MAS Journal of Applied Sciences
Uygulamalı Bilimler Dergisi
ISSN: 2757-5675
masjaps.com

OPEN ACCESS

DOI: http://dx.doi.org/10.5281/zenodo.8411096

Derleme Makalesi / Review Article

The Effects of Plant-Based Feed Additives on Productive and Reproductive Performans in Poultry

Arda Onur ÖZKÖK[1*]

[1]Amasya University, Suluova Vocational School, Amasya

*Sorumlu yazar (Corresponding author): arda.ozkok@amasya.edu.tr

Geliş Tarihi (Received): 12.06.2023 **Kabul Tarihi (Accepted)**: 27.07.2023

Abstract

The poultry sector is very important in order to meet the nutritional needs of the increasing world population. Compared to other farm animals, poultry has a shorter production period and is a relatively inexpensive source of protein. Feed additives are used to increase performance, improve product quality, and protect animal health in poultry. The demand for alternative additives has also increased with the prohibition of the use of growth promoting antibiotics in animal nutrition. Studies on plant-based feed additives have gained momentum because they are natural and more reliable. These additives, called phytobiotics, contain bioactive components. Some of these bioactive components have various properties such as antioxidant, antimicrobial, antiviral, and anti-inflammatory. In some *in-vivo* studies in poultry, it has been reported that various phytobiotics have positive effects on production and reproductive performance. In this review, general information about phytobiotics was given and their effects on production and reproductive performance were presented in poultry.

Keywords: Phytobiotics, poultry, productive performance, reproductive performance

1. Introduction

Compared to other livestock sectors, poultry industry has some advantages. These advantages are short production times, more animals per unit area, relatively cheap products, and easier maintenance. This sector plays an important role in meeting the increasing protein demand in parallel with the world population growth. For this reason, especially sustainability, increase in production, and protection of animal health are necessary. Feed additives are used to do all of this. One of them is antibiotics. The antibiotics were used in animal nutrition at sub-therapeutic levels from the early 1950s until 2006 (Redondo et al., 2014). The antibiotics have significantly contributed to maintaining animal health and increasing production performance (Diarra and Malouin, 2014). However, use of the antibiotics in animal nutrition has been banned since 2006 due to bacterial resistance and residue in products (Omolere and Alagbe, 2020). Producers of animal products have turned to alternative sources (Ayalew et al., 2022). Probiotics, prebiotics, enzymes, and phytobiotics are among the additives investigated as alternatives to antibiotics in poultry (Pandey et al., 2019). Phytobiotics are defined as plant/plant-based products (Rafeeq et al., 2023). These are classified as herbs, spices, essential oils, and oleoresins (Gheisar and Kim, 2018). Plants contain various secondary metabolites (phytochemicals) (Kumari et al., 2017).

