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INFLUENCE OF FEEDING WORMWOOD (*ARTEMISIA CAPILLARIS*) ON QUAIL MEAT PRODUCTIVITY

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Abstract

Recently, the requirements for the quality and safety of poultry products have significantly increased, what has notably limited the use of antibiotics in feeding poultry. This is one of the reasons for the growing interest in the use of phytogenic feed additives. We have conducted an experiment to determine the influence of *Artemisia capillaris* on young quail meat productivity. To carry out the experiment, we have formed five groups, each counting 100 quail heads. During the experiment, which lasted for 35 days, dried powdered wormwood (*Artemisia capillaris*) in the amount of 0.5%, 1.0 and 1.5% by weight of compound feed was introduced into the feed of birds of the 2nd, 3rd and 4th experimental groups. The experiment showed a positive effect of the studied factor on the body weight of quail; the highest body weight was in quail of the 3rd group – 251.03 g, and the lowest it was in the control group – 238.24 g. Also during the experiment, the lowest feed costs per 1 kg of body weight gain were in quail of the 3rd experimental group, which by this indicator exceeded the control group by 4.91%. Feeding wormwood as a part of the compound feed in the amount of 0.5 and 1.0% of the 2nd and 3rd experimental groups increased the weight of gutted carcass by 0.41–1.67%, while further increase of wormwood content to 1.5% in the feed of the 4th experimental group led to a decrease in the weight of gutted carcass by 0.26% compared to the control group.

Keywords: *Artemisia capillaris,* Pharaoh Quail, body weight, average daily gain in body weight, feed conversion, bodystock retention, slaughter traits

INTRODUCTION

In the last two decades, there has been a growing interest in the use of phytogenic feed additives (PFAs) in animal feed (Mohammadi Gheisar and Kim, 2018). To date, antimicrobial, antioxidant, anti-inflammatory and growth-promoting effects of PFA on animals have been reported in many studies (Kim *et al.*, 2010; Abdel-Wareth and Lohakare, 2014; Qin and Hou, 2017; Abou-Elkhair *et al.*, 2018; Mohammadi Gheisar and Kim, 2018). Phytogenic sources contain a large number of phytochemicals, which are mainly divided into three categories: carotenoids, isothiocyanates and polyphenols, and it is recognized that most polyphenols have beneficial properties (Fraser, 2009).

The traditional medicinal herb wormwood has long been used to treat a variety of diseases. The genus Artemisia has more than 500 species and grows mostly in temperate regions of Europe, Asia and North America. *Artemisia capillaris* is a species of flowering plant belonging to the genus *Artemisia,* family Asteraceae (Bora and Sharma, 2011). Its homeland is Pakistan, the western Himalayas, China, Mongolia, the Korean Peninsula, the Irkutsk region and the Primorsky Krai of Russia, Japan; it has been also imported to Afghanistan, India, Nepal, Southeast Asia, Malaysia and Taiwan. *A. capillaris* has been widely used in traditional Chinese medicine as an alternative medicinal plant since ancient times to improve conditions such as fever, pain, hepatotoxicosis, inflammation, cholestasis and jaundice (Cha *et al*., 2005).

The content of biologically active components of grass depends on the type and origin of the plant. For instance, the clinical use of wormwood in traditional Chinese medicine includes *A. capillaris* and *Artemisia scoparia* (*A. scoparia*). Although *A. capillaris* is the main species used in medicines, *A. scoparia* contains higher levels of the main active compound scoparone, while *A. capillaris* contains plenty of chlorogenic acid (Tang and Eisenbrand, 1992). Harvest time and growth region also affect the chemical composition of bioactive compounds. The content of capillaryrisin and scoparon (6.7-dimethyl esculetin) reaches a peak in the leaves of *A. capillaris* in late July. However, the maximum level of capillarazine and scoparon is found in the flower (basket) in early August and early September, respectively (Choi *et al*., 2007). The best time to collect *A. capillaris* is an important factor influencing the pharmacological action, including the possible toxicity of scoparone. Thus, the therapeutic properties of *A. capillaris* depend on the part of the plant and the time of harvest and should be balanced depending on the content of biologically active components.

