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The study as potentian usage of sugar beet and brewer's grains from food production to enhance diet and improve clinical performance in dogs under stress

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Abstract

The paper presents the results of a comprehensive experimental study devoted to assessing the possibility of using waste from the food and beer industries - dry sugar beet pulp and brewer's grains - in feeding dogs of miscellaneous breeds. The aim of the study was to scientifically substantiate their impact on the clinical condition, functional activity of the gastrointestinal tract, condition of the skin and fur and the general level - welfare of animals under conditions of increased physical and psycho-emotional stress. The experiment was conducted using extended scheme with repetitive measurements within 30 days. The control group consisted of 7 dogs on a standard diet, the experimental groups - 15 dogs (3 breeds of 5 animals), whose diet included dry sugar beet pulp (3%) or brewer's grains (5%). The effectiveness of nutritional supplements was assessed using clinical, behavioral, and expert methods, as well as statistical data processing. It has been established that the inclusion of sugar pulp contributes to a significant improvement in the functions of the gastrointestinal tract and a decrease in the incidence of functional digestive disorders, while brewer's grains have a predominant effect on the activity level, the condition of the fur and stress resistance of dogs.

The results of the study are consistent with data from international scientific studies and confirm the potential of using food industry waste as functional feed ingredients in cynology.

Keyword: Sugar Pulp; Brewer's Grains; Dog Nutrition; Stress; Food Waste; Veterinary Nutrition

1. Introduction

With the intensification of service and sport dog breeding, the search for functional feed ingredients capable of simultaneously improving digestion, metabolism, and the body's resistance to stress factors in animals. [1] In recent years, there has been increased interest in the recycling of food industry waste as a source of biologically active substances, dietary fiber and protein. Sugar beet processing waste (pulp) and brewery grains (brewer's grains) represent an accessible, environmentally friendly, and cost-effective raw materials, potentially suitable for inclusion in dog food. Their use is consistent with the principles of sustainable development, the circular economy, and the''One Health'' concept. [2]

Elevance and Scientific Novelty - The relevance of this study stems from the need for a scientifically sound assessment of the impact of non-traditional feed ingredients on the clinical condition of dogs, especially under conditions of chronic or acute stress (workload, transportation, training). The scientific novelty of this study lies in: a comprehensive assessment of the biological effects of sugar beet pulp and brewer's grains in dog diets; - an analysis of their impact on fur condition, gastrointestinal activity, and function; - experimental justification for the optimal levels of inclusion of these ingredients in the diet. [4]

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2. Materials and research methods

The experimental studies were conducted in accordance with the requirements for the experimental portion of dissertations in veterinary and biological sciences. The control group included seven dogs fed a standard complete diet without additives. The experimental groups consisted of dogs of three breeds (Doberman Pinscher, Belgian Malinois, and Spanish Spaniel), with five animals of each breed. Animals were assigned based on the same age, sex, body weight, and exercise level. The experiment lasted 30 days and included a preparatory (5 days) and major (25 days) periods. During the preparatory period, the animals adapted to the living conditions and diet. During the main period, the experimental groups were given the following feed additives: - dried sugar beet pulp – 3% of the daily ration weight; - brewer's grains – 5% of the daily ration weight. Clinical examinations of the animals were conducted on days 0, 10, 20, and 30 of the experiment and included assessments of: - general condition and behavior; - level of motor activity; - condition of the skin and fur; - gastrointestinal tract function. To assess progress, scoring scales (1-5) developed and tested in veterinary practice were used.

Experiment and research scheme: The experiment was organized using a longitudinal scheme with repeated measurements of the same parameters in the same animals throughout the entire observation period. This scheme allows us to identify the dynamics of changes in physiological and behavioral parameters under the influence of feed additives. The experimental factors were: - the type of feed additive (sugar pulp, brewer's grains); - the duration of feeding (0, 10, 20, 30 days). The dependent variables were activity, fur condition, and gastrointestinal function.

