

Full Length Research Paper

Influence of garlic (*Allium sativum* L.) and copper as phytoadditives in the feed on the content of cholesterol in the tissues of the chickens

Vidica Stanacev^{1*}, Dragan Glamocic¹, Niko Milošević¹, Lidija Peric¹, Nikola Puvaca¹, Vladislav Stanacev², Dragan Milic² and Nada Plavša¹

¹Department of Animal Science, Faculty of Agriculture, Trg Dositeja Obradovića 8, University of Novi Sad, Novi Sad, Serbia.

²Perutnina Ptuj, Petefi Brigade 2, 24300 Bačka Topola, Serbia.

Accepted 26 October, 2011

This work shows the effect of added garlic and high dosage of copper in the feed of broilers, especially in combination of both preparations, to the level of cholesterol in the muscle tissue and the skin of chickens. Four groups are formed, control (I) without the addition of additives and three experimental groups were included in the following order 2% of garlic (II), 2% of garlic and 100 ppm Cu (III) and 100 ppm Cu (IV). Experiment lasted for 42 days. Based on the results gained, it can be concluded that the addition of additives significantly lowers the level of cholesterol in the tissues of chickens. Garlic is the most efficient in red meat where the decrease of cholesterol is 83.53%. In white meat the effect is significantly less shown in the group with garlic (24.16%) and the most efficient is the effect of garlic and copper together (31.29%). Skin contains ten times more cholesterol compared to muscular tissue and non organic copper in this case decreased cholesterol for 72.53%. The greatest effect is made in red meat, then comes skin, while in the white meat the effect of additives to a decrease of cholesterol is the smallest.

Key words: Cholesterol, garlic, copper, chickens.

INTRODUCTION

Significant factor for risk appearance of atherosclerosis and also ischemic heart disease and cerebrovascular ailments increases the level of cholesterol in blood or hypercholesterolemia. Cholesterol is alcohol, included in zoosterols, because it is a typical product of animal metabolism and it appears in food of animal origin. It represents building material of the cells' wall and beside that it is of priceless importance in normal functioning of endocrine glands, especially gonads and adrenal glands. Live cells of human and animal organism, especially liver, have the ability to synthesise about two thirds of endogen

cholesterol while the smaller part is taken in with food. Taken in the organism it bounds to proteins, dissolves in blood plasma and together with them circulates in bloodstream. There are two forms of cholesterol bound to proteins, low-density lipoprotein (LDL) and high-density lipoprotein (HDL) cholesterol of low and high density. The difference between them is of great importance because the level of LDL cholesterol in plasma defines the risk for atherosclerosis, which is higher if the concentration of these types of particles is higher. HDL particles do not have atherogen potential but in some way represent protectors of blood vessels. Synthesis of cholesterol is done in the liver and cholesterol builds in lipoproteins of small density LDL. Variation of the amount of cholesterol in nutrition reflects on the production of endogen cholesterol.

Low level in feed stimulates its synthesis, otherwise if the exogenous cholesterol increases, endogen production can not completely be repressed by increasing the

*Corresponding author. E-mail: nikolapsto@yahoo.com.

Abbreviations: LDL, Low-density lipoprotein; HDL, high - density lipoprotein; VLDL, very low-density lipoprotein; TG, triglyceride.

Table 1. The plan of additives supplement.

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

Table 2. Amount of cholesterol in red meat-drumstick and thigh.

Group	Control	II	III	IV
Garlic, %	-	2	2	-
Copper, ppm	-	-	100	100
Average	73.24	12.06	50.65	62.91
Minimum	30.23	7.28	33.46	42.02
Maksimum	101.51	18.29	71.61	109.77
Index, %	100.00	16.47	69.16	85.90

content in feed, because it inhibits only synthesis in the liver, while the synthesis in the guts is inhibited by bile acid.

Attempts to lower the level of cholesterol in plasma at people by decreasing the amount of cholesterol in feed are shown as successful. From the factors that lower blood cholesterol the most researched is the substitute of some saturated acids from feed, polisaturated fat acids. Corn oil, sunflower, soy and flax lower the level of cholesterol in plasma, because they contain high level of linolenic and flax oil also linoleic acid. Adding fish oil to feed of broilers Hulan et al. (1988) determined that white meat has smaller amount of lipids and tryglicerides and higher content of cholesterol and phospholipids than red meat and also increased content of PMNK. Linolenic acid decreases cholesterol in blood and beside the whole and LDL cholesterol significantly decreases triglyceride (TG) and synthesis of very low-density lipoprotein (VLDL) particles in liver (Lepšanović, 1990; Lei, 1991; Božić, 1997). Based on the named, the aim of this work was to examine the influence of garlic and copper in the nutrition of broiler chickens especially and in combination of both preparations to the content of cholesterol in the muscular tissue and skin.

