

DEVELOPMENT OF ORYZANOL-RICH NUT SPREAD

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ABSTRACT

The present investigation was carried out to develop a functional peanut-based nut spread enriched with rice bran oil (RBO), a natural source of gamma-oryzanol, as a healthier alternative to conventional fat-based spreads. A control formulation was prepared using palm oil as stabilizing fat, while four experimental formulations were developed by keeping peanuts (64-68%), jaggery (11-12%), and salt (0.5%) constant and varying the proportion of RBO (18-22%).

All formulations, along with the control, were analyzed for proximate composition, gamma oryzanol content, microbiological safety, and sensory acceptability. Results indicated that the incorporation of RBO significantly improved the functional quality of the spreads, with gamma-oryzanol levels ranging from 70 to 80 mg/100 g in experimental trials, compared with negligible amounts in the palm oil-based control. Trial 2 (68.1% peanuts, 20.5% RBO, 12.3% jaggery, 0.5% salt) achieved the most desirable balance of nutritional value and sensory acceptability (7.1 ± 0.4). Trail 1 and Trail 3, though acceptable, scored low in terms of texture, while Trail 4 exhibited excessive oiliness due to higher fat levels.

The findings demonstrate that replacing conventional stabilizing fat with RBO enhances both the nutritional and functional profile of nut spreads without compromising consumer acceptability. Among the experimental formulations, Trail 2 was identified as the optimized product, combining superior functional properties with favorable sensory attributes.

Keywords: Peanut spread, rice bran oil, gamma-oryzanol, functional food, sensory evaluation.

1. INTRODUCTION

Nut spreads, especially those prepared from peanuts, are gaining wide recognition due to their nutrient density, convenience, and strong consumer appeal. They provide significant amounts of protein, essential fatty acids, vitamins, and minerals, making them suitable for children, athletes, and health-conscious adults. With the increasing emphasis on functional and clean-label foods, spreads are now expected to offer benefits beyond basic nutrition.

1.1 Importance of Nut Spreads

Peanut-based spreads are nutrient-dense products rich in proteins, unsaturated fatty acids, vitamins, minerals, and bioactive compounds. For those following vegetarian or vegan diets, they serve as an important source of plant-based proteins. Because of their creamy texture and calorie density, they are especially suited for school-going children, athletes, and adults with busy lifestyles, as they provide both satiety and sustained energy.

From a nutritional perspective, peanuts are rich in monounsaturated and polyunsaturated fatty acids that support cardiovascular health by lowering LDL cholesterol and improving lipid profiles. Regular consumption of peanut-based spreads has been linked with reduced risk of atherosclerosis and other heart diseases. With growing consumer awareness about the relationship between diet and long-term health, nut spreads have become a convenient functional food option.

In addition to these health benefits, nut spreads are highly versatile and can be used in multiple food preparations. They are consumed directly, spread on bread, blended into smoothies, or used as ingredients in baked goods and confectionery. This wide range of uses increases their commercial value and consumer appeal. Their stability, palatability, and dense nutrition make them especially suitable for treating malnourished children in developing countries.

1.2 Common Oils in Commercial Spreads

In most commercial formulations, oils such as palm oil, soybean oil, and partially hydrogenated vegetable oils are commonly used. These oils act as stabilizers, provide texture, and extend shelf life. However, their nutritional drawbacks are significant. Palm oil contains high levels of saturated fatty acids, which hydrogenated oils generate trans fats during processing. Both of these are recognised as major dietary risk factors for obesity,

diabetes, and cardiovascular diseases.

Due to these concerns, consumer demand has shifted towards oils with better nutritional profiles. Oils with high monounsaturated and polyunsaturated fatty acid content, as well as natural antioxidants, are gaining attention in functional food development. Among them, rice bran oil (RBO) has emerged as a promising substitute for conventional oils in spreads. Global food industries are gradually shifting away from palm oil based products due to rising consumer awareness and stricter health regulations. This has created a strong opportunity for oils like RBO, which combine technological suitability with proven health advantages.