The pharmacological effect of *A. capillaris* is well studied, but its properties as a feed additive have not been researched enough. Only a few studies have examined the effect of adding *A. capillaris* to poultry diets. Thus, the addition of aqueous extracts of *A. capillaris*, *C. sinensis, S. chinensis and V. Coloratum* to the diets of laying hens leads to a significant ($p < 0.05$) increase in egg production, egg weight and improved feed conversion rate, egg yolk color, Howe units but does not notably affect the quality of the eggshell. It causes a significant decrease ($p < 0.05$) in total serum cholesterol. Moreover, the addition of aqueous extracts of *A. capillaris, C. sinensis, S. chinensis* and *V. coloratum* to the diet leads to an increase in the shelf life of eggs without compromising their quality. The results indicate that the extracts of medicinal plants can be used as a feed additive for laying hens (Kim *et al*., 2010).

Addition of aqueous extract of *A. capillaris* to the diets of broiler chickens leads to a significant ($p < 0.05$) increase in body weight, decrease in relative weight and length of the small intestine, the number of salmonella in the cecum. The use of aqueous extract of *A. capillaris* causes a decrease ($p < 0.05$) in serum levels of total cholesterol, aspartate aminotransferase and alanine aminotransferase. In conclusion, the authors suggest that these extracts may be an alternative to growth-promoting antibiotics (Kim *et al*., 2010).

MATERIALS AND METHODS

The aim of the experiment was to study the effect of feeding dried powdered wormwood (*Artemisia capillaris*) on quail meat productivity. Dry powder of wormwood *(Artemisia capillaris)* manufactured by Naturalin Bio-Resources Co, Ltd China was used in the experiment. For this purpose, 400 heads of Pharaoh quail at the age of one day were selected, from which four groups were formed on the principle of analogues – control and three experimental, 100 heads in each. In the selection of analogues we considered the age and body weight of the bird (Tab. I). Pharaoh Quail were bred by American breeder A. Marsh. This is the first and only breed for meat, which is characterized by fairly large carcasses suitable for culinary purposes. The experiment lasted for 35 days and was divided into two periods (1–21 days and 22–35 days) and 5 subperiods lasting for 7 days each.

I: *Scheme of the experiment*

Group	Number, heads of quail	Age, days	
		1–21	22–35
		Artemisia capillaris content in the compound feed, %	
1 – control	100	Basic compound feed (BCF)	
2 – experimental	100	BCF + 0.5% of dried powdered wormwood in 1 kg of the feed	
3 – experimental	100	BCF + 1.0% of dried powdered wormwood in 1 kg of the feed	
4 – experimental	100	BCF + 1.5% of dried powdered wormwood in 1 kg of the feed	

During the experiment, quail were kept in single-tier battery cages. In each cage measuring 46 × 40 × 20 cm, 25 heads bodyd, i.e. the floor area per head was 73.6 cm². At the same time, the design of the cage provided a feed front of at least 1.5 cm. Vacuum drinkers were used to water the quail. In the period from 1 to 21 days there was used artificial heating of quail housing at the level of 32–36 °C, then the room temperature was at the level of 21–23 °C. Relative humidity was 65–70%.

In the first three weeks of life there was used around the clock lighting. Later, the length of daylight was reduced by 3 hours during the week and finally consisted 12 hours per day.

Young quail of all experimental groups during the experiment were fed complete feed, balanced for all nutrients in accordance with the recommended norms, the nutritional value of which corresponded to the recommended norms according to the age of quail. The birds were fed based on the norms of feeding meat quail developed by the Poultry Research Institute of the Ukrainian Academy of Agrarian Sciences (Ryabokon *et al.*, 2005) and previous studies by Ukrainian scientists (Plyska *et al.*, 2021). In the composition of compound feeds for quail control and experimental groups, the set and number of ingredients were the same. The composition of the compound feed used in feeding young quail is shown in Tab. II.

