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REPORT - Team 3

USING LAMB BY-PRODUCTS FOR PRODUCING SUPPLEMENTS FOR ELDERLY PEOPLE

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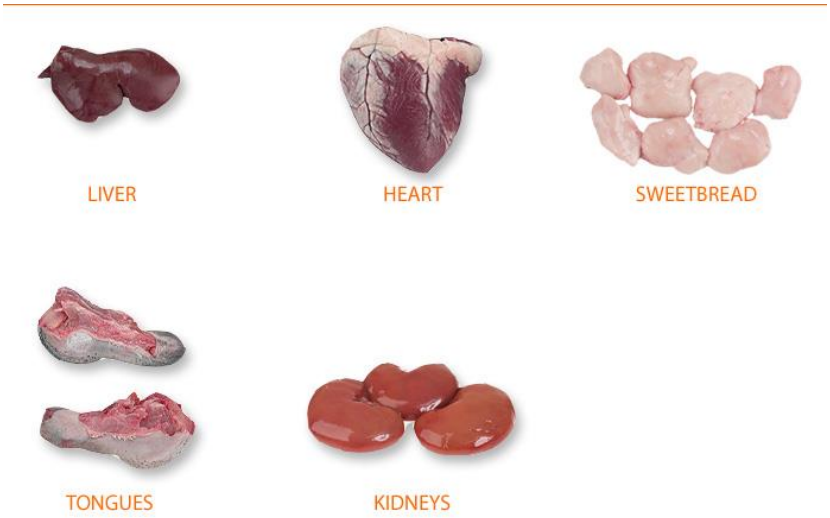
Uzbekistan 2023

ABSTRACT

The purpose of the study is that it is currently important in the food industry to produce ready-made products that preserve useful substances. From this point of view, most of the by-products are usually not processed. Eating liver, lungs and kidneys is very beneficial for the elderly. They contain protein, calcium and vitamin B12. But due to the long preparation, the elderly consumes very few of them. This became an incentive for the development of ready-made dried offal for making soups.



INTRODUCTION

Edible by-products from the slaughter of sheep are significant sources of essential nutrients, and as does the meat itself, they enjoy comparable nutritional values. The scientific data on the nutritional value of these by-products are relatively scarce, with values available on the internet in the limited form of nutritional food tables; these being much fewer in number for lamb by-products. It is noteworthy, however, that the results reported include chemical analysis, proximate compositions, cholesterol, fatty acid profiles, and sheep by-product minerals, especially from the brain, heart, liver, and tongue. Other studies have addressed the characterization of amino acids, fat, cholesterol, and moisture in sheep by-products. The amino acid profiles found in ovine meat organs demonstrate that, in general, leucine, valine, methionine, and threonine are found in higher concentrations in the liver than in other organs. Amino acid concentrations tend to be lower in the lungs and spleen, however, the higher content of tryptophan found in the pancreas is highlighted.

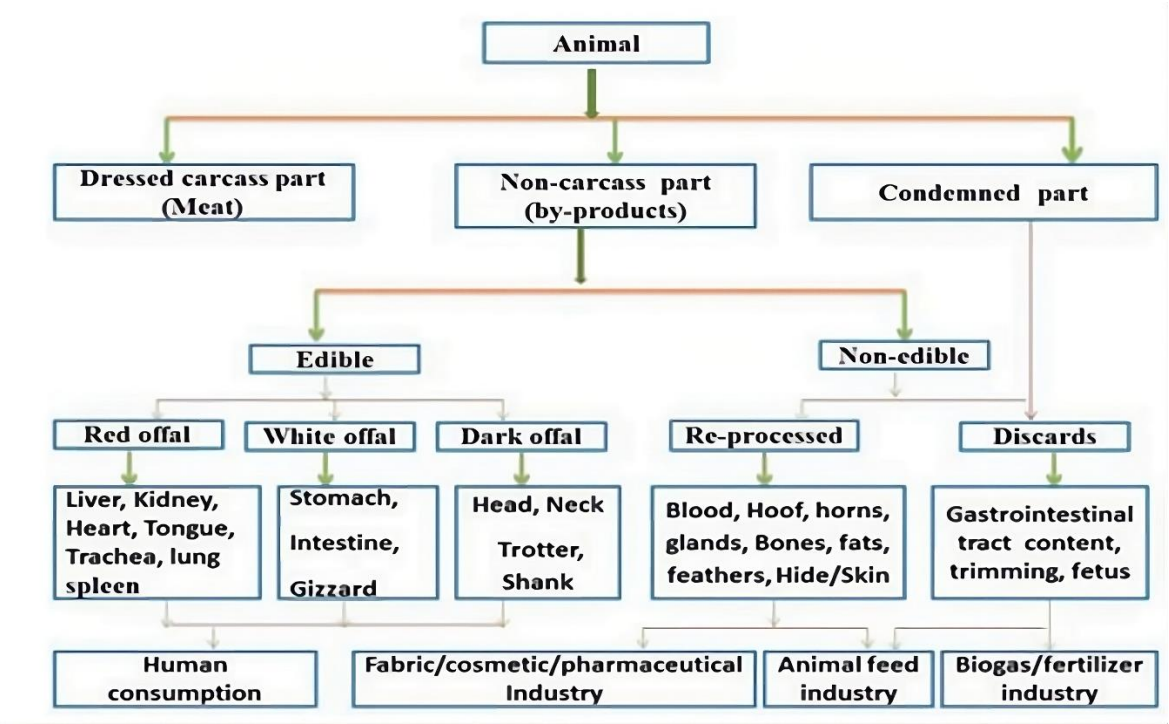
By-products usually include secondary products of livestock slaughter, the yield of which is 10 ... 18% of the animal's live weight. According to GOST R 524282005 (Meat industry products. Classification) by-products are divided into:

- Depending on their nutritional value:

1) by-products of category I (liver, tongue, heart, kidneys, brains, udder, diaphragm, beef and mutton tails, meat trimmings). These by-products have the highest nutritional value and contain a lot of protein (9.0... 17.4%). They also contain fat - from 1.2% (brains) to 13.7% (udders), minerals (salts of phosphorus, iron, calcium, magnesium, potassium, sodium and other elements), and in terms of vitamins, some of them, especially liver and kidneys, even surpass meat. It is no coincidence that the liver and kidneys have not only nutritional, but also therapeutic value. And in terms of energy value, some by-products of this category almost do not differ from meat of slaughtered animals;

2) by-products of the II category (heads without tongues, lungs, kaltyk (throat), scar, rennet, pork stomach, ears, lips, pork and lamb legs, spleen, trachea, beef legs and put joint, pork tail, pical meat (from the esophagus)). They contain few full-fledged proteins, although the total amount of proteins in them is quite large and therefore have low nutritional value. By-products such as ears, lips, legs contain a lot of collagens (up to 12... 18% of the pulp), which gives glue when cooked, therefore they are called gluing and are widely used in the production of jellies, potions and other products.

Table 1



https://www.mdpi.com/2071-1050/9/7/1089

By-products of category I will be a good supplement for elderly people. But one moment, by products may be a bit heavier for their stomach, for this reason, will be better compound by-products with ferments.

Numerous studies indicate that it is possible to prevent many diseases of old age through proper nutrition. The food of older people should be varied, easily digestible, biologically valuable, but less energetically saturated compared to the food of young people. Food must contain a sufficient number of proteins, vitamins and salts, especially calcium, potassium and iron, trace elements, as well as a sufficient amount of liquid.

With age, the need for proteins, fats and carbohydrates decreases, which is associated with a decrease in physical activity and a decrease in the rate of metabolic processes. The optimal ratio of proteins, fats and carbohydrates should be 12-15, 25-30 and 55% of calories (Table 1). At the same time, the need for such minerals as calcium, magnesium, potassium, iron, and vitamins A, B, E, B12 remains quite high.

Vitamins necessary for the absorption of food, cell growth and restoration take an active part in metabolism. Most of them are not synthesized in the body, but come from foods of plant and animal origin. As a result of malnutrition, elderly patients may develop a number of diseases associated with a deficiency of various nutrients

• encephalopathy (Wernicke-Korsakow syndrome - vitamin Bx deficiency);

• xerophthalmia (vitamin A deficiency);

• stomatitis, cheilitis, glossitis (vitamin B6 deficiency);

• gingivitis (vitamin C deficiency);

Health problems

Age-related changes in the body that older people experience:

Skin becomes more sensitive, dry, easily dislodged, quickly damaged, and difficult to heal.

Hair becomes thin, thins, breaks, turns grey.

Posture, joints, cartilage - the total amount of bone tissue decreases, posture changes, cartilage becomes thinner, and pain occurs when moving.

Muscles - muscle tissue contracts, activity decreases, a person is unable to perform basic household activities, begins to get tired after lunch, quits work halfway through.

The gait becomes slow, it is more difficult for people to turn around, they rely on both legs longer during the step, they are unstable, they can fall, which can lead to fractures.

Breathing - the lung tissue is less susceptible to stretching, it becomes difficult to take a big breath, the lungs do not clear as quickly as in a young person, which leads to diseases.

What is the danger of a deficiency of specific vitamins in the body of an elderly person?

Vitamin D. A deficiency of this vitamin worsens the condition of hair and nails, the condition of the skin worsens, apathy sets in, mood worsens, and sweating increases.

Vitamin A (retinol). Vitamin deficiency leads to dry skin, brittle hair, splitting of nail plates, decreased vision, runny nose, and frequent colds.

