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PROSPECTS FOR THE PRODUCTION OF DOMESTIC FEED FOR SERVICE PUPPIES

Abstract. Scientific research and the development of domestic technology for the production of extruded dry feeds for non-productive animals (service puppies) have been conducted. These feeds are designed for complete nutrition from the age of two months. This advancement is expected to reduce the import of equivalent products, enhance the production capabilities of the domestic feed industry, improve environmental conditions, and generate additional revenue. Based on the review of scientific and technical documentation, GOST standards, literature sources and existing physical and chemical specifications for imported foods, the nutritional value of food for puppies of service dogs was determined. The scientific literature review on the subject revealed that the extrusion process of multicomponent food mixtures is not yet adequately investigated. Considering the need of dog puppies in nutrients, metabolic energy, two formulations of complete foods have been designed. The formulations were mainly based on domestically produced ingredients. A comparison of the feeding value of the developed complete feeds with imported foods currently available in the market has been presented. An experiment has been done with puppies fed with the developed foods. Throughout the experiment, each group of puppies was weighed regularly, examined medically, and monitored for physical development, activity, and general health. Thus, the experiment involving puppies in a service dog breeding facility is a landmark study with the potential to make a major contribution to the understanding of optimal nutritional and care strategies for young dogs.

Keywords: dry mixed feeds, extruding, protein, fat, quality, metabolic energy, technological parameters.

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Introduction. Service breeds comprise the groups of guard, search, sled and sporting dogs. Service dogs stand out from domestic dogs by their endurance, keen

sense of smell, well-developed intuition, balanced behavior, and bravery. Shepherds are the largest group in the service breed category.

Animal business in Kazakhstan is merely at the beginning of its journey. Producing domestically extruded feed for service puppies will enable a more rational use of material resources from non-food raw materials of processing enterprises. The lack of domestic scientific research in the field of dog food production has resulted in the Kazakhstani market being predominantly occupied by products from foreign manufacturers. Currently, foreign companies offer a wide variety of complete and balanced dry dog foods. A whole range of feeds for non-productive animals has been developed over many years in leading research centers in the US, Canada, Europe, China, Japan, and Russia. However, there is a notable scarcity of scientific literature focused on the optimal extrusion parameters for formulating feed for non-productive animals. This may be attributed to the fact that research in this field is most often funded by foreign feed manufacturers who are not inclined to disclose their findings. This creates significant obstacles for Kazakhstani scientists and technologists who wish to study the process of preparing extruded feed, which has not previously been produced in our country.

Foreign manufacturers supply dog feed produced through the extrusion method. At present, a significant number of plant and animal components utilized in feed for non-productive animals are subjected to extrusion. This technology is becoming increasingly popular for pelleted feed, where pre-processed ingredients are blended to produce pellets with desired characteristics such as size and porosity. The primary advantage of extrusion lies in its ability to alter the structure, physical properties, and nutritional value of the raw materials during the process. By adjusting the parameters of the technological process, the properties of the final feed can be extensively modified [1]. Despite the numerous scientific studies focused on the extrusion of single raw materials, research on mixtures of two components is comparatively scarce. The extrusion process of multi-component mixtures, such as dog food, remains insufficiently studied. Therefore, the established patterns of this process require further development, especially considering the incorporation of new, non-traditional components such as hydrolysates, insect flour, and others [2].

Given that animal protein predominates in the natural diet of dogs, comprising up to 70% or more, there is a significant need for animal protein in the diet of service dogs [3].

Feeds based on animal raw materials (such as blood meal, fish meal, meat-and-bone meal, krill meal, and other similar ingredients) are distinguished by their high protein content. Extrusion has a profound impact on the properties and structure of protein, as well as its interactions with other components. Research by T.A. Samuelsen underscores the importance of fish meal quality in producing high-quality extruded aquafeed. According to him, the use of finely ground fish meal with a fibrous structure enhances the efficiency of the extrusion process and improves the quality of the feed pellets [4].

In contrast, plant-based feeds are characterized by high levels of carbohydrates, including starch, dietary fibers, and sugars. This significantly impacts the extrusion process, as the structural changes in starch during extrusion enhance the expansion of the extrudate and improve its digestibility. Process temperature and moisture content of the raw materials are key parameters that determine the transformation of starch during extrusion [5].

