UDK [636.7/.8.085.55:66.083]:636.087.7
DOI: https://doi.org

O. Voietska, PhD Technical Sciences, Associate Professor, E-mail: vecombi@gmail.com
T. Bordun, PhD Technical Sciences, Associate Professor, E-mail: bordun.tatjana@gmail.com
O. Tsiundyk, PhD, Senior Lecturer, E-mail: malik2008ts@gmail.com
Department of Feed and Biofuel Technologies,
Odessa National Academy of Food Technologies, 112, Kanatna Str., Odessa, 65039, Ukraine

PRACTICAL FOUNDATIONS OF THE PRODUCTION OF PET FOOD

Abstract

The article presents data on the population of dogs and cats in European countries for 2018, countries with a high number of animals per capita. On the basis of the conducted scientific research, the composition of compound pet food, the needs of domestic animals for nutrient and biologically active substances, their content in recipes and the calculation of compound feed recipes are analyzed. The features of technological processes for the production of extruded pet food are determined and their characteristics are given. A technology has been developed for the production of dry pet food, which makes it possible in private enterprises to ensure the production of domestic competitive in the market complete pet food, depending on their breed, age, and physiological condition.

A line for the production of dry compound feeds for dogs with a productivity of 1...3 t/h with the possibility of producing up to 20 tons of finished compound feed per month has been developed. To organize production, a production manufacture, a raw material warehouse, a finished product warehouse, a utility room, and the ability to drive vehicles into the raw materials storage and unload them are necessary. To service the feed production line, two specialists are needed - a technologist and an operator for servicing the extruder and expander, as well as a worker who is responsible for the preparation of components and packaging of finished products. To implement the project, technological equipment is needed: a hammer mill, air conditioning, extruder, hopper scales, mixer, expander, dryer, cooler, device for spraying on the surface of the liquid components. The main stages of production include intake, unloading and refining of raw materials; grinding grain components in the same fraction; extruding and cooling grain components; grinding extruded grain components; weighting of feed components; mixing the components to a homogeneous mixture; conditioning; expansion of bulk feed; drying; size control of finished products; spraying on the surface of the liquid components; cooling; feed packaging.

Key words: *pet food, extrusion, expansion, technology of pet food production.*

Introduction

The global pet care market reached U.S.$125 billion in 2018 and 73 percent of that total, about U.S.$91.1 billion, was global pet food sales. Those figures represent a 6 percent compound annual growth rate (CAGR) since 2013 and 31% overall growth during the same period.

Dry dog food is the dominant pet food segment worldwide in terms of formats, recording value sales of nearly U.S.$35 billion in 2018, according to Euromonitor's data. Though the segment has experienced healthy growth since 2013 of about 5 percent CAGR, growth was stronger for dog treats (almost 6 percent CAGR), dry cat food (5.5 percent) and, especially, cat treats, the highest growth segment at 9 percent CAGR.

Global cat treat sales are relatively low, only about U.S.$2 billion in 2018, but their growth is even more robust in some regions such as Asia-Pacific, which saw a rise of 23 percent CAGR from 2013-2018. In that region particularly, the cat treat segment includes newer formats, such as seafood "sticks" and creamy purees [1, 2].

In their latest report, the European Pet Food Federation (FEDIAF) estimated the number of dogs in cats in Europe in 2018. FEDIAF estimated that at least 80 million European households include at least one pet animal. In the European Union countries, 26 percent of households owned dogs, compared to 24 percent in Europe as a whole.

In 2018, FEDIA estimated that annual sales of pet food in Europe reached a turnover of EUR 20.5 billion and a volume of 8.5 million tons. The pet food industry grew 2 percent per year over the last three years. In addition, the federation counted 132 companies producing pet food in Europe in 2018, which operated 200 production facilities [3].

The European Pet Food Federation (FEDIAF) estimated the number of cats in Europe in 2018, along with other data on EU member and other European pet food markets, in the latest edition of the report "FEDIAF Facts & Figures." Compared to 2017, cat ownership increased slightly compared to dogs (fig. 1). Russia, Germany and France held the largest numbers of cats owners overall (fig. 2) [4].

Some of the countries with the highest cat populations ranked lower in per capita cat population. The top countries for cat ownership purr capita in 2018 were Romania, Hungary and France.

Russia provided a home to the most dogs overall in 2018, while Romania had the highest per capita dog density. Those dog demographics are similar to the cat population in Europe. Russia, Germany and the United Kingdom held the largest numbers of dogs overall (fig. 3). Some of the countries with the highest dog populations ranked

