Global Research journal of Natural Science and Technology (Grjnst)
Volume: 03 - Issue 4 (2025) p.ISSN: 2790-7643 e.ISSN: 2790-7651

Development And Nutritional Evaluation of Oat Granola Bars Enriched with Pumpkin Seeds

Seerat Saleem
Human Nutrition and Food Technology
Faculty of Allied Health Sciences
Superior University Lahore
seeratrao79@gmail.com

Muhammad Umar Badshah
Food Science and Technology
University of Agriculture Peshawar
umarbmk278@gmail.com

Nadia Jabeen
Department of Agriculture
Hazara University Mansehra
nadia.agri@hu.edu.pk

Adeela Sabir
National Institute of Food Science and Technology
University of Agriculture, Faisalabad
adeelasabir98@gmail.com

Um E Laila Naqvi
Food Science and Technology
PMAS Arid Agriculture University Rawalpindi
lailanaqvi417@gmail.com

Mahmood Khan
National Institute of Food Science and Technology,
University of Agriculture, Faisalabad
mahmooduaf786@gmail.com

Nida Shahzadi
National Institute of Food Science and Technology
Faculty of Food, Nutrition and Home Sciences
University of Agriculture, Faisalabad
shahzadinida041@gmail.com

Abstract: *Growing consumption of cereal-based foods raises health concerns because of their high sugar content and limited nutritional value. Modern lifestyles often contribute to unhealthy eating habits, as ready-to-eat foods are popular but frequently lack nutritional value. Thus, this study aims to develop and analyze the nutritional value of oat granola bars enriched*

with pumpkin seeds as a healthier alternative. Granola is a convenient breakfast or snack option, typically made from grains and nuts. Pumpkin seeds are highly nutritious, and their wide availability makes them a desirable ingredient in various baked goods such as cakes, bars, etc. Five treatment plans were developed with varying compositions of pumpkin seeds and oats which include T_0 (100% oats), T_1 (90% oats and 10% pumpkin seeds), T_2 (80% oats and 20% pumpkin seeds), T_3 (70% oats and 30% pumpkin seeds), and T_4 (60% oats and 40% pumpkin seeds). Comprehensive analyses were conducted to assess the energy bars' composition, antioxidant activity, and overall quality. T_0 (100% oats) had the highest moisture content, while T_4 (60% oats and 40% pumpkin seeds) had the lowest. The moisture, crude protein, crude fat, crude fiber, ash and NFE had ranged of 28.01-27.96, 5.99-5.02, 42.00-41.40, 7.93-8.84%, 1.29-1.27% and 28.45-30.20 respectively. The TPC, TFC and DPPH of all treatments were analyzed and showed significant results 8.01-7.07mg GAE/100g, 3.33-3.00mg QE/100g and 1.67-1.57% respectively. Mineral profiling showed that while the level of minerals like magnesium (from 6.26 to 5.08mg/100g), the level of zinc (from 16.18-16.12mg/100g), potassium (from 6.09-6.00mg/100g) and iron (from 5.4-4.99mg/100g). Sensory analysis (color, flavor, texture and overall acceptability) was done using 9-point hedonic scale. It is concluded that the preferred granola bar was T_4, which contains 40% pumpkin seeds and 60% rolled oats was more acceptable with respect to sensory analysis. This study emphasizes the possibility of incorporating oats and pumpkin seeds to make a functional, nutritious snack bar that promotes overall health and well-being. According to this study, using pumpkin seeds in granola bars can increase dietary intake of essential elements. It's a simple, food-based strategy to reduce stress related to medical conditions.

Keywords: *Granola bars, oats, pumpkin seeds, nutritional value, antioxidant activity, vulnerable populations*

