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Full Length Research Paper

Effect of garlic (*allium sativum l.*) in fattening chicks nutrition

Vidica Stanacev[1]*, Dragan Glamocic[1], Niko Miloševic[1], Nikola Puvaca[1], Vladislav Stanacev[2] and Nada Plavša[1]

[1]Faculty of Agriculture, University of Novi Sad,Trg Dositeja Obradovi a 8, Novi Sad, Serbia.
[2]"Tehno oprema", Ba ka Topola, Serbia.

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The paper examines the effects of garlic (*Allium sativum* L.) and Cu separately as well as their combined effects on the production parameters and carcass quality in broiler chicks. Garlic has antimicrobial, antihypertensive and antioxidative properties, while high copper levels in feed (100 ppm) displays stimulating and bacterial effects, which may be an alternative to antibiotics whose use is prohibited by the EU. Bearing in mind the aforementioned, the objective of this study was to prove the effects of garlic in broiler feed on production parameters, health status and carcass quality. The testing was carried out under production conditions with one-day-old Hubbard broilers of the same weight divided in 4 groups, each consisting of 75 birds, in 4 repetitions. Treatment groups were given: 2% of commercial garlic in group II, 2% garlic and 100 ppm Cu in group III, and 100 ppm Cu in group IV. At the end of the experiment which lasted 42 days it was found that the addition of garlic led to a significant ($P < 0.05$) increase of body mass in group II (2055.55 g) and group III (2038.65 g) in comparison to the control group (1964.52 g). The feed exploitation was found to be better in groups treated with garlic.

Key words: Garlic, copper, broilers, production parameters, carcass quality.

INTRODUCTION

In addition to nutritional substances necessary for growth and development of chicks, the feed is regularly supplemented with pharmacological products, either for preventive purposes, as prevention against certain diseases (coccidiostatics) or as growth stimulators (antibiotics), primarily in case of young chicks as Doyle (2001) defined. The application of such treatment reduces the number of chicken deaths and the costs of medical treatment. In addition, these additives have a positive effect on growth, feed conversion and meat quality, but they also have negative effects manifested through the emergence of pathogens resistant to the applied antibiotics in animals and human beings. For these reasons the European Union prohibited the use of such supplements in 2006.

The alternatives to antibiotics as growth stimulators are numerous, amounting to finding an adequate non-pharmacological products from the group prebiotics, probiotics, organic acids and other essential oils, medicinal plants or parts of plants such as thyme, basil, oregano and others reported by Simon (2005).

The beneficial effects of garlic *(Allium sativum L.)* on human and animal organism, which result from its antimicrobial, antioxidative and antihypertensive properties was reported by Konjufca et al. (1997), Sivam (2001), Prasad and Saharma (1981), have been known from ancient times. Scientific research has shown that these effects can be attributed to its bioactive components, the most important among which are sulphuric compounds, allin, diallylsulphide, allyldisulphide and allicin defined by Kumar and Berwal (1998). Amagase et al. (2001) proved its medicinal effects on intestinal disorders, abdominal distension and treatment of intestinal worms and respiratory infections. Garlic also manifests hypocholesterolemic effects on chickens through inhibition of the most important enzymes that participate in the synthesis of cholesterol and lipids (tri-hydroxy-tri-methyl-glutaril coenzyme A reductase,

*Corresponding author. E-mail: vidica.stanacev@gmail.com.

Table 1. The plan of additives supplement.

Group	I	II	III	IV
Garlic,%	Control	2	2	0
Copper, ppm		0	100	100

cholesterol-7- -hydroxylase and the synthesis of fatty acids). In addition, this additive has a relatively low market price, is added in small amounts of 1 to 2%, thus not increasing production costs, which is of particular importance to manufacturers.

