



Review Article

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DEVELOPMENT OF SOYA CHUNK-BASED PROTEIN BARS WITH NOVEL AND DISTINCT INGREDIENT: A REVIEW

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ABSTRACT

Protein bars are becoming more and more popular as people's interest in healthy living grows. However, the health benefits of commercial bars are compromised by their high calorie, sugar, and artificial ingredient content. The goal of this research was to create a protein bar with a balanced macronutrient composition made from natural components. Soya protein extract, a plant-based protein source with a complete amino acid profile but a methionine shortage, was employed in the protein bar formulation. Oats were added to compensate for this shortfall. Based on customer input, a database was developed to assess the cost-effectiveness of commercially available protein bars. The nutritional value, shelf life, and physiological impact of the experimental bar were evaluated utilizing only natural components for stability, taste, and texture. Due to the lack of preservatives, the experimental protein bar had a lower shelf life (7 days vs. 90 days) but a greater protein and fiber content than a chosen commercial bar. Target customer groups were identified with the use of the database, which also made sure the food was reasonably priced and nutritious. This study shows that a protein bar with a better balanced nutritional profile may be made without hazardous additions by utilizing natural, complimentary components. Because of its high-quality protein content, the finished product supports muscle protein synthesis.

Keywords: Protein, Protein bars, Macronutrients, Soya

INTRODUCTION

Consumer habits are always changing in today's quickly changing market, thereby impacting lifestyle choices¹. One notable trend is the growing emphasis on health and wellbeing, which encourages individuals to develop routines like regular exercise, enough hydration, and better eating habits. To meet this need, food producers have created items that satisfy consumers' need for greater nutrition by having a higher protein content while lowering fat and calorie levels². Protein bars have become much more well-known as health-conscious eating has grown in popularity. When these bars were first released in the early 1980s, fitness enthusiasts and professional athletes looking for a quick supply of nourishment to enhance their performance. Their popularity has grown throughout time, and they are now a mainstay in many diets. These days, protein bars are important in a number of areas, such as general health, weight control, muscle growth, and sports nutrition supplementation. Their capacity to offer a wide range of vital nutrients in a portable, easy-to-use form is what makes them successful³. The creation of such goods has been further fueled by the ongoing hunt for novel food items that efficiently and easily supply vital macronutrients and micronutrients⁴.

A balanced combination of the proteins, carbs, fats, vitamins, and minerals required for daily nourishment are included in nutrition bars. Those who participate in sports and fitness will especially benefit from these goods. because they promote muscular development, improve recuperation, and restore energy lost during exercise. For those who want to maximize their athletic performance while keeping a healthy diet, dietary supplements—including protein bars—are crucial. Whether the goal is to gain

muscle, reduce weight, or just fulfill daily nutritional needs, these products provide a workable and efficient way to promote general health and wellbeing^{5,6}. The protein in many protein-rich bars comes from plant-based substitutes, especially legumes, or dairy-based sources like whey and casein. Soy is unique among plant proteins because of its high biological value and balanced amino acid composition, which is similar to premium whey protein⁷.

In addition to offering a more affordable formulation, the addition of soy protein to protein bars enables producers to highlight its proven cardiovascular advantages on product labels, appealing to consumers who are health-conscious⁸. Because it contains isoflavones, which are bioactive substances associated with a number of health advantages, including lowering LDL cholesterol, soy protein is especially prized. Its reputation as a heart-healthy component stems from these qualities, which have made it a popular option for the creation of functional meals⁹. Furthermore, protein bars are often enhanced with important vitamins and minerals, which increases their nutritional value and makes them especially helpful for people who are malnourished or have higher dietary needs. There are still disagreements over the general makeup of protein bars and their physiological effects, despite their nutritional benefits. These bars' effects on metabolism, muscle synthesis, and general health are mostly determined by the interplay and balance of their macronutrients. Therefore, the goal of our study, which is based on a thorough analysis of the scientific literature, is to create a protein bar made from soy protein extract that provides a proportionately balanced intake of vital elements. Many facets of protein bars' composition and functional characteristics are being investigated in current research. The impact of protein sources on bar texture and the

mechanical and physical interactions between components during production are important areas of investigation¹⁰. developments in formulation methods to improve shelf stability and sensory appeal¹¹.

