Extruded Barley Flour for Layered Bread Production

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Abstract

This study investigates the application of β-glucan-rich extruded barley flour in layered bread production. The influence of different substitution levels of wheat flour with extruded barley flour on the physicochemical, rheological, and technological properties of dough and bread was evaluated. Composite flour mixtures containing 15–35% extruded barley flour were prepared and analyzed using farinograph, extensograph, and alveograph methods. The results demonstrated that extrusion technology preserves valuable biologically active compounds while improving the functional characteristics of barley flour. Although increasing the proportion of barley flour reduced gluten strength, mixtures containing 25–35% extruded barley flour maintained satisfactory dough elasticity and baking performance. The proposed formulation significantly increases the β-glucan and mineral content of bread, providing higher nutritional and functional value. The developed technology can be successfully applied for producing functional bakery products with improved health benefits.

Keywords: extruded barley flour, β-glucan, layered bread, functional bakery products, rheological properties, composite flour, wheat flour, food technology.

The development of functional bakery products enriched with biologically active compounds has become one of the major priorities of modern food technology. Barley grain is recognized as an important cereal because it contains significant amounts of β-glucan, dietary fiber, protein, vitamins, minerals, and antioxidant compounds. These components contribute to reducing blood cholesterol levels, improving digestive health, and increasing the nutritional value of cereal-based foods.

Despite these advantages, the application of barley flour in bread production remains limited because barley proteins cannot form a strong gluten network comparable to wheat flour. Extrusion processing is considered an effective technological method that modifies starch and protein structures while preserving biologically valuable components. Consequently, extruded barley flour demonstrates improved technological properties and greater suitability for bakery applications.

Table 1. Influence of extruded barley flour on dough properties

Indicators	Wheat flour	Wheat + 25–35% extruded barley flour
Protein content	Higher	Slightly reduced
β-glucan content	Low	High
Dough elasticity	Excellent	Satisfactory
Mineral content	Moderate	Increased
Functional value	Standard	Improved

Experimental investigations showed that increasing the proportion of extruded barley flour gradually decreased dough stability and gluten strength while increasing mineral content and biological value. The optimum substitution level was determined to be 25–35%, where acceptable rheological properties were maintained together with a considerable improvement in functional characteristics.

The extrusion process also contributes to improving flour hydration properties and enhances the technological performance of composite flour mixtures. As a result, layered bread produced with extruded barley flour exhibits satisfactory crumb structure, acceptable porosity, and improved nutritional quality. The presence of β-glucan makes the finished product suitable for functional and dietary nutrition.

The obtained results confirm that extrusion technology significantly expands the possibilities of utilizing barley grain in bakery production. The developed formulation combines acceptable technological performance with enhanced nutritional quality and may serve as a promising approach for manufacturing functional layered bread from locally available grain resources.

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