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USE OF MAGNESIUM ASPARTATE FOR ENRICHMENT OF SEMI-FINISHED MEAT PRODUCTS

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Annotation. In this work, the influence of magnesium aspartate on the biological value and organoleptic characteristics of meat patties - semi-finished products made of minced meat - was studied.

The role of magnesium for human is extremely large, it is one of the essential nutritional factors, since magnesium can improve metabolism and blood formation.

Magnesium aspartate is a biologically active substance that has the ability to increase the bioavailability of magnesium and improve its absorption in the body. Recently, magnesium aspartate has been actively used not only as a medicine, but also as an additive to food products, in particular, for enriching semi-finished meat products.

The purpose of this work is to study the effect of enrichment of meat patties with magnesium aspartate on their biological value, product storage ability, taste, smell and texture characteristics. Experiments were carried out and meat patties were evaluated before and after enrichment with magnesium aspartate.

As a result of the study, it was found that the enrichment of meat patties with the studied additive leads to an increase in the magnesium content in the product, which can have a positive effect on the health of the consumer.

A recipe for patties with the addition of magnesium salts has been developed. A comparative evaluation of control samples and samples with different concentrations of additive was carried out. It was found that the additive affects the organoleptic characteristics, and also inhibits the growth and development of microflora in semi-finished products, which leads to an increase in shelf life.

Evaluation of the taste, smell and texture characteristics of meat patties showed that enrichment with magnesium aspartate in the recommended doses does not affect the taste and smell of the product, but leads to an improvement in the texture. Increasing the water-binding capacity of the product makes it more tender, juicy and appetizing.

Taking into account that for better absorption of ions in the body, the presence of vitamin D and B6 is necessary, the required amount of vitamins was calculated and introduced into the product.

Thus, the enrichment of meat patties with magnesium aspartate can be beneficial for human health and improve the quality of the product. These results can be used in the food industry when developing new products.

Key words: magnesium aspartate, meat technology, chopped semi-finished products, biological value.

ВИКОРИСТАННЯ АСПАРТАТУ МАГНІЮ ДЛЯ ЗБАГАЧЕННЯ М'ЯСНИХ НАПІВФАБРИКАТІВ

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Анотація. У роботі досліджено вплив аспартату магнію на біологічну цінність та органолептичні показники м'ясних котлет – напівфабрикатів із рубленого м'яса.

Роль магнію для людини надзвичайно велика, він є одним з найважливіших факторів харчування, оскільки магній може покращувати обмін речовин і кровотворення.

Магнію аспарат – біологічно активна речовина, яка має здатність підвищувати біодоступність магнію та покращувати його засвоєння організмом. Останнім часом аспарат магнію активно

використовують не тільки як лікарський засіб, але і як добавку до харчових продуктів, зокрема, для збагачення м'ясних напівфабрикатів.

Мета роботи – вивчити вплив збагачення м'ясних котлет магнію аспаратом на їх біологічну цінність, здатність до зберігання, смак, запах і консистенцію. Були проведені експерименти та оцінені м'ясні котлети до та після збагачення аспаратом магнію.

У результаті дослідження встановлено, що збагачення м'ясних котлет досліджуваною добавкою призводить до збільшення вмісту магнію в продукті, що може позитивно позначитися на здоров'ї споживача.

Розроблено рецептуру пиріжків з додаванням солі магнію. Проведено порівняльну оцінку контрольних зразків і зразків з різними концентраціями добавки. Встановлено, що добавка впливає на органолептичні показники, а також пригнічує ріст і розвиток мікрофлори в напівфабрикатах, що призводить до збільшення терміну зберігання.

Оцінка смакових, запахових і консистенційних характеристик м'ясних котлет показала, що збагачення магнію аспаратом у рекомендованих дозах не впливає на смак і запах продукту, але призводить до поліпшення консистенції. Підвищення водозв'язуючої здатності продукту робить його більш ніжним, соковитим і апетитним.

Враховуючи, що для кращого засвоєння іонів в організмі необхідна наявність вітаміну D і B6, була розрахована необхідна кількість вітамінів і введена в продукт.

