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CONTENT

BOTANY

Palamarchuk I.
STUDY OF INDICATORS OF CHEMICAL COMPOSITION OF ZUCCHINI PRODUCTS (*CUCURBITA PEPO VAR. GIRAUMONTIA DUCH.*) IN THE CONDITIONS OF THE FOREST-STEPPE OF UKRAINE 3

GENETICS AND BIOTECHNOLOGY

Vuhliar V.
PRODUCTIVITY OF YOUNG PIGS DURING FEEDING OF PVMS "EFIPROT" 8

MATERIALS SCIENCE AND MECHANICS OF MACHINES

Bazhak O., Naidenov I.
DESIGN OF METHODS OF IMPROVING ENVIRONMENTAL INDICATORS OF RIVER TRANSPORT IN CONDITIONS OF OPERATION.....13

MATHEMATICS

Dubchak V., Manzhos E.
THE INVESTIGATION OF CONDITIONS OF THE EXTREME ARRANGEMENT OF SEVERAL CLASSICAL GEOMETRIC FIGURES WITH A COMMON CENTER BY ESTIMATING THE LENGTH OF THE LINE AND THE AREA OF THEIR DIVERGENCE 21

NEUROBIOLOGY

Semchyshyn M., Shevaga V., Zadorozhna B., Zadorozhnyi A.
THE CONTENT OF ZINC IN THE BLOOD SERUM OF SOLDIERS OF THE JOINT FORCE OPERATION AND IN VICTIMS OUTSIDE THE CONFLICT ZONE WITH MILD AND MODERATE TRAUMATIC BRAIN INJURY IN THE ACUTE AND INTERMEDIATE PERIODS.....30

PHYSIOLOGY OF ANIMALS

Chudak R., Poberezhets J.
INFLUENCE OF PHYTOBIOTIC ON QUALITY INDICATORS OF QUAIL MEAT AND LIVER 36
Budakva Ye.
ADVANTAGES OF IMMUNOLOGICAL CASTRATION OF PIGS AS HUMANE ALTERNATIVE TO TRADITIONAL METHOD WITH ANALYSIS OF PATHOLOGIES AND STEROID HORMONE CONTENT 44
Tsaruk L.
PRODUCTIVITY, SLAUGHTER AND HEMATOLOGICAL PARAMETERS OF BROILER CHICKENS UNDER THE ACTION OF BIOSEVEN PROBIOTICS 48

PHYSIOLOGY OF ANIMALS

INFLUENCE OF PHYTOBIOTIC ON QUALITY INDICATORS OF QUAIL MEAT AND LIVER

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Abstract

The purpose of the research was to investigate the dry *Echinacea pallida* extract effect on the amino acid and fatty acid content of quail meat of the Pharaoh meat breed. It has been investigated that the amount of essential amino acids was greater by 1.31% in the pectoral muscles of quails that consumed 12 mg of *Ehinacea pallida* dry extract per kg of live weight. This increase was due to the better accumulation of lysine, arginine, threonine, leucine and phenylalanine. The amount of essential amino acids was the highest in the thigh muscles of the control group. It was found that the quality of fatty acid composition of the pectoral muscles was better due to the greater accumulation of linoleic, γ-linolenic and α-linolenic acids. Linoleic, γ-linolenic and arachidonic fatty acids were better accumulated in the thigh muscles of the experimental quail.

Keywords: quails, phytobiotics, *Echinacea pallida,* amino acids, meat, fat acids.

Introduction

In recent years, feed additives of natural origin have been extensively studied and used in animal husbandry. They are the most promising due to their accessibility, the absence of undesirable side effects, and the wide range of biological effects on the animal body [10, 13, 20].

The problem of meeting the needs of the population for more environmentally friendly products is rather relevant nowadays. The antibiotics application in European countries has been forbidden. That's why scientists and practitioners are looking for natural additives of natural origin containing biologically active substances that increase productivity, strengthen immunity and improve digestive processes [14, 19].