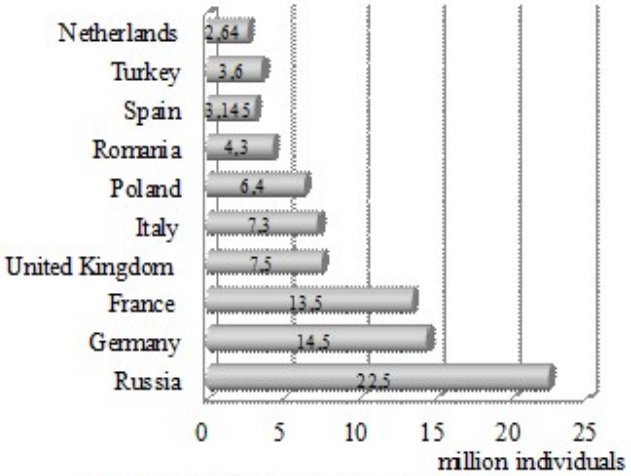

Fig. 1 -Top 10 cat-owning nations in Europe in 2018

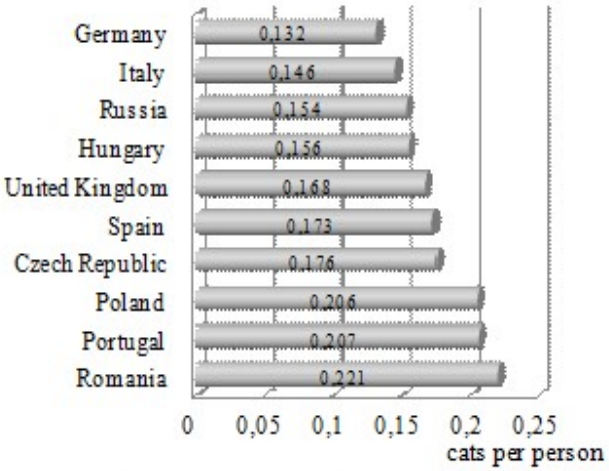

Fig. 2 - Top 10 cats per capita in Europe in 2018

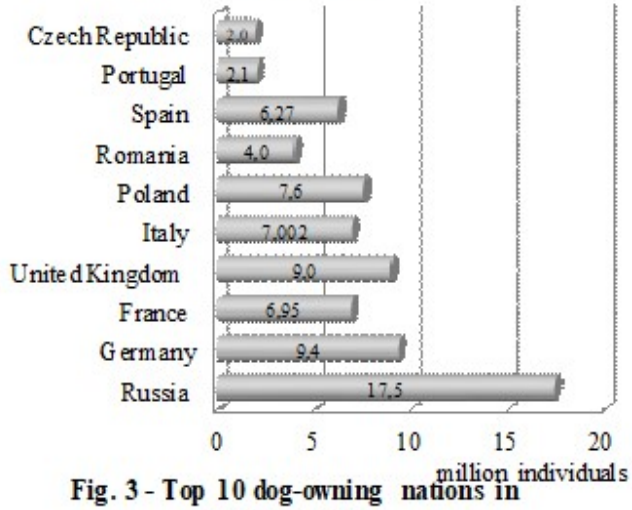

Fig. 3 - Top 10 dog-owning nations in Europe in 2018

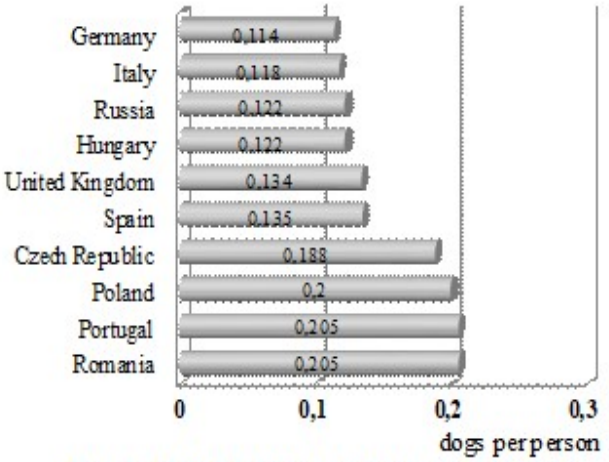

Fig. 4 - Top 10 dogs per capita in Europ in 2018

lower in per capita dog population. The top countries for dog ownership per capita in 2018 were Romania, Portugal and Poland (fig. 4) [5].

Purpose and objectives of the analysis

The purpose of the research was the theoretical justification and development of a line for the production of dry compound feeds for dogs.

Analysis of the literature data

Feed production begins with the calculation of feed recipes. For the calculation, it is necessary to know the species of animals, its physiological state, the need for nutrients and biologically active substances, the requirements of standards, restrictions on the introduction of components, the chemical composition of the components, the availability and amount of raw materials at the enterprise. For the calculation of recipes people use special programs which optimize the composition of recipes with the lowest cost to ensure maximum quality [6, 7].

The nutrient content of compound feed recipes for cats and dogs is different. The analysis of dry compound feeds (Table 1) showed that in 100 g of compound pet food of metabolic energy ranges from 1250...2000 kJ, crude protein – 20...42 %, crude fat – 5...24 %, crude fibre – 2...5 % [8–12].

The nutritional value of feed depends on the species, breed, age and physiological condition of the animals. So, for example, in compound feeds for puppies, as the rule, the content of proteins and fats is higher than in compound feeds for adult animals. Also in these compound feeds there is a high content of minerals and vitamins: vitamin A – 15000 IU per 1 kg of compound feed, vitamin D3 – 1200 IU, vitamin E – 120 mg per 1 kg of compound feed. The gross energy of compound feed for puppies is 1630...1797 kJ per 100 g of compound feed [8, 13].

The crude protein content in compound feeds for adult dogs ranges from 25...27 %, crude fat content is 10...16 %, and minerals content is 6...6.5 %. The gross energy of 1 kg of feed is 16302...17556 kJ.

In aging dogs, the metabolism in the body slows down, the tone, motor activity decreases and the musculoskeletal system weakens, diseases of the internal organs arise. Therefore, in compound feeds for aging dogs, as a rule, an increased content of vitamins C and E is observed to slow down the aging process. Such compound feeds have a low phosphorus content to prevent kidney disease and an increased digestibility. The risk of kidney disease is reduced if the protein content in the diet is reduced [8, 11, 14].

Table 1 - The nutrient content of the pet food

Animal species	Gross energy, kJ/100 g	Content, %		
		Crude protein	Crude fat	Crude fibre
Mixed feeds for dogs				
Adults dogs	1450...1750	20...27	12...19	2...5
Puppies dogs	1500...1850	26...36	14...24	2...5
Aging dogs	1250...1750	17...27	5...16	2...4
Active dogs	1550...2000	27...32	20...29	2...4
Mixed feeds for cats				
Adults cats	1600...1800	25...32	10...20	2...5
Puppies cats	1750...1900	35...42	17...22	2...5
Aging cats	1450...1700	20...35	15...18	2...5
Active cats	1750...2000	35...42	17...22	2...5

In compound feeds for active dogs, the content of proteins and fats is 10 % higher than usual. The calorific value of such compound feeds is 18000...20500 kJ per 1 kg of compound (mixed) feed [8, 15].

