

# Development and Standardization of Protein Mix Products for Enhancing Nutritional Recovery and Performance

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**Abstract:** Protein is an essential macronutrient for body function and to improve athletic performance by enhancing the right muscle mass in the athlete. Protein and amino acid supplements are popularly known for sports personalities and active individuals as muscle-boosting, performance-intensifying products, and high-protein, low-carbohydrate diets are traditionally applied for weight-loss purposes. The study aimed to identify different protein sources for the mix, assess its protein content, and evaluate its acceptability and palatability. The present study aims to develop a protein mix product that provides intensified nutritional support for recovery and enhances athletic performance. The ingredients were chosen for their protein content, micronutrient profile, and potential muscle recovery and growth benefits. Two variants of the protein mix were prepared and analyzed for their macronutrient composition. Sensory evaluation of both variants was conducted using the 9-point hedonic scale, assessing parameters such as colour, appearance, aroma, consistency, taste, and overall acceptability. The results showed that Variant 2 received higher mean scores in all parameters compared to Variant 1, indicating its superior acceptability among the panellists and chosen for further study. It was found that Variant 2 of the protein mix contains 22.35 kcal of energy, 2.3g of carbohydrates, 1.1g of protein, and 0.9g of fat per 5g of powder; hence, it can be recommended as a recovery drink mix for athletes, providing a balanced ratio of carbohydrates and protein.

**Keywords:** Recovery, performance, positive nitrogen balance, Protein mix, hedonic scale, Macronutrients

## Abbreviations:

ICMR- Indian Council of Medical Research

NIN- National Institute of Nutrition

ACSM- American College of Medical Research

FSSAI- Food Safety and Standards Authority of India.

## Note:

1. The paper has not been published elsewhere and also is not under review for publication in another journal.
2. The study is based on the Development of a Protein mix to Enhance nutritional recovery.

## Novelty Expression File

Our current study develops a protein mix which is free from preservatives, added sugars and gluten. So this protein mix can help individuals with celiac disease. The main scope of this product development is to help athletes as a post workout drink. As of now there is no such products which is free from artificial ingredients. This is a new product which is not available in the market.

## Research highlights:

- This is the new product which is free from preservatives and added sugars.
- The main thing in this product is it is satisfying the protein and carbohydrate requirements of post workout/training recommended by American College of Sports Medicine for a healthy recovery.
- This protein mix is an instant one and can easily prepared at household.

## 1. Introduction

Protein – the body-building warrior, plays a critical role in countless physiological processes in the body. In sports nutrition, athletes are more concerned about muscle gain, which is increased by protein supplementation. Protein and amino acid supplements are widely marketed for athletes and habitually active consumers as muscle growth and performance-enhancing products, and high-protein, low-carbohydrate diets are traditionally applied for weight-loss purposes (Anna et al., 2019). The protein source is vital for muscle protein synthesis after any workout and maintains the balance between protein breakdown and synthesis. For athletes, it is essential to maintain a positive protein balance. Protein helps in muscle repair, growth, and differentiation of cells. The demand for protein supplements is increasing enormously, according to a study conducted by (Petróczi et al., 2007). Protein requirements are increased by hard training, and it is often recommended that the protein intake of strength athletes should be 50 – 100% greater than their sedentary counterparts. In resistance-trained subjects younger than 49, protein supplementation has been suggested to maximize skeletal muscle's anabolic reactions and enhance the adaptive response to resistance training. Some biomarkers of high protein intake have been found to correlate with enhanced muscle function in young adults. Protein consumption before and after resistance training may enhance recovery, resulting in hypertrophy and strength gains (Roberts et al., 2017). Studies show beneficial effects such as reduced muscle soreness and markers of muscle damage become more evident when supplemental protein is consumed after daily training sessions. A review stated that protein supplements

are used during resistance training to enhance gains in muscle mass and strength and during an aerobic- or sport-based training program to enhance gains in aerobic and anaerobic power (Pasiakos et al., 2015).

## 2. Problem Statement

The protein mixes currently available are expensive and have some preservatives not recommended for athletes. This product, which has been developed, contains the common ingredients commonly used in households and is very cost-effective. The preparation process is easy and does not require special skills. Athletes need protein after training; instead of supplements, they can mix this protein with carbohydrates and protein.