The chemical composition of the feed used for feeding quail was the same and differed only in the content of powdered wormwood as shown in Tab. III. Adding dried powdered wormwood (*Artemisia capillaris*) to the feed took place by the method of weight dosing and multistage mixing according to the scheme of the experiment (Tab. I). The introduction of wormwood into compound feed was carried out by multi-stage mixing using a ZMG-4000 mixer (Khorol Mechanical Plant, Ukraine). Duration of mixing is 4 minutes. The compound feeds were given twice a day (in the morning and in the evening). Throughout the experiment, there were kept careful records of distributed feed and unconsumed residues. In addition, there was recorded the retention of quail, their body weight and growth, feed consumption per 1 kg of growth. At the end of the experiment, slaughter of the experimental birds (10 heads from each group) was conducted and slaughter quality traits were investigated. Slaughter of the birds was carried out by decapitation.

Evaluation of quail slaughter quality traits was carried out according to the following indicators:

- pre-slaughter weight – body weight of quail after 12-hour fasting;
- ungutted carcass weight – carcass weight without blood and feathers;
- semi-gutted carcass weight – carcass weight without blood, feathers and intestines;
- gutted carcass weight – carcass weight without blood, feathers, head, legs, wings at the elbow, intestines;
- weight of edible parts – weight of the entire edible part of the gutted carcass;
- weight of internal fat.

The recipe for compound feed was calculated using the WinMix computer program. The components for the production of compound feed previously underwent laboratory analysis for the main indicators (protein, fat, fiber, ash, Ca, P). The obtained compound feed was also analyzed in the laboratory of the P.D. Pshenychnyy Department of Animal Nutrition and Feed Technology, National University of Life and Environmental Sciences of Ukraine, according to the main indicators, other indicators are declared by a quality certificate from the manufacturer.

II: *Composition of complete compound feed for young quail raised for meat, % by weight*

Indicator	Age of quail, days	
	1–21	22–49
Soybean meal	29.8	–
Corn	26.4	40.3
Wheat	23.2	27.4
Fishmeal	10.0	6.0
Soy meal	5.8	21.5
Sunflower meal	2.6	2.1
Limestone	0.2	0.1
Premix 2%;	2.0	–
Premix 2.5%	–	2.5

III: *Energy and nutrient content in 100 g of quail feed*

Metabolic energy, MJ	1,21	1,25
Crude fat, g	5.0	5.0
Crude fiber, g	4.2	4.29
Crude protein, g	27.5	20.5
Linolenic acid, g	1.62	1.90
Methionine, g	0.65	0.46
Methionine+cystine, g	1.00	0.75
Lysine, g	1.68	1.11
Threonine, g	1.00	0.75
Tryptophan, g	0.33	0.23
Calcium, g	1.00	1.00
Phosphorus, g	0.80	0.80
Sodium, g	0.25	0.25
Vitamin A, MO	1500	700
Vitamin E, mg	2.0	0.50
Vitamin D_3, MO	300	150

The weight of slaughter products was determined using VLTK-500 scales. Based on indicators for quail post-slaughter quality traits, the following indices of meat qualities of carcasses were determined:

- carcass meatiness – the ratio of all muscles weight to the weight of the gutted carcass, %;
- breast meatiness – the ratio of pectoral muscle weight to the weight of the gutted carcass, %;
- leg meatiness – the ratio of leg muscle weight to the weight of the gutted carcass, %;
- yield of edible parts – the ratio of all muscles weight to the weight of ungutted carcass, %.

In the process of processing experimental data, the arithmetic mean (M) and its error (± m), as well as the level of reliability (P) were calculated. Biometric data processing was carried out on a personal computer using MS Excel software using built-in statistical functions. When calculating statistical reliability, it was taken into account that the P indicator is characterized as follows: $P \leq 0.05$ – "Statistically reliable (significant) differences detected", $P \leq 0.01$ – "Differences at a high level of statistical significance detected", $P \leq 0.001$ – "Differences at the highest level of statistical significance detected." The following symbols are used to indicate the level of significance of the probability criterion (P) in the tables: *$P \leq 0.05$, **$P \leq 0.01$, ***$P \leq 0.001$ compared to the first control group.