Explain how eating protein bars affects particular biological parameters^{12,13}. The propensity of protein bars to harden over time, resulting in unfavorable texture changes that jeopardize palatability and customer acceptability, is one of the most enduring problems in the development of protein bars. Recent research has provided ample evidence of this phenomena, who found that moisture movement and protein polysaccharide interactions are important factors in bar hardening during storage^{14,15}. While earlier research, looked at how the kind of syrup and protein source affected the texture and durability of soy-based bars. By creating a cold-processed, preservative-free soy protein bar with solely natural ingredients, our study enhances this research. We also provide a direct comparison with a commercial counterpart in terms of cost-effectiveness, shelf life, and nutritional content, with a focus on clean-label formulation and practical application. In order to ensure both nutritional effectiveness and a pleasurable eating experience, addressing this issue continues to be a crucial goal in the continuous improvement of protein bar formulations. The goal of this study was to create a protein bar with a well-balanced macronutrient profile by using natural components to increase nutritional value while reducing the possible negative impacts of artificial additives, excessive sugar, and unhealthy fats. Our goal was to develop an affordable, easily available product that satisfies consumer dietary requirements, promotes general health, and fits in with current functional food trends. In order to enhance the bar's texture, flavor, and stability without sacrificing its nutritional integrity, we also tried to use the best ingredients¹⁶.

Selection of Ingredients and Protein Bar Formulation

In order to create a stable, nutritionally balanced, and consumer-acceptable product, a methodical selection of ingredients was the first step in the formulation of the experimental protein bars. We reviewed the nutritional makeup of commercially available protein bars through a variety of online shops and product databases as part of a thorough market investigation to guide our

selection process. Common ingredient selections, average macronutrient distributions, and market trends in protein bar formulations were all revealed by this survey. We determined essential components based on this assessment that would work together to promote a balanced macronutrient profile, guaranteeing appropriate amounts of fats, proteins, carbs, and fibers. The finished product's nutritional objectives were in conformity with the European Food Safety Authority's macronutrient consumption guidelines and general recommendations for functional snacks aimed at active people¹⁷.

Functional factors that are essential to the quality of the final product were taken into account while choosing ingredients, in addition to nutritional sufficiency. The ingredients were selected to keep the bar cohesive and avoid excessive crumbling or hardening while being stored. To improve palatability without depending on artificial additions, natural flavoring agents were given priority. To increase shelf life without the use of chemical preservatives, components with natural preservation properties—such as those high in fiber and antioxidants—were favored. In order to guarantee that the finished product would be available to a wider range of consumers without sacrificing its nutritional or sensory qualities, ingredient cost was assessed. After choosing the components, we calculated how much of each to use in the mixture. In order to do this, standardized recipes for high-protein bars that are frequently found in scientific and commercial literature were consulted. The average caloric values and macronutrient profiles of top commercial protein bars were taken into account, and the macronutrient content per serving was matched with EFSA recommendations for energy and nutrient intake, especially for people who engage in moderate to high levels of physical activity. In order to provide a nutritionally dense and useful snack without using artificial stabilizers, added sugars, or artificial flavorings, the final formulation was rationalized to deliver a balanced intake of proteins ($\geq 20\%$ of total weight), complex carbohydrates, dietary fiber, and healthy fats. Carefully picked ingredients with complementing nutritional profiles and functional qualities were added into the final protein bar recipe. Among the components were soya chunk, lupine seed, spirulina powder, puffed rice, wheat germ, pumpkin seed, chia seed, coconut flakes, dried apricot, moringa powder, chicory root, date syrup.

Proportional pie chart illustrating the gram contribution of each ingredient to the total 35g protein bar formulation

