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**Annals of Biological Research, 2014, 5 (12):29-33**
*(http://scholarsresearchlibrary.com/archive.html)*

Annals of Biological Research
Scholars Research Library
ISSN 0976-1233
CODEN (USA): ABRNBW

# Influence of black pepper (*Piper nigrum* L.) on productive performances and blood lipid profile of broiler chickens

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**ABSTRACT**

*This experiment was conducted to investigate the influence of black pepper (Piper nigrum L.) in broiler chicken nutrition on productive performances and blood lipid profile. For biological research three treatments with the total of 450 broiler chickens of hybrid line Hubbard were formed, with four replicates. In the control treatment (T1) the chickens were fed with commercial mixtures of standard composition and quality based on corn flour and soybean meal. Experimental treatments were fed with the same commercial mixtures only with addition of spice as follows: pepper 0.5 (T4) and 1.0 g/100g (T5). During the first two weeks chickens were on the preparation period with starter mixtures diets without addition of pepper, after which chickens were fed with grower and finisher mixtures according to the plan until the end of the experiment which lasted 42 days. At the end of the experiment and on the basis of gained results it can be concluded that the chickens in experimental treatments T4 and T5 achieved higher final body masses (2076.5 and 2077.8 g) compared to the chickens in the control and other treatments but without statistically significant ($p>0.05$) significant differences. Feed conversion ratio for the entire fattening period ranged from 1.8 kg/kg (T5) to 2.1 kg/kg (T1) with no statistically significant differences ($p>0.05$). The highest amounts of triglycerides, total cholesterol, low density lipoprotein (LDL) and non high density lipoprotein (non HDL) was recorded in chicken blood in treatment T1 with statistically significant ($p<0.05$) differences compared to the treatments with addition of black pepper. The lowest share of high density lipoprotein (HDL) with statistical significance ($p<0.05$) was determined also in control treatment T1. In the end, it can be concluded that the chickens in treatments with addition of black pepper achieved better production results and much better lipid profile status compared with the control treatment.*

**Keywords:** Black pepper, nutrition, chickens, cholesterol

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## INTRODUCTION

For improvement of animal health and wellbeing,apart from animportant role of spices in daily human nutrition,spices have also been efficiently used in animal nutrition. With the ban of antibiotics use in animal nutrition due to the emergence of microbe resistance, alternative growth promoters must be found [1]. Removal of antibiotics as growth promoters has led to animal performance problemsand a rise in the incidence of certain animal diseases [2]. The alternatives to antibiotics as growth promoters are very large [3, 1, 4]. Plant-derived additives used in animal nutrition to improve performance have been called “phytogenic feed additives” [5]. This form of feed additives has recently become of particular interest for use in poultry production since the ban of in-feed antibiotics growth promoters in 2006. In commercial broiler production mainly powder forms or essential oils of oregano, rosemary, sage, thyme, garlic, black pepper and chilli are used singly or in combination as feed additives [6, 7]. Black pepper is well-known as a spice due to its pungent quality. Black pepper was found to improve feed

digestibility [8]. It also proved to be rich in enzymes such as glutathione peroxidase and glucose-6-phosphate dehydrogenase. It has been shown that piperine can dramatically increase absorption of selenium, vitamin B complex, β carotene as well as other nutrients [9, 10]. Piperine enhances the thermogenesis of lipids and accelerates energy metabolism in the body and also increases the serotonin and β-endorphin production [11]. Pepper has been found to have antioxidant properties [12] and anticarcinogenic effect, especially when combined with hot red pepper [13]. Among its chemical and biological activities, piperine is characterised by antimicrobial [14] and antiinflammatory [15] properties. Piperine is an active alkaloid that modulates benzopyrene metabolism through cytochrome P450 enzyme, which is important for the metabolism and transport of xenobiotic and metabolites [16]. Investigation of Abou-Elkhairet al. [17] showed that black pepper in broiler nutrition had influence on improved health status through increase of serum globulin concentration. Piperine possibly reduces LDL, triglyceride and cholesterol in serum and tissues [18], and it has been used in treatments against cardiovascular diseases. Black pepper has been found to lower serum and liver cholesterol and reduce oxidative stress. In broilers, it was reported that pepper, as a natural feed additive, has improved feed conversion ratio and decreased mortality rate [19].

The aim of this study was to investigate the influence of black pepper (*Piper nigrum* L.) in broiler chicken nutrition on productive performances and blood lipid profile.