Introduction

Granola is a breakfast cereal made out of grains such as oats, walnuts, peanuts, and wheat. Granola is usually rich in carbohydrates, low in fat, and rich in fiber. Granola bars are extremely popular as a healthy and quick snack, fulfilling the increasing demand for healthier food products in modern society. Granola bars are famous for being rich in calories, anti-oxidant content and nutritional value (Wang *et al.,* 2021). Oats are available in red, yellow, black, and white varieties and have a visual resemblance to barley. Globally, they rank as the sixth-largest grain production, after barley, sorghum, corn, wheat, and rice, regarding production. Oats are one of the ancient grains and food crops that are cultivated and consumed all over the world. They are gaining popularity because of their nutrient composition and the multifunctional advantages of some bioactive ingredients. Oats are well-known for their high dietary fiber content. Their main components include starch (60%) and protein (11-15%), with oat protein consisting of 80% globulins, 15% prolamins, 4% glutelins, and 1% albumin. Oats also contain 5-9% lipids, of which 78-81.5% are unsaturated. Their antioxidant potential comes from 5.7%

phenolic compounds. Additionally, oats provide essential vitamins, including vitamin B1 (0.002%), vitamin B2 (0.001%), vitamin B3 (0.032%), and vitamin E (0.84%) (Ibrahim *et al.,* 2020).

Oats, a commonly grown cereal grain, are nutritionally diverse and rich, containing important minerals, lipids, proteins, and a distinct mixed-bond polysaccharide, β-glucan. The major constituent of oat dietary fiber and other phytochemicals, including avenanthramides (AVAs), flavonoids, gramine, and triterpenoid saponins, underpin oats' long history as a medicinal agent. Aside from their fiber content, oats also have over 20 different polyphenols, especially AVAs, that are endowed with anti-inflammatory, antiproliferative, potent antioxidant, and anti-itching activities (Kumari *et al.,* 2024).

The nutritional composition of oats includes high-quality protein, polyunsaturated fatty acids, soluble fiber, polyphenolic compounds, and vital micronutrients. In contrast to other cereals, in which the storage proteins are prolamins, oat grains possess a unique protein structure, with the storage protein being globulins. Oats contain the richest fat content among all cereals. They are also low in saturated fat and high in essential unsaturated fatty acids, which could aid in lowering cardiovascular diseases (Alemayehu *et al.,* 2023).

Pumpkins (*Cucurbita moschata*), which belong to the *Cucurbitaceae* family, consist of 130 genera and 800 species. In 2019, they were among the most widely produced agricultural products globally, with a total annual output of 27.7 million tons. Both South Asia and the Americas have traditionally utilized their seeds for medicinal purposes. In past decades, there has been growing attention in the field of diet and illness studies in pumpkin seeds due to the growing popularity of alternative medicine and healthy nutrition (Syed *et al.,* 2019).

Pumpkin seeds contain potassium (K) and are abundant in manganese (Mn). Pumpkin seeds are also abundant in magnesium (Mg), phosphorus (P), and calcium (Ca), and low in sodium (Na) content. Pumpkin seeds are also abundant in precious trace elements like copper (Cu), zinc (Zn), and iron (Fe). Health benefits of low sodium and high potassium content are also provided by pumpkin seeds towards improving heart health. Zinc is essential for the formation of structural proteins, cell protection, and the maintenance of male reproductive health. Because of these mineral contents, pumpkin seeds can be an important food fortification component at least in baked foods (Dotto *et al.*, 2020).

Pumpkins, which are rich in essential vitamins and minerals, are generally known to be a healthy food with potential virtues in fighting health risks, including the COVID-19 pandemic. Fresh pumpkin sprouts are rich in antioxidants and packed with phytonutrients. Various parts of the pumpkin, including flowers, leaves, seeds, and pulp, are rich in high antioxidant compounds that are highly bioactive. The antioxidants contribute to human health by scavenging free radicals and reactive oxygen species, thereby preventing cardiovascular diseases, cancer, and neurodegenerative disorders. Pumpkin flesh,

peel, and seeds are also rich in total phenolics, carotenoids, flavonoids, and essential minerals (Hussain *et al.,* 2021).

Materials and Methods

Procurement of Raw Materials

Rolled oats, pumpkin seeds, and other ingredients such as dates, nuts, and honey were purchased from a local market in Faisalabad, Pakistan. All experimental trials were carried out at the National Institute of Food Science and Technology, University of Agriculture, Faisalabad.

Product Development

Rolled oats, pumpkin seeds, and chopped nuts were dry-roasted over medium heat until golden and aromatic, enhancing their flavor and crunch. After cooling, they were combined with a smooth paste of honey, pitted dates, and a pinch of salt, blended to serve as a binder. Crushed dried coconut was gently folded in for a chewy contrast. The mixture was pressed into a baking dish and refrigerated for 1-2 hours to set. Once firm, it was cut into bars or broken into clusters.