Phytobiotics are increasingly used in animal feeding. They are phytocorrectors modifying the digestive glands work providing the conditions for competitive growth of beneficial microflora, which stabilizes acidity and enhances the processes of nutrient absorption [6, 8]. Feed additives of plant origin ncluded into the farm animals diets help to increase productivity; improve the gut microflora; improve the taste of feed; stimulate salivation and secretion of digestive juices due to the rapid passage of feed and absorption of nutrients, and the nutrient system [1, 7, 9].

Recently, foreign and domestic scientists have become interested in the study and application of the genus Echinacea species [4, 11]. They have very valuable medicinal, fodder properties, and their chemical composition contains a large number of biologically active substances. They are carbohydrates, nitrogenous substances, organic acids, lipids, vitamins, polyphenolic compounds (coffee derivatives, flavanoids, tannins), isoprenoids, saponins, essential oils, alkaloids and minerals [3, 17, 22].

Echinacea pallida is becoming more widespread in medicine and zoo veterinary as therapeutic and prophylactic medicine and a feed additive of plant origin [2, 12, 21]. It should be noted that it has a mild action, low toxicity and a high content of vital substances affecting the animals` metabolism [5, 16].

The purpose of the research was to investigate the dry *Echinacea pallida* extract effect on the amino acid and fatty acid content of quail meat of the Pharaoh meat breed.

Material and Methods

Research of Echinacea pallida feed additive application for quails feeding were conducted at the research farm of Vinnytsia National Agrarian University.

The scientific experiment was conducted on poultry in accordance with conventional methods, by the method of groups-analogues taking into account live weight, age, sex, breed, productivity, and conditions of keeping and feeding [15]. We have used zootechnical, physiological, biochemical and statistical methods of research.

The duration of the experiment was 56 days. Four groups of one-day-old Pharaoh meat quail were formed for the experiment, each group includes 50 animals. The control group consumed a basic diet (BD), i.e. complete feeds of the Multigain trademark. The experimental group was additionally fed by different doses of Echinacea pallida feed additive extract (table 1).

The researched phytobiotics is a homogeneous, powdered, dry extract of Echinacea pallida roots; it is brown powder with a characteristic smell and a specific bitter taste.

The manufacturer of the extract from Echinacea pallida is LLC Kharkiv Research Plant, Ukraine. The main active biologically substances are polysaccharides, i.e. fructosans, phenolic compounds, hydroxycoric acids having anti-inflammatory, antimicrobial and adaptogenic activities.

Table 1

Scheme of experiment

Group	Number of animals in group, heads	Duration of the experiment, days	Feeding characteristics
1-control	50	56	BD* (complete feeds)
2-experimantal	50	56	BD + Echinacea pallida (6 mg per kg of body weight)
3-experimantal	50	56	BD + Echinacea pallida (12 mg per kg of body weight)
4-experimantal	50	56	BD + Echinacea pallida (18 mg per kg of body weight)

*BD – basic diet

We have researched the fatty acid composition by gas chromatography, the meat amino acid composition was determined in the laboratory of the Biochemistry Research Institute named after O.V. Paladin (Kyiv) by TTT 339 automatic analyzer using LG ANB cation exchange resin with SO_3 active group.

The experimentally obtained data were processed by the method of variational statistics according to the algorithms proposed by Plohinskiy N.A. (1969) [18]. The computer technology and Microsoft Excel were used for the experimental data processing.

Results and Discussion

The nutritional value of meat depends on the quantitative content of the protein, its quality, and its value. Muscle tissue proteins are valuable because they contain almost all essential amino acids. It should be noted that amino acids are not synthesized in sufficient quantity in the body of a bird, they must necessarily come from the feed.

Research has found that the amino acid content of quail meat is affected by different doses of Echinacea pallida feed additive extract (Table 2).

It was found that the poultry consuming the researched supplement had a higher lysine content in white meat than control sample, i.e. by 0.45 % (P<0.001) in the 3rd group and 0.12% (P<0.001) in the 4th group. It should be noted that the meat of quails of the 2nd group had a decrease this amino acid by 0.31% (P<0.001).