MATERIALS AND METHODS

Biological researches are made in the production conditions on the experimental property »Pustara« of the Agricultural Faculty in Novi Sad and chemical researches in the laboratory for the control of the quality of the animal feed in stuffs at the Department of Animal Science. At the beginning of fattening, four groups are formed with 75 one day chicken hybrids Hubbard, of the equal mass. Experiment is made in four repetitions on totally 300 chickens per treatment and it is done by the scheme given in Table 1. Three mixtures are used for nutrition, starter, finisher I and II with 23, 20 and 18% of protein. The experiment lasted for 42 days and the mixtures were changed every fourteen days. During the

experimental period, chickens were fed and given to drink optionally and microclimatic conditions were regularly checked. At the end of the experiment, ten chickens from every group was sacrificed and the content of cholesterol was analysed in white meat, red meat and skin. Total cholesterol is determined by spectrophotometric method with the usage of o-phtalaldehida, by the method of Rudel and Morris (1973).

RESULTS

Based on the results, it can be stated that the addition of additives significantly lowers the level of cholesterol in tissues of chickens. Garlic is most efficient in red meat and its level of decrease in cholesterol is 83.53%. In white meat, effect is significantly less expressed in the group with garlic (24.16%) and the most efficient is the influence of garlic and copper together (31.29%). The skin contains ten times more cholesterol compared to muscular tissue and non organic copper in this case decreased the cholesterol for 72.53%. The greatest effect is made in red meat and then skin, while in white meat the effect of additives to decreasing of cholesterol is the smallest. Based on the results it can be stated that the addition of stimulating doses of copper in feed in general, decreases the level of cholesterol in the tissues of chickens (Tables 1, 2, 3 and 4). Significant decrease is in skin, on the treatment with flax oil and the addition of 200 ppm Cu and it is 24.37%, compared to treatment of flax oil (Table 4). Great decrease of cholesterol is seen in red meat in groups with sunflower and soy oil with the addition of copper (10.67 and 10.32%), while in white meat the decrease is significantly smaller. Fat tissue contains the biggest amount of cholesterol, but with the expressed effect of copper. When serum is in question, content of cholesterol in groups with copper is significantly lower compared to groups with clear oil. Also, it can be established that the amount of cholesterol

Table 3. Amount of cholesterol in white meat, mg/100 g.

Group	Control	II	III	IV
Garlic, %	-	2	2	-
Copper, ppm	-	-	100	100
Average	60.88	46.17	41.83	52.09
Minimum	53.51	34.77	17.79	42.55
Maksimum	64.88	55.95	58.18	66.17
Index, %	100.00	75.84	68.71	85.56

Table 4. Amount of cholesterol in skin, mg/100 g.

Group	Control	II	III	IV
Garlic,%	-	2	2	-
Copper, ppm	-	-	100	100
Average	384.35	285.77	138.76	105.59
Minimum	268.95	216.42	59.66	76.82
Maksimum	646.59	390.91	271.27	129.10
Index,%	100.00	74.35	36.10	27.47

in serum in group with flax oil is significantly lower compared to sunflower and soy, that suits fat acids content of the same oil. High content of linolenic and linoleic acid decreases the serum cholesterol and increases the tissue one.

DISCUSSION

By discovering the increased level of cholesterol in blood opens series of questions connected to atherosclerosis and the most important question is how to treat the resulting state. The most rational is the prevention with dietetic measures. Because the chicken meat is the most represented dietetic product in nutrition when hypercholesterolemia in question, it is desirable to additionally reduce the whole cholesterol in the muscular tissue if it is possible. Examinations showed that the high dosages of copper in the feed for chickens (100 and 200 ppm) lower the cholesterol in plasma for 11.8% and in white meat for 20.4%, what makes copper important additive in nutrition and production of dietetic groceries, necessary for cardiovascular patients (Georgievski et al., 1982; Stanačev et al., 1998; Bakalli et al., 1995; Stanačev et al., 2004; Konjufka et al., 1997; Stanačev et al., 2010). It is also proved that garlic also shows hypoallergic effects with chickens by inhibiting the most important enzymes that participate in synthesis of cholesterol and lipids (tri-hydroxil-tri-metil-glutaril-coenzym-A-reductase, cholestrol-7-hidroxilase and synthesis of fat acids) (Stanačev et al., 2011). Beside that, this additive is relatively cheap on the market, it is added in small amounts 1 to 2% and because of that it

does not increase the expenses of production, that is very important for the producers (Sivam, 2001; Prasad and Saharma, 1981; Prasad et al., 1995; Ankri and Mirelman, 1999; Kumar and Berwal, 1998).

