World Journal of Advanced Engineering Technology and Sciences
eISSN: 2582-8266
Cross Ref DOI: 10.30574/wjaets
Journal homepage: https://wjaets.com/

(RESEARCH ARTICLE)

Check for updates

Preparation of Rolled Oats Omega-3 Laddu Using Fish Oil Capsules: Its Sensory Evaluation and Nutritional Value

Shrilaxmi Nayak and Ramya Gangolli *

Food Science and Nutrition Programme, Department of Biosciences, Mangalore University, Mangalagangothri -574 199 Dakshina Kannada District, Karnataka, India.

World Journal of Advanced Engineering Technology and Sciences, 2025, 16(02), 136-140

Publication history: Received on 30 June 2025; revised on 05 August; accepted on 08 August 2025

Article DOI: https://doi.org/10.30574/wjaets.2025.16.2.1275

Abstract

The Rolled Oats Omega – Laddu is a nutrient dense snack that combines the health benefits of omega 3 fatty acids, fiber and natural sweeteners. This innovative recipe incorporates fish oil extracted from capsules, offering a convenient and effective way to boost omega -3 intake. Rolled oats ground into powder, serve as the base, providing complex carbohydrates, fiber and essential micronutrients. In addition to adding flavor, honey provides natural sugars, making it a healthier alternative to refined sweeteners. Dry fruits provide a wide range of vitamins and minerals, proteins, and healthy fats. Cardamom powder and a hint of vanilla essence add a delightful aroma and flavor to the desiccated coconut, which is loaded with healthy fats, particularly medium chain triglycerides, which provide a quick source of energy. Fish oil's omega-3 content will not be diminished by this recipe's lack of heating or cooking. The rolled oats Omega-3 Laddu is a food that is high in calories and is ideal for people who want to consume more calories, improve their cardiovascular health, and support their overall well-being. The purpose of this study is to determine whether the laddu is an excellent snack for active people, people who need a lot of energy, or people who want to improve their nutritional profile. This recipe also caters to those who may have limited access to fatty fish, providing a particular source of omega-3 fatty acid through a simple homemade preparation. The rolled oats omega -3 laddu is a fusion of taste and nutrition, offering a unique, healthy alternative to traditional sweets. The shelf of prepared product in refrigerator was two weeks and in room temperature was one week.

Keywords: Fish oil; Rolled oats; Natural sweetener; Omega-3 fatty acid; Nutrition

1. Introduction

Fish oil is widely recognized as one of the most significant natural sources of omega-3 polyunsaturated fatty acids (PUFAs), particularly eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), both of which are crucial for various bodily functions and offer a range of health benefits. These benefits include promoting cardiovascular health, improving cognitive function, and supporting immune system performance. However, despite these advantages, the practical use of fish oil is often limited due to certain inherent challenges. PUFAs like EPA and DHA are highly prone to oxidation, which leads to the degradation of their quality and loss of their health benefits. Additionally, PUFAs have poor water solubility, making it difficult to effectively incorporate them into food products without compromising the overall product stability and texture. These limitations have led to the exploration of innovative methods to enhance the stability and bioavailability of fish oils. Encapsulation techniques, in particular, have emerged as a viable solution. By encasing the sensitive PUFAs within protective materials, encapsulation can shield them from oxidation, preserve their beneficial properties, and enhance their solubility. This approach not only helps maintain the nutritional value of fish oil but also expands its potential applications in various food formulations, supplements. Through encapsulation, fish

* Corresponding author: Ramya Gangolli

oil can be more effectively utilized in the food industry, allowing consumers to enjoy its health benefits without the challenges associated with oxidation and solubility (Khoshnoudi *et al*., 2022).

Oats (*Avena sativa*), belonging to the Poaceae family, are recognized for their health benefits. They are a rich source of soluble fiber, particularly β-glucan, which offers numerous advantages for digestive health and acts as a preventive against colorectal cancer. Additionally, oats help maintain an optimal weight due to their high fiber content. Oats are also packed with antioxidants, vitamins, phenolic acids, sterols, and phytic acid, all of which play vital roles in bodily functions. The key component in oats that helps reduce cholesterol levels is soluble fiber, with β-glucans being the most abundant non-starch polysaccharides. β-glucan has a high viscosity even at low concentrations, and this property is crucial in eliciting beneficial physiological effects, including appetite regulation (Pallavi *et al*., 2021).