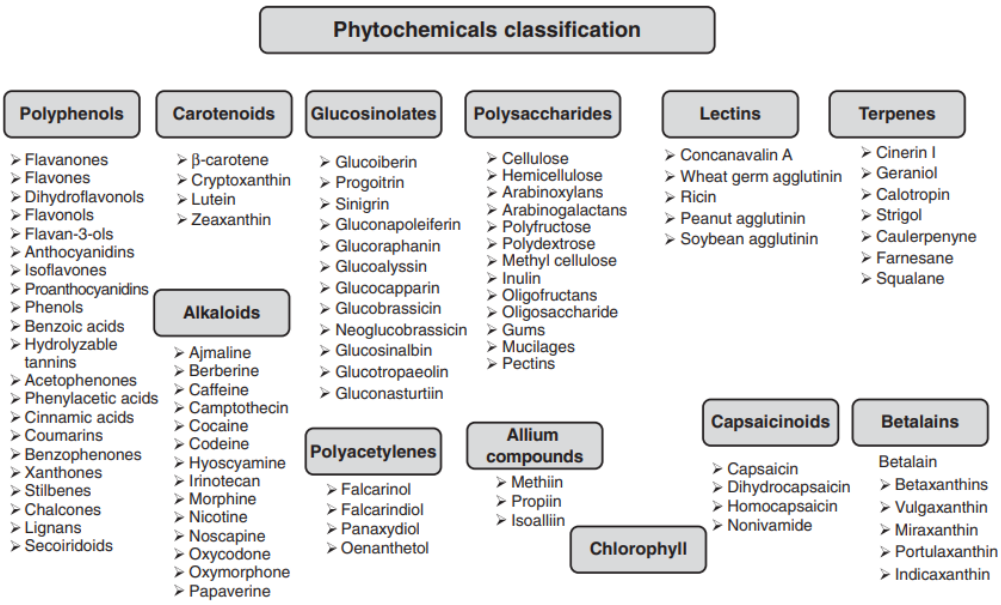

Figure 1. Classification of phytochemicals (Campos-Vega and Oomah, 2013)

A general classification of phytochemicals is given in Figure 1 (Campos-Vega and Oomah, 2013). These substances show the important properties such as antioxidant, antimicrobial, anti-carcinogenic, antiallergic, and hypoglycemic due to the various secondary metabolites they contain (Kumari et al., 2017). The main components and effects of some herbs are given in Table 1 (Parham et al., 2020).

Table 1. Main compound and effects of some plants (Parham et al., 2020)

Plant	Main Compounds	Effects	References
Cinnamon	- Cinnamaldehyde - Eugenol	Antioxidant Antimicrobial Anti-inflammatory Anticancer Immunomodulatory Hypocholesterolemic	Friedman et al. (2002) Willis et al. (2019)
Garlic	- Organosulfurs - Phenolic Compounds	- Antioxidant - Antimicrobial - Antidiabetic - Anti-cancer - Cardioprotective	Martins et al. (2016) Toledano et al. (2019)
Ginger	- Phenolic acids - Gingerols - Shogaols - Paradols	- Antioxidant - Antimicrobial - Antidiabetic - Anti-inflammatory - Anticancer - Cardiovascular	Singh et al. (2018) Idris et al. (2019)
Mint	- Phenolic compounds	- Antioxidant - Antimicrobial - Anticancer - Anti-inflammatory	Mimica and Bozin (2008)
Pennyroyal	- Pulegone - Methone	- Antioxidant - Antimicrobial - Anti-hepatic	Miraj and Kiani (2016) Zahra et al. (2013)
Thyme	- Carvacrol - Thymol - Phenols	- Antioxidant - Antimicrobial - Mucolytic - Spasmolytic	Oliviero et al. (2016) Tzima et al. (2015)
Turmeric	- Vitamin C - Cineole - Borneol - Tumerone - Zingiberene - d-sabinene - d-phellandrene	- Antioxidant - Antimicrobial - Anti-inflammatory - Anticancer - Anticoagulant - Hypoglycemia	Panpatil et al. (2013) Sharma et al. (2019)

It have been reported that the phytobiotics have improved the health and performance of poultry (Alghirani et al., 2021). Activities in poultry of phytobiotics are given in Figure 2 (Prabakar et al., 2016).