However, scientific publications regarding the extrusion process of mixtures of plant and animal raw materials for dog food are virtually nonexistent. This

indicates that the optimal parameters for the extrusion of such mixtures, as well as their effects on the properties of the final products, are still inadequately explored. The topic of extrusion for service dog feed holds promising potential but requires further investigation to establish the general process parameters and their impact on the quality of the final product. The limited literature on the formulation of extruded feed for service puppies highlights the need for further research in this area.

The study was aimed at evaluating the physiological and economic efficacy of the extruded feed for service puppies developed in Kazakhstan.

Materials and methods. The study material comprised complete feed formulations for service puppies. The formulations for service puppies were developed in the Laboratory of Grain Products and Feed Technology at Kazakhstan Research Institute of Processing and Food Industry in 2023. A trial batch of the feed was produced at the ROYAL PETS plant, located in the Almaty region. The feed was produced utilizing the extrusion method. The quality parameters of the feed were determined using an infrared analyzer (Ekan LLC, INFRASCAN-3150) and moisture content was measured with an EVLAS-2M device. The quality parameters of the produced feed were assessed based on levels of protein, fat, fiber, nitrogen-free extractives (NFE), energy value, and the quantitative content of amino acids, which were determined using a calculation method and reference materials. The technological parameters of the produced trial batches of feed were determined according to the current GOST R 59369-2021, GOST R 55453-2022 standards.

Research results and discussion. A market survey of raw materials was conducted. The market features domestically available high-protein components, including corn gluten, wheat gluten, melange, and skim milk powder. Unfortunately, fish meal and meat-and-bone meal exhibit elevated levels of ash and fat, coupled with relatively low protein content. Cereals and their processed by-products are abundantly available.

The vitality and performance of service dogs are significantly influenced by their proper feeding, which involves a structured feeding regimen with diets that are complete and balanced according to physiologically justified nutrient requirements. Optimal nutrition is crucial for dogs. It depends on factors such as breed, body weight, age, physiological condition, and health. Most commercial dog foods differ significantly in nutritional characteristics from the traditionally natural diet of dogs.

Many researchers assert that it is advisable to feed high-breed-value service puppies exclusively with super-premium and premium class foods, excluding economy class options. For puppies aged 2 to 6 months, it is recommended to use feeds specifically formulated for their developmental stage [6].

The overall nutritional requirement for service dogs is determined by the energy value of the feed (expressed in kcal/100 g) and the total amount of organic matter. The energy requirement level depends on factors such as body weight, age, condition of the animal, ambient temperature, coat condition, level of physical activity (including the work performed by service dogs), and other variables. As body weight increases, the energy expenditure per unit of weight decreases. Smaller dogs have a more intensive energy metabolism compared to larger dogs. When ambient temperature decreases, heat production in the body increases. In summer, the daily energy requirement decreases by approximately 15%. As body size increases, so does the energy requirement.

Diets for dogs must meet their requirements not only for energy but also for essential nutrients, including proteins (especially high-quality, animal-based proteins), fats, carbohydrates, minerals, and vitamins [7].

Proteins play a crucial role in nutrition, and their biological value for dogs can vary. Only specific proteins are broken down into amino acids essential for muscle growth. These proteins are referred to as complete proteins. They are primarily found in animal-based products such as meat, fish, dairy products, eggs, blood, and others. Plant-based feeds typically contain incomplete proteins.

In evaluating proteins, it is essential to consider not only their quantity but also their quality and digestibility. For instance, chicken and turkey protein is digestible at 90-98%, horse meat protein at 86%, beef protein at 77%, while pork and lamb proteins are digestible at 66-68%. The completeness of proteins is determined by their amino acid profile, especially the presence of essential amino acids such as lysine, tryptophan and methionine. These amino acids must be obtained through the diet, as the body cannot synthesize them. Dietary deficiencies of these amino acids results in protein metabolism disorders [8].