Vitamin E. Lack of vitamin leads to general weakness, rapid fatigue, and muscle pain.

Vitamin B1. A deficiency of this vitamin negatively affects memory, leads to rapid fatigue, numbness of the limbs, dizziness, and tinnitus.

Vitamin B12. Lack of vitamin leads to loss of sensitivity of the limbs, pale skin, nausea, muscle weakness, and loss of appetite.

Vitamin B6. Inflammation and redness of the skin, skin rashes, sleep disturbance, lethargy.

Vitamin B2. A lack of vitamin leads to loss of appetite, a sharp decrease in body weight, and inflammation of the oral mucosa.

Vitamin C. Lack of ascorbic acid leads to decreased immunity, frequent colds, bleeding gums, and dry skin.

Vitamin K. Vitamin deficiency leads to bleeding gums, nosebleeds, internal bleeding of the gastrointestinal tract, slow healing of wounds and cuts.

Vitamin PP. A lack of nicotinic acid leads to diarrhea, poor appetite, increased fatigue, sleep disturbances, and dermatitis.

Iron, its deficiency in the body leads to weakness, fatigue, pale skin, memory loss, and loss of appetite.

Zinc, a deficiency of this microelement leads to runny nose, nasal congestion, partial loss of taste, loss of smell, dandruff, and various skin rashes.

Calcium, its deficiency in the body can provoke the development of osteoporosis.

Iodine deficiency can cause thyroid disease.

Magnesium. Magnesium deficiency can cause calcium deposits in blood vessels in older people.

Table 2. Nutritional composition of sheep meat and edible by-products.

	Beef	Brain	Heart	Kidneys	Liver	Lung	Gut	Spleen	Tongue
Centesimal Composition (g/100 g), Total Caloric Value—VCT (kcal/100 g) and Cholesterol (mg/100 g)									
Moisture	74.05	78.36–79.2	76.7–77.06	79.23–79.77	69.71–71.37	79.7–80.41	78.81	78.15–79.66	66.6–68.77
Ash	1.15	1.19–1.33	0.93–0.97	1.00–1.26	1.26–1.44	0.97–1.10	0.26	1.17–1.3	0.92–1.06
Proteins	24	10.4–13.05	16.47–8.19	15.74–6.22	20.38–2.26	16.7–16.12	16.76	16.02–17.2	15.7–16.61
Fat	8.1	7.29–8.58	3.66–5.68	2.92–2.95	4.87–5.02	2.41–2.6	4.05	3.05–3.1	13.53–17.17
Total Caloric Value (TCV)	175	118–122	106–122	92–97	134–139	87–95	104	92	187–222
Cholesterol	66	1336–1352	112–135	299–337	371–430	431	113	250–262	156–210
Minerals (mg/100 g)									
Al	Na	0.14	0.03	0.19	0.16	0.48	0.27	0.16	0.28
Ar	Na	0.73	6.04	2.1	1.66	1.85	0.1	0.92	0.34
Ca	5–7	9.0–10.27	6.0–6.79	13.0–14.15	5.92–7.0	7.74–10.0	8.0–14.85	9.0–11.49	8.05–9.0
Cr	Na	0	0.01	0.01	0.03	0.02	0.02	0.01	0.08
Cu	0.120	0.24–0.28	0.29–0.40	0.38–0.45	5.70–6.98	0.25–0.41	0.06	0.12–0.16	0.17–0.21
Fe	1.0–2.2	1.75–1.93	3.07–4.60	6.11–6.38	6.15–7.37	6.40–8.58	0.90–2.30	41.89–53.11	2.46–2.65
Mg	24	12.0–14.08	15.19–17.0	17.0–17.46	17.91–19.0	11.68–14.0	17.81–21.0	17.23–21.0	21.0–24.53
Mn	0.010	0.04	0.03–0.05	0.11–0.69	0.18–0.28	0.02–0.03	0.04–0.16	0.04–0.05	0.03–0.05
Hg	Na	0.02	0.03	0.61	0.16	0.07	0.19	0.04	0.45
Mo	Na	0	0	0.02	0.15	0.01	0	0.04	0
Ni	Na	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.02
P	176–215	270.0–271.0	163.0–175.0	204.0–246.0	334.0–364.0	187.0–219.0	55.61–400.0	266.0–280.0	184.0–207.0
K	333	296.0–312.0	225.0–316.0	198.0–277.0	280.0–313.0	204.0–238.0	42.0–48.75	327.0–358.0	220.0–257.0
Se	Na	34.6	33.3	127	43.38	16.12	13.92	64.53	23.2
Na	72	112.0–122.0	72.62–89.0	156.0–163.0	55.82–70.0	109.0–157.0	18.37–75.0	50.58–84.0	78.0–185.0
Zn	3.83	1.11–1.17	1.31–1.87	1.92–2.24	3.73–4.66	1.58–1.80	1.89–1.93	1.71–2.84	2.32–2.46
Water-soluble vitamins (mg/100 g)									
B1-Thiamin	0.102	0.12	0.15	0.07	0.34	0.17	0.02	0.07	0.35
B2-Riboflavin	0.267	0.21	0.2	0.23	0.3	0.35	0.08	0.23	0.31
B3-Niacin	6.29	2.66	2.78	2.75	5.43	15.66	0.63	5.42	5.51
Pantothenic acid	0.685	1.73	0.35	0.88	1.66	6.95	0.2	6.07	6.22
B6- Pyridoxine	0.15	0.33	0.16	0.02	0.3	0.26	0.22	0.27	0.51
B9- Folic acid	0.023	1.86	2.4	13.89	2.17	206	1.87	3.19	46.21
B12–Cyanocobalamin	0.0026								
Vit. C	1.0								
Fat-soluble vitamins (mg/100 g)									
Vit. A	0.045	0.0015	0.0047	0.067	14,106	0.0024	0.003	0.0066	0.0073
Vit. E	-	0.09	0.15	0.10	0.60	0.08	0.20	0.10	0.07
Vit. D	-								
Vit. K	-	0.0028	0.0097	0.0029	0.0147	0.005	0.011	0.0075	0.0015

