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A REVIEW OF MODERN APPROACHES TO HEALTHY DIETS FOR DOGS AND CATS

Sobol O.M. – Candidate of Agricultural Sciences, Associate Professor,
Associate Professor at the Department of Technology of Livestock Production,
Kherson State Agrarian and Economic University

Kryvyi V.V. – Assistant at the Department of Technology of Livestock Production,
Kherson State Agrarian and Economic University

Bokshan H.I. – Candidate of Philological Sciences, Associate Professor,
Associate Professor at the Department of Tourism, Hotel and Restaurant Business and
Foreign Languages,
Kherson State Agrarian and Economic University

The paper presents the results of analysis of information sources concerning healthy diets for dogs and cats. It establishes that nowadays there is an increase in the importance of such feed characteristics as safety, guaranteed controllable indexes, digestibility, attractiveness and high nutritional value. Examination of the impact of dietary intrusions aimed at using non-invasive research can apply methods ranging from express-analysis, analyses in vitro and in vivo to molecular technologies.

Since it is necessary to ensure active longevity of domestic animals, the main trend in modern petfood industry is development of feed lines for healthy animal diets. It has caused an increase in the quantity and diversity of manufactured feeds, higher requirements for their composition, production of functional feeds and feed supplements. Ensuring usefulness and safety of healthy manufactured feeds takes place at all stages of their production provided that healthy characteristics of raw materials are retained and the final stage of this process is testing taste characteristics.

Taking into consideration the requirements for healthy diets for domestic animals, main recommendations are determined by the Association of American Feed Control Officials / AAFCO; European Petfood Industry Federation / FEDIAF (Fédération Européenne De l'Industrie des aliments pour Animaux Familiers); National Research Council / NRC. The main directions in control exerted by these organizations are feed evaluation, ensuring safety of use, the system of preventing violations in feed safety and providing generally available information concerning feed compliance.

In Ukraine, producers of healthy feeds for dogs and cats use a nutrient approach according to the manual FEDIAF. They apply Holistic-fresh technology, functional healthy supplements, prebiotics and probiotics, alpha-tocopherol as an antioxidant that arouses interest in animal owners.

Key words: cats, dogs, feeding, healthy diet, dry feeds, AAFCO, FEDIAF, NRC.

Соболь О.М., Кривий В.В., Бокишань Г.І. Огляд сучасних підходів до здорового харчування для собак та кішок

У статті представлені результати аналізу інформаційних джерел щодо здорового харчування собак та кішок. Визначено, що у сучасних умовах підвищується значення таких характеристик кормів як безпечність, гарантовані контрольовані показники, перетравність, привабливість та висока поживна цінність. Пошук вивчення впливу дієтичних втручань направлений на використання неінвазійних досліджень, можуть використовувати і методику від експрес-аналізу, аналізів in vitro та in vivo до молекулярних технологій.

У зв'язку із необхідністю забезпечення активного довголіття домашніх тварин, основним трендом сучасної petfood індустрії є розробка лінійок кормів для здорового харчування тварин. Це призвело до зростання кількості та різноманіття промислових кормів, збільшення вимог до їх складу, виробництво функціональних кормів та кормових добавок. Забезпечення корисності та безпечності здорового промислового корму відбувається на всіх стадіях його виробництва за умов збереження корисних якостей сировини і завершується тестуванням смакових показників.

З урахуванням вимог здорового харчування домашніх тварин основні вимоги визначають Американська асоціація державного контролю за якістю кормів/AAFCO (Association

of American Feed Control Officials); Європейська федерація виробників кормів для домашніх тварин/FEDIAF (Fédération Européenne De l'Industrie des aliments pour Animaux Familiars); Національна дослідницька рада/NRC (National Research Council). Основними напрямками контролю збоку цих організацій є оцінка кормів, забезпечення безпеки їх використання, система профілактики порушень безпеки кормів та видання загальнодоступної інформація щодо відповідності кормів.

В Україні виробники здорового харчування для собак та кішок використовують нутрієнтний підхід згідно мануалу FEDIAF. Використовується Holistic-fresh технологія, функціональні корисні добавки, пребіотики і пробіотики, альфа-токоферол у якості антиоксиданту, що збільшує зацікавленість власників тварин.

Ключові слова: кішки, собаки, годівля, здорове харчування, сухі корми, здорове харчування, AAFCO, FEDIAF, NRC.