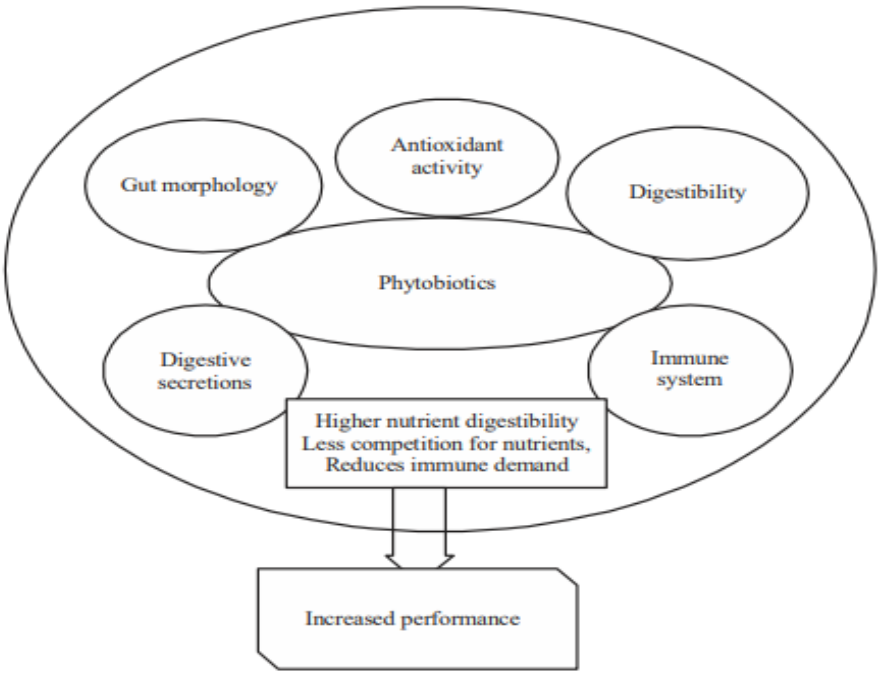

Figure 2. Activities of phytobiotics in poultry (Prabakar et al., 2016)

There are different studies investigated on the use some phtobiotics such as thyme (Khaksar et al., 2012; Heydarian et al., 2020), rosemary (Alagawany and El-Hack, 2015; Sevim et al., 2023), garlic (Khaidem et al., 2019; Omer et al., 2019), wild leek (Kılınç et al., 2023), turmeric (Ekine et al., 2020), sage (Farhadi et al., 2020; Mortezayi et al., 2020), ashwagandha (Nagar et al., 2021; Kılınç, 2023), cinnamon (Mehdipour et al., 2013; Ghanem et al., 2021), jujube (Abdulameer et al., 2017; Kılınç et al., 2020), and ginger (Saeid et al., 2010) in poultry. In this review, general information about phytobiotics was given and their effects on productive and performance parameters in poultry nutrition were presented in poultry.

2. Effects of phytobiotics on productive and reproductive performance in poultry

Reproductive performance is very important for sustainability in livestock breeding (Mihaylova et al., 2020). There are many studies on production and reproductive performance in poultry. It has been reported that the phytobiotics have improved some production parameters (Roofchaee et al., 2011; Omer et al., 2019; Abo-Ghanima et al., 2020; Feng et al., 2021; Meligy et al., 2023) and reproductive performance parameters (Radwan-Nadia et al., 2008; 2008; Saeid et al., 2011; Şimşek et al., 2015; El-Hindawy et al., 2021; Ndzi et al., 2022). The effects of some phytobiotics on production and reproductive performance are summarized in poultry nutrition (Table 2).

Table 2. Effects of phytobiotics on productive and reproductive performance in poultry