(PDF) Valuation of Goat and Sheep By-Products: Challenges and Opportunities for Their Use (researchgate.net)

From this table we can see that best parts of sheep's offal are heart, kidneys, liver, lung, gut, spleen and tongue. Brain cause of contain a high level of cholesterol, not even good for elderly people.

In general, consumption of offal is part of the human diet. Daily consumption (different ways and in different countries) results in a variety of nutritionally appealing foods. Edible organs are highly valued in Southeast Asia and Africa, with low demand in the United States, but fluctuating demand in Australia. For example, heart is often used as a table meat, roasted or sauteed, and can also be used in processed meats. Kidney can be boiled, grilled, stewed, or fried, and liver, the most commonly consumed liver, can be used in sausages and patties. In the United States and Europe, lamb liver is popular for its light flavor and texture. Lamb lungs are used in certain types of sausages and other processed meats. Intestines were first

used as sausage casings, but in some countries, they are also used as food after cooking. The spleen is usually eaten fried or used in the preparation of chorizo.

Sheep by-products, internal organs, organs and blood are characterized by being part of different cultural identities, play a very important role and represent the animal element gastronomic and nutritional heritage, consumed for centuries. Many of these products, called "ethnic meat foods," are unknown to the general public.

They are based on the foods of people in developing countries and have special sensory properties. Nevertheless, they offer high nutritional value and even nutraceutical properties.

``Ethnic cuisine" is unique to a region or community. While some are exotic and rare, they often include meat, internal organs, organs, and blood. Some "ethnic meat products" such as sausages and dried and smoked meats are sold in local markets and contribute to the local economy. The preparation of most 'lamb foods' has unique characteristics and typical organoleptic aspects. These aspects are due to the addition of herbs and spices during preparation, which provide important antimicrobial activity and improve the microbiological quality of the final product.

For example, in Uzbekistan, a dish made from the internal organs of a sheep is called KHASYP. It is a gut stuffed with rice and a finely chopped mix of internal organs. It looks like a long sausage and is served sliced.

It has a soft consistency and is very satisfying, but the cooking process takes a very long time. So, we decided to recreate the same taste, but so that people spend much less time cooking. Khasyp is recommended for people with hypertension as it has a positive effect on lowering blood pressure in older people.

TECHNOLOGY PROCCESS

The technological process includes the preparation of raw materials, freezing, freeze-drying and packaging of dried products.

The quality of products dehydrated by sublimation depends on the initial properties of the raw material, the conditions and mode of its technological processing, storage and recovery conditions (watering). Depending on the nature of the pre- (pre-drying) processing of raw materials, dehydrated products can be eaten immediately after recovery or after culinary processing of the product.

Selection of raw materials and its pretreatment. By-products of all kinds can be sent for drying. The composition of the incoming raw materials determines the nutritional value of the dehydrated product, the drying rate and the nature of the change in properties during storage. Bearing in mind that dehydrated by-products are relatively expensive products, raw materials containing a minimum number of defective proteins should be used for its production. It should also be borne in mind that the presence of dense connective tissue and cartilage makes it difficult to dry the pieces and slows down the process of their rehydration.

The content of adipose tissue in such internal organs should also be minimal. At the final stage of drying, the possibility of melting fat and reducing the pore lumen in this regard is not excluded, as a result of which the drying speed decreases and the amount of water perceived by by-products during rehydration of the dry product decreases. Oxidative changes in lipids during storage of a dehydrated product can significantly

worsen its organoleptic properties and lower its nutritional value. The most suitable raw materials are the offal of young sheep.

