Functional and technological properties and methods of introduction of grain raw materials in the manufacture of meat and vegetable products

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Abstract. Currently, it is possible to ensure the protein balance in food only when combining plant and animal proteins. The functional and technological properties and methods of introducing non-meat ingredients (meal and grain raw materials) in the production of meat and vegetable pates are investigated. The influence of the degree of grinding of cereals on the viscosity properties of flour that has undergone hydrothermal treatment is studied. A direct dependence of the maximum value of the loading force on the degree of grinding of cereals is established, with an increase in the degree of grinding of cereals, the strength characteristics increase. The water-retaining capacity (WRC) of flour proteins was studied, so deodorised non-fat soy flour has the least ability to bind water, with a hydromodule of 1:1.75, 6.1% of water is separated, with a hydromodule of 1:2.25, buckwheat groats did not bind only 6.6% of water. Flour from cereal oat flakes, separation of non-cohesive water (8.5%) with a hydromodule of 1:2.5, with an increase in the hydromodule to 1:3, there is a slight decrease in this indicator by 7.5%. The fat module has a weak effect on the FRC of the flour samples being studied. Flour from cereals has a lower FRC, with fat modules (1:0.5) FRC does not change significantly and is from 0.44 to 0.45 g of oil per 1 g of flour, and for deodorised non-fat soy flour it is 100%. The mathematical description of the process of absorption of water and fat by flour from cereals and soy flour showed a steady decrease in WRC and an increase in WRC with an increase in hydro-and fat modules.

1 Introduction

Taking into account the forecast of the global supply of the Earth’s population with proteins, in modern conditions, ensuring the protein balance in food can only be achieved by combining plant and animal proteins. Therefore, many scientists are working on the development of new types of meat products, including those treated with ionizing radiation, with the use of dihydroquercetin in order to increase the stability of the properties of ghee in meat products, and their introduction to the consumer market [1-10].

We have conducted research on the functional and technological properties and methods of introducing meal and grain raw materials-soy flour and flour from cereals, which are non-meat ingredients and are of interest in the production of meat and vegetable pates. The carbohydrate part of cereals is represented by starch and mono-and disaccharides, fiber, the protein content in flour from cereals is up to 11.5%, in soy flour up to 36.5% (Fig. 1).

To study the compatibility of non-meat ingredients introduced into the pate recipes, the influence of the degree of grinding of cereals on the rheological, in particular on the viscosity properties of flour that has undergone hydrothermal treatment, was studied.

Fig.1. Protein and carbohydrate content in soy and grain raw materials

Four types of cereals were studied: buckwheat groats (GOST 5550 – 74), rice groats (GOST 6292-93), millet groats (GOST 572 – 60) and oat flakes (GOST 21149 – 93). Grinding of all types of cereals was carried out on a laboratory hammer crusher Z A13 – MIZ24 (Budapest), designed for grinding grain. After grinding, the grains were sieved on an A-20 analyzer designed for dry sieving.
of bulk materials into a number of particle size classes using vibrating screens with a cell size, mm: 1.2; 0.9; 0.315. The resulting flour was subjected to hydrothermal treatment with the hydromodule water: groats 2:1. The resulting semi-finished product had a gelatinous consistency with a mass fraction of dry substances of 34.8±0.5%. The measurements were carried out on the device "Structurometer".

## 2 Equations and mathematics

As a result of the experiment, a direct dependence of the maximum value of the loading force on the degree of grinding was established. Thus, with an increase in the degree of grinding of oat flakes (from a sieve of 1.2 mm to a sieve of 0.315 mm), there is an increase in the maximum value of the loading force from 30.25 g to 37.0 g, respectively. This tendency to increase the maximum loading force can be traced in all the studied semi-finished cereals.

A significant influence on the resulting structure of cereals that have undergone hydrothermal treatment is exerted by starch, which occupies the first place among carbohydrates in terms of its quantitative content. The ability of starch to swell and form jelly is of great technological importance and significantly affects the quality of meat-containing products under temperature exposure. The water-holding capacity of the flour also depends on the presence of starch in the flour. As you know, the main proteins of soy and cereals are albumins and globulins.

The calculated mass fraction of water in the flour inputs researched, which provides the maximum WRC for various hydromodules.

A mathematical description of the process of water and fat absorption by flour is carried out using trend lines, which represents a steady change in the indicator depending on the concentrations of water and fat, which is a deterministic component. It expresses the analytical function on which the forecast estimates are formed.

<table>
<thead>
<tr>
<th>Hydromodule (water: raw material)</th>
<th>1.2</th>
<th>2.2</th>
<th>2.7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soy flour, deodorized, not fat-free</td>
<td>0</td>
<td>6.1</td>
<td>24.1</td>
</tr>
<tr>
<td>Buckwheat flour</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Flour from millet groats, ground</td>
<td>0</td>
<td>0</td>
<td>3.4</td>
</tr>
<tr>
<td>Flour from cereals oat flakes</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

The water-holding capacity of the flour also depends on the presence of starch in the flour. The starch content in soy is not high - about 10%, in flour from cereals the starch content is much higher and is in buckwheat up to 60.7%, in millet up to 64.8%, in oat flakes up to 48.9%.

### Table 1. Water holding capacity of flour processing products, % of separated water.

<table>
<thead>
<tr>
<th>Flour samples</th>
<th>1:1.5</th>
<th>1:1.75</th>
<th>1:2.0</th>
<th>1:2.5</th>
<th>1:3.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soy flour</td>
<td>6.6</td>
<td>38.2</td>
<td>45.5</td>
<td>53.5</td>
<td>58.5</td>
</tr>
<tr>
<td>Buckwheat</td>
<td>6.6</td>
<td>38.2</td>
<td>45.5</td>
<td>53.5</td>
<td>58.5</td>
</tr>
<tr>
<td>Millet</td>
<td>6.6</td>
<td>38.2</td>
<td>45.5</td>
<td>53.5</td>
<td>58.5</td>
</tr>
<tr>
<td>Oat flakes</td>
<td>6.6</td>
<td>38.2</td>
<td>45.5</td>
<td>53.5</td>
<td>58.5</td>
</tr>
</tbody>
</table>

An important functional and technological property is the fat-restraining capacity (FRC) of the studied samples of grain raw materials in the form of flour. Since the composition of the minced meat of most meat-containing products includes fat-containing raw materials, in particular, semi-fat pork, which improves the taste and nutritional properties of products, as well as their consistency, it was interesting to study the FRC of the studied types of flour. As you know, the fat contained in the recipe, up to a certain limit (up to 20%) gives meat-containing products elasticity and tenderness; with an increase in its content, the stickiness increases, the moisture-holding capacity and the quality decreases.

For the determination of FRC, 8 variants of samples with a fat module were also prepared at the ratio (% by weight) flour: butter from 1 : 0.25 to 1 : 2 with an interval of 0.25 oil weight (Table 2).
However, this indicator is for flour from different types of cereals, with a fat modulus 1:2 increases by 150-160% and is from 1.15 to 1.3 g of butter per 1 g of flour. In addition to proteins, carbohydrates - starch and fiber-can also have adsorption properties in relation to fats.

### Conclusion

Thus, the mathematical description of the process of absorption of water and fat by flour from cereals and soy flour showed a steady decrease in WRC and an increase in FRC with an increase in hydro- and fat modules; the highest FRC is flour from cereal millet ground at a hydromodule of 1:1.2; for the analyzed samples of flour from cereals, the FRC is lower than the WRC and slightly differs depending on the type of flour; the mass fraction of fat that provides the maximum FRC is 0.86 - 0.13 g of fat per 1 g of flour.

### References


