



MULTIDIMENSIONAL CHARACTERIZATION OF A RAW VEGAN BAR BASED ON SEEDS AND DRIED FRUITS: PHYSICOCHEMICAL, FUNCTIONAL, AND SENSORY ANALYSIS



Sabina – Georgiana Faur, Mihaela Lăcătuș, Robert Neagu,
Delia-Gabriela Dumbrava, Camelia Moldovan*

Food Engineering Faculty, University of Life Sciences "King Mihai I" from Timișoara, Calea Aradului 119A, 300645, Romania



Abstract: The primary objective of this research was the development and comprehensive characterization of a raw vegan bar. The formulation utilized common, nutrient-dense ingredients, specifically sunflower seeds, oat flakes, wheat bran, raisins, dried plums and carob. Following production, the bars underwent a series of physicochemical and bioactive analyses. Standard parameters, including moisture content, acidity, soluble solids, and salt content, were determined, and the resulting values were found to be consistent with previously published data. Furthermore, the product's functional properties were assessed by measuring its polyphenol content and its antiradical scavenging activity (RSA), determined via the DPPH assay. The results established that the final product possessed a superior nutritional profile, exhibiting a very good RSA percentage and a higher polyphenols content compared to values reported in the existing literature. The analysis of the proximate composition revealed that the carbohydrate content was aligned with literature values. However, the protein content was found to be lower, while the lipid content was higher than the data reported for similar products. The bar was subsequently evaluated through sensory analysis, which demonstrated high consumer appreciation. In conclusion, the bars developed in this study represent a nutritionally and sensorially attractive alternative. They are specifically positioned to meet the demands of consumers seeking no-added-sugar products, the vegan demographic, and individuals prioritizing healthier food options.

Keywords: bar, nutritional value, polyphenols, antiradical activity, sensory analysis.

Introduction

Nutrition bars are an exceptional healthy snack option, having their origins in the United States of America, where they were initially developed in the second half of the twentieth century, in the context of the need for compact and energizing food. In the 1970s, the food industry was developing the first commercial forms of nutrition bars, which provided simple and complex carbohydrates, essential vitamins and minerals. These products have experienced a significant expansion among modern consumers, due to their adaptability to the alert lifestyle, being perceived as a practical and healthy alternative to traditional snacks. Their popularity is especially manifested among athletes, active people, employees with a busy schedule, but also those interested in a balanced diet. The development of the nutrition bars market is closely related to global trends in health, fitness, and preventive nutrition. Against the backdrop of urbanization and changes in eating behavior, consumers are increasingly attracted to products that are convenient but at the same time offer functional benefits. Innovation is a central element in this industry. Manufacturers are constantly releasing new formulas to meet the growing demand for vegan, gluten-free, high-fiber, high-protein, or functional ingredients like probiotics, adaptogens, and superfoods. At the same time, there is a strong preference for products with clear labeling, natural ingredients and sustainable packaging. Regionally, North America dominates the market in terms of consumption, but the Asia-Pacific region is experiencing the fastest growth, due to demographic and economic changes. E-commerce also plays a key role in expanding access to these products, especially among young consumers.