Using the minimum (second group), medium (third group) and maximum (fourth group) doses of Echinacea pallida feed additive extract a significant increase in quail histidine in the pectoral muscles was observed, respectively, by 0.29% (P<0.001), 0.11% (P<0.01) and 0.24% (P<0.001) than control one.

The highest arginine content was found in the second and third groups by 0.30% and 0.37%, respectively (P<0.001) than control one. However, there is a tendency for the increase of arginine by 0.08% in the 4th group; there is no significant difference with the control indicator.

The aspartic acid content increased by 0.65% and 0.11% respectively (P<0.001) in the third and fourth poultry experimental groups. It should be noted that there was a significant decrease in aspartic acid content by 0.33% (P<0.001) in the 2nd experimental group than the control group.

Table 2

Amino acid composition of quail pectoral muscles, % (100 mg) (M ± m, n=4) (total number of amino acids)

Indicator	Group			
	1–control	2–experimental	3– experimental	4– experimental
Lysine	9.29 ± 0.007	8.98 ± 0.012***	9.74 ± 0.005***	9.41 ± 0.014***
Histidine	3.26 ± 0.024	3.55 ± 0.013***	3.37 ± 0.014**	3.50 ±0.002***
Arginine	6.64 ± 0.037	6.94 ± 0.022***	7.01 ± 0.012***	6.72 ± 0.029
Aspartic acid	6.50 ± 0.005	6.17 ± 0.003***	7.15 ± 0.012***	6.61 ± 0.010***
Threonine	4.89 ± 0.019	5.12 ± 0.014***	4.91 ± 0.009	4.48 ± .014***
Serine	4.19 ± 0.014	4.40 ± 0.003***	4.21 ± 0.009	4.20 ± 0.002
Glutamic acid	16.77±0.030	16.42±0.040***	15.38 ±0.017***	17.04±0.027***
Proline	5.06 ± 0.058	4.35 ± 0.077***	3.55 ± 0.036***	4.36 ± 0.051***
Glycine	4.72 ± 0.012	4.85 ± 0.002***	4.96 ± 0.003***	4.74 ± 0.007
Alanine	6.26 ± 0.007	6.39 ± 0.010***	6.49 ± 0.003***	6.07 ± 0.009***
Cystine	1.19 ± 0.029	1.31 ± 0.017*	1.25 ± 0.012	1.39 ± 0.015***
Valine	5.36 ± 0.025	5.56 ± 0.020***	5.60 ± 0.007***	5.52 ± 0.008***
Methionine	2.88 ± 0.011	2.75 ± 0.013***	2.89 ± 0.010	2.98 ± 0.017**
Isoleucine	5.01 ± 0.016	5.21 ± 0.030**	5.17 ± 0.014***	5.11 ± 0.007**
Leucine	9.12 ± 0.031	9.27 ± 0.035*	9.49 ± 0.007***	9.06 ± 0.020
Tyrosine	4.15 ± 0.036	4.05 ± 0.042	4.04 ± 0.012*	4.09 ± 0.030
Phenylalanine	4.65 ± 0.025	4.61 ± 0.021	4.73 ± 0.009*	4.67 ± 0.009
Essential acids amount	51.10	51.99	52.41	51.45
Substitutable acids amount	48.84	47.94	47.03	48.50

The content of glutamic acid in the pectoral muscles significantly increased in by 0.27% (P<0.001) the 4th poultry group; this indicator decreased by 0.35% and 1.39% (P<0.001) in the 2nd and 3rd groups than control one.

The threonine and serine amount in the pectoral muscles of the quail exceeded by 0.23% and 0.21% (P<0.001) in the second research group.

The proline content decreases by 0.71%, 1.51% and 0.70% respectively (P<0.001) in the quails of the experimental groups than control one under the action of the researched additive.

