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# Formulation of Nutritious Protein Enriched Oats Bar; A Functional Snack for Athletes' Post-Training Recovery

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Abstract: Protein and carbohydrates play a crucial role in athletic performance, recovery, and muscle adaptation. Carbohydrates serve as the primary fuel source, replenishing glycogen stores and preventing fatigue, while protein supports muscle repair, growth, and reduces exercise-induced muscle breakdown. Understanding the role of these macronutrients is essential for developing effective nutrition strategies tailored to athletes' specific training demands. This study aims to develop an easy to prepare, minimally processed oats energy bar, free from artificial additives. This energy bar serves as an ideal post-training or post-workout snack for athletes and active individuals. Which contains the appropriate proportions of carbohydrates to protein (1:3 ratio) to facilitate better recovery. Thereby, it leads to improved performance and recovery efficiency in subsequent training sessions. The ingredients were chosen based on their protein and carbohydrate content, easy availability, cost-effectiveness, macro and micronutrient profile, and potential for better recovery. Sensory evaluation was done using a 9-point hedonic scale to examine product attributes such as colour, appearance, aroma, consistency, taste and overall acceptance. Among panel members the oats energy bar had an overall acceptability of 8.43±0.68. The properties of the developed energy bar suggest it is a convenient, nutritional ergogenic aid, recommended as a post-training snack for athletes. <u>Highlights of the Work</u>: a) The oats protein bar is designed as a post-exercise recovery snack, incorporating protein rich ingredients and optimizing macronutrient composition for muscle recovery. b) This product satisfies the protein and carbohydrate requirements of post-training snack recommended by American College of Sports Medicine for better recovery. c) Which can be conveniently prepared at household using simple cost-effective ingredients.

Keywords: Oats, protein, recovery, post-training snack, athlete, nutritional ergogenic aid

#### 1. Introduction

In the post-pandemic era, people have become increasingly conscious about their health, well-being and recovery. People desire functional foods that encourage a healthy lifestyle while being convenient to prepare and consume (Menon et al., 2022). Energy bars have grown in popularity due to their health benefits. These bar-shaped snacks provide vital nutrients and boost energy levels. According to a study, these functional foods are popular among people of all ages, but particularly among athletes and physically active adults (Aljaloud et al., 2020). Athletes require greater nutrient intake than common people. Many athletes find it difficult to meet their nutritional needs for peak sports performance. This is related to increased levels of activity, leading to higher metabolism, heat production, and hormone synthesis (Braun & Miller, 2008). It is important to produce alternative food products such as energy bars that are high in calories, protein, and fibre for athletes. The use of oats in ready-to-eat food products has shown potential for enhancing satiety and modulating digestive responses, making them suitable candidates for sports nutrition applications (Behall et al., 2005). Using functional foods to boost the nutritional

value of food products and snacks can help address future health issues for the Indian population.

#### 2. Literature survey

Adequate protein and carb consumption in the post-exercise window, has been extensively studied for its effects on muscle protein synthesis, recovery, and performance enhancement (Tipton et al., 2004; Phillips, 2012). Ingredients for bar formulation were chosen based on their nutraceutical qualities. Oats a protein rich cereal with a balanced amino acid composition (Stewart & McDougall, 2014). Micronutrients contained in oats include vitamin B1, B6, folate, pantothenic acid, manganese, magnesium, selenium, iron, zinc, and copper. This cereal also contains phenolic compounds with strong antioxidant properties such as ferulic acid, vanillic acid and p-Coumaric acid. Enzymes such as protease, maltase,  $\alpha$ -amylase, and lichenase present in oats aid digestion, biochemical reactions and making it beneficial for gut health (Stewart & McDougall, 2014).