Lysine is essential for dogs to synthesize tissue proteins and also serves a key role in the production of sperm, creatine, and insulin. Histidine is involved in energy metabolism and is required for the synthesis of hemoglobin, red blood cells, and some muscle proteins. Phenylalanine and tryptophan affect digestive enzymes, cellular oxidizing enzymes, and certain hormones. Tryptophan is also crucial for the renewal of blood plasma proteins. Cystine promotes insulin activation and, together with tryptophan, is involved in the synthesis of bile acids, which are essential for the absorption of nutrients in the intestine. Methionine is vital for the synthesis of choline, creatinine, adrenaline, niacin and other substances, and also has a major role in the body's fat metabolism. Methionine and cystine are part of the coat and promote its growth.

Adult dogs fed meat by-products and plant foods are often deficient in lysine, methionine, and tryptophan, while methionine and cystine may be deficient in puppies. If the diet lacks essential amino acids, the amount of protein should be increased or synthetic amino acids should be added up to the normal amount. When there is an excess of amino acids, the amount of protein from animal foods should be reduced. The coefficient of digestible protein utilization helps determine its completeness. A deficiency of proteins in the diet can result in stunted growth and development of puppies, reproductive issues, impaired nutrient absorption, reduced milk production, slow growth of coat and nails, and decreased disease resistance. Enzymatic function of the liver and hemoglobin levels in the blood may also decrease. Protein deficiency leads to a decreased proportion of urea in the urine, and amine nitrogen is excreted with the urine due to a lack of enzymes to digest it. Excessive protein can overload the liver and kidneys with its breakdown products, lead to putrefactive processes in the intestines, and disrupt the body's acid-base balance. Therefore, a key principle in organizing a balanced protein diet for dogs is the careful selection and proportioning of components in the diet to meet the physiological needs of service dogs.

Adult dogs optimally require approximately 4.5 grams of protein per kilogram of body weight, while growing puppies need about 9.0 grams per kilogram of body weight. The critical requirement for essential amino acids is approximately 60 mg of lysine, 70 mg of methionine, and 15 mg of tryptophan per kilogram of body weight for adult dogs; and approximately 210 mg of lysine, 190 mg of methionine, and 60 mg of tryptophan per kilogram of body weight for puppies. For service dogs with moderate physical activity, the protein requirement

increases by approximately 30%, with at least one-third of the protein coming from animal-based sources.

Carbohydrates (sugar, starch, fiber, and others) provide the main source of energy for dogs. Fiber also plays a crucial role in forming fecal mass and stimulating intestinal peristalsis. Plant-based feeds serve as the primary source of fiber for dogs. The optimal carbohydrate requirement for adult dogs is 10 grams per kilogram of body weight, including 1 gram of fiber; for puppies, it is 15.8 grams per kilogram of body weight, with 1.5 grams of fiber included. The carbohydrate requirement for adult dogs depends on the fat content in their diet: the lower the fat content, the higher the carbohydrate intake needed. In summer, carbohydrates can partially replace fats. Excessive sugar and starch in the diet can lead to obesity [9].

Fats are crucial for dogs as they provide essential fatty acids and have high caloric density. The optimal lipid requirement is 1.32 grams per kilogram of body weight for adult dogs and 2.64 grams per kilogram for puppies. A deficiency of fat in the diet can lead to stunted growth, reproductive issues, vitamin deficiencies, and skin disorders such as dermatitis, hyperkeratosis, scaling, and coat depigmentation. Excessive fat intake can also be detrimental.

The diet of dogs must include vitamins A, D, E, K, B complex, and others. Vitamin deficiencies can lead to serious conditions known as hypovitaminoses. A deficiency of vitamin A can lead to impaired vision, reproductive issues, stunted growth in puppies, and decreased disease resistance. Vitamin A is found in sources such as milk, fish oil, and liver, whereas provitamin A (carotene) is found in plant-based feeds, including carrots and leafy greens. Deficiency of vitamin D leads to rickets in puppies and osteomalacia in adult dogs. Vitamin D is found in fish oil and liver. Deficiency of vitamin E can result in reproductive issues and infertility. Sources of vitamin E include vegetables, leafy greens, and sprouted grains. Vitamin K deficiency can lead to subcutaneous hemorrhages. Vitamin K is found in cabbage, spinach, pumpkin, and tomatoes. Vitamin C protects against scurvy. Sources of vitamin C include vegetables and sauerkraut, as well as scalded nettles. B vitamin deficiencies cause muscle weakness, coordination disorders, paralysis, seizures, coat loss and depigmentation, dermatitis, and other problems. B vitamins are found in yeast, liver, cottage cheese, milk, potatoes and cauliflower [10].

