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# ИССЛЕДОВАНИЕ ВЛИЯНИЯ ПРОЦЕССА ДЕГИДРАТАЦИИ НА КАЧЕСТВО И БЕЗОПАСНОСТЬ КОРМОВ ЖИВОТНОГО ПРОИСХОЖДЕНИЯ

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Представлены этапы производства сухих кормов для непродуктивных животных и результаты исследований полученной продукции на соответствие ГОСТам. Изучены показатели качества и безопасности сухих кормов для непродуктивных животных из сырья животного происхождения, подвергнутого процессу дегидратации. Установлено, что процесс сушки с конвекционным принципом действия положительно влияет на показатели пищевой ценности готового продукта. Полученная продукция соответствует ГОСТ Р 54954–2012. Эксперимент проведен в 2021, 2022 гг. В качестве объекта исследования использованы селезенки, полученные от клинически здорового крупного рогатого скота (возраст 18 мес) при убое на мясоперерабатывающих предприятиях Алтайского края. Согласно полученным лабораторным результатам установлено, что в исследуемом виде сырья в процессе дегидратации существенно снизился такой показатель, как массовая доля влаги, он составил 5,5 ± 0,01%. Показатели массовой доли белка и золы после процесса сушки остались практически неизменными: 20,27 ± 0,001 и 0,05 ± 0,01% соответственно. Массовая доля сырого жира в исследуемых образцах составляла 0,4 ± 0,01%, что ниже показателей стандарта на 4,6–8,6%. Проведено исследование полученной продукции на соответствие требованиям, предъявляемым к сухим полнорационным кормам взрослых животных (собак). Проведен сравнительный анализ химического состава образцов сухого корма. В исследуемых образцах отмечено необходимое содержание следующих незаменимых макроэлементов: фосфора, кальция и натрия. Выявлено наибольшее содержание кальция (2,3%). Лабораторными методами в соответствии с утвержденными правилами бактериальных исследований установлены показатели безопасности полученных сухих кормов животного происхождения для непродуктивных животных.

**Ключевые слова:** процесс дегидратации, непродуктивные животные, селезенка, качество кормов

# STUDY OF THE EFFECT OF THE DEHYDRATION PROCESS ON THE QUALITY AND SAFETY OF ANIMAL FEED

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The stages of dry feed production for unproductive animals and the results of the research of the resulting products for compliance with GOSTs are presented. The quality and safety parameters of dry feeds for unproductive animals made of raw materials of animal origin subjected to dehydration process have been studied. It was found that the drying process with the convection principle of action, positively affects the indicators of nutritional value of the finished product. The resulting products comply with GOST R 54954-2012. The experiment was conducted in 2021, 2022. Spleens obtained from clinically healthy cattle (age 18 months) during slaughter at the meat processing enterprises of the Altai Territory were used as an object of the study. According to the laboratory results, it was found that in the studied form of raw materials in the process of dehydration such an indicator as the mass fraction of moisture significantly decreased and amounted to 5.5 ± 0.01%. The indicators of the mass fraction of protein and ash after the drying process, remained virtually unchanged: 20.27 ± 0.001 and 0.05 ± 0.01% respectively. The mass fraction of crude fat in the studied samples was 0.4 ± 0.01%, which is 4.6-8.6% lower than the standard. Study of the resulting products for compliance with the requirements for dry full-fat adult fodder (dogs) was carried out. A

comparative analysis of the chemical composition of dry feed samples was conducted. In the tested samples the required content of the following essential macronutrients: phosphorus, calcium and sodium was observed. The highest calcium content (2.3%) was detected. Laboratory methods in accordance with the approved rules of bacterial studies established safety indicators of dry animal feed for unproductive animals.

**Keywords:** dehydration process, unproductive animals, spleen, feed quality

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## INTRODUCTION

One of the conditions for the effective development of the livestock industry is sustainable feed production [1, 2]. In the modern concept the term " feed" defines a product for feeding animals that does not have a harmful effect on their organism[1]. The modern market of feed for pets, depending on the method of manufacture, is represented by complete and incomplete, dry and wet, dietary, functional and supplementary feed [3]. The most common Russian foods are brand names "Zoogurman" and "Caesar" [4]. According to the experts of the "Zoobusiness in Russia" magazine, the production of feed for non-productive animals such as cats and dogs was 124.8 thousand tons of finished products by the end of 2021[2]. In accordance with the subprogram "Development of animal feed and feed additives production" one of the main objectives is to increase feed production using secondary raw materials from the processing industries of the agro-industrial complex[3].