For overweight dogs, compound feeds with a reduced content of fats and proteins are made. But, so that the dog does not feel hungry, such feeds contain a large amount of fiber, which, getting into the stomach swells and creates a feeling of the satiety. The content of vitamins and minerals is the same as in mixed feeds for adult animals [15].

Compound feeds for cats and dogs vary in nutritional value. Therefore, it is not recommended to feed cats with dog feed and vice versa. The protein and fat content of a cat's diet should be significantly higher than that of a dog. High fat content not only improves the palatability of the feed. Young cats that get enough fats grow and develop much better than those that lack these fats. Cats, unlike dogs, have a great need for vitamin A. Moreover, they need it not in the form of provitamin, which is found in green vegetables and fruits, from which vitamin A is then formed, but in a ready-made synthesized form [16].

In a young cat that grows, the need for crude protein is 34...40 % of the total dry weight of animal feeds. In an adult cat, for proper metabolism, proteins should be about 24 %. This amount is necessary to cover the needs for protein in feeds. For cats, the need for protein in feed is 2...4 times higher than for dogs of the same age [8, 16, 17].

Cats are sensitive to a lack of taurine amino acid. The need for taurine cannot be fully satisfied through the synthesis of amino acids containing sulfur and come only with feed. Therefore, cats should be given feed containing mainly animal protein, since taurine is not found in plant components. According to scientists, the minimum level of taurine should be 1000 mg per 1 kg of dry feed, or 0.1 %, and 2 times more for wet feed, that is, 0.2 % [8, 17].

Cats are characterized by a high demand for B vitamins. Compared to dogs, cats have a 2 times more needs for B vitamins. The need for mineral salts in cats is lower than in dogs. It is necessary to ensure the exact ratio of calcium and phosphorus to vitamin D. Calcium and phosphorus cats should receive in a ratio of 1:1. The skeleton of an aging animal does not grow and does not develop, as in young ones. Therefore, for aging animals it is not recommended to change the content of phosphorus and calcium, and leave it at the same level as for young animals, about 0.6...0.7% per dry substance [8, 17].

In the technology of production of pet food the following technological processes are used: cleaning, grinding, weighting, mixing, extrusion, conditioning, expansion, drying, adding of fat and application of liquid components to the surface of the finished compound feed, cooling and packaging.

The cleaning process.

The feed components are cleaned of impurities that worsen the processing conditions. This operation is mandatory, as it prevents the ingress of various types of impurities into the feed. For cleaning grain raw materials from non-feed waste, light impurities, sieve-air separators are used. Sieve separators are used to clean sunflower meals, meat and bone meals, fish meals etc. Metallomagnetic impurities are isolated by the magnetic separators based on differences in the magnetic susceptibility of components and impurities [18, 19].

The grinding process.

In the production of compound feeds for domestic animals, the grain components included in their composition are mainly grinded. When grinding, the total surface area the feed particles increases, which contributes to better absorption. In addition, the grain shell is destroyed in cereal crops, which inhibits the action of enzymes on other parts of the grain. Therefore, the digestibility of feed is in direct proportion to the particle size of the components that make up its composition. Grinding all types of raw materials to the same particle size contributes to their better mixing and prevents self-sorting during transportation. The grain raw materials are crushed on hammer mills, in which a sieve with holes ø 3...4 mm is installed, which reduces the yield of powdery fraction and improves the efficiency of extrusion [18, 19, 22].

The extruding process.

Due to the physiology and structure of the gastrointestinal tract, pets do not digest starch well. Extruding is used to increase the digestibility of starch of grain components. During the extrusion process, significant

changes occur in the qualitative and quantitative characteristics of the nutrients included in the biochemical complex of grain and animal feed, the digestibility of protein and starch increases, and the palatability of the feed and its sanitary condition improve [20–22].

Twin screw extruders have the processing advantage over single screws for high-meat pet food extrusion due to the improved mixing and kneading capabilities within twin screw design. Processing high meat levels requires a reduction in throughput rate relative to classic dry food. The challenge for the extruder manufacturer is to develop methods that allow the higher throughput rates needed to process the high-meat slurries within the extruder, while still maintaining overall physical size [23, 24]

The weighing and mixing processes.

Weighing and mixing processes mainly determine the quality of the finished product, its cost and the competitiveness in the market. As a result of weighing-mixing, a homogeneous mixture of doses according to the recipe of the components is obtained. The quality and intensity of the mixing process mainly depends on the physic-mechanical characteristics of the components of the mixture. Therefore, the mixing process must be organized in such a way as to ensure the highest homogeneity of the mixture with a minimum duration of the process with minimal energy consumption [25–27].

The conditioning process.

The purpose of the process is to moisten and heat bulk feed with hot dry steam at a pressure of 0.2...0.5 MPa and a temperature of 110...130°C, under which the feed is softened, warmed up to a temperature of 65...75°C, it becomes more viscous. This creates the best conditions for extrusion-expansion processes. The pre-conditioning process ensures the humidification of the feed, allows the introduction of an increased amount of liquid components in the feed, increases the sanitary quality of the feed, reduces the load on the extruder-expander and the energy costs of the process, wear of the working bodies of the extruders and expanders, reduces the duration and increases the productivity of the processes. Mixed feed conditioners are installed before of the extruders and the expander in the line [22].

The expanding.