It was found that the highest content of glycine and alanine was observed in the 2nd and 3rd poultry groups by 0.13%, 0.24% and 0.13%, 0.23% (P<0.001) respectively than control one.

The cystine content in the pectoral muscles increased in the 2nd and 4th experimental poultry groups by 0.12% (P<0.05) and 0.20% (P<0.001) respectively than control one.

Thus, additional introduction of Echinacea pallida dry extract to the quail main diet causes increase valine in white meat of the 2nd, 3rd and 4th poultry group by 0.20%, 0.24% and 0.16% (P<0.001) respectively than control one.

The use of phytobiotic supplements increases the proportion of methionine in the 4th experimental poultry group by 0.10% (P<0.01). However, this amino acid decreases by 0.13% (P<0.001) in the 2nd group.

There is a tendency for the leucine content in the pectoral muscles of the 4th experimental group to decrease by 0.06% than control one.

The highest level of isoleucine was observed in the quails of the 2nd, 3rd, 4th experimental groups by 0.2% (P<0.01), 0.16% (P<0.001) and 0.1% (P<0.01) than control one.

The significant decrease in the tyrosine content in the white meat of the third experimental group was noted by 0.11% (P<0.05) under the influence of the phytobiotic.

The highest proportion of phenylalanine was recorded in the 3rd poultry group; it was by 0.08% (P<0.05) larger than control one.

Thus, the feeding of birds with different doses of Echinacea pallida extract causes an increase in of essential amino acids amount by 0.89, 1.81, and 0.35%, respectively, in the 2nd, 3rd, and 4th experimental groups. However, the control group quails have the greater amount of substitutable amino acids; it was by 48.84% larger.

The research of the amino acid composition in the quail femur muscles are shown in table 3.

Thus, the researched additive causes lysine increasing in quail red meat in the 2nd, 3rd and 4th groups by 0.68%, 0.15% and 0.59% (P<0,001) respectively than control one.

It should be mentioned that the histidine level in the third poultry group was less than the control analogues by 0.1% (P<0.001).

The amount of arginine decreases by 0.31% (P<0.001) and 0.17% (P<0.01) in the femur muscles of the 2nd and 3rd poultry group respectively than the control one.

The content of aspartic acid in the poultry thighs outweighed the control sample in the 4th group by 0.83% (P<0.001) and glutamic acid by 2.26% (P<0.001) in the 3rd group.

The amount of threonine in the poultry muscles of the 4th experimental group increased by 0.05% (P<0.01); this amino acid was less than the control by 0.08% and 0.10% (P<0.001) respectively in the 2nd and 3rd groups.

It was found that, serine content significantly decreased in the femurs of the 2nd, 3rd, and 4th experimental groups of birds by 0.07%, 0.06%, and 0.06%, respectively (P< 0,001) under the action of Echinacea pallida extract.

Consumption of phytobiotic supplement causes the proline content increasing in red meat of the 2nd, 3rd and 4th groups by 0.1%, 0.12% and 0.05% respectively. However, a probable difference hasn't been established.

Table 3

Amino acid composition of quail femur muscles, % (100 mg) (M ± m, n = 4) (total number of amino acids)

