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NUTRITIONAL AND SENSORY PROFILE OF AN INNOVATIVE NO-SUGAR ANTIOXIDANT PLANT-BASED BAR

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Abstract: *This paper focuses on the development and complex characterization of an innovative nutritional bar, formulated from a blend of plant-based raw materials: oat flakes, wheat bran, sunflower seeds, dried plums, raisins, and carob powder. The study aimed to obtain a nutritionally balanced product with no added sugar, targeting vegan consumers and individuals interested in healthy eating. Regarding the physicochemical indicators, the bar exhibited an acidity of 12 degrees, moisture 33.4 ± 2.46%, and a soluble solids concentration of 47.2°Brix. The nutritional profile per 100 g of product highlights an energy value of 351.4 kcal, with a protein content of 8.33 g, 11.3 g of lipids, and a significant carbohydrate intake (63.4 g), of which 8.85 g are fibers - essential elements for supporting digestion. The functional properties of the product are supported by a notable level of total polyphenols (26.6 mg GAE/100 g) and a very good radical scavenging activity (RSA) of 63.45%. These results suggest significant antioxidant benefits for the body, comparable to data reported in the literature for similar fruit- and seed-based products. Sensory evaluation confirmed a very high level of general acceptability, with the product achieving a score of 8.22 out of 9 points. Detailed analysis via the spider diagram reveals maximum ratings for aroma, taste, and appearance, while consistency represented the limiting parameter, with a score of 7.84. The results demonstrate the success of the proposed formulation, as the bar represents an attractive alternative from both a nutritional and sensory perspective, providing a solid foundation for future optimizations within advanced research programs.*

• Introduction

The modern food industry is undergoing a profound transformation, driven by an increasing demand for functional, convenient products with optimized nutritional profiles. In this context, nutritional bars have emerged as a significant category, valued for their nutrient density, portability, and formulation versatility. Originally developed in the United States during the second half of the 20th century to meet the need for compact, energizing foods, these products saw their first commercial forms emerge in the 1970s.

Today, these bars are widely embraced by modern consumers—ranging from athletes and active individuals to busy professionals—as a practical and healthy alternative to traditional snacks. Innovation is central to this industry, with manufacturers constantly launching new formulas to meet demands for vegan, gluten-free, high-fiber, and "clean label" products.

This study aims to develop an innovative nutritional bar by leveraging a strategic combination of plant-based ingredients, each selected for its specific functional and nutritional contributions:

Provide essential unsaturated lipids (linoleic acid), vitamin E, and vegetable proteins, enhancing the lipid profile and texture.

Derived from *Ceratonia siliqua*, it acts as a natural sweetener and a source of insoluble fiber and antioxidant polyphenols.

Offer a natural source of simple sugars for palatability, along with dietary fiber and phenolic compounds. Plums specifically contribute to digestive health due to their sorbitol and insoluble fiber content.

Selected for their high soluble and insoluble fiber content. Oats provide beta-glucans, known for lowering cholesterol and stabilizing glycemic response, while wheat bran improves intestinal transit and structural integrity.

The primary objective of this project is to formulate an optimal product that harmonizes these functional benefits with sensory acceptability. By utilizing the synergy between these ingredients, the proposed bar serves as a complete functional product suitable for daily consumption with a preventive role in metabolic health.

• Material and method

Formulation and Manufacturing Process. The functional bar was developed using a plant-based matrix procured from the local market. The formulation (Table 1) was designed to balance nutritional density with technological stability.

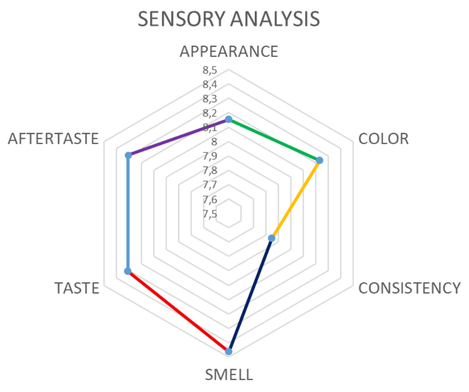
Raw Materials	Quantity (g)
Oat flakes	52
Wheat bran	30
Sunflower seeds	100
Dried prunes	70
Raisins	250
Carob powder	10
Salt	1

Sensory evaluation

Analytical methods:

- **Moisture content**: Determined by drying the sample at 105 ± 2°C in a laboratory oven until a constant mass was reached.
- **Titratable acidity**: Measured by neutralizing an aqueous extract with 0.1 N NaOH, using phenolphthalein as a pH indicator.
- **Total Soluble solids**: Determined using the r**efractometric method** (°Brix), calibrated for the sample's dilution factor.
- **Salt content (NaCl)**: Calculated via the **Mohr method**, based on argentometric titration with AgNO3 and K2CrO4 as an indicator.
- **Total Phenolic Content (TPC)**: Evaluated using the **Folin-Ciocâlteu method**, with results expressed in mg Gallic Acid Equivalents (GAE) per gram, measured spectrophotometrically at 750 nm.
- **Antioxidant activity**: Measured by the **DPPH radical scavenging assay** at 517 nm.
- **Proximate composition and energy value**

• Results and discussions



Parameter	Unit	Nutritional bar value
Acidity	Degrees of acidity	12 ± 1.27
Moisture	%	33.4 ± 2.46
Salt	%	0.292 ± 0.03
Soluble solids	°Brix	47.2 ± 1.4
TPF	mg GAE/100 g	26.6 ± 1.42
RSA%	%	63.45 ± 2.18

	Value per 100g
Energy Value	**351.4 kcal**
Proteins	**8.33 g**
Carbohydrates	**63.4 g**
of which sugars	*35.6 g*
of which fiber	*8.85 g*
Lipids	**11.3 g**
Salt	**0.29 g**

• Conclusions

- **High consumer acceptance:** The developed plant-based bars demonstrated excellent overall acceptability, achieving a mean score of 8.22 out of 9 points on the hedonic scale.
- **Sensory profile optimization**: While overall scores were high, consistency was identified as the least appreciated sensory attribute (7.84 points), indicating a focal point for future structural improvements.
- **Nutritional density**: The product features a balanced profile with 351.4 kcal/100g, containing 8.33% protein, 11.3% lipids, and 63.4% total carbohydrates (of which 8.85% is fiber).
- **Antioxidant potency**: The bars exhibited significant functional properties, with a total phenolic content of 26.6 mg GAE/100g and a high radical scavenging activity (RSA of 63.45%).
- **Healthy alternative**: The formulation serves as an attractive alternative for vegans and health-conscious consumers, effectively providing a "no-added-sugar" snack option through the synergy of prunes, raisins, and carob.
- **Future research**: This study provides a foundational framework for further optimization of the product's nutritional and structural properties during graduate-level (Master's) research.