Таким чином, збагачення м'ясних котлет аспаратом магнію може бути корисним для здоров'я людини та покращити якість продукту. Ці результати можуть бути використані в харчовій промисловості при розробці нових продуктів.

Ключові слова: магнію аспарат, технологія м'яса, січені напівфабрикати, біологічна цінність.

Introduction. Mineral elements are indispensable nutrients which are necessary for the normal functioning of the body. One of these elements is magnesium, which is involved in the regulation of more than 300 biochemical reactions in the human body, including the synthesis of proteins and DNA, as well as the regulation of blood glucose levels [4, 14]. One of the main biochemical mechanisms of action of magnesium is its ability to interact with adenosine triphosphate (ATP), which is the main energy molecule in the human organism. Magnesium is involved in the ATP phosphorylation reaction, which allows the body to use the energy necessary to perform various functions [8, 26]. Magnesium is involved in the regulation of ionic balance inside and outside of cells, including regulating calcium metabolism [25]. It plays an important role in maintaining the normal function of the cardiovascular system, improves oxygen uptake, and may reduce the risk of arterial hypertension and other cardiovascular diseases [6, 9, 12]. Magnesium may also help lower blood cholesterol levels and improve blood sugar regulation [22, 30].

In addition, magnesium plays a role in the regulation of the nervous system. It is involved in the transmission of nerve impulses and helps reduce stress and anxiety. Magnesium deficiency can lead to disruption of the normal function of the nervous system and even to the development of nervous disorders such as depression and bipolar disorder [16, 21, 33]. Also, magnesium is involved in maintaining bone health. It helps absorb calcium and phosphorus, which are essential for healthy bones and teeth. Magnesium deficiency can lead to disruption of normal bone structure and even to the development of osteoporosis [25].

Thus, magnesium plays an important role in the biochemical processes in the human body and its deficiency can lead to various diseases and disorders in the functioning of organs and body systems. In this regard, the enrichment of food with magnesium is becoming an increasingly important issue.

Meat and meat products are one of the main sources of protein, iron and zinc. However, the magnesium content of meat is relatively low. Therefore, there is a need to develop products enriched with magnesium.

The effect of magnesium on human health

To study the effect of fortification of meat products with magnesium on human health, studies have been conducted, including both clinical and epidemiological analyzes. Eating magnesium-fortified meat products has been shown to increase blood magnesium levels. In addition, a decrease in blood cholesterol levels has been observed, which may be associated with improved heart and vascular health [15, 30]. A decrease in blood sugar levels has also been shown with the consumption of meat products with magnesium [27]. This may indicate that magnesium fortification of meat products may help improve blood glucose levels and reduce the risk of diabetes. High magnesium intake has been shown to be associated with a lower risk of developing type 2 diabetes [23].

Biochemical properties

When magnesium is added in the form of aspartate to meat products, magnesium is easily and quickly absorbed by the body due to the biochemical mechanism of action of this compound. The biochemical mechanism of absorption of magnesium aspartate in the body is associated with active transport in the intestine. It passes through the cells of the intestinal epithelium with the help of special protein carriers that ensure its

transport into the blood. Then, magnesium, which is associated with aspartic acid, can be used by cells to maintain magnesium balance in the body and participate in many biochemical processes, such as protein synthesis, glucose metabolism, and energy generation in cells [4, 11, 34].

In addition, aspartic acid can help reduce the acidity of the intestinal contents and thus improve the absorption of magnesium in the body. This is especially important for people suffering from low stomach acid, which can lead to low levels of magnesium absorption in the body [22].

Moreover, aspartate may have higher bioavailability than other forms of magnesium such as magnesium oxide, chloride or sulfate. This may be due to the fact that magnesium aspartate is more soluble in water, which allows for more efficient absorption in the intestines.

Interaction with vitamins

There is evidence that magnesium can affect the absorption of some vitamins, in particular vitamin D and vitamin B6 [5].

It has been found that postmenopausal women who took magnesium supplements increased blood levels of vitamin D significantly faster than those in the control group who did not take magnesium supplements. Vitamin D plays an important role in the absorption of minerals in the body. It improves the absorption of calcium and magnesium in the intestine by regulating the expression of transporter proteins in the intestinal cells. In addition, vitamin D increases bone density, which helps to reduce the loss of minerals from the bones and improve their resorption [25]. In general, having adequate levels of vitamin D in the body can improve magnesium absorption and help maintain normal magnesium levels.

