

# EVALUATION OF THE INFLUENCE OF THE AMINO ACID COMPOSITION OF WHEAT GERM AS ADDITIVE TO MEAT PRODUCTS

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*Vegetable raw materials are used in sausage products, which are a source of vitamins, micro- and macroelements, and create a positive role of dietary fibers and pectins for strengthening human health. In the scientific paper, using the example of wheat germ fiber with apple pectin, the amino acid composition of the protein of this biologically active substance was investigated. The amino acid composition of the additive was determined by the method of ion chromatography. Other indicators were determined according to generally accepted physicochemical research methods. It has been established that the protein in the amount of 16% of wheat germ fiber with apple pectin contains all essential amino acids. A comparative analysis of the amino acid composition of the protein of the vegetable supplement with the ideal protein of FAO/WHO established that the content of all essential amino acids, except for tryptophan, is 5.32% less than in the ideal protein. However, this protein contains a significant amount of such substitute amino acids as glutamine, arginine, histidine and proline. These acids provide a high hydration capacity of wheat germ fiber with apple pectin, and the use of this plant additive in sausage production technology will lead to improvement of the functional properties of minced meat and finished sausage products for healthy nutrition. The ratio of replaceable and non-replaceable amino acids in the protein supplement does not significantly differ from the adequate and maximum permissible values and approaches the ideal protein. Research allows to harmonize the amino acid composition of the protein component in finished sausage products for proper nutrition.*

*Keywords: amino acids, herbal supplement, fiber, wheat germ*

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## **Introduction**

Healthy nutrition is an important component of maintaining a person's physiological state. The state of human health prompts scientists to develop new types of products, including meat products, with an increased content of biologically active substances - proteins, vitamins, minerals and a reduced content of fat and sugar, which is a necessary condition for ensuring the health of the population of Ukraine (Zinchenko & Slyva, 2022). Therefore, one of the primary tasks of the modern meat processing industry is the production of sausage products with increased nutritional value (Bozhko et al., 2018).

The socio-economic problem of scarcity, high cost and low quality of food products, in particular meat products, has become particularly acute in Ukraine, the level of physical activity has also decreased significantly, the concept of healthy eating has changed, and consumer requests have

become different (Khomenko et al., 2022). In view of this, some of the previously declared indicators of sausage products do not meet today's demand, for example, high caloric content, which is not attractive, but requires a downward adjustment (Feifei et al., 2022).

Today, in the production of meat products, the use of protein, meal, and dietary fibers is widespread. When these ingredients are successfully combined with high-quality ground beef, they increase the yield of the finished product and reduce its quantity. In the production of cooked sausage products, the use of plant raw materials contributes to increasing the physical and biological value of the finished product, allows to fully distribute all the ingredients that are absorbed by a food meat product of stable quality. This will allow you to eat properly and thereby improve human health.

All groups of sources of dietary fibers are produced at meat processing enterprises, namely: natural products rich in dietary fibers (vegetables and fruits), meat products from the manufacture of lean meat (offal) and refined cellulose from mineral fibers with the aim of enriching ready-made sausage products with mineral fibers (Snizhko & Momot, 2022).

In the production of meat products, it is recommended to add fiber in all types up to 2% to the mass of the finished product with a degree of nutrition from 1:3 to 1:8. In this group of sausage products, it is recommended to add fiber with a length of 80-90 microns. This helps to increase the productivity of the product, increase the yield of finished products, and prevent the formation of jelly in the structure of sausages (Shang et al., 2021).

Wheat germ fiber is a special ingredient to add to meat products due to the fact that it contains a large amount of trace elements. Getting into the body, it significantly positively affects the condition of the tissues of the gastrointestinal tract and does not harm the human body at all.

The wheat fiber used, modified with pectin, has the form of coarse grinding, so it is not affected by the digestive system, and moving through the intestine, it cleans it of impurities. Wheat fiber is considered an excellent dietary product (Chen et al., 2019).

In the production of beef products, it is advisable to use pectin substances due to its ability to block the entry of heavy metals and radionuclides into the human body. Along with various types of low-quality food, a certain amount of toxic radionuclides enter the body, which have a negative effect on tissues.

