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Short-Review

Effect of activated charcoal on different aspects of poultry performance: a review

[1*]Okey, S.N., [1]Ogbu, C.C. [2]Akomas, S.C. & [2]Okoli, I.C.

[1]Department of Veterinary Biochemistry and Animal Production, Michael Okpara University of Agriculture Umudike,
[2] Department of Veterinary Physiology & Pharmacology, Michael Okpara University of Agriculture Umudike, Nigeria
[3]Department of Animal Science and Technology, Federal University of Technology, Owerri, Nigeria.

*Corresponding author: nnamuokey@gmail.com, +23407038932128

Abstract

This paper presents a short review of the effects of activated charcoal (AC) on different aspects of poultry performance. Activated charcoal is a solid, porous, tasteless and black carbonaceous material prepared from a variety of carbon containing materials, including agricultural residue. In powder form it acts as adsorbent for many toxins according to physical and chemical nature of the precursor. Several studies reviewed showed AC, as a non-digestible and cheap substance that may be of benefit to poultry gut health, growth and laying performance, especially in the tropics where microbial degradation of feed is a major threat.

Keywords: Activated charcoal, broilers, layers, poultry performance.

INTRODUCTION

Feed remains the most important component of the cost of production in the intensive poultry sector. Several biotechnology techniques are currently being used to reduce cost and increase poultry productivity. One of the viable methods has been the use of growth promoters such as prebiotics to improve feed efficiency and poultry health. These substances do not contribute to the nutrient needs but are rather used to control pathogenic organisms in the gut. This is desirable in view of the fact that the gut is one of the major organs determining the performance of birds and the economics of production, with the profile of intestinal microflora playing a significant role in gut health. However, most of these substances or natural growth promoters are not readily available to Nigerian poultry farmers who are mostly small-scale producers. Therefore, cheaper alternative additives like activated charcoal and clay minerals (Thacker, 2013) which could be produced on the farm or supplied from a nearby cottage industry will be of value to farmers.

Activated charcoal also called activated carbon or biochar is a solid, porous, tasteless and black carbonaceous material prepared from a variety of carbon containing materials, including agricultural residues. Activated charcoal when ground into fine powder acts as an adsorbent for many toxins with the absorbance being dependent on pore size, surface area, concentration and chemical nature of the precursor (Yahya *et al.*, 2015). Awad *et al.* (2009) reported that adding activated charcoal to poultry diet can help recover the intestinal integrity, improve gut health and thus increase nutrient availability and absorption. Currently, the use of activated charcoal in poultry production is an emerging research area that is still generating the needed literature for ultimate on-farm application. There is therefore, the need to articulate what is currently known, especially as it applies to poultry production in the tropics.

This paper presents a short review of the effects of activated charcoal on different aspects of poultry performance.

EFFECT ON GROWTH, HAEMATOLOGY AND SERUM CHEMICAL PROFILES

Growth is an increase in mass of a living substance and so, weight change can be considered an index of growth. Odunsi *et al.* (2007) supplemented wood charcoal into broiler starter and finisher diets and reported that body weight gains and feed conversion ratio (FCR) were significantly better in the control group than those fed charcoal based diets. This is in

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agreement with the report of Kutlu *et al.* (2001) that charcoal supplementation reduces feed intake and feed conversion ratio, with the reduction being attributed to higher bulk density of charcoal supplemented feed (Evans *et al.,* 2015). Majewska and Zaborowski (2003) however reported that AC supplemented birds were 1- 6.5% heavier, 5.9% better in their FCR and 1.6% better in their survival rate than the control group. Dim *et al.* (2018) reported that the final body weight, average daily weight gain and FCR were better in birds on 6% AC inclusion than other groups after 56 days trial period similar to the reports of Kutlu *et al.* (1999).

Dim *et al.* (2018) also noted that WBC count and PCV were not affected at both the starter and finisher phases, while haemoglobin concentration (Hb) and RBC count were significantly improved and cholesterol and lipoprotein levels were significantly reduced, probably due to the ability of the birds on AC to maximally utilize the vitamin-mineral premix in the diet. No significant differences in high density lipoprotein (HDL) and triglycerides were observed across the treatment groups. Majewska *et al.* (2009) reported that dietary supplementation of AC at 0.3% did not significantly affect RBC, WBC, Hb and PCV values of broilers fed aflatoxin-B1 contaminated feeds. Majewska *et al.* (2002) had used charcoal as feed additive to raise turkeys and reported non-significant differences in the serum biochemical indices.

