



CODEN [USA]: IAJPBB

ISSN: 2349-7750

**INDO AMERICAN JOURNAL OF
PHARMACEUTICAL SCIENCES**<http://doi.org/10.5281/zenodo.3634327>Available online at: <http://www.iajps.com>

Research Article

**EXCHANGE PROCESSES IN TURKEY ORGANISM BY
USING THE PROTEIN FROM THE LARVAS OF THE FLIES
OF THE POPULATION LUCILIA CAESAR**Romanenko Evgenia Alexandrovna ¹, Istomin Alexey Igorevich ²¹Alternate Director, Central Scientific and Methodical Veterinary Laboratory²Header, ²LLC «New Biotechnology»**Abstract:**

One of the urgent directions of finding promising raw ingredients in the feeding of farm animals and birds is the use of larvae of flies as a source of alternative protein. In Russia, LLC «New Biotechnology» is engaged in the processing of organic waste using the larvae of the flies of the population Lucilia Caesar under a project accredited at the Skolkovo Innovation Center, which, after a global reconstruction, started its production. The use of flour from larvae of flies in feeding poultry, including turkeys, is a new direction that is becoming more widespread among leading world producers. The authors established the high efficiency of using protein-lipid concentrate (PLC) from the larvae of flies of the population Lucilia Caesar in the production of cross BIG-6 turkey meat. It is proved that the use of the studied additives in the amount of 5.0 and 7.5% in the diet of turkey-poults for fattening can increase the digestibility of nutrients of the feed. The digestibility of crude feed protein by turkeys of the experimental groups increased by 2.3 and 3.1%, crude fat - by 1.9 and 2.7%, NFE - by 2.7 and 3.8%. The deposition of nitrogen in the organism of turkeys exceeded the control by 5.07 and 7.43%, and its use from the accepted by 1.52 and 2.28%. The increase in digestibility of feed nutrients contributed to the activation of metabolic processes in the body of turkeys. The red blood cells in the blood of turkeys of the experimental groups increased by 6.63 and 7.53%, the concentration of hemoglobin increased by 4.48 and 7.84%. The total protein content in the blood serum of turkeys of the experimental groups increased by 10.17 and 15.59%, and the level of the albumin fraction - by 13.49 and 20.69% relative to the control, which is a reserve for the growth of body tissues, determines the growth rate of animals. The content of calcium and phosphorus, characterizing the level of mineral metabolism in the body, increased by 18.15 and 19.22%; 12.84 and 14.86% compared with the control. The results of the study allowed us to conclude that the protein-lipid concentrate (PLC) from the larvae of flies of the population Lucilia Caesar helps to improve the digestibility of feed nutrients, the use of nitrogen, and the activation of protein and mineral metabolism.

Keywords: fly larvae meal, protein source, turkey, exchange processes, bioconversion of feed

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Please cite this article in press Evgenia Alexandrovna Romanenko et al., *Exchange Processes In Turkey Organism By Using The Protein From The Larvas Of The Flies Of The Population Lucilia Caesar.*, Indo Am. J. P. Sci, 2020; 07(01).

INTRODUCTION:

Turkey farming - as a poultry industry has an inexhaustible reserve for increasing a valuable dietary product, the quality of which largely depends on both heritable factors and conditions of keeping and feeding.

Recently, all over the world there has been an increased interest in insects as a source of highly digestible feed protein, fat with unique properties, antioxidants, immunomodulators, and raw materials for the production of new drugs [7,8,9]. The larva of flies contains about 40% of amino acids, which have a beneficial effect on the growth and development of farm animals and birds and confirm the possibility of using dry larvae as a feed additive [1,3,5,6].

The world is witnessing a gradual transition of countries to a closed-loop economy with a developed system of product recycling, for example, the processing of organic agricultural waste to produce animal protein for feeding animals and poultry. The so-called trend of transition to high-protein feed with low cost for farm animals [4].

Processing organic agricultural waste with the help of larvae of flies solves several critical problems of

agricultural development: the production of cheap and high-quality animal protein; the involvement of biological waste in recycling; reducing the burden on the environment [2].

Tests on the use of flour from fly larvae as an additive in feed have been carried out by many scientists on different types of farm animals, however, protein-lipid concentrate (PLC) based on fly larvae in turkey diets is being conducted for the first time.

The aim of our research was: to study the effect of protein-lipid concentrate from larvae of flies of the population *Lucilia Caesar* on metabolic processes in the body of cross BIG-6 turkeys.