Minerals include phosphorus, calcium, sodium, magnesium, potassium, chlorine, iron, zinc, copper, cobalt, iodine and manganese. Calcium and phosphorus deficiencies cause rickets in puppies and brittle bones in adult dogs. Deficiencies of sodium and chlorine (salt) lead to loss of appetite and decreased secretion of gastric juice. The salt requirement is 375 mg for adult dogs and 530 mg for puppies per 1 kg of body weight. Deficiencies of potassium and magnesium lead to hyperexcitability and cardiac dysfunction. Hemoglobin requires iron, copper, and cobalt to be present for its formation. Zinc deficiency slows growth, disrupts puberty and causes dermatitis. Iodine deficiency causes goiter disease. Commercial dog foods are formulated according to standards and contain the requisite amounts of nutrients, minerals, and vitamins [11].

Based on the optimal vitamin and mineral macro- and micronutrient requirements necessary for maintaining health and normal physiological functions, premixes have been developed. Premixes are added to animal feed to enhance its nutritional balance and improve nutrient digestibility (Table 1).

Table 1

Premixes for service puppies per 1 tonne

Name	Unit	Puppies
Vitamin A (retinol)	IU (mln)	800
Vitamin D3 (calciferol)	IU (mln)	300
Vitamin E (tocopherol)	IU (mln)	850
Vitamin B1 (thiamine)	g	280
Vitamin B2 (riboflavin)	g	900
Vitamin B3 (pantothenic acid)	g	230
Vitamin B4 (choline)	g	410
Vitamin B5 (calcium pantothenate)	g	270
Vitamin B6 (pyridoxin)	g	25
Vitamin B12 (cobalamin)	g	9
Vitamin B9 (folic acid)	g	150
Vitamin B7 (biotin)	g	25
Vitamin C (ascorbic acid)	g	2000
Zinc sulphate	g	1350
Copper sulphide	g	780
Iron sulphide	g	1500
Manganese sulphate	g	250
Potassium iodide	g	190
Cobalt chloride	g	110
Sodium selenite	g	20
Magnesium sulphate	g	250

Dogs are provided with feed products as part of a diet designed to fully meet their needs for energy, proteins, carbohydrates, fats, minerals, and vitamins, taking into account their breed, sex, age, and physiological condition. Diets are formulated from a variety of feed products that align with the natural preferences and tastes of dogs. Each type of feed is included in the diet in optimal quantities to avoid any potential adverse effects on the animal's health. Diets include a variety of feed types, which may be more appealing to dogs, including by-products from the meat, dairy, fish, and food industries. The proper combination of these feed products ensures a complete and balanced diet for dogs.

The foundation of a dog's diet should be proteins, primarily of animal origin. Proteins found in muscle tissue (meat) and by-products are absorbed by the body at a rate of 90-95%, whereas plant-based proteins are absorbed at only 40-60%. Furthermore, the absorption of plant-based protein is only possible after processing, which breaks down the cell walls of the plant materials. The dog's body is unable to extract nutrients from plant-based food due to the complete absence of enzymes required to break down fiber. An excess of poorly digestible plant-based products in the diet can lead to fermentation and putrefaction processes in the stomach. As a result, the mucous membranes become inflamed, beneficial microflora is destroyed, and conditions become favorable for the proliferation of parasites. Chronic protein deficiency in the diet leads not only to wasting and muscle dystrophy but also to other severe health issues. The immune system weakens, and disruptions occur in the function of endocrine glands.

Based on the review of scientific and technical documentation, GOST standards, literature sources and existing physical and chemical specifications for imported foods, the nutritional value of food for puppies of service dogs was determined (Table 2). The nutritional needs of puppies and adult dogs differ significantly.