## 3. Literature Survey

An increasing corpus of research aiming at enhancing athletic performance and boosting athletes' general health is propelling the fast evolution of sports nutrition. The necessity of customized nutritional approaches was highlighted by Graybeal et al.'s cross-sectional data from 2023, which showed age-related disparities in dietary supplement use among endurance athletes. The integration of research data on dietary protein into useful applications for improving muscle growth and health advantages in athletes was discussed by Carbone and Pasiakos (2019).

The physicochemical characteristics of cashew kernel starch were described by Chen et al. (2022), which advanced our knowledge of food functioning in sports nutrition. The effects of an extract from fennel seeds on intestinal barrier function were studied by Das et al. (2022), with possible implications for athletes' digestive health. A scoping assessment of the prevalence of dietary supplement use among athletes globally was carried out by Daher et al. (2022), demonstrating the broad acceptance of supplementation techniques.

The effects of graded whey supplementation during resistance training were investigated by Haun et al. (2018), who provided insightful information on muscle adaptation and recovery techniques. The nutritional makeup of roasted fox nuts was investigated by Liaquat et al. (2022), who found that they may be useful for athletes' dietary planning as a source of antioxidants. In order to better understand plant-based protein sources for sports nutrition, Liu et al. (2018) looked at the molecular and functional characteristics of protein fractions from cashew nuts. In young, healthy people, Lustgarten et al. (2015) found analytes and metabolites linked to muscle quality, which may provide biomarkers for evaluating sports performance and recuperation.

Mishra et al. (2015) investigated the use of powdered fruits and starchy vegetables to create gluten-free biscuits for athletes with certain dietary needs or preferences. Protein supplementation tactics for athletes were informed by a systematic analysis by Pasiakos et al. (2015) on the effects of protein supplements on muscle mass, strength, and aerobic power in healthy individuals.

Petróczi et al. (2007) emphasized the necessity for evidence-based supplementation approaches in sports nutrition by highlighting discrepancies between the theory and practice of using supplements to increase performance. The study conducted by Rebello et al. (2016) investigated the impact of oats on satiety, so advancing our knowledge of the function of dietary fiber in enhancing satiety and its potential to impact dietary decisions made by athletes.

Protein intake techniques for maximizing athlete recovery have been informed by Roberts et al. (2017)'s investigation on the short-term effects of high versus moderate protein intake on recovery following strength training in resistance-trained individuals. In their study, Shakeb et al. (2022) concentrated on the sattu mix's quality profile and standardization, emphasizing the significance of food processing methods for maintaining athletes' nutritional integrity.

As a whole these studies advance our knowledge on sports nutrition and provide evidence for evidence-based strategies that enhance athletes performance and health.

## 4. Materials and Methods

Protein source selection: For the preparation of the mix, the following ingredients are selected as

**4.1 Procurement of raw material:** The ingredients such as Makhana, Milk powder, Bengal gram, Sunflower seeds, Pumpkin seeds, Cashew nuts, Almonds, and Fennel seeds were procured (per the standards laid down by FSSAI). They were stored in an air-tight container to protect them from pests and insects.

**4.2 Product standardization** is establishing and maintaining a set of product specifications. For this purpose, the protein mix is standardized such that the product's overall weight is 100 grams, distributed among the ingredients.

**4.3 Formulation of Protein Mix:** Ingredients were roasted well. The ingredients are carefully blended together to retain maximum flavour and nutrition. Composition of the protein mix variants are shown (Table:1)

## 5. Results

The two variants of protein mix macronutrient contents are analysed based on IFCT food composition tables (Table:2). Both variants were subjected to sensory evaluation to evaluate texture, colour, taste, consistency, aroma and appearance. The Mean and SD of overall acceptability of sample one is 7.32, 0.97, and sample two is 8.23, 0.80. The standard deviation of the sample one parameter is higher except for aroma when compared to sample 2 parameters. The overall acceptability standard deviation is less in sample one when compared to sample 2. (Table 3) (Fig.1). The variant accepted after the hedonic rating scale is further tested for proximate analysis of 7 nutrients (Table:4).