Analysis of the literature showed that most of the processed by-products of slaughter (blood and its elements, glands and bone) are used in the manufacture of medical and veterinary organotherapeutic drugs, nutrient media, meat and bone meal[4] [5-11]. Some by-products of the first and second categories are used in the production of finished meat products such as sausages, cold cuts, jelly, zeltsy, pates [12]. The spleen is less widely used in the meat processing industry. It is not only an organ of hematopoiesis and immunity protection during animal life, but also a source of fodder protein of animal origin. A number of authors have proved a high rate of digestibility of spleen proteins[5].

The owners' choice in favor of dry feed is obvious: natural composition; content of all nutrients required to meet the needs of the pets' organism; long shelf life. One of the modern technological processes for dewatering of raw materials is dehydration [13-15]. This process has advantages because it maintains the qual-

[1]GOST R 54954-2012 Feed and feed additives for nonproductive animals. Terms and definitions. Moscow: Standartinform, 2020.

[2]Russian pet food production is growing. URL: https://zooinform.ru/ (accessed on: 09.06.2022).

[3]The development of animal feed and fodder additives production: Russian Government Resolution No. 1489 of September 3, 2021. URL: https://base.garant.ru/402789234/ (accessed on: 04.04.2022).

[4]Gorbunova N.V., Rudik F.Ya., Bystrova I.S. Development of the technology of poultry bone processing with obtaining the powder of functional purpose. Innovations in the intensification of production and processing of agricultural products: Proceedings of the International Scientific-Practical Conference, Volgograd, June 17-18, 2015, ed. by Acad. RAS I.F. Gorlov. Volgograd, 2015. pp. 279-282.

[5]Lebedeva L.I., Nasonova V.V., Verevkina M.I. Rational use of low-value by-products in sausage production. Proceedings of the International Scientific and Practical Conference "Innovations in the intensification of production and processing of agricultural products". 2015. pp. 202-224.

ity and nutritional value of the finished product. [16]. Feeds for non-productive animals must meet the requirements of regulatory and technical documentation of the manufacturer. Quality and safety control of raw materials and finished products is of great importance in the production process. Since the processing of low-value raw materials in the conditions of import substitution is growing, the use of slaughter products for obtaining feeds and additives is currently relevant.

The purpose of the study is to investigate the effect of the dehydration process on the quality and safety indicators of dry animal feed.

The research objectives are:

– evaluate the organoleptic and physical-chemical characteristics of raw materials of animal origin for feed production;

– describe the process of feed production;

– conduct laboratory tests of finished feed for non-productive animals;

– analyze the data of the dehydration process and indicators of the obtained dry animal feed.

## MATERIAL AND METHODS

The study was conducted in 2021, 2022. Spleens obtained from clinically healthy cattle (9 heads, age 18 months) at slaughter at meat processing enterprises of the Altai Territory were used as an object of the study. Generally accepted methods of animal feed quality evaluation were used: determination of crude ash content using crucible and desiccator filled with effective water-absorbing substance; determination of mass fraction of crude fat by skimmed residue; determination of moisture content by sample drying at 103 °C in a desiccator. Methods used are: the Kjeldahl method for determining the mass fraction of protein; atomic absorption method for determining calcium in the samples prepared by dry ashing; photometric method for determining phosphorus content with sample mineralization by dry or wet ashing; ionometric method for determining sodium using a glass sodium-selective electrode.

Physico-chemical quality parameters of raw materials were studied in the chemical toxicological department of an accredited testing laboratory "AKVTS" (Barnaul). The content of protein, fat, moisture, ash was carried out using an automatic titrator Titroline 5000/20 M2, electronic scales AS-121S and a drying cabinet ShS-80-01 SPU. At manufacture of forages for preservation of protein and removal of moisture the method of dehydration or drying of raw materials was used. Ready-made dry full-fat animal fodder was examined for compliance with the requirements of GOST[6].