Table 2

Established nutritional requirements for service puppies

Parameter name, %	Compound feed for:	
	puppies 2 to 4 months	puppies 4 to 6 months
Protein content	28-30	27-29
Fat content	18-19	16-17
Fiber content	1.1-1.3	1.5-2.5
Ash content, NMT	10	10
Calcium content	1.2-1.6	0.6-1.1
Phosphorus content	1.2-1.7	0.6-1.5
Sodium content, at least	0.3	0.45
Chlorides, NMT	0.3	0.45
Lysine, at least	1.5-1.7	1.5-1.7
Methionine+cystine, at least	0.7	0.7
Tryptophan, at least	0.2	0.2
Gross energy, kcal/100g	At least 450	

In developing the formulations for service dog feed, numerous important factors were considered. The primary objective was to ensure the maximum enrichment of complete dry feeds with proteins, fats, amino acids, vitamins, and minerals. This approach enabled the achievement of optimal physiological nutritional standards and the creation of a balanced feed with high digestibility.

The feasibility of incorporating plant-based protein products into dry feeds depends on the content of digestible protein. Therefore, assessing digestibility is the first step in determining the potential of the food ingredient under investigation. Assessing feed digestibility is crucial both for research on nutrient requirements and for developing more cost-effective formulations. Feeds are assessed from both a biological perspective, where the pellets can be consumed by dogs with minimal energy expenditure, and a physiological perspective, where the feed is acceptable in taste and smell, is easily digestible, and possesses high nutritional value, meeting the body's energy and structural needs.

Considering that dry feeds for service dogs are produced from raw materials such as meat and bone meal and chicken mince, there are certain limitations on their use from both an environmental and economic perspective due to high costs and availability constraints. As a result, it is essential to use raw materials economically and to explore alternative sources of protein, both plant-based and animal-based.

Considering the established nutrient requirements for puppies, scientifically grounded formulations for complete dry feeds were developed (for service puppies aged 2 to 4 months and 4 to 6 months). The formulation for puppies aged 2 to 4 months comprised 50% animal-based components and 33% plant-based components. For puppies aged 4 to 6 months, the formulation included 51% animal-based components and 37% plant-based components. The developed feeds included components with high levels of crude protein and low fat content, as the formulation was specifically designed for extruded feeds. The remaining fat content (rendered chicken fat) was incorporated through atomization.

The trial batches of the feed were produced utilizing the extrusion method. The processing of feed ingredients through extrusion is considered one of the most effective technological solutions. Following thermal processing, the development of aromatic compounds enhances the palatability of the feed, while also increasing the activity of enzymes essential for the digestion process. Extruded feed is

absorbed at rates of up to 90-95%. This advanced feed, produced using a barothermal method, effectively eliminates pathogenic microorganisms, including mold fungi and their toxins.

Extrusion not only disinfects the raw material but also slows down the protein degradation process, promotes the synthesis of microbial protein, and enhances starch digestibility by converting it into sugars and dextrins. This method also slows down the fermentation of starch and increases the dietary energy value by 10-15%.

After extrusion, proteins are more readily digestible as the amino acids become more accessible due to the disruption of secondary bonds within the protein molecules. The extrusion process also neutralizes factors that negatively impact digestion, such as trypsin inhibitors and urease. During this process, amino acids are preserved due to the optimal temperatures and the brief duration of thermal treatment.

D.A. Blagov, S.V. Mitrofanov et al. showed in their study that grain extrusion provides sterilization from pathogenic microflora and breakdown of complex indigestible polysaccharides into simple carbohydrates and sugars. This process decreases the moisture content of the final feed by 2-2.5 times compared to the initial values, thus contributing to its longer storage. The barothermal treatment hydrolyzes the starches in cereal grains into simple sugars, enhancing the organoleptic qualities and increasing the palatability of the feed. Following extrusion, the sugar content increases by 106.83% in wheat, 71.43% in barley, and 15.28% in peas. Extruded feeds are crucial for the rearing of young dogs, as they significantly mitigate mortality rates associated with gastrointestinal diseases and pathogens that may be transmitted via the feed.