MATERIAL AND RESEARCH METHODS:

Experimental studies were carried out in the conditions of one of the largest turkey-breeding enterprises in Russia, ZAO Krasnobor, Tula Region, on turkey-poults of the cross BIG-6. As a test additive in the diet, flour was used from larvae of *Lucilia Caesar* flies (protein-lipid concentrate, PLC), the nutritional value of which, in a comparative aspect, is presented in Table 1.

Table 1 - The chemical composition and nutritional value of animal protein sources

Indicators	PLC (Russia)	Fish meal (Morocco)	Meat-and-bone meal (Germany)
Mass fraction, %			
moisture	5,00	8,00	8,00
protein	52,04	67,74	56,10
fat	30,50	8,50	10,30
ash	5,80	15,70	21,42
Exchange energy, MJ/kg	15,20	12,30	11,50
Feed units, f.un/kg	1,57	1,00	0,80
Digestible protein, %	95,00	92,00	70,00
Arginine	5,302	3,62	4,62
Lysine	6,022	5,65	2,93
Tyrazine	5,973	1,94	1,27
Phenylalanine	4,899	2,36	1,78
Histidine	2,964	1,98	1,27
Leucine + isoleucine	9,252	6,81	4,94
Methionine	2,025	2,30	0,91
Valine	4,066	2,99	2,27
Proline	3,848	2,59	4,15
Threonine	3,762	4,60	1,78
Serine	5,501	2,42	2,12
Alanine	3,583	3,92	3,76
Glycine	3,497	3,96	5,32
Tryptophan	1,084	0,71	0,52

The experiment involved three groups of turkey-poults with 20 goals each. The control group received a general diet (GD). The experimental groups received protein-lipid concentrate (PLC): I experimental - 5%, II experimental - 7.5% by weight of feed.

Laboratory studies of protein-lipid concentrate (PLC) of the morpho-biochemical composition of turkey blood, the chemical composition of feed, litter, and muscles were carried out under the conditions of the Central Scientific and Methodological Veterinary Laboratory (Moscow) and the Research Institute of Applied Veterinary Medicine and Biotechnology (Vitebsk).

RESULTS AND DISCUSSION:

When studying the effectiveness of using new feeds or feed additives in animal feeding, special attention is paid to the digestibility and use of nutrients in diets, since the productivity of animals and birds largely depends on these processes.

According to the results of the analysis of the nutritional value of the protein-lipid concentrate, the digestible protein content in it is 95%, and the level of individual amino acids significantly exceeds their content in fish meal: arginine - by 1.68; lysine - by 0.372; tyrazine - by 4.033; phenylalanine - by 2.539; histidine - by 0.984; leucine + isoleucine - at 2,442; valina - by 1.076; proline - at 1.258; serine - by 3.081 and tryptophan - by 0.374%. The advantage in the content of digestible protein, the amino acid composition of the protein of flour from the larvae of flies, in our opinion, should affect the digestibility of the nutrients of the feed and the assimilation of nitrogen by the organism of turkeys.

Digestibility of nutrients in the diet is one of the main stages in the metabolism that takes place in the body. During the physiological experiment, it was proved that the high nutritional value of flour from larvae of flies contributed to an increase in the digestibility of nutrients of food by turkeys of the experimental groups (table 2).

Table 2 - Digestibility of feed nutrients, % (n = 3)

Indicators	control	I experimental	II experimental
Crude protein	79,6±0,49	81,9±0,57	82,7±0,37**
Crude fat	65,2±0,39	67, 1±0,28*	67,9±0,31**
Crude fiber	12,7±0,32	13,5±0,21	13,9±0,24
NFE	84,1±0,41	86,8±0,54*	87,9±0,47**

In the I experimental group, the digestibility of crude protein increased by 2.3 (P <0.05), in the II experimental group - by 3.1% (P <0.01), crude fat - by 1.9 (P <0.05) and 2.7% (P <0.01), NFE - by 2.7 (P <0.05) and 3.8% (P <0.01) in relation to the control group. There was also a tendency to increase the digestibility coefficient of crude fiber in the experimental groups by 0.8 and 1.2% with an unreliable difference. Analyzing the obtained data in the context of the groups it should be noted that the highest digestibility of the main nutrients of the feed

was recorded in the II experimental group, where turkey-poult received 7.5% of the larvae of flies of the population *Lucilia Caesar* in the diet.