## RESULTS AND DISCUSSION

The main criteria for the quality of raw materials of animal origin are organoleptic and physico-chemical parameters (see Fig. 1).

The organoleptic evaluation of the spleens, selected from clinically healthy cattle, showed: the surface of the material was clean; blood and impurities were removed; the shape of the organ was flat, with rounded edges; the consistency was elastic, grey with a violet tint, without foreign smell; the absolute weight of the organ was 0.724-0.920 kg, length 29-40 cm. The physical and chemical characteristics of the spleen meet the requirements presented in Table 1.

Packaged and labeled spleens obtained at slaughterhouses in the Altai Territory come in separate batches for the production of chilled feed to meat processing plants accompanied by veterinary documents (see Fig. 2).

All sections of the production room are divided into zones by partitions, which exclude the intersection of raw materials and finished products. Prepared and cleaned raw materials with a total weight of up to 150 kg are placed on Teflon nets with an anti-stick effect and sent to the "Dehydration Zone" for drying.

The drying process takes place in the chamber KS-16 with the convection principle of operation at a temperature no higher than 65 ° C for 10-36 hours with constant circulation of air inside the device. At the end of the drying process complete fodder enters the "Packing Zone", where on the table with the help of electronic scales of VET-15-1/2-1S-AB brand further products are weighed into individual dis-

[6]GOST R 55453-2013 Feed for non-productive animals. General technical conditions. Moscow: Standardinform, 2014.

***Рис. 1.*** Селезенка крупного рогатого скота (18 мес)
***Fig. 1.*** Spleen of cattle (18 months)

**Табл. 1.** Физико-химические показатели качества селезенок крупного рогатого скота, %
**Table 1.** Physical and chemical indicators of the quality of spleens of cattle, %

| Mass fraction | Test results | Error (uncertainty) |
|---|---|---|
| Moisture | 66,5 | 6,7 |
| Protein | 23,59 | 1,89 |
| Fat | 0,9 | 0,2 |
| Ash | 0,14 | 0,04 |

posable packaging, sealing bags with the help of manual pulse table sealer FS-400 ABS. Then the dry fodder is labeled and sent to the warehouse for storage of finished products in clean dry, well-ventilated conditions at a temperature of 25 ° C and relative humidity of no more than 80% for up to 7 months. Samples taken from the batch from the manufacturer's warehouse are sent to the testing laboratory.

According to the laboratory results, it was found that in the studied form of raw materials in the process of dehydration such an indicator

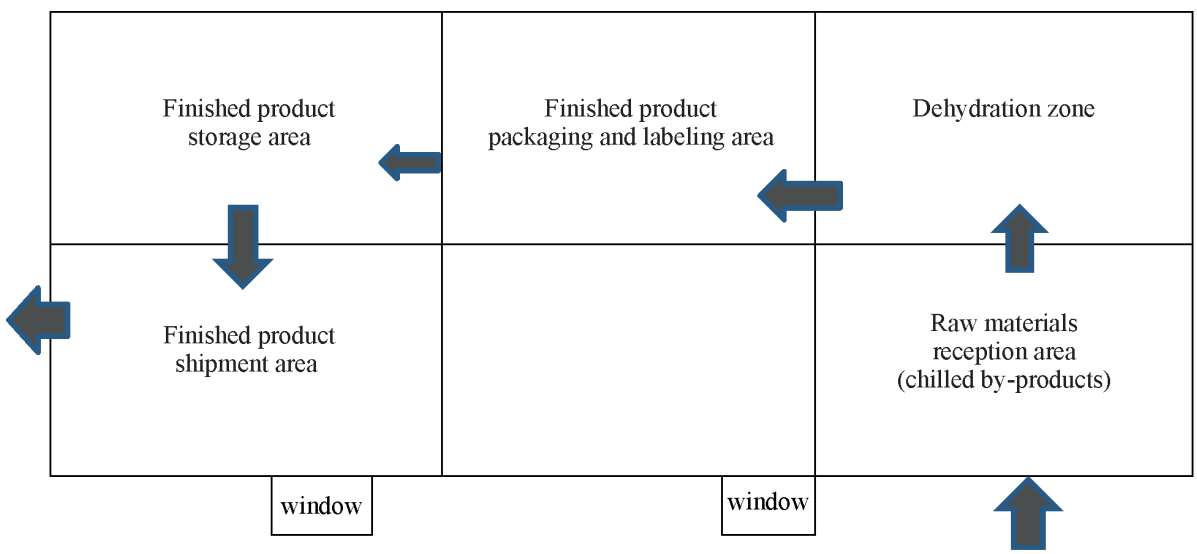
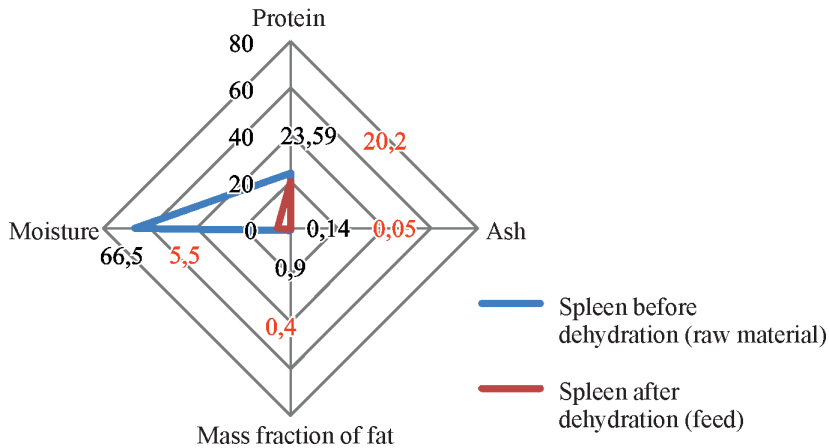