## MATERIALS AND METHODS

*Animal trials*

Prodactive experiment with the chickens were carried out at the experimental farm "Pustara" in Temerin. At the beginning of the experiment, a total of 450one-dayold 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 in amount of 3 kg/m$^2$. For nutrition of chicks three mixtures were used, starter, grower and finisher.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 days, and then for the last 7 days of fattening period with finisher mixtures according the experimental desing given in Table 1.

**Table 1. Experimental design with broiler chickens**

| Experimental treatmens | Concetration of additives in chicken diets | | | |
|---|---|---|---|---|
| | Additive | In starter, g/100g | In grower, g/100g | In finisher, g/100g |
| | | 1 – 14 days | 15 – 35 days | 36 – 42 days |
| T1 | Control treatment | 0.0 | 0.0 | 0.0 |
| T4 | Black pepper powder | 0.0 | 0.5 | 0.5 |
| T5 | Black pepper powder | 0.0 | 1.0 | 1.0 |

During the experiment chicks were fed and watered *ad libitum* while microclimate conditions were regularly monitored. Body weight was controledat an individual level during the entire experimental period every seven days, while the feed consumption and feed conversion ratio were monitoredat the pen level also every seven days.

*Blood lipids*

At the end of 6$^{th}$ week, 12 chickens (6 male and 6 female) were randomly chosen from each treatment, in total of 36 chickens, and bled via wing vein puncture to obtain blood samples. Serum samples from blood were separated by centrifugation of 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*

Statistical analyses were conducted within statistical softwere program Statistica 12, 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

Based on the obtained results it can be concluded that the addition of black pepper in the diet of broiler chickens did not led to a statistically significant ($p>0.05$) differences in body weightat the end of the experiment (Table 2).

**Table 2. 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 |
| T1 | LSM | 42.8[a] | 162.7[a] | 388.6[a] | 785.6[a] | 1162.4[a] | 1643.8[a] | 2075.8[a] |
| | $SE_{LSM}$ | 0.47 | 1.52 | 3.64 | 8.38 | 11.84 | 12.2 | 24.23 |
| T4 | LSM | 42.4[a] | 159[a] | 384.2[a] | 754.1[b] | 1117.1[b] | 1577.8[b] | 2076.5[a] |
| | $SE_{LSM}$ | 0.47 | 1.62 | 3.79 | 8.41 | 11.8 | 12.39 | 24.42 |
| T5 | LSM | 42.4[a] | 160.4[a] | 386.6[a] | 727.5[c] | 1055.6[c] | 1503.7[c] | 2077.8[a] |
| | $SE_{LSM}$ | 0.47 | 1.62 | 3.86 | 8.35 | 11.75 | 12.16 | 23.96 |

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

From the preparatory period chickens have exit with almost equal body weight. After the completion of 42 days experimental period, the highest achieved body weight of chicken was in treatment T5 (2077.8 g) which was followed by treatment T4 (2076.5 g) without statistically significant differences (p>0.05) compared between treatments themselves and control treatment T1 (2075.8 g). This study has shown that the addition of black pepper has positive effect on production results of chickens, which is also in agreement with previous findings of Al-Kassieet al.[11] and Valiollahiet al.[20]. Abou-Elkhairet al. [17] showed that the addition of black pepper and mixture of black pepper and turmeric powder to broiler chicken diet led to a higher final body weight of chickens during the fattening period of 35 days. Improvement of broilers body weight gain as a result of supplementation of black pepper powder was observed and reported by Ghazalahet al. [21] and Mansoub [22]. Hosseini [23] showed that black pepper increases digestion through arousing digestive liquids of stomach and eradicates infectious bacteria. Black pepper affects the absorption power, decreases material transit velocity and increases digestive enzymes. The most active component in black pepper, piperine, promotes pancreatic digestive enzymes such as lipase, amylase and proteases, which play important roles in the digestion process [24].

From the results given in Table 3 it can be seen that feed conversion ratio in preparation period of chicken was inconsiderably different and ranged between 1.3 and 1.4 kg of feed per kg of gain.