Honey is regarded as the first natural sweetener discovered and is widely utilized as a nutritious food supplement and medicinal agent. Its quality and flavour vary depending on factors such as floral sources, climate, and geographic conditions. Honey is known for its potential health benefits, including antimicrobial, antioxidant, anti-inflammatory, anticancer, antihyperlipidemic, and cardioprotective effects. These properties make honey beneficial in treating eye disorders, gastrointestinal diseases, neurological conditions, fertility issues, and promoting wound healing. These bee products are effective in preventing disease and promoting good health due to the presence of bioactive compounds such as flavonoids, phenolic acid, terpenes and enzymes (Prem, 2021).

Polyunsaturated fatty acids (PUFAs) from the omega-3 series, particularly the long-chain EPA and DHA, have a significant positive impact on human health. However, the typical intake of these fatty acids is often too low, leading to various negative health effects in the general population. As a result, increasing omega-3 fatty acid consumption is recommended. One effective approach to raise omega-3 intake, without major changes to eating habits, is to enrich commonly consumed food products. This study aimed to investigate the potential for enriching selected food items with omega-3 PUFAs using fish oil preparations, while minimizing negative impacts on taste. These enriched foods were intended to function as functional foods, beneficial for the prevention of various diseases (Kolanwoski *et al.*, 1999).

2. Materials and Methods

The ingredients such as fish oil capsule, rolled oats, honey, desiccated coconut, cardamom powder, vanilla essence, dry fruits were purchased from the local market. Fish oil was extracted from the capsule. To this fish oil, honey, cardamom powder, and a drop of vanilla essence were added. These three ingredients masked the fishy odour of the fish oil. All the ingredients were mixed thoroughly. Rolled oats were ground into a fine powder. To this powder, desiccated coconut and dry fruits were added. The previously prepared liquid mixture of fish oil was added to this solid mixture and stirred well to combine. Once the mixture reached the desired consistency, small portions were taken and rolled into round laddus. Then, they were chilled in a refrigerator for about 20 minutes. This helped them firm up further.

2.1. Test for Rolled Oats Omega 3 Laddu:

- **Determination of Moisture content**: Moisture content was determined by the moisture analyzer. Moisture analyzers typically employ the principle of thermogravimetric analysis (TGA). The instrument heats the sample while monitoring its weight loss, which is directly proportional to the moisturecontent. This weight loss is measured continuously until the sample reaches a stable, moisturefree state, providing accurate and reliable results (ISO 22000:2018).
- **TVB-N Estimation:** Five grams of product sample were weighed into a distillation tube. Then, 0.5 g of magnesium oxide and 3 drops of antifoaming agent (silica) were added, and the mixture was dissolved in 70 ml of distilled water. 20ml of 4% boric acid were added to a conical flask, which was then set up for distillation for about 5 minutes. After distillation, the distillate was titrated against 0.1N HCl by adding phenolphthalein as an indicator until the malachite green changed to a dark pink color. The final result was calculated using the standard formula (ISO 22000:2018).
- **Ash content:** The crucible and lid were first placed in the furnace at 550 °C overnight to ensure that impurities on the surface of the crucible were burnt off. The crucible was then cooled in a desiccator for 30 minutes. The empty crucible with lid was weighed. Approximately 1 g of product sample was weighed into the crucible. The sample was heated at 600 °C for 2 and 1/2 hours. It was then cooled in the desiccator. The ash, along with the crucible and lid, was weighed. The ash was expected to be white or light gray. If not, the crucible and lid were returned to the furnace for further ashing. The final result was calculated (ISO 22000:2018).
- **Test for Protein** : One gram of the product sample was accurately weighed. Seven grams of potassium sulfate, 0.8 g of copper sulfate, 3 to 5 anti-bumping granules, and 12 ml of concentrated sulfuric acid were added to a digestion tube. The tube was covered with an exhaust manifold and placed in the preheated digester, where it

was digested at approximately 110– 130 °C for 15 minutes (this step was ignored if a non-liquid sample was used). The digester was then adjusted to the digestion temperature, normally around 420 °C,and the sample was digested for about an hour until the solution turned light green. The tube was removed and allowed to cool. 50ml of distilled water were cautiously added to the cooled sample. The distillation apparatus was switched on and pre-washed for 10 minutes. 30ml of 4% boric acid were dispensed into a 250 ml conical flask, and the flask was placed under the condenser, ensuring that the condenser tip was immersed in the boric acid solution. The digestion tube containing the digested sample was connected to the distillation apparatus. 70ml of 40% sodium hydroxide were carefully dispensed into the digestion tube. The steam supply valve was immediately turned on to initiate distillation. The sample was heated for 5 minutes until all the ammonia had passed over into the boric acid. The conical flask was then lowered to ensure that the condenser tip was no longer immersed in the solution, and heating was continued for an additional minute. Approximately 120 ml of distillate were collected. The tip of the condenser was washed with distilled water. The conical flask containing the ammonia distillate was placed on a magnetic stirrer. 1ml of phenolphthalein indicator was added, and the sample was titrated with standard 0.3N hydrochloric acid until the solution changed from green to pinkish. The volume of acid used for titration was recorded. Finally, the total protein content was calculated using the given formula (ISO 22000:2018).