1.3 Health Concerns with Traditional Oils

The sharp rise in lifestyle diseases, particularly obesity, type 2 diabetes, and coronary artery disease, has prompted greater scrutiny of the type of fats included in food products. Traditional oils such as palm and hydrogenated vegetable oils supply large quantities of saturated and trans fats. These fats not only raise LDL cholesterol but also lower HDL cholesterol, thereby increasing the risk of heart attack and stroke.

Furthermore, their pro-inflammatory properties worsen metabolic conditions.

Public health organisations now advise reducing saturated and trans-fat intake in favour of unsaturated fats. This has encouraged food manufacturers to replace conventional oils with alternatives such as olive oil, avocado oil, and, more recently, rice bran oil.

The inclusion of rice bran oil in nut spreads directly aligns with this trend by offering a healthier lipid profile and added functional benefits.

Consumers are also becoming more label-conscious, actively checking for trans-fat and saturated fat content before purchasing products. This changing consumer behaviour has put pressure on brands to adopt healthier oils in their formulations to maintain trust and market share.

1.4 Advantages of Rice Bran Oil

Rice bran oil is unique among edible oils due to its favourable fatty acid composition and the presence of gamma oryzanol, tocopherols, and tocotrienols. It contains approximately 40% monounsaturated fats, 33% polyunsaturated fats, and only about 20% saturated fats, making it one of the healthiest cooking oils. Gamma-oryzanol, a mixture of ferulic acid esters and plant sterols, is especially valuable. Research has demonstrated its ability to

reduce cholesterol absorption in the intestine, improve lipid metabolism, and act as a potent antioxidant. Its antioxidative properties protect against oxidative stress, which is linked with aging, diabetes, cancer, and cardiovascular disorders. Another advantage of rice bran oil is neutral flavour and high smoke point, which make it suitable for a wide range of culinary and food processing applications. In processed foods, its natural antioxidant properties help extend product shelf life without synthetic stabilizers, making it an excellent choice for peanut spread formulations.

Moreover, the use of rice bran oil contributes to sustainability. Since it is extracted from the bran layer of rice, which is often treated as a by-product, its utilisation adds value to agricultural waste and supports resource-efficient practices in the food industry. This balance of cost effectiveness, functionality and health benefits makes it highly attractive for product development.

1.5 Project Rationale

The central aim of this project was to develop a peanut spread with improved nutritional and functional quality by replacing palm oil with rice bran oil. Peanuts naturally supply proteins, essential fatty acids, and micronutrients, while rice bran oil contributes additional health benefits through its gamma-oryzanol content. The combination is expected to enhance the product's antioxidant activity, reduce cholesterol absorption, and support overall cardiovascular health. Instead of refined sugar, jaggery was chosen as the sweetening agent. Jaggery is less processed and retains essential minerals such as iron, calcium, and magnesium. Its slightly lower glycaemic index compared to refined sugar makes it more suitable for individuals who need to manage blood sugar levels. Along with its nutritional value, jaggery imparts a pleasant caramel-like flavour that enhances consumer acceptability.

This project, therefore addresses two consumer expectations: taste and health. The formulation trials were designed to balance oil stability, texture, and sensory quality to arrive at an optimised peanut spread that could appeal to health-conscious consumers. The inclusion of jaggery also reflects consumer preferences for traditional and culturally familiar ingredients. By integrating modern health concepts with traditional sweeteners, this formulation has the potential to appeal to a wide demographic of consumers.

Furthermore, the use of rice bran oil instead of palm oil aligns with the current market positioning of health-oriented spreads. It allows the development of a differentiated product that stands out in terms of functionality and consumer value.

1.6 Consumer Demand for Natural and Clean-Label Ingredients

Modern consumers are increasingly drawn toward clean label foods- those made with simple, natural, and recognisable ingredients. Consumers are increasingly avoiding artificial sweeteners, preservatives, and colours. This has encouraged industries to reformulated products using natural alternatives .

Jaggery satisfies this demand by serving as a mineral – rich , natural sweetener , while RBO provides antioxidants and stability without artificial additives . Together with peanuts, these ingredients create a spread that reflects modern expectations of health transparency, and authenticity in food products.