Indicator	Group			
	1–control	2–experimental	3– experimental	4–experimental
Lysine	9.07 ± 0.011	9.75 ± 0.005***	9.22 ± 0.019***	9.66 ± 0.008***
Histidine	2.79 ± 0.004	2.76 ± 0.014	2.69 ± 0.008***	2.79 ± 0.007
Arginine	6.88 ± 0.004	6.57 ± 0.024***	6.71 ± 0.030**	6.73 ± 0.014***
Aspartic acid	6.60 ± 0.009	7.22 ± 0.011***	7.30 ± 0.002***	7.43 ± 0.009***
Threonine	5.08 ± 0.008	5.00 ± 0.007***	4.98 ± 0.002***	5.13 ± 0.007**
Serine	4.40 ± 0.002	4.33 ± 0.005***	4.34 ± 0.003***	4.34 ± 0.007***
Glutamic acid	16.93 ± 0.005	17.12±0.017***	19.19 ±0.021***	17.51 ± .021***
Proline	4.76 ± 0.031	4.86 ± 0.064	4.88 ± 0.088	4.81 ± 0.081
Glycine	5.06 ± 0.005	5.03 ± 0.005**	5.09 ± 0.002**	4.99 ± 0.008***
Alanine	5.94 ± 0.005	5.88 ± 0.008***	5.91 ± 0.012	5.76 ± 0.005***
Cystine	1.28 ± 0.012	1.25 ± 0.012	1.04 ± 0.012***	1.24 ± 0.012
Valine	5.20 ± 0.013	4.99 ± 0.005***	4.79 ± 0.012***	4.99 ± 0.010***
Methionine	3.13 ± 0.002	3.05 ± 0.009***	2.55 ± 0.012***	2.84 ± 0.012***
Isoleucine	4.94 ± 0.007	4.83 ± 0.010***	4.45 ± 0.002***	4.79 ± 0.016***
Leucine	9.05 ± 0.008	8.81 ± 0.020***	8.77 ± 0.020***	8.73 ± 0.016***
Tyrosine	4.17 ± 0.047	3.85 ± 0.023***	3.67 ± 0.017***	3.79 ± 0.019***
Phenylalanine	4.75 ± 0.078	4.61 ± 0.007	4.33 ± 0.009***	4.40 ± 0.007**
Essential acids amount	50.89	50.37	48.49	50.06
Substitutable acids amount	49.14	49.54	51.42	49.87

The glycine content in the femur quail muscles was greater by 0.03% (P<0.01) in the 3rd experimental group than in the control sample. However, this indicator was lower by 0.03% (P<0.01) and 0.07% (P<0.001) in the 2nd and 4th groups.

The level of alanine significantly decreased by 0.06% and 0.18% (P<0.001) in the 2nd and 4th group than the control group.

It should be noted that feeding by Echinacea pallida extract different doses causes valine content decreasing by 0.21%, 0.41% and 0.21% (P<0.001) in the femurs of the experimental group poultry.

The lowest amount of cystine and methionine was in the red meat of 3rd poultry group by 0.24% and 0.58% (P<0.001), respectively, compared to the first control group.

It should be noted that the lowest levels of isoleucine and leucine were in the poultry muscles from the 2nd and 4th experimental groups, respectively by 0.49% and 0.32% (P<0.001) compared to the control.

It was noted that the smallest tyrosine accumulation was observed in the femurs of the poultry of all experimental groups by 0.32%, 0.5% and 0.38% (P<0.001), respectively, compared to the control sample.

It was also found that the reduction of phenylalanine content is observed in the quails of the 3rd and 4th groups by 0.42% (P<0.001) and 0.35% (P<0.01), respectively, compared to the control group analogues.

The amount of essential amino acids decreases by 0.52 %, 2.4 % and 0.83% in quails of the 2nd, 3rd and 4th experimental groups fed by the experimental supplement. However, the amount of substitutable amino acids increased by 0.4 %, 2.28 % and 0.73% in these groups, respectively, compared to the first poultry control group.

Thus, mixed doses of Echinacea pallida dry extract have a positive effect on the amount of substitutable and essential amino acids in the quail meat.

Fat plays an important role in human nutrition. It has high taste qualities and it is an important source of energy. It is also used by the body for energy and plastic purposes. Fat is a part of cells and it participates in metabolism. Fat consists of glycerol and higher fatty acids; they are divided into saturated and unsaturated ones. The unsaturated acids contribute to the normalization of cholesterol, stimulate its oxidation and excretion from the body. Their deficiency in the body causes lots of disorders, decreased resistance and increased cholesterol in the blood.

The research results showed that different doses of Echinacea pallida extract had different effects on the fatty acid content of the pectoral muscles of the quail (Table 4).

Table 4.