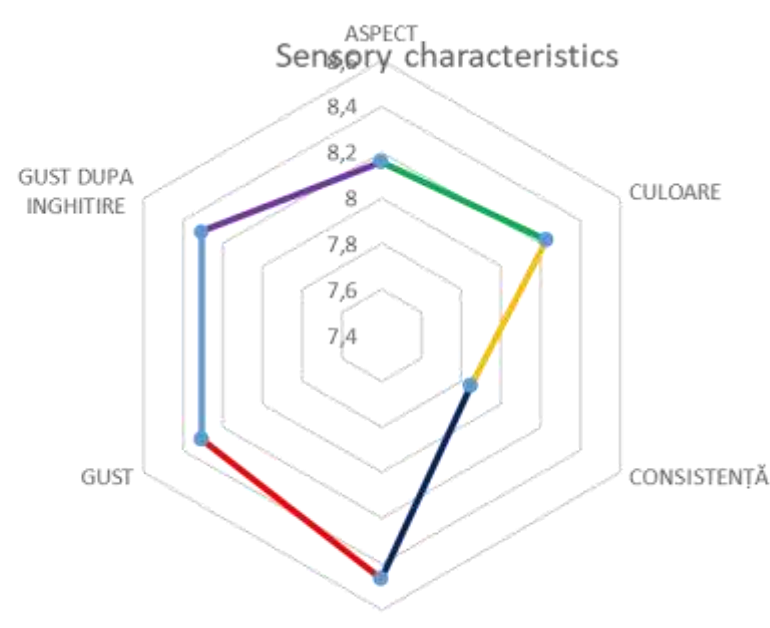
Plums are nutritionally valuable dehydrated fruits, with a high content of dietary fiber, potassium, vitamin K, sorbitol and antioxidant compounds. They are commonly used in functional food products, due to their health benefits and high technological stability. They are used as natural sweeteners and fat substitutes, they help to improve texture, retain moisture and reduce the need for added sugar or fats, being useful in the formulation of functional foods. Raisins have multiple health benefits, being an important source of dietary fiber that favors the regulation of intestinal transit and prevents constipation. They also contribute to the maintenance of cardiovascular health through the content of potassium, an essential mineral in the regulation of blood pressure, and through compounds with antioxidant properties that reduce oxidative stress. In addition, thanks to minerals such as calcium, boron and magnesium, raisins can support bone health and strength, essential aspects in the prevention of osteoarticular diseases. Sunflower seeds offer multiple health benefits, being an important source of healthy fats that help regulate cholesterol levels and maintain cardiovascular function. Also, the high content of vitamin E gives them significant antioxidant properties, protecting cells against oxidative stress and supporting the immune system. Essential minerals, such as magnesium and selenium, present in the composition of seeds, play a vital role in metabolic processes, bone health and reduced inflammation. Oatmeal is composed mainly of carbohydrates, especially in the form of complex starch and soluble fiber such as beta-glucans. They also contain significant amounts of protein with a balanced amino acid and lipid profile, predominantly unsaturated fatty acids. In addition, oatmeal provides essential vitamins, including B vitamins, as well as important minerals such as iron, magnesium, phosphorus and zinc, which contribute to their nutritional value and functional properties. Eating oatmeal is associated with improved cardiovascular health, due to its high soluble fiber content that helps lower blood cholesterol levels. The fiber in oatmeal supports digestive health by improving intestinal regularity and supporting a balanced gut microbiome. Eating them contributes to feelings of fullness and can help manage weight by regulating appetite and stabilizing blood sugar levels. Wheat bran is recognized for its beneficial effects on human health, especially due to its high content of dietary fiber and bioactive compounds. The predominance of insoluble fiber helps maintain normal intestinal transit by accelerating peristalsis and increasing stool volume, thus reducing the risk of constipation and conditions such as diverticulosis. Several studies suggest that regular consumption of wheat bran could help prevent colorectal cancer, through mechanical and biochemical mechanisms such as dilution of carcinogens, increased volume of fecal matter, and formation of volatile fatty acids following fermentation. The consumption of wheat bran is also associated with improved metabolic profile. They may help reduce total and LDL cholesterol, and may have a moderate effect on regulating blood sugar by slowing down the absorption of carbohydrates. Carob powder is an important source of dietary fiber that supports digestive function and may prevent constipation, while the tannins present exert a moderate astringent effect. Polyphenolic compounds, including gallic acid and flavonoids, give the powder antioxidant properties, thus helping to reduce oxidative stress. Additionally, fiber and polyphenols may help reduce LDL cholesterol levels, supporting cardiovascular health. Due to its low glycemic index and lack of caffeine, carob powder is a suitable alternative for people with diabetes. Also, carob extracts show antimicrobial activity, attributable to the high content of polyphenols and tannins