EFFECT OF ACTIVATED CHARCOAL ON CARCASS QUALITY

Kutlu *et al*. (2001) reported that wood charcoal significantly increased the carcass weight, carcass yield and carcass ash and fat contents in broiler chickens. However, charcoal inclusion to the diet did not affect carcass dry matter and protein contents significantly. Majewska and Zaborowski, (2003) reported that carcass yield, liver, spleen and kidney weights did not show any major variations among the treatment groups though the broilers fed 7.5% wood charcoal had the least percentage carcass yield and abdominal fats, while cut-up parts did not vary across the groups. The lung, heart and gizzard showed slight changes among the treatment groups when compared with the control. This showed that wood charcoal used in the study had no major physiological effects on tissue and organ development and functions when compared with the control. However, a positive development in the reduction of abdominal fat deposition in broilers fed wood charcoal based diets was noticed when compared to the control group. These results with respect to subcutaneous and abdominal fat deposition could indicate lower intake of dietary energy with charcoal inclusion in the diet (Kutlu *et al.,* 2001). This means that as the charcoal level in the diet increases, FCR and fat excretion increases, while fat deposition also reduces.

EFFECT OF ACTIVATED CHARCOAL ON LAYING PERFORMANCE AND EGG QUALITY

The addition of beneficial feed additives such as AC to the diet can help recover the intestinal integrity, improve gut health and thus increase nutrient availability and absorption (Awad *et al.,* 2009) which result to increased laying performance. A mixture of bamboo charcoal powder and bamboo vinegar has been shown to induce a significant increase in egg production by stimulating intestinal functions of laying hens in the early phase of production (Yamauchi *et al.,* 2010). These were attributed to the beneficial effects of the product in promoting intestinal functions which may help to absorb and assimilate more nutrients. In late phase of production, Rattanawut *et al.* (2017) supplemented with the commercial bamboo vinegar, SuperBob® at 0, 0.5, 1.0 and 1.5% inclusions to the basal diet. They reported no significant differences between the groups with respect to egg shell weight, yolk colour and Haugh (an index of albumen quality).

Kutlu *et al.* (2001) studied the effects of dietary oak charcoal on laying performance using Hyline breed fed a standard commercial layer diet and supplemented with 0, 10, 20 and 40g ground wood charcoal per kg. There was no effect on egg weight, albumen weight, yolk weight, shell weight, shell thickness and shape index. However, AC supplementation reduced the number of cracked eggs in a dose-related manner which is attributed to the absorption capacity of charcoal for dietary fat and its excretion. Increased fat excretion promoted by charcoal probably enhanced mineral utilization, particularly calcium which promotes shell formation in the shell gland. Charcoal supplementation induced a non-significant reduction in feed intake, egg production and FCR. The lower feed intake was possibly due to higher bulk density and blackening of the diets by charcoal and decrease in palatability (Jindal *et al.,* 1994).

EFFECT OF ACTIVATED CHARCOAL ON EXCRETORY PRODUCTS

Studies by Plank *et al.* (1990) revealed that wood charcoal increased fat excretion which is expected in view of its binding effect on fat, fat soluble substances and noxious substances that may interfere with digestion. This increased fat excretion could be beneficial in preventing the malfunctioning of the gastrointestinal tract (GIT) associated with poor fat digestion as a result of limited bile synthesis in young birds. This result in addition to reduced carcass fat content and abdominal fat weight suggest reduced intake of dietary energy sources with charcoal inclusion in diet (Kutlu *et al.,* 2001). In other words, as the charcoal level in the diet is increased, the FCR and fat excretion increase, while fat deposition in the body decreases.

Activated charcoal inclusion in the diet reduces nitrogen free extract excretion while markedly increasing fiber excretion in a dose-dependent manner (Duke, 1986). This means that increased levels of AC in high fibre diet will increase fibre consumption and excretion. The major constituents of dietary fibre are cellulose, hemicellulose and lignin which are poorly digested by birds (Kutlu *et al.,* 2001). Activated charcoal also increases carcass ash content in a dose-dependent manner and this is a reflection of the increased mineral intake (Duke, 1986).

EFFECT OF ACTIVATED CHARCOAL ON GASTROINTESTINAL TRACT HISTOMORPHOLOGY AND ECOLOGY

Activated charcoal as an adsorbent has the potential to condition the cell membranes, reduce surface tension by eliminating gases and toxins in the GIT to improve absorption and utilization of nutrients (Majewska *et al.*, 1999). Broiler chickens fed 1% bamboo charcoal diet recorded the highest body weight with the jejunal villus height and area being higher than those of other groups (Xia *et al.,* 2004). Increased villus height is indicative of a greater absorptive surface area and a better capacity of absorbing available nutrients. Villus height is increased by enhanced efficiency of digestion and absorption in the small intestine due to increased population of beneficial bacteria that supply nutrients and stimulate vascularization and development of the intestinal villi (Gilmore & Ferreti, 2003). Choct (2009) reported a shorter villus when the counts of pathogenic bacteria increased in the GIT, which results in fewer absorptive and more secretory cells. It has been suggested that there is a strong correlation between gut structure and type of feeding materials and that villus height can be used to predict weight gain. A commercial charcoal product, Nekka-Rich®, was fed as prebiotic to leghorn chickens and it reduced significantly Salmonellae recovered from the large intestine and faecal samples.

CONCLUSION

Activated charcoal, a non-digestible and cheap substance may be of benefit to poultry gut health, growth and laying performance, especially in the tropics where microbial degradation of feed is a major threat.

