by the 2nd one. As far as overall acceptance was concerned, (Aparecida *et al.*, 2016) found that consistency of cereal bars increases when concentration of pineapple peel flour increases and this may have negative effects on the the sensory acceptance of the products. It is concluded in a nutshell that nutritional granola bites are highly acceptable by consumer due to its organic and natural formulation.

CONCLUSION

PCOS is one of those conditions that are highly prevalent in society. The best way to cure or prevent them is maintaining a healthy lifestyle and making sure to have all the essential nutrients in their diet. Nutritious granola bites are highly preferred in this regard as it is a complete organic product made up of a combination of nuts and seeds(Zafar et al., 2024). Along with that dates and jaggery are added as a binder. Moreover, kamarkas and lotus seeds served as key ingredients due to their high nutritional value. To analyze its authenticity; we have conducted a case study. A person having PCOS is given 3 granola bites in the morning and 3 in the evening each of 5 g.

Results show various changes in a person’s health condition regarding PCOS such as weight loss and reduction in mood swings. It is concluded in a nutshell that nutritional

granola bites are highly acceptable by consumers due to their organic and natural formulation.

Figure 1: *Flowchart of formulation of Granola Bars*

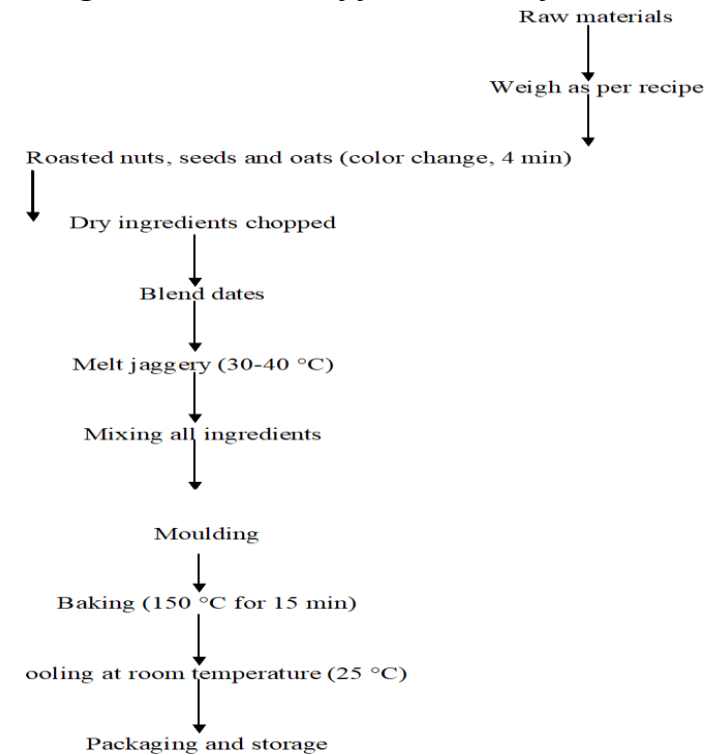


Table 1.Proximate composition of granola bites

Parameters	Value (g/100g)
Protein	8.75±0.03
Ash	2±0.04
Moisture	13±0.02
Fat	6±0.01
Fiber	19±0.08
Carbohydrate	51.25±1.71

Table 2.pH, TSS Total phenolic content ,Total flavonoid contentand color analysis of granola bites

Treatment	Color			pH	TSS (Brix °)	TPC	TFC
T ₁	L*	a*	b*				
	48±1.71	10.5±0.02	28.3±0.08	5.59±0.01	8.0±0.03	0.721±0.008	0.49±0.008

Table 3. DPPH radical scavenging activity of granola bites

Concentration (g/mL)	Scavenging effect %
2	40.73±1.71
4	56.82±1.95
6	59.75±2.04
8	64.39±2.20
10	70±2.36

Table 4.Sensory evaluation of granola bites

Treatment	Color	Appearance	Texture	Aroma	Flavor	Stickiness	O.A
	7.15±0.008	7±0.01	7.5±0.03	8±0.008	8±0.04	7±0.008	7.43±0.04
T1	7.5±0.01	7.5±0.03	7.15±0.04	7.25±0.01	7±0.02	6.66±0.01	7.15±0.008
	7.5±0.02	7±0.02	7±0.01	7±0.02	7.5±0.03	7±0.02	7.2±0.02

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