The quality of the dehydrated by-products also depends on the level of development of autolytic processes in the raw material. In this regard, by-products should be kept at -2 °C for at least four days before drying. Since sublimation does not destroy microorganisms, the raw materials must certainly be of good sanitary and hygienic quality.

Preparation of offal for drying includes dismemberment of carcasses into parts, deboning and careful venation. Depending on the type of product obtained by dehydration, the offal can then be crushed, salted or subjected to heat treatment. In order to destroy pathogenic microorganisms, it is possible to process offal by boiling for 2 minutes.

During preparation, the skin and subcutaneous fat are removed from the carcasses. If necessary, separate the solid parts. Steamed broth can be added to boiled chopped pieces.

Freezing conditions. The freezing conditions affect both the quality of the dried products and the duration of the drying process. As is known, the smallest changes in properties are observed during rapid freezing. However, rapidly frozen raw organs dehydrate more slowly, which, in all likelihood, is the result of the formation of ice crystals inside fibers and tissues, as a result of which water vapor must overcome the resistance of the sarcolemma. An increase in the drying time leads to deeper changes in organs, which are inevitable during this process. For freezing of raw materials, it is possible to recommend a rate of temperature decrease of 1-2 °C per hour.

To increase the drying speed and uniformity of dehydration of various pieces, it is better to cut frozen organs across the fibers. This should be taken into account when forming blocks before freezing: organs should be placed in a mold so that the muscle fibers are located approximately in the same direction. Frozen blocks are cut into pieces in a room with subzero temperatures with band saws, disc knives or other devices. When the crushed raw material is frozen, it is placed tightly in a mold or syringed into shells. After freezing, the molded crushed raw materials are cut into pieces of a specified thickness. During the laying of the pieces on baking sheets, loading the sublimator and vacuuming the system, the surface temperature of the product should be below zero.

Drying mode. The optimal drying mode should ensure high product quality at maximum process intensity.

During freeze-drying, denaturation changes of protein substances may occur, accompanied by a decrease in their solubility and a decrease in enzymatic activity. As a result of denaturation changes, the water-binding capacity of internal organs decreases. Under harsh drying conditions, due to changes in the content of free functional groups, pH may shift to the acidic side, color change as a result of the transition and development of reactions.

To obtain a dehydrated product of sufficiently high quality, about 80-90% of moisture must be removed at a negative temperature in the central zone of the material. Therefore, the temperature in the depth of the sample during the period of moisture sublimation should be within -10-20°C.

The drying conditions at the stage of removing residual moisture are crucial for the quality of the product: the maximum temperature value and the duration of the product's stay at elevated temperatures. The duration of the final drying period depends on the properties of the product, the dehydration regime and the set level of residual moisture. To prevent the development of a color change reaction during storage of the dried product, the moisture content in it should be 2-5%.

Depending on the nature of the pretreatment and the duration of drying, the permissible temperature of by-products during the removal of residual moisture is in the range of 40-90 °C. During freeze drying with a one-way contact heat supply, the drying time of raw materials, the thickness of which is 12-15 mm, reaches 12-15 hours. In this case, the temperature of the product at the stage of removing residual moisture should not exceed the lower temperature limit. The use of two-way contact and radiation heat supply reduces the drying time by half. This allows you to increase the temperature for raw materials to 50-60 °C, and for boiled to 80-90 °C.

Packaging and storage. Under unfavorable storage conditions, the quality of dehydrated products decreases due to the development of various chemical processes in it. Changes in nitrogenous substances and lipids can lead to a decrease in water binding capacity, deterioration of consistency, changes in its color, taste and smell. The probability of undesirable changes should be taken into account when selecting raw materials and pre-processing them, determining the degree of dehydration, as well as when choosing packaging and storage conditions.

Studies have shown that an increase in the moisture content of up to 8% in raw dehydrated offal leads to a significant change in the state of proteins and a decrease in water-binding capacity already in the first months of product storage. When the storage temperature rises to 40 °C, these changes are clearly detected already in the first month of storage. Since these changes are largely due to exposure to oxygen in the air, it is necessary to protect the product from contact with air during unloading and packaging. Therefore, before unloading, it is recommended to let inert gas into the sublimator, and pack the product in an impermeable container.