**Protein:** To estimate the protein content of the blend, the Kjeldhal method is used from the FSSAI manual for food grains.

**The fat** content of the protein mix is estimated using the Soxhlet extraction method by the FSSAI manual for food grains.

**The carbohydrate** content is estimated using the general formula: the total amount of product(100g) minus moisture, Ash, fat, and protein.

Carbohydrates =100 (fat, protein, moisture, Ash)in the protein mix.

**Moisture** is estimated using the method demonstrated in the FSSAI manual.

**Total ash** content is estimated by the drying method demonstrated in the FSSAI manual for food grains.

**Dietary fibre** is estimated using the enzymatic gravimetric method demonstrated by AOAC 985.29, 22nd edition.

## 6. Discussion

The main intention of the study is to make a healthy, budget-friendly protein mix for athletes, which will enhance their recovery. The main ingredients used in the protein mix are natural products, and no preservatives are added. All the core ingredients are gluten-free, so athletes sensitive to gluten can also have this protein mix. Makhana is a popped kernel obtained from the gorgon nut, which is gluten-free, rich in protein and can be used for the vegan population. (Mishra et al., 2015) It is used to make gluten-free biscuits and starchy powders. Concerning the above study, makhana is used in the protein blend as it is gluten-free and a good source of protein. Studies reported that oats are a good source of dietary fibre and add satiety. (Rebello et al., 2016) It is gluten-free and a good source of carbohydrates. Considering the above study, oats increase the satiety feel and improve the mix's carbohydrate quality as athletes need enough carbohydrates and protein for healthy recovery. Cashew nuts are added as they are rich in protein and healthy fats (Chen et al., 2022). Cashew nut proteins represent an abundant nutrient with a well-balanced amino acid composition and could meet the requirements recommended by FAO/WHO. Cashew nuts are added to increase the protein quality of the blend. Fennel seeds are also one ingredient in the mix as they give a pleasing aroma and help digestion (Das B, Rabalais J, et al., 2022). The gastrointestinal tract is improved by fennel seed extract, suggesting the potential utility of this agent as an alternative or adjunctive therapy in IBD. So, concerning the protein mix, fennel seeds are used for digestion. Apart from the ingredients used, the nutrient profile of the mix is much appreciated as it is rich in energy, healthy fats, protein and carbohydrates. The moisture content of the protein mix is less than 4%; it can be stored for approximately 60 days. Dietary fibre is crucial as it cures other health complications like constipation and improves gut health.

## 7. Conclusion

We developed the protein mix of two variants, 1 and 2, for the benefit of the athletes after training. From the above results among the two variants, Variant 2 has more ratings in all the parameters than Variant 1 and is accepted as a recovery drink

mix, giving a 2-3: 1 ratio of carbohydrate and protein for 5g of powder. As per the American College Of Sports Medicine, the carbohydrate and protein ratio is 3:1 for optimal glycogen replenishment. So, the protein mix fulfils the requirement as a post-work drink for athletes.

Energy is 23.14 kcal for 5g of powder. Carbohydrates are 2.74g for 5g of powder. Protein is 0.99g for 5g of powder. Fat is 0.9g. since the protein mix requires macronutrients, it can be used as a recovery drink for athletes. This protein mix offers an affordable and accessible alternative to expensive commercial protein supplements. Its development process is simple, requiring no special skills. Utilizing common household ingredients provides athletes a convenient and cost-effective option to support muscle repair, growth, and recovery after training.

## 8. Future Scope

our newly developed product can replace most of the expensive powders available in market. Instead of expensive powders for grass root athletes we can recommend our low cost and highly nutritious natural protein powder.