**Table 3. Chicken feed conversion ratio, kg/kg**

| Experimental treatments | | Periods of nutrition | | | |
|---|---|---|---|---|---|
| | | Starter phase | Grower phase | Finisher phase | Entire period |
| | | 1 – 14 days | 15 – 35 days | 36 – 42 days | 1 – 42 days |
| T1 | LSM | 1.3[ab] | 1.8[ab] | 3.0[a] | 2.1[a] |
| T4 | LSM | 1.4[ab] | 1.9[a] | 2.5[b] | 1.9[a] |
| T5 | LSM | 1.3[b] | 1.9[ab] | 2.3[b] | 1.8[a] |

*Treatments with different letter indexes in the same column are statistically significantly different (p<0.05);*
*$SE_{LSM}$ values for the starter phase was equal to 0.01; grower phase 0.05; finisher phase 0.14 and for entire period 0.15.*

In the grower phase the lowest achieved feed conversion ratio was in treatment T1 (1.8 kg/kg) and the highest in T4 and T5 (1.9 kg/kg) treatments. Feed conversion ratio in finisher phase was the highest in the control treatment T1 (3.0 kg/kg) with statistically significant (p<0.05) differences in comparison to the black pepper powder treatments. The lowest feed conversion ratio of 2.3 kg/kg was recorded in T5 treatment, followed by 2.5 kg/kg in T4. Lower feed conversion ratio in experimental treatments shows that addition of black pepper have positive influence on feed utilization and efficiency. Al-Kassieet al.[11] and Abou-Elkhairet al. [17] with the use of black pepper powder in chicken nutrition did not recorded positive influence of the added spice on feed conversion ratio. In our study, for the entire experimental period, feed conversion ratio was the lowest in treatment T5 (1.8 kg/kg) and the highest in control treatment T1 (2.1 kg/kg), but without statistically significant (p>0.05) differences.

Addition of black pepper as feed additive to broiler chicken nutrition in this experiment led to high improvement of blood lipid profile. From the results given in Table 4it 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 treatment T1 with statistically significant (p<0.05) differences in comparison to black pepper powder treatments.

**Table 4. Biochemical blood parameters and lipid profile, mg/dl**

| Experimental treatments | | Triglycerides | Total cholesterol | HDL | LDL | non HDL | HDL/LDL |
|---|---|---|---|---|---|---|---|
| T1 | LSM | 65.9[a] | 97.2[a] | 19.2[c] | 36.7[a] | 78.0[a] | 0.5[b] |
| | $SE_{LSM}$ | 0.8 | 0.9 | 1.16 | 1.01 | 1.03 | 2.33 |
| T4 | LSM | 16.5[b] | 54.1[b] | 29.7[b] | 16.6[b] | 24.4[b] | 1.8[a] |
| | $SE_{LSM}$ | 0.8 | 0.9 | 1.16 | 1.01 | 1.03 | 2.33 |
| T5 | LSM | 14.4[b] | 55.5[b] | 35.6[a] | 13.4[c] | 19.9[c] | 2.6[a] |
| | $SE_{LSM}$ | 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)*

Addition of black pepper in the amount of 1.0 g/100g (T5), significantly ($p<0.05$) decreased the concentration of triglycerides (14.4 mg/dl) in blood serum. This effect can be explained by the possible inhibition of the Acetyl CoA syntheses enzyme that is necessary for the biosynthesis of fatty acids. In ours study the lowest concentration of the total cholesterol was recorded in treatmentT4 ($p<0.05$). The highest concentration of HDL (35.6 mg/dl) was recorded in treatment T4 with addition of 0.5 g/100g of black pepper powder. Both levels of black 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 [26]. In investigation of Ghaediet al. [25] addition of black pepper decreased triglycerides and the total cholesterol while the concentration of HDL was increased. Al-Kassieet al.[11] showed that broilers fed with black pepper mixtureshad significantly lowered cholesterol, heterophil and lymphocyte ratio (H/L), red blood cell count, packed cell volume and haemoglobin compared with the control group, from which can be seen that the H/L ratio could serve as a good indicator to examine the stress level of chickens. In the research of the same authors the reduction of the total blood cholesterol in broiler chickens fed with addition of black pepper in amount of 0.5 and 1 g/100g was about 16 mg/100ml.Furthermore, addition of spice herbs in broiler nutrition 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.

## CONCLUSION

Based on the results obtained in this study, it can be concluded that the addition of black pepper in broiler chicken nutrition has positive effect on production performances and blood lipid profile. Addition of black pepper in the amount of 1.0 g/100g has led to the highest final body weights, lower feed conversion ratio and higher feed utilization. Also it can be concluded that significant lowering of plasma cholesterol, triglycerides, LDL and increase of HDL by black pepper powder supplementation in broiler diet indicates effective results 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.