It is used to process bulk feed in order to obtain the final product of a certain shape, which depends on the installed matrix. This allows you to receive feed in the form of: pellets, tablets, balls, seeds, pads, squares, hearts, etc. The principle of the expander and its main structure are similar to an extruder. The difference lies in the fact that the product is pressed out not through the die matrix, but through the annular gap, the size of which is regulated using a special hydraulic system. Steam is supplied to the expander casing, additionally provides heating of the product. Because to such changes, the specific energy consumption for expansion is reduced by 2.0...2.5 times, compared with extrusion, and amounts to 25...60 kWh per 1 ton of raw material. An additional advantage of the expander is the ability to introduce up to 20 % fat into the composition of the expandate, while during extrusion the introduction of fat cannot be higher than 5 %, since the extrudated pellets become brittle [22].

The drying.

Diets containing large amounts of fresh meat are particularly difficult to dry. The meat contains significant moisture, resulting in a significant risk of deformation because of the soft texture of the extruded pellets or kibbles. The undenatured and functional proteins in the meat tend to retain moisture, requiring long drying times.

Pellets are spongy, soft and have a high moisture content on leaving the extruder. While being conveyed, they are easily deformed. Some 2…3 % of the moisture content is lost by evaporative cooling while they are still hot. However, about 10…15 % of the moisture still needs to be removed by a dryer.

Using a predryer with a shallow bed to reduce the moisture in the product helps to prevent this problem. The shallowness of the layer means that the possibility of deformation or clumping from the weight of the top pellets is minimised. However, a large, relatively costly is needed to ensure a consistently shallow depth throughout predrying.

There are two kinds of dryers commonly used in pet food processing. The first is the horizontal fluidized bed dryer. This is a long, oblong unit consisting of a slow, perforated conveyor belt with a swing-feeder inlet on one side and an exit on the other. These machines may be single pass, in which case the product moves through the machine only once, or multiple pass, meaning that the product moves through and drops to a second level, moving back the same way and then exiting.

Vertical bed dryers have several decks or layers. The product enters at the top level and then drops from one level to another. All or some of the product can be discharged to a lower level of the dryer in a controlled way, so that the drying profile can be varied. This permits considerable flexibility, so that a differentiated product line can be produced.

Both vertical and horizontal dryers can be divided into zones with different temperatures. Horizontal drying technology is sometimes said to be less energy-efficient than vertical dryers. However, drying uniformity is generally better maintained by horizontal dryers. Initial drying zones often warm the product at 80…100 °C, with subsequent primary drying taking place at 120…150 °C. The final zones are again often maintained at 80…100 °C [28].

The adding of the fat to the compound feed.

The adding of fats in the composition of compound feeds allows the increase the level of energy; it improves taste and leads to the saving of grain and protein types of ingredients. When extruding, you can add from 3 to 5 % fat. The adding of more fat degrades the quality of the granules, makes them brittle and reduces the performance of the press equipment. Fat is metered into the feeder of an extruder or expander. A fat can be applied to the surface of extrudated feeds by equipment specially designed for this purpose. The fat is sprayed onto the product with the help of nozzles, while its absorption by the porous surface of the product occurs. The amount of fat that can be introduced in this way depends

