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*Original research paper*

# EVALUATION OF BROILER CHICKENS LIPID PROFILE INFLUENCED BY DIETARY CHILI PEPPER ADDITION

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**ABSTRACT:** Experiment was conducted to investigate the effect of chili pepper in broiler nutrition on productive performances and blood lipid profile. For biological research three treatments with the total of 450 broilers were formed, within four replicates. Control treatment (C) of chickens were fed with mixture based on corn flour and soybean meal of standard composition and quality, while the experimental treatments were fed with the same mixture only with addition of two levels of chili pepper 0.5 (CP-0.5) and 1.0 g/100g (CP-1.0). Addition of chili pepper in the amount of 0.5 g/100g has led to the highest final body weight of chickens (2460.6 g), followed by the addition of 1.0 g/100g (2442.4 g) with significant differences ($p<0.05$) compared to a control treatment (2075.8 g). The lowest amounts of triglycerides, total cholesterol, low density lipoprotein (LDL) and non-high density lipoprotein (non HDL) was recorded in broilers in treatments with chili with statistically significant ($p<0.05$) differences compared to a control treatment. The highest share of high density lipoprotein (HDL) with statistical significance ($p<0.05$) was determined also in chili pepper treatments. Based on the obtained results, it can be concluded that the addition of chili pepper in broiler chicken nutrition has positive effects on production performances and in improvement of chicken blood lipid profile.

**Key words:** *chili pepper, cholesterol, nutrition, chickens, feed*

## INTRODUCTION

Beside of an important role of chili pepper in daily human nutrition for enhancement of taste, aroma and colour of food, this spice have also been efficiently used in animal nutrition for improvement of animal health and production of healthier meat and eggs. With the ban of antibiotics use in animal nutrition due to the emergence of microbe resistance, alternative growth promoters must be found (Steiner, 2009). Removal of antibiotics as growth promoters has led to animal performance problems, increase of feed conversion ratio, and a rise in the incidence of certain animal diseases (Wierup, 2001). The alternatives to antibiotics as growth stimulators are numerous (Steiner, 2009; Puvača et al., 2013). Chili pepper (*Capsicum annuum* L.) plays an important role in decreasing the deposition of cholesterol and fat in the body, contributes to decreased levels of triglycerides and supports the vascular system in the body. Efficient chili pepper compounds consist of capsaicin, capsicin and capsanthin. Hencken, (1991) explained that chili pepper is rich in vitamin C, which have a considerable impact in improving production through contributes the reduction of heat stress (Yoshioka et al., 2001). A recent studies involved in chicken performance have shown that blends of active compounds for chili pepper have chemopreventive and chemotherapeutic effects (Popović et al., 2018; Puvača, 2018). In research of Al-Kassie et al. (2012) addition of hot red pepper had significant effect on the heterophil/lymphocytes (H/L) ratio, which reflects the role of hot red pepper, especially its active compound capisicine, which is involved in stress hormones, and which supports the immune system of birds and enhances its resistance against disease through decreasing (H/L) ratio.

The aim of this study was to investigate the effect of chili pepper in broiler nutrition on blood lipid profile and productive performances.

## MATERIAL AND METHODS

Content of capsanthin or colored matter in a sample of chili pepper powder is determined by the reference method SRPS EN ISO 7540 (2012). The method is based on extraction of colored substances from a sample of chili pepper with benzene and then spectrophotometric measurement of maximum absorbance at a wavelength of 477nm. Content of capsanthin in samples of ground pepper is expressed in g/kg of dry matter of the sample. The content of capsaicin in a sample of pepper is determined according to the method described in the manual for quality control of fresh and processed fruits, vegetables and mushrooms and non-alcoholic beverages. The method is based on extraction of capsaicin from a sample of hot red pepper, separation of coloring matters and the development of color characteristic of capsaicin, followed by spectrophotometric measurement of maximum absorbance at a wavelength of 433nm. The color intensity of the solution is proportional to the concentration of capsaicin. The content of capsaicin in samples of hot red pepper powder is expressed in g/100g dry matter of the sample. Concentration of capsanthin and capsaicin is given in Table 1.