Fatty acid composition of quail pectoral muscles, % (100 mg) (total number of fat)

Fatty acid	Group			
	1-control	2-experimental	3- experimental	4- experimental
Myristic	0.29	0.25	0.30	0.22
Stearic	12.69	11.54	11.33	14.38
Palmitic	18.61	16.91	18.30	16.56
Arachidic	0.14	0.13	0.11	0.05
Margaric	0.12	0.17	0.21	0.15
Pentadecanoic	0.06	0.07	0.03	0.05
Linoleic	23.45	25.38	28.86	26.23
γ- linolenic	0.12	0.14	0.19	0.19
α - linolenic	1.05	1.20	1.20	1.26
Arachidonic	9.04	8.55	8.50	12.26
Oleic	25.92	27.40	24.27	20.11
Gondoinic	0.07	0.15	0.06	0.05
Pentadecileine	0.03	0.03	0.04	0.02
Palmitoleic	5.90	5.83	3.74	4.47
Margarinolein	0.03	0.06	0.05	0.05
Dihomolinoleic	0.12	0.17	0.07	0.15
Dihomo-γ-linolenic acid	0.13	0.08	0.08	0.31
Docosatetraenoic	0.09	0.08	0.08	0.13
Docosapentaenoic	0.09	0.09	0.08	0.14
Clupanodonic	0.27	0.38	0.20	0.41
Docosahexaenoic	1.79	1.38	2.29	2.78

The supplementary feeding of poultry (4th group) by the maximum dose of the researched feed additive caused the increase of stearic acid content in white poultry meat by 1.69%, margaric acid by 0.03%, linoleic acid by 2.78%, γ- linolenic acid by 0.07% and α - linolenic acid by 0.21% than the control one.

However, the poultry of this group has decreased content of myristic, palmitic, arachidic and oleic fatty acids by 0.07%, 2.05%, 0.09% and 5.81%, respectively, compared with indicators of the 1st group.

Minimal and medium doses of Echinacea pallida extract cause increased linoleic acid content by 1.93% and 5.41% in the pectoral muscle of the poultry compared to the control group.

Poultry of the 2nd and 3rd experimental groups had a decrease of stearic and palmitic fatty acids by 1.15%, 1.36% and 1.7%, 0.31% respectively compared to the control analogues.

The content of essential fatty acids such as dihomo-γ-linolenic and arachidonic acids increased by 0.18% and 3.22% in the fourth experimental group compared to the control indicators. The levels of arachidonic acid in the 2nd and 3rd experimental groups decreased by 0.49% and 0.54%, respectively, relative to the control data.

It was found that the concentration of docosatetraenoic and docosapentaenoic acids in the pectoral muscles exceeded the control by 0.04% and 0.05% in the fourth group fed by the maximum dose of the researched supplement.

The content of clupanodonic and docosahexaenoic fatty acids increased in the bird of the fourth experimental group by 0.14% and 0.99%, respectively, compared with the control sample.

Researches have proved that feeding different doses of Echinacea pallida extract changed the fatty acid composition of the femur muscles of the quail (Table 5).

Table 5

Fatty acid composition of quail femur muscles, % (100 mg) (total number of fat)

Fatty acid	Група			
	1-control	2-experimental	3- experimental	4- experimental
Myristic	0.24	0.22	0.20	0.21
Stearic	16.85	14.27	17.11	17.43
Palmitic	15.47	17.30	15.59	14.32
Arachidic	0.06	0.10	0.15	0.10
Margaric	0.14	0.09	0.14	0.17
Pentadecanoic	0.05	0.04	0.02	0.02
Linoleic	23.19	24.94	25.67	25.86
γ- linolenic	0.12	0.18	0.13	0.15
α - linolenic	0.92	0.80	0.73	1.13
Arachidonic	9.54	9.93	11.93	11.32
Oleic	23.27	23.06	19.03	18.74
Gondoinic	0.06	0.12	0.09	0.12
Pentadecileine	0.01	0.02	0.02	0.02
Palmitoleic	5.62	4.47	2.90	3.47
Margarinolein	0.05	0.05	0.04	0.03
Dihomolinoleic	0.15	0.14	0.10	0.23
Dihomo-γ-linolenic acid	0.08	0.16	0.11	0.26
Docosatetraenoic	0.33	0.46	0.45	0.71
Docosapentaenoic	0.18	0.32	0.24	0.32
Clupanodonic	0.41	0.75	1.25	0.75
Docosahexaenoic	3.24	2.58	4.08	4.64