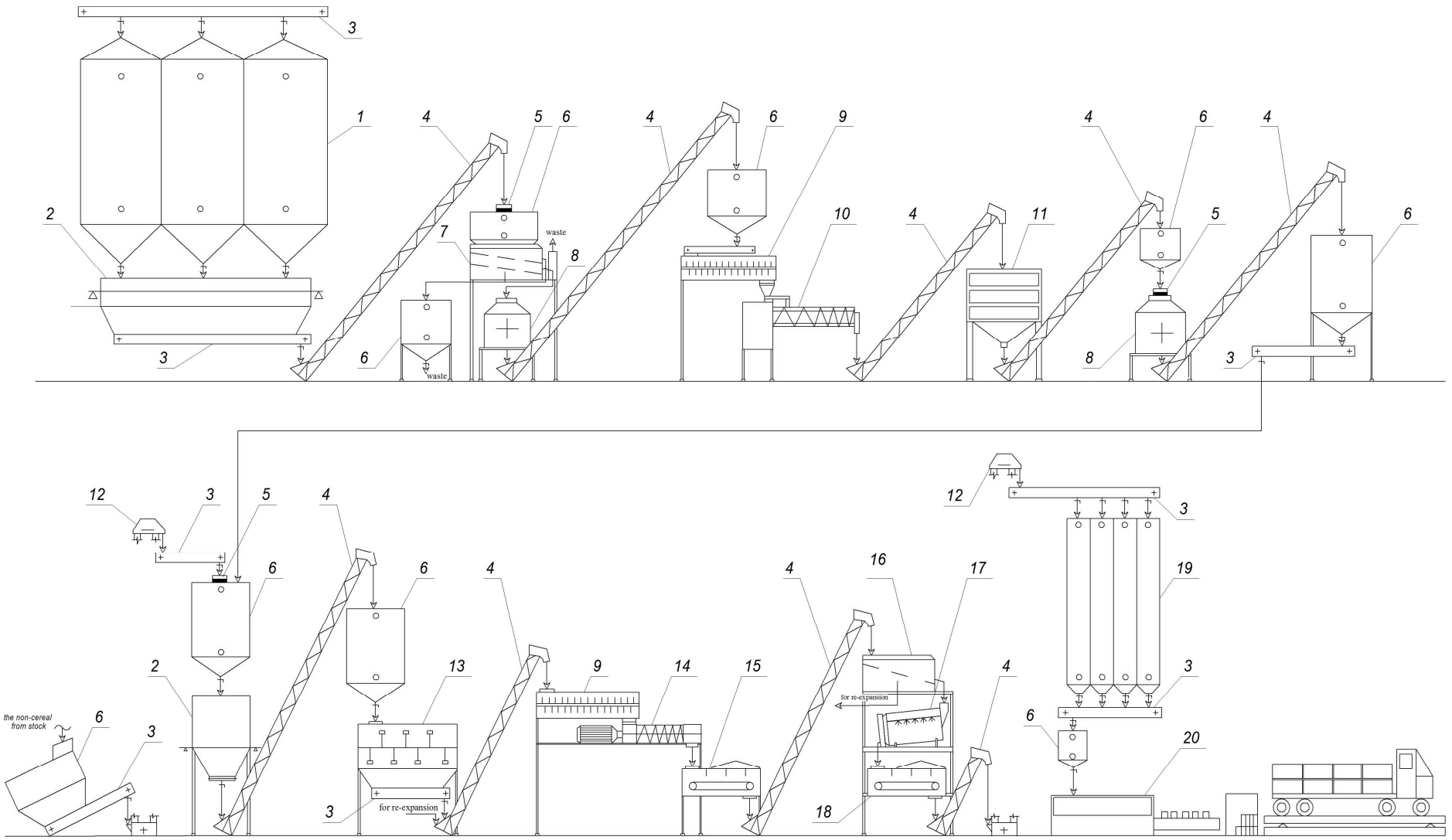

Fig. 5 – Line for the production of dry compound feeds for dogs:

1 – bunker storage, 2 – scales bunker, 3 – screw conveyor, 4 – belt conveyor, 5 – magnetic separator, 6 – operational bunker, 7 – air separator, 8 – grain grinder (mill), 9 – conditioner, 10 – extruder, 11 – vertical cooler, 12 – bucket elevator, 13 – mixer, 14 – expander, 15 – horizontal dryer, 16 – separator, 17 – application of liquid components, 18 – horizontal cooler, 19 – stock of products, 20 – packaging machine

on the total surface area of the pellets. The smaller is their diameter, the greater the adsorption capacity of the granules is. This method allows you to apply on the surface of the granules up to 3...20 % fat [29, 30].

The cooling process.

One of the critical processing steps in the production of extruded, dry pet food is cooling. The cooling step is required after the drying and liquid-coating processes to remove excess heat. If enough heat is not removed, condensation can occur in the product storage bins or in the product package.

For cooling, vertical shaft or counterflow coolers are used, much less often horizontal belt types are used. The general design of a horizontal cooler consists of a perforated conveyor on which the pet food is uniformly distributed up to depths of 4 to 12 inches. The conveyor is sized with sufficient length and width to provide ample retention time to cool the product. Ambient or chilled air is pulled through the product bed with a centrifugal fan to remove the heat. The temperature of the pellets after cooling should not exceed the ambient temperature by more than 10 °C, and the humidity should not be higher than 14.5 %. When cooling, it is important to ensure the air flow rate in the range of 0.4...0.5 m/s at an air flow rate of 1500 m^3/t. The duration of cooling depends on the size of the pellets and is 300...900 s. An increase in the air flow rate accelerates the cooling process of the pellets, however, the surface layer of the pellets hardens, which slows down the diffusion of moisture from the center to the outer surface. This contributes to moisture condensation, leads to the appearance of microcracks on the surface of the granules and increases their fragility. Such pellets during storage quickly mold [31].

Results and its discussion

At the Department of Mixed Feeds and Biofuel Technologies of the Odessa National Academy of Food Technologies, by order of entrepreneurs, a technology and a project for the production of dry compound feeds for dogs have been developed. The productivity of the manufactory is 1...3 t/h. The production of up to 20 tons of finished feeds per month is possible. To organize production, you need a production manufactory, a warehouse of raw materials, a warehouse of finished products, and a storeroom. It is also necessary to ensure the possibility of vehicles accessing the raw materials and unloading them, as well as provide packaging and shipment of finished products.

To service the feed production line, two workers are needed – a technologist and an operator for servicing the extruder and expander, as well as a worker who is responsible for the preparation of components and packaging of finished products. For the production, equipment of domestic and foreign manufacturers is used. The main equipment necessary for the implementation of the project: hammer mill, feed conditioner, extruder, hopper scales, mixer, expander, dryer, cooler, device for spraying on the surface of the liquid components.

The production process consists of the following steps (fig. 5):

– intake, unloading and cleaning of raw materials;
– grinding of the grain components to the same fraction;
– extrusion and cooling of grain components;
– grinding of the extruded grain components;
– weighting of feed components;
– mixing of the components to a homogeneous mixture;
– conditioning;
– expansion of bulk feed;
– drying;
– size control of finished products;
– spraying on the surface of the liquid components;
– cooling;
– feed packaging.

According to the developed technology, the grain raw materials from the bins 1 are sent for weighting to the bunker scales 2. The weighted grain components are conveyed by a conveyors 3, 4 to remove metal-magnetic impurities (5) and no feed wastes (7). The cleaned grain components are grinded by a hammer mill 8, in which a sieve with holes ø 3 mm is installed and then sent to the feed conditioner 9. The extrusion (10) of the grain components is carried out under the following conditions: a pressure in the working area of the extruder is 2...3 MPa, a power consumption of the electric motor is 4.0...4.5 kW, the temperature of the product at the exit of the extruder is 100...110° C, the duration of 60...120 s, the diameter of the hole of the matrix 10 mm The hot extrudate is cooled by using a vertical cooler 11 to a temperature not exceeding the ambient temperature of more than 15 °C. The cooled extrudate is crushed on a hammer mill 8. The crushed extrudate is sent to a weighing bin 2.

Non-cereal components are prepared at the same time. Meat-bone meal, fishmeal, mineral raw materials and premix are unloaded, if necessary, they are cleaned of no feed waste and metallomagnetic impurities. Prepared non-cereal components will be sent for weighting to the bunker scale 2. Weighted ingredients (according to the recipe) are mixed in a batch mixer 13. The obtained bunk feed is sent for moisturizing and heating to a conditioning 9, and then processed to an expander 14. The feed is expanded (14); in the following regimes: an average moisture content of the feeds is 18...20 %, the pressure in the working zone of the expander is 2...3 MPa, the temperature of the product at the outlet of the expander 90...100 °C. The obtained expandate is sent to a horizontal dryer 15 and is controlled by size (16). A large fraction of the feed is sent to the device 17 for spraying on the surface of the liquid components, cooled (18) and sent to the packaging (20). The fine fraction is sent to a re-expansion.