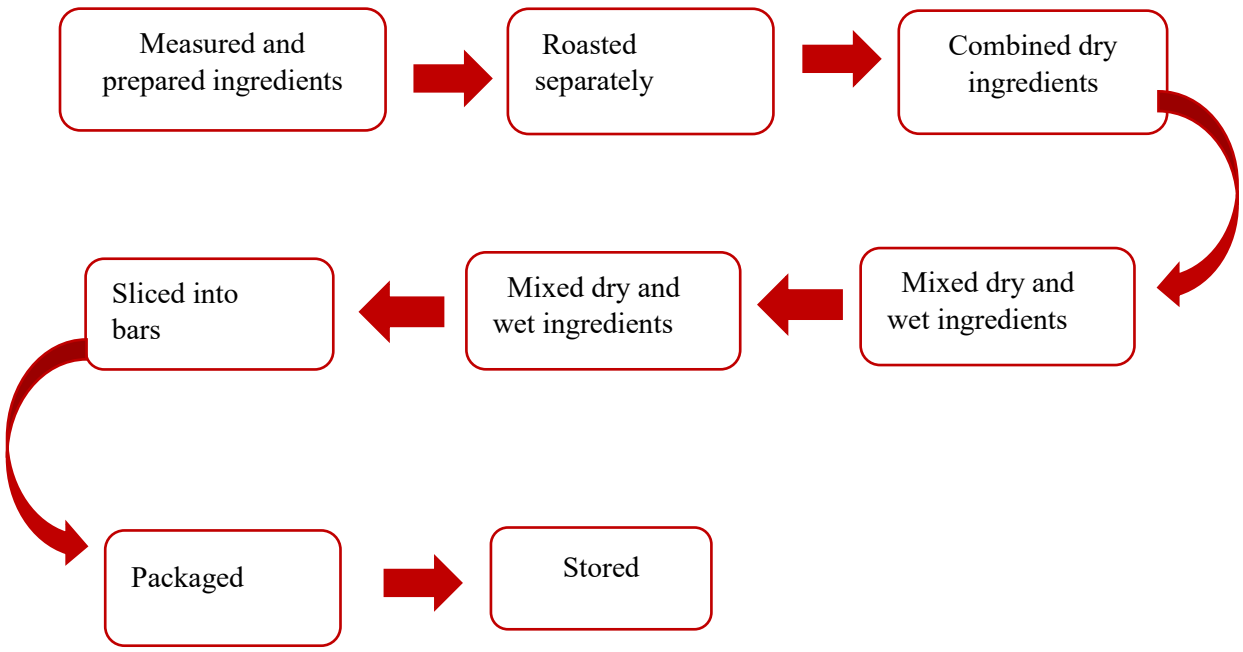

Table 1: Treatment plan for the development of pumpkin seeds enriched oat granola bars

Treatments	Rolled oats (%)	Pumpkin seeds (%)
T_0	100	0
T_1	90	10
T_2	80	20
T_3	70	30
T_4	60	40

Proximate Analysis

The proximate analysis including moisture content, crude fat, crude fiber, crude protein, ash content and NFE of oat granola bars with pumpkin seeds were determined by following the protocols of AOAC (2019).

Antioxidant Analysis

The DPPH, TPC, and TFC were analyzed using the technique suggested by Chen *et al.* (2018).

Sensory Evaluation

The sensory evaluation of the granola bars assessed multiple attributes, including aroma, color, appearance, taste, texture, holding ability, mouthfeel, and overall acceptability. This assessment was conducted using a 9-point hedonic scale, as described by Talwar and Brar (2018).

Statistical Analysis

According to Montgomery (2019), the significance of the collected data was assessed using statistical analysis.

Results and discussion

Proximate analysis

The moisture content of the granola bars was analyzed according to the AOAC (2019) procedure. Approximately five grams of each sample were placed in a previously weighed porcelain dish and dried

in a hot air oven at 105 °C until the weight is constant. All moisture in the sample was eliminated by this drying process, making it possible to get an accurate estimate of its moisture content. Moisture content is significant as it determines the texture, shelf life, and overall quality of the granola bars. The moisture content is lowest in T_4 and highest in T_0. Because pumpkin seeds has a lower water binding capacity.