- **Estimation of Fat by Soxhlet extraction method:** One gram of dried product sample was accurately weighed into the thimble or flask. The thimble was inserted into a Soxhlet liquid/solid extractor. A clean, dry 150 ml round-bottom flask was accurately weighed, and about 90 ml of petroleum benzene was added to the flask. The extraction unit was assembled over an electric heating mantle or water bath. The solvent in the flask was heated until it boiled. The extraction process was continued for 3 hours. The extraction unit was then removed from the heat source, and the extractor and condenser were detached. The flask was placed in an oven at 60 to 80 ºC for 20 minutes. It was cooled in a desiccator and weighed with its contents. The fat percentage was calculated using the formula given below (ISO 22000:2018).
- **Test for Free fatty acid:** Free fatty acid testing was performed after Fat extraction. Fat content which was obtained during the extraction process was used for the determination of Free fatty acid content. A 150 ml conical flask was taken, and 25 ml of petroleum benzene, 25 ml of ethyl alcohol, and 3 drops of 1% phenolphthalein indicator were added. The solvent was titrated with 0.02N NaOH until a pale pink colour appeared. This solution was transferred into a sample flask and mixed accordingly. It was then titrated against 0.02N NaOH until a pale pink colour appeared. The burette reading was noted. The fat content was calculated using the formula given below (ISO 22000:2018).
- **Sensory analysis:** The prepared Rolled Oats Omega-3 Laddu were evaluated for sensory parameters consisting of characteristics such as appearance, texture, aroma, colour, taste, mouth feel, after taste, overall acceptability using nine-point hedonistic scale. The sensory evaluation was done by using 20 panel members.
- **Shelf life of the product:** The shelf life of prepared product in refrigerator was found to be two weeks and in room temperature was found to be one week.
- **Result and Discussion:** The Rolled Oats Omega-3 Laddu is a nutritious and delicious snack prepared with rolled oats, fish oil, honey, dry fruits, desiccated coconut, and vanilla essence. This laddu combines the benefits of omega-3 fatty acids from fish oil with the wholesome goodness of oats, natural sweetener honey, and nutrient-rich dry fruits and coconut, making it a healthy and tasty treat.

The nutritional composition of the prepared laddu was compared with other fish oil-fortified products: The laddu's moisture content (12.343%) falls within the range reported by Pankyamma *et al*., (2014) for fish oil-fortified snacks (12-20%), but is significantly lower than Uriho *et al*., (2022) finding for fish oil-fortified bread (45.87%). The laddu's protein content (9.03%) is higher than Hamed *et al*., (2019) finding for fish oil-fortified yogurt (5.20%), but lower than Lamas *et al*., (2021) report for fish oil-fortified snacks (around 17%). The laddu's fat content (15.41%) is slightly higher than Jeyakumari *et al*., (2016) finding for fish oil-fortified cookies (13.85-14.93%). The laddu's ash content (1.354%) is higher than Meral *et al*., (2024) finding for low-calorie cookies fortified with fish oil (0.75%). The laddu's TVB-N value (6.91mg/100g) indicates good freshness and quality. The laddu's free fatty acid value (2.443%) suggests relatively low lipid oxidation.

Table 1 Sensory analysis of Rolled Oats Omega-3 Laddu

Hedonic scale	Accepted value
Appearance	8.275 ± 0.553715
Colour	8.175 ± 0.473443

Aroma	8.25 ± 0.58009
Texture	8.085526 ± 0.611804
Taste	8.275 ± 0.603773
Mouth feel	8.15 ± 0.613384
After taste	7.975 ± 0.595487
Overall acceptability	8.25 ± 0.542875