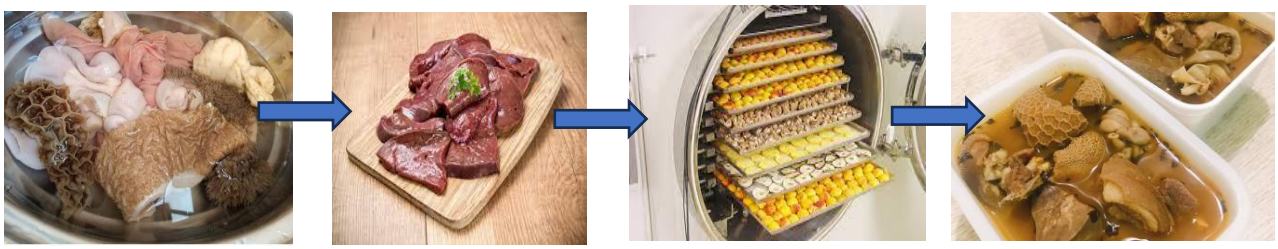
The container must ensure the isolation of the product from oxygen in the air, protect it from moisture sorption, loss of flavor and the penetration of foreign odors. When packing, the products must be protected from the effects of light and mechanical damage. Currently, tin cans and polymer films are used as containers. Sufficiently good tightness is achieved by using combined materials made of aluminum foil and polymer films. The volume of the container is evacuated after filling with the product, after which it is filled with nitrogen and sealed. It is advisable to pack in an airtight chamber filled with nitrogen, into which the product enters from the sublimator without contact with atmospheric air. In the absence of such chambers, nitrogen should be injected directly into the sublimator after drying.

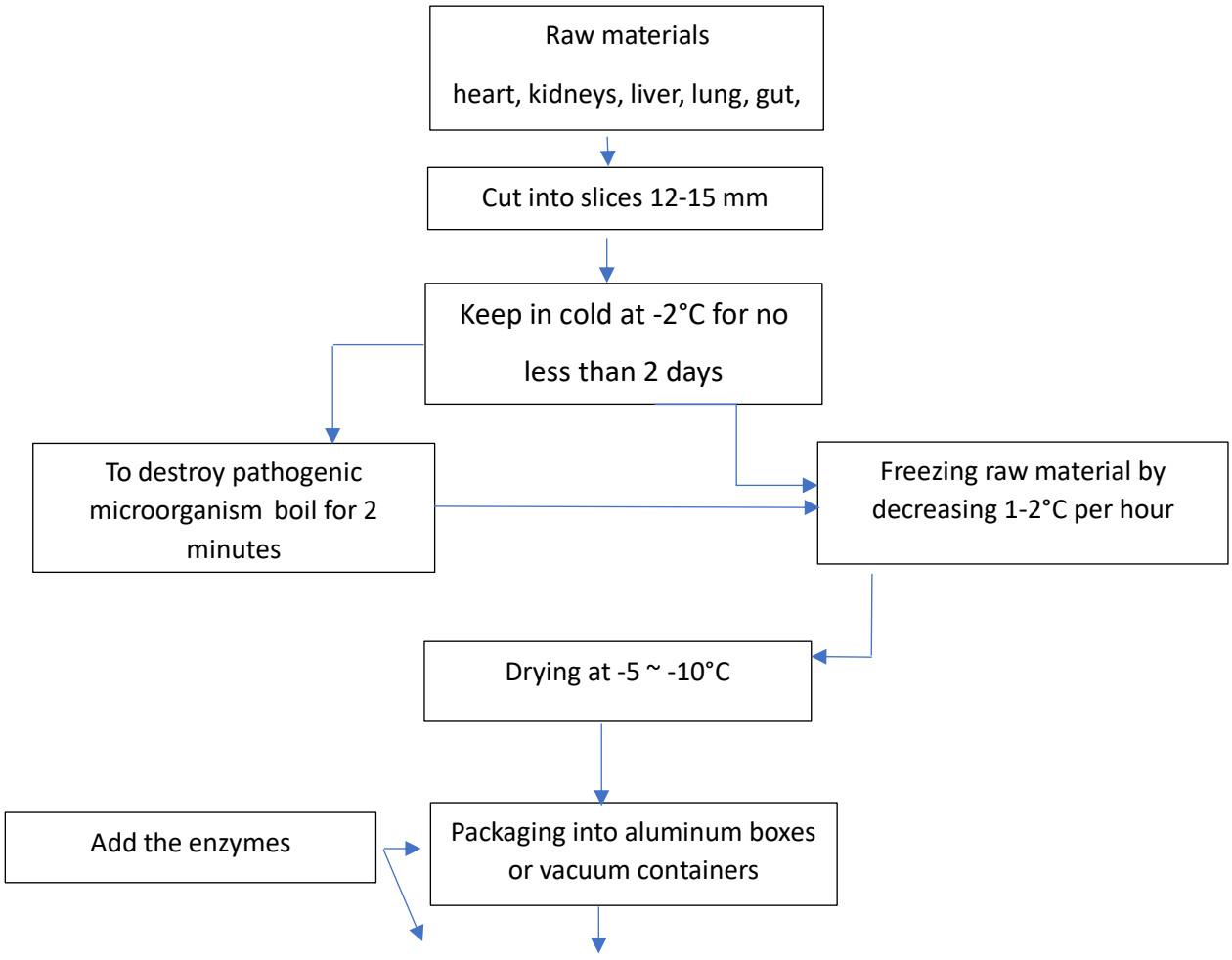
The main causes of undesirable changes in the properties of dehydrated products are oxidative transformations. Due to the high porosity, the contact area of the substances that make up the dry residue with the external environment is large, which enhances the development of oxidative processes. These processes are accompanied by changes in the colloidal properties of proteins, as a result of which the product becomes tougher and less juicy. The oxidation of heme pigments leads to a change in the color of organs. The accumulation of lipid oxidation products adversely affects the taste and smell of the product and reduces its biological value. Some vitamins are also oxidized. The nature and intensity of the development of oxidative processes in dehydrated products depend on their properties, the duration of contact with oxygen in the air and the storage temperature.