Phytobiotic	Poultry	Dose	Effects	References
Oregano Thyme Rosemary Turmeric	Laying hens	0, 0.5, and 1%	-Increased the fertility (1% oregano, 1% rosemary, 0.5% turmeric) - Increased the percentages of hatchability of fresh eggs (1.0% thyme and 0.5-1.0% turmeric)	Radwan-Nadia et al. (2008)
Satavari Ashwagandha	Quail	0, 0.5, 1, and 1.5%	- Positive effecs on age at sexual maturity, hatchability, fertility	Bhardwaj (2009)
Oregano	Broiler	0, 300, 600, and 1200 mg/kg	- Increased body weight gain (600 mg/kg EO in grower diet) - Improved feed conversion ratio	Roofchaee et al. (2011)
Cinnamon Ginger	Broiler (Breeder male)	0, 500, and 1000 mg/L of drinking water	- Increased sperm concentration and movements - Increased ejaculate volume (ml) - Decreased abnormal sperm (%)	Mohammed and Amin (2019)
Oregano Thyme	Quail	0, 1 g/kg thyme, oregano, and mix (0.5 g/kg)	- Increased fertility (%) (oregano-supplemented group) - Increased egg number and egg mass in all experimental periods (thyme-supplemented group) - Improved FCR (thyme and thyme + oregano)	El-Hindawy et al. (2021)
Oregano	Laying hens	0, 100, 200, and 400 mg/kg	- Improved feed conversion ratio (200 mg/kg EO)	Feng et al. (2021)
Garlic Ginger Euphorbia Moringa Thyme	Hen	0.5, and 1% (garlic, ginger, thyme) 0.75, and 1.5% (euphorbia) 2.5, and 5% (moringa)	- Increased chick body weight at hatching (1% thyme-supplemented group)	Ndzi et al. (2022)
Oregano Cinnamon Clove	Broiler	0, 200, 300, and 400 mg/kg	- Improvemet in feed conversion ratio and body weight gain	Meligy et al. (2023)

2. Conclusions

Due to the prohibition of the use of antibiotics in animal nutrition, producers and researchers have turned to natural alternative sources. Phytobiotics, one of them, have a very important place because they are natural and more reliable. Many studies have shown that different plants

have positive effects on productive and reproductive performance. It is thought that it would be beneficial to determine the most effective dose and toxicity studies of plant-originated additives.

References

Abdulameer, Y.S., Husain, F., Al-cekal, S.H.A., 2017. Efficacy of *Ziziphus mauritiana* leaves extract as antibiotic alternatives in broiler chicken. *Journal of Entomology and Zoology Studies*, 5(5): 742-746.

Abo-Ghanima, M.M., Elsadek, M.F., Taha, A.E., Abd El-Hack, M.E., Alagawany, M., Ahmed, B.M., Elshafie, M.M., El-Sabrout, K., 2020. Effect of housing system and rosemary and cinnamon essential oils on layers performance, egg quality, haematological traits, blood chemistry, immunity, and antioxidant. *Animals*, 10(2): 245.

Alagawany, M., El-Hack, A.M.E., 2015. The effect of rosemary herb as a dietary supplement on performance, egg quality, serum biochemical parameters, and oxidative status in laying hens. *Journal of Animal and Feed Sciences*, 24(4): 341-347.

Alghirani, M.M., Chung, L.T., Jesse, F.A., Sazili, A.Q., Loh, T.C., 2021. Could phytobiotics replace antibiotics as feed additives to stimulate production performance and health status in poultry? An overview. *Journal of Advanced Veterinary Research*, 11(4): 254-265.

Ayalew, H., Zhang, H., Wang, J., Wu, S., Qiu, K., Qi, G., Tekeste, A., Wassie, T., Chanie, D., 2022. Potential feed additives as antibiotic alternatives in broiler production. *Frontiers in Veterinary Science*, 9: 916473.

Bhardwaj, R.K., 2009. Study on efficiency of shatavari and ashwagandha root powder supplementation on production, reproduction and carcass traits of Japanese quails. Ph.D. Thesis submitted to Govind Ballabh University of Agriculture and Technology, Pantnagar. Uttarakhand, India.

Campos-Vega, R., Oomah, B.D., 2013. Chemistry and classification of phytochemicals. *Handbook of Plant Food Phytochemicals*, 5-48.

Diarra, M.S., Malouin, F., 2014. Antibiotics in Canadian poultry productions and anticipated alternatives. *Frontiers in Microbiology*, 5: 282.

Ekine, O.A., Udoudo, E.F., George, O.S., 2020. Influence of turmeric (*Curcuma longa*) as feed additive on the performance, serum enzymes and lipid profile of broiler chickens. *Nigerian Journal of Animal Science*, 22(2): 57-63.