Problem statement. Feeding is the most important factor of growth and development, functional and morphological changeability of animals of all species. The type of nutrition of agricultural animals affects immediately the systems related to consumption and use of nutrients and has a purposeful impact on health, productivity level and product quality. It is proved that feeding is the factor affecting intensity of metabolic processes, in particular, growth and development of cattle replacements. It was found that the higher the concentration of metabolic energy, raw and digestible protein in 1 kg of dry feed matter was, the less the need of an organism of them was, the higher effectiveness of using feeds for young animal growth and development, and manufacturing products was [1]. In sheep industry an increase in the content of energy and proteins in the diets for Askania fine wool breeds by 15–20% ensured the yield of 3.0 – 3.5 kg of net wool and improved its quality [2].

In poultry industry, introduction of high energy feeds and different biologically active supplements, in particular, amino-acids, vitamins, macro- and micro-elements and antioxidants in mixed fodders has a positive impact on digestion of feed nutrients and egg productivity of laying hens [3].

When it comes to dogs and cats, pet owners have increasing concerns about the nutrition of their pets, and they desire foods and treats that are safe, traceable, and of high nutritive value, that requires special, long and expensive research. To meet these high expectations, detailed chemical composition characterization of ingredients well beyond that provided by proximate analysis will be required, as will information about host physiology and metabolism [4].

Taking into account the specificity of feeding pets, we consider nutritional value, digestibility, attractiveness etc. to be important indexes of evaluation of certain feeds and feed rations. Because of specificity of feeding dogs and cats, the modern systems of determining quality, safety and attractiveness of feeds and rations use of faster and more precise analytical methodology and novel technologies that have the potential to improve pet food safety and quality will be implemented, i.e. laboratory and bio-technological methods are used more increasingly.

For instance, in vitro and in vivo assays will continue to be used as screening tools to evaluate nutrient quality and adequacy in novel ingredients prior to their use in animal diets. The use of molecular and high-throughput technologies allows implementation of noninvasive studies in dogs and cats to investigate the impact of dietary interventions by using systems biology approaches. These approaches may further improve the health and longevity of pets [5].

Many years of experience in keeping and breeding productive and non-productive animals shows that feeding can either contribute to recovery or, vice versa, cause some diseases and reduce organism resistance to different pathogens.

In case of infectious and invasive diseases feeding plays a role of a powerful factor maintaining organism resistance. Therefore, it is very important to develop special diets considering sex, age, body weight, physiological condition, housing conditions and other factors affecting metabolism of both dogs and cats.

A positive impact of a healthy diet on a healthy or ill animal was proved, appropriate feeding allows avoiding diseases, related to a diet, and also contributes to recovery from other diseases at all life stages [6].

Thus, requirements to ration quality for pets become higher, they should not only meet the needs of animals of necessary nutrients and biologically active substances and comply with veterinary and sanitary requirements in terms of quality, but also ensure maintaining high living standards of animals. Therefore, the research aimed at developing adapted and balanced feed rations based on healthy diets for pets is considered to be topical that affected the choice of the review subject.

Analysis of the latest studies and publications. Appropriate feeding plays a major role in maintaining animals' health and proper treatment of many diseases. Nutrients maintain life activity and perform many functions in an organism: they are structural components of an animal body; they participate in chemical reactions of metabolism; regulate consumption, distribution and discharge of different substances; maintain thermal regulation; affect feed taste and attractiveness; provide an organism with energy.

Health and functional state of a nervous system, growth and development rates immediately depend on appropriate animal feeding. Inappropriate feeding of young animals, especially of large breeds, has a negative impact not only on their weight and measurements, but also deteriorates body construction and reproductive characteristics. Poor feeding of pedigree animals has a negative impact on quantity and quality of gametes, on embryo development and offspring quality, reduces ability to fertilize and is often a reason for birth of weak and inviable progeny; it often causes diseases of a digestive system and metabolism. Thus, appropriate feeding should be healthy, balanced and effective [7].

Mistakes in feeding occur especially often in using home unbalanced rations – it is quite difficult to balance them since digestive systems of dogs and cats are not adapted to feeding on either porridge with meat, or on feeds of BARF type or human food. For instance, German shepherd females fed on appropriate dry feeds exceeded in live weight those fed on home rations by 9,20% [8].

It is more difficult to meet nutritional requirements of cats since veterinary nutritionists must take into account that phylogenetic specificity of water consumption causes risks of pathologies of digestive, endocrine and urinary systems [9; 10].