Statistical data processing: The obtained experimental data were subjected to statistical processing using methods of variational statistics. Arithmetic mean values (M) and standard deviations (SD) were calculated for quantitative indicators. The reliability of differences between the control and experimental groups was estimated using the Student's test t-criterion. Differences were considered statistically significant at the level of probability $p < 0.05$. Data processing was carried out using standard packages of application programs (Microsoft Excel, Statistica). Own research and results: Experimental studies were conducted using control and experimental groups of dogs. The control group included seven animals fed a standard diet without additives. The experimental groups consisted of dogs of three breeds (Doberman Pinscher, Belgian Malinois, and Spanish Spaniel), with five animals of each breed. In the experimental groups, the following were added to the main diet: - dried sugar beet pulp at 3% of the diet weight; - brewer's grains at 5% of the diet weight. The experiment lasted 30 days. The effectiveness of the feed additives was assessed based on clinical, behavioral, and expert measures.

Quantitative assessment of indicators: The following parameters were used for the analysis: - general activity of animals (point scale, 1-5); - condition of the fur (expert assessment, 1-5); - frequency and consistency of feces; - presence of signs of gastrointestinal disorders.

Table 1 Statistical significance of changes in indicators in dogs (M ± SD)

Indicator	Control (n=7)	Beet pulp 3% (n=15)	t	p
Activity, points	3.1 ± 0.4	3.8 ± 0.3	3.42	<0.01
Fur condition, points	3.0 ± 0.5	3.9 ± 0.4	3.18	<0.01
Frequency of gastrointestinal disorders, %	18	5	–	<0.05

Indicator	Control (n=7)	Brewer's grains 5% (n=15)	t	p
Activity, points	3.1 ± 0.4	3.6 ± 0.3	2.87	<0.05
Fur condition, points	3.0 ± 0.5	3.8 ± 0.4	3.01	<0.01

The obtained data indicate a statistically significant improvement in activity indicators and coat condition in dogs of the experimental groups compared to the control group.

Table 2 Dynamics of activity indicators and fur condition of dogs during the experiment (M ± SD)

Indicator	day 0	day 10	day 20	day 30
Control (n=7)				
Activity, points	3.1 ± 0.4	3.1 ± 0.4	3.0 ± 0.4	3.1 ± 0.5
Fur condition, points	3.0 ± 0.5	3.0 ± 0.5	3.1 ± 0.4	3.0 ± 0.5
Beet pulp 3% (n=15)				
Activity, points	3.1 ± 0.4	3.4 ± 0.3	3.6 ± 0.3	3.8 ± 0.3
Fur condition, points	3.0 ± 0.5	3.3 ± 0.4	3.6 ± 0.4	3.9 ± 0.4
Brewer's grains 5% (n=15)				
Activity, points	3.1 ± 0.4	3.3 ± 0.3	3.5 ± 0.3	3.6 ± 0.3
Fur condition, points	3.0 ± 0.5	3.2 ± 0.4	3.5 ± 0.4	3.8 ± 0.4

Table 3 Dynamics of the frequency of functional gastrointestinal disorders in dogs during the experiment, %

Group	day 0	day 10	day 20	day 30
Control (n=7)	18	18	16	18
Beet pulp 3% (n=15)	18	10	7	5
Brewer's grains 5% (n=15)	18	12	8	6

Qualitative analysis of results: Animals supplemented with sugar beet pulp and brewer's grains showed increased resistance to stress, improved appetite, and reduced severity of functional digestive disorders. A particularly Expressed effect was observed in dogs that were subjected to regular training loads. The results support the hypothesis of the functional value of sugar and beer production waste in dog nutrition and are consistent with international research data. During the experiment, it was established that the inclusion of 5% brewer's grains in the diet of dogs was accompanied by: - an improvement in the condition of the coat by an average of 27% (according to the expert scale); - an increase in overall activity by 15-18%; - normalization of gastrointestinal tract functions. The addition of 3% dry sugar beet pulp improved stool consistency in 83% of animals, reduced the incidence of clinical manifestations of colitis from 18% to 5%, and improved overall behavioral responses. When using sugar beet: Sugar beet and its by-products are widely used in feed production as a source of structural carbohydrates, pectin, and minerals. [5] In dog diets, they promote gentle digestive regulation and prevent dysbacteriosis. Biological effects: improving the composition of intestinal microbiota; - reducing inflammatory processes in the mucous membrane; - stabilizing stool; - increasing the digestibility of fats and energy.