Table 1. Concentration of capsanthin and capsaicin in experimental chili pepper

| **Bioactive compounds** | |
|---|---|
| Capsanthin, g/kg | Capsaicin, g/kg |
| $3.31^{a}$ | $0.96^{b}$ |
| 0.58 | 0.04 |

Treatments with different letter indexes in the same row are statistically significantly different ($p<0.05$)

Biological tests were carried out under the experimental conditions at broiler chickens farm. At the beginning of the experiment, a total of 450 one-day old Hubbard broilers were distributed into three dietary treatments with four replicates each. Every dietary tretment included 150 chickens, which were divided in four pens with 37-38 chicken per each pen. Chickens were reared on floor holding system with the chopped straw as litter material. Chickens were provided with the light regime of $23^{h}$ of day per entire experimental period of 42 days with incandescent light source. For nutrition of chicks three mixtures were used, starter, grower and finisher throught pan feeders. For the first 14 days, during the preparatory period, chicks were fed with starter mixtures. Following the preparation period, chicks were fed with grower mixtures for the next 21 day, and then for the last 7 days of fattening period with finisher mixtures according the experimental desing given in Table 2 and dietary chemical composition of used starter, grower and finisher mixtures which is given in Table 3.

Table 2. Experimental design with chickens

| **Experimental treatmens** | Additive | **Concetration of additives in chicken diets** | | |
|---|---|---|---|---|
| | | In starter, g/100g | In grower, g/100g | In finisher, g/100g |
| | | 1 – 14 days | 15 – 35 days | 36 – 42 days |
| **C** | Control treatment | 0.0 | 0.0 | 0.0 |
| **CP-0.5** | Chili pepper | 0.0 | 0.5 | 0.5 |
| **CP-1.0** | Chili pepper | 0.0 | 1.0 | 1.0 |

During the experiment chicks were fed and watered *ad libitum.* Chickens were watered through the nipple water system. Microclimate conditions were regularly monitored. Body weight was monitored at an individual level during the entire experimental period every seven days, while the feed consumption and feed conversion ratio were monitored at the pen level also every seven days.

Table 3. Chemical composition of dietary mixtures, g/100g

| **Nutrients** | **Diet mixtures** | | |
|---|---|---|---|
| | **Starter** | **Grower** | **Finisher** |
| **Dry matter** | 89.4 | 89.3 | 89.4 |
| **Moisture** | 10.5 | 10.7 | 10.5 |
| **Crude protein** | 21.1 | 20.7 | 17.3 |
| **Crude fat** | 3.9 | 3.9 | 4.7 |
| **Crude fibre** | 3.5 | 3.5 | 3.6 |
| **Crude ash** | 5.0 | 4.8 | 5.6 |
| **Ca** | 0.8 | 0.9 | 1.1 |
| **P** | 0.6 | 0.6 | 0.5 |
| **Metabolic Energy, MJ/kg** | 12.5 | 12.8 | 13.3 |

*Chili pepper is added *on top* on the basic diet

At the end of 6$^{th}$ week, twelve birds were randomly chosen from each treatment and bled via wing vein puncture to obtain blood samples. Serum samples from blood were separated by centrifugation (4000 rpm for 5 min at 20 °C). Commercially available kits (Randox Laboratories Limited - United KIngdom) were used to analyse the serum for triglycerides, total cholesterol, HDL and LDL on an biochemical autoanalyzer Cobas Mira Plus (Roche Diagnostics). Values were expressed as mg/dl.
Statistical analyses were conducted within statistical softwere program Statistica 12 for Windows, to determine if variables differed between treatments. Significant effects were further explored using analysis of variance (ANOVA) with repeated measurements, least square means (LSM) and standard errors of least square menas ($SE_{LSM}$), as well as Fisher's LSD post-hoc multiple range test with Bonferroni corrections to ascertain differences among treatment means. A significance level of $p<0.05$ was used.