The crude protein level in the granola bars was quantified by the Kjeldahl method as per AOAC (2019) regulations. One 2 g sample was placed in a digestion tube with a digestion tablet and 20 mL of 98% sulfuric acid. Digestion was done until the mixture was a transparent residue. On cooling, 50 mL of distilled water was added. In order to neutralize the solution and evolve ammonia gas, 10 mL of 40% sodium hydroxide (NaOH) was added to the distillation apparatus. The neutralized mixture was distilled, and the evolved ammonia was collected in a 4% boric acid solution with methyl red indicator. Last but not least, the quantity of ammonia was quantitated by titration with 0.1N sulfuric acid until a purple endpoint was observed. Protein content is highest in T_4 and lowest in T_0. Because pumpkin seeds are rich in protein contents.

The sample's crude fat content was obtained according to the AOAC (2019) method. Soxhlet's extractor was utilized for fat extraction, in which hexane served as the solvent. Fat content also increased with increase of pumpkin seeds.

The fiber content in the sample was determined through acid-base digestion of fat-free bar samples using a 1.25% H_2SO_4 solution, followed by a 1.25% NaOH solution, as per AOAC (2019). The fiber content gradually increases with increase the number of pumpkin seeds.

Ash content of the granola bar was determined by putting a 3 g dry sample into a crucible and heating it over the flame until it produced no smoke. The procedure adopted the method described in AOAC (2019). Ash content is used to measure mineral richness. Ash content increase with increase of pumpkin seeds because mineral content increase in pumpkin seeds when it becomes mature.

Table 2: Proximate analysis values of oat granola bars enriched with pumpkin seeds

Treatment	Moisture	Protein	Fat	Ash	Fiber
T_0	27.96±0.82	5.02±0.47	41.40±0.23	1.27±0.79	0.50±0.79

T_1	32.12±0.81	5.02±0.47	40.90±0.74	1.15±0.44	0.80±0.44
T_2	32.12±0.81	6.49±0.76	39.90±0.66	1.02±0.40	1.78±0.40
T_3	40.06±0.67	7.62±0.58	38.80±0.51	0.92±0.42	2.68±0.42
T_4	43.59±0.46	7.62±0.58	37.90±0.82	0.84±1.33	3.66±1.33

Antioxidant analysis of oat granola bars

The antioxidant activity (DPPH, 1,1-diphenyl-2-picrylhydrazyl) of granola bars was measured with slight modifications to Omran's (2018) method. The antioxidant activity increased in order T_4 (2.39) > T_3 (2.19) > T_2 (1.86) > T_1 (1.73) > T_0 (1.69) as shown in table. The antioxidant level increase gradually with increase of pumpkin seeds.

The spectrophotometer was employed to analyze the total phenolic content of the granola using the Folin-Ciocalteu method outlined by Chen *et al.* (2018). TPC, TFC and DPPH content shows increasing trend with increase in concentration of pumpkin seeds in bars in **Table 3**. The values of TPC range from 5.01 to 9.07 mg/g. The values of TPC increased in order of T_4 (9.07) > T_3 (8.06) > T_2 (7.05) > T_1 (6.03) > T_0 (5.01). This consistent rise in TPC with increasing levels of oat granola bars not only enhances the nutritional quality of the bars but also adds value from a functional food perspective.

The TFC values ranged from 3.33 to 4.51 mg/g. The TFC increased in order T_4 (4.51) > T_3 (4.21) > T_2 (3.85) > T_1 (3.65) > T_0 (3.33). The flavonoid content in granola was quantified according to the method of Ismail *et al.* (2024).

Table 3: Antioxidant analysis of oat granola bar enriched with pumpkin seeds

Treatment	TPC (mg GAE/100g)	TFC (mg QE/100g)	DPPH (%)
T_0	7.07±1.21	3.42±0.96	1.57±0.86
T_1	5.12±0.49	4.18±0.91	1.68±0.54

T_2	5.13±0.85	4.69±0.92	1.81±0.96
T_3	4.14±0.50	4.59±0.93	2.07±0.91
T_4	3.15±0.91	4.86±0.89	2.34±0.47

Sensory evaluation of oat granola bars

Based on sensory evaluation, T_4 (60% Rolled Oats, 40% Pumpkin seeds) received the highest overall acceptability, including a favorable balance of taste, texture, and appearance. Incorporating pumpkin seeds up to 40% enhanced the sensory attributes of bars without compromising their traditional qualities. The panelists assigned T_4 (8.2) the highest mean score, while T_0 (5.10) received the lowest mean score. The panelists rated granola bars made with T_4 as highly preferred and T_3 as much preferred, with T_2 (6.2) being preferred over T_1 (6.5) and T_0 (5.8). The panelists have made it evident that lighter-colored and less-aromatic oat bars has produced better outcomes. T_0 is not accepted by the panelists because of less amount of pumpkin seeds.