1.7 Objectives:

1. To develop Oryzanol rich nut spread
2. To evaluate the sensory and physicochemical properties of Oryzanol rich nut spread

2. Review of Literature

2.1 Development of peanut-based spreads

Peanut-based spreads have been extensively studied for their nutritional and functional qualities. **Bhattacharya and Prakash (2014)** formulated a spread similar to peanut butter using fermented groundnuts, which showed desirable sensory characteristics and improved nutrient content. Their findings provided a foundation for further development of functional nut-based spreads.

2.2 Influence of roasting on quality

Roasting plays a vital role in defining the sensory appeal and quality of peanut butter. **Handa et al. (2013)** reported that roasting parameters significantly affected the physicochemical properties, flavour and consumer acceptance of peanut spreads, highlighting the importance of optimising roasting conditions.

2.3 Nutraceutical Properties of Rice Bran Oil (RBO)

Rice bran oil is recognised for its high nutritional value due to the presence of bioactive compounds, especially gamma-oryzanol. **Das and Sen (2019)** emphasised that oryzanol exhibits antioxidant, anti-inflammatory, and cholesterol-lowering effects, establishing RBO as a valuable ingredient in functional food formulations.

2.4 Functional Role of RBO In Health Foods

Pandey et al. (2015) reviewed the applications of RBO in functional food products, stressing its oxidative stability and favourable fatty acid profile. These attributes support its use in developing health-oriented spreads and processed spreads.

2.5 Antioxidants in RBO-based spreads

Zhang and wang (2021) highlighted that the incorporation of oryzanol and antioxidants in RBO-based spreads not only enriches nutritional quality but also protects against oxidation, thereby extending product stability.

2.6 Peanut-based functional foods

Peanuts, being rich in protein, fibre and beneficial fats, are ideal for functional foods. **Singh and Chauhan (2018)** reported that peanut-based products contribute to improved cardiovascular and metabolic health, supporting their role in developing functional formulations.

2.7 Shelf life and stability of peanut butter

Kumar and Goyal (2020) explained that the choice of oils and sweeteners influences texture, microbial stability and shelf life of peanut butter. They highlighted the necessity of aligning ingredient selection with functional and storage requirements.

2.8 Role of Stabilizers in Product Consistency

Oil separation is a common issue in natural peanut spreads. He et al. (2020) found that stabilizers such as lecithin and plant derived gums improved texture and storage stability without compromising sensory attributes.

2.9 Future Trends in RBO-Based Spreads

Mehta and Patel (2019) discussed the rising interest in RBO based spreads, driven by clean label demands and the functional benefits of RBO. They concluded that rice bran oil offers both nutritional and technological advantages of modern spread formulations.

2.10 Impact of Sweeteners on Quality

Park and Kim (2016) investigated the role of sweeteners in peanut spreads and reported that jaggery not only enhanced flavour but also improved mineral content, making it a suitable option for natural, clean-label formulations.

2.11 Effect of Oryzanol on Lipid Metabolism

Chung et al. (2017) observed that gamma-oryzanol reduces the cholesterol absorption in the gut, lowers LDL cholesterol, and supports cardiovascular health, thus making it suitable for incorporation in therapeutic foods.

3.1 Equipment Used

The equipment used in this project included a high-speed blender for preparing the peanut paste, a digital weighing scale for accurate measurement of ingredients, mixing bowls and spatulas for combining ingredients, a pH meter for acidity analysis, and air-tight food-grade containers for storing the final spread. Sensory score sheets were also used to collect data from panellists during product evaluation.

3.2 Microbiological Analysis

Microbiological evaluation was carried out to ensure product safety and storage stability. Due to laboratory constraints, only TPC and yeast & Mold counts were analyzed, which serve as primary indicators of microbial quality.

Total Plate Count(TPC)

TPC was measured using the pour plate method on PCA. Samples were incubated at $35 \pm 2^\circ\text{C}$ for 48h. The observed count was 5×10^2 CFU/g, reflecting satisfactory hygienic quality.