Conclusions

Based on the conducted scientific research, the composition of compound feeds for dogs and cats, the content of nutrient and biologically active substances in the recipes are analyzed, the main technological processes of their production are described. The technology has been developed for the production of the dry compound feeds for pets, which makes it possible in private enterprises to ensure the production of domestic competitive in the market complete feed for dogs and cats, depending on their breed, age, and physiological condition.

REFERENS

1. *Debbie Phillips-Donaldson Global pet food sales hit $91 billion in 2018: veb-sait. URL: https://www.petfoodindustry.com/articles/7899-global-pet-food-sales-hit-91-billion-in-2018 (data zvernennia: 04.06.2019).*
2. *Bordun, T.V. (2014). Stan i perspektyvy rozvytku svitovoho ta ukrainskoho rynku kormiv dlia sviiskykh tvaryn. Khranenye y pererabotka zerna, 5 (182), 22–26.*
3. *Tim Wall EU pet food sales at EUR21 billion in 2018; employs 100K: veb-sait. URL: https://www.petfoodindustry.com/articles/8266-eu-pet-food-sales-at-eur21-billion-in-2018-employs-100k (data zvernennia: 09.07.2019).*
4. *Tim Wall Pet cats Europe 2018: Russia top, Romania #1 per capita: veb-sait. URL: https://www.petfoodindustry.com/articles/8277-pet-cats-europe-2018-russia-top-romania-1-per-capita (data zvernennia: 09.07.2019).*
5. *Tim Wall Pet dogs per capita in Europe: Romania, Portugal top list: veb-sait. URL: https://www.petfoodindustry.com/articles/8278-pet-dogs-per-capita-in-europe-romania-portugal-top-list (data zvernennia: 09.07.2019).*
6. *Egorov, B.V., Mardar, M.R., Bordun, T.V. (2004). Osobennosti formirovanija receptov kombikormov dlja domashnih zhivotnyh. Zernovye produkty i kombikorma, 4, 33–38.*
7. *Ehorov, B.V., Mardar, M.R., Voetskaia, E.E., Lepykhov, K.S. (2004). Obgruntuvannia skladu retseptiv kombikormiv dlia domashnikh tvaryn. Zb. nauk. pr. Odesa: ODAKhT, Vyp. 27, 33–36.*
8. *Kniga o kormlenii domashnih zhivotnyh (1997). Pod red. A. Burgera. Moskva: Biainformservis, 182.*
9. *Mejer Gel'mut, Zentek Jurgen. (1998). Kormlenie sobaki. Moskva: Akvarium, 144.*
10. *Oreshkin, E.F. (1992). Proizvodstvo kormov dlja domashnih zhivotnyh: Obzor. inform. AgroNIITJeIMMP, 30.*
11. *Kononova, E.V. (2001). Kak pravil'no kormit' vashu sobaku ot rozhdenija do starosti. Rostov-na-Donu: Feniks, 160.*
12. *Kombikorma dlja sobak i koshek. (1987). CNIITJeIHleboproduktov. Kombikormovaja prom–st'. Ser. «Kombikorm. prom–st' za rubezhom», 12, 18–21.*
13. *Provatorov, H.V., Provatorov, V.O. (2004). Hodivlia silskohospodarskykh tvaryn: Pidruchnyk. Sumy: VTD Universytetska knyha, 510.*
14. *Palika Liz. (1999). Pitanie i zdorov'e sobaki. Moskva: Centrpoligraf, 234.*
15. *Zorin, V.L. (2002). Kormlenie sobaki. Moskva: Akvarium, 63.*
16. *Zorin, V.L. (2001). Kormlenie koshki. Moskva: Akvarium LTD, 64.*
17. *Dobeneker, B., Tilen, K. (1999). Kormlenie koshki. Moskva: Akvarium LTD, 144.*
18. *Egorov, B.V., Kochetova, A.A., Voeckaja, E.E. (2005). Razrabotka sposoba podgotovki zernovogo syr'ja pri proizvodstve kombikormov dlja domashnih zhivotnyh. Hranenie i pererabotka zerna, 9, 40–43.*
19. *Iehorov, B.V., Voietska, O.Ie. (2006). Sposib otrymannia kombikormu dlia sobak: pat. No 11977 Ukrainy: MPK A23K 1/16 A23V 4/044. No u200503916; zaiavl. 25.04.2005; opubl. 16.01.2006, Biul. 1, 3.*
20. *Stankevich, G.N., Kochetova, A.A., Voeckaja, E.E. (2007). Issledovanie processa jekstrudirovanija zernovogo syr'ja i kombikormov s povyshennym soderzhaniem zhira. Zernovye produkty i kombikorma, 2, 35–39.*
21. *Iehorov, B.V., Bordun, T.V., Sharova, A.I. (2011). Pidvyshchennia efektyvnosti pidhotovky zernovykh komponentiv u skladi volohykh kombikormiv dlia kotiv. Zernovi produkty i kombikormy, 2 (42), 33–37.*
22. *Voietska, O.Ie. (2007). Tekhnolohiia vyrobnytstva ekstrudovanykh kombikormiv dlia sobak. Khranenye y pererabotka zerna, 9, 48–51.*
23. *Lindsay Beaton 2 things to know about the future of pet food extrusion: veb-sait. URL: https://www.petfoodindustry.com/articles/7630-two-things-to-know-about-the-future-of-pet-food-extrusion?v=preview (data zvernennia: 05.09.2019).*
24. *Lindsay Beaton. The challenges of extruding high-meat pet food: veb-sait. URL: https://www.petfoodindustry.com/articles/5690-the-challenges-of-extruding-high-meat-pet-food (data zvernennia: 05.09.2019).*
25. *Hobin, V.A. (2002). Avtomatizacija processov porcionnogo mnogokomponentnogo vesovogo dozirovanija: problemy, puti reshenija, perspektivy. Zernovye produkty i kombikorma, 1, 60–61.*
26. *Hobin, V.A., Dec, D.V. (2002). Avtomatizacija processov porcionnogo mnogokomponentnogo vesovogo dozirovanija: problemy, puti reshenija, perspektivy. Zernovye produkty i kombikorma, 2, 49–56.*
27. *Stankevich, G.N., Kochetova, A.A., Voeckaja, E.E. (2007). Optimizacija processa smeshivanija kombikorma s zhirovoj kompoziciej. Hranenie i pererabotka zerna, 4, 21–24.*
28. *Robert Sunderland, Steve Campbell Wenger Horizontal Dryer and Dryer/Cooler Styles: veb-sait. URL: http://www.wengerdryers.com/dryer-styles.php (data zvernennia: 10.09.2019).*
29. *Extru-Tech Introduces Advanced Batch Coating Technology: veb-sait. URL: http://www.extru-techinc.com/news/extru-tech-introduces-advanced-batch-coating-technology (data zvernennia: 12.09.2019).*
30. *Egorov, B.V., Kochetova, A.A., Voeckaja, E.E. (2007). Ispol'zovanie zhirov pri proizvodstve kombikormov dlja domashnih zhivotnyh. Zernovye produkty i kombikorma, 1, 34–37.*
31. *Cooling of Extruded, Dry Pet Foods: veb-sait. URL: http://www.extru-techinc.com/news/cooling-of-extruded-dry-pet-foods (data zvernennia: 12.09.2019).*

