Are Phytochemical Compounds Essential for Poultry as Feed Additive ? – A short Communication

[1]Johnson, N. C. [1*]Diri, M. [1]Fakae, L. B.. and [1]Eli, O. H

Department of Animal Science, Rivers State University, Port Harcourt, Nigeria

Corresponding Author: dirimoses@yahoo.com

Abstract

Poultry and swine have been identified as the fastest growing species of farm animals in the animal and livestock industries. Poultry, such as broilers get to market weights of about 3kg in eight weeks. However, this well-cherished economic benefit in poultry production is gradually eroding away, primarily due to the ban of the use of antibiotics in poultry diets. Antibiotics are usually used to control the negative effects of pathogenic organisms and thus serve as growth promoters. This has gradually disappeared. The use of antibiotics at sub-therapeutic levels have been used for decades to aid in improving poultry production. Therefore, with the ban and thus elimination of the use of antibiotics by poultry producers presents special challenges to all stakeholders in the industry, including the nutritionists and feed millers. This has resulted in the search for alternatives to anti-biotic that would produce similar effects without compromising production and also without any prejudice on the eventual final product, such as poultry meat. This has also resulted in the development of strategies for adoption for the industry. Special natural products, such as nutraceuticals, phytonutrients, phytochemicals and some bioactive compounds of both plant and animal sources had been identified and synthesized as replacements to antibiotics without any detrimental or side effects for the poultry industry. They have shown to be efficient and effective in enhancing poultry health, nutrient digestibility and thus improve performance. Some of these products are identified here as they have gained interest in the animal industry.

Key words: Phytochemicals, Health, Performance and Poultry

INTRODUCTION

Poultry, such as broilers are fasting growing species reaching market weights of about 3kg in eight weeks. This phenomenon poses stress on the birds in addition to other environmental stressors leading to high susceptibility to diseases and pathogenic agents (NRC, 1993). The attendant effects of these lead to significant reduction in the poultry farmer profit margin. It is common knowledge that poultry wholesomeness and welfare depend on multifarious factors. One of such factors is the use of antibiotics as sub-therapeutic levels to enhance poultry production, especially as it relates to disease control and prevention (Byarugaba, 2005). The use of antibiotics therefore has been used successfully for decades to overcome the negative effects of pathogenic agents to improve production (Byarugaba, 2005).

Phytochemicals are chemical compounds produced by plants which can be use as feed addictive to boast the immune system and prevent poultry birds from unwanted pathogenic infections. Presently, the use of certain antibiotics in livestock and poultry productions have been banned, principally due to the resistance of pathogenic organisms to antibiotics (Akin-Osanaiye *et al.*, 2015).An earlier study (Sosa *et al.*, 2010) had reported that pathogenic agent resistant capability to antibiotic was mainly based on the modification of the structure and the reaction pathway of pathogenic-agent in circumventing the inhibition effect of antibiotic as to enable it survive. To this point therefore, in an attempt to diminish the potential negative effects of pathogens in disease management for the poultry industry Fernebro (2011) posited that both conventional and non-conventional strategies should be adopted in managing the pathogen menace. Additionally, it has been shown that plant-based phytochemicals are a mixture of different components that are effective in dealing with pathogens as a result of the additive effects, yet less expensive compared to antibiotics and also time-saving (Karnath, 2002).

Based on the fore-stated, it is not a gainsaying that the resistance of pathogenic organisms to antibiotics constitutes one of the greatest threat and challenge to the livestock and poultry industries, including human health due to zoonosis (NRC, 2012).To this extent, therefore, there is a need to strategize for alternatives to the use of antibiotics in dealing with the resistance of pathogenic-agents to antibiotics. Therefore, the objectives of this paper is to identify and highlight some of the phytochemicals that can be used as alternatives to antibiotics in livestock and poultry productions without any detrimental effects.

Phytochemical Compounds used as Alternatives to Antibiotics and their Origins

Phytochemical compounds used as alternatives in improving poultry and livestock production indices come under different classifications based on their definitions and origins according to the studies data of Karnath (2002) and Lucia *et al.* (2011) shown in Table 1.