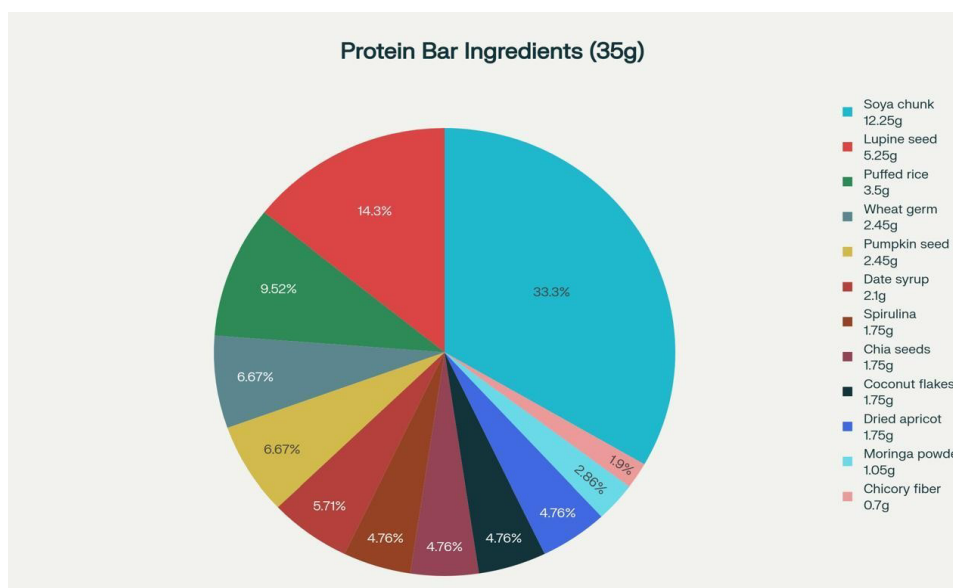


Figure 1: Each ingredient's role in creating the protein bar

Preparation Procedure

Hydration of Finer Source

Finer ingredients such as soya chunk flour, lupine seed flour, spirulina powder, and moringa powder are initially hydrated by mixing with a controlled amount of water or binder syrup (e.g., date syrup). This step ensures proper moisture absorption, resulting in a cohesive dough base.

Preparation of Binding Paste

A natural binding paste is prepared by combining liquid binders such as date syrup with softened dried fruits (like chopped dried apricots) or nut butters if used. This paste acts as a glue to hold all ingredients together and contribute to the sweetness and texture of the bar.

Incorporation of Dry Ingredients

Remaining dry ingredients such as puffed rice, seeds (pumpkin, chia, flax), wheat germ, coconut flakes, chicory root fiber, and other supplementary elements are gradually folded into the hydrated dough and binding paste. This integration helps maintain the bar's crunch, nutritional fiber, and flavor balance.

Shaping and Setting

The mixture is then pressed firmly into molds or shaped manually into uniform bars. The shaped bars are either baked at a low temperature (typically 160-180°C for 10-15 minutes) to solidify the structure and develop flavor or cold-set in refrigeration for 1-2 hours for a chewy, no-bake texture. Once set, bars are cooled and packed under hygienic conditions for storage or sale.

Refrigeration and Portioning

For cold-set bars or post-baking, bars are placed in a refrigerator for at least 1-2 hours to firm up. After firming, bars are cut or portioned into uniform weights of 35 grams each to meet serving size consistency. Uniform portioning ensures accurate nutritional content per bar and consumer satisfaction.

Evaluation of Protein Bar

Physical Evaluation

Ten knowledgeable panelists were chosen to assess the protein bars' sensory qualities, such as their color, flavor, taste, and general acceptability. A hedonic scale of nine points was employed, where one point represented "dislike extremely" and nine represented "like extremely." Before tasting each item, panelists were told to rinse their mouths with cold, filtered water. The assessments were carried out in the daytime.

Chemical Evaluation

Ash Content

The percentage of residual minerals and inorganic substances in a protein bar is ascertained by the ash content assessment test. In this test, a protein bar sample is burned at high temperatures (usually between 500 and 600°C), and the weight of the resultant ash is measured. Next, the ash content is computed as a percentage of the initial sample weight.

Moisture Content

The moisture content test determines the percentage of water present in the protein bar. This is done by drying a sample in a controlled environment (typically using a desiccator or oven) and measuring the weight loss, which corresponds to the moisture content. The result is expressed as a percentage of the original sample weight.

Fiber Content

This test quantifies the protein bar's dietary fiber content. Digestible carbohydrates are typically broken down by enzymatic digestion, and the leftover fiber residue is then analyzed gravimetrically. A percentage of the initial sample weight is used to indicate the outcome.

