UDC: 664.6

STUDY OF THE EFFICIENCY OF USING FEED MEAL AS A FLOUR SUBSTITUTE IN THE PREPARATION OF STARTER

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Received: 12.10.2025
Revised: 13.10.2025
Accepted: 14.10.2025

Keywords:
starter, feed flour, flour replacement, fermentation, food industry, acidity, organoleptic properties, cost

Abstract. This paper examines the possibility of using feed flour as a partial or complete substitute for wheat flour in sourdough starter preparation. Laboratory studies were conducted to assess the effect of feed flour on fermentation processes, acidity, microbiological composition, and organoleptic properties of the starter. The results showed that, at certain replacement ratios, feed flour can be effectively used without significantly degrading the product's processing and flavor characteristics. This opens up opportunities for reducing production costs and utilizing agricultural byproducts.

Introduction. Bread is a socially significant food product, the prices of which are regulated by the state. Therefore, reducing production costs and increasing profitability are of particular importance. To this end, the possibility of partially replacing flour in the nutrient mixture for polystrain spontaneous fermentation starter (PSFS) with secondary raw materials from cereal production while maintaining the required quality of the finished bread was investigated.

When grain is processed into cereals, a by-product called bran is formed, the yield of which depends on the parameters of hulling and polishing. Given the significant volumes of grain processed, the scale of loss of nutrients contained in bran is quite significant [1]. In recent years, the Republic has seen an increase in the production of grain crops. The bulk of grain production is represented by wheat and barley (on dryland), corn (on irrigated land), and other cereal crops [2]. Accordingly, the volume of cereal production and the amount of by-products from processing are increasing.

The aim of this study was to determine the feasibility of using feed flour as a flour substitute in the production of baked goods while maintaining the technological and quality characteristics of the resulting products. To this end, a comparative analysis of the chemical composition of various types of feed flour was conducted: barley (BF), wheat (WF), pea (PF), oat (OF), and corn (CMC). Second-grade wheat flour (WF) and oat flour (OF) were used as control samples.

The chemical composition of starchy foods, including proteins, fats, carbohydrates, minerals, vitamins, and dietary fiber, was studied. Based on the ranking of their content, the leading products with the lowest overall ranking were identified. It was found that, based on

the content of elements influencing the development of yeast and bacterial microflora, the studied raw materials are arranged in the following order (descending): YMC → HMC → OMC → PM → CMC → PM → OM. It should be noted that this approach does not fully reflect the biological value of the raw materials, as proteins from different types of flour differ in amino acid composition and digestibility.

It has been established that PM $_{Ch}$ is digested by 86...90%, YM $_{Ch}$ - by 75...80%, OM $_{Ch}$ - by 75...76, GM $_{Ch}$ - by 90...91. The protein complex of secondary raw materials of cereal production in terms of the composition of fractions differs sharply from the proteins of whole grain. They are represented mainly by the sum of albumins and globulins and constitute on average 60.0%. Proteins of flours, in terms of essential amino acids, are more complete than the proteins of the original grain [3].

An analysis of the chemical composition of the flours revealed the presence of various sugars. Thus, in oat flour (OMC), only sucrose (0.4%) was detected, while in pea flour (PMC), the main carbohydrate is non-reducing carbohydrate. tetrasaccharide stachyose (2.56%); in addition, sucrose (0.5%) and raffinose (0.7%) are present. It has been established that in terms of the content of minerals necessary for the normal metabolism of yeast and bacterial microflora, the flour significantly exceeds flour. In particular, the mass fraction of potassium (the main cation of the cytoplasm, influencing biosynthesis) in the OMP is higher than in oat and wheat flour, by 1.37 and 2.18 times, respectively. The content of calcium (an activator of enzymatic reactions and a stimulator of energy metabolism) exceeds similar values by 1.45 and 4.53 times, phosphorus (the main energy component of biosynthesis) - by 2.40 and 2.63 times, and iron - by 8.17 and 19.30 times, respectively.

Flour is also rich in vitamins: HMC contains more vitamin B_1 (2.65–4.77 times), while YMC contains more vitamins B_2 and PP (1.15–11.75 and 1.05–14.12 times, respectively). Overall, feed flour significantly exceeds similar flours in vitamin content. For example, YMC contains 2.61, 7.83, and 1.54 times more of these vitamins than barley flour, while OMC contains 1.53, 10.25, and 0.66 times more of these vitamins than oat flour.

When testing the sanitary and hygienic indicators in accordance with the requirements of SanPiN No. 0283-10, it was established that the content of toxic elements in the flour does not exceed the maximum permissible concentration; pesticides and mycotoxins were not detected, confirming their environmental friendliness.

Conclusion. Thus, feed flours are characterized by high biological value and safety, which makes them a promising component of the nutrient medium for the cultivation of polystyrene spontaneous fermentation starter (PSFS) used in bread baking.

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