Material and method

An assortment of nutritional bar based on oatmeal, wheat bran, sunflower seeds, salt, raisins, prunes and carob powder for sweetening was obtained. All raw and auxiliary materials were purchased from the domestic market. The recipe used to obtain the finished product is shown in Table 1. The raw materials were weighed, then the oatmeal was shredded together with the wheat bran, the sunflower seeds, raisins, prunes, carob powder and salt were added, and they were continued to be mixed in the electric shredder until the desired consistency and result were obtained, the shape of the bar was shaped and properly packaged. For the characterization of the raw materials and the finished product, sensory (by hedonic method) and physico-chemical examination (determination of water content, determination of titratable acidity, determination of soluble solids, determination of total polyphenol content and evaluation of antiradical activity) was performed.

Results and discussions

The bars obtained were well appreciated, having a very good degree of acceptability of 8.22 points out of 9 possible. The most scoring sensory characteristic was consistency, which accumulated only 7.84 points, followed by appearance with an average score of 8.15. The most appreciated was the smell 8.46 followed by the taste and after-taste of 8.3 points.



The level of total polyphenols detected in the bars was 26.6 mg GAE/100 g, a value significantly higher than those found by Tyzb *et al.* (2020), 3.6–18.8 mg GAE/100 g, but lower than those reported by Alfheaid *et al.*, (2023) – 9.12–13.74 mg GAE/10 g for date bars (Alfheaid *et al.*, 2023). The bar also had very good anti-radical activity, with the RSA being 63.45%, compared to the data of Ekielski *et al.* (2022) who reported a DPPH inhibition of 84–85% for the bars. The acidity of the product prepared was found that the titratable acidity was 12±1.27 degrees of acidity. Ali *et al.* (2023) determined the pH value and reported pH values between 3.54 and 4.07 in roselle-fig fruit bars, while Ekielski *et al.* (2022) identified values closer to neutrality (6.34–7.01) in protein products with added cereal ingredients. The moisture content of the bars obtained in this study was 33.4%, slightly higher than that found in the study by Ekielski *et al.* (2022), where organic protein bars showed an average humidity of 22.5%, AlJaloudi *et al.*, (2024) reported a water content of 25.74% for protein bars, and Alfheaid *et al.*, (2023) determined only a water content of 11.22-13.24% water in date bars. The data of the present study, on total soluble substances, show an average values of 47.2 1.4 values correlated with the data reported by Bora *et al.* (2023) 56 – 64 °Brix in date bars, while Ali *et al.* (2023) indicated much lower values in roselle-fig bars (1.71–1.86 °Brix).

Energy value	351.4 kcal / 100 g	Acidity, Acidity degrees	Water, %	Salt, %	Soluble solids, Brix
		12±1.27	33.4±2.46	0.292±0.03	47.2±1.4

The energy value of the bar is 351.4 kcal/100g, as found by Bchir *et al.*, (2018) - 300 kcal/100 g, and AlJaloudi *et al.*, (2024) - 344.85 Kcal/100 g but lower than that of the researched bar of 481.35–679.87 kcal/100g Samakradhamrongthai *et al.*, (2021). The carbohydrate content reported by Samakradhamrongthai *et al.*, (2021) 64.26% (of which sugars 38.16%) was very close to the values of the bar in this diploma project 63.4% (of which sugars 35.6%). For the bars researched by Alfheaid *et al.*, (2023) the protein content was 21.4% and AlJaloudi *et al.*, (2024) found 32.25% in lupin bars, compared to only 8.33% in the bar obtained in this diploma project. The lipid content of the bars of the present study was 11.3%, while Alfheaid *et al.*, (2023) found only 7.81% in the bars studied.

Conclusions

Although overall acceptability was high, consistency was identified as the least appreciated sensory characteristic (7.84 points) and appearance was a limiting factor for acceptability. The bars showed a notable content of total polyphenols (26.6 mg GAE/100 g) and a very good anti-radical activity (RSA of 63.45%), suggesting antioxidant benefits. The bar's nutritional profile indicates balanced proportions of nutrients and is an attractive alternative both nutritionally and sensorially, addressing consumers who want products without added sugar, vegans and all people who want to consume healthier foods.