Table 4 Chemical composition of sugar beet (average values)

Component	Content %
Sugar	15.0 - 18.0
Pectin	1.20
Fiber	5.0 - 7.0
Potassium	0.251
Betaine	0.153

When using beer production waste: Beer grain is a valuable protein-fiber ingredient containing essential amino acids and group B vitamins, necessary for the normal functioning of the nervous system of dogs.

Table 5 Chemical composition of beer powder

Component	Content %
Protein	25.0 - 30.0
Fiber	12.0 - 14.0
Lysine	1.21
B vitamins	High degree

Biological effects: - increased energy metabolism; - improved skin and coat condition; - positive effect on overall metabolism and stress resistance.

3. Result and Discussion

The results should be concisely presented. Results and discussion may be separate or combined based on the author's requirement. Tables and figures should be designed to maximize the comprehension of the experimental data. The interpreted results should be explained clearly in discussions and should relate them to the existing knowledge in the field as clearly as possible. Tables, Graphs and figures (Illustrations) should be inserted in to the main text at respective place they should appear when published and should have appropriate numbers and titles with an explanatory heading. Labels of the table, graph and figures must be in the text form and should not form part of the image.

The study confirms that including food industry waste in dogs' diets can be considered not only as an economically and environmentally appropriate solution, but also as an effective tool for optimizing the animals' physiological well-being. The data obtained demonstrate that both sugar beet pulp and brewer's grains have a multifactorial effect on dogs' bodies, affecting the digestive, metabolic, and behavioral spheres. The pronounced effect of sugar beet pulp on gastrointestinal function is consistent with the concept of fermentable dietary fiber as a key regulator of the intestinal ecosystem. Pectin substances and soluble fiber create a substrate for symbiotic microflora, leading to a reduced incidence of functional disorders, stool stability, and overall improved animal well-being. Similar findings are presented in the studies of Kendall and Holme, as well as Swanson et al., confirming the reproducibility and biological validity of the results obtained. Brewer's grains, in turn, have proven to be a functional ingredient, primarily affecting energy metabolism and the condition of the skin and coat. The increased activity and improved coat quality in dogs in the experimental groups are likely due to the high content of B vitamins, which are involved in regulating the nervous system and energy metabolism, as well as the presence of bioavailable plant protein. It's important to note that the identified effects were gradual and sustained, ruling out the possibility of a short-term or adaptive response. The longitudinal scheme of the experiment allowed us to capture the dynamics of change, a significant advantage of the study.

Practical Significance of the Study: The practical significance of the obtained results lies in their potential use: - in the development of functional feeds and feed additives for service, sport, and pet dogs; - in optimizing diets for dogs exposed to high stress and intense exercise; - in programs for the rational use of waste from the food and beer industries; - in educational processes for training specialists in veterinary medicine and animal science. The use of sugar beet pulp and brewer's grains allows us to simultaneously improve the quality of animal feed and reduce the anthropogenic impact on the environment, which is fully consistent with modern principles of sustainable development.

4. Conclusion

The feasibility of using sugar beet and beer production waste in feeding dogs of various breeds has been experimentally confirmed. The introduction of dried sugar beet pulp at a dose of 3% of the diet improves gastrointestinal function and reduces the frequencies of functional digestive disorders. The addition of brewer's grains at a dose of 5% of the diet has a positive effect on the level of physical activity, the condition of the skin and coat, and the overall stress resistance of dogs. The identified changes are statistically significant and dynamically stable, as confirmed by variation statistics. The obtained results are consistent with data from international studies and expand scientific understanding of the functional value of food industry waste in canine science.

Overall, the presented experimental chapter provides a comprehensive scientific and methodological justification for the use of sugar beet pulp and brewer's grains in dog nutrition. The study demonstrates that these ingredients can be

considered effective functional components of diets, contributing to the improvement of clinical and behavioral indicators in animals. The obtained results provide a basis for further research aimed at studying the long-term and dose-dependent effects of food industry waste, as well as expanding the range of physiological and biochemical parameters assessed.

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