***Рис. 2.*** План цеха по изготовлению сухих кормов животного происхождения для непродуктивных животных
***Fig. 2.*** Plan of the workshop for the production of dry animal feed for unproductive animals

as the mass fraction of moisture (5.5 ± 0.01%) significantly decreased (see Fig. 3).

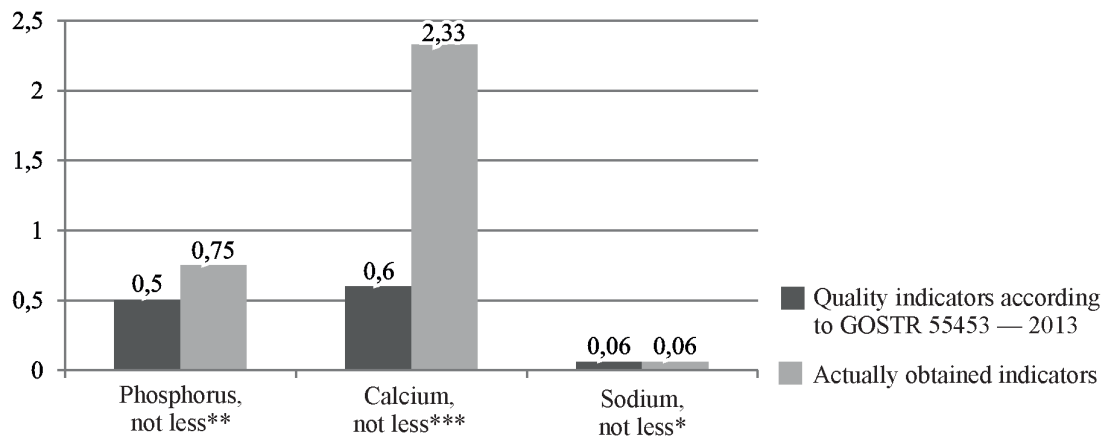
Such indicators as the mass fraction of protein and ash remained practically unchanged after the drying process: 20.27 ± 0.001% and 0.05 ± 0.01%, respectively. The mass fraction of crude fat in the studied samples was 0.4 ± 0.01%, which was 4.6-8.6% lower than the standard. Therefore, the fodder with inadequate indices refers to incomplete dry food for maintenance of adult animals (dogs). The mineral indices of forages were also examined for compliance with the requirements of normative and technical documentation of the manufacturer (see Fig. 4).

