THE EFFECT OF CHARCOAL ADDITION TO DIETS FOR BROILERS ON PERFORMANCE AND CARCASS PARAMETERS

Teresa Majewska, Krzysztof Pudyszak, Krzysztof Kozłowski
Department of Poultry Science, University of Warmia and Mazury in Olsztyn, Oczapowskiego 5, 10-719 Olsztyn, Poland, Tel.+48 89 5233988, Fax. +48 89 5233323, E-mail: teresa.majewska@uwm.edu.pl

Summary. The experimental materials comprised 800 Cobb 500 broiler chickens. One-day-old chickens of both sexes were randomly allocated to two feeding groups, each with four replicates of 100 birds. The chickens were reared for six weeks on deep litter and were fed standard pelleted diets in a three-stage system (starter, grower and finisher). Control group (I) birds received basal diets and experimental group (II) birds received identical diets supplemented with charcoal in the amount of 0.3%. Charcoal was added to diets at the feed mill. Dietary supplementation with charcoal was found to have a beneficial effect on the performance results of broilers. At the completion of a six-week rearing period, the body weights of chickens in the experimental group (fed charcoal-supplemented diets) increased significantly by 3.5% and their feed conversion ratio improved by 2.0%, compared with the control group.

Keywords: charcoal, broiler chickens, performance, carcass parameters.

MEDŽIO ANGLIES PRIEDO VIŠČIUKŲ BROILERIŲ RACIONUOSE POVEIKIS PRODUKTYVUMUI IR SKERDENOS RODIKLIAMS

Teresa Majewska, Krzysztof Pudyszak, Krzysztof Kozłowski
Paukštininkystės katedra, Olštino Varmijos ir Mozūrijos universitetas, 10 – 718 Olštinas, Oczapowskiego 5, Lenkija tel.+48 89 523 3988; faks. +48 89 523 3323; el. paštas: teresa.majewska@uwm.edu.pl

Santrauka. Tyrimas atliktas su 800 „Cobb 500“ viščiukų broilerių. Vienadieniai abiejų lyčių viščiukai analogų principu suskirstyti į dvi lesinimo grupes. Kiekvienoje grupėje atlikti keturi lygiagretūs bandymai su 100 paukščių. Viščiukai 6 savaites auginti ant gilaus kraiko ir lesinti standartiniais granuliuotais lesalais trijų fazių (standartinės, penėjimo ir baigiamosios) sistema. Kontrolinės grupės (I) viščiukai gavo bazinį racioną, o eksperimentinės grupės (II) – tą patį racioną, 0,3 proc. papildytą medžio anglies priedu.

Medžio anglies priedas į lesalus įmaišytas pašarų gamykloje. Tyrimais nustatyta, kad medžio anglies priedas darė teigiamą poveikį viščiukų broilerių produktyvumui. Po 6 savaičių auginimo tiriamosios grupės viščiukų broilerių (lesintų racionais, papildytais medžio anglies priedu) kūno masė reikšmingai padidėjo 3,5 proc., o jų pašarų konversijos koeficientas – 2,0 proc. palyginti su kontroline grupe.

Raktažodžiai: medžio anglis, viščiukai broileriai, produktyvumas, skerdenos rodikliai.

Introduction. Charcoal obtained through dry distillation of hardwood contains approximately 96% of pure carbon and 4% of other mineral compounds in organic form (Majewska and Zaborowski, 2003). Insoluble mineral compounds contained in charcoal undergo dissociation in the presence of gastric hydrochloric acid. They are converted into colloidal, soluble and active form (Scott et al., 1976). Ions of elements act as biocatalysts. Therefore, they contribute to regulating metabolic processes, maintaining the proper osmotic potential of body fluids, activating enzymes, hormones and antibodies. Charcoal has enormous adsorptive properties. It acts curatively on the gastrointestinal tract, adsorbing gases such as hydrogen sulfide and ammonia that are formed there, bacterial toxins as well as mycotoxins produced by fungi (Edrington et al., 1997; Shareef et al., 1998). According to Garwacki and Wiechetek (1998), charcoal is also beneficial in cases of poisoning by such compounds as alkaloids, phenol, glycosides and even strychnine and potassium cyanide. Charcoal is not digested in the gastrointestinal tract, and it binds various substances through physical interactions regardless of whether they are ionized or not. By binding of ammonia, charcoal protects the intestines against alkalization. It prevents intestinal infections and stops diarrhea by adsorbing and eliminating the germs in feces, but it not bactericidal. The minerals contained in charcoal form bases with water, lower the surface tension of the digesta and emulsify fat, thereby supporting liver functions and enabling the digestion and assimilation of fat. The beneficial effect of charcoal on humans and animals has been known for a long time. Its favorable influence on increasing the body weight of broiler chickens, their survival and feed utilization has been described by Edrington et al. (1997), Kutlu and Ünsal (1998), Majewska et al. (1999), Majewska and Zaborowski (2003), Majewska and Siwik (2006), Shareef et al. (1998). The aim of this study was to determine the effect of hardwood charcoal on the performance of broiler chickens.

