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Changes in The Biological and Nutritional Value of Halva Enriched with Sesame and Flax Seeds

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Abstract

This work studies the possibilities of increasing the nutritional and biological value of traditional halva by enriching it with sesame and flax seeds. According to the results of the study, the introduction of these additives increased the content of protein, fat, dietary fiber and minerals in the product, and to a certain extent reduced the share of carbohydrates. At the same time, the composition of fatty acids improved qualitatively, and in particular, the content of omega-3 fatty acids increased significantly. The study also revealed that the antioxidant properties of the product increased as a result of the addition of sesame and flax seeds. The increase in phenolic compounds and total antioxidant activity indicators confirms the increased contribution of functional components. As a result, such halva is considered not only a high energy source, but also a functional food product that meets the requirements of healthy nutrition.

Keywords: Holwa, sesame, flaxseed, omega-3, antioxidant, dietary fiber, biological activity, fatty acid.

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1. Introduction

Traditional halva is considered a confectionery product with high energy value and is mainly prepared from sunflower seeds and sugar–molasses syrup. Although such a product contains a high amount of fats and carbohydrates, the content of dietary fiber, omega-3 fatty acids, and certain biologically active compounds is limited. Therefore, enriching the composition of halva with functional plant raw materials is considered one of

the important approaches to increasing its biological value [1,2]

Sesame and flax seeds contain polyunsaturated fatty acids, plant proteins, minerals, dietary fibers, and natural antioxidants. Incorporating them into the halva formulation contributes not only to improving the nutritional value of the product but also to enhancing its functional properties. In this section, the changes in the biological and nutritional value of traditional halva and halva enriched with sesame and flax seeds are analyzed [3,4].

The addition of sesame and flax seeds influenced the overall chemical composition of the product. In particular, the qualitative composition of fats improved, and the content of proteins and dietary fiber increased. Traditional halva and halva prepared with these additions were comparatively analyzed, and the results are presented in Table 1 below.

Table 1. Changes in the Composition of Halva Enriched with Flax and Sesame Seeds Compared with Traditional Halva

Nutritional value (per 100 g)	Traditional Halva	Halva Enriched with Additives
Protein, g	11,0	13,4
Oil, g	29,0	32,5
Carbohydrates, g	52,0	48,5
Dietary fiber, g	2,1	6,3
Mineral substances, g	1,7	2,4

As can be seen from the data, the addition of these components enriched the product with dietary fiber and proteins. Further analysis shows the changes in the composition of halva with the added ingredients compared to the traditional product. The obtained results are presented in Table 2.

Table 2. Changes in the Fatty Acid Composition of Halva Enriched with Flax and Sesame Seeds Compared with Traditional Halva

Fatty acids	Traditional Halva	Halva Enriched with Additives
Saturated, %	28	24
Omega -6, %	38	34
Omega -3, %	0,2	6,8

The addition of sesame and flax seeds qualitatively improved the fatty acid composition. In particular, the inclusion of flax seeds significantly increased the proportion of omega-3 fatty acids. Flax seeds and whole sesame seeds increased the dietary fiber content of the product, which positively affected its digestibility. An increase in dietary fiber helps reduce the glycemic response and prolong the feeling of satiety [5-6].

Sesame contains sesamin and sesamol, while flax seeds

contain lignans, which possess antioxidant properties. Their presence helps reduce the effect of free radicals in the product and slows down the oxidation of the fat phase. The obtained results are presented in Table 3 below.

Table 3. Changes in the Antioxidant Composition of Halva Enriched with Flax and Sesame Seeds Compared with Traditional Halva

Indicators	Traditional Halva	Halva Enriched with Additives
Phenolic compounds, mg/100 g	42	118
Antioxidant activity%	26	57

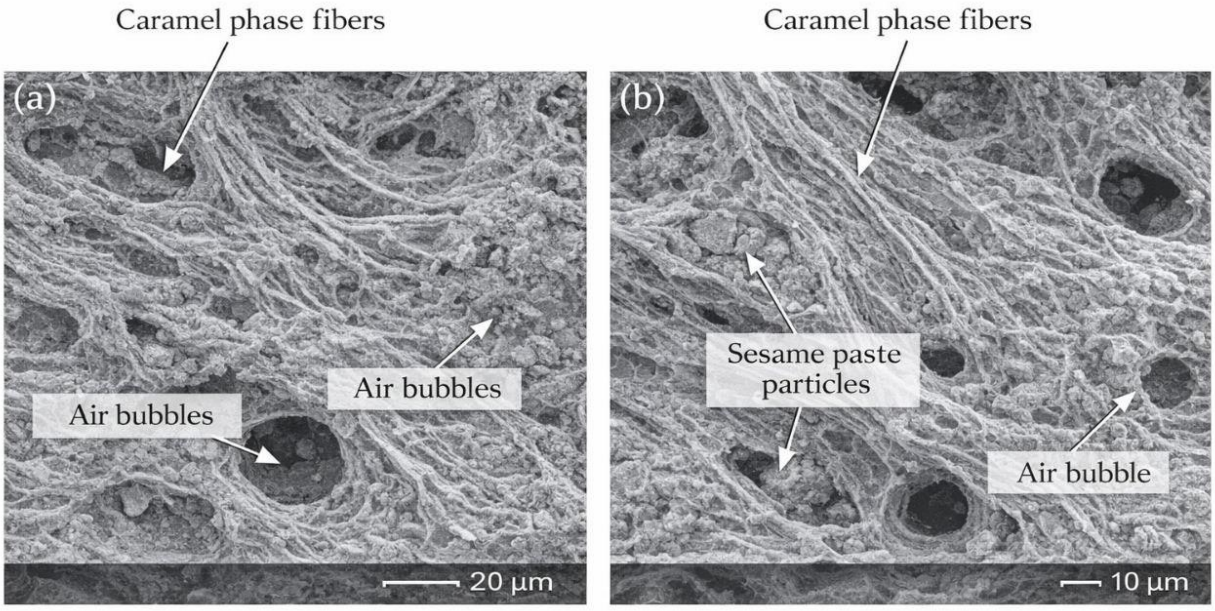
Although the addition of these ingredients slightly increased the total caloric value of the product, the qualitative improvement in the fat composition enhanced its physiological value. The comparative results are presented in Table 4.