At the beginning of the eighties it is established that the unavailability of copper in feed changes serum and the content of cholesterol in liver and leads to hypercholesterolemia, decreasing the concentration of glutathione in liver, which is known as a regulator of biosynthesis of cholesterol. Because of that synthesis of endogen cholesterol and the concentration in tissues is very variable and narrowly connected to the amount of the taken copper in the organism (Stanačev et al., 2008).

Conclusion

Based on the results gained it can be concluded that the addition of additives in feed significantly decreases the level of cholesterol in tissues of chickens. The greatest effect is made in red meat, then skin, while in white meat the effect of additives to the decrease of cholesterol is the smallest.

REFERENCES

- Ankri S, Mirelman D (1999). Antimicrobial properties of allicin from garlic. *Microb. Infect.*, 1: 125-129.
- Bakalli R, Pesti G, Ragland W, Konjufka V (1995). Dietary copper in excess of nutritional requirements reduces plasma and breast muscle cholesterol of chickens. *Poult. Sci.*, 74: 360-365.
- Božić A (1997). Influence of origin of feed fatty acid composition and the fatty acid atherogenic potential of muscle and fat tissue of broilers. Doctoral thesis, Fac. Agric., Novi Sad.

- Georgievski V, Annenkov B, Samokhin V (1982). Mineral nutrition of animals. Butterworths; London, Boston, Sydney, Durban, Wellington, Toronto.
- Hulan H, Ackman G, Ratnayake W, Proudfoot F (1988). Omega-3 fatty acid levels and performance of broiler chickens fed redfish meal or redfish oil. *Can. J. Anim. Sci.*, 68: 533-547.
- Konjufka V, Pesti G, Bakalli R (1997). Modulation of cholesterol levels in broiler meat by dietary garlic and copper. *Poult. Sci.*, 76: 1264-1271.
- Kumar M, Berwal J (1998). Sensitivity of food pathogens to garlic (*Allium sativum* L.). *J. Appl. Microbiol.*, 84: 213-215.
- Lei K (1991). Dietary copper: Cholesterol and lipoprotein metabolism. *Ann. Rev. Nutr.*, 11: 265-283.
- Lepšanović L (1990). The possibility and importance of assessment atherogenic potential of food. Bulletin 3 of the Yugoslav Committee for lipids, pp. 15-17.
- Prasad G, Laxdal V, Yu M, Raney B (1995). Antioxidant activity of allicin, an active principle in garlic. *Mol. Cell. Biochem.*, 148: 183-189.
- Prasad G, Saharma V (1981). Antifungal property of garlic (*Allium sativum* L.) in poultry feed substrate. *Poult. Sci.*, 60: 541-545.
- Rudel L, Morris M (1973). Determination of cholesterol using o-phthalaldehyde. *J. Lipid Res.*, 14: 364-366.
- Sivam G (2001). Protection against *Helicobacter pylori* and other bacterial infections by garlic. *J. Nutr.*, 131: 1106-1108.
- Stanačev V, Milošević N, Plavša N, Bjedov S, Stanačev V, Puvača N, Arapović Ž (2010). Phyto additives (*Allium sativum* L.) in the diet of fattening chickens. Proceedings of the 14th International Symposium of Feed Technology, Novi Sad, pp. 295-302.
- Stanačev V, Glamočić D, Milošević N, Puvača N, Stanačev V, Plavša N (2011). Effect of garlic (*Allium sativum* L.) in fattening chicks nutrition. *Afr. J. Agric. Res.*, 6: 943-948.
- Stanačev V, Kovčín S, Arapović Ž, Milošević N, Filipović S, Božić A, Stanačev V (2008). Influence of garlic involved in feed for fattening chicks on production parameters. *Cont. Agric.*, 57: 201-207.
- Stanačev V, Kovčín S, Božić A, Lukić M (2004). Influence of copper on cholesterol meat content in chicken tissue. III International EKO Conference, Food Safety, Proceedings, Novi Sad, pp. 121-126.
- Stanačev V, Kovčín S, Perić L (1998). Copper as a stimulant of feeding chickens for fattening. I: Influence of high doses of copper on the production of chickens. *Cont. Agric.*, 47: 127-132.