

APPLICATION OF AMARANTH FLOUR IN BAKERY PRODUCTS IN FOOD TECHNOLOGY

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Abstract

This article provides a scientifically grounded analysis of the possibilities of using amaranth flour in bakery products. The rich content of biologically active compounds in the amaranth plant, including high levels of protein, lysine, unsaturated fatty acids, and minerals, is identified as a significant factor in enhancing the nutritional and functional value of bread products. The results of the study indicate that the optimal formulation is achieved by incorporating amaranth flour at a ratio of 10–15% in combination with wheat flour. Such supplementation increases the protein content of bakery products, reduces their glycaemic index, and contributes to the prevention of cardiovascular diseases. The article highlights the physicochemical, biological, and economic advantages of amaranth flour and outlines the prospects for its industrial-scale application under the conditions of Uzbekistan.

Keywords: Amaranth flour, bakery products, functional food, protein, biological value, healthy nutrition, technology, glycaemic index.

Introduction

Although the amaranth plant has played an important role in human nutrition since ancient times, it has regained considerable scientific and industrial attention in recent years. The growing global interest in healthy nutrition, the production of functional foods, and the processing of raw materials rich in biologically active components has made the study of the role and

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significance of amaranth flour in bakery products a relevant scientific and practical issue. Amaranth seeds possess high nutritional value and contain significant amounts of protein, unsaturated fatty acids, vitamins, minerals, and natural antioxidants. In particular, the protein fraction of amaranth flour has a more complete amino acid profile compared to wheat flour, with higher levels of essential amino acids such as lysine, methionine, and tryptophan. Therefore, the use of amaranth flour enhances the biological value of bakery products and makes them suitable for dietary and therapeutic nutrition.

Another important advantage of amaranth flour is its gluten-free nature. This characteristic makes amaranth-based bakery products safe for individuals suffering from coeliac disease or gluten intolerance. In addition, the presence of squalene in amaranth contributes positively to cardiovascular protection, cholesterol reduction, and immune system strengthening. The antioxidant properties of squalene help neutralise free radicals in the human body, thereby slowing cellular ageing processes. Consequently, the incorporation of amaranth flour into bakery technology improves not only the nutritional quality but also the health-promoting properties of bread products.

Research findings indicate that when amaranth flour is blended with wheat flour at ratios ranging from 5% to 20%, significant changes occur in the chemical composition of bread. The contents of protein, fat, and dietary fibre increase, while the levels of vitamin E, magnesium, calcium, iron, and zinc are enriched. The most optimal results are observed at a substitution level of 10–15%, as this proportion enhances the biological value of bread while maintaining acceptable volume, taste, and structural characteristics. At substitution levels above 20%, a slight reduction in elasticity is observed, the loaf volume coefficient decreases, and the crust colour becomes darker. Therefore, from a practical standpoint, the 10–15% substitution range is considered the most favourable.

The addition of amaranth flour also reduces the glycaemic index of bakery products, which is particularly important for individuals with diabetes mellitus. The complex carbohydrates present in amaranth are digested slowly, preventing sharp increases in blood glucose levels. As a result, amaranth-enriched bread provides a gradual release of energy and promotes prolonged satiety. From a food technology perspective, this represents a

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significant advantage, as it aligns with contemporary healthy nutrition trends.

The physicochemical composition of amaranth flour has a noticeable influence on the bread-making process. The fat content of amaranth flour is approximately 7–8%, consisting mainly of linoleic and oleic acids. These fatty acids contribute to extending the shelf life of bread products due to their antioxidant properties. In addition, amaranth flour contains natural tocopherols (vitamin E), which slow oxidative processes. Such components allow bakery products to be stored for longer periods, providing economic benefits for manufacturers.

In experimental applications of amaranth flour, particular attention is given to compensating for the absence of gluten, which plays a crucial role in the formation of bread structure. Since amaranth does not contain gluten, technologists consider it appropriate to incorporate amaranth flour at levels of up to 10–15% while preserving the gluten content of wheat flour. At this ratio, the structural integrity of bread is maintained, while its nutritional composition is significantly enriched. If necessary, additional stabilisers, such as ascorbic acid or emulsifiers, may be used to address structural challenges.

The protein fraction of amaranth flour consists mainly of albumins and globulins, which exhibit high water-binding capacity, thereby improving the moisture retention properties of dough. As a result, bread enriched with amaranth flour remains soft for a longer period and is less prone to staling. This characteristic is of practical importance, as it enhances consumer satisfaction with product quality.