Special conditions of a cat life in places of the species origin led to such an important feature of a cat organism as an ability to concentrate urine, that under modern housing conditions can cause a feline lower urinary tract disease [11]. Moreover, they are too conservative in choosing feeds, poorly digest plant carbohydrates even after thermal treatment, there are individual advantages of certain animals and breed characteristics of feeding [12].

While eating, cats are slow and finicky, they spend much time licking their hair and hairs get into their digestive system, some of them are released in a natural way, others are coughed up by animals. Mixed with feeds, hairs make large pieces that can cause thrombosis of organs of a digestive system. Therefore, feeds must contain probiotics, prebiotics, fibers and ingredients accelerating the process of releasing hair pieces.

The ration of domestic cats must contain a high content of protein, essential amino-acids: tryptophan, threonine, methionine, histidine, lysine and isoleucine. Protein

deficiency can cause processes when a liver starts fermenting protein of its cell. Methionine, taurine and cystine deficiency in tissue cells can cause degenerative processes in organs and tissues, serious diseases (cardiomyopathy, central retina degeneration, reproductive function disorders) [10].

Thus, healthy diets for pets are a main factor of their longevity and well-being, and diet therapy is a main component of pathogenetic therapy and helps prolong and improve well-being of animals with different pathologies [12].

Materials of the research. Problems of ensuring active longevity of pets induce to search for the modes of their healthy diets that would contribute to their growth, optimal development, appropriate life activity, improve health and prevent non-communicable diseases including such widespread causes of mortality as diseases of cardiovascular and digestive systems, metabolism and oncological diseases.

A healthy diet in the entire course of life is the most important element in health maintenance and improvement of the present and future generations of dogs and cats, an indispensable condition for their longevity and high living standards. Exact composition of a healthy diet depends on individual characteristics of animals – largely on their species, breed, age, sex, way of life, reproductive status, level of physical activeness, list of available products [13].

In terms of higher requirements for healthy diets of pets, the use of manufactured and traditional (home-made) feeds has its advantages and disadvantages, but on the whole, there is a steady tendency to an increase in the quantity and diversity of manufactured feeds and the requirements for their composition become higher – a balanced ration must combine good taste qualities and adequate content of all necessary nutrients [14].

There is a high rate of development in production and consumption of functional feeds and feed supplements which provide health benefits if they are consumed on a regular basis as part of a varied diet. Indeed, functional foods modify gastrointestinal physiology, promote changes in biochemical parameters, improve brain functions and may reduce or minimize the risk of developing specific pathologies [5].

In the USA and the countries of Western Europe petfood industry has the history of 150 years, whereas in Ukraine this business has operated for about two decades. Before the 2000s the need of Ukrainians of petfood was satisfied by 100% by the importers from Europe and the USA на 100%, currently there are about ten petfood producers in the domestic market [16; 17].

The problem of manufacturing healthy ready-made feeds starts prior to their production, since there is a problem of developing formulations and searching for high-quality raw materials – meat, offal (heart, liver) and others. Moreover, in order to improve animal immunity, different plant components are added: chamomile, thyme, ginger, ginseng, blackberries, flax. In large-scale production there are about 150–200 formulations.

Before make an agreement with a supplier, it is necessary to evaluate safety of manufacturing raw materials that requires not less than half a year and monitor each batch. After it is delivered to an enterprise, it undergoes quality control by the indexes of microbiological evaluation, safety and nutritional value. After these stages, animal needs are examined and taste qualities are tested by means of animals-tasters whose owners have signed agreements with a company [13].

Further it is necessary to determine the ways to preserve useful qualities of raw materials in the processes of extrusion and vacuum deposition in manufacturing dry feeds. Extruders transform dry mixed and chopped raw materials into granules of dry feeds. The following step: the system of vacuum deposition covers the surface of a granule

with fat to saturate it with nutrients. In the process of vacuum deposition dry granules are placed in a container, air is pumped out that results in vacuum, then fat is added. At the next stage air again fills the container, fat is pressed into a granule and is fixed in it firmly, after that packaging takes place. After vacuum deposition dry feeds are packaged.

In production of moist feeds meat raw materials are processed into emulsion, which, after testing with metal detectors, are passed to steam tunnels. Prepared meat pieces are brought to an automatic packaging line by means of multi-head weighers, after that packaged feeds are sterilized [16; 17].