Yeast and Mold Count

Yeast and Mold populations were determined using RBA(Rose Bengal Agar). Incubation was performed at $25 \pm 2^\circ\text{C}$ for 3-5 days. The count was 50 CFU/g, indicating minimal fungal contamination and acceptable shelf-life

3.3 Evaluation Parameters

The developed formulations were assessed for their physical, textural, and sensory quality attributes. Oil separation was measured after seven days of storage, where the amount of separated oil was weighed and expressed as a percentage of the initial sample weight. Texture and consistency were evaluated manually with emphasis on spread ability, smoothness, and homogeneity. Sensory evaluation was carried out with a semi-trained panel of ten members, who scored the samples for appearance, colour, taste, aroma, texture, and overall acceptability using a 9-point hedonic scale. The data generated from these evaluations were compiled to identify and analyse the most suitable formulation in terms of both stability and consumer preference.

4. Results and Discussion

This chapter presents the findings from the evaluation of five formulations: the control sample(C) and four experimental trials (T1-T4). Physicochemical properties, proximate composition, oryzanol content, microbial safety, and sensory attributes were analysed. All results are expressed as mean \pm SD. This study identifies the optimal formulation, with T2 emerging as best.

4.1 Oil Separation Percentage:

Oil separation percentage indicates the extent of free oil released from the product during storage. It is calculated as the proportion of separated oil to the total sample weight.

Table 4.1.1 :Oil Separation Percentage

Sample	Oil separation (%)
Control	6.5 \pm 0.4
T1	6.4 \pm 0.3
T2	6.2 \pm 0.3
T3	6.4 \pm 0.4
T4	6.3 \pm 0.3

$$\text{Oil Separation (\%)} = (\text{Weight of Separated Oil} / \text{Initial Weight of Spread}) \times 100$$

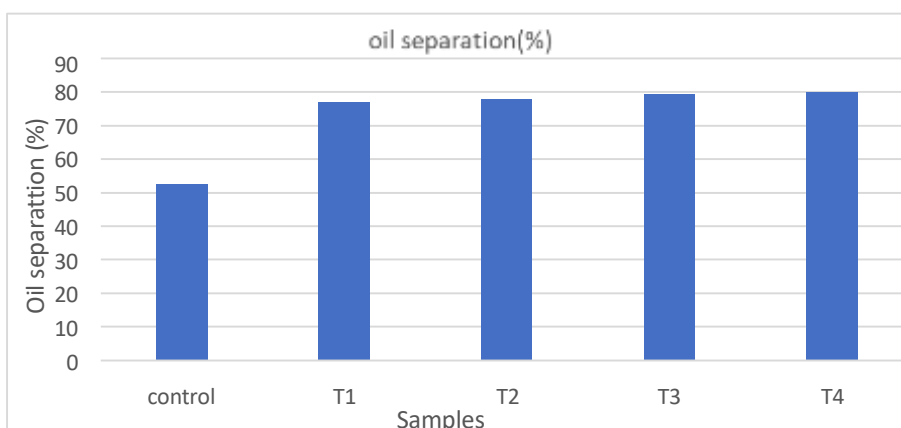


Fig. no 4.1.1: Graphical representation of oil separation percentage

Discussion: The control sample exhibited the highest oil separation, but T2 showed a slight improvement where it lower oil separation with more stability, while still remaining close to the control

4.2 : Spreadability Ratio:

It refers to the ease with which a spread can be applied on the surface. A higher ratio means better spreadability.

