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Preparation and evaluation of mango oat bar fortified with chia seeds

Neha Mahendra Yadav * and Dhanya Joseph

Department of Food Technology, PIAS, Parul University Vadodara, India.

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Abstract

Ready-to-eat (RTE) cereal bars have undergone numerous advancements that blend various components to produce alternative cereal bar options. In conclusion, this study sought to create a high-energy cereal bar with a satisfying texture and high consumer acceptance using regional ingredients from local market. Other ingredients, such as exotic fruits and organic residues, can be utilized to make cereal bars and are still added to the final product as enrichment. From the breakfast table to the dinner table, cereal goods have been consumed in the form of flakes, rice, chapatti, or cereal bars as a snack. Cereals are essential in the creation of ready-to-eat snacks including cereal bars, energy bars, and quick bars. Because whole grains and their products include all three components in the same ratio as found in the intact original grain, people have come to appreciate their consumption. Mango is also discovered to be a high source of antioxidants such ascorbic acid, carotenoids, and phenolic compounds, as well as dietary fibers, starch, and pectin. A good number of dietary antioxidants like ascorbic acid, carotenoids, and phenolic compounds is found in the fruit mango (*Mangifera indica* L.). Cereal bars made with mango pulp at concentrations of 40%, 45%, and 50% were one such product developed.

Keywords: Yielding; Wholesome; Ready-to-Eat; Antioxidant; Fortifier; Conveying

1. Introduction

Because they are low in fat and high in fiber, cereal bars are regarded as a healthy food. They come in little packets or pouches, are packed with a variety of nutrients, are light and portable, and may be consumed at any time. Every variety of cereal bar has unique qualities and functions that meet the trend for eating wholesome, cutting-edge, and useful foods, which has caused the market for cereal bars to gradually expand. To maximize product qualities and characteristics like form, colour, appearance, flavour, and texture, new product development is crucial. To achieve a complete balance that yields great quality and high acceptability, component interactions must also be tuned. Ready-to-eat (RTE) cereal bars have undergone numerous advancements that blend various components to produce alternative cereal bar options. According to research on the optimization of various cereal bar ingredients, cereals, nuts, and seeds can be combined to create high-energy cereal bars that can give consumers both energy and essential nutrients. (Taruedee Jannu et al; Physiochemical properties and sensory evaluation of high energy cereal bar and its consumer acceptability; food science and Technology Program, faculty of Agro-Industry, Prince of Songkla University, Hat Yai, Songkla; 10 August 2021)

A base of grains, such rice or oats, or proteins, like soy or whey, is frequently used to make cereal bars. These bars' primary flavours used to lean more toward chocolate and peanut butter. The bars are frequently fortified with a variety of vitamins, minerals, herbs, and other nutrients, as well as components that are high in energy, like dietary fiber. Other ingredients, such as exotic fruits and organic residues, can be utilized to make cereal bars and are still added to the final product as enrichment. Co-products that are high in fiber could be employed for their practical and technological benefits. Its physico-chemical qualities may enhance a product's viscosity, texture, sensory qualities, and shelf life.

* Corresponding author: Neha Mahendra Yadav

Therefore, co-products may be added to food items as low-cost, non-caloric bulking agents, as agents that increase the retention of water and oil, or as agents that enhance emulsion or oxidative stabilities. The phenolic content and antioxidant qualities of fruit co-products can also be used. (Brahim Bchir et al; Effect of pear apple and date fibers incorporation on the physico-chemical, sensory, nutritional characteristics and the acceptability pf cereal bars; Food Science and Technology International; 2017)

The alteration in consumers' lifestyles has resulted in a significant rise in the demand for ready-to-eat foods. According to this study, eating a diet that is nourishing, healthy, balanced, and safe can help prevent diseases like diabetes, obesity, cardiovascular conditions, and malnutrition. Cereals are essential in the creation of ready-to-eat snacks including cereal bars, energy bars, and quick bars. From the breakfast table to the dinner table, cereal goods have been consumed in the form of flakes, rice, chapatti, or cereal bars as a snack. The widespread availability and low price of refined cereal-based goods are to blame for the rise in their consumption. However, because the bran and germ fractions are removed during the milling process, many important phytochemicals and macro-nutrients and micronutrients that are directly related to human health are lost from the diet. Because whole grains and their products include all three components in the same ratio as found in the intact original grain, people have come to appreciate their consumption. Cereal-based bars have significantly increased in popularity in the human diet, particularly among youngsters, and they can have an impact on total nutrition. (Farhana Mehraj Allai et al; Development of Protein Rich Pregelatinized Whole Grain Cereal Bar Enriched with Non-traditional Ingredient: Nutritional, Phytochemical, Textural, and Sensory Characterization; April 8 2022)