El-Hindawy, M.M., Alagawany, M., Mohamed, L.A., Soomro, J., Ayasan, T., 2021. Influence of dietary protein levels and some cold pressed oil supplementations on productive and reproductive performance and egg quality of laying Japanese quail. *Journal of the Hellenic Veterinary Medical Society*, 72(3): 3185-3194.

Farhadi, M., Hedayati, M., Manafi, M., Khalaji, S., 2020. Influence of using sage powder (*Salvia Officinalis)* on performance, blood cells, immunity titers, biochemical parameters and small intestine morphology in broiler chickens. *Iranian Journal of Applied Animal Science*, 10(3): 509-516.

Feng, J., Lu, M., Wang, J., Zhang, H., Qiu, K., Qi, G., Wu, S., 2021. Dietary oregano essential oil supplementation improves intestinal functions and alters gut microbiota in late-phase laying hens. *Journal of Animal Science and Biotechnology*, 12(1): 1-15.

Friedman, M., Henika, P.R., Mandrell, R.E., 2002. Bactericidal activities of plant essential oils and some of their isolated constituents against *Campylobacter jejuni*, *Escherichia coli*, *Listeria monocytogenes*, and *Salmonella enterica*. *Journal of Food Protection*, 65(10): 1545-1560.

Ghanem, H.M., Mahmoud, R.E.S., Gadalla, H.E.S., Ibrahim, S.S., 2021. Egg productive performance, serum lipid profile and economic efficiency of laying hen fed different levels of cinnamon oil supplemented diet. *Adv. Anim. Vet. Sci*, 9(12): 2014-2020.

Gheisar, M.M., Kim, I.H., 2018. Phytobiotics in poultry and swine nutrition–a review. *Italian Journal of Animal Science*, 17(1): 92-99.

Heydarian, M., Ebrahimnezhad, Y., Meimandipour, A., Hosseini, S.A., Banabazi, M.H., 2020. Effects of dietary inclusion of the encapsulated thyme and oregano essential oils mixture and probiotic on growth performance, immune response and intestinal morphology of broiler chickens. *Poultry Science Journal*, 8(1): 17-25.

Idris, N.A., Yasin, H.M., Usman, A., 2019. Voltammetric and spectroscopic determination of polyphenols and antioxidants in ginger (*Zingiber officinale* Roscoe). *Heliyon*, 5(5).

Khaidem, A., Zuyie, R., Haque, N., Vidyarthi, V.K., 2019. Effect of garlic supplementation on performance, carcass traits and blood profile of broiler chicken. *International Journal of Bio-resource and Stress Management*, 10(3): 292-297.

Khaksar, V., Van Krimpen, M., Hashemipour, H., Pilevar, M., 2012. Effects of thyme essential oil on performance, some blood parameters and ileal microflora of Japanese quail. *The Journal of Poultry Science*, 49(2): 106-110.

Kılınç, G., Sezener, M.G., Gülhan, T., 2020. Yumurtacı tavuklarda hünnap (*Zizyphus jujuba* Mill.) yaprak ekstraktının ince bağırsak mikroflorası ve bazı kan parametreleri üzerine etkileri. *Uluslararası Tarım ve Yaban Hayatı Bilimleri Dergisi*, 6(1): 91-99.

Kılınç, G., 2023. The Effects of ashwagandha (*Withania somnifera*) root powder on performance, egg quality and yolk lipid oxidation in laying hens. *Journal of Anatolian Environmental and Animal Sciences*, 8(1): 37-41.

Kılınç, G., Yalçın, S., Yalçın, S., 2023. Effects of supplemental dried wild leek (*Allium scorodoprasum* L. subsp. *rotundum*) leaves on laying performance, egg quality characteristics, and oxidative stability in laying hens. *Tropical Animal Health and Production*, 55(3): 169.