## RESULTS AND DISCUSSION

From the results given in Table 1 it can be seen the concentration of capsanthin (3.31 g/kg) and capsaicin (0.96 g/kg) as the main bioactive components in chili pepper. According the Serbian regulation (Gazette of SFRY, No. 1/79) chili pepper on 1 kg of dry matter should comprise at least 2 g of capsanthin and capsaicin between 0.5 to 0.7 g. As it can be seen from the results shown in Table 1, samples of chili pepper correspond to quality parameters requirements of Serbian regulations, except for the content of capsaicin, which in the tested samples was higher for 0.26 g of dry mater. Taking into account that the capsaicin is alkaloid responsible for the hot taste of pepper, this result was expected because the chili pepper is recognizable its pungent quality. Similar result was obtained by Dang et al. (2014) in their study of three-liquid-phase extraction and separation of capsanthin and capsaicin from *Capsicum annum* L. The highest content of capsaicin was found in the placenta, as well as dihydrocapsaicin, 10.48 and 6.43 g/kg, respectively, while the highest ratio of 3.71 estimated from the quantity of capsaicin and dihydrocapsaicin was calculated in the pericarp. The determined pungency level in placenta of 272 211 SHU was almost five times and two times higher than the pungency level in the seed and pericarp, respectively (Simonovska et al., 2014).

Based on the obtained results it can be concluded that the addition of chili pepper in the diet of broiler chickens led to a statistically significant ($p<0.05$) differences in body weight (Table 4). Chickens have finished the preparatory period with uniform body weight with no statistical significant differences ($p>0.05$). At the end of the second fattening period, addition of chili pepper exerted the stimulating effect and led to statistically significant differences ($p<0.05$) in body weight in relation to the control treatment. After the completion of the experimental period, the highest achieved body weight of chicken was in treatment CP-0.5 (2460.6 g) which was followed by treatment CP-1.0 (2442.4 g) with statistically significant differences ($p<0.05$) compared to control treatment (C).

Table 4. Body weight of chickens in experiment, g

| **Experimental treatments** | | **Age of chickens** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 1 day | 7 days | 14 days | 21 days | 28 days | 35 days | 42 days |
| **C** | **LSM** | 42.8$^{a}$ | 162.7$^{a}$ | 388.6$^{a}$ | 785.6$^{a}$ | 1162.4$^{a}$ | 1643.8$^{b}$ | 2075.8$^{b}$ |
| **CP-0.5** | **LSM** | 42.5$^{a}$ | 162.5$^{a}$ | 385.3$^{a}$ | 770.5$^{a}$ | 1193.6$^{a}$ | 1815.1$^{a}$ | 2460.6$^{a}$ |
| **CP-1.0** | **LSM** | 42$^{a}$ | 161.6$^{a}$ | 385.1$^{a}$ | 762.4$^{a}$ | 1183.6$^{a}$ | 1812.1$^{a}$ | 2442.4$^{a}$ |
| Pooled $SE_{LSM}$ | | 0.47 | 1.6 | 3.87 | 8.38 | 11.84 | 12.2 | 24.33 |

Treatments with different letter indexes in the same column are statistically significantly different ($p<0.05$)

Our study has shown that the addition of chili pepper has positive effect on production results of chickens, which is also in agreement with previous findings of Alaa (2010), Al-Kassie et al. (2012) and Puvača et al. (2014c) with the use of hot red pepper in broiler chicken nutrition. Research of Al-Kassie et al. (2011) revealed that the inclusion of chili pepper at levels of 0.5%, 0.75% and 1% in the diets of broiler chicken of hybrid line Ross 308 improved body weight gain and feed conversion ratio. Investigation of Thiamhirunsopit et al. (2014) with the different forms of chili peppers showed better growth performance results of chickens on experimental chili pepper treatments in comparison to control treatments. Addition of chili pepper as feed additives to broiler chicken nutrition in this experiment led to high improvement of lipid profile of chickens. From the results given in Table 5 it can be noticed that the highest amounts of triglycerides (65.9 mg/dl), total cholesterol (97.2 mg/dl) and LDL (36.7 mg/dl) were in control treatment with statistically significant ($p<0.05$) differences in comparison to treatments with the dietary addition of chili pepper.

