Meat minced semi-finished products with iodine-containing vegetable components

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Abstract. The problem of iodine deficiency for most residents of the Russian Federation remains relevant for many decades. The situation is aggravated by the fact that with an inferior monotonous diet, a deficiency of proteins, vitamins and trace elements occurs side by side. To solve this problem, we can choose the path of enrichment of the product with organic iodine, as well as vitamins and vegetable protein. It is economically feasible to provide a combination of raw meat with cheaper functional components that are full in amino acid composition. The possibility of using the kelp preparation in the production of food products based on meat raw materials with the aim of correcting the iodine deficiency of the population in ecologically unfavorable areas was investigated. We used a natural iodinating dietary supplement - a hydrated preparation of Japanese kelp, which is a source of dietary fiber. A study of the process of the influence of this additive on the functional and technological properties of minced meat systems shows the promise of the use of this drug in the production technology of meat food products.

In addition, the rational use of meat raw materials (fatty pork and spike fat) in combination with vegetable components (Dantex soybean texturate) and Japanese kelp in an optimal dose of 5% has a number of economic advantages compared to similar products.

1. Introduction
In the course of the analysis of literature data, statistical calculations, analysis of studies in the field of human health, it was revealed that the nutrition of a modern person, despite the spread of the ideas of a healthy and balanced diet, is unbalanced. An imbalance in the diet is especially evident in the increased intake of saturated fats [1–6]. In this case, there is a decrease in the proportion of polyunsaturated fatty acids, a general decrease in the protein part of the diet, and an imbalance in its amino acid composition. This is all aggravated by the problems of the gastrointestinal tract due to a decrease in the content of...
dietary fiber, as well as a decrease in the content of micronutrients in food [7–10]. The most natural way to eliminate micronutrient deficiencies is to “tacitly” enrich certain foods with vitamins and minerals offered to specific populations. Micronutrients enrichment of habitual products is carried out in quantities that correspond to the physiological norms of human beings of people living in the corresponding problem region or “biogeochemical provinces” [11–14].

Replenishment of micronutrient deficiencies while maintaining product safety and maintaining its quality is a fundamental task. The introduction of minerals, vitamins, and vitamone-like substances is a necessary action—these micronutrients are catalysts for almost all biochemical processes that occur in the human body [15–20].

A permanent deficiency in human nutrition of various micronutrients, especially against the background of increased environmental stress, can cause disturbances in the immune status, a decrease in homeostasis and, accordingly, general tone, of the human body. Therefore, the additional enrichment of the usual daily diet of a person with individual micronutrients or their specific complexes should become a necessary and conscious need [10].

One of the most scarce micronutrients, the lack of which is clearly manifested on the continental part of our country, is iodine.

Diseases caused by iodine deficiency in the body are pronounced endemic. Iodine deficiency leads to a decrease in the status of the endocrine system. A negative effect on the iodine metabolism in the body is exerted by an inferior monotonous diet. Moreover, the imbalance in the ratio of the protein part and the fat part of the diet only worsens the situation. Deficiency of certain micronutrients, such as zinc, cobalt, copper, molybdenum, also negatively affects the absorption of iodine from food.

Some foods contain substances that inhibit the penetration of iodides into the thyroid gland. For example, thiocyanates, perchlorates, thiourocil prevent the conversion of iodides, reduce the synthesis of thyroid hormones.

After notable successes in the prevention of iodine deficiency diseases in the 30–60s from the beginning of the 70s, insufficient attention was paid to the work with iodine deficiency states of non-population in our country, which significantly increased the prevalence and severity of iodine-dependent diseases.

The elimination of iodine deficiency diseases is one of the important areas of humanitarian activity of various international organizations whose work is aimed at maintaining health and improving human life.

Based on the analysis of world practice in working with iodine-deficient conditions, the most common methods have been identified. These include individual or group administration of iodine-containing prophylactic drugs that provide physiologically necessary amounts of iodine.

This method of prevention is not always acceptable for the consumer due to his psychological, emotional characteristics, religious or national traditions.

