Products of processing of Jerusalem artichoke for enrichment of food systems based on resources of rabbit breeding

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Abstract. The development of meat-based foods enriched with functional ingredients is an urgent and promising direction and allows expanding the market of products produced for healthy eating. The aim of the work was to develop prescription-component solutions of meat-growing systems with functional properties. The efficiency of creation of meat and vegetable chopped semi-finished products enriched with dietary fibers obtained on the basis of Jerusalem artichoke tubers with the use of enzyme preparation Pectinase and powdered semi-finished product of Jerusalem artichoke is shown. The composition of meat systems on the basis of resources of animal husbandry and rabbit breeding is proved. The optimal dosage of introduction of vegetable additives from Jerusalem artichoke (15% for dietary fibers and 12% for powder of Jerusalem artichoke) on the basis of studying functional and technological properties of forcemeat systems is experimentally established. The chemical composition and organoleptic characteristics of chopped semi-finished products of enriched composition were studied and the positive influence of introduced plant composites on quality indicators and flavor profile was established.

1. Introduction

Unbalanced nutrition contributes to the development of metabolic disorders in the human body, which leads to the development of various diseases [1–3], which is primarily due to the lack of necessary nutrients and ballast substances in the diet, including dietary fibers. Therefore, promising in this context is the inclusion in food rations of dietary fibers isolated from tubers with high fiber content, which includes Jerusalem artichoke.

Dietary fiber is an essential component in the diet, which is obtained mainly from plant sources such as Jerusalem artichoke, yacon, and scorzonerra products processing Jerusalem artichoke-pulp and powder semi-finished products are a promising source of raw materials for the enrichment of food rations by entering into food systems based on meat.

Jerusalem artichoke is an unpretentious crop characterized by high yields, cultivated almost everywhere and is used in various branches of the food industry.

We know [4] dietary and therapeutic properties of Jerusalem artichoke, as well as its ability to accumulate inulin, containing in its composition 95% fructose. Under the action of gastric juice inulin is hydrolyzed to fructose, which is absorbed almost without the involvement of insulin, which in turn
opens up opportunities for the use of products of processing of Jerusalem artichoke in the production of functional foods with antidiabetic orientation.

Another important component of Jerusalem artichoke tubers is a significant amount of fiber (dietary fiber), which has a high sorption capacity, which is proved by a number of authors [5].

The aim of the work is to develop prescription-component solutions of meat-growing systems with functional properties.

2. Materials and methods
Experimental studies were carried out in the conditions of NIL of the Department of private zootechnics of vgau and the center for collective use of VGUIT in 2013-2016.

The objects of the study were meat systems obtained on the basis of beef and pork, as well as partial replacement of the main meat raw materials with rabbit meat of manual deboning. As vegetable fortifiers used dietary fibers of Jerusalem artichoke obtained in the Department of private animal husbandry Voronezh GAU and powder of Jerusalem artichoke (manufacturer LLC "Ryazan expanses"). Powdered semi-finished products of Jerusalem artichoke were introduced into the model stuffing system replacing meat raw materials in the amount of 5-20%. In meat-growing systems, dietary fibers and Jerusalem artichoke powder, the chemical composition and functional and technological properties were determined by standard methods [6].

3. Results and discussion
Dietary fibers were obtained from Jerusalem artichoke pulp [7] by treating vegetable raw materials with pectinase with pectattranselaminase activity 32380.0 u / ml, which was introduced into the pre-prepared Jerusalem artichoke pulp in an amount of 0.010% by weight of raw materials. Hydrolysis is carried out at t=60°C for 2.5 hours. Then the enzyme is inactivated, keeping the mixture at a temperature of 75 C for 20 minutes, the food fibers are filtered and clarified with a 10% solution of hydrogen peroxide. Clarified dietary fibers are washed with water, pressed and freeze-dried. The yield of dietary fiber is 81.26-83.87% of the original content in the raw material.

The whiteness of the obtained fibers was determined on a tester for flour P3-BPP-CM (Figure 1).

![Figure 1. Determination of the whiteness of dietary fibers of Jerusalem artichoke.](image)

In order to create meat and vegetable systems, a powdered semi-finished product obtained from Jerusalem artichoke tubers was used, as well as dietary fibers of Jerusalem artichoke by freeze-drying.

The preparation of dietary fiber Jerusalem artichoke contains 85.78% carbohydrates, including dietary fiber 80.08%. Powdered semi-finished Jerusalem artichoke is characterized by a lower carbohydrate content-47.0%, but a higher content of protein substances-10%, fat -1.5% and ash -6.8%.