Table 5. Biochemical blood parameters and lipid profile, mg/dl

| Experimental treatments | | Triglycerides | Total cholesterol | HDL | LDL | non HDL | HDL/LDL |
|---|---|---|---|---|---|---|---|
| **C** | **LSM** | 65.9$^{a}$ | 97.2$^{a}$ | 19.2$^{b}$ | 36.7$^{a}$ | 78.0$^{a}$ | 0.5$^{b}$ |
| **CP-0.5** | **LSM** | 16.7$^{b}$ | 52.4$^{b}$ | 35.5$^{a}$ | 9.4$^{b}$ | 16.9$^{b}$ | 3.8$^{a}$ |
| **CP-1.0** | **LSM** | 17.7$^{b}$ | 54.3$^{b}$ | 35.7$^{a}$ | 10.3$^{b}$ | 18.6$^{b}$ | 3.6$^{a}$ |
| Pooled $SE_{LSM}$ | | 0.8 | 0.9 | 1.16 | 1.01 | 1.03 | 2.33 |

Treatments with different letter indexes in the same column are statistically significantly different ($p<0.05$)

This effect can be explained by the possible inhibition of the Acetyl CoA syntheses enzyme that is necessary for the biosynthesis of fatty acids. Afzal et al. (1985) reported that polyunsaturated fatty acids prevent atherosclerosis through the formation of cholesterol esters. Both levels of chili pepper in our study decreased LDL levels compared to the levels in chickens of the control treatment. This effect can be explained by the possible mechanism of antioxidant and antiperoxide lowering action on LDL or the decrease in hepatic production of very low density lipoprotein (VLDL) which serves as the precursor of LDL in the blood circulation (Kim et al., 2009). Addition of chili pepper to the broiler diet in different amounts from 0.25 to 1% had influence on decreased concentration of blood cholesterol, and other blood biochemical parameters (Alaa, 2010; Al-Kassie et al., 2012; Puvača et al., 2018). Furthermore, addition of spices and medicinal plants can facilitate activity of enzymes which are involved in the conversion of cholesterol to bilious acids and subsequently will result in lower cholesterol concentration in the carcass. Similar results with the lowering effects of total cholesterol in red and white meat and skin of chickens fed with dietary garlic powder was obtained by Stanaćev et al. (2012). Spices, herbs an d essential oils in human nutrition had a very large influence in health promotion and lowering concentration of blood cholesterol and lipid oxidation (Ahuja and Ball, 2006; Puvača et al., 2019; Aćimović et al., 2019). Beside the chili pepper, garlic (Puvača et al., 2014a) and black pepper (Puvača et al., 2014b) had a high impact on alteration of blood lipid profile of chickens. Capsinoids present in chili peppers causes pungent, hot tasting sensations when consumed as a part of the diet in addition to sensory properties of chicken meat that may be affects human health, because capsinoids includes antimicrobial activities against disease caused by bacteria. Meat obtained by chickens fed with chili pepper poses better lipid profile and can be successfully used in daily human nutrition as a dietetic food.

## CONCLUSION

Based on the obtained results, it can be concluded that the addition of chili pepper in broiler chicken nutrition has positive effect on production performances. Addition of chili pepper in the amount of 0.5 g/100g has led to the highest final body weights of chickens. Also it can be concluded that significant lowering of plasma cholesterol, triglycerides, LDL and increase of HDL by this spice supplementation in broiler diet could indicates effective in regulation of lipid metabolism in a favourable manner for prevention of atherosclerosis or coronary heart diseases in humans who use this kind of chicken products in their daily nutrition.

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