Studies focused on growth, conversion and meat quality of different types of animals indicate positive effects. Cullen et al. (2005) examined the effect of garlic supplement in the amount of 1% in pig feed and recorded an increase in growth, conversion and meat quality in comparison to the control group. Horton et al. (1991b), Freits et al. (2001), Bampidis et al. (2005), had similar results in their study of broilers, but they also concluded that lower concentrations, ranging between 1 and 2%, were actually more effective. A 4.5% content of commercial garlic in the chicken feed had no influence on growth and food conversion. Then Horton et al. (1991) studied the effects of feed flavour with garlic supplement on the consumption, certain performances and blood parameters in horses, pigs and sheep.

High doses of copper in the chicken feed (100 and 200 ppm) show similar effects: stimulating, bacterial and bacteriostatic. Moreover, such nutrition reduces the cholesterol level in tissues, which makes copper an important nutrition additive and supplement in the production of dietary foodstuffs necessary for people suffering from cardiovascular diseases, as well as an alternative to antibiotics defined by Stana ev et al. (1998) and Stana ev at al. (2004).

Regarding the quality of chicken carcasses, studies have been focusing on the improvement of the properties and build of chicken carcasses that would meet the food industry requirements for many years. The best results are achieved through genetic selection, nutrition and breeding technology, which are reflected in a significant increase of overall carcass masses and the share of breast meat as well as a reduction of the abdominal fat content in 6-week-old chicks. Bearing in mind the aforementioned, the study focused on examining the effects of garlic supplement in broiler feed, both alone and in combination with copper, on the production parameters, health and quality of chicken carcasses.

MATERIALS AND METHODS

Biological experiments were performed under production conditions in the experimental farm “Pustara” of the Faculty of Agriculture in Novi Sad. At the start of the fattening period, four groups of 75 one-day- old Hubbard hybrid broilers of the same weight were formed. The experiment was performed with four repetitions covering a total of 300 chickens per treatment, and was set according to the scheme given in Table 1.

There were three nutrient mixtures used: starter, finisher I and finisher II with 23, 20 and 18% protein content respectively (Table 2). The experiment lasted for 42 days, during which time the mixtures were changed in intervals of fourteen days. During the experimental period, the birds received a free supply of food and water, while the microclimatic conditions were regularly monitored. To maintain optimal temperature in the building of 30 – 32°C during the first week of age, were used electric heater with thermostat. Every week, temperature is retreat for 2°C, that in the course of six weeks was 20 to 22°C. Ventilation building was done by ventilator with potentiometers regulating the air flow. Monitoring of body weight and food exploitation was carried out every seven days. The 45 days old chickens were sacrificed for the purposes of testing carcass quality. The 10 birds (5 male and 5 female) of an average body weight were separated from each flock and after a 12 h starvation period they were slaughtered, followed by procedures of bleeding, scalding, defeathering and evisceration. Chilled carcasses “ready for grilling” were cut into the basic anatomical parts and measured. The research results are presented in table form, as average treatment values and the data processing statistical method applied was ANOVA.

RESULTS

At the end of the second week the body mass in the control group was 357.4 g, and in the experimental groups II, III and IV was 345.7, 339.9 and 346.9 respectively. At the end of the experiment, group II achieved body mass of 2055.55 g and group III 2038.65 g registered a statistically significant ($P < 0.05$) increase in body weight in comparison to group I 1964.52 g (Table 3).

The body weight of chicks at the end of the experiment separated by gender was the highest in the group II with addition of 2% garlic and it was 2192.7 g for male chicks and 1913.7 g for female chicks. The lowest body mass was recorded in control group 2125.4 g (Table 4).

The lowest conversion rates of 1.73 kg/kg were recorded in group II and the highest in the control group 1.92 kg/kg (Table 5). In regard to carcass quality, the results shown in Table 6 indicate that the average mass of the chilled carcasses “ready for grilling” was lowest in the garlic treatment group II (1539 g) and highest in the control group (1578.5 g). The mass of breasts was lowest in group III (472.5 g) and highest in group I (491.1 g), while leg and thigh mass was lowest in group II (457.5 g) and highest in the control group (477.1 g). The mass of back ranges from 374.9 g in group II to 383.7 g in group I, while the mass of wings ranges from 200.1 g in group III to 209 g in group IV. The recorded values of abdominal

Table 2. Composition of feed for chicks with chemical analysis of feeds.