RESULTS

With different wormwood content in the feed, the body weight of the experimental birds varied differently (Tab. IV). Thus, at the age of one day the body weight of young quail of the control and experimental groups did not differ significantly, while from the age of 7 days it changed, depending on the period of growth.

At the age of 7 and 14 days, the body weight of quail varied insignificantly; however, there was a tendency to increase it in quail of the second group, which consumed feed with a wormwood content of 0.5%. At the age of 21 days, the largest body weight was in quail of the third group, which consumed the compound feed with a content of 1.0% powdered wormwood. It was higher than in the control, second and fourth groups by 3.61% ($P0 \leq .01$), 1.36% and 2.52%, respectively.

From the age of 28 days, the body weight of quail fed wormwood in the feed composition was higher than in the control group. Quail of the second and third groups, fed 0.5% and 1.0% of powdered wormwood in the feed composition, had a significantly higher body weight by 2.99% ($P \leq 0.05$) and 4.16% ($P \leq 0.01$), respectively, compared to quail of the control group.

At the end of the experiment, the largest body weight was in quail of the third group, which were

IV: *Dynamics of daily body weight (BW) gain in average, g (M ± m, n = 100)*

Age, days	Group			
	control	experimental		
	1-	2	3	4
1	9.43 ± 0.089	9.47 ± 0.097	9.40 ± 0.097	9.46 ± 0.103
7	31.94 ± 0.600	32.04 ± 0.567	31.90 ± 0.526	31.95 ± 0.550
14	89.39 ± 1.009	91.86 ± 1.013	92.22 ± 0.994	90.28 ± 1.070
21	147.87 ± 1.229	151.15 ± 1.107	153.21 ± 1.579**	149.45 ± 1.158
28	200.05 ± 1.815	206.04 ± 1.808*	208.38 ± 1.941**	204.71 ± 2.123
35	238.24 ± 2.594	246.16 ± 2.703*	251.03 ± 2.873**	245.28 ± 2.990

Here and further *$P0 \leq .05$, **$P \leq 0.01$

V: *Average daily feed consumption, g/age/days (M ± m, n = 100)*

Age, days	Group			
	control	experimental		
	1	2	3	4
1–7	3.2 ± 0.07	3.2 ± 0.07	3.2 ± 0.06	3.2 ± 0.08
8–14	8.2 ± 0.06	8.5 ± 0.07***	8.6 ± 0.08***	8.3 ± 0.09
15–21	8.3 ± 0.04	8.4 ± 0.03*	8.7 ± 0.18	8.4 ± 0.06
22–28	7.5 ± 0.10	7.8 ± 0.11*	7.9 ± 0.14*	7.9 ± 0.15*
29–35	5.5 ± 0.12	5.7 ± 0.14	6.1 ± 0.14**	5.8 ± 0.16
During the experiment period	5.9 ± 0.06	6.1 ± 0.06**	6.3 ± 0.07***	6.1 ± 0.07*

Notes: *$P0 \leq .05$; **$P \leq 0.01$; ***$P \leq 0.001$ compared to the first group

VI: *Feed costs per 1 kg of body weight gain, kg*

Day	Group			
	control	experimental		
	1	2	3	4
1–7	1.394	1.377	1.364	1.384
8–14	1.755	1.707	1.687	1.754
15–21	2.382	2.275	2.424	2.398
22–28	3.719	3.561	3.571	3.553
29–35	6.428	6.194	5.864	6.085
During the experiment	3.136	3.023	2.982	3.035

fed 1.0% powdered wormwood in the feed, what is 5.37% ($P \leq 0.01$) more than the weight in the control group.

The main product of quail raised for meat is the increase in body weight (Tab. V). Thus, if in the first week of raising (1–7 days) the average daily gain of young quail of the control and experimental groups did not differ significantly, then during the second week of raising, quail of the 3rd group prevailed control analogues on average daily weight gain by 0.4 g or 4.87% ($P \leq 0.001$). However, the birds of the 2nd and 4th experimental groups also outperformed the control indicators, respectively, by 0.3 g or 3.66% ($P \leq 0.001$) and 0.1 g or 1.22%.

