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Evaluation of the effectiveness of a general tonic feed additive for minks under industrial production conditions

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Abstract. Feeding balanced in amino acids, micro and macro elements, vitamins and other biologically active substances is a necessary condition for the productivity and development of fur animals, as well as for obtaining high-quality fur raw materials. Analysis of the amino acid profile of the main productive diet of the mink at JSC Fur Farm "Saltykovsky" revealed a deficiency of the essential amino acids: histidine, tryptophan and threonine, when maintaining a total protein within the normal range. To correct protein metabolism, a hydrolysate from sable and mink carcasses after technological euthanasia and skinning was included in the diet of minks. The hydrolysate is sterile, does not have pyrogenicity, acute and chronic toxicity, does not cause allergic reactions, contains 18 amino acids, including 10 essential, 6 macronutrients (Ca, Na, S, Mg, K, P) and 18 trace elements. A scientific and economic experiment was carried out by a commission on the basis of JSC Fur Farm "Saltykovsky" on standard wild mink 3 months of age, of which 1 control and 2 experimental groups of 120 animals each (60 males and 60 females) were formed. The results of the experiment showed that the feed additive in doses of 2 and 4 ml of a 15% solution per capita mixed with feed of the productive diet once a day for 4 months has a tonic effect on the mink organism.

Keywords: essential and non-essential amino acids, enzymatic hydrolysis, amino acid nutrition, complete and incomplete proteins, meat industry waste, fish industry waste

Author contribution: Denisenko V.N. — concept and design of the study; Abramov P.N. — collection and processing of materials, writing an article; Balakirev N.A. — concept and design of the study; Albulov A.I. — concept, analysis of the obtained data; Frolova M.A. — analysis of the obtained data, editing the article. All authors reviewed the final version of the manuscript and approved it.

Conflict of interest. The authors declare no conflict of interests.

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Introduction

Feeding balanced in amino acids, micro and macro elements, vitamins and other biologically active substances is known to be a necessary condition for the growth and development of fur animals, as well as for obtaining high-quality fur raw materials [1].

The basis of the diet of fur animals of cage management is the waste of the meat and fish industries. By-products are used for feeding animals: spleen, rumen, abomasum, esophagus, diaphragm, trachea, tail region of the spine, ears and lips of productive animals, as well as heads and internal organs of fish. Non-grade, unsuitable for food purposes meat is also used [2].

Our analysis [3] of the amino acid profile of the main productive diet of mink at JSC Fur Farm "Saltykovsky" revealed a deficiency of essential amino acids: histidine, tryptophan and threonine, with a total protein content within the normal range.

To correct protein metabolism, feed containing complete proteins of animal origin or their hydrolysates is included in the diet of animals [4–6]. The use of enzyme hydrolysates is more effective, since they do not require the body's energy costs for digesting food and do not depend on the functional state of the digestive system organs [7, 8].

However, food products of animal origin and chemically pure proteolytic enzymes that are used in enzyme hydrolysis have a high cost, so their use for obtaining a feed additive in production conditions is economically impractical.

We have developed an original method for obtaining a relatively cheap hydrolysate from sable and mink carcasses after technological euthanasia of animals and skinning. Where in the source of proteolytic enzymes is the pancreas of a pig [4, 9, 10].

The aim of the study is to investigate the use of enzyme hydrolysate of minks as a general tonic feed additive in fur farming conditions.

Materials and Methods

Conducting experiments on animals, a hydrolysate from mink carcasses manufactured by Bioprogress LLC in accordance with TS 91-86-036-117-341-26-17 and the technological regulations of the Customs Union (TR CU 029) 2012 was used. It is a yellow-cream powder with a mass fraction of amine nitrogen 6.9%, a moisture content 5.0%, pH 6.4. The hydrolysate is sterile [11], does not have pyrogenicity, acute and chronic toxicity [12, 13], does not cause allergic reactions [14].

The hydrolysate contains 18 amino acids, including 10 essential ones: arginine (4.5%), valine (3.72%), histidine (1.85%), isoleucine (2.75%), leucine (5.4%), lysine (5.35%), methionine (1.5%), threonine (3.1%), tryptophan (1.2%), phenylalanine (2.7%).

In addition to amino acids, the drug contains 6 macronutrients (Ca, Na, S, Mg, K, P) and 18 trace elements (I, Ca, Fe, Zn, Al, etc.).

A scientific and economic experiment was carried out by a commission on the basis of JSC Fur Farm "Saltykovsky" using standard wild-type mink.