Materials and Methods. The experiment was conducted on 800 Cobb 500 chickens. One-day-old chickens of both sexes were randomly allocated to two feeding groups, each with four replicates of 100 birds. The chickens were reared for six weeks on deep litter and were fed standard pelleted diets in a three-stage system (starter, grower and finisher). Control group (I) birds received basal diets and experimental group (II) birds received

identical diets supplemented with charcoal in the amount of 0.3% (3 kg per ton). Charcoal was added to diets at the feed mill. The nutritional value of diets is presented in Table 1.

All birds were weighed individually on day 21 and 42 of age. Feed consumption was determined weekly and mortality rates were recorded daily. At the end of the experiment, 16 males of each group with body weights close to the average value of the group were slaughtered and dissected (Ziołecki and Doruchowski, 1989). The results were verified statistically by an analysis of variance and Duncan's test, with the use of Statistica for Windows software (StatSoft Inc. 2009). The experimental results were processed statistically using Statistica for Windows software (StatSoft Inc. 2009). Data in tables are given as means ± standard deviation.

Table 1. **Calculated energy and nutrient content of diets**

Specification	Starter 0 –14 days	Grower 15 – 35 days	Finisher 36 – 42 days
ME, kcal	2954	3020	3150
Crude protein, g	215.2	194.9	178.3
Crude fiber, g	33.5	31.9	31.2
Available P, g	5.03	4.59	4.21
Natrium, g	1.73	1.68	1.42
Lysine, g	12.11	11.07	10.35
Methionine, g	5.21	4.76	4.39
Coccidiostat	Clinacox	Clinacox	-

Results and Discussion. Charcoal had a beneficial effect on the growth performance of broilers (Table 2). At 21 days of age, experimental group (II) birds receiving diets with 0.3% of charcoal were by around 5% (39g) heavier than control group (I) birds (statistically significant difference). After 42 days, experimental group birds were significantly (89 g i.c., 3.5%, $p<0.01$) heavier than control group birds. The addition of charcoal favorably affected the feed conversion ratio (Table 2). Chickens fed charcoal-supplemented diets consumed on average around 2% less feed per kilogram of body weight than control group birds.

The mortality rate of birds was similar in both groups, reaching 3.7% in the control group and 3.1% in the experimental group. The addition of charcoal to diets had no significant effect on carcass dressing percentage and the proportion of muscles in body weight (Table 3).

Table 2. **Growth performance of broilers**

Specification	Groups		Relative value (control = 100)	SEM	*P*
	I - control	II - experimental (charcoal)			
Body weight, kg					
21 days	$0.801^{b} \pm 0.012$	$0.839^{a} \pm 0.013$	104.7	0.008	0.005
42 days	$2.561^{b} \pm 0.040$	$2.650^{a} \pm 0.025$	103.5	0.020	0.009
Feed conversion ratio, kg/ kg weight gain (1-42 days)	1.983 ± 0.038	1.944 ± 0.028	98.0	0.014	0.102
Mortality, % (1-42 days)	3.7	3.1			

Values followed by different superscript letters are significantly different; a, b - $P \leq 0.05$

Table 3. **Slaughter analysis** (%) **of broilers** (body weight = 100%)

Specification	Groups		SEM	*P*
	I - control	II - experimental (charcoal)		
Dressing percentage	76.09 ± 0.65	76.38 ± 0.85	0.138	0.311
Breast muscles	15.75 ± 0.56	16.28 ± 0.87	0.140	0.060
Thigh muscles	9.08 ± 0.44	9.31 ± 0.29	0.070	0.096
Drumstick muscles	7.21 ± 0.31	7.25 ± 0.55	0.080	0.824
Heart	0.41 ± 0.04	0.39 ± 0.03	0.006	0.247
Liver	1.63 ± 0.11	1.65 ± 0.12	0.021	0.606
Gizzard	0.97 ± 0.10	0.98 ± 0.12	0.021	0.774