Studies have also shown that vitamin D deficiency can reduce the absorption of magnesium in the body. Therefore, it is recommended to consume foods rich in vitamin D to ensure optimal absorption of magnesium in the body [4].

Also important is the presence of a sufficient amount of vitamin B6, which helps transport magnesium into cells [34]. Some studies show that the absorption of magnesium aspartate may improve when taken with vitamin D and vitamin B6. It has also been shown that the addition of magnesium to the diet of mice improved the absorption of vitamin B6 and increased its blood levels [5].

Diet can also play an important role, as certain foods can increase or decrease the absorption of minerals, including magnesium. For example, phytic acid, which is found in grains, nuts, and legumes, can bind magnesium and make it difficult for the body to absorb it. At the same time, vitamin C, which is found in vegetables and fruits, can improve the absorption of magnesium [4].

Thus, the effect of magnesium aspartate on the absorption of vitamins can be multidirectional and depends on specific conditions and dosages.

Role in bone tissue

Magnesium is essential for the construction and functioning of healthy bone tissue. It is involved in the formation of the bone matrix, which is made up of collagen and minerals such as calcium and phosphorus. Magnesium also regulates the level of hormonal metabolism in bone tissue [10].

Magnesium interacts with parathyroid hormone (PTH), which plays an important role in regulating blood levels. With low blood cholesterol levels, PTH stimulates the release of bone marrow, maintains its level in the blood. However, magnesium deficiency can disrupt this process, resulting in bone loss [25].

Magnesium also increases liver activity, which plays an important role in calcium metabolism and strong bones. It helps synthesize proteins that are needed for food intake and phosphorus from food, and increases the amount of vitamin D, which facilitates absorption of the ions from the intestine [5].

In addition, magnesium interacts with a number of other factors that play a role in bone health, including inflammation, oxidative stress, hormone imbalances, and more [20]. Therefore, a lack of magnesium can manifest itself in various types of development of bone lesions, such as osteoporosis, osteomalacia, and others.

Nervous system

Magnesium is an important parameter for the normal function of the nervous system. It is involved in the transmission of nerve impulses, regulates the input and output of metabolism in cells, the nervous system, and disruption of cell membranes [1]. In addition, magnesium is involved in the synthesis of neurotransmitters such as serotonin, norepinephrine, and dopamine, which play an important role in the regulation of mood and behavior [21].

Magnesium deficiency can manifest itself in nervousness, anxiety, insomnia, headaches and depression. On the other hand, it can improve mood, reduce anxiety, and improve sleep quality [16].

It is also significant that magnesium can exert an anticonvulsant effect and control seizure activity. It can also improve cognitive functions such as memory and attention and play an important role in protecting cells from damage [38].

In general, magnesium aspartate has a positive effect on the nervous system and can help maintain its natural function.

Interaction with iron

Magnesium plays an important role in regulating iron levels in the body. It is involved in the synthesis of hemoglobin and other blood components, and also helps to transport iron within cells. Moreover, magnesium contributes to the activation of enzymes necessary for the formation of hemoglobin and myoglobin, proteins that contain iron in the blood and muscles, respectively [34].

A lack of magnesium can lead to a disruption in the transport of iron within cells, which in turn can lead to the development of anemia. Some studies have also linked magnesium deficiency to impaired circulatory function and the possibility of developing cardiovascular disease [12].

On the other hand, an excess of magnesium can also lead to impaired iron absorption. Studies show that high doses of magnesium can bind to iron in the gut and reduce its absorption [23].

Despite the many positive effects of magnesium on the human body, an excess of this element can cause some negative effects. Some studies have shown that high doses of magnesium can lead to diarrhea, nausea, vomiting, and abdominal tenderness. It has also been found that with an increased intake of magnesium, the risk of hypermagnesemia increases, which manifests itself in the form of a decrease in blood pressure, respiratory depression and drowsiness [13].