Feed	Starter	Finisher I	Finisher II
Oil (%)	4	4	4
Corn(%)	41.78	50.91	57.8
DL Methionine (%)	0.27	0.23	0.23
Foolfat soya bean (%)	12.5	11.5	11
Soya bean meal (%)	37	29	23
Monocalcium phosphate (%)	1.4	1.31	1
Premix (%)	1	1	1
Salt (%)	0.25	0.3	0.4
Limestone (%)	1.6	1.6	1.49
Lysine (%)	0.2	0.15	0.08
Total (%)	*100*	*100*	*100*
Crude protein (%)	23.21	20.18	18.03
Metabolic energy, MJ/Kg	12.95	13.29	13.6
DM, (%)	91.08	90.91	90.79
Moisture, (%)	8.92	9.09	9.21
Crude protein, (%)	22.58	20.05	17.52
Fat, (%)	7.1	6.67	6.51
Crude fiber, (%)	3.88	3.71	3.41
Ash, (%)	5.58	5.33	4.53
NFE, (%)	51.94	55.17	58.82
Calcium, (%)	1.06	1.11	0.96
Phosphorus, (%)	0.61	0.65	0.5

*2 kg of garlic was added on 100kg of feed mixture.

Table 3. Body weight of birds(g).

Group	I	II	III	IV
Additive	**Control**	**Garlic**	**Garlic+Copper**	**Copper**
Initial	43.3	43.4	43.4	43.4
Week 1	141.1	140.7	135.5	137.5
Week 2	357.4	345.7	339.9	346.9
Week 3	680.6	729.1	732.4	744
Week 4	1048.9	1098.8	1090	1119.6
Week 5	1490.3	1570	1534.8	1555.6
Week 6	1964.52	2055.55*	2038.65*	2016.4

*Significantly ($P < 0.05$).

Table 4. The body weight of chicks at the end of the experiment, given separately for male and female birds.

Group	I		II		III		IV	
Additive	**Control**		**Garlic**		**Garlic+Copper**		**Copper**	
Gender								
Body weight (g)	2125.4	1822.5	2192.7	1913.7	2165.7	1880.7	2141.8	1881
Index, %	100	100	103.17	105	101.9	103.19	100.77	103.21

fat indicate that the lowest amount of fat was found in group II (17 g), while the highest was in group IV (21.2 g). The relative share of more valuable parts in the mass of the processed carcasses shows much smaller difference.

Table 5. Feed conversion (kg).

Group	I	II	III	IV
Additive	**Control**	**Garlic**	**Garlic + Copper**	**Copper, 100 ppm**
Week 1 - 2.	1.45	1.22	1.37	1.52
Index, %	100.00	84.48	94.42	105.20
Week 3 - 4.	1.77	1.53	1.64	1.78
Index, %	100.00	86.31	92.32	100.15
Week 5 - 6.	2.19	2.04	2.05	2.07
Index, %	100.00	93.36	93.94	94.88
Week 1 - 6	1.92	1.73	1.80	1.88
Index, %	100.00	89.81	93.43	97.64

Table 6. The quality of carcasses.

Group	I	II	III	IV
Cu level, ppm	0	0	100	100
Garlic content, %	0	2	2	0
Carcass weight and yield				
Before slaughtering, g	2326	2290	2312	2296
Carcass mass, g				
Ready for grilling	1578.5	1539	1541,5	1565,5
Yield, %	67.86	67.2	66.67	68.18
Mass of carcass parts of higher value (g)				
Leg and thigh	477.1	457.5	464.5	473.1
Breasts	491.1	476.9	472.5	479.3
Wings	202.8	205.4	200.1	209
Back	383.7	374.9	377.6	378.2
Mass of carcass parts of lesser value (g)				
Neck	60.95	62.55	62.94	73.12
Edible entrails	105.18	107.31	102.7	113.16
Abdominal fat	19	17	18.8	21.2
Total:	185.13	186.86	184.44	207.48
Relative share of more valuable carcass parts, (% carcass)				
Leg and thigh	30.22	29.71	30.11	30.13
Breasts	31.12	31.01	30.69	30.73
Wings	12.85	13.35	12.99	13.34
Back	24.29	24.34	24.47	24.12