Presence of Beta glucan in oats makes it fibre rich and is linked to cholesterol reduction, improved heart health, and blood sugar regulation. A study showed that oat protein

treatment for 19 days significantly reduced skeletal muscle soreness caused by eccentric exercise. It also decreased serum creatine kinase, myoglobin, C reactive protein levels and plasma interleukin-6 concentrations. Oat protein supplementation reduced limb oedema after injurious exercise and improved muscle strength, knee-joint range of motion, and vertical jump performance (Xia *et al.*, 2018).

There has been an increasing interest in the health advantages of plant-based foods and concerns over the sustainability of sourcing animal-based proteins. Data from the National Health and Nutrition Examination Survey shows an impressive increase in plant protein intake from 1999 to 2010. This trend is expected to continue in the next decades. Protein isolates from plant-based foods are sold to support exercise training. Peanut flour and defatted peanut powder are gaining popularity. Peanut protein contains an array of essential amino acids (Sexton et al., 2021). Except for methionine and threonine, which is complimented by oat protein. Relative to other plant-based proteins such as wheat or legumes, peanut protein possesses a reasonably higher PDCAAS of 0.70/1.00 (Sexton et al., 2021).

Brown rice is a whole grain that contains the bran and germ layers intact, while it is removed from white rice during the milling process. This outer layer provides brown rice its distinctive chewy texture and nutty flavour. Because it is less processed, it is a popular choice for individuals looking to eat healthy. Whole grains have shown to protect against CVD, obesity, DM and cancer (Slavin 2004). Brown rice contains the protein rich endosperm while the bran contains over 80% of minerals. The germ layer contains Vitamin E, unsaturated fatty acids, minerals, antioxidants, and phytochemicals. These bioactive molecules contribute to their protective properties (Newby et al., 2007).

A study indicated that 24 young athletes of two groups who consumed either 48g rice protein or whey protein after 8 weeks of resistance exercise experienced similar substantial gains in muscle protein synthesis, strength and acute recovery. Despite variations in amino acid profile, digestibility, and protein digestion rate, no statistical differences were found between the two groups (Joy et al., 2013). The authors suggest that when critical nutrients are sufficiently supplied here leucine, protein type or content is less important. The brown rice protein supplement supplied leucine levels that appeared to be within or over the 2-3g threshold required to maximise muscle protein synthesis (Norton et al., 2006). The combination of oats with protein rich ingredients improves the amino acid score of the final product and supports the anabolic demands of physically active individuals.

# 3. Problem Definition

Energy bars currently available in the market are expensive and contain additives not recommended for athletes. This research aims to fill the gap between sports nutrition and functional foods formulated with whole grains. While oats have been extensively studied for their cardiovascular and glycemic benefits, their direct application in compact, shelfstable, protein-dense snack options for post-exercise consumption is underexplored. This energy bar has been formulated using commonly used ingredients which are cost effective. Athletes can consume this product with a glass of milk to meet their post-training snack carb-protein requirements.

# 4. Materials and Methodology

This study of developing a nutritional product for athletes was conducted in the Research Kitchen of Sports Nutrition Department of Sports Authority of India (SAI), NSSC, Bengaluru.

#### a) Raw materials

The raw materials mentioned in Table 1. were procured from the mess kitchen of SAI, NSSC, Bengaluru.

<b>Table 1:</b> Composition of ingredients- Variant 1 and Variant
2 of the oats bar

S. No	Ingredient	Variant-1: Quantity	Variant-2: Quantity		
1.	Oats	250g	250g		
2.	Peanut Butter	200g	200g		
3.	Brown rice	50g	50g		
4.	Honey	50g	100g		
5.	Powdered Jaggery	50g	-		
6.	Salt	1⁄4 tsp	¼ tsp		
7.	Cinnamon Powder	¹∕₂ tsp	¹∕2 tsp		
8.	Butter	1½ tbsp	1½ tbsp		
9.	Almonds	80g	-		

#### b) Optimization of ingredients

The ingredients used for preparing the oats protein bar were pre-treated, such as roasting the oats for 4 minutes, brown rice for 6-7 minutes for it to get puffed. 70% of the roasted oats and puffed brown rice were blended separately. The remaining oats were kept for topping and for maintaining the consistency of the base. The peanut butter and honey mixture melted to get smooth flowy texture. For the toppings oats were tossed in butter to add crunch.