According to the requirements for a healthy diet, animal feeds must contain minimum and maximum levels or quantity of certain nutrients. Currently main universal requirements for animal feeds are determined by such reputable global organizations as: Association of American Feed Control Officials /AAFCO; European Federation of Feed Producers for Domestic Animals / FEDIAF (Fédération Européenne De l'Industrie des aliments pour Animaux Familiers); National Research Council / NRC. On the basis of their research they develop nutrient profiles of for petfood containing acceptable levels of these substances. Compliance with these nutrition profiles is marked on packages and it is often obligatory [18].

There are also requirements for labels and instructions concerning the use of such product markings as organic, made of organic meat; or markings concerning control over tooth stone; pH level; nutrient profiles for dogs and cats including minimum and maximum requirements for essential nutrients supposed to be included into petfood formulations for a certain stage of their life and also procedures accepted to evaluate sufficiency of feeding; additional materials according to an organization's agreement.

AAFCO (Association of American Feed Control) has existed since 1991 (for dogs) and since 1992 (for cats). It publishes recommendations on pet feeding annually. In the USA, in order to be marked as «complete and balanced», it should comply with the requirements of AAFCO. Individual states often use AAFCO's recommendations to create pet food regulations.

AAFCO does not directly test, regulate, approve, or certify pet foods to make sure that they meet the standard requirements. Instead, they establish guidelines for ingredient definitions, product labels, feeding trials, and laboratory analyses of the nutrients that go into pet foods.

In order to evaluate feeds according to the AAFCO guidelines, pet food companies use third-party testing agencies to analyze their foods. An important direction in the activity of AAFCO is to ensure safety of using feeds due to the Food and Drug Administration (FDA), which makes sure that the ingredients used in pet food are safe and have a purpose in pet food. The FDA also regulates specific claims such as “low magnesium” [19].

The system of prevention of food safety violation has several levels, pet food is regulated at both the federal and state levels. While the U.S. Food & Drug Administration (FDA) has federal regulatory authority, pet food is also typically regulated in states by their departments of agriculture. AAFCO, an organization of state and federal regulators, develops model pet food regulations for states to adopt as part of their oversight of pet food.

Data on compliance of feeds of different brands is widely accessible. Each year, AAFCO publishes its “Official Publication” (“OP”), which contains model rules that may be adopted in part or in full by state regulators. Adoption of the model law makes it easier for states to keep their pet food regulations current. The full AAFCO membership meets twice per year, typically in January and early August. In addition, committees and working groups collaborate throughout the year on various topics.

FEDIAF (European Federation of Feed Producers for Domestic Animals) was founded in 1970. It involves organizations of 26 European countries and represents about 650 companies producing over 90% of pet food in Europe [20]. FEDIAF represents producers, packaging companies and importers of ready-made feeds for pets (dogs, cats, birds etc.) and collaborates with European authorities in implementation of legislation concerning petfood to ensure production and distribution of safe, balanced and high-quality taste of petfood.

In the structure of the committees of the Federation there are trade associations of member countries (70% votes) and companies manufacturing feeds (30% feeds). Since 1970 European legislators have made a number of acts and regulations immediately affecting all production stages and marketing of petfood. Legislative acts are regularly reviewed in order to adapt them to scientific and technological advances. FEDIAF issues 3 main codes concerning exploitation of enterprises producing petfood; rules for petfood labelling; general rules for advertising; use of raw materials of animal and plant origin; use of supplements depending on their usefulness, effectiveness and safety; sanitary and hygienic measures (including special medical certificates for trade and meat product processing); selection of samples and methods for analysis to control raw materials and ready-made products; special sanitary and safety measures, and also control over declarations on labels; use of dietary feeds for animals whose metabolism has temporary or irreversible disorders [21].

Legislative acts on control over petfood quality include a number of regulatory documents:

Guide to Good Practice for the Manufacture of Safe Pet Foods;

FEDIAF Code of Good Labelling Practice for Pet Food;

Nutrition Guidelines for Complete and Complementary Pet Food for Cats and Dogs.

One more global regulatory body is National Research Council (NRC) / sub-department of the National Academy of Sciences (the USA) has published reports on needs of nutrients of many animal species since the forties of the 20th century serving the basis for recommendations on nutrients for dogs and cats (1974 – 1978) containing one recommendation for all stages of animal life. Since 2006 the NRC has indicated minimum and maximum quantities or concentrations for each nutrient in ingredients which are usually produced and available for sale, what genetically modified organisms (GMO) and meat semi-finished products can be, including those obtained from dead, ill, dying and crippled animals.

The main problem of NRC data is objectivity – the organization does not receive proper financial aid, i.e. depends on sponsors by each report [22].

