Use of flaxseeds for the development of fortified prophylactic products

V L Borisova1*, E A Bobrov2, A V Vernigor1, G A Fomchenkova1, and Yu E Volkova3

1 Federal State Budgetary Educational Institution of Higher Education "Smolensk State Agricultural Academy", 10/2, Bolshaya Sovetskaya St., Smolensk, 214000, Russia
2 Federal State Budgetary Educational Institution of Higher Education "Smolensk State University", 4, Przhevalskogo st., Smolensk, 214000, Russia
3 Branch of the National Research University Moscow Power Engineering Institute in Smolensk, 1, Energeticheskiy proezd, Smolensk, 214013, Russia

Abstract. The article is devoted to a review of scientific literature on the nutritional value of plant raw materials: oil flax. This culture and its processed products have been used in the food industry for quite a long time. Today, there has been renewed interest among food producers due to a more thorough study of the nutritional value of oil flax and the development of new varieties that better meet the requirements of nutritional value and safety. The practical part of the article presents the results of growing the Ural oilseed flax variety in an experimental field and its quality indicators. The results of an organoleptic evaluation of an oilseed experimental sample enriched with flax seeds and an unfortified control sample of semi-finished poultry meat products are also presented. Improvements in the organoleptic quality indicators of the developed semi-finished products have been established.

1 Introduction

It is known that nutritious and safe nutrition is the most important condition for maintaining health, high performance and endurance of a person, and preserving the gene pool of the nation. A balanced diet also reduces the risk of various diseases. At the same time, the modern human diet does not meet the body’s needs for a sufficient supply of macro and micronutrients.

Nutritional imbalances in the modern world are widely recognized as the main cause of serious pathologies in the human body. In this regard, products for the prevention of various diseases - functional products - are becoming extremely popular in many countries around the world.

The quality of nutrition in general and its individual components (foods and dishes) in particular directly affects the state of human health. Nutrition plays a huge role both in the prevention and in the occurrence of a large number of diseases of various classes, and also underlies or has a significant role in the occurrence, development and course of about 80% of all known pathological conditions. Among the diseases, the main role in the origin of

* Corresponding author: BorisowaVeronika@yandex.ru
which is played by the nutritional factor: 63% - cardiovascular disorders; 30% – neoplasms; 5% – diabetes mellitus type II (non-insulin dependent); 2% – nutritional deficiencies (iodine deficiency, iron deficiency, etc.). Nutrition is essential in the occurrence and development of diseases of the gastrointestinal tract, liver and biliary tract, endocrine pathologies, diseases of the musculoskeletal system, caries. Diseases associated with food intake are called nutrition-dependent diseases. This also includes the so-called mass non-infectious diseases, often also called “diseases of civilization,” which are directly related to nutritional imbalances [1].

Violations of rational nutrition are caused both by the crisis in the production of food raw materials and food products, and by a sharp decrease in the purchasing power of the majority of the population of our country. The problem of the quality of food products and food raw materials is acute. It has been proven, in particular, that the increase in the number of diseases associated with overweight and obesity, atherosclerosis, hypertension, metabolic disorders, immunodeficiency states is due to several external factors, the leading of which are:

- Violation of the ratio of the content of main groups of nutrients in food (this is the name given to biologically significant chemical elements necessary for the human body to ensure normal life functions). Nutrients are classified into macroelements (the content of which in living organisms is more than 0.001%) and microelements (the content of less than 0.001%).
- Changing the lifestyle of a modern person (decreased physical activity and increased stress).

The fundamental reasons for such changes are recognized as industrialization, urbanization and globalization of the food and service markets, which have changed not only food production, but also the stereotype of food choice.

For the prevention of diseases, along with drug treatment and prevention, fortified food products can be used, which have a functional focus due to the introduction of functional ingredients contained in the fortifying raw materials.

Raw materials of this type may include oil flax seeds and its processed products.