Most studies, however, indicate that magnesium intake in reasonable doses, including through fortified meat products, does not cause any significant negative effects on human health.

Statistical data

Magnesium deficiency is a common problem in the world, especially among people with a poor diet and certain medical conditions. Data from the World Health Organization shows that more than 60% of the world's adult population may be deficient in magnesium in the body. In the US, for example, more than half of adults don't get enough magnesium in their diets. In Europe, the situation is similar, depending on the country, magnesium deficiency affects from 20% to 70% of the population [37].

Higher risk of magnesium deficiency in people with chronic diseases such as diabetes, chronic kidney disease, Crohn's disease, celiac disease, and others. Also, low magnesium content can be observed in people who abuse alcohol or suffer from anorexia [22, 24].

A study conducted in 2017 based on the analysis of medical records and questionnaires from more than 7,000 residents of Odesa showed that magnesium deficiency was observed in 65.2% of women and 47.5% of men. In a study conducted in 2018 among students of the Medical University in Kharkiv, it was found that magnesium deficiency was observed in 46% of men and 52% of women.

Studies have also been conducted in which magnesium levels in blood plasma were assessed in children and adolescents in Ukraine. More than half of children and adolescents were found to be magnesium deficient [40].

While these studies may not be representative of the entire Ukrainian population, they do indicate that magnesium deficiency is a common problem in Ukraine.

Impact on shelf life

Several studies have investigated the effect of magnesium supplementation on the shelf life of patties.

It was found that the addition of magnesium aspartate to pork patties at a storage temperature of 4 degrees Celsius increased their shelf life by 2 days compared to control samples without the addition of magnesium. At the same time, patties with the addition of magnesium aspartate retained their freshness and taste characteristics throughout the entire shelf life [19].

The addition of magnesium aspartate to chicken patties increased their shelf life to 8 days at 4 degrees Celsius. At the same time, patties retained their texture, color and taste throughout the entire shelf life [7].

Thus, these studies indicate that the addition of magnesium aspartate to meat products can increase their shelf life and preserve their taste and texture characteristics.

Studies have shown that magnesium aspartate can improve the quality and extend the shelf life of meat products due to its antioxidant properties. Magnesium in combination with aspartic acid can improve the stability of fats and prevent their oxidation, resulting in improved aroma, taste and color of the product, as well as reducing the amount of oxidation products such as peroxides, which can impair product quality and safety for human health [32].

Effect on microorganisms

There are several studies that have looked at the effects of magnesium aspartate on microorganisms.

It has been shown that the addition of magnesium aspartate to pork and meat products based on it, as well as cheeses, significantly reduces the number of microorganisms such as *Listeria monocytogenes*, *Salmonella typhimurium*, *Staphylococcus aureus*, and *Escherichia coli* [2, 35].

However, not all studies have reached similar conclusions. Some studies have not found a significant effect of magnesium aspartate on the growth of microorganisms in meat products [18]. Thus, a more accurate understanding of the effect of magnesium aspartate on microorganisms in meat products may require additional research.

Magnesium is known to be an essential trace element for the growth and development of many microorganisms. Some studies have shown that the effect on microorganisms can be both positive and negative, depending on their type and concentration of this element. Low concentrations stimulate bacterial growth, while high concentrations inhibit it.

Thus, the effect on microorganisms can be varied and depends on many factors, including the concentration of ions and the type of microorganism.

Some studies have shown that magnesium aspartate at a concentration of 0.1% or higher can inhibit the growth of various microorganisms, including bacteria and fungi [35]. However, other studies have shown that the concentration of magnesium aspartate required to inhibit the growth of microorganisms may be higher or lower than 0.1% [19].

In general, the concentration of magnesium aspartate that can inhibit the growth of microorganisms may depend on many factors, and more detailed studies may be necessary to determine the optimal concentration for a particular type of microorganism and environmental conditions.

Technological properties

Magnesium aspartate can affect the water-binding capacity of meat. This may be due to the fact that magnesium is involved in the regulation of the ionic balance of cells, including muscle cells, which in turn affects their ability to retain water [31]. In addition, magnesium can improve the quality of meat products such as patties due to its ability to prevent the formation of toxic combustion and oxidation products during frying or baking [3, 36].