The use level of nitrogen of feed is directly related to the growth rate and, consequently, productivity. The introduction of flour from larvae of flies into the main diet of turkeys of the experimental groups improved the balance of nitrogen and increased its use (table 3).

Table 3 - Taking and balance of nitrogen (n = 3)

Indicators	control	I experimental	II experimental
Taken with feed, g	7,43±0,071	7,52±0,063	7,54±0,077
Highlighted with litter, g	2,51±0,043	2,43±0,059	2,39±0,051
Digested nitrogen, g	4,92±0,031	5,09±0,037*	5,15±0,028**
Retained nitrogen in the organism, g	2,96±0,032	3,11±0,041*	3,18±0,029**
Used from taken, %	39,84±0,39	41,36±0,23*	42,12±0,27**
Used from digested, %	60,16±0,17	61,10±0,13**	61,75±0,19**

The nitrogen consumption of the turkeys in the control and experimental groups did not differ significantly. Moreover, its deposition in the body of turkeys of the experimental groups exceeded the control by 5.07 (P <0.05) and 7.43% (P <0.01). It was established that the use of nitrogen from the

experimental groups accepted by the turkeys increased by 1.52 (P <0.05) and 2.28% (P <0.01) under the influence of flour of the larvae of the flies, and by 0.94 from the digested one (P <0.01) and 1.59% (P <0.01), respectively.

An increase in the digestibility of feed nutrients and the fullest use of nitrogen by the turkeys of the experimental groups had a positive effect on the

morpho-biochemical parameters of the blood (table 4).

Table 4 - Morpho-biochemical parameters of the blood (n = 5)

Indicators	control	I experimental	II experimental
Hemoglobin, g/l	156,10±2,46	163,72±1,37*	168,34±3,13*
Hematocrit, %	37,40±0,29	38,70±0,36*	33,20±0,41**
ESR mm/g	2,73±0,19	2,65±0,24	2,57±0,27
Erythrocytes, 10 ¹² /l	3,32±0,046	3,54±0,052*	3,57±0,057**
Leukocytes, 10 ⁹ /l	34,40±0,96	33,80±0,61	33,20±0,74
Total protein, g/l	45,15±0,68	49,74±0,59**	52,19±0,83***
Albumins, g/l	21,50±0,47	24,40±0,51**	25,95±0,75***
%	47,61±0,69	49,07±0,81	49,73±0,78
Globulins, g/l	23,65±1,17	25,34±1,21	26,24±1,25
%	52,39±2,34	50,93±1,46	50,27±1,84
Alkalinity reserve, mmol/l	50,2±0,73	48,7±0,81	48,1±0,94
Calcium, mmol/l	2,81±0,081	3,32±0,069**	3,35±0,089**
Phosphorus, mmol/l	1,48±0,029	1,67±0,032**	1,70±0,037**

It was proved, that the erythrocyte content in the blood of turkeys of the I experimental group increased by 6.63 (P <0.05), the II experimental - by 7.53% (P <0.01), the concentration of hemoglobin and hematocrit increased in the I experimental group by 4.88 (P <0.05) and 7.84% (P <0.05), in the II experimental - by 1.3 (P <0.05) and 1.8% (P <0.01).

The level of total protein in the blood serum of turkeys of the experimental groups was higher than the control by 10.17 (P <0.01) and 15.59% (P <0.001), the albumin fraction by 13.49 (P <0.01) and 20.70% (P <0.001). Along with an increase in the intensity of protein metabolism, mineral activation is observed. Minerals in general bind together the conversion and use of nutrients in the body. The calcium level in the experimental groups exceeded the control indicators by 18.15 (P <0.01) and 19.22% (P <0.01), phosphorus - by 12.84 (P <0.01) and 14.86% (P <0.01).

An increase in the content of red blood cells, hemoglobin, total protein, and the albumin fraction in the blood of turkeys of the experimental groups can be considered as a factor in more intense redox processes in the body associated with an increase in live weight under the influence of the studied additive.

CONCLUSION:

The use of flour from larvae of flies of the population *Lucilia Caesar* in the amount of 5.0 and 7.5% in the diet of turkeys for fattening, due to the content of highly effective protein, essential amino acids, unsaturated fatty acids, as well as high content of minerals (iron, calcium, phosphorus, etc.) contributed to the activation of metabolic processes

in the body of turkeys, increase meat productivity and improve the quality of meat.

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