2 Materials and methods

The paper presents the results of a review and analysis of scientific literature on the nutritional value and functional significance of raw materials of plant origin - oil flax and lupine.

The results of our own research on the cultivation and use of flax seeds of the Ural oil variety are presented. The organoleptic characteristics of semi-finished poultry meat products were determined with the addition of varying amounts of enriching raw materials of plant origin.

The following methods were used as the methodological basis of the study: analytical, system analysis.

3 Results and Discussion

Today, society has become aware of maintaining a healthy lifestyle, one of the components of which is healthy nutrition, which implies the inclusion in the diet of a sufficient amount of necessary micro and macronutrients in a form accessible to the human body. As a result, there is an increased demand for fortified food products that have a functional focus. One of the priority directions for the development of the food industry is the inclusion of plant raw
materials in the composition of traditional types of mass-consumed products, which makes it possible to improve nutritional value indicators [2-3].

Oil flax seeds today act as an object of research and are of interest to nutritionists, specialists in the food and processing industry, and physicians due to their composition and unique properties as a promising raw material for the enrichment of various types of food products. Along with such crops as wheat, barley, soybeans, cotton, and corn, people have been cultivating flax since time immemorial. Flax came to the territory of the ancient Slavs from the Gauls and Celts. The birthplace of this culture is Western Persia. During the time of Peter I, great attention was paid to flax growing and the production of flaxseed oil: it was forbidden to export flax seeds for trade for the purpose of selling them abroad. Over time, an increase in the area of sunflower, the advantages of storing sunflower oil compared to flaxseed oil, led to a decrease in the volume of production of flaxseed oil [4].

A new wave of interest in flaxseed oil emerged after 2009, when the production volumes of flaxseed oil increased. The main producers are concentrated in the Central and Siberian districts. At the same time, the main oilseed raw materials and oil were exported, mainly to China.

Flax seeds and products of its processing - oil and flaxseed flour are used as a functional food ingredient in the production of bakery, meat, dairy, flour and sugar (sweets) confectionery products. The wide distribution of oil flax and its processed products is explained by the content of useful substances in oil flax seeds. It is not without reason that flax is firmly included in the list of plant raw materials that are a source of functional ingredients. Flax seeds are a source of nutrients and biologically active substances that have a beneficial effect on the human body.

First of all, the fatty acid composition of this raw material is of interest. Oil flax seeds contain up to 52% oil, which contains more than 50% α-linolenic acid. This acid belongs to the polyunsaturated fatty acids of the ω-3 class and is an important component for the human body [5].

Table 1 shows data on the fatty acid composition of oil flax seeds and other crops.

<table>
<thead>
<tr>
<th>Types of oils</th>
<th>Saturated fatty acids</th>
<th>Monounsaturated fatty acids</th>
<th>Polyunsaturated fatty acids</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Oleic (Omega-9)</td>
<td>Linoleic (Omega-6)</td>
</tr>
<tr>
<td>Linen</td>
<td>8-10</td>
<td>14</td>
<td>25-50</td>
</tr>
<tr>
<td>Soy</td>
<td>7.2-15.1</td>
<td>32.5-35.6</td>
<td>51.7-57</td>
</tr>
<tr>
<td>Olive</td>
<td>9.1-14.2</td>
<td>70-87</td>
<td>4-12</td>
</tr>
<tr>
<td>Sunflower</td>
<td>9</td>
<td>33.3</td>
<td>39.8</td>
</tr>
<tr>
<td>Corn</td>
<td>11.9</td>
<td>44.8-45.4</td>
<td>41-48</td>
</tr>
<tr>
<td>Hemp</td>
<td>4.5</td>
<td>14</td>
<td>65</td>
</tr>
</tbody>
</table>