The technological parameters of the trial batches of compound feed were assessed and are detailed in Table 3.

Table 3

Technological parameters of complete dry feeds for service puppies

Parameter name	Compound feed for:	
	puppies 2 to 4 months	puppies 4 to 6 months
Pellet		
diameter, mm	8.35±0.25	8.48±0.25
length, mm	7.38±0.38	9.74±0.05
Volume weight, g/L	411.3±1.32	524.1±1.14
Repose angle, deg	38	40
Pellet water resistance, min	over 24 hours	
Swelling, mL/g	4.29 ± 0.13	4.69±0.17
Friability,%	0.148± 0.028	0.173±0.06
Homogeneity of mixing of components in the pellet, %:		
Protein	98.57	99.64
Fat	98.84	98.73

According to the data in Table 4, the trial batches of compound feeds exhibit favorable technological parameters and nearly fully meet the requirements of the GOST standard. The spherical shape of the pellets and the bulk density indicate that the feed has been extruded. The pellets exhibit porosity, and the uniformity of mixing is excellent, both in terms of fat and protein distribution. The fat was applied to the finished pellets, and it is noteworthy that the fat coating is of high

quality, with the pellets absorbing it uniformly. The friability is negligible in both trial batches (friability according to GOST should not exceed 3%). The swelling capacity of the developed extruded feeds exceeded 4 mL/g, which is considered a high value. Swelling capacity indicates the ability of dry feeds to absorb moisture, retain it, and restore their properties, thereby increasing in volume, becoming softer, and consequently more accessible for gastric juice action and further digestion by the puppies' bodies.

In the developed trial batches of puppy food, the nutritional value was assessed (Table 4).

Table 4

Nutritional value of complete dry foods for service puppies

Parameter name, %	Compound feed for:			
	puppies 2 to 4 months		puppies 4 to 6 months	
	native state	per absolute dry matter	native state	per absolute dry matter
Moisture	7.70±0.15	-	9.81±0.05	-
Dry matter	92.30	92.30	90.19	90.19
Protein content	29.96±0.31	32.46	29.41±0.07	32.61
Fat content	11.51±0.13	12.47	12.62±0.11	13.99
Fiber content	1.32±0.03	1.43	1.96±0.07	2.17
Ash content, NMT	6.54±0.05	7.08	5.32±008	5.90
Gross energy, kcal/100g	449.01	455.7	435.33	444.65
Metabolic energy, kcal/100g	395.13	401.0	383.09	391.3

Based on the data presented in Table 4, it is evident that the developed feeds meet the established nutritional standards for service puppies. Subsequently, the trial batches of feed were transferred to a breeding facility for scientific and practical evaluation.

A service dog breeding facility is a comprehensive institution specializing in the breeding, preparation, and training of dogs for various service roles. These facilities play a pivotal role in ensuring public safety, assisting in emergency situations, and enhancing the quality of life for individuals. Within a service dog breeding facility, optimal conditions are established for the development and training of future service partners. This includes state-of-the-art training grounds, specialized equipment, and highly qualified instructors and trainers with expertise in various aspects of dog training.

The experiment involving puppies aged 2 and 4 months, fed with the developed feeds, represents a comprehensive study aimed at examining the impact of nutrition on growth, health, and overall development of young dogs. This experiment holds significant practical value for the formulation of optimal feeding strategies and the enhancement of dogs' quality of life.

Conducted within the breeding facility, the study comprised two groups of puppies in each age category: one group at 2 months and another at 4 months. The puppies in these groups were provided with both the developed and control feeds – specifically, the Best breeders puppy 32-18 for the 2-month-old puppies and the Puppy condro active for the 4-month-old ones. Each group consisted of several individuals of the German Shepherd and Belgian Shepherd breeds. For a duration of 60 days, the 2-month-old puppies were fed 105 grams of food four times daily (totaling 420 grams), while the 4-month-old puppies received 275 grams twice

daily (totaling 550 grams). Each group of puppies was regularly weighed, underwent medical examinations, and was monitored for physical development, activity levels, and overall health status. Additionally, the experiment included biochemical and general blood analyses to assess the overall health and bodily functions of the puppies. This approach aimed to provide a deeper understanding of the impact of nutrition on internal processes and overall well-being.