During design and performance of the experiment, we followed the "Recommendations for the use of 15% protein hydrolysate", approved by the methodological commission of the Section of Animal Science and Veterinary Science of the Department of Agricultural Sciences of the Russian Academy of Sciences [15].

We formed 3 groups of 3-month-old mink puppies for the studies, each group consisted of 120 animals, 60 males and 60 females. The first group of minks was a control one and received a main productive diet. The animals of the 2nd and 3rd experimental groups received once a day a 15% solution of the mink carcasses hydrolysate at the rate of 2 and 4 ml per capita, respectively, added to the main diet. The drug was used before the planned euthanasia of animals.

After the experiment blood samples were taken from the animal tail tip immediately prior to euthanasia and skin samples were taken from the chest area after slaughter.

Morphological and biochemical blood tests were performed using the Mindray BC-2800 Vet haematology analyser and the BioSystems BA-200 automatic biochemical analyser.

Skin samples were fixed in a 10% buffered solution of neutral formalin. Histology specimens were prepared on a Leica SM2000R microtome and stained with hematoxylin and eosin. The histological picture was studied using a Carl Zeiss AxioScope microscope.

The dynamics of body weight of animals of the control and experimental groups, haematological, biochemical parameters and thickness of individual layers of the dermis were assessed.

Results and Discussion

The indicators of experimental and control animals are shown in the table.

The above data (Table) indicate an increase in the body weight gain of animals of the 2nd and 3rd experimental groups by 3.6 and 10.2% compared to the control.

Blood parameters of experimental animals are characterized by a significant increase in leukocyte levels and a decrease in ESR. In animals of the 3rd experimental group, there is a significant decrease of segmented neutrophils and an increase of band neutrophils.

A statistically significant increase in the relative and absolute levels of lymphocytes was found in the leukogram of both experimental groups.

There was a significant increase in the concentration of total protein in blood serum in experimental animals.

A significant increase in the thickness of the papillary layer of the dermis was revealed in the experimental minks, no significant changes in the micrometric parameters of the reticular layer were observed.

Under production conditions, the effect of a new feed additive on the organism of young minks was studied, as animals were fed an unbalanced in essential amino acids (histidine, tryptophan, threonine) diet.

The results of feeding wild type mink with a 15% solution of a tonic feed additive mixed with feed of the basic diet for weight gain, leukogram, haematological and biochemical parameters of blood and thickness of the papillary and reticular layer of the dermis

No.	Parameters	Reference values (Berestov V.A., 2002)	Control *n* = 120 group 1	Experiment	
				Group 2*n* = 120	Group 3*n* = 120
1	Weight gain, kg (%), for 4 months		1.37 ± 0.26 (100)	1.42 ± 0.17 (103.6)	1.51 ± 0.17 (110.2)
2	Blood parameters				
	Erythrocytes, 10^{17}/l	8.7 ± 0.6	7.8 ± 0.7	8.7 ± 0.8	8.4 ± 0.4
	Haemoglobin, g/l	180 ±18	132.0±18.5	141.0 ± 25.1	139.6 ± 23.0
	Leukocytes, 10^9/l	5.7 ± 1.4	5.8 (0.4)	8.8 ± 0.3	9.2 ± 0.2*
	ESR	–	1.9 ± 0.4	0.95± 0.2*	0.92 ± 0.1*
3	Leukogram:				
	Eosinophils,%	0…10	2.7 / 1.2	2.6 ±1.3	3.1 ± 1.1
	10^9/l		0.25 ± 0.06	0.24 ± 0.11	0.33 ± 0.2
	Band neutrophils,%	1 … 12	2.4 ± 0.1	2.8 ± 0.2	3.2 ± 0.3
	10^9/l		0.23 ± 0.2	0.24 ± 0.1	0.33 ± 0.2
	Segmented neutrophils,%	20…74	60.5 ± 2.3	40.1 ± 2.2*	41.1 ± 3.3*
	10^9/l		3.5 ± 0.7	3.59 ± 0.8	3.9 ± 1.4
	Monocytes,%	0…6	3.1 ± 1.4	3.8 ± 1.8	3.6 ± 1.8
	10^9/l		0.26 ± 0.2	0.33 ± 0.1	0.33 ± 0.2
	Lymphocytes,%	19…82	30.3 ± 4.1	50.0 ± 4.3*	48.0 ± 4.4*
	10^9/l		1.9 ± 0.5	4.4 ± 0.5*	4.4 ± 0.6*
4	Biochemical values:				
	Total protein, g/L		74.6 ± 21.0	130.0 ± 14.8*	105.2 ± 18.6*
	Glucose, mmol/L		7.2 ± 0.8	6.4 ± 1.4	6.9 ± 1.8
5	Thickness of dermis:				
	Papillary layer, μm		423.6 ± 15.1	645.4 ± 16.8*	748.8 ± 21.7*
	Reticular layer, μm		890.6 ± 20.6	900.5 ± 18.5	950.1 ± 19.8

Note. * Significance of the difference relative to the control group ($p \leq 0.05$).