Some preliminary tests were done to create healthy, nutrient-dense cereal bars. The versatility of extrusion processing, which combines several different unit operations like conveying, mixing, cooking, shearing, shaping, and forming in a single system, makes it a top choice. This method transforms the natural ingredients found in cereals into a new functional product with a distinctive shape and size. The nutritional, antioxidant, sensory, colour, and textural components of the functional cereal bar were examined. Additionally, a link between sensory qualities and instrumental texture was found. (Farhana Mehraj Allai et al; Development of Protein Rich Pregelatinized Whole Grain Cereal Bar Enriched with Non-traditional Ingredient: Nutritional, Phytochemical, Textural, and Sensory Characterization; April 8 2022)

Oats (*Avena sativa*) are a fantastic source of nutrition for people. Oat grain has the greatest protein level of any major cereal. The amino acid composition of oat proteins is generally balanced. The main protein found in oats, globulin, is poorly soluble in water when the pH level is neutral or slightly acidic. Oat globulin has a molecular structure that is extremely compact and a denaturation temperature that is greater than that of the majority of plant seed globulins at 112 °C. Oat globulin exhibits poor functions in watery meals as a result, which restricts the usage of oats and oat proteins in food. (Zhong-qing Jiang et al; Oat protein solubility and emulsion properties improved by enzymatic deamidation; Department of Food Science and Environmental Sciences, University of Helsinki, Finland; 5 April 2015)

From western Mexico to northern Guatemala, chia (*Sativa hispanica* L.), an annual plant of the Lamiaceae family, grows naturally. Its seeds were the primary source of plant-based sustenance for the Aztecs who lived in these regions, along with corn, beans, and amaranth. Due to its excellent nutritional potential, chia seeds are currently employed extensively in both the food and animal feed industries. Chia seeds have roughly 35% fat, the vast majority of which are polyunsaturated fatty acids, with -linolenic acid making up even 68% of all fatty acids in chia seeds. (Angelika Kosiorowska et al; The effect if the addition of gold flax (*Linum usitatissimum* L.) and chia seeds (*Salvia hipanica* L.) on the physicochemical and antioxidant properties of cranberry jams; European Food Research and Technology; 9 August 2022)

The annual herb chia seed (*Salvia hispanica* L.), which is a member of the Lamiaceae (Mint) family, is just starting to gain interest from scientists across the globe as a novel meal. It contains a lot of proteins, soluble dietary fiber, phytochemicals, omega-3 and omega-6 fatty acids. Numerous *in-vitro* investigations have demonstrated the chia seed components' antioxidant potential. Therefore, it provides nutritional advantages in the prevention of a number of non-communicable diseases, including obesity, hypertension, cardio-vascular disease (CVD), cancer, and diabetes. Chia seed, flour, and gelatin have all been used in the formulation of several items.

A good number of dietary antioxidants like ascorbic acid, carotenoids, and phenolic compounds is found in the fruit mango (*Mangifera indica* L.). Leucocyanidin, catechin, epicatechin, chlorogenic acid, and quercetin are believed to be the primary phenolics present in mango, according to numerous research. Mango peel is also discovered to be a high source of antioxidants such ascorbic acid, carotenoids, and phenolic compounds, as well as dietary fibers, starch, and pectin.