The experimental setup involved two groups of puppies in each age category: one group at 2 months and another at 4 months. Each group was provided with a unique diet tailored to their age and nutritional needs. The feeding regimen was strictly adhered to, with precise quantities and schedules to ensure uniform conditions for all participants. Specifically, the 2-month-old puppies received 105 grams of food four times a day (420 grams total), while the 4-month-old puppies were fed 275 grams twice daily (550 grams total).

Throughout the experiment, each puppy was closely monitored for physical condition, weight, growth, as well as activity levels and behavior. This allowed for the tracking of any changes associated with the type of nutrition provided.

Over the 60-day feeding period, the following changes in body mass were observed in the service puppies fed with the test diets: for puppies aged 2-4 months, weight increased within the range of +3.8 to +8.5 kg; for puppies aged 4 months and older, weight increased within the range of +6.3 to +7.5 kg. The weight gain in the puppies was consistent, indicating that the domestic feed provided adequate energy and nutrients for healthy growth and development. No significant differences were observed compared to the control group.

Thus, feeding domestic food to 2- and 4-month-old puppies may have numerous positive effects, including improved digestion, immune support, and stimulation of growth and development. The experiment demonstrated that this feeding approach can be effective and contribute to the overall health and well-being of the puppies.

At both the beginning and end of the feeding period, primary and secondary blood analyses were conducted for the 2- and 4-month-old puppies.

Biochemical blood analysis:

1. Protein levels: The biochemical blood analysis can reveal the total protein level, which is a crucial indicator of nutrition and overall health in puppies. A positive protein result was observed in puppies fed with domestically produced food, indicating sufficient nutrient intake from the local feed.

2. Glucose Levels: Normal glucose levels suggest proper carbohydrate metabolism. Stable glucose levels in puppies fed with domestic feed reflect a balanced diet.

3. Aminotransferases: These enzymes are indicators of liver and muscle health. Positive results in puppies fed with domestic feed suggest the absence of pathological processes.

According to the general blood analysis, the puppies fed with domestic feed exhibited the following positive results:

1. Red blood cells and hemoglobin: Normal erythrocyte and hemoglobin levels indicate proper hematopoietic function. Stable levels suggest the absence of anemia and adequate iron and nutrient intake.

2. White blood cells: WBC levels serve as indicators of immune response. Normal leukocyte counts in puppies fed with domestic feed reflect a healthy immune system and absence of inflammatory processes.

3. Platelets: Normal platelet levels are crucial for effective blood coagulation. Stable platelet counts signify proper blood clotting function in the puppies.

In addition, the biochemical and hematological analyses of puppies fed with domestic feed revealed:

4. Fat levels: Normal fat levels in the blood indicate appropriate lipid and energy metabolism. Consistent fat levels reflect adequate nutrition and physical activity.

5. Urea and creatinine levels: These parameters are indicators of kidney function. Normal levels of urea and creatinine suggest healthy renal function in the puppies.

In summary, the positive outcomes observed in both biochemical and hematological blood analyses for puppies fed with domestic diets indicate not only overall health and proper nutrition but also normal functioning of the liver, kidneys, and circulatory system.

Conclusion. Based on the presented findings, it can be concluded that the development of extruded production feeds for service puppies, grounded in an analysis of nutritional needs, will enhance the ecological conditions at processing enterprises and ensure the full utilization of raw material resources. The developed complete extruded feed for service puppies represents a product that substitutes imported goods. Establishing feed production for non-productive animals in Kazakhstan will reduce the need for imports of similar products and save foreign currency.

Furthermore, the implementation of such technologies in production promotes the creation of new job opportunities and the growth of the local economy. Utilizing local raw materials for feed production diminishes dependence on imported supplies and reduces transportation costs, which positively impacts the environmental situation by decreasing carbon dioxide emissions. It is also important to note that the quality of the produced feed will meet international standards, ensuring the necessary nutrition and health for service puppies, thereby enhancing their performance and extending their service lifespan.