The isolation of products from oxygen in the air does not exclude the development of processes in them that are associated with melanoidin reactions. The product loses its natural color, acquires a brown tint, the product's ability to hydrate decreases, its consistency deteriorates, and foreign odors and tastes appear. These changes depend on the nature of the product and the content of reducing sugars in it. The intensity of the reactions increases with an increase in the moisture content of the products being stored, as well as with an increase in the storage temperature. The presence of oxygen in the air, which stimulates the formation of carbonyl compounds, also accelerates the development of melanoidin formation reactions.

Recovery. Before using dried products for food, they are rehydrated (watered). The amount of moisture perceived by by-products during recovery depends on the initial properties of the product, freezing, drying and storage conditions and is approximately 90-95% of the water content in the initial product. The rate and degree of rehydration increase in the presence of electrolytes and substances that shift the pH of the medium. Good results were obtained by watering offal in an aqueous solution of 1-2% sodium chloride containing 0.10-0.15% sodium pyrophosphate or 0.3% sodium bicarbonate. To eliminate the increased rigidity inherent in raw dehydrated by-product, it is advisable to restore it in solutions of proteolytic enzymes. Due to the porous structure of by-products, solutions of these enzymes are rapidly and evenly distributed throughout the volume.

To restore the products, they are immersed in water or solutions of substances that improve organoleptic characteristics and nutritional value. The duration of recovery, depending on the properties of by-products, ranges from 5-10 to 20-30 minutes. When restoring raw materials, the temperature of the liquid in which the recovery takes place should not exceed 40 °C. By-products that have undergone heat treatment before drying can be restored in hot water. When restoring crushed organs, water is added to them based on the calculation of bringing humidity to the initial level.





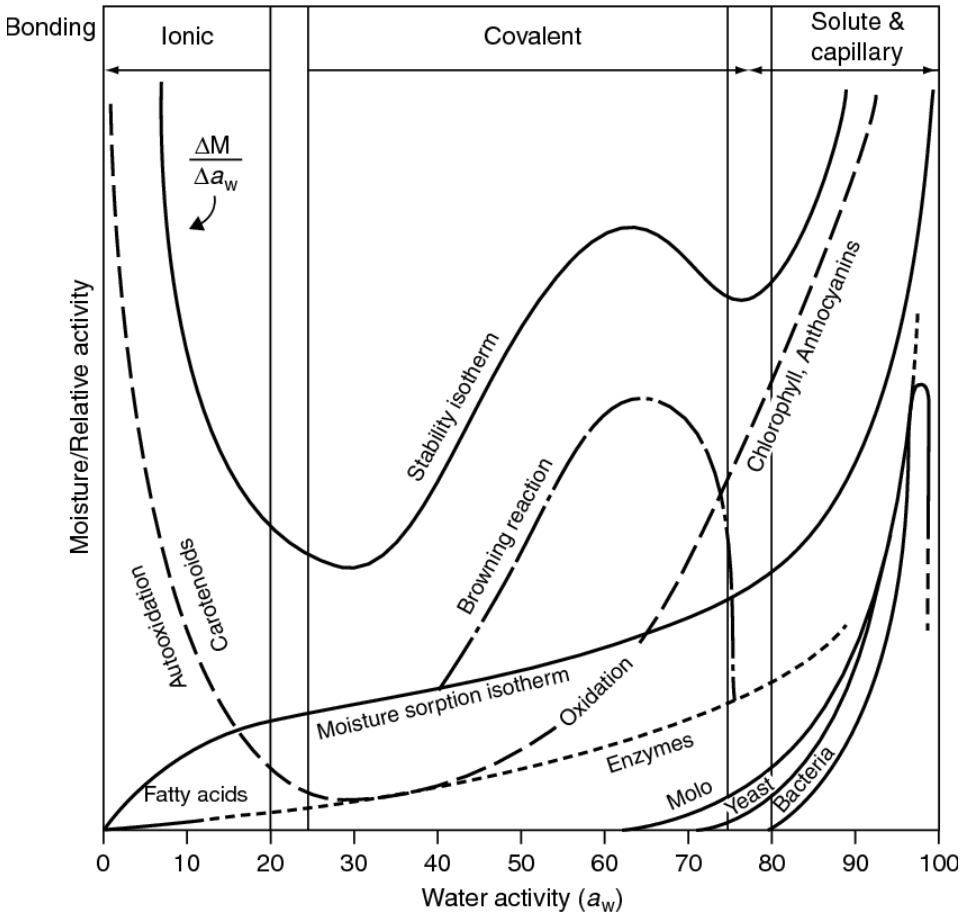
Rehydrating the dried by-products to make instant soup