Thus, the content of stearic fatty acid increased in the poultry red meat (the 3rd and 4th experimental groups) by 0.26% and 0.58% respectively.

However, the accumulation of myristic acid in these groups was less than the control by 0.04% and 0.03%.

It was found that linoleic acid content in all the experimental groups increased by 1.75%, 2.48% and 2.67% compared to the first control group respectively under different doses of Echinacea pallida extract.

It should be noted that the level of accumulation of γ-linolenic and α-linolenic fatty acids increased in the 4th experimental group by 0.03% and 0.21% relative to the control.

There is an increase in arachidonic fatty acid content in poultry of the 2nd group by 0.39%, the 3rd group by 2.39% and the 4th group by 1.78% compared to the control analogues.

It should be noted that the content of oleic and palmitoleic fatty acids was lower in all researched groups.

However, the highest rate of accumulation of dihomo-γ-linolenic, docosatetraenoic and docosahexaenoic fatty acids was observed in the femur muscles of the birds the fourth experimental group by 0.18%, 0.38% and 1.4%, respectively, compared to the first control group.

It is known that the liver is involved in the metabolism and synthesis of proteins to meet the needs of other organs and tissues, it is responsible for the processes of breakdown and rearrangement of amino acids. Therefore, our task was to research the effect of dry extract of Echinacea pallida on the amino acid content of quail liver. (table 6).

Thus, the content of lysine increases by 0.36% ($P < 0.001$) in the liver when poultry is fed by the minimum dose of the researched additive, it decreases by 0.58% and 0.16%, respectively ($P < 0.001$) with the average and maximum doses compared with the control indicator.

It should be noted the probable decrease in histidine by 0.37% and 0.11% ($P<0.001$) in the 3rd and 4th experimental groups.

The content of arginine increases by 0.25% ($P < 0.01$) in the 3rd group. The share of this essential amino acid decreases by 0.34% ($P < 0.01$) in the 2nd group.

Table 6

Amino acid content of quail liver, % (M ± m, n = 4) (y 100 mg)
(total number of amino acids)

Indicator	Group			
	1–control	2–experimental	3– experimental	4–experimental
Lysine	7,11±0,004	7,47±0,012***	6,53±0,010***	6,95±0,008***
Histidine	2,53±0,007	2,50±0,017	2,1±0,005***	2,42±0,011***
Arginine	6,60±0,063	6,26±0,012**	6,85±0,002**	6,48±0,016
Aspartic acid	7,70±0,008	6,99±0,008***	9,00±0,004***	7,46±0,007***
Threonine	5,22±0,008	5,27±0,010**	5,19±0,003*	5,19±0,010
Serine	5,03±0,015	5,01±0,012	5,27±0,007***	5,04±0,002
Glutamic acid	15,10±0,023	15,06±0,017	15,67±0,079***	15,21±0,017**
Proline	4,83±0,039	5,05±0,016**	6,24±0,109***	5,86±0,033***
Glycine	5,30±0,010	5,37±0,002***	5,19±0,020**	5,31±0,014
Alanine	6,80 ± 0,008	6,78 ± 0,005	6,26±0,019***	6,73± 0,009**
Cystine	1,51±0,014	1,39±0,012***	1,45±0,038	1,35±0,015***
Valine	6,19±0,015	6,33±0,005***	5,90±0,019***	6,23±0,014
Methionine	2,51±0,012	2,54±0,004	2,49±0,013	2,59±0,003***
Isoleucine	4,69± 0,005	4,74 ± 0,004***	4,46 ± 0,013***	4,66 ± 0,010*
Leucine	9,67 ± 0,019	9,78 ± 0,019**	8,82±0,015***	9,33±0,012***
Tyrosine	4,00 ± 0,031	4,11 ± 0,022*	3,65 ± 0,052**	4,02 ± 0,008
Phenylalanine	5,16 ± 0,012	5,27±0,003***	4,81±0,017***	5,08±0,005***
Essential acids amount	49,68	50,16	47,15	48,93
Substitutable acids amount	50,27	49,76	52,73	50,98