During the raising period from the age of 15 to 21 days, the largest average daily gain was observed in the birds of the 3rd group, where it was 0.4 g, or 4.82% higher than the birds of the 1st group. In the birds of the 2nd and 4th groups it was 0.1 g or 1.2% g ($P < 0.05$) higher than in young quail of the control group.

During the fourth week of raising, quail of the control group yielded to analogues of the 2nd, 3rd and 4th groups in terms of average daily weight gain by 0.3 g or 3.85% ($P \leq 0.05$), 0.4 g or 5.06% ($P \leq 0.05$) and 0.4 g or 5.06% ($P \leq 0.05$) respectively.

In the last week of raising, quail of the 3rd experimental group dominated the birds of the control group in terms of average daily gain in body weight by 0.6 g or 10.91% ($P < 0.01$). The birds of the 2nd and 4th experimental groups outperformed the control group on this indicator less significantly – by 0.2 g and 0.3 g, which is, respectively, 3.64% and 5.45%.

For the entire raising period, the average daily gain in body weight of young quail of the experimental groups was respectively 3.39% ($P \leq 0.01$), 6.78% ($P0 \leq .001$) and 3.39% ($P \leq 0.05$) higher compared to the control group.

The dependence of the growth intensity of young quail on the different content of wormwood in the compound feeds affected the cost of feed per unit of gain in their body weight (Tab. VI). During the first week of life, quail of the 3rd experimental group consumed the least feed per gain – 30 g or 2.15% less than their control analogues. In the birds of the 2nd and 4th experimental groups, this indicator was lower than in the control group, respectively, by 17 g or 1.22% and 10 g or 0.72%.

At the age of 8–14 days, the quail of the 4th experimental group in terms of feed consumption per 1 kg of body weight gain were almost equal to the control group (difference was 0.05%), 2nd and 3rd experimental groups – yielded to it by 48 g or 2.74% and 68 g or 3.87%.

During the third week of quail raising, the 3rd and 4th experimental groups exceeded the control animals in terms of feed consumption per 1 kg of body weight gain – by 42 g or 1.76% and 16 g or 0.67%. Instead, the birds of the 2nd experimental group yielded to the control group, respectively, by 107 g or 4.49%.

Consumption of feed in the period of 22–28 days per 1 kg of body weight gain of the birds of the 2nd, 3rd and 4th groups was lower than the control one, respectively, by 158 g, 148 and 166 g or, respectively, by 4.25%, 3.98 and 4.46%.

In the last week of quail raising, the lowest feed consumption was in the quail of the 3rd experimental group – 564 g or 8.77% less than in the quail of the 1st control group. In the birds of the 2nd and 4th experimental groups, feed consumption per 1 kg of body weight gain was lower than in the control group, respectively, by 234 g or 3.64% and 343 g or 5.34%.

In general, for the entire period of the experiment, which lasted for 35 days, the lowest feed consumption per 1 kg of body weight gain was in the quail of the 3rd experimental group. In terms of this indicator, they yielded to control analogues by 154 g or 4.91%. The birds of the 2nd and 4th experimental groups had almost identical indicators, which yielded to the control one by 113 g or 3.60% and 101 g or 3.22%

During the experiment, we recorded quail retention number on regular basis. To do this, the experimental birds were inspected daily and dead individuals were removed. It should be noted that the retention number in all groups was at a high level of 94–95%.