Adding magnesium aspartate to meat products can improve texture. This additive helped to increase the elasticity and improve the texture of the meat. It was also found that patties with the addition of magnesium aspartate had a higher resistance to destruction during chewing [39]. This may be due to the fact that magnesium is part of myosin, a protein that plays a key role in muscle contraction. Thus, the addition of magnesium aspartate can improve the mechanical properties of meat products.

However, it should be noted that other studies have not found a significant effect of magnesium aspartate on the texture of meat products. Some studies also show that its addition may cause undesirable texture changes such as reduced softness and firmness [17]. Such differences in results may be due to differences in the composition of meat products, methods and conditions of preparation, as well as the concentration and form of the additive.

Studies conducted to evaluate the taste, odor and texture characteristics of meat patties before and after fortification with magnesium aspartate have shown different results depending on the type of meat and the concentration of added magnesium. The results showed that with the addition of a low concentration (0.1%), there were no significant changes in the taste, smell or texture of the patties. However, with the addition of a higher concentration of the additive (0.5%), changes in texture were detected, which may be associated with the formation of gel-like structures in the meat. In addition, some participants in the study noted a slight metallic taste in patties with a higher concentration of magnesium [18, 19].

Thus, the results of studies evaluating the organoleptic characteristics of meat patties before and after enrichment with magnesium aspartate show that changes can be associated with the concentration of added magnesium and the type of meat. Low concentrations of additive do not significantly affect the taste, smell and texture of meat patties, while higher concentrations can lead to changes in texture and possible off-flavours.

Purpose of the study

The purpose of this study is to study the effect of magnesium aspartate on the quality of meat patties, organoleptic indicators, as well as the shelf life of finished semi-finished products.

Materials and methods

We used deboned and trimmed pork, beef and chicken meat. Magnesium was used in the form of aspartate. Vitamin D - in the form of an oily solution of cholecalciferol (vitamin D3), vitamin B6 - in the form of pyridoxine hydrochloride. Chopped semi-finished products were made according to traditional technology. The mass fraction of water and pH were determined by conventional methods [28]. Water-binding capacity of minced meat - by pressing according to Grau-Hamm [28]. General microbial contamination - using meat-peptone agar as a medium for microbial growth [29]. Organoleptic properties - on a 9-point scale.

Patties formula was calculated taking into account next considerations. The recommended daily intake of magnesium for adults is 310 to 420 mg, depending on gender and age. We recommend using processed foods as a prevention of hypomagnesemia rather than a cure. Therefore, we calculate the amount of magnesium ions in the product so that 200 g of patties cover 80% of the RDA (recommended daily allowance).

Magnesium aspartate is a compound of magnesium with aspartic acid. Its chemical formula $Mg(C_4H_6NO_4)_2$ indicates that it contains 1 magnesium atom in its structure, which means that 100 g of magnesium aspartate contains about 8.4 g of magnesium (Mg).

We accept that 200 g of the product will contain 250 mg of magnesium. So, in order to achieve this amount of magnesium in the product, it must contain approximately 3 g of magnesium aspartate. This corresponds to 1.5% aspartate in the product. Further studies are aimed to determine the amount of magnesium aspartate in the product based on its effect on technological and organoleptic properties.

On average, the daily dose of cholecalciferol (vitamin D) is 15 mcg (600 IU). For 100 grams of the product, we introduce 5 micrograms of this substance. Therefore, 200 grams of semi-finished products will contain 10 micrograms of vitamin. The recommended daily dose of pyridoxine hydrochloride (vitamin B6) is 1.8 mg. For 100 grams of patties, we add 0.75 mg of vitamin. Thus, it will contain 1.5 mg per 200 grams of product.