**Acknowledgments**
This paper is a part of the project III 46012 which is financed by Ministry for Science and Technological development of the Republic of Serbia. Also the realization of one part of this experiment was supported by the PerutninaPtuj – Topikoa.d., Petefi brigade 2, 24300 BačkaTopola, Serbia.

## REFERENCES

[1] T.Steiner, Phytogenics in animal nutrition Natural concepts to optimise gut health and performance. Nottingham University Press, **2009**, 1.
[2] M. Wierup, *Mic. Drug Resist.*,**2001**,7, 183.
[3] O.Simon, *Adv. Pork Produc.*,**2005**, 39, 161.
[4] Lj.Kostadinović, J. Lević, In: Proceedings of International Feed Technology Symposium, Novi Sad, Serbia,**2012**, 15, 64.
[5] W.Windich, K. Schedle, C. Plitzner, A. Kroismayr, *J. Anim. Sci.*,**2008**,86, 140.
[6] M.A. Grashorn, *J. Anim. Feed Sci.*,**2010**,19, 338.
[7] N.Puvača, V. Stanaćev, D. Glamočić, J. Lević, L. Perić, V. Stanaćev, D. Milić,*World's Poultry Sci. J.*,**2013**, 69, 27.
[8] M.Moorthy, S. Ravikumar, K. Viswanathan, S.C. Edwin, *Int. J. Poultry Sci.*,**2009**, 8, 779.
[9] A.N.Khalaf, A.K. Shakya, A. Al-Othman, Z. El-Agbar, H. Farah, *Turkish J. Biol.*,**2008**,32, 51.
[10] S.M.E., Tazi, M.A. Mukhtar, K. Mohamed, M.H. Tabidi, *Int. J. Pharm. Res. Anal.*,**2014**, 4, 108.
[11] G.A.M., Al-Kassie, M.A.M. Al-Nasrawi, S.J. Ajeena, *Res. Opin. Anim. Vet. Sci.*,**2011**,1, 169.
[12] R.Mittal, R.L. Gupta, *Meth. Find. Exp. Clinic. Pharm.*,**2000**, 122, 271.
[13] N., Nalini, Y. Manju, V. Menon, *J. Med. Food*,**2006**, 9, 237.
[14] S.V., Reddy, P.V. Srinivas, B. Praveen, K.H. Kishore, B.C. Raju, U.S. Murthy, J.M. Rao, *Phytomed.*,**2004**, 11, 697.
[15]C.R.Pradeep, G. Kuttan, *Int. Immunopharm.*,**2004**, 4, 1795.
[16] R.K.Reen, S.F. Roesch, F. Kiefer, F.J. Wiebel, J. Singh, *Biochem. Bioph.Res. Comm.*,**1996**, 218, 562.
[17] R.Abou-Elkhair, H.A. Ahmed, S. Selim, *Asian Aus. J. Anim. Sci.*,**2014**, 27, 847.
[18] N.Puvača, V. Stanaćev, M. Beuković, D. Ljubojević, Lj.Kostadinović, N. Džinić, In: Proceedings of International Scientific Conference, Vukovar, Croatia,**2014**, 7, 75.
[19] N. Puvača, Lj. Kostadinović, D. Ljubojević, D. Lukač, J. Lević, S. Popović, N. Novakov, B. Vidivić, B. Jurišić, *Europ.Poultry Sci. J.*,**2015**, In press.

[20] M.R., Valiollahi, Y. Rahimian, Y. Miri, A. Rafiee, *Sch. J. Agr. Sci.*,**2013**,3, 535.
[21] A.A., Ghazalah, A.S.A. El-Hakim, A.M. Refaie, *Egyp. Poultry Sci. J.*,**2007**, 27, 53.
[22] N.H. Mansoub, *Annals Biol. Res.*,**2011**, 2, 486.
[23] M.N. Hosseini, *J. Basic Appl. Sci. Res.*,**2011**, 11, 2425.
[24] K.Platel, K. Srinivasan, *Nahrung.*,**2000**, 44, 42.
[25] H.Ghaedi, J. Nasr, F. Kheiri, Y. Rahimian, Y. Miri, *Res. Opin. Anim. Vet. Sci.*,**2014**,4, 91.
[26] Y.J. Kim, S.K. Jin, H.S. Yang, *Poultry Sci.*,**2009**, 88, 398.