In a previous study conducted by Majewska et al. (1999), a similar trend was noted in broilers as a result of 0.3% charcoal supplementation. The final body weight of broilers was approximately 5.32% (127 g) higher and the FCR was around 0.50% (11 g) lower. The mortality rates in the control group reached 4.00%, while in the experimental group no cases of death were recorded. Edrington et al. (1997) fed superactivated charcoal (SAC) to broilers and reported a 4.4% increase in their body weight gain after 21 days. Shareef et al. (1998) who added SAC in the amount of 0.5% to broiler diets reported an increase in the body weights of birds (approx. 4.6%) and lower mortality rates, in comparison with the control group after 3 weeks.

In another experiment (Majewska et al., 2002), after an 18-week rearing period, turkeys receiving charcoal supplementation in the amount of 0.3% were by 5.9% (850 g on average) heavier and their feed conversion ratio was by 6.5% lower, compared with the control group. The livability of birds receiving supplemental charcoal was very good (99.02%), while in the control group mortality rates reached 12.7%. In an experiment by Kutlu et al. (1999), the body weights of broilers fed charcoal-supplemented diets increased by 5.9% and 7.8% at 3. and 6. weeks of age, respectively. The cited authors reported also a better dressing percentage (by 0.3%) in the experimental group.

The authors attributed the above results to the presence of available microelements and to the detoxicating effect of charcoal, lowering the surface tension of the intestinal digesta and supporting liver function with respect to fat digestion. Research findings suggest that the beneficial influence of charcoal is higher in poor-quality diets.

Conclusion

The addition of charcoal in the amount of 3 kg per ton of feed improved the performance of broiler chickens, including an approximately 3.5% increase in their body weight and an approximately 2.0% better feed conversion ratio.

References

1. Edrington T.S., Kubena L.F., Harley R.B., Rottinghaus G.E. Influence of a superactivated charcoal on the toxic effects of aflatoxin or T-2 toxin in growing broilers. Poult. Sci. 1997. T. 76. P. 1205–1211.

2. Garwacki S., Wiechetek M. Ogólna Toksykologia Weterynaryjna. Wydawnictwo SGGW, Warszawa. 1998.

3. Kutlu H.R., Ünsal I. Effects of dietary wood charcoal on performance and fatness of broiler chicks. Brit. Poult. Sci. 1998. T. 39. Suppl. P. 31–32.

4. Kutlu H.R., Ünsal I., Gorgulu M., Baykal L., Effect of providing dietary wood charcoal to broiler chicks of different ages. Brit. Poult. Sci. 1999. T. 40. P. 34–36.

5. Majewska T., Pyrek D., Faruga A. A note on the effect of charcoal supplementation on the performance of Big 6 heavy tom turkeys. J. Anim. Feed Sci. 2002. T. 11. P. 135–141.

6. Majewska T., Siwik T. Silica grit, charcoal, hardwood ash and the preparation Humokarbowit as dietary additives for broiler chickens. Pol. J. Nat. Sci. 2006. Suppl. 3. P. 445–449.

7. Majewska T., Zaborowski M. Charcoal in nutrition of broiler chickens. Med. Weter. 2003.Vol. 1. P. 81–83.

8. Majewska T., Zaborowski M., Zalewski K. Effect of feed supplementation with charcoal on production results of broiler chickens. Zesz. Nauk. Przegl. Hod. 1999. T. 45. P. 371–378.

9. Scott M.L., Nesheim M.C., Young R.J. Nutrition of the chicken. Publishers Ithaca, New York 1976.

10. Shareef A.M., Al-Jubory K.M.T., Hassan M.G. Effect of activated charcoal in reducing dietary aflatoxin-induced stress in broiler chicks. Iraqi J. Vet. Sci. 1998. T. 11. P. 23–29.

11. StatSoft Inc. Statistica (data analysis software system). 2009. version 9.0. www.statsoft.com.

12. Ziołecki J., Doruchowski W. Metody oceny wartości rzeźnej u drobiu. COBRD, Poznań, 1989. P. 1–22.

Received 29 October 2010
Accepted 27 June 2011