VII: *Yield of slaughter products, % (M ± m, n = 10)*

Indicator	Animal group			
	control	experimental		
	1	2	3	4
Yield of semi-gutted carcass	81.54 ± 1.024	81.46 ± 0.682	82.37 ± 0.884	82.22 ± 2.160
Yield of gutted carcass	75.61 ± 1.132	76.02 ± 1.725	77.28 ± 1.419	75.35 ± 0.754
Yield of edible parts:				
pectoral muscles	15.79 ± 0.546	17.00 ± 0.442**	17.99 ± 0.570***	16.37 ± 0.711
leg muscles	11.00 ± 0.715	11.33 ± 0.321	12.08 ± 0.318*	10.65 ± 0.633
skin	7.12 ± 0.178	6.99 ± 0.053	7.03 ± 0.249	7.05 ± 0.302
internal fat	1.48 ± 0.066	1.40 ± 0.069	1.30 ± 0.084*	1.26 ± 0.039**
bodyr	2.49 ± 0.053	2.51 ± 0.043	2.50 ± 0.084	2.78 ± 0.201
lungs	0.88 ± 0.069	0.97 ± 0.067	0.94 ± 0.088	0.95 ± 0.092
kidneys	0.66 ± 0.037	0.70 ± 0.051	0.72 ± 0.069	0.69 ± 0.078
gizzard	1.74 ± 0.040	1.64 ± 0.056*	1.63 ± 0.069*	1.57 ± 0.059**
heart	0.98 ± 0.071	1.02 ± 0.080	1.01 ± 0.061	1.02 ± 0.098

Notes: *P0 ≤ .05; **P0 ≤ .01; ***P ≤ 0.001 compared to the 1st group

The yield of slaughter products is the main characteristic of meat productivity. In addition, the ratio between the bones, muscles and fat will characterize the influence of the studied factor on quail organism.

The yield of gutted carcass (Tab. VII) increased by 0.41–1.67% in the 2nd and 3rd experimental groups with an increase in the amount of dried wormwood in the feed to 1.0%. A further increase in the wormwood content to 1.5% in the compound feed of the birds of the 4th experimental group led to a decrease in the yield of gutted carcass by 0.26% compared to the control group and by 0.67–1.93% compared to the indicators of the 2nd and 3rd experimental groups.

Analyzing the yield of edible parts, we can note the most significant differences in the proportion of pectoral muscles and pelvic floor muscles. The pectoral muscle yield in the birds of the 2nd and 3rd experimental groups was higher than in the control analogues by 1.21–2.20% (P ≤ 0.01) and higher than in the young quail of the 4th experimental group by 0.63–1.62%.

We can observe a similar pattern in the output of the pelvic floor muscles. This indicator in the birds of the 2nd and 3rd experimental groups was higher than in the 1st group by 0.33–1.08%. The indicator of the quail of the 4th experimental group was lower than in the control group by 0.35%.

Thus, the introduction of dried powdered wormwood into the feed of young quail up to 1.0% had a positive effect on the output of the pectoral and pelvic floor muscles. Further increase of wormwood content in the compound feed to 1.5% led to a decrease in these indicators.

Significant changes were also observed in the amount of internal fat in the carcass. As the amount of wormwood in the diet increased, the yield of internal fat decreased. Thus, this indicator in the birds of the 2–4 experimental groups was lower than in the control one by 0.08–0.22% (P ≤ 0.01).

VIII: *Meat indices (M ± m, n = 10)*

Indicator	Animal group			
	control	experimental		
	1	2	3	4
Carcass meatiness	49.98 ± 0.618	52.18 ± 0.625**	54.54 ± 0.836***	50.01 ± 2.694
Breast meatiness	20.89 ± 0.961	22.37 ± 0.808*	23.28 ± 0.408***	21.73 ± 0.963
Leg meatiness	14.54 ± 0.768	14.90 ± 0.117	15.63 ± 0.237	14.14 ± 0.946
Yield of edible parts	70.27 ± 0.849	72.21 ± 0.905**	74.12 ± 1.109**	70.33 ± 3.009
Bones	29.73 ± 0.849	27.79 ± 0.905*	25.88 ± 1.109**	29.67 ± 3.009

*P ≤ 0.05, **P ≤ 0.01, ***P ≤ 0.001

We should also note the reduction of gizzard in the birds of the experimental groups. The gizzard yield was lower by 0.10–0.17% ($P0 \leq .01$).

As for the indicators of meatiness (Tab. VIII), the highest rates can be observed in the young quail of the 2nd and 3rd experimental groups. Under the influence of the studied factor, the carcass meatiness of the birds of the 2nd and 3rd experimental groups increased by 2.20–4.56% ($P < 0.001$). Breast meatiness also increased in the birds of these groups by 1.48–2.39% ($P \leq 0.001$).