REFERENCES

Awad, W. K. G. & Bohm, J. (2009). Intestinal structure and function of broiler chickens on diets supplemented with a synbiotic containing *Enterococcus faecium* and oligosaccharides. *International Journal of Molecular Sciences*, 9, 2205 - 2216.

Choct, M. (2009). Managing gut health through nutrition. *British Poultry Science,* 50, 9 - 15.

Chu, G. M., Jung, C. K., Kim, H. Y., Ha, J. H., Kim, J. H., Jung, M. S., Lee, S. J., Song, Y., Ibrahim, R. I. H., Cho, J. H., Lee, S. S. & Song, Y. M. (2013). Effect of bamboo charcoal and bamboo vinegar as antibiotic alternatives on growth performance, immune responses and faecal microflora population in fattening pigs. *Animal Science Journal*, 84, 113-120.

Dim, C. E., Akuru, E. A., Egom, M. A., Nnajiofor, N. W., Ossai, O. K., Ukaigwe, C. G. & Onyimonyi, A. E. (2018). Effect of dietary inclusion of biochar on growth performance, haematology and serum lipid profile of broiler birds. *Agro Science,* 17(2), 8-16.

Duke, G.E. (1986). Alimentary canal: secretion and digestion, special digestive functions, and absorption. In: Sturkie, P.D. (Ed.), *Avian Physiology Springer*, New York, Pp: 289-302.

Evans, A. M., Loop, S. A. & Moritz, J. S. (2015). Effect of poultry litter biochar diet inclusion on feed manufacture and 4-21-d broiler performance. *Journal of Applied Poultry Research*, 24, 380-386.

Gilmore, M. S. & Ferretti J. J. (2003). The thin line between gut commensal and pathogen. *Science*, 299, 1999-2002.

Jiang, S., Cui, L., Shi, C., Ke, X., Luo, J. & Hou, J. (2013). Effect of dietary energy and calcium levels on performance, egg shell quality and bone metabolism in hens. *Veterinary Journal*, 198, 252-258.

Jindal, N., Mahipal, S.K. & Mahajan, N.K. (1994). Toxicity of aflatoxin B_1 in broiler chicks and its reduction by activated charcoal. *Research Veterinary Science,* 56, 37-40.

Kutlu, H.R., Unsal, I. & Gorgulu, M. (2001). Effect of providing dietary wood (Oak) charcoal to broiler chicks and laying hens. *Animal Feed Science Technology,* 90, 213-226.

Kutlu, H. R., Unsal, T., Gorgulu, M. & Baykal, I. (1999). Effect of prosviding dietary wood charcoal to broiler chicks of different ages. *British Poultry Science*, 40, 34-36.

Majewska, T. & Zaborowski, M. (2003). Charcoal in the nutrition of broiler chickens. *Medycyna Weterynaryjina*, 59, 81-83.

Majewska, T. D. & Pryrek-Faruga, A. (2002). A note on the effect of charcoal supplementation on the performance of big 6 heavy tom turkeys. *Journal of Animal Feed Science.*, 11, 135-141.

Majewska, T., Zaborowski, M. & Zaewski, K. (1999). Effect of feed supplementation with charcoal on production results of broiler chickens (In polish). *Zesz Nauk PrzHod*, (45), 371-378.

Majewska, T.D., Mikulski, D. & Siwik, T. (2009). Silica grit, charcoal and hardwood ash in turkey. *Journal of food Science,* 11, 135 – 141.

Odunsi, A. A., Oladele, T. O., Olaiya, A. O. & Onifade, O. S. (2007). Response of broiler chickens to wood charcoal and vegetable oil based diets. *World Journal of Agriculture Science,* 3(5), 572-575.

Plank, G., Bauer, J., Grunkemeier, A., Fischer, S., Gede, B. & Berner, H. (1990). The protective effects of adsorbents against ochratoxinA in swine. *Tierarztl. Prax,* 18, 483-489.

Rattanawut, J., Todsadee, A. & Yamauchi, K. (2017). Effects of bamboo charcoal powder including vinegar supplementation on performance, eggshell quality, alterations of intestinal villi and intestinal pathogenic bacteria populations of aged laying hens. *Italian Journal of Animal Science,* 16 (2), 259-265.

Thacker, P.A. (2013). Alternatives to antibiotics as growth promoters in swine production: A review. *Journal of Animal Science and Biotechnology*, 4(10), 4-35

Xia, M. A., Hu, C. H. & Xu, Z. R. (2004). Effects of copper bearing montmorillonite on growth performance, digestive enzyme activities and intestinal microflora and morphology of male broilers. *Poultry Science*,83, 1868-1875.

Yahya, M.A., Al-Qodah, Z. & Ngah, C.Z. (2015). Agricultural bio-waste materials as potential sustainable precursors used for activated carbon production. A review. *Renewable and Sustainable Energy Review*, 9, 851 – 855.

Yamauchi, K., Ruttanavut, J. & Takenoyama, S. (2010). Effect of dietary bamboo charcoal powder including vinegar liquid on chicken performance and histological alternations of intestine. *Journal of Animal Feed Science,* 19, 257-268.

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