It is proved [8–11] that the use of functional orientation of food fibers in the technology of meat products contributes to the functional and technological properties of food systems. But it should take into account the qualitative side of the issue.
To justify the optimal dose of plant introduction of the obtained composites we investigated their functional and technological properties. It was found that Jerusalem artichoke powder and dietary fibers have increased functionality, which is characterized by moisture-holding capacity of 9.24±0.34 and 11.47±0.19 g of water/g of the drug; fat-holding capacity is 5.21±0.24 and 7.33±0.19 g of fat/g of the drug.

As model forcemeat the system received on the basis of beef and meat of a rabbit of the manual boning taken in different ratios was used. Experimentally, the optimal ratio of meat ingredients was 1:2 (table 1).

**Table 1. Functional and technological properties of model minced meat**

| Indicator | Ratio of meat raw materials (single-grade beef: minced rabbit meat) |
|-----------|---------------------------------------------------------------|
|           | 1:1   | 1:0.5 | 0.5:1 | 2:1   | 1:2   |
| MBC, %    | 67.1  | 66.2  | 69.2  | 70.5  | 74.4  |
| WHC, %    | 58.9  | 54.7  | 60.4  | 61.3  | 68.4  |
| FHC, %    | 61.2  | 57.3  | 58.6  | 64.7  | 66.5  |

On the basis of a series of experiments, it was found that the optimal dosage of hydrated in a ratio of 1:3 dietary fibers of Jerusalem artichoke and powder of Jerusalem artichoke to the mass of minced meat is 15.0 and 12%, respectively. At the same time, there is an increase in the functional and technological properties of model stuffing systems (MBC, WHC and FHC) to the level of 77.5 and 76.4, 72.3 and 71.8, 70.4 and 71.6%, respectively.

Samples of chopped semi-finished meatballs "Slavyanski" and schnitzel "Pervomayski" were developed in the conditions of LLC "HERMES" Terbunsky district of the Lipetsk region in the amount of 200 kg.

An increase in the yield of the developed products depends on the type of heat treatment (Figure 2).

![Figure 2. Influence of the type of heat treatment on the yield of chopped semi-finished products](image)

The conducted tasting evaluation found that the appearance, color, smell and taste of the developed samples did not differ from the control ones and were characterized by a delicate consistency and juiciness (table 2).

The study of the chemical composition of the developed semi-finished products found that they contain a higher amount of carbohydrates, including fiber and reduced fat content in comparison with control samples (table 3).

We conducted a study of microstructural features of the developed meat semi-finished products (Figure 3).

Histomorphological evaluation of meat and vegetable chopped semi-finished products showed the predominance of muscle fibers. Minced systems are a combination of small and medium fragments of muscle and connective, as well as carbohydrate components. The samples are characterized by a
homogeneous structure with a preserved general histomorphological picture of muscle tissue of meat raw materials. The introduction of plant composites, both powder and dietary fibers of Jerusalem artichoke, contributes to the production of food systems with a monolithic structure.

**Table 2.** Organoleptic characteristics of minced meat semi-finished products

| Name of the indicator | Characteristics and norms for semi-finished products |
|-----------------------|-----------------------------------------------------|
|                       | The meatballs                                      | Schnitzel                             |
| Appearance            | The surface of the product is evenly covered with a thin layer of breading, without cracks, torn and broken edges and unmixd stuffing | The form is rounded-flattened; without torn and broken edges, the surface is evenly sprinkled with breadcrumbs, there is no unmixd stuffing |
| Type of minced meat on the cut | Minced meat is evenly mixed without inclusions of bone and connective tissue | Characteristics of benign raw materials |
| Taste and smell | Juicy, note crumbly corresponding to the consistency of chopped semi-finished products (hot) |
| Consistency | | |

**Table 3.** Chemical composition of chopped semi-finished products

| Indicator       | Characteristic and norm |
|-----------------|-------------------------|
|                 | The Meatballs “Prasdnichnii” Control | The Meatballs “Slavynskii” experience | Schnitzel “Sochnii” Control | Schnitzel “Pervomaiskyi” experience |
| moistures       | 60.22                   | 61.5                      | 62.40                     | 62.90                     |
| fat             | 10.00                   | 9.00                      | 10.40                     | 8.50                      |
| protein         | 18.00                   | 17.80                     | 18.4                      | 19.50                     |
| carbohydrates’ | 1.20                    | 6.74                      | 2.00                      | 7.52                      |
| including dietary fiber | -                       | 5.40                      | -                         | 5.22                      |

**Figure 3.** Histomorphological structure of minced meat semi-finished products.
4. Conclusion
Thus, the use of products of processing of Jerusalem artichoke with a high content of hemicelluloses allows obtaining products of functional orientation with increased nutritional value and improved organoleptic characteristics. The developed products can be recommended for functional nutrition.

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