Table 4. Changes in the Energy Content of Halva Enriched with Flax and Sesame Seeds Compared with Traditional Halva

Indicator	Traditional Halva	Halva Enriched with Additives
Energy value, kcal	510	535

In conclusion, halva enriched with flax and sesame seeds demonstrated several advantages over the traditional product, namely: it serves as a source of omega-3 and omega-6 fatty acids, is rich in dietary fiber, and provides antioxidant compounds. These qualities allow it to be considered a functional food.

The microstructure of the halva product was studied using Scanning Electron Microscopy (SEM), and the obtained results are presented in the figure below. This method allows high-magnification analysis of the surface morphology and is effective for determining the spatial arrangement of structural elements within the product.



Microscopic Image of the Halva Product.

Analysis of the SEM images indicates that the halva mass exhibits a well-developed fibrillar structure. The caramelized sugar phase is arranged in the form of elongated fibers, among which finely dispersed oily seed paste particles are evenly distributed. This microstructure ensures the product's characteristic crumbly yet soft consistency.

The following structural elements are observed in the microscopic images:

- Elongated fibers of the caramel phase
- Dispersed particles of the seed paste
- Microvoids formed by air bubbles

These elements determine the texture and mechanical properties of the halva product.

SEM analysis shows that the formation of fibers in the caramel mass occurs as a result of mechanical stretching and mixing during the technological process. During this process, the caramelized sugar phase becomes plastic, stretches into long fibers, and the seed paste is incorporated between them.

At the same time, the size and distribution of the seed paste particles directly affect the product's structure. If the particles are too large, the halva structure becomes non-uniform. Therefore, during the technological process, it is important to obtain a highly dispersed paste using roller grinders (two-roller or five-roller) to achieve the desired consistency.

SEM image analysis confirms that the fibrillar structure of the halva mass is formed as a result of the interaction between the sugar caramel phase and the oily seed paste. This structure determines the product's organoleptic properties, particularly its smoothness, crumbliness, and light consistency.

The results of the microstructure analysis indicate that the fibrillar structure in the halva mass is primarily formed as a result of the mechanical stretching of the caramel mass and its mixing with the seed paste. During this process, the interaction between the sugar phase and the oily phase leads to the formation of a stable composite structure.

Thus, Scanning Electron Microscopy (SEM) allows for an in-depth analysis of the halva product's

microstructure, the assessment of the effects of technological process parameters on the product structure, and the scientific evaluation of product quality.

The results of the study showed that the addition of sesame and flax seeds significantly increased the biological and nutritional value of halva. The increase in omega-3 fatty acids, dietary fiber, and antioxidant compounds allows the product to be characterized as a functional food that meets the requirements of healthy nutrition.

References

1. Papakonstantinou E. et al. Lentils with Lupins, Trahana with Tomato Sauce and Halva as Traditional Meals with Low Glycemic Responses. Nutrients. 2022.
2. Sekhavatizadeh S.S. et al. Encapsulation of probiotic Lactobacillus acidophilus in tahini halva and evaluation of survival during storage and simulated gastrointestinal conditions. Food Science & Nutrition. 2023.
3. Kajla P., Sharma A., Sood D.R. Flaxseed-a potential functional food source. Journal of Food Science and Technology. 2015.
4. Dossou S.S.K. et al. Antioxidant lignans sesamin and sesamolin in sesame: biosynthesis, regulation, and molecular mechanism. Oil Crop Science. 2023.
5. Andargie M. et al. Lignans of Sesame (Sesamum indicum L.). Molecules. 2021.
6. M. Muratov et al., Waste-derived activated carbons from phenol-formaldehyde and polystyrene: The role of PAN and alkali treatment, Chemical Review and Letters. 8(5) (2025) 981-1002. https://doi.org/10.22034/crl.2025.532995.1651