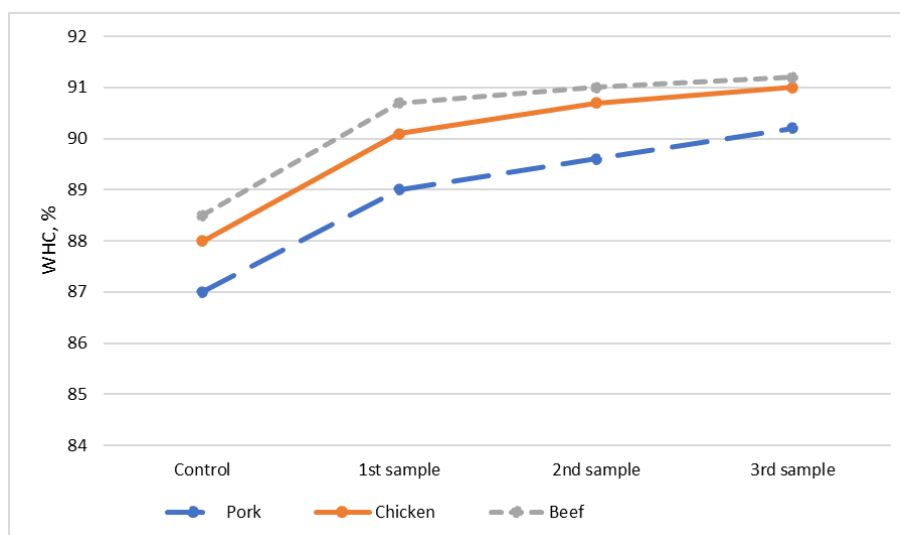
Meat patties were prepared from minced pork, beef and chicken with the addition of magnesium aspartate. The samples were divided into several groups: the control group and minced meat with the addition of 1, 1,5 and 2 % to the mass of product.

Table 1 - Composition of chopped semi-finished products

Ingredients	Quantity, g			
	Control	Sample 1	Sample 2	Sample 3
Minced meat (chicken/pork/beef)	50	49,5	49	48,5
Pork fat	10	10	10	10
White bread	18	18	18	18
chicken eggs	5	5	5	5
Onion	3	3	3	3
Kitchen salt	1,2	1,2	1,2	1,2
Black pepper	0,3	0,3	0,3	0,3
Water	12,5	12,5	12,5	12,5
Magnesium aspartate	0	0,5	1	1,5
Quantity, mg				
Pyridoxine hydrochloride	0	0,75	0,75	0,75
Quantity, mcg				
Cholecalciferol	0	5	5	5

Results and discussion

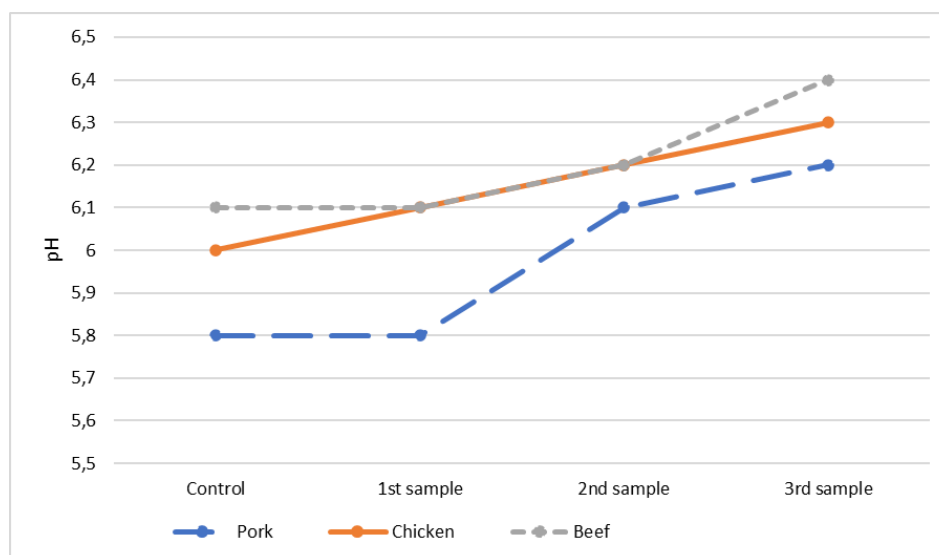
One of the most significant indicators for the production of meat products is the ability of meat to retain moisture.