Kumari, P., Kumari, C., Singh, P.S., 2017. Phytochemical screening of selected medicinal plants for secondary metabolites. *Int. J. Life. Sci. Scienti. Res*, 3(4): 1151-1157.

Martins, N., Petropoulos, S., Ferreira, I.C., 2016. Chemical composition and bioactive compounds of garlic (*Allium sativum* L.) as affected by pre-and post-harvest conditions: A review. *Food Chemistry*, 211: 41-50.

Mehdipour, Z., Afsharmanesh, M., Sami, M., 2013. Effects of dietary synbiotic and cinnamon (*Cinnamomum verum*) supplementation on growth performance and meat quality in japanese quail. *Livestock Science*, 154(1-3): 152-157.

Meligy, A.M., Abd El-Hamid, M.I., Yonis, A.E., Elhaddad, G.Y., Abdel-Raheem, S.M., El-Ghareeb, W.R., Mohamed, M.H.A., Ismail, H., Ibrahim, D., 2023. Liposomal encapsulated oregano, cinnamon, and clove oils enhanced the performance, bacterial metabolites antioxidant potential, and intestinal microbiota of broiler chickens. *Poultry Science*, 102(6): 102683.

Mihaylova, D., Krastanov, A., Vasilev, N., 2020. Non-hormonal feed additives as an alternative in animal reproduction. *Trakia Journal of Sciences*, 18(4): 405-411.

Mimica, D.N., Bozin, B., 2008. Mentha L. species (Lamiaceae) as promising sources of bioactive secondary metabolites. *Current Pharmaceutical Design*, 14(29): 3141-3150.

Miraj, S., Kiani, S. 2016. Study of pharmacological effect of *Mentha pulegium*: A review. *Der Pharmacia Lettre*, 8(9): 242-5.

Mohammed, A.Q., Amin, A.M.Q.H., 2019. Effects of supplementation cinnamon cassia and zingiber officinale powder on reproductive performance of broiler breeder male. *Plant Arch.*, 19: 567.

Mortezayi, A., Mamouei, M., Erfani Majd, N., Ghorbani, M.R., 2020. Effect of using sage extract after experimental copper poisoning on performance and blood metabolites of Japanese quail. *Animal Production*, 22(1): 143-151.

Nagar, A., Pandey, R., Singh, A.K., Thakur, R., 2021. Impact of dietary supplementation of Shatavari (*Asparagus racemosus*) and ashwagandha (*Withania somnifera*) root powder on performances in broilers. *Journal of Animal Research*, 11(2): 333–339.

Ndzi, N.H., Christian, K.T., Tennyson, N.G., Jacob, K., Ndamukong, N., 2022. Reproductive performance of the cameroon kabir chicken fed natural feed additives. *ASRIC Journal on Agricultural Sciences*, 26.

Oliviero, M., Romilde, I., Beatrice, M.M., Matteo, V., Giovanna, N., Consuelo, A., Claudio, C., Giorgio, S., Filippo, M., Massimo, N., 2016. Evaluations of thyme extract effects in human normal bronchial and tracheal epithelial cell lines and in human lung cancer cell line. *Chemico-Biological Interactions*, 256: 125-133.

Omer, H.A., Ahmed, S.M., Abdel-Magid, S.S., El-Mallah, G.M., Bakr, A.A., Abdel Fattah, M.M., 2019. Nutritional impact of inclusion of garlic (*Allium sativum*) and/or onion (*Allium cepa* L.) powder in laying hens' diets on their performance, egg quality, and some blood constituents. *Bulletin of the National Research Centre*, 43: 1-9.

Omolere, A.B.M., Alagbe, J.O., 2020. Probiotics and medicinal plants in poultry nutrition: A review. *Int J Fam Med Prim Care.*, 1(4): 1020.

Pandey, A.K., Kumar, P., Saxena, M.J., 2019. Feed additives in animal health. *Nutraceuticals in Veterinary Medicine*, 345-362.