Therefore, products of the new generation by combining raw materials of plant and animal origin, which have prophylactic and healing effects, are of particular importance (Svidlo et al., 2022). Such products are boiled sausage products, which can combine in their composition lean and veal meat. First, it allows you to make a ready-made product. Secondly, to produce a high-quality and nutritionally complete product. Thirdly, such a product will be both tasty and useful in terms of nutrient content and energy value (Dessev et al., 2022). Therefore, the use of cereal and vegetable raw materials in sausage products, which is a source of vitamins, micro- and macroelements, leads to a positive role of dietary fibers and pectins contained in the cell walls of cereal and fruit raw materials. Such fibers and pectin substances affect the process of digestion, excretion of harmful toxic substances from the body, etc. In addition, the positive side of this addition to sausage products is the low-calorie content of these ingredients (Kamani et al., 2019). Therefore, this will be an additional advantage for its use in high-calorie sausage products.

Ukraine has its own raw material base for the production of such a plant supplement as wheat germ fiber with apple pectin. Therefore, the research of the properties of cooked sausage products with the addition of wheat fiber, which is enriched with apple pectin, and the improvement of their

production technologies are relevant. This will allow finished sausage products to have increased biological value and health and preventive properties which will have a positive effect on good health.

Boiled sausage with vegetable fiber supplement from wheat germ with apple pectin is characterized by increased nutritional value due to the content of proteins, minerals, pectin, essential amino acids above the level of adequate consumption, a balanced amount of mineral ingredients, vitamins and carbohydrates.

The works of many foreign and domestic scientists have proven the expediency of researching the quality and safety of meat products in general and sausage products in particular (Huabin et al., 2020; Nikolaenko, 2021), improving their consumer properties and the prospects of using various additives to increase nutritional value (Rudy et al. 2020; Glisic et al., 2018).

The possibility of extracting fiber in the composition of meat products is becoming particularly relevant, thanks to its nutritional value and functional and technological properties. These fibers significantly contribute to increasing the vulnerability of the human organism to the harmful effects of the environment. An increase in the production of products enriched with pectin substances and fiber is necessary not only for use in medical and preventive nutrition for those workers who work in conditions of increased radioactive background or in contact with heavy metals, but also for mass consumption.

Thus, the analysis of work performance confirms the expediency of adding vegetable raw materials to minced meat. And therefore, the study of amino acid composition in a herbal supplement is an expedient and relevant issue from the point of view of good health and healthy nutrition.

### **Materials and methods**

For research, a plant additive was used - fiber from wheat germ with apple pectin, which is manufactured by Agrosilprom (Ukraine).

The amino acid composition of this herbal supplement was determined on an amino acid analyzer type AAA-T339 of the INGOS company (Czech Republic) by the method of ion exchange chromatography. The basis of the separation of a mixture of amino acids by this method is the ability to ionize certain groups in them. These groups determine the total positive or negative charge of molecules, the value of which depends on the value of pH, tryptophan was determined according to the DSTU ISO 13904:2008 standard (DSTU ISO 13904:2008, 2008).

The amino acid score is a calculation method for determining the ratio of the content of each essential amino acid in the studied protein to their content in the standard - an ideal protein that is balanced in terms of essential amino acids and proposed by the joint expert committee of FAO/WHO (Food, 2023).

