ABOUT WASTELESS PROCESSING OF BONES OF SLAUGHTER ANIMALS

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In most cases the applied technologies of bone processing provide two types of ready products: fat and feed meal. In this connection technology efficiency may be characterized by the level of fat extracted as the index of objective evaluation of the process because it appears to be the ratio of final fat to the content of fat in the raw material: $\Theta = \frac{G_T}{G_C} \times 100\%$. Hence, total fat losses may be expressed as the difference: 100 - Θ, %. In this case, however, it becomes impossible to determine the quantity of losses at any stage of processing. To determine the zone and quantity of losses, the following equation of the material balance is used:

$$G_c = G_т + G_м + G_в + G_ф \text{ , where:}$$

G_c is the content of fat in original raw materials, kg;

$G_т$ is the quantity of obtained (final) fat, kg;

$G_м$ is the content of fat in the meal, kg:

$G_в$ is the content of fat in the waste water, kg;

$G_ф$ is the content of fat in the separator slime, kg

It is clear from the equation that irreversible losses are connected with the waste water and separator slime. Hence, reducing the expenditure water and the content of residual fat in water, and limiting the number of stages of separation leading to reduction of slime will help to increase the yield of fat and to achieve more effective removal of fat from bones.

At the same time, it is important to note that substantial quantity of soluble protein particles and products of bone collagen disaggregation are lost with the waste water, that results in the saturation of the waste water with organic substances, and the higher are the time and temperature during the processing, the higher is their concentration.

When the waste water is discharged, the necessity arises to carry out special processing of this water requiring high energy consumption before drainage into the sewerage system.

To eliminate or minimize water consumption in the process of fat removal from bones, a drastic measure should be applied. The Meat Research Institute worked out the technology based on a two-stage consecutive removal of fat from bones including short-time conductive heating at moderate temperature with continuous fat removal from the processing zone and the centrifugal pressing that prevents the contact of bone with water. Thus the fat would be purified by means of one-stage separation instead of the two-stage that allows to minimize organic substances losses up to 0,2% from their content in the raw material. Such method provides wastless technology with the fat yield up to 85%.

Thorough bone processing makes it possible to use all components of the raw material: proteins, lipides, and minerals. For this purpose methods of mechanical and thermal bone processing are combined in order to remove the left flesh and then during the thermal processing fat, protein, and mineral components are obtained. Thus, the wasteless use of the raw matetial is achieved and different products are obtained including meat mass, edible fat, dry half-finished protein components, and mineral-protein fraction.

Material balance achieved during fat processing for this technology may be expressed as:

$$G_c = G_{мм} + G_т + G_{сбп} + G_{мбч} + G_в + G_{ф,} \text{ , where}$$

G_c is the content of fat in the raw material, kg;

$G_{мм}$ is the content of fat in the meat mass, kg;

$G_т$ is the content of obtained (final) fat, kg;

$G_{сбп}$ is the content of fat in the dry half-finished protein component, kg;

$G_{мбч}$ is the content of fat in the mineral-protein fraction, kg;

$G_в$ is the content of fat in the waste water, kg;

$G_ф$ is the content of fat in the slime, kg.

This technology of fat purification includes only one-stage separation, that's why allows to limit water consumption and slime formation. As the moisture and vapour condensate educed at the stage of fat removal during thermal processing, they are removed in the process of drying of the protein solution formed.

However this method provides a relatively low level of fat separation (in its reduced value) which results from the transition of a considerable quantity of bone marrow into the meat mass at the stage of mechanical separation of left flesh by pressing. Thus, the actual level of the fat separation is not higher than 40% from its content in original raw material.

The undoubted advantage of the thorough bone processing is the extended range of edible products and minimum losses of raw materials.

In this technology, the higher level of fat separation may be achieved, if the fat is extracted simultaneously with collagen disaggregation products within the centrifugal field, the same as it is realized in LILLDAL installation (Denmark). In this case the level of the fat separation achieves 45% from its content in the raw material.

A very complicated is the problem of the effective application of bone protein and mineral components obtained. In this connection, the Meat Research Institute works out new kinds of food products and medicines on the basis of different bone components. The use of integrated thermo-mechanical effects on the recipe mixture containing vegetable raw material along with bone components appeared to be a basically new approach to the manufacture of mentioned products. Under the influence of high pressure and temperature new lipoprotein-carbohydrate complexes are formed and material structure is changed with the results that finished products differ from traditional ones by their nutritional value and assimilation. Chemical composition of the products containing protein and mineral bone components is characterized by the following values (Table 1).

Table 1. Chemical composition of products containing bone components

Product	Content, %				
	moisture	protein	fat	carbohydrates	ash
Product with bone protein component	8-10	10-14	2-3	60-70	1-2
Product with bone mineral component	8-10	16-17	0,1-0,2	69-72	5-6

To study the assimilation of calcium contained in new products with bone mineral additive, medical and biological analyses were carried out in laboratory conditions. All experimental animals were divided into three groups. The first group of animals received calcium with new product; the second group of animals had low calcium rations, and the third group of animals (control) got calcium with chalk. The rest of feed components were balanced in all componenets. The diets contained about 0,7% of phosphorus.

Experiments were carried out during 30 days. Calcium assimilation was evaluated by the concentration of total and ionized calcium and inorganic phosphorus in blood serum.

Indices of calcium content in the blood serum of experimental animals are summarized in Table 2.

Table 2. Changes of calcium content in the blood serum of experimental animals

Group of animals	Content in blood serum of		
	calcium mmol/g	ionized calcium mmol/dm^3	inorganic phosph. mmol/dm^3
Group 1	2,39 ±0,07	1,17 ± 0,02	3,0 ± 0,09
Group 2	1,15 ± 0,05	0,6 ± 0,01	3,07 ± 0,11
Control	2,38 ± 0,05	1,15 ± 0,01	3,03 ± 0,07

The obtained data show that new product provides the same calcium content in the blood serum of experimental animals as of control animals, that demonstrates relatitively high assimilation of calcium contained in the new product. It is confirmed by comparative data concerning the second control group of animals fed with low calcium rations.

Data summarized in Table 2 demonstrate that new products contain sufficient level of protein and low level of fat. Low caloric value of such products makes them useful for patients with disturbances of lipid metabolism.

Thus, the thorough processing of bones provides complete and purposeful use of all components of these raw materials for the manufacture of food products and medical and curative products.