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ҚЫЗМЕТТІК ИТТЕР КҮШІКТЕРІНЕ АРНАЛҒАН ОТАНДЫҚ ҚҰРАМА ЖЕМ ӨНДІРІСІНІҢ БОЛАШАҒЫ

Аңдатпа. Екі айдан бастап толық тамақтандыруға арналған өнімсіз жануарларға (қызметтік иттер күшіктеріне) арналған экструдталған жем өндірудің отандық технологиясына ғылыми зерттеулер мен әзірлемелер жүргізілді, бұл аналогты өнімдердің импортын қысқартуға, отандық құрама жем өнеркәсібінің өндірістік мүмкіндіктерін күшейтуге, экологиялық жағдайды жақсартуға және қосымша пайда алуға мүмкіндік береді. Ғылыми-техникалық құжаттаманы, ГОСТ-тарды, әдеби дереккөздерді және қолданыстағы физика-химиялық көрсеткіштерді импорттық жемге зерттеу нәтижесінде қызметтік күшіктерге арналған жемнің тағамдық құндылығы анықталды. Осы тақырып бойынша ғылыми әдебиеттерге шолу көп компонентті жем қоспаларын экструдтау процесі әлі де жеткілікті зерттелмегенін көрсетті. Иттердің күшіктерінің қоректік заттарға деген қажеттілігін ескере отырып, метаболикалық энергия толық жем үшін екі рецепт әзірленді. Рецепттерді әзірлеу кезінде негізінен отандық өндірістің компоненттері қолданылды. Әзірленген толыққанды жем құндылығы бойынша қазіргі уақытта жем нарығында бар импорттық жеммен салыстыру жүргізілді. Күшіктерге эксперимент жүргізілді, онда олар әзірленген жеммен тамақтандырылды. Эксперимент барысында күшіктердің әр тобы үнемі өлшеніп, медициналық тексеруден өтіп, физикалық дамуды, белсенділікті және жалпы денсаулығы бақыланды. Осылайша, қызметтік ит питомнигіндегі күшіктерге арналған эксперимент жас иттерді тамақтандыру мен күтудің оңтайлы стратегияларын түсінуге айтарлықтай үлес қосуға мүмкіндігі бар маңызды зерттеу болып табылады.

Тірек сөздер: құрғақ құрама жем, экструдтау, ақуыз, май, сапа, алмасу энергиясы, технологиялық көрсеткіштер.

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ПЕРСПЕКТИВЫ ПРОИЗВОДСТВА ОТЕЧЕСТВЕННЫХ КОМБИКОРМОВ ДЛЯ ЩЕНКОВ СЛУЖЕБНЫХ СОБАК

Аннотация. В статье приведены результаты исследования и разработки отечественной технологии производства экструдированных сухих кормов для непродуктивных животных (щенков служебных собак), предназначенных для полнорационного кормления с 2-х месячного возраста, что позволит сократить импорт продуктов-аналогов, усилит производственные возможности отечественной комбикормовой промышленности, улучшит экологическую обстановку и позволит получить дополнительную прибыль. В результате изучения научно-технической документации, ГОСТов, литературных источников и существующих физико-химических показателей на импортные корма, была установлена питательная ценность кормов для щенков служебных собак. Обзор научной литературы по этому вопросу показал, что процесс экструзии многокомпонентных кормовых смесей все еще изучен недостаточно. Учитывая потребность щенков собак в питательных веществах, обменной энергии были разработаны два рецепта полнорационных комбикормов. При разработке рецептов были использованы в основном компоненты отечественного производства. Проведено сравнение по кормовой ценности разработанных полнорационных кормов с импортными кормами присутствующими в данное время на рынке кормов. Проведен экперимент над щенками, где их кормили разработанными кормами. В течение эксперимента каждая группа щенков регулярно взвешивалась, проходили медицинские обследования и подвергались наблюдениям за физическим развитием, активностью и общим состоянием здоровья. Таким образом, эксперимент над щенками в питомнике служебных собак представляет собой важное исследование, которое имеет потенциал принести значительный вклад в понимание оптимальных стратегий питания и ухода за молодыми собаками.

Ключевые слова: сухие комбикорма, экструдирование, протеин, жир, качество, обменная энергия, технологические показатели.