Numerous researchers have demonstrated how ready-to-eat bars can be made with a variety of nutrient-rich components. Cereal bars made with mango pulp at concentrations of 40%, 45%, and 50% were one such product developed. The results showed that the cereal bars had increased protein, moisture, and decreased fat content. With varied levels of sweeteners (4%, 5%, and 10%) to provide the consumer with a nutrient-rich food with the addition of more oats, the nutritional bar's overall calorie count increases noticeably. (Poonam Jethwani et al; Formulation and Quality Evaluation of Antioxidant Rich Bars Enriched with Chia seed, Whole Mango, Apple and Guava; Department of Food and Nutrition, College of Home Science, Punjab Agriculture University, Ludhiana, India; 2 September 2020)

A detailed investigation of several characteristics is required for the development of a nutrient-rich product with potential health advantages. According to the ongoing conversation, it was intended for the current study to construct ready-to-eat bars employing nutrients and antioxidant-rich substances, and to further examine the nutritional and sensory qualities of the developed bars. (Poonam Jethwani et al; Formulation and Quality Evaluation of Antioxidant Rich Bars Enriched with Chia seed, Whole Mango, Apple and Guava; Department of Food and Nutrition, College of Home Science, Punjab Agriculture University, Ludhiana, India; 2 September 2020)

2. Material and methods

2.1. Raw Material

Chia seeds (black variety), Mango pulp, Rolled Oats and Honey were purchased from the local market.

2.2. Preparation of Bars

Three different kinds of nutrient-rich bars—mango, chia seed, oats, and honey bars—have been created. The amount of mango fruit pulp that was incorporated was 50, 45, and 40 g. Because they include protein like albumins, globulins, prolamins (*avenins*), and glutelins, which is greatly preferred by those who cannot consume gluten, rolled oats are utilized as a source of protein. The chia seeds are used as a fortifier and as an additional ingredient in a variety of cuisines that also include processed foods. The total calories obtained from the bar shows 318.82 Kcal. The bar sample shows the protein (5.50 g), fat (2.90 g), ash (1.34 g) and the Free fatty acid (0.28 g). The sensory overall acceptability of sample 3 was very higher. (Poonam Jethwani et al; Formulation and Quality Evaluation of Antioxidant Rich Bars Enriched with Chia seed, Whole Mango, Apple and Guava; Department of Food and Nutrition, College of Home Science, Punjab Agriculture University, Ludhiana, India; 2 September 2020)

Chia seed is quickly gaining popularity across the globe as people become more motivated to adopt better lifestyles and the prevalence of conditions including obesity, type 2 diabetes, colorectal cancer, and cardiovascular diseases rises. (Jhon M. Nduko et al; Application of chia (*Salvia hipanica*) seeds as a functional component in the fortification of pineapple jam; Food Science and Nutrition; 16 October 2018)

The mixture of ingredients was bound by the addition of honey, and 100g bars were created by pouring the mixture into a tray. The bars were then placed in a drier at 60 ℃ for one hour, followed by a refrigerator, before being stored in LDPE. The perforated bars were kept at a cold temperature until analysis.

2.3. Sensory Evaluation of Bars

For all three trials, the mango oat bars sensory evaluation was recorded. Ten semi-trained panelists from the Department of Food and Nutrition of Parul University, Vadodara, conducted sensory evaluations using a 9-point hedonic scale ranging from 1 (extremely dislike/ most undesirable) to 9 (extremely like/most desirable). A test proforma was also supplied to the panelists at the time of evaluation. It is given here, 9 = like extremely, 8 = like very much, 7 = like moderately, 6 ¼ like slightly, 5 = neither like nor dislike, 4 = dislike slightly, 3 = dislike moderately, 2 = dislike very much, 1 = dislike extremely, for various parameters, including appearance, texture, taste, consistency and overall acceptability. All panelists were professors and P.G. students between the ages of 20 and 34.