The yield of edible parts increased with the increase in the amount of wormwood in the feed to 0.5 and 1.0% in the diet of quail of the 2nd and 3rd experimental groups – by 1.94–3.85% ($P \leq 0.01$). On the other hand, the indicator of bones decreased by 1.94–3.85%, respectively ($P \leq 0.01$).

It should be noted that the meatiness indicators in the quail of the 4th experimental group, which consumed the compound feed with 1.5% of wormwood, were at the level of the control group and, accordingly, were significantly lower than those of analogues of the 2nd and 3rd experimental groups.

DISCUSSION

The results of our studies showed a positive effect of feeding quail rations containing 1.0% *Artemisia capillaries* on their body weight and average daily weight gain. It should be noted that the bitterness in the wormwood herb contributes to increasing the motility of the stomach and improving microcirculation in its mucous membrane. It has been proven that the compounds contained in wormwood stimulate acid formation and improve blood flow in the stomach (Szopa *et al*., 2020). The mechanism of action on the animal body is explained by the presence in *Artemisia Capillaris* of: *p*-hydroxyacetophenone, *β*-sitosterol, scoparon, cirsimarin, quercetin, arcapiline, capilin, 6,7-dimethylesculetin, 6,7-dimethoxycoumarin, capilon, capillarin, 4-methylcapillarisin, cirsilylineol, cirsimaritin, and capillarizin, which showed antihepatofibrotic, anti-inflammatory, choleretic, and hepatoprotective effects. That, in its turn, stimulates productivity growth (Seon *et al*., 2005; Xie, 2004). Thus, at the end of the experiment, the body weight of quail was 5.37% ($P \leq 0.01$) higher than the weight of the birds in the control group, and on average during the raising period the average daily increase in body weight of young quail was 6.78% ($P \leq 0.001$) higher compared to this indicator in the birds of the control group. However, there are conflicting data in the literature on the impact of *Artemisia* on quail productivity. For instance, some researchers report that feeding *Artemisia* is unlikely to affect changes in body weight and weight gain. According to research (Toosi *et al*., 2020), the addition of 2% *Artemisia annua* (Annual Wormwood) to the diets of quail did not increase their body weight. Cherian *et al.* (2013) reported that broilers that received rations containing 2 and 4 g/kg *Artemisia annua* did not have a significant difference in body weight and gain. In addition, Khalaji *et al.* (2011) reported that diets containing 1.0% *Artemisia sieber* did not affect the final body weight and weight gain of broiler chickens. At the same time the results of our studies are in good agreement with the results obtained by Kim *et al.* (2010), according to which the use of aqueous extract of *Artemisia capillaris* contributed to the increase ($P \leq 0.05$) of body weight of the birds and their body weight gain, and the authors suggest that this extract may be an alternative to antibiotics and growth stimulants.

Feeding young quail compound feeds with different levels of *Artemisia capillaris* led to a decrease in feed consumption per 1 kg of body weight gain during the entire growing period. In general, for the entire period of the experiment, which lasted for 35 days, the lowest feed consumption per 1 kg of body weight gain was in the quail consuming the compound feed with 1.0% *Artemisia capillaries*, which was 4.91% less than in the control counterparts. Kostadinović *et al.* (2015) obtained similar data in broiler chickens feeding them *Artemisia absinthium* (Bitter Wormwood) and explaining this fact by the presence of essential amino acids, minerals, vitamins and flavonoids in wormwood. This is somewhat consistent with the results (Toosi *et al*., 2020), which report that feeding quail rations with 2.0% *Artemisia annua* led to a significant reduction ($P < 0.05$) in feed consumption during the last two weeks of raising. Gholamrezaie *et al.* (2013) obtained similar results as well and reported that broilers that consumed a diet with powdered *Artemisia annua* leaf used less feed compared to the control group; they explained a reduction in feed intake with a high fiber content in *Artemisia annua*. However, in both studies, this did not affect the feed conversion rate.