Table 4.2.1: Ratio of spread ability

Sample	Spreadability
Control	42.0± 2.3
T1	40.5±2.2
T2	41.0±2.0
T3	40.3±2.1
T4	40.8±2.0

Formula (based on diameter method):

Spreadability Ratio=D/T Where:

D = Diameter of spread in mm (after applying load for fixed time) T = Thickness or height of spread layer (mm)

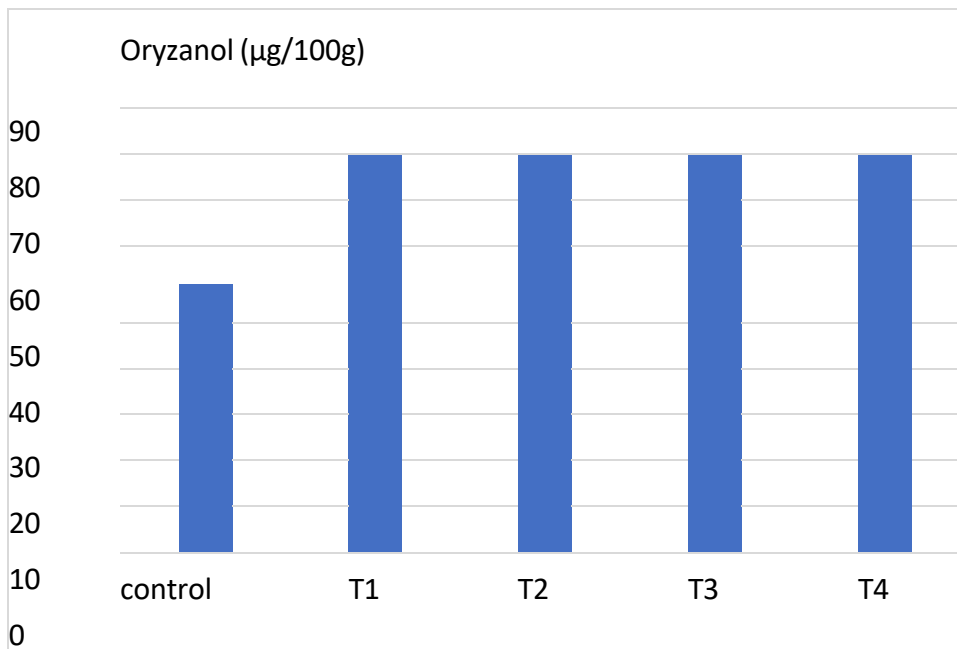


Fig. no 4.2.1: Graphical representation of the spreadability ratio

Discussion: Using the reference as a baseline of control sample, T2 had the better spreadability, indicating smoother texture while maintaining the control standard.

Higher ratio = better spread ability (more area spread for the same thickness)

4.3 Proximate Composition(%)

According to (FSSAI 2011: FPSFA Regulations), peanut butter should meet certain compositional standards. The moisture content should not exceed 3%, while protein should be not less than 25% on a dry weight basis. The fat content is expected to fall within the range of 40-55%, and the total ash should not be more than 3%. Crude fiber is limited to a maximum of 1.5%. Carbohydrates, estimated by the difference, generally fall in the range of 15-20%, and the energy value is expected to be about 550-600 kcal per 100g of the product. In the case of sweetened spreads, sugar should be maintained between 5-10%, and salt, if added, should be within 0.5-1.5%

Table 4.3.1: Proximate composition(%)

Parameter	Control	T1	T2	T3	T4
Moisture (%)	2.8 ± 0.1	2.8±0.1	2.7±0.1	2.8±0.1	2.7±0.1
Protein (%)	23.5 ± 0.8	23.8±0.8	24.0±0.7	23.7±0.8	23.9±0.7
Fat (%)	52.0±1.2	51.8±1.1	51.5±1.0	51.9±1.1	51.6±1.0
Carbohydrate (%)	18.0±0.9	18.2±0.8	18.4±0.8	18.1±0.9	18.3±0.8
Energy (%)	575±5	576±4	578±4	576±5	577±4