A comparative analysis of the chemical composition of dry feed samples was carried out. It was noted that the samples under study contain such essential macronutrients as phosphorus, calcium and sodium. The high content of calcium (2,3 ± 0,001%) was detected. According to the approved rules of bacterial examination of fodders[7] safety indicators of dry fodders of animal origin for nonproductive animals were established by laboratory methods (see Table 2).




***Puc. 3.*** Показатели качества селезенки до и после процесса дегидратации

***Fig. 3.*** Spleen quality indicators before and after the dehydration process




*$p \leq 0.05$.
**$p \leq 0.01$.
***$p \leq 0.001$.

***Puc. 4.*** Показатели качества сухих полнорационных кормов животного происхождения для непродуктивных животных

***Fig. 4.*** Quality indicators of dry complete feed of animal origin for unproductive animals

[7]Rules of bacterial examination of fodder. Chief Veterinary Administration of the Ministry of Agriculture of the USSR. Moscow: Kolos, 1976.

**Табл. 2.** Показатели безопасности сухих кормов животного происхождения для непродуктивных животных

**Table 2.** Safety indicators of dry animal feed for unproductive animals

| № п/п | Indicator | Unit of measure | Test results | Error (uncertainty) | Standard | RD for the test method |
|---|---|---|---|---|---|---|
| | | | *Mycotoxins* | | | |
| 1 | Aflotoxin B1 | mg/kg | Less than 0,001 | – | No more than 0,010 | MF for the determination of aflotoxin B1 dated 26.07.1972 |
| | | | *Pesticides* | | | |
| 2 | Pesticides | mg/kg | DDT and its metabolites less than 0.02; HCCH (ß isomer) less than 0.014 (a-,ß isomers) less than 0.02 | – | DDT and its metabolites no more than 0.05; HCCH (isomers) no more than 0.2 | GOST 13496.20–2014 |
| | | | *Microbiological indicators* | | | |
| 3 | Enteropathogenic E. coli types | – | Not detected | – | Not acceptable | Rules for bacterial examination of fodder, approved by the Main Directorate of the Ministry of Agriculture of the USSR dated 10.06.1975 |
| 4 | Salmonella | | Not detected | – | Not acceptable | Rules for bacterial examination of fodder, approved by the Main Directorate of the Ministry of Agriculture of the USSR dated 10.06.1975 |
| | | | *Nitrites and nitrates* | | | |
| 5 | Nitrites | mg/kg | Less than 0.01 | – | No more than 10,0 | GOST 13496.19–2015 |
| 6 | Nitrates | mg/kg | 25 | ± 6 | 250 | GOST 13496.19–2015 |
| | | | *Radionuclides* | | | |
| 7 | Strontium 90 | mg/kg | Less than 3,7 | – | 100 | IFC No. 40152.4Д362/01.00294–2010 |
| 8 | Cesium 137 | Bq/kg | Less than 7,1 | – | 600 | GOST P54040–2010 |
| | | | *Safety Indicators* | | | |
| 9 | Total Toxicity | – | Nontoxic | – | Not acceptable | GOST 31674–2012 |
| | | | *Toxic elements* | | | |
| 10 | Cadmium | mg/kg | Less than 0,1 | – | No more than 1,0 | GOST 30692–2000 |
| 11 | Arsenic | mg/kg | 0,10 | ± 0,02 | No more than 2,0 | GOST 26930–86 |
| 12 | Mercury | mg/kg | Less than 0,0015 | – | No more than 0,4 | GOST 26927–86 |
| 13 | Lead | mg/kg | Less than 0,1 | – | No more than 5,0 | GOST 30692–2000 |

Analysis of the tabulated data shows that the feeds meet the standards, which makes it possible to further sell them freely.

## CONCLUSIONS

1. The method of raw material dehydration has a positive effect on the preservation of the useful properties of the product. The content of protein of animal origin is 20,27 ± 0,001%, which indicates a high nutritive value of the finished feed. It is determined that the composition of the feed contains the following macronutrients: calcium, phosphorus, sodium. The highest indicator was noted for calcium content (2,3 ± 0,001%).

2. In the process of dehydration of meat raw materials there is a release of moisture, which increases the shelf life of finished feed up to 7 months. The residual moisture content is 5.5 ± 0.01%, which is 60.5% lower than the same indicator of the studied raw materials.

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