Source: compiled by V.N. Denisenko, P.N. Abramov, N.A. Balakirev, A.I. Albulov, M.A. Frolova.

The feed additive is obtained by enzyme hydrolysis of fur farming waste — mink carcasses — using lytic enzymes of the pancreas.

It contains all essential and non-essential amino acids, as well as macro- and microelements. The feed additive is harmless to animals and has a low cost, which determines the economic feasibility of its use in fur farms.

After feeding a 15% solution of the feed additive mixed with feed of the basic diet for 4 months at doses of 2 and 4 ml per capita, once a day in experimental animals, an increase in body weight gain and levels of total protein in blood serum was noted.

The limiting amino acids contained in the feed additive are assimilated by the animal body and participate in the synthesis of proteins [3, 7], their metabolites are catalysts of metabolic processes.

Histidine is necessary for the synthesis of blood cells, including lymphocytes.

Tryptophan metabolites are involved in nucleic acid metabolism, serotonin synthesis, and the formation of digestive enzymes.

Threonine derivatives are precursors of adrenaline and thyroid hormones — thyroxine and triiodothyronine.

The leukogram showed a significant, but not exceeding physiological limits, increase in the relative content of band neutrophils and a decrease in segmented neutrophils. The increase in the percentage of young forms of neutrophils indicates the predominance of regenerative processes in experimental animals over degenerative ones.

A significant increase in the absolute and relative content of lymphocytes was revealed in the experimental minks, within the limits of physiological variations.

Lymphoid cells are the morphological basis of the immune system [6], therefore, the results obtained convincingly indicate an increase in immune reactivity in experimental animals.

In histological studies of skin samples of experimental animals, an increase in the thickness of its dermis due to the papillary (trophic) layer was found. In the papillary layer there are plexuses of lymphatic and glomerular blood vessels. An increase in the thickness of the skin, and, consequently, an increase in its technological properties, in experimental minks is associated with an improvement in trophism.

Conclusion

The results of studying the effect of an amino acid-mineral feed additive obtained by enzyme hydrolysis of mink carcasses on the body of mink puppies in fur farming conditions allow us to draw the following conclusions.

1. The results of the experiment showed that the feed additive in doses of 2 and 4 ml of a 15% solution per capita mixed with feed of the productive diet once a day for 4 months has a tonic effect on the mink organism.
2. The supplement stimulates protein synthesis, growth and development of animals.
3. It improves the regenerative activity of neutrophils and the overall immune reactivity of the body.

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Оценка эффективности использования общетонизирующей кормовой добавки для норок в условиях промышленного производства

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Аннотация. Необходимым условием для работы и развития пушных зверей, а также для получения высококачественного пушно-мехового сырья является сбалансированное по аминокислотам, микро- и макроэлементам, витаминам и другим биологически активным веществам кормление. Анализ аминокислотного профиля основного хозяйственного рациона норок ОАО «Племенной зверосовхоз „Салтыковский“» выявил дефицит в нем эссенциональных аминокислот гистидина, триптофана и треонина при создании общего белка в пределах нормы. Для коррекции белкового метаболизма в рацион норок был включен гидролизат из тушек соболя и норки после технологической эвтаназии животных и снятия шкурки. Гидролизат стерильный, не обладает пирогенностью, острой и хронической токсичностью, не вызывает аллергических реакций, содержит 18 аминокислот, в т.ч. 10 незаменимых, 6 макроэлементов (Ca, Na, S, Mg, K, P) и 18 микроэлементов. Научно-хозяйственный опыт проведен комиссионно на базе ОАО «Племенной зверосовхоз «„Салтыковский“» на стандартных норках дикого тила 3-х месячного возраста, из которых было сформировано 1 контрольная и 2 опытные группы по 120 голов в каждой (по 60 самцов и 60 самок). Результаты опыта показали, что кормовая добавка в дозах 2 и 4 мл 15%-го раствора на голову в смеси с кормами хозяйственного рациона один раз в сутки в течение 4 месяцев оказывает общетонизирующее влияние на организм норок.

Ключевые слова: заменимые и незаменимые аминокислоты, ферментативный гидролиз, аминокислотное питание, полноценные и неполноценные белки, отходы мясной промышленности, отходы рыбной промышленности

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