Control - minced meat without the addition of magnesium aspartate, the first sample - 1% magnesium aspartate to the mass of minced meat, the second sample – 1,5% magnesium aspartate to the mass of minced meat, the third sample - 2% magnesium aspartate.

Fig. 1 - Change in the water-binding capacity of meat depending on the concentration of magnesium aspartate in minced meat

As it can be seen from the data in Figure 1, magnesium aspartate slightly raises the percentage of bound moisture in minced meat for semi-finished products. From literary sources it was found that magnesium is involved in the regulation of the ionic balance of cells, including muscle cells, which in turn affects their ability to retain water. Also, it increases the pH of the medium (Fig. 2), which allows you to get away from the isoelectric point. However, this is not enough to replace functional additives such as phosphates to improve water-binding capacity. It is possible that magnesium salts will be synergistic for phosphorus salts and the addition of magnesium will improve the work of phosphates. An example of such synergists are citrates and lactates, which enhance the action of phosphates. But in order to find out, more research is needed in this direction.



Control - minced meat without the addition of magnesium aspartate, the first sample - 1% magnesium aspartate to the mass of minced meat, the second sample – 1,5% magnesium aspartate to the mass of minced meat, the third sample - 2% magnesium aspartate.

Fig. 2 - Change in pH depending on the concentration of magnesium aspartate in minced meat

Magnesium aspartate leads to a decrease in the acidity of minced meat. This affects not only the water-binding capacity of meat, but also leads to an improvement in the juiciness of the finished product. The discrepancy in pH in different types of meat is explained by the initial acidity, defects of autolysis, as well as the content of myoglobin. But, regardless of the type of raw meat, magnesium aspartate lowers the acidity of meat by 0.3-0.4 units. Perhaps it makes sense to select different salts of magnesium and other biologically active metals to increase not only the biological value, but also improve the functional and technological properties.

An important object of research is the effect of magnesium aspartate on the shelf life of semi-finished products. We examined the total contamination of the control and test samples on days 1, 2, 4, 6 and 8.

According to DSTU 4437:2005, chilled semi-finished products are stored at temperatures from 0°C to 6°C and relative air humidity from 75% to 78%. The shelf life of chilled semi-finished products is defined taking into account that number of mesophilic aerobic and facultative anaerobic microorganisms (CFU) in 1 g of the product, not more than 1×10^7 . We set the shelf life limit for semi-finished products from this consideration.

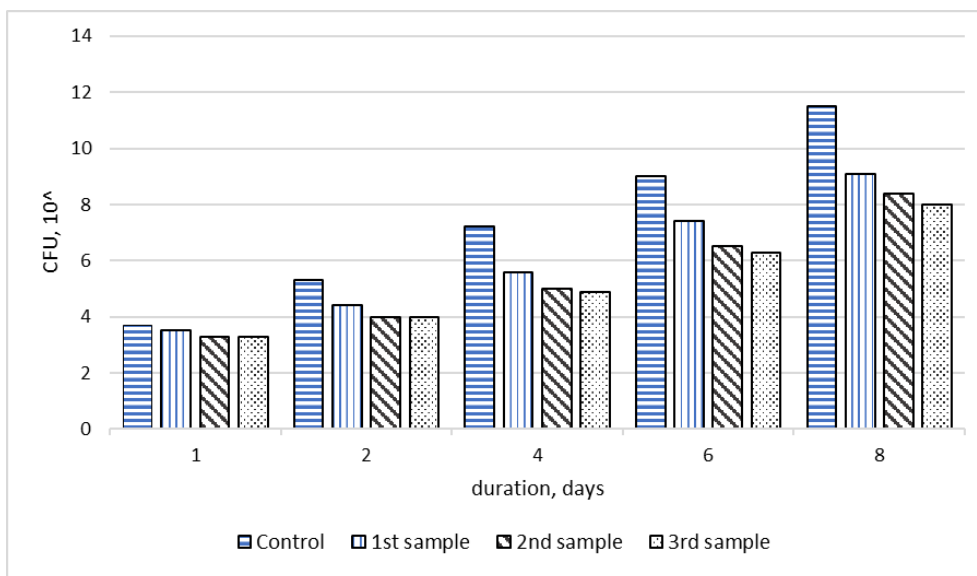
The graph shows that magnesium aspartate somewhat inhibits the growth of microflora. The introduction of 1% additives can slightly increase the shelf life of patties. This is not enough to be used as a preservative, but it is likely that the additive may have a synergistic effect with other preservatives. For example, iso-ascorbic acid (erythorbic) and its salts can enhance the preservative effect of sodium nitrite and allow it to be used in smaller quantities.