According to experimental results, the incorporation of 10% amaranth flour increased the average protein content of bakery products to 12.3% and the fat content to 1.8%. The dietary fibre content increased to 0.7%, which is considered a positive factor for improving digestive processes. In addition, the levels of iron and magnesium in amaranth-enriched bread increased by 1.5–2 times. This enrichment may contribute to the prevention of anaemia as well as cardiovascular and nervous system disorders.

Sensory analysis revealed that bread samples containing 10–15% amaranth flour received the highest consumer ratings. These products exhibited a slightly darker colour, a mild nutty flavour, and a pleasant aroma. In contrast,

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formulations containing more than 20% amaranth flour resulted in denser bread with reduced loaf volume and a more pronounced bitter taste. This effect can be explained by the specific chemical composition of amaranth flour, particularly the presence of saponins and polyphenols, which impart bitterness at higher concentrations.

During technological processing, the hydrophilic properties of amaranth flour must be taken into account. Due to its high water-binding capacity, it is recommended to increase the water content in dough formulation by 2–3% to maintain optimal dough plasticity. Furthermore, since the enzymatic activity of amaranth flour is relatively low, dough fermentation and loaf expansion occur more slowly. Therefore, a slight increase in yeast dosage or the use of enzyme complexes is recommended to ensure proper dough development.

The role of amaranth flour in bakery products is significant not only from a chemical perspective but also in terms of biological and functional properties. Research indicates that amaranth protein is well digested in the human body and positively contributes to nitrogen balance. Moreover, bioactive peptides present in amaranth exhibit antioxidant and anti-inflammatory properties. These components play a beneficial role in regulating blood pressure and improving lipid metabolism. From this standpoint, amaranth-enriched bread is recognised not merely as a food product but also as a functional dietary product.

International experience demonstrates that the production of amaranth-based bread has already been established in several countries. In the United States, Mexico, Russia, Poland, and China, bread products containing amaranth flour are widely used in dietary and infant nutrition. For example, the Mexican product “Pan de Amaranto” has been incorporated into national healthy nutrition programmes. Under the conditions of Uzbekistan, amaranth cultivation is also feasible, as the plant is drought-resistant and characterised by high yield potential. Consequently, expanding the local raw material base creates significant prospects for the production of amaranth-based bakery products.

Amaranth flour also offers notable economic advantages. When used as a cost-effective raw material, it does not significantly increase the production cost of bread, as the crop requires minimal agricultural inputs. Amaranth is

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a fast-growing, low-water-demand plant, yielding approximately 2–2.5 tonnes of grain per hectare. Therefore, it is well suited to environmentally sustainable production systems.

From an environmental perspective, the use of amaranth flour is beneficial because the crop is typically cultivated in areas requiring minimal application of pesticides and mineral fertilisers. This contributes to improving the ecological purity of bakery products. Within the framework of the “Healthy Nutrition” strategy of the Republic of Uzbekistan, which supports the production of biologically active additives and functional foods, amaranth-based bread products have the potential to be competitive in both domestic and export markets.

Scientific research has extensively demonstrated the positive effects of amaranth flour on human health. It contributes to lowering cholesterol levels, regulating blood pressure, and strengthening the immune system. For this reason, amaranth flour is considered an important component in dietary and therapeutic bakery products. In particular, amaranth-based products are recommended for individuals suffering from cardiovascular diseases, diabetes, obesity, and digestive disorders.

In Uzbekistan, a number of scientific studies are being conducted to explore the prospects of using amaranth flour under local conditions. Experimental results obtained at food industry enterprises indicate that the incorporation of amaranth flour at a level of 10–15% improves bread quality, enhances nutritional value, and increases consumer acceptance. Based on these findings, there is a growing need to develop new types of bread based on amaranth flour and to certify them as functional and dietary products.

Conclusion

In conclusion, the application of amaranth flour in bakery products is scientifically and technologically justified, with substitution levels of up to 10–15% yielding the most favourable results. This proportion improves the organoleptic, chemical, and biological characteristics of bread while providing health benefits to consumers. Amaranth-based bread products represent an important source of healthy and functional food for the population of Uzbekistan. Therefore, the wider implementation of amaranth flour in local production, along with the development of technological

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regulations and standardisation, is necessary. Such measures will not only strengthen national food security but also contribute to the promotion of healthy dietary habits among the population.

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