Table 1. Classification of phytochemical compounds based on their definitions and origins

Compound	Definition	Origin
Nutraceuticals	Part of food that provides health benefits	Plant and animal

Phytonutrient	Plant derived component with health benefits	Plant
Phytochemicals	A variety of plant compounds with therapeutic benefits, including anti-carcinogenic, anti-mutagenic,anti-inflammatory and anti-oxidantactivities	Plant
Bioactive compounds	Dietary supplements with health benefits beyond basic nutritional needs	Plant and animal

As shown in Table 1, the uses of the listed phytochemicals have come to stay as they have demonstrated to be efficient and effective in managing animals' health without the drawbacks associated with antibiotics.

PHYTOCHEMICAL AND SALMONELLA

The postulation of Karnath (2002) is supported by evidences demonstrated with independent studies data or recent findings, such as those of Gast and Porter (2020) on the efficacy of the control of *salmonella* disease in poultry by phytochemicals. *Salmonella* diseaseis of bacteria origin that is associated by high mortality rates in birds, such as *S. pullorum* disease infection.*S. pullorum* disease in most cases are present in the eggs of infected layers and in the litter or soil in which it may remain for as much as a year. It may infect through hatchery, droppings and by egg-consumption. The susceptibility of chicks to infection is greatest during the first and second day up to three weeks after hatching. Phytochemicals are effective in preventing its occurrence without resistance as in the use of antibiotic with significant improvement in broiler performance and reduction in *Salmonella* bacteria (Gast and Porter, 2020; Wati *et al.*, 2015).

Similarly, phytochemicals have been shown to be effective in dealing with coccidiosis. Coccidiosis disease is mainly caused by eight species of protozoa of the genus *Eimeria*. Two of the species cause wasting diseases that may affect egg production. The parts affected by this disease are the caeca (*E. tenella*), duodenum (*E. acervulina*), jejunum (*E. necatrix*) and lower bowel (*E. brunetti*). The other species are *E. mitis* and *E. magna*. From the fore-stated, it can be seen at a glance that coccidiosis impedes nutrient digestibility and absorption as it causes intestinal lesions and damages leading to declined nutrient digestion, absorption and assimilation resulting in runted growth in birds. However, phytochemical compounds have been demonstrated to be effective in preventing coccidiosis.To this point, most plants and their bioactive compounds used against *Eimeriaspp*. infections have shown high degree of efficacy against avian coccidiosis and anti-coccidial effects were identified in the inhibition of different *Eimeria spp*. growth, prevention of invasion,

strengthening of immune response, inhibition of sporulation, prevention of oocysts shedding and reduction in oocyst scores (El-Shall *et al.,* 2022).These observations were also shown in earlier data of Awoyinka *et al.* (2007). Due to the efficacy of phytochemical compounds against coccidiosis and other poultry diseases, they have been shown to also improve bird performance.

PHYTOCHEMICALS, BIRD PERFORMANCE AND MEAT QUALITY

Large volume of studies and literature reviews on the phytochemicals are at a wash in the literature on the efficacy of phytochemical compounds on animal performance. Mordi and Akanji (2011) demonstrated that phytochemicals improved animal growth in laboratory animals. Furthermore, phytochemical compounds have been used in maintaining important organs' integrity, such as the liver, kidney and the heart. The liver, kidney and the heart are very essential organs in different physiological functions, such as xenobiotic metabolism and excretion. Liver, for instance is critical in most biochemical pathways involving growth, disease control, nutrient, such as energy metabolism and reproduction (Ward and Daly, 1999). Therefore, hepatic damage is associated with impediments in nutrient metabolisms (Wolf, 1999). It is common knowledge that hepatic damage results in impeding lipid metabolism and importantly reduced glutathione levels whereas the serum levels of alanine amino transaminase, aspartate amino transaminase, alkaline phosphate, triglycerides and cholesterol become significantly elevated due to hepatic damage. A condition that compromises performance particularly growth.