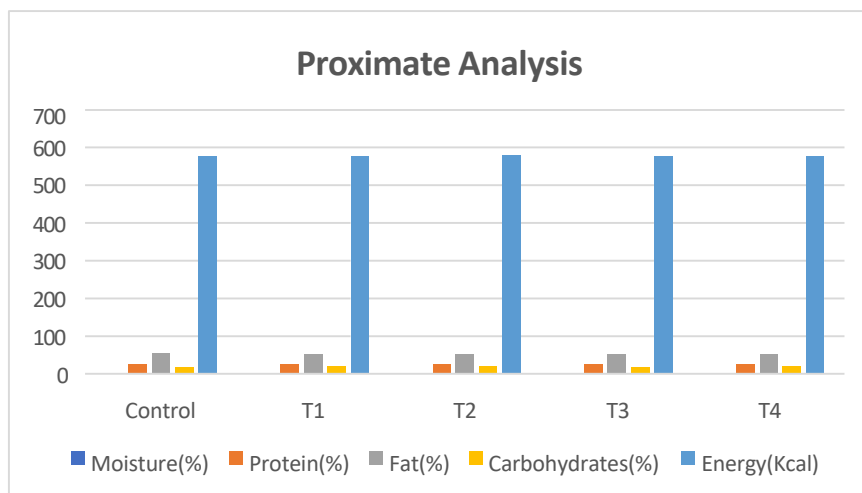


Fig no4.3.1.1: Graphical representation of proximate analysis

Discussion: The reference sample provided baseline nutrient values. All trials maintained values near the control, with T2 slightly higher in protein and carbohydrate, while fat remained moderate.

4.4 Oryzanol Content:

It is valued for its antioxidant activity, which enhances product stability. Estimation of oryzanol helps determine the nutritional and functional quality of the spread.

Table 4.4.1 Oryzanol content

Sample	Oryzanol
Control	52.0±1.3
T1	76.0±2.0
T2	77.0±1.5
T3	78.8±1.8
T4	79.5±1.7

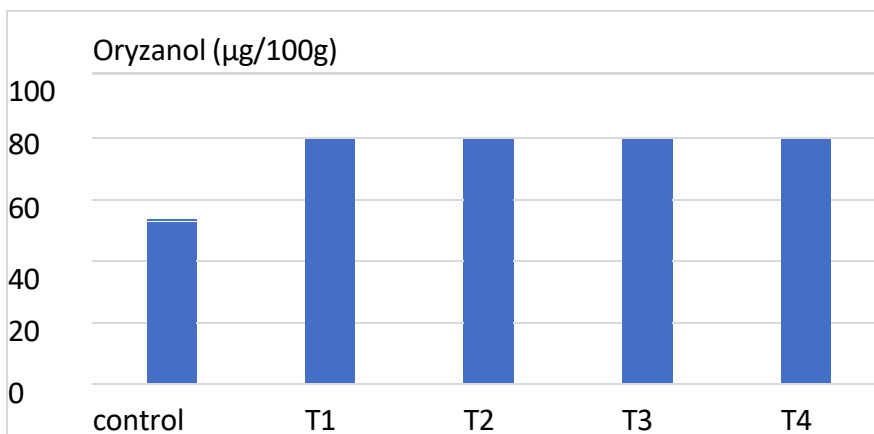


Fig no 4.4.1.1: Graphical representation of oryzanol content

Discussion: The reference sample provided baseline antioxidant potential. T4 has the highest oryzanol content, but T2 has better consistency.

5. Summary and Conclusion

This study mainly focused on the development of a functional, oryzanol-enriched nut spread using roasted peanuts as the main ingredient, which is stabilized by using rice bran oil. Four different formulations were prepared by varying oil content while keeping the other ingredients constant. Each formulation was evaluated for proximate composition, oryzanol content, oxidative stress, microbial quality, and sensory attributes to identify the best-performing trial.

The proximate analysis indicated that the T2 formulation had an ideal balance of fat, protein, and carbohydrates, making it nutritionally superior. Oryzanol content was contributed solely by rice bran oil, enhancing the functional properties of the spread. Sensory evaluation revealed that T2 had the most favourable taste, texture, colour, and overall acceptability compared to other trials.

In conclusion, the T2 formulation was identified as the best-performing product, combining optimal nutrition, functional benefits, microbial safety, and superior sensory quality. The study demonstrates that careful optimization of ingredients can lead to a ready-to-use, nutritionally enriched nut spread suitable for health-conscious consumers. The developed product offers a practical and healthy addition to functional foods, providing both taste and nutritional benefits.

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