QUALITY CONTROL AND SAFETY

It is well known that the most important "barrier" for the development of microorganisms, along with the level of water activity, is active acidity (pH). The combination of these two indicators is taken into account when determining the ability of various food products to be stored for a long time by the recommendations of the Food Code.

According to this document, in the range of active acidity and water activity characteristic of meat snacks (pH >4.6–5.0 or >5.0; aw <0.88), these products are not potentially dangerous from the standpoint of microbiological safety and temperature/time control is optional.

The mass fraction of moisture (humidity W, %) can be determined on the MX-50 analyzer (AnD, Japan) according to the standard method at 180 °C, water activity: for products with aw below 0.85 on the HygroPalmAw hygroscopic analyzer (Rotronic, Switzerland), with aw above 0.85 – mainly on the AVK-10 analyzer (SSAU, AVK LLC) according to cryoscopic temperature, active acidity (pH) by potentiometric method using a microprocessor pH meter HI 213 (Hanna Instruments, Germany).



Food stability as a function of water activity. (From Rockland, L. B. and Beuchat, L. R. 1987. In: Introduction, Water Activity: Theory and Applications to Food. Rockland, L. B. and Beuchat, L. R. eds. Marcel Dekker, New York. p. v.)

Acceptable levels of toxic elements (General technical regulations on the safety of meat and meat products, 2018)

Chilled, frozen by-products of slaughter animals (liver, kidneys, tongue, brains, heart), pork skin, edible blood and products of its processing	**Toxic Elements:**	Permissible levels, mg/kg, no more than	
	Plumbum	0,6	
		1	Kidneys
	Arsenic	1	
	Cadmium	0,3	
		1	Kidney
	Mercury	0,1	
		0,2	Kidneys
	Zinc	70	
	Copper	5	

Microbiological indicators (General technical regulations on the safety of meat and meat products, 2018)

Index, product group	**total viable count, CFU/g, max**	**Mass of product (g) not allowed**			**Mould, CFU/g, max**	**Note**
		bacteria of the E. coli group (coli-forms)	**Sulfite-reducing clostridia**	**Pathogenic, including salmonella**		
5. Offal of slaughter animals, chilled, frozen, frozen in blocks, pork skin.	-	-	-	25	-	sample preparation with flambéing of frozen blocks; L.monocytogenes in 25 are not allowed

CONCLUSION

Lamb by-product supplements can have popularity in the next years due to their numerous health benefits. These supplements are made by dehydrating lamb organ meats at low temperatures, which preserves their nutritional content. These Lamb by-products can save time for cooking.

Here are some of the benefits of taking lamb organ meat supplements:

Rich in Nutrients: lamb organ meats, such as liver, heart, and kidney, are packed with essential vitamins and minerals. These include vitamin A, vitamin B12, iron, zinc, and copper, which are necessary for healthy bodily functions.

Supports Immune System: lamb organ meats are rich in antioxidants, which help to boost the immune system. These antioxidants protect the body against free radicals, which can damage cells and lead to chronic diseases.

Improves Digestion: lamb liver is a good source of vitamin B12, which helps to maintain healthy digestion. It also contains choline, which aids in the digestion of fats.

Supports Brain Function: Lamb organ meats are rich in choline, which is essential for brain health. Choline helps to improve cognitive function, memory, and learning.

Boosts Energy: Lamb organ meats are a good source of iron, which is necessary for the production of red blood cells. Red blood cells carry oxygen to the body's cells, which can help to boost energy levels.

Supports Heart Health: Lamb's heart is a good source of CoQ10, which helps to support heart health. CoQ10 is an antioxidant that helps to protect the heart from damage caused by free radicals.

But important thing is control quality and safety during the process.

The most important benefit of the supplements from by-products is lowering blood pressure and normalizing the balance of vitamins necessary for older people.

Our further research will be aimed at quantifying the effect of these products on hypertension.

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