2.3.1. Graphical representation of sensory evaluation

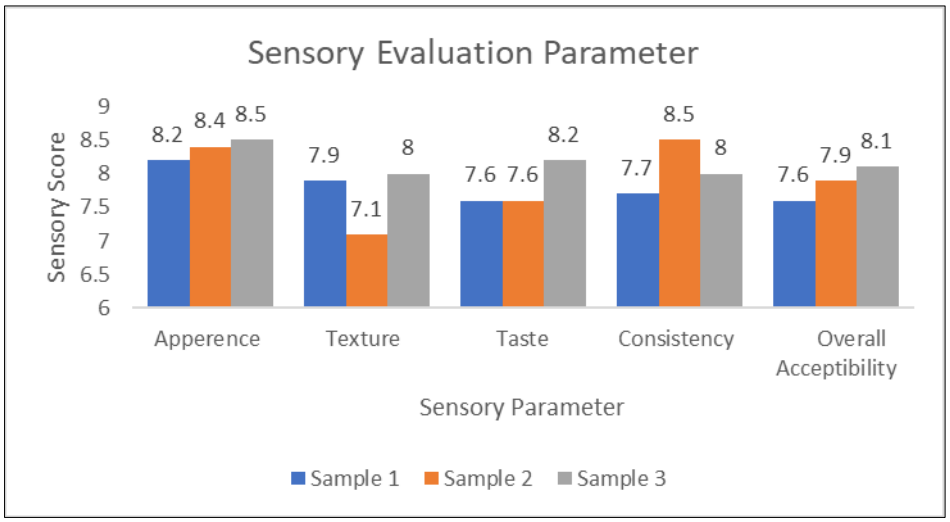

Figure 1 Sensory Evaluation Parameters

2.4. Quality Evaluation of the Bar

Food quality management is a multifaceted process with many different components. Analysis and assessment are crucial tools for enhancing processing and boosting productivity.

Instrumentation and the use of physical and chemical methods are used to assess the quality of foods. Both subjective and objective factors affect food quality.

Table 1 Physico-chemical Analysis

Sr. No.	Quality Evaluation Parameters	Sample 1	Sample 2	Sample 3
1.	Fat	3.34	3.00	2.90
2.	Protein	3.23	5.90	5.50
3.	Ash	2.34	1.00	1.34
4.	Moisture	23.03	25.22	22.58
5.	Sugar	11.23	10.01	9.94
6.	Carbohydrate	68.03	67.68	67.68

2.4.1. Graphical Representation of Physio chemical Analysis

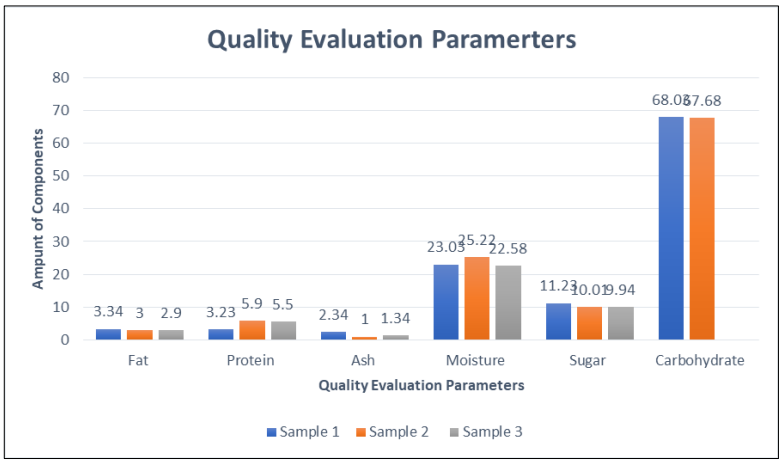

Figure 2 Quality Evaluation Parameters

2.5. Storage stability

2.5.1. Peroxide Value (PV)

Proxied value was determined as per AOCS (1973) methods. 10g of samples was added to 75 ml of chloroform in a stoppered Erlen Meyer flask. The contents of the flask were shaken in a mechanical shaker for half an hour at room temperatures and filtered. 20ml aliquots of chloroform extracts were treated with 30 ml of glacial acetic acid solution. One ml of saturated solution of potassium iodide was added and the flasks were kept in dark. After 20 minutes, 50 ml of distilled water was added to the flask followed by freshly prepared starch solution (0.1%) as an indicator and titrated against 0.02N sodium thiosulphate solution. The fat content in the extract was determined by evaporating 10 ml of the extract at 80 °C in tared aluminum dishes to a constant weight. Peroxide value was expressed as meq O_2/kg oil/fat as follows.

$$\text{Peroxide Value} = \frac{\text{Titer Value x N x 28.2}}{\text{Weight of oil/fat}}$$

Where, N is Normality of sodium thiosulphate

2.5.2. Free Fatty Acids (FFA)

Free fatty acid values were determined as per the method of AOCS (1973). Designated size of the sample was treated with 50 ml chloroform in a stoppered Erlen Meyer flask and shaken in a mechanical shaker for 30 mins. Contents were filtered and 10 ml of filtrates was evaporated at 80 °C. After the complete removal of residual solvent, the fat was treated with 50 ml of (1:1) neutralized benzene: alcohol mixture and titrated against 0.02N alcoholic KOH using phenolphthalein as an indicator. Weight of the fat / oil was determined by evaporating 10 ml of the extract in a tared flask.