УДК [636.7/.8.085.55:66.083]:636.087.7

О. Є. Воєцька, канд. техн. наук, доцент, E-mail: vecombi@gmail.com
Т. В. Бордун, канд. техн. наук, доцент, E-mail: bordun.tatjana@gmail.com
О. Г. Цюндик, канд. техн. наук, ст. викл., E-mail: malik2008ts@gmail.com
Кафедра технології комбікормів і біопалива
Одеська національна академія харчових технологій, вул. Канатна, 112, Одеса, 65039, Україна

ПРАКТИЧНІ ОСНОВИ ВИРОБНИЦТВА КОМБІКОРМІВ ДЛЯ ДОМАШНІХ ТВАРИН

Анотація

У статті представлені данні щодо популяції собак і котів у країнах Європи за 2018 рік, країн з високою кількістю тварин на душу населення. На основі проведених наукових досліджень проаналізовано особливості складу комбікормів для собак та котів, потреби домашніх тварин у поживних та біологічно активних речовинах, їх вміст у рецептах та особливості розрахунку рецептів комбікормів. Визначені особливості технологічних процесів виробництва екструдованих комбікормів для домашніх тварин та дана їх характеристика. Розроблена технологія виробництва сухих комбікормів для домашніх тварин дозволяє забезпечити в умовах приватних підприємств виробництво вітчизняних конкурентоспроможних на ринку повнораціонних комбікормів для собак і котів в залежності від їх породи, віку та фізіологічного стану.

Розроблена лінія по виробництву сухих комбікормів для собак продуктивністю 1…3 т/год з можливістю виробництва до 20 т готового комбікорму на місяць. Для організації виробництва необхідний виробничий цех, склад сировини, склад готової продукції, побутове приміщення, а також можливість під'їзду автотранспорту до складу сировини та його розвантаження. Для обслуговування лінії по виробництву комбікормів необхідні два фахівця – технолог і оператор по обслуговуванню екструдера та експандера, а також робочий, який відповідає за підготовку компонентів і упаковку готової продукції. Для реалізації проекту необхідне технологічне обладнання: молоткова дробарка, кондиціонер, екструдер, ваги бункерні, змішувач, експандер, сушарка, охолоджувач, пристрій для нанесення рідких компонентів на поверхню готового комбікорму. Основні етапи виробництва включають приймання, розвантаження та очищення сировини; подрібнення зернових компонентів до однакової фракції; екструдування та охолодження зернових компонентів; подрібнення екструдованих зернових компонентів; дозування компонентів комбікорму; змішування компонентів до однорідної суміші; кондиціонування; екпандування розсипного комбікорму; сушіння; контроль крупності готової продукції; напилення на поверхню рідких компонентів; охолодження; пакування комбікорму.

***Ключові слова**: комбікорми для собак та котів, екструдування, експандування, технологія виробництва.*

ЛІТЕРАТУРА

1. *Debbie Phillips-Donaldson Global pet food sales hit $91 billion in 2018: веб-сайт. URL: https://www.petfoodindustry.com/articles/7899-global-pet-food-sales-hit-91-billion-in-2018 (дата звернення: 04.06.2019).*
2. *Бордун Т.В. Стан і перспективи розвитку світового та українського ринку кормів для свійських тварин // Хранение и переработка зерна. 2014. № 5 (182). С. 22–26.*
3. *Tim Wall EU pet food sales at EUR21 billion in 2018; employs 100K: веб-сайт. URL: https://www.petfoodindustry.com/articles/8266-eu-pet-food-sales-at-eur21-billion-in-2018-employs-100k (дата звернення: 09.07.2019).*
4. *Tim Wall Pet cats Europe 2018: Russia top, Romania #1 per capita: веб-сайт. URL: https://www.petfoodindustry.com/articles/8277-pet-cats-europe-2018-russia-top-romania-1-per-capita (дата звернення: 09.07.2019).*
5. *Tim Wall Pet dogs per capita in Europe: Romania, Portugal top list: веб-сайт. URL: https://www.petfoodindustry.com/articles/8278-pet-dogs-per-capita-in-europe-romania-portugal-top-list (дата звернення: 09.07.2019).*
6. *Егоров Б.В., Мардар М.Р., Бордун Т.В. Особенности формирования рецептов комбикормов для домашних животных // Зерновые продукты и комбикорма. 2004. № 4. С. 33–38.*
7. *Егоров Б.В., Мардар М.Р., Воецкая Е.Е., Лепихов К.С. Обґрунтування складу рецептів комбікормів для домашніх тварин // Зб. наук. пр. Одеса: ОДАХТ. 2004. Вип. 27. С. 33–36.*
8. *Книга о кормлении домашних животных / под ред. А. Бургера. Москва: Биаинформсервис, 1997. 182 с.*
9. *Мейер Гельмут, Зентек Юрген. Кормление собаки. Москва: Аквариум, 1998. 144 с.*
10. *Орешкин Е.Ф. Производство кормов для домашних животных: Обзор. информ. АгроНИИТЭИММП, 1992. 30 с.*
11. *Кононова Е.В. Как правильно кормить вашу собаку от рождения до старости. Ростов-на-Дону: Феникс, 2001. 160 с.*