The content of aspartic and glutamic acids increased by 1.3% and 0.57%, (P<0.001) respectively in the liver of quails of the 3rd experimental group.

It was found that the content of threonine was higher in the 2nd group by 0.05% (P <0.01), it was slightly lower by 0.03% (P <0.05) in the 3rd group compared to with the control group.

The lowest proportion of glycine and alanine by 0.11% (P <0.01) and 0.54% (P<0.001) is observed in the 3rd experimental group respectively.

The content of cystine in the liver of quails decreased by 0.12% and 0.16% (P<0.001), respectively, compared with the first control group at the consumption of the minimum and maximum doses of the supplement.

It should be noted that the highest level of valine was recorded in the 2nd group; it was higher by 0.14% (P <0.001). This amino acid was lower by 0.29% (P <0.001) in the 3rd group.

The content of methionine in the quail liver of the 4th experimental group was higher than the control by 0.08% (P <0.001).

The application of Echinacea pallida dry extract in the quails feeding allows to increase the amount of isoleucine and leucine by 0.05% (P<0.001) and 0.11% (P<0.01) in the liver of the 2nd group, respectively. This indicator decreased by 0.23% (P<0.001), 0.03% (P <0.05) and 0.85%, 0.34% (P <0.001), respectively while in the 3rd and 4th groups.

The highest level of tyrosine and phenylalanine accumulation is observed when the minimum dose of the researched additive is consumed (second group); it was higher by 0.11% (P <0.05) and 0.11% (P <0.001), respectively. The medium dose (third group) caused the least content of this amino acids; it is less than the control indicator by 0.35% (P <0.01) and 0.35% (P <0.001).

It was found that the application of the minimum dose (second group) of Echinacea pallida extract increases the amount of essential liver amino acids by 0.48%, while the number of substitutes decreases by 0.51% compared to the control.

Therefore, the use of different doses of Echinacea pallida extract in quail feeding had a positive effect on the amino acid, fatty acid and chemical composition of the meat.

Conclusion

1. The application of a dry extract of Echinacea pallida to quail feed increases the synthesis of essential amino acids in white meat, i.e. lysine by 0.45% (*P*<0.001), histidine by 0.11% (*P*<0.01), arginine by 0.37% (*P*<0.001), valine by 0.24% (*P*<0.001), isoleucine by 0.16% (*P*<0.001), phenylalanine by 0.08% (*P*<0.05) and the amount of essential amino acids by 1.81%.

2. The herbal supplements application in quail compound feed has caused the increase of substitutable amino acids content in red meat, i.e. serine by 0.06% (*P*<0.001), proline by 0.12%, glycine by 0.03% (*P* <0.01) and an increase in the amount of substitutable amino acids by 2.28%.

3. The Echinacea pallida extract application for quails feeding causes the increase of fatty acids in the pectoral and femor muscles, i.e. linoleic by 5.41%, dihomo-γ-linolenic by 0.18%, arachidonic by 3.22% and linoleic by 2.48%, stearic by 0.26%, and arachidonic by 2.39%.

4. The content of essential amino acids increases, i.e. lysine by 0.36% (P <0.001), threonine by 0.05% (P <0.01), valine by 0.14% (P <0.001), isoleucine by 0.05% (P <0.001), leucine by 0.11% (P <0.01), phenylalanine by 0.11% (P <0.05) and the amount of essential amino acids by 0.48% under the action of the researched additive the in the liver and liver.

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