Additional introduction into the diet of broiler chickens *Artemisia annua* in the amount of 1.0%, according to Saracila *et al.* (2018), contributed to a decrease in feed conversion by 1.69%, an increase in average daily gain by 10.8–11.0% and an increase in bodyr weight by 5.0%, even under conditions of thermal stress, which is also confirmed by our research.

The positive effect of wormwood on body weight and feed conversion found its confirmation in feeding rabbits, as proved by Puvača *et al.* (2015), although other researchers, such as Iqbal *et al.* (2013) when using *Artemisia absinthium* in feeding young goats noted a decrease in body weight of animals.

The results of our studies are consistent with experiments conducted on broiler chickens (Lee, Sung-Jin *et al*., 2010). The researchers studied the effect of a mixture of different types of wormwood: *A. princeps*, *A. argyi*, *A. capillaris*, and *A. Iwayomogi* on body weight gain and feed consumption. With the introduction of 1.0% wormwood in the compound feed, the body weight of the birds increased and feed costs decreased by 1 kg. With a further increase in wormwood in the feed, body weight decreased and feed consumption increased (Lee, Sung-Jin *et al*., 2010).

Feeding quail diets with *Artemisia capillaris* led to significant changes in the content of carcass internal fat. With the increase in the amount of wormwood in the diet, the yield of internal fat decreased ($P \leq 0.01$) in the birds of the experimental groups by 0.08–0.22% compared to the control one. This is in good agreement with the results (Toosi *et al*., 2020) which report that feeding Japanese quail 2.0% *Artemisia annua* can increase their productivity by reducing abdominal fat. Cherian *et al*. (2013) obtained similar data and proved that birds fed 4.0% *Artemisia annua* had less internal fat and bodyr and explained that in addition to the added nutritional value of wormwood, there are antioxidant compounds such as vitamin E and phenolic complexes. Lim *et al*. (2013) also proved the reduction in internal fat mass by using *Artemisia capilaris* in obese rats.

As for bodyr yield, our study showed an unlikely increase in this indicator with increasing content of *Artemisia capillaris* in the feed, which can be explained by the proven by Hrytsyk *et al*. (2019) hepatoprotective effect of *Artemisia absinthium* and *Artemisia vulgaris* (Wild Wormwood) on the body. It is found that LD_{50} is 5000 mg/kg, i.e. the product is non-toxic and can be safely used in animal feed.

However, feeding compound feeds with different levels of *Artemisia capillaris* did not affect the yield of the heart, lungs and kidneys. Khalaji *et al*. (2011) got similar results and reported that diets containing 1.0% *Artemisia sieberi* did not affect breast, bodyr and heart weight.

The slaughter characteristics of young quail obtained in our studies are consistent with similar indicators received in broiler chickens by feeding them a mixture of different species of wormwood: *A. princeps*, *A. argyi*, *A. capillaris*, and *A. Iwayomogi* (Lee *et al*., 2010). The authors (Lee *et al*., 2010) got similar results: reduction of abdominal fat weight ($P \leq 0.05$); increase in bodyr weight due to the introduction of wormwood in the feed in excess of 5%; decrease in ventricular muscle weight with wormwood intake to 5% and increase in this figure with wormwood intake of more than 5%.

CONCLUSION

Feeding poultry of the 3rd experimental group with compound feeds containing 1.0% of *Artemisia capillaris* contributed to the growth of body weight by 5.37% ($P \leq 0.01$) at the lowest feed consumption per 1 kg of body weight gain, according to this indicator they yielded the control analogues by 4.91%. The introduction of 1.0% of wormwood into the compound feeds of the 3rd experimental group increased the yield of gutted carcass by 1.67%, pelvic floor muscles – by 1.08%, edible parts – by 3.85% ($P \leq 0.01$) compared to the control group.

Increasing the amount of *Artemisia capillaris* in the diet to 1.5% in the feed of the 4th experimental group, helped to reduce the content of internal fat by 0.22% ($P \leq 0.01$); it also reduced the yield of gutted carcass by 0.26%, the yield of pelvic floor muscles by 0.35% and gizzard by 0.17% compared to the control group.

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