Fat content

The fat content test entails employing solvents like ether or hexane to remove fat from a bar sample. After that, the extracted fat is weighed, and the outcome is given as a percentage of the initial sample weight. Soxhlet extraction and the Babcock method are popular techniques.

Nutritional Value of Bar

This 35g soya chunk protein bar contains 114-130 kilocalories and offers 13-14 grams of protein from soya chunk flour, lupine seed flour, spirulina, and moringa powder, comprising all essential amino acids. It provides 10.5-14 grams of carbohydrates primarily from puffed rice and dried fruits for balanced energy.

High dietary fiber (3-5 grams) from chia and pumpkin seeds aids digestion. The fat content (2.8-3.9 grams) is from healthy unsaturated fats, including omega-3s. Micronutrients include 280-385 IU of vitamin A, 0.25-0.4 mg of vitamin E, 1.753.5 mg of iron, and 35-122 mg of calcium, contributing to immune health, energy metabolism, and bone strength. Overall, the bar is a nutrient-dense option that supports muscle synthesis and overall wellness.

Nutrient	Amount	Source
Energy [kcal]	114-130	All ingredients
Protein (g)	13-14	Soya chunk flour, lupin, spirulina, moringa
Carbohydrate (g)	10.5-14	Puffed rice, dried apricot, date syrup, wheat germ
Dietary fiber (g)	3-5	Seeds, chicory fiber, dried fruit
Fat (g)	2.8-3.9	Seeds, coconut flakes, wheat germ
Vitamin A (IU)	280-385	Dried apricot, moringa
Vitamin E (Mg)	0.25-0.4	Wheat germ, seeds
Iron (Mg)	1.75-3.5	Soya chunk, moringa
Calcium (Mg)	35-122	Wheat germ, Moringa
Omega -3 (g)	0.63-0.84	Chia, flax, pumpkin seeds

Shelf Life of Protein Bars

The experimental protein bar has a very short shelf life of approximately seven days when refrigerated at 4 °C, compared to ninety days for the commercial version. This difference underscores the importance of chemicals and preservatives in

extending shelf life and maintaining quality. The shorter shelf life aligns with the clean label objectives, but highlights the need for research into natural preservation methods or improved packaging. The study did not conduct microbiological tests, relying instead on qualitative assessments of texture, fragrance, and appearance for initial insights into stability. Future research

should include microbiological evaluations to ensure safety and shelf-life stability. The extended shelf life of the commercial protein bar is primarily attributed to sunflower lecithin, which stabilizes emulsions through its amphiphilic properties, aiding in product longevity.¹⁸

Storage

The storage of soya chunk protein bars should be done under cool and dry conditions to maintain their quality and extend shelf life. Ideally, they should be stored at temperatures between 15°C and 25°C with low humidity to prevent moisture absorption that could lead to spoilage. Packaging in airtight, food-grade materials is essential to protect against oxygen and moisture, which can degrade fats and vitamins and promote microbial growth. If the bars are cold-set or contain sensitive bioactives, refrigeration at around 4°C can preserve freshness and prevent texture changes for at least a week. After opening, bars should be consumed quickly or kept refrigerated to maintain safety and palatability. Protecting the bars from direct light exposure is also important to prevent nutrient degradation and rancidity. Overall, following these storage guidelines ensures that soya chunk protein bars retain their nutritional value, texture, and sensory qualities throughout their shelf life.

Packaging

To maintain freshness and avoid contamination, protein bars are packaged using protective materials like paper, foil, or plastic film. Usually, the bar is put in a square or rectangular wrapper and sealed with glue, pressure, or heat. The texture, taste, and nutritional value of the bar are preserved with proper packaging.¹⁹

CONCLUSION

Protein bars are a useful way to improve nutritional balance and increase protein consumption. They can be produced more cheaply and healthily than commercial alternatives. It is necessary to comprehend consumer wants in order to optimize benefits. Because soy protein has less saturated fat and cholesterol than animal proteins, it helps avoid cardiovascular disease. Although epidemiological data indicates that diets high in soy are beneficial to health, the effects of soy are controversial, with some research associating it with an increased risk of cancer. The kind, quality, and ratios of the ingredients in protein bars determine their effects on health. To prevent health problems, especially cardiovascular problems, and to promote a healthy lifestyle, it is crucial to select products with natural components and little sugar.

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