Treatment	**Taste**	**Texture**	**Color**	**Flavor**	**Overall Acceptability**
T_0	6 ± 0.13	3.30±0.92	6 ± 0.14	6 ± 0.14	5 ± 0.13
T_1	7 ± 0.12	4.18±0.50	6 ± 0.12	6 ± 0.10	6 ± 0.14
T_2	8 ± 0.11	4.69±0.60	7 ± 0.13	7 ± 0.13	7 ± 0.12

T_3	9 ± 0.14	4.59±0.66	8 ± 0.14	8 ± 0.14	7 ± 0.11
T_4	9 ± 0.12	4.86±0.92	9 ± 0.13	9 ± 0.12	8 ± 0.13

Conclusion

This study underscores the importance of incorporating nutrient-rich ingredients like oats and pumpkin seeds into everyday foods to promote health and well-being. The study demonstrates that incorporating pumpkin seeds into granola bars enhances their nutritional content, providing essential nutrients such as protein, calcium, and important fatty acids. The production of pumpkin seed-enriched oat granola bars provides a practical and approachable means of increasing nutrient intake and reducing the risk of chronic illnesses. These nutrient-dense bars focus on affordability and optimize the production process, which can have a substantial effect on public health, especially in regions with limited resources.

References

Alemayehu, G. F., S.F. Forsido, Y.B. Tola and E. Amare. 2023.Nutritional and phytochemical composition and associated health benefits of oat (*Avena sativa*) grains and oat based fermented products. The Scientific World Journal. 23:1-6.

AOAC (Association of Official Analytical Chemists). 2019. The Official methods of analysis of association of Official Analytical Chemist International. 21st Ed. Arlington, USA.

Chen, C., L. Wang, W. Ren, X. Luo, Y. Li, J. Li, Y. Li and Z. Chen. 2018. Phenolic contents, cellular antioxidant activity and antiproliferative capacity of different varieties of oats. Food Chemistry. 239:260-267.

Dotto, J. M. and J.S. Chacha. 2020. The potential of pumpkin seeds as a functional food ingredient. Scientific African. 10:575-579.

Hussain, A. 2023. Development of nutritional biscuits for children, rich in Fe and Zn, by incorporation of pumpkin *(Cucurbita maxima*) seeds powder; a healthy pharma food in current post covid 19 period. Pure and Applied Biology. 6:12-23.

Ibrahim, M. S., A. Ahmad, A. Sohail and M.J. Asad. 2020. Nutritional and functional characterization of different oat (*Avena sativa L.*) cultivars. International Journal of Food Properties. 23:1373-1

Ismail, B. P. 2024. In vitro phytochemical investigation of Helianthus annuus seeds. Nielsen Food Analysis Laboratory Manual. 14:129-131.

Kumari, A., M. Kumar, A. Tyagi, C. Maheshwari and N.L. Meena. 2024. Nutritional composition of oats and its comparison with other major cereal crops. Oats. 7:123-127.

Montgomery, D.C. 2019. Design and Analysis of Experiments. 10th Ed. John Wiley and Sons. Inc. Hoboken, New Jersey, USA.

Omran, A. A. 2018. Enhancing the nutritional value of oat bars. American Journal of Food Science and Technology. 6:151-160.

Syed, Q. A., M. Akram and R. Shoukat. 2019. Nutritional and therapeutic importance of the pumpkin seeds. Seeds. 21:15798-15803.

Talwar, G., and S.K. Brar. 2019. Study of physiochemical, sensory and color properties of pinni variants. Indian Journal of Science and Technology. 8:629-636.

Wang, Z., S. Chockchaisawasdee, J. Ashton, Z. Fang and C.E. Stathopoulos. 2021. Study on glass transition of whole-grain wheat biscuit using dynamic vapor sorption, differential scanning calorimetry, texture and color analysis. Food Science and Technology. 150:111969-111976.