12. *Комбикорма для собак и кошек // ЦНИИТЭИХлебопродуктов. Комбикормовая пром–сть. Сер. «Комбикорм. пром–сть за рубежом». 1987. № 12. С. 18–21.*
13. *Проваторов Г.В., Проваторов В.О. Годівля сільськогосподарських тварин: Підручник. Суми: ВТД Університетська книга, 2004. 510 с.*
14. *Палика Лиз. Питание и здоровье собаки. Москва: Центрполиграф, 1999. 234 с.*
15. *Зорин В.Л. Кормление собаки. Москва: Аквариум, 2002. 63 с.*
16. *Зорин В.Л. Кормление кошки. Москва: Аквариум ЛТД, 2001. 64 с.*
17. *Добенекер Б., Тилен К. Кормление кошки. Москва: Аквариум ЛТД, 1999. 144 с.*
18. *Егоров Б.В., Кочетова А.А., Воецкая Е.Е. Разработка способа подготовки зернового сырья при производстве комбикормов для домашних животных // Хранение и переработка зерна. 2005. № 9. С. 40–43.*
19. *Єгоров Б.В., Воєцька О.Є. Спосіб отримання комбікорму для собак: пат. № 11977 України: МПК A23K 1/16 A23B 4/044. № u200503916; заявл. 25.04.2005; опубл. 16.01.2006, Бюл. № 1. 3 с.*
20. *Станкевич Г.Н., Кочетова А.А., Воецкая Е.Е. Исследование процесса экструдирования зернового сырья и комбикормов с повышенным содержанием жира // Зерновые продукты и комбикорма. 2007. № 2. С. 35–39.*
21. *Єгоров Б.В., Бордун Т.В., Шарова А.І. Підвищення ефективності підготовки зернових компонентів у складі вологих комбікормів для котів // Зернові продукти і комбікорми. 2011. № 2 (42). С. 33–37.*
22. *Воєцька О.Є. Технологія виробництва екструдованих комбікормів для собак //Хранение и переработка зерна. 2007. № 9. С. 48–51.*
23. *Lindsay Beaton 2 things to know about the future of pet food extrusion: веб-сайт. URL: https://www.petfoodindustry.com/articles/7630-two-things-to-know-about-the-future-of-pet-food-extrusion?v=preview (дата звернення: 05.09.2019).*
24. *Lindsay Beaton. The challenges of extruding high-meat pet food: веб-сайт. URL: https://www.petfoodindustry.com/articles/5690-the-challenges-of-extruding-high-meat-pet-food (дата звернення: 05.09.2019).*
25. *Хобин В.А. Автоматизация процессов порционного многокомпонентного весового дозирования: проблемы, пути решения, перспективы // Зерновые продукты и комбикорма. 2002. № 1. С. 60–61.*
26. *Хобин В.А., Дец Д.В. Автоматизация процессов порционного многокомпонентного весового дозирования: проблемы, пути решения, перспективы // Зерновые продукты и комбикорма. 2002. №2. С. 49–56.*
27. *Станкевич Г.Н., Кочетова А.А., Воецкая Е.Е. Оптимизация процесса смешивания комбикорма с жировой композицией //Хранение и переработка зерна. 2007. № 4. С. 21–24.*
28. *Robert Sunderland, Steve Campbell Wenger Horizontal Dryer and Dryer/Cooler Styles: веб-сайт. URL: http://www.wengerdryers.com/dryer-styles.php (дата звернення: 10.09.2019).*
29. *Extru-Tech Introduces Advanced Batch Coating Technology: веб-сайт. URL: http://www.extru-techinc.com/news/extru-tech-introduces-advanced-batch-coating-technology (дата звернення: 12.09.2019).*
30. *Егоров Б.В., Кочетова А.А., Воецкая Е.Е. Использование жиров при производстве комбикормов для домашних животных // Зерновые продукты и комбикорма. 2007. № 1. С. 34–37.*
31. *Cooling of Extruded, Dry Pet Foods: веб-сайт. URL: http://www.extru-techinc.com/news/cooling-of-extruded-dry-pet-foods (дата звернення: 12.09.2019).*

Received 12.10.2019 **Revised 20.12.2019**
Reviewed 05.11.2019 **Approved 27.12.2019**

Cite as Vancouver Citation Style
Voietska O., Bordun T., Tsiundyk O. Practical foundations of the production of pet food. Grain Products and Mixed Fodder's, 2019; 19 (4): 37-45. DOI: https://doi.org/

Cite as State Standard of Ukraine 8302:2015
Practical foundations of the production of pet food / Voietska O. et al. // Grain Products and Mixed Fodder's. 2019. Vol. 19, Issue 4 (76). P. 37-45. DOI: https://doi.org/