The free fatty acids were expressed as the % of oleic acid as follows

$$\text{Free fatty acids} = \frac{\text{Titer Value x N x 28.2}}{\text{Weight of oil/fat}}$$

N is Normality of alcoholic KOH

Table 2 Storage stability parameters

Sr. No.	Stability parameters	Sample 1	Sample 2	Sample 3
1.	Peroxide Value	1.872%	1.684%	1.784%
2.	Free Fatty Acid	0.27%	0.24%	0.28%

2.5.3. Graphical Representation of Storage Stability Parameters

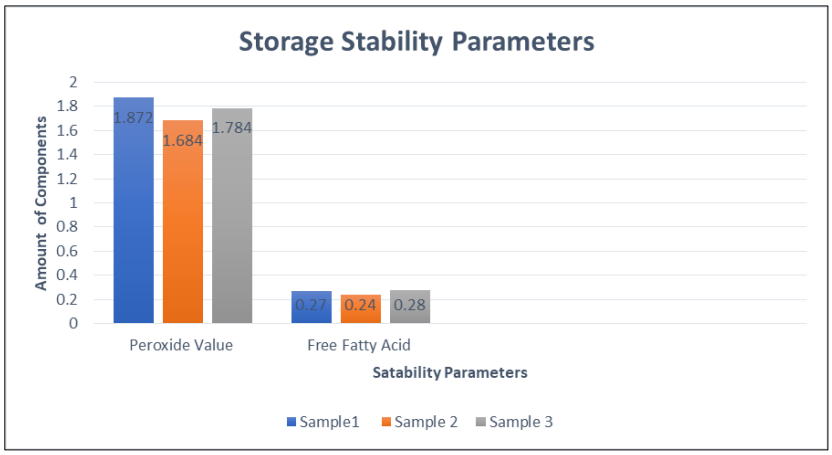

Figure 3 Storage Stability Parameters

Table 3 Microbial Analysis

Sr.No.	Test Parameters	Sample 1	Sample 2	Sample 3
1	TBC	< 20 cfu/gm	< 40 cfu/gm	< 10 cfu/gm
2	TFC	< 30 cfu/ gm	< 45 cfu/gm	< 10 cfu/gm