Another way of group prevention of iodine deficiency for a wide range of consumers is the production of certain groups of foods enriched with iodine in organic or mineral form. This method on a national scale is the most effective and cost-effective. The most famous product of group prophylaxis is iodized salt. But at the same time, modern medicine recognizes certain difficulties—this is the low efficiency of the absorption of mineral iodine compounds. Organic iodine compounds based on protein, hydrocarbon or lipid nature more fully meet the human needs for iodine.

When analyzing literature data, it was found that the organic forms of iodine that make up seaweed, namely Japanese kelp (Laminaria japonica Aresch), are more quickly absorbed by the human body than mineral forms of iodine compounds. The complete assimilation of iodine is facilitated by the fact that seaweed contains various microelements, including a group of ultra microelements, such as molybdenum, cobalt, etc.

At the Department of Technology of Meat, Dairy Products and Chemistry of the Bashkir State Agrarian University, work is underway to create combined meat products enriched with biologically active additives containing organically bound iodine, for example, Japanese kelp preparation. The basis of this development was the idea of “silent” enrichment of the product with an organic form of iodine.
based on substances contained in seaweed, and the addition of a functional vegetable protein of domestic origin [21–26]. The combination of animal and vegetable proteins allows you to get a complete balanced product with high technological properties. And additional enrichment with kelp gives such a product certain therapeutic and prophylactic characteristics.

2. Materials and methods

The object of research was to determine the effect of kelp on the functional and technological properties of minced meat. Minced meat was prepared for beef of the second grade and fatty pork. To obtain a balanced amino acid composition, enrich the product with dietary fiber and improve their consistency, textured vegetable proteins were used (in this work, Dantex soybean texturate). A natural iodinated dietary supplement is a pre-hydrated preparation of Japanese kelp, which is also an additional source of dietary fiber. Structural-mechanical and functional-technological properties of meat and meat-and-vegetable model minced meat using kelp and soy texture were determined by conventional methods. The content and amount of bound iodine was determined by the rhodanide-nitrite method.

3. Results and discussion

To justify the amount of application of the kelp preparation, iodine loss was studied during the process. Loss of iodine increases from 51 to 67% depending on the duration of the heat treatment and temperature conditions.

Also studied the technological properties of the cutlet mass with the preparation of kelp. Its moisture-binding, water-retaining, emulsifying ability and emulsion stability were studied depending on the amount of kelp preparation added (figure 1 and 2).

![Figure 1. Moisture-binding and water-holding ability of meat model systems, depending on the mass of the kelp preparation.](image-url)

The change in the functional and technological stuffing systems for the production of cutlets (an increase in the moisture-binding ability, the water-holding ability) is explained by the chemical composition of sea kale - kelp is rich in polysaccharides, for example, such as beckon, which has gelling capabilities during heat treatment. Kelp also has a rich mineral composition, a large amount of
magnesium, potassium, calcium, iron, phosphorus, which positively affect the state of the protein molecule, increasing its hydrophilicity.

![Graph showing emulsifying ability and stability of the emulsion of meat model systems depending on the mass of the kelp preparation.](image)

**Figure 2.** Emulsifying ability and stability of the emulsion of meat model systems depending on the mass of the kelp preparation.

At the same time, sea kale in the above ratio does not have a negative effect on such functional and technological properties, as emulsifying ability and stability of the emulsion in minced meat. An increase in the amount of kelp introduced above 7.5% by weight of raw meat negatively affects the stability of the emulsion and the organoleptic characteristics of the product.

Based on the study of the effect of the kelp preparation on the functional-technological properties and the safety of organically bound iodine during heat treatment, the optimal doses of introducing this preparation into the minced systems for the production of chopped semi-finished products were determined.

4. **Conclusion**

As the results of experimental studies have shown, the use of a given amount of sea kale preparation ensures the content in chopped semi-finished products, after heat treatment, at least 30% of the daily iodine requirement per 100 g of product.

Due to the use of fatty pork and spike fat in cutlets, the lipid fraction of the products is enriched with polyunsaturated fatty acids.

Based on the results of the work, a package of regulatory and technical documentation for new types of minced meat semi-finished products was developed.

At the final stage of our research, we conducted an analysis of technical and economic indicators and an assessment of the production efficiency of this type of chopped semi-finished products in comparison with existing similar products, which revealed an advantage due to the rational use of raw meat and vegetable components. The introduction of new types of chopped semi-finished products into production does not require additional investment.
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