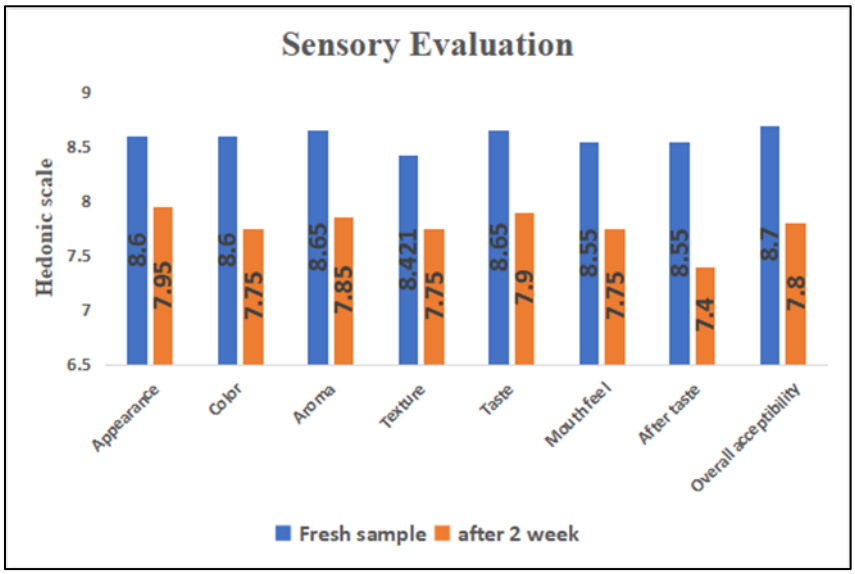

Figure 1 Sensory evaluation for the Rolled Oats Omega-3 Laddu

Table 2 Quality test for the Rolled Oats Omega-3 Laddu

Moisture	TVB-N	Protein	Ash	Fat	Free Fatty acid
12.343±0.0503	6.91±0.9179	9.03±0.366	1.354±0.111	15.41±2.383	2.443±0.5795

3. Conclusion

The study demonstrated the potential of developing a nutritious and delicious snack, Rolled Oats Omega-3 Laddu, using fish oil capsules and rolled oats. The laddu's nutritional composition and quality characteristics make it a promising product for consumers looking for healthy snack options.

References

[1] Alvarez, T. S., & Lamas, D. L. (2021). Chemical characteristics and sensory properties of novel snacks produced with okara fortified with omega-3 from fish oil. *International Journal of Food Studies*, *10*.

[2] Hamed, S. F., Soliman, T. N., Hassan, L. K., & Abo-Elwafa, G. (2019). Preparation of functional yogurt fortified with fish oil-in-water nanoemulsion. Egyptian Journal of Chemistry, 62 (Special Issue (Part 1) 301-314.

[3] ISO 22000:2018.

[4] Jeyakumari, A., Janarthanan, G., Chouksey, M. K., & Venkateshwarlu, G. (2016). Effect of fish oil encapsulates incorporation on the physico-chemical and sensory properties of cookies. Journal of food science and technology, 53, 856-863.

[5] Khoshnoudi-Nia, S., Forghani, Z., & Jafari, S. M. (2022). A systematic review and meta-analysis of fish oil encapsulation within different micro/nanocarriers. Critical Reviews in Food Science and Nutrition, 62(8), 2061-2082.

[6] Kolanowski, W. (2024). Foods Enriched with Fish Oil. J Nutrition Science and Culinary Techniques, 1(1), 1.S.

[7] Meral, R., Kına, E., & Ceylan, Z. (2024). Low-Calorie Cookies Enhanced with Fish Oil-Based Nano-ingredients for Health-Conscious Consumers. *ACS omega*, *9*(37), 39159-39169.

[8] Pallavi, D., Hiremath, J. P., & Madhusudan, N. M. (2021). Oats as a functional food. *Bhartiya Krishi Anusandhan Patrika*, *36*(4), 350-352.

[9] Pankyamma, V., Basu, S., Bhadran, S. S., Chouksey, M. K., & Gudipati, V. (2014). Fish oil-fortified extruded snacks: Evaluation of physical properties and oxidative stability by response surface methodology. *Journal of food process engineering*, *37*(4), 349-361.

[10] Prem Jose Vazhacharickal. (2021). A review on health benefits and biological action of honey, propolis and royal jelly. Journal of Medicinal plants Studies, 9(5), 01-13.

[11] Uriho, A., Chen, K., Zhou, F., Ma, L., Chen, C., Zhang, S., ... & Liang, L. (2024). Functional Breads with Encapsulated Vitamin C and Fish Oil: Nutritional, Technological, and Sensory Attributes. *Antioxidants*, *13*(11), 1325.