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**TABLES**

**Table 1:** Composition of protein mix variants.

Ingredients (g)	Variant1	Variant 2
Milk powder	25	25
Makhana	0	20
Cashew nuts	10	15
Oats	10	10
Almonds	10	10
Pumpkin seeds	5	5
Sunflower seeds	0	5
Fennel seeds	0	5
Bengal gram	35	5
chia seeds	5	0
Total	100g	100g

\*V1 is variant 1, V2 is variant 2

**Table 2:** Macronutrient analysis of variants based on IFCT food composition tables.

Parameters	Variant -1	Variant-2
Energy(kcal)	401	447
Carbohydrate(g)	39	44.8
Protein (g)	22.1	22.2
Fat (g)	16	18

**Table 3:** Results of the Sensory Evaluation

S.no.	MEAN SCORE OBTAINED FOR PROTEIN MIX		
	PARAMETERS	VARIANT-1	VARIANT- 2
1	COLOUR	7.32±1.12	7.5±1.07
2	APPEARANCE	7.26±0.9	7.7±0.88
3	AROMA	7.141±0.5	8.09±0.65
4	CONSISTENCY	7.11±1.03	7.88±0.89
5	TASTE	6.9±1.08	8.11±1.06
6	OVERALL ACCEPTABILITY	7.32±0.97	8.23±0.80

**Table 4:** Proximate Analysis of Accepted Variant-2

Name Protein mix	Energy (kcal)	Carbohydrates(g)	Protein(g)	Fat(g)	Moisture(g)	Total Ash (g)	Dietary fibre (g)
Variant -2	464	54.8	19.95	18.2	3.98	2.98	10.2

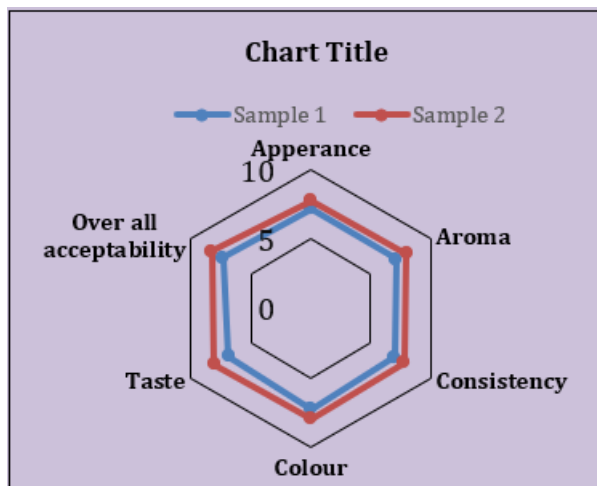
**Table legends:**

**In table 1,** composition of protein mix variants and quantity of items.

**In table 2,** Macronutrient analysis of variants based on IFCT food composition tables.

**In table 3,** Results of the Sensory Evaluation. Sample 1 is variant 1 and sample 2 is variant 2.

**In table 4,** Proximate analysis of accepted variant-2

**Figures**

\*sample 1 is variant 1

\*sample 2 is variant 2

**Figure legend:**

The above picture depicts acceptability of two variants of protein mix.

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**Declarations**

The work described has not been published before (except in the form of an abstract. It is not under consideration for publication elsewhere. Its submission to IJSR publication has been approved by all authors as well as the responsible authorities – tacitly or explicitly – at the institute where the work has been carried out, if accepted, it will not be published elsewhere in the same form, in English or in any other language, including electronically without the written consent of the copyright holder, and IJSR will not be held legally responsible should there be any claims for compensation or dispute on authorship. Data sharing is not applicable to this article as no datasets were generated or analysed during the current study.

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**Availability of data and material:** Not Applicable

**Code availability:** Not Applicable

**Authors contribution:** SP developed the product, done the sensory evaluation and also proximate analysis of the product developed.

**Author Profile**

**Pragathi Tammireddy** pursued her master's degree in Sports Nutrition from ICMR-NIN. During her master's programme, she was supposed to do an internship. This research process taught confidence, patience, and innovative thinking. Exercise and physiology concerning nutrition are current research priorities. PhD journey will be a challenge for her in future. Her first aspiration is to develop research in sports in India.



**Namratha Pramod** is a Registered Dietician and also a Certified Sports Nutritionist, with almost 2 decades of experience in the field. She is currently serving as a High-Performance Analyst - Nutrition at Sports Authority of India, Bengaluru. She has been a part of athlete's journey in winning various medals at Asian Games, Olympics and Paralympics. She works as team nutritionist for Indian Hockey team. She has served as IDA (Indian Dietetic Association) Local executive committee member (Bengaluru Chapter) and presently the convenor of ASNFS, Association of Sports Nutrition and Fitness Sciences. She has authored and published about 8 studies in both national and international journals.