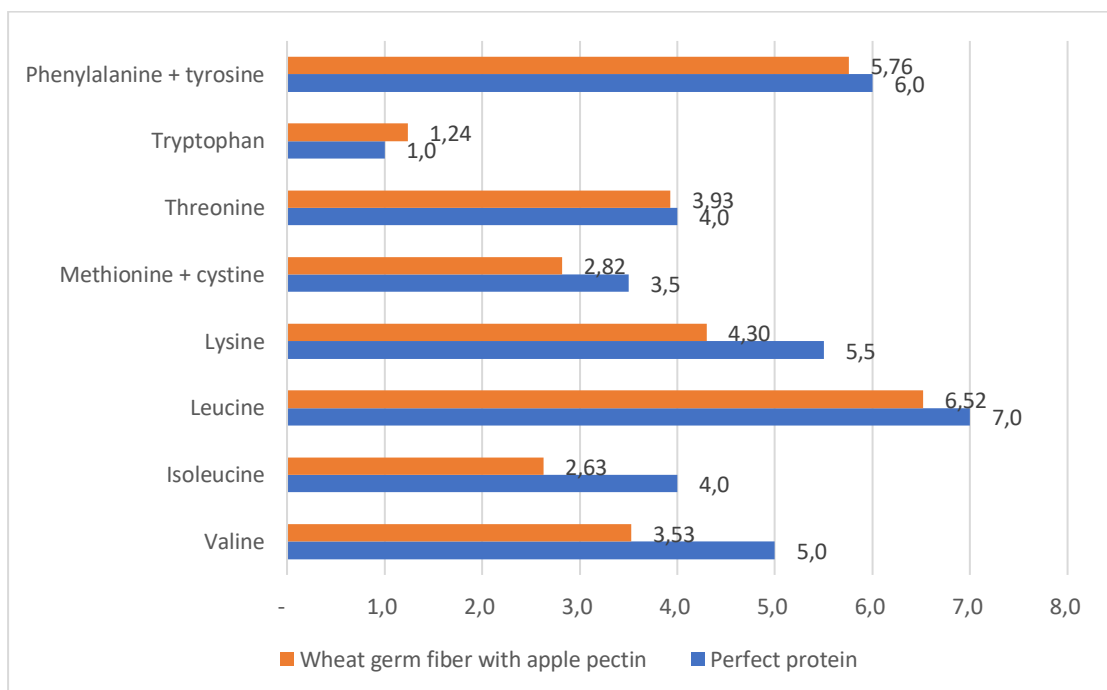
The biological value of fiber from wheat germ was determined by the ratio of the amount of amino acids found in 100 g of this herbal supplement to the content of amino acids found in 100 g of chicken protein.

The utilitarian coefficient was determined by the sum of the products of all essential amino acids per amino acid score and the utilization coefficient of each essential acid in the studied protein – fiber from wheat germ with apple pectin (Zheplinska et al., 2022).

Statistical data processing was performed in Microsoft Excel 2016. Values were evaluated using means and standard deviations and then evaluated in XL Stat statistical software.

## Results and discussion

Organic amino acids exhibit a wide range of biological activity (Narancic et al., 2019). It has been established that food amino acids are an important source for the synthesis of proteins that perform various functions in the human body - from plastic to functional ones that regulate the activity of organs and tissues (Romano et al., 2019). The main criteria for the biological value of protein is the assessment of its quality in accordance with the ideal protein recommended by FAO/WHO (Food, 2023). The results of studies of the amino acid composition of the protein plant supplement of wheat germ fiber with apple pectin and its assessment in accordance with the ideal protein are shown in Figure 1.



**Figure 1. Comparative data on the amino acid composition of ideal protein and fiber from wheat germ with apple pectin (content, g/100 g of protein)**

As can be seen from Figure 1 wheat germ fiber protein with apple pectin includes all the essential amino acids, but the sum of these amino acids in the protein of the herbal supplement is less than in the ideal protein. For the ideal protein, this amount corresponds to 36 g/100 g of protein, and for the vegetable supplement 30.73 g/100 g of protein, which is 14.6% less. The content of almost all essential amino acids, with the exception of tryptophan, is lower than in an ideal protein.

One of the indicators of the biological value of the protein is the determination of the amino acid score and the compliance of their number with the adequate and upper permissible values, which were established by medical scientists. The comparative characteristics of the amino acid score of protein fiber from wheat germ with apple pectin of an adequate and its upper permissible level are given in the Table 1.

As can be seen from the obtained data presented in the Table 1, the lowest score is determined for isoleucine - 65.75%, that is, this amino acid is limiting and all essential amino acids according to this criterion will participate in protein biosynthesis at this level. To date, the physiological needs of humans for essential amino acids have not been identified. The FAO/WHO ideal protein scale has a

recommended nature, so it is interesting to evaluate the biological value of protein from the standpoint of adequate and upper acceptable levels of amino acid consumption, which are established on the basis of medical research (Song et al., 2016; Yakubchak et al., 2005). As can be seen from the Table 1 the sum of essential and replaceable amino acids significantly exceeds these indicators at adequate and upper permissible levels of consumption. The level of practically all essential amino acids in wheat germ fiber with apple pectin is higher than adequate and not too lower than the upper limit, with the exception of tryptophan, the level of which is 124%. The ratio of replaceable to non-replaceable amino acids in the protein of the herbal supplement does not significantly differ from the adequate and upper limit values and approaches the ideal protein.