The organoleptic evaluation of the cooked semi-finished products (Fig. 4) showed that the addition of 1% aspartate did not affect the taste, aroma and color in any way. But, with an increase in the concentration of the additive in minced meat, the texture of the finished product improved. It is noticed that the addition of 1,5% magnesium salt leads to unpleasant notes in the taste of patties. With an increase in the concentration of aspartate to 2%, a pronounced, unusual taste for this product appeared.

Conclusion. In our work, we investigated the possibility of enriching meat patties with magnesium aspartate. From literary sources it was found that the enrichment of meat patties with magnesium aspartate leads

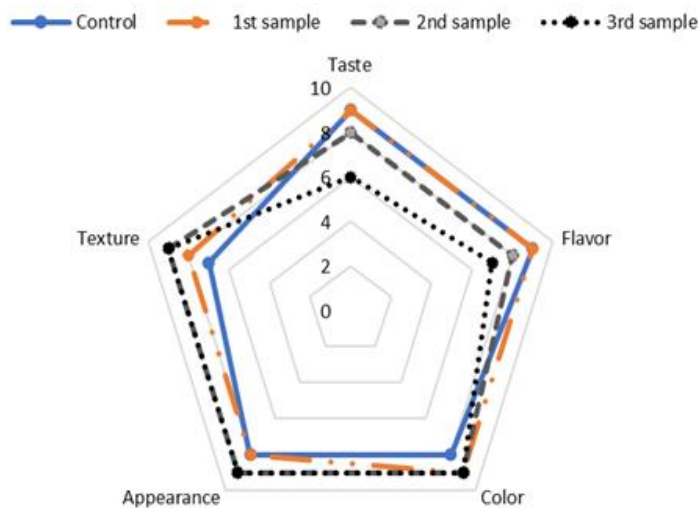
to an increase in the biological value in the product with an improvement in its texture. We tested its effect on the texture of minced meat products, as well as on water-binding capacity, pH and shelf life of the product.

Based on the data obtained, we can recommend the addition of magnesium aspartate in an amount of 1% to the mass of minced meat.



Control - minced meat without the addition of magnesium aspartate, the first sample - 1% magnesium aspartate to the mass of minced meat, the second sample – 1,5% magnesium aspartate to the mass of minced meat, the third sample - 2% magnesium aspartate.

Fig. 3 - Change in the total microbial contamination of minced meat semi-finished products depending on the concentration of magnesium aspartate in minced meat



Control - minced meat without the addition of magnesium aspartate, the first sample - 1% magnesium aspartate to the mass of minced meat, the second sample – 1,5% magnesium aspartate to the mass of minced meat, the third sample - 2% magnesium aspartate.

Fig. 4 - Organoleptic evaluation of cooked semi-finished products

As a result, we can conclude that the addition of magnesium aspartate into minced meat for patties leads to a slight improvement in the texture of semi-finished products and an increase in shelf life. However, an increase in the amount of the introduced additive more than 1%, although it inhibits the growth of microorganisms, negatively affects the taste of patties. Therefore, we recommend introducing magnesium aspartate in an amount of not more than 1% by weight of minced meat. Thus, in order to cover 80% of the daily requirement for

magnesium, it is necessary to consume approximately 300 grams of patties. Since the average person cannot consume this amount of meatballs, the goal of our future research is to create a supplement for semi-finished meat products that can cover 80% of the human need for magnesium without compromising taste.

Our study confirms that fortifying meat products with magnesium can be an effective way to improve human nutrition. Further research may be aimed at determining the optimal amount of magnesium aspartate with a combination of other organic magnesium compounds. This work gave rise to the study of not only the properties of magnesium aspartate in meat products, but also as a potential synergist for preservatives and water-binding agents.

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