Panpatil, V.V., Tattari, S., Kota, N., Nimgulkar, C., Polasa, K., 2013. *In vitro* evaluation on antioxidant and antimicrobial activity of spice extracts of ginger, turmeric and garlic. *Journal of Pharmacognosy and Phytochemistry*, 2(3): 143-148.

Parham, S., Kharazi, A.Z., Bakhsheshi-Rad, H.R., Nur, H., Ismail, A.F., Sharif, S., Krishna, S. R., Berto, F., 2020. Antioxidant, antimicrobial and antiviral properties of herbal materials. *Antioxidants*, 9(12): 1309.

Prabakar, G., Gopi, M., Karthik, K., Shanmuganathan, S., Kirubakaran, A., Pavulraj, S., 2016. Phytobiotics: could the greens inflate the poultry production. *Asian Journal of Animal and Veterinary Advances*, 11(7): 383-392.

Radwan-Nadia, L., Hassan, R.A., Qota, E.M., Fayek, H.M., 2008. Effect of natural antioxidant on oxidative stability of eggs and productive and reproductive performance of laying hens. *International Journal of Poultry Science*, 7(2): 134-150.

Rafeeq, M., Bilal, R.M., Batool, F., Yameen, K., Farag, M.R., Madkour, M., Elnesr, S.S., El-Shall, N.A., Dhama, K., Alagawany, M., 2023. Application of herbs and their derivatives in broiler chickens: a review. *World's Poultry Science Journal*, 79(1): 95-117.

Redondo, L.M., Chacana, P.A., Dominguez, J.E., Fernandez Miyakawa, M.E., 2014. Perspectives in the use of tannins as alternative to antimicrobial growth promoter factors in poultry. *Frontiers in Microbiology*, 5, 118.

Roofchaee, A., Irani, M., Ebrahimzadeh, M.A., Akbari, M.R., 2011. Effect of dietary oregano (*Origanum vulgare* L.) essential oil on growth performance, cecal microflora and serum antioxidant activity of broiler chickens. *African Journal of Biotechnology*, 10(32): 6177-6183.

Saeid, J.M., Mohamed, A.B., Al-Baddy, M.A., 2010. Effect of aqueous extract of ginger (*Zingiber officinale*) on blood biochemistry parameters of broiler. *International Journal of Poultry Science*, 9(10): 944-947.

Saeid, J.M., Shanoon, A.K., Marbut, M.M., 2011. Effects of *Zingiber officinale* aqueous extract on semen characteristic and some blood plasma, semen plasma parameters in the broilers breeder male. *International Journal of Poultry Science*, 10(8): 629-633.

Sevim, B., Olgun, O., Kılınç, G., Yavuz, M., 2023. Yumurtacı bıldırcın (*Coturnix coturnix japonica*) karma yemlerine farklı formlarda biberiye esansiyel yağı ilavesinin performans, yumurta kalitesi ve yumurta antioksidan özellikleri üzerine etkisi. *Osmaniye Korkut Ata Üniversitesi Fen Bilimleri Enstitüsü Dergisi*, 6(2): 1579-1588.

Sharma, S., Ghataury, S.K., Sarathe, A., Dubey, G., Parkhe, G., 2019. *Curcuma angustifolia* Roxb, (Zingiberaceae): Ethnobotany, phytochemistry and pharmacology: A review. *Journal of Pharmacognosy and Phytochemistry*, 8(2): 1535-1540.

Singh, A., Rani, R., Sharma, M., 2018. Medicinal herbs of Punjab (India). In *Biol. Forum*, 10: 10-27.

Şimşek, Ü.G., Ciftci, M., Özçelik, M., Azman, M.A., Tonbak, F., Özhan, N., 2015. Effects of cinnamon and rosemary oils on egg production, egg quality, hatchability traits and blood serum mineral contents in laying