The proportion of breasts varies in the range of 30.69% in group III to 31.12% in group I, while the share of leg and thigh yield is approximately the same in all groups and is approximately 30%. The average share of back in all groups is approximately 24%, while wings yield ranges from 12.85% (control) to 13.35% (group II). The lowest proportion of abdominal fat of 1.12% was found in garlic treatment group II and the highest (1.38%) in the treatment group IV receiving 100 ppm Cu.

Statistical analysis of the data for the average values of mass and relative proportion of the basic carcass parts (chilled carcass, breasts, leg and thigh, back, wings and

abdominal fat) in the control and treatment groups carried out with Duncan's test using the model:

$_{ew} = 1 - (1 - \quad _{pc})^{k-1}$

$_{ew} = 1 - (1 - \quad _{pc})^{k/2}$

where k is Number of groups

Differences in values between the examined groups were not statistically significant (P > 0.05).

DISCUSSION

Based on the obtained results it can be concluded that the introduction of commercial garlic and copper in broiler feed had a significant effect on the intensity of the increase in body weight.

In the first fattening period, at the end of the second week, the highest body mass was achieved in the control group while in the experimental groups it was slightly lower. That was probably due to reduced food consumption, resulting from the intense smell of garlic, which required a period of adaptation of chickens to this kind of feed. Horton et al. (1991b) reported similar results. However, during the second fattening period, garlic manifested its stimulating effects and at the end of the fourth week, the experimental groups had higher body mass than the control group. At the end of the experiment, group II and III registered a statistically significant (P < 0.05) increase in body weight in comparison to the control group.

In regard to the weight of chicks, separated by gender, the same tendency is observed in both male and female birds at the end of the experiment. The use of different additives in this experiment had different effects on the efficiency of the food exploitation. The lowest conversion rates during the entire experiment were recorded in group II with 2% garlic content in feed, which means by 10.19% less than the control group.

Experiment shows good results thanks to hypocholesterolemic effect of garlic and stimulating effect of copper, but in some studies Berthold et al. (1998), Isaacsohn et al. (1998) and McCrindle et al. (1998) have suggested that commercial garlic oil, garlic powder and commercially garlic extract may not be hypocholesterolemic. Kasuga et al. (2001) reported that the different garlic products that are commercially available may be divided into allicin-rich products and nonallicin-rich products.

The active components in garlic have not yet been determinate, although many studies have indicated that allicin is potentially active component. It has been observed that allicin is unstable and poorly absorbed form the digestive tract defined by Lawson et al. (1992).

Also Chiou et al. (1999) shows that high dietary copper supplementation of 500 ppm in the broiler diet significantly influenced on the morphology of the digestive tract. Beside growth stimulating properties of copper, Voget et al. (1981), Brunell et al. (1988) reported that copper have also antimicrobial properties. It has also been demonstrated by Zhou et al. (1994) that intravenous injection of copper stimulates growth of weanling pigs. In copper supplemented chickens, copper plays a major role as cofactor in hematogenesis reported by Chiou et al. (1999). Copper is one of the most critical trace elements in livestock because it is necessary for haemoglobin formation, iron absorption from digestive tract and iron mobilization from tissue stores defined by Mpofu et al. (1999).

Conclusion

On the basis of our results it can be concluded that the chicks treated with garlic and copper have achieved better production results than the control group. Body weight was significantly increased, the food conversion reduced by 10%, while the birds maintained good health status. In regard to carcass quality it can be concluded that the impact of treated feed on yield indicated no statistical significance. The relative share of more valuable carcass parts (breasts and leg and thigh) in the processed carcass weight also shows no dependence on the examined diet treatments.

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