#### c) Formulation of the product

The pre-treated ingredients were added in a mixing bowl and mixed thoroughly. The mixture was spread out uniformly on butter paper placed on the baking tray. The mixture was flattened using a silicone spatula, a layer of melted peanut butter was spread over the base and was topped with roasted oats. This was set in the freezer for 2 hours to harden, which was then subjected to sensory evaluation.

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Figure 1: Flowchart representing processes involved in preparation of the oats bar

## 5. Results and Discussion

Athletes require adequate nourishment for good health status and optimal performance. Consuming these energy bars posttraining helps to satiate hunger and replenish energy. The nutritive value of the oats bar was calculated based on IFCT food composition tables.

**Table 2:** Nutritive values for one oats bar-Variant 2(weighing 40g)

(weigning 40g)		
Energy (kcal)	184.48	
CHO (g)	21.3	
Protein (g)	6.36	
Fat (g)	8.51	
Fibre (g)	1.96	
Ca (mg)	175.415	
P (mg)	1450.2	
Fe (mg)	12.945	
Zn(mg)	11.046	
Mg (mg)	493.268	
Vit A(µg)	102.975	
Vit E (mg)	18.951	
Vit B6 (mg)	1140.911	
Vit B3 (mg)	27264.26	

A group of 21 panel members evaluated the sensory quality of the product using a nine-point hedonic scale. Sensory evaluation interprets how consumers respond to food items through their senses of sight, smell, touch, taste, and hearing. Evaluating sensory quality is crucial for marketing as it provides valuable insights into consumer preferences and acceptance. Variant 1 was produced using 50% of jaggery and 50% of honey for sweetness, along with crushed almonds. It had a crumbly texture which made it difficult to be cut into bars. Variant 2 that was made using only honey for sweetness had a better consistency, due to the binding nature of honey. Variant 2 was subjected for sensory evaluation. The mean score for variant 2 from all panel members was computed, reflecting the panel's assessment of the product's sensory quality. Mean and SD of overall acceptability of the oats bar is 8.43±0.68.

**Table 3:** Mean and SD of the different parameters used for sensory evaluation-Variant 2

S. No	Parameter Mean		SD
1.	Appearance	8.2857	0.72
2.	Colour	8.4762	0.75
3.	Smell	8.381	0.74
4.	Taste/ Flavour	8.7143	0.46
5.	Texture	8.0476	0.86
6.	Overall acceptability	8.4286	0.68



Figure 2: Radar chart indicating product sensory attributes

#### a) Costing

The costing of one energy bar weighing 40g comes to Rs. 10.3.

#### b) Shelf-life Analysis

The shelf life of the oats bar was found to be good up to 4 days in room temperature, due to lower moisture content. While the shelf life in the refrigerator was 1.5 months

# 6. Conclusion

This oats protein bar as a post-exercise snack is a highly practical and cost-effective solution for individuals seeking a nutritious and energy-dense snack option. The simplicity of the ingredients and the easy preparation process make it apt for home production, reducing reliance on expensive commercial alternatives. Additionally, its convenience allows for easy storage, portability, and quick consumption, making it an ideal choice for athletes, fitness enthusiasts, and individuals with busy lifestyles. With 4 days shelf life at room temperature, this can be an ideal snack for athletes during their travel or at competition venue. The ability to customize ingredients based on personal dietary preferences and nutritional goals adds to its appeal, ensuring a balanced and health-conscious post-exercise recovery snack.



Figure 3: Samples of Variant 1(Right) and Variant 2 (Left) of the oats bar

## 7. Future Scope

This oats energy bar developed can be used as a sustainable alternative to the expensive energy bars present in the market. It provides a cheaper option for post-training snacks instead of supplements for athletes. Which can be conveniently prepared at home.

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