Flaxseed oil is superior to soybean oil and hemp oil in the content of saturated fatty acids. Omega-3 content exceeds their content in soybean and hemp oil. In addition to the high content of polyunsaturated fatty acids, their ratio in the product is important. This ratio is important for homeostasis and the full development of the human body. If the human body has a high content of ω-6, it can lead to an increase in blood viscosity and constriction of blood vessels. At the same time, ω-3 has a positive effect on the cardiovascular system of the body, providing an antirhythmic, vasodilating effect. The optimal ratio is ω-6: ω-3 = (5-10):1. In flaxseed oil this ratio is ω-6: ω-3 = 1: 2.4, which is better even in comparison with soybean oil, in which this ratio is 7.1: 1 [6,7].
Oil flax seed proteins are distinguished by their high biological value and balanced amino acid composition. Protein in flax seeds is contained in an amount of 18-25%. After fat removal, the protein level corresponds to 25-40%. Flax seed proteins are characterized by high technological properties, such as oil absorption, water binding, and emulsifying ability [8]. In the presence of polysaccharide mucus, these properties increase.

An important component of flaxseeds is carbohydrates. Flax seeds are a rich source of dietary fiber, such as fiber, cellulose, lignin, and pectin. Including them in the diet stimulates intestinal motility, removes foreign substances, lowers blood sugar levels, and also helps with weight loss, because dietary fiber is not digested, but gives a feeling of satiety [9-10].

The presence of water-soluble polysaccharides - pentosans - in flax seeds leads to the formation of mucus on the surface of the seeds when soaked, the content of which is approximately 2-7% of the total mass. The mucilages of flaxseeds are a heterogeneous system of polysaccharides. The composition of monoses includes galactose - 14.1%, fructose - 3.0%, arabinose - 8.9%, xylose - 33.0%, rhamnose - 7.9%, glucose - 3.7%, galacturonic acid - 28.6%. Mucus polysaccharides reduce the risk of developing diabetes and coronary vascular diseases.

In the conditions of the experimental field of the Smolensk State Agricultural Academy, oil flax of the Ural variety is grown. Picture 1 shows photos of flax in different years.

![Fig. 1. Oil flax variety "Ural" on an experimental field.](image)

The main quality indicators of oil flax seeds obtained in the experimental field have been determined. The research was carried out in the scientific laboratory of the Smolensk State Agricultural Academy.

### Table 2. Quality indicators of the obtained oil flax seeds.

<table>
<thead>
<tr>
<th>Name of determined indicators</th>
<th>Name of RD for test method</th>
<th>The value of indicators when tested for a.s.v.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crude protein content, %</td>
<td>GOST 13496.4-93</td>
<td>12.45</td>
</tr>
<tr>
<td>Crude fat content, %</td>
<td>GOST 1349615-2016</td>
<td>36.99</td>
</tr>
<tr>
<td>Moisture contents, %</td>
<td>GOST R 54951-2012</td>
<td>6.38</td>
</tr>
</tbody>
</table>

As can be seen from the data obtained, a high content of crude fat can be noted, which indicates the high quality of the seeds and their suitability for enriching products.

A study was conducted on the addition of flax seeds 5% in crushed form to the composition of semi-finished products (cutlets) from poultry meat. It was found that the developed semi-finished products with the addition of flax seeds had higher scores for
consistency (5 points), cut appearance (5 points) and taste (5 points) compared to the control sample, which, according to experts, received an average score for the following indicators: consistency (5 points), cut appearance (4 points) and taste (4 points). Enriched semi-finished products had a denser structure and were more juicy. The cut showed less looseness. The taste of the samples with the addition of flax seeds was noted as more pleasant and pronounced due to the addition of flax.

4 Conclusion

As a final conclusion based on the results of the review of information on the nutritional value of oil flax seeds, we can note the prospects of its use for fortifying food products. Thus, the addition of crushed oil flax seeds had a positive effect on organoleptic characteristics.

Also, an experimental study proved the possibility of growing oilseed flax variety "Ural" in the middle zone with the production of high quality seeds.

References

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