**Table 1. Characterization of the rapid, adequate and upper permissible level of amino acids of the herbal supplement**

Amino acid name	Amino acid ratio of wheat germ fiber with apple pectin (%) <sup>*</sup>	Fiber from wheat germ with apple pectin (g/100 g of protein) <sup>*</sup>	Consumption level (g/100 g of protein) <sup>**</sup>	
			adequate	upper limit
Valin	70.60	3.53	2.50	3.90
Isoleucine	65.75	2.63	2.00	3.10
Leucine	93.00	6.51	4.60	7.30
Lysine	78.00	4.29	4.10	6.40
Methionine + cystine	80.57	2.83	1.80	2.80
Phenylalanine + tyrosine	96.00	5.76	4.40	6.90
Tryptophan	124.00	1.24	0.80	1.20
<i>Together, essential amino acids</i>	<i>607.92</i>	<i>30.68</i>	<i>20.20</i>	<i>31.60</i>
Alanine	-	5.60	6.60	10.60
Arginine	-	5.32	6.10	9.80
Aspartic acid	-	9.27	12.20	19.90
Histidine	-	2.37	2.10	3.40
Glycine	-	6.56	3.50	5.60
Glutamic acid	-	25.30	13.60	21.80
Proline	-	9.34	4.50	7.20
Serin	-	5.56	8.30	13.30
Together, replaceable amino acids	-	<i>69.32</i>	<i>56.90</i>	<i>91.60</i>
<i>The sum of all amino acids</i>		<i>100.00</i>	<i>77.1</i>	<i>123.2</i>
Ratio of acids: replaceable/irreplaceable		2.26	2.82	2.90

Note. <sup>\*</sup>Data of the authors. <sup>\*\*</sup>Source data Food and Agriculture..., 2012

It is worth noting the high amount of glutamic acid, which is 25.30 g/100 g of protein. The presence of such diaminodicarboxylic acids as arginine and histidine, aminodicarboxylic acids (glutamic and aspartic) and proline in the protein fiber from wheat germ with apple pectin ensure a high hydration property of the plant supplement.

The authors (Wang et al., 2019; Vasylyv et al., 2022) established that their polar functional groups interact with dipole water molecules due to hydrogen bonds and, thus, contribute to the redistribution of moisture between the components and the formation of a homogeneous consistency. Thus, the use of fiber from wheat germ with apple pectin in the composition of cooked sausage products will help to increase the moisture-holding capacity due to the content of a larger number of hydrophilic amino acids. It will also ensure an increase in the functional and technological properties of finished sausage products.

When characterizing the biological value of protein components in scientific research, the most common indicators and criteria were developed by the author. These criteria include the following: biological value, amino acid score difference coefficient, which shows the excess of essential amino acids for use in plastic exchange, and utility coefficient, which characterizes the balance of essential amino acids in relation to the physiological norm of an ideal protein. The results of the calculations of these coefficients are presented in the Table 2.

**Table 2. Comparative characteristics of ideal protein and wheat germ fiber protein with apple pectin**

Indicator	Perfect protein	Wheat germ fiber protein with apple pectin
Biological value (%)	100	86.52
Amino acid score difference Coefficient (%)	0.0	13.48
Coefficient of utilitarianism	1.0	0.68

*Note. Data of the authors.*

As can be seen from the obtained results from the Table 2, the biological value of protein fiber from wheat germ with apple pectin is very high and is 86.52%. Only 13.48% of amino acids will not be assimilated for plastic exchange and the utilitarian coefficient of amino acids is 0.68.

### **Conclusions**

Due to the fact that there is no limiting amino acid in meat raw materials, the combination of meat and vegetable raw materials - fiber from wheat germ with apple pectin in the production of sausage products will allow to harmonize the amino acid composition of the protein component and due to the content of diamino and aminodicarboxylic acids will help to increase the moisture retention capacity and provide good functional and technological properties of ready-to-eat sausage products. The results of research into the amino acid composition of the plant fiber supplement from wheat germ with apple pectin allowed us to establish that with a protein content of 16%, this supplement is characterized by the presence of all essential amino acids. A comparative analysis of the amino acid composition of the protein of the vegetable supplement with the ideal protein of FAO/WHO determined that the content of all essential amino acids, with the exception of tryptophan, is 5.32%

less than in the ideal protein. However, this protein contains a significant amount of such substitute amino acids as glutamine, arginine, histidine and proline. These acids ensure the high hydration capacity of wheat germ fiber with apple pectin, and the use of this plant additive in sausage production technology will lead to improvement of the functional properties of minced meat and finished sausage products.

### **Conflict of interest**

The authors state no conflict of interest.

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