A certain preventive measure against bias is restrictions concerning the proportion of sponsor financial aid. In order to protect its reputation, the NRC has clear methods confirming that research is based on high quality scientific data and discussions.

Feed industry representatives decide on standards they follow in their work either according to the regulatory measures of their country or on their own. Manuals of different organizations may have a different order of nutrients in the tables. Although all these documents have a common table in which the needs of nutrients are given in units per 1000 kcal ME (metabolic energy), these units can be different.

For instance, NRC indicates requirements for vitamins A, D and E in RE (retinol equivalents) in mcg and mg, respectively. Therefore, it is necessary to compare these units with the units of ME, used for these vitamins in AAFCO and FEDIAF. Unlike AAFCO and FEDIAF, in NRC the acceptable values in terms of composition and ingredients are meant for practical use, therefore, they are suitable for using in

practice in comparison with the values of AAFCO and FEDIAF. On the whole, members of FEDIAF and AAFCO actively use the manuals of NRC, many nutritionists actively use those of NRC or FEDIAF or AAFCO [23].

In Ukraine registration of ready-made feeds included only registration of each formulation of a ready-made product imported or produced in Ukraine. In January 2020 the Law "About feed safety and hygiene" became operative. According to the new system of registration of feed supplements, ready-made feeds can be produced or imported into Ukraine only if the supplements used are registered in the State Catalogue of Feed Supplements.

In 2019 the total volume of the market of petfood in Ukraine made more than UAH 6 billion, and in 2020 this process continued [16; 17]. But many pet owners pay attention not only to a feed price, but also to its composition and probable impact on health. Taking into consideration the global main stream with regard to increasing well-being and longevity of dogs and cats, feed producers pay more attention to the brands declaring standards of healthy diets. For instance, the feed portfolio of Royal Canin numbers more than 350 formulations. The main lines include Breed Health Nutrition (for pure breed cats and dogs), Size Health Nutrition (for animals of different sizes and ages), Canine Care Nutrition (for animals with certain health features), innovative ICU – the first ration for feeding animals in a critical condition through a tube.

Against a background of these tendencies in Ukraine in 3 December, 2021 "UFP YUNION" – "ASSOCIATION OF UKRAINIAN PRODUCERS OF HEALTHY PET FOOD" was established [24]. The producers of this Association use a nutrient approach according to the manual of FEDIAF, each ration can include more than 40 nutrients. For instance, one of the members of the Association – the company Praktik introduces itself as a family of brands of healthy feeds for dogs and cats. Holistic-fresh technology of adding fresh meat to dry granules is used in production of innovative feeds of the lines Praktik Fresh. Components of animal origin make 67% for dogs and 78% for cats and include fresh turkey, beef, duck, sprat, pork, offal (heart, liver), eggs and turkey fat.

Such useful supplements as fresh carrot, cranberries, dried apples, pumpkin seeds, alfalfa, a complex of vitamins, prebiotics and probiotics, alpha-tocopherol as an antioxidant are added to feeds [25; 26]. The only problem of using feeds produced with Holistic-fresh technologies is a short shelf life – 4 months, for dry feeds manufactured with traditional technologies it is about 2 years.

Conclusions and suggestions. The analysis of the information sources indicates an increase in the importance of such feed characteristics as safety, guaranteed controllable indexes, digestibility, attractiveness and high nutritional value. In order to examine the impact of dietary intrusions, methods of express-analysis can be used, but at the current development stage of petfood industry there are more widespread fast and accurate analytical methods, including molecular technologies for conducting non-invasive research on dogs and cats. Analyses *in vitro* and *in vivo* still remain important instruments for evaluation of nutrient quality and adequacy of new ingredients in terms of use in animal rations considering their physiology and metabolism.

Since requirements for petfood quality become higher, there is an increase in topicality of developing adapted balanced feed rations based on the principles of healthy diets for pets, since low-quality feeds for pedigree animals have a negative impact on all organism systems, general well-being, cause weaker immunity and diseases, mainly, of digestive organs and metabolic disorders. Inappropriate feeding is especially dangerous in terms of metabolic and behavioral features.

The main trend of the modern petfood industry is development of feed lines of healthy diets for animals aimed at maintaining and improving health of the present and future generations, their active longevity and high living standards. It has resulted in an increase in the quantity of manufactured feeds and their diversity, higher requirements for their composition, production of functional feeds and feed supplements. Ensuring usefulness and safety of healthy manufactured feeds takes place at all stages of their production provided that useful characteristics of raw materials are retained and the final stage of this process is testing taste characteristics.

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