To this extent therefore, it has been demonstrated thatphytochemicals improved bird performance parameters, including weight gain, feed intake and feed efficiency as demonstrated by the data of Jiang *et al.* (2007). Furthermore, the positive effects of phytochemicals proved to enhanced performance parameters in all the phases of poultry productions (Goliomytis *et al.,* 2014). Additionally, apart from enhancing bird performance phytochemicals were observed to improved meat quality for better value capture as seen in the significantly improved the water holding capacity of meat and thus extended their shelf-life. This characteristic is very important in keeping meat fresh and appealing to consumers by preventing pale, soft and exudative (PSE) traits or qualities, rather phytochemicals aid in keeping the meat dark, firm and dry (DFD). Consumers prefer DFD meats to meats showing PSE. This is one of the highly desired effects of phytochemicals.

Conclusions: Phytochemical compounds are both of plant and animal origins. As present, the use of phytochemical compounds has received tremendous attraction and interests of producers principally as a result of the ban of the use of antibiotics in poultry productions due to pathogenic agents' resistance. Photochemical appear as alternatives to antibiotics as they control pathogenic proliferations thereby keeping birds healthy, improve performance parameters and also improve meat quality for better value capture, implicated in increasing the profit margin of the poultry farmer.

REFERENCES

Akin-Osanaiye, B. C. Adeniran, O. I. and Aderemi, S. A. (2015). Auspicious Antimicrobial potentials of ethanol extracts of stem and root of *Cnidoscolus aconitifolius.International Journal of Medical Plant and Natural Product. 1:15-19.*

Awoyinka, O. A. Belogun, I. O. and Ogunowo, A. A. (2007). Phytochemical screening and in vitro bioactivity of *Cnidoscolus aconitifolius*. J. Medicinal Plants Res. 1(3):063-065.

Byarugaba, O. K. (2005).Antimicrobial resistance and its containment in developing countries. In Antibiotic policies: Theory and practice, Ed. I. Gould and V. Meer, Pp. 627-646. New York.

El-Shall, N. A. El-Hack, M. E. Albaqami, N. M. Khafaga, A. F. Taha, A. E. Swelum, A. A. etc. (2022). Phytochemical Control of Poultry Coccidiosis: A Review. Poultry Science. 101: 5-42.

Fernebro, J. (2011). Fighting bacterial infection in future treatment options. Dry resist updates.14:125-139.

Gast, R. K. and Porter, R. E (2020).Salmonella infections. In: Diseases of Poultry. John Wiley and Sons, Ltd.Hoboken, NJ, USA, Pp. 717-753.

Goliomytis, M. Tsoureki, D. Simitzis, P. E. Charismiadou, M. A. Hager-Theodorides, A. I. and Deligeorgis, S. G. (2014). The effects of quercetin dietary supplementation on broiler growth performance, meat quality and oxidative stability. Poultry Science. (93:1957-1962.

Jiang, Z. Y. Jiang, S. Q. Lin, Y. C. Xi, P. B. Yu, D. Q. and Wu, T. X. (2007).Effects of soybean isoflavone on growth performance, meat quality and anti-oxidation in male broilers. Poultry Science. 86 (7):13356-13362.

Karnath, L. (2002). The new paradigm of botanical drugs. Eur. Pharm. Rev. 7:19-20.

NRC, 1993. Nutrient Requirements of Poultry, 9th Edition. National Academies Press, Washington, D. C.

NRC, 2012. Nutrient Requirements of Swine. 11th Edition, National Academies Press, Washington, D. C.

Sosa, A. J. Byarugaba, D. K. Amabile, C. and Okeke, I. N. (2010). Antimicrobial resistance in developing countries. www.sosa.springer.com Accessed on 15th April, 2023.

Ward, T. M. and Daly, M. J. (1999). “Hepatic disease”: In: Clinical pharmacy and therapeutics. R. Walker and C. Edwards Eds. Pp. 195-212. Churchill Livingstone, New York, USA.

Wati, T, Ghosh, T. K. Syed, B and Haldar, S. (2015). Comparative efficacy of a phytogenic feed additive and an antibiotic growth promoter on production performance, caecal microbial

population and humoral immune response of broiler chickens inoculated with enteric pathogens. Animal Nutrition. 1:213-219.

Wolf, P. L. (1999). Biochemical diagnosis of liver disease. *Indian Journal of Clinical Biochemistry*. *14(1):59-90.*