2.5.4. Graphical Representation

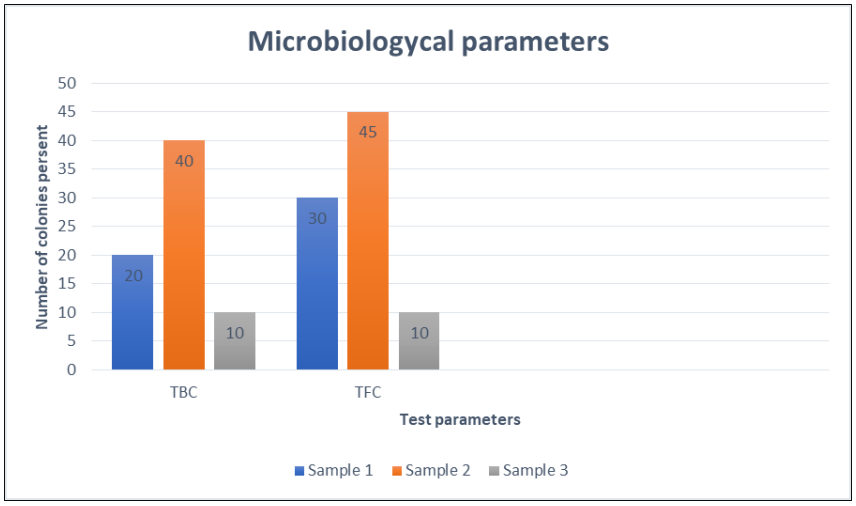

Figure 4 Microbiological Parameters

3. Results and discussion

The Sample No 3 which had the composition (4:4:1 Oats: Mango: Chia Seeds) had been selected for its desirable organoleptic parameters. The hedonic score with the Overall Acceptability of the sample is 8.1. The sample had the following quality evaluation parameters (Proximate composition of Fat(2.90), Protein(5.50), Ash(1.34), Moisture(22.58), Sugar(9.94), Carbohydrate(67.68). The shelf life study had also been done for the three samples out of which the sample no 3 tend to be least affected & had the maximum retention of quality comparatively. The peroxide value & Free fatty acid value of which is 1.784% and 0.28% respectively. The microbial analysis of sample no. 3 is in TBC (total bacterial count) and TFC (total fungal count) are < 10 cfu/gm and < 10 cfu/gm.

4. Conclusion

Cereal bars are a healthy food that are low in fat and high in fiber. They come in little packets or pouches, are packed with a variety of nutrients, are light and portable, and may be consumed at any time. To maximize product qualities and characteristics, new product development is necessary and component interactions must be tuned. Cereals, nuts, and seeds can be combined to create high-energy cereal bars that can give consumers both energy and essential nutrients. Co-products that are high in fiber can be added to food items as low-cost, non-caloric bulking agents, as agents that increase the retention of water and oil, or as agents that enhance emulsion or oxidative stabilities. These ingredients can help prevent diseases like diabetes, obesity, cardiovascular conditions, and malnutrition. Cereal-based bars have become increasingly popular due to the availability and low price of refined cereal-based goods, but due to the milling process, many important phytochemicals and macro-nutrients and micronutrients are lost. Oats (*Avena sativa*) are a great source of nutrition, with the greatest protein level of any major cereal and a balanced amino acid composition. The annual herb chia seed (*Salvia hispanica* L.), which is a member of the Lamiaceae (Mint) family, is becoming increasingly popular as a novel meal due to its antioxidant potential. It contains a lot of proteins, soluble dietary fiber, phytochemicals, omega-3 and omega-6 fatty acids, and dietary fibers, starch, and pectin. Mango peel is also a high source of antioxidants such as ascorbic acid, carotenoids, and phenolic compounds. Sample No 3 had the highest hedonic score with the Overall Acceptability of 8.1.

Compliance with ethical standards

Acknowledgments

We are grateful to all those with whom we have had the pleasure to work during this research project. Each and every member of my Research Project work has provided us with extensive personal and professional guidance and taught us a great deal about both scientific research and life in general.

Disclosure of conflict of interest

The authors declare that there is no conflict of interest.

References

[1] Taruedee Jannu et al; Physiochemical properties and sensory evaluation of high energy cereal bar and its consumer acceptability; food science and Technology Program, faculty of Agro-Industry, Prince of Songkla University, Hat Yai, Songkla; 10 August 2021.

[2] Brahim Bchir et al; Effect of pear apple and date fibers incorporation on the physico-chemical, sensory, nutritional characteristics and the acceptability pf cereal bars; Food Science and Technology International; 2017.

[3] Farhana Mehraj Allai et al; Development of Protein Rich Pregelatinized Whole Grain Cereal Bar Enriched with Non-traditional Ingredient: Nutritional, Phytochemical, Textural, and Sensory Characterization; April 8 2022.

[4] Zhong-qing Jiang et al; Oat protein solubility and emulsion properties improved by enzymatic deamidation; Department of Food Science and Environmental Sciences, University of Helsinki, Finland; 5 April 2015.

[5] Angelika Kosiorowska et al; The effect if the addition of gold flax (*Linum usitatissimum* L.) and chia seeds (*Salvia hipanica* L.) on the physicochemical and antioxidant properties of cranberry jams; European Food Research and Technology; 9 August 2022.

[6] Poonam Jethwani et al; Formulation and Quality Evaluation of Antioxidant Rich Bars Enriched with Chia seed, Whole Mango, Apple and Guava; Department of Food and Nutrition, College of Home Science, Punjab Agriculture University, Ludhiana, India; 2 September 2020.

[7] Jhon M. Nduko et al; Application of chia (*Salvia hipanica*) seeds as a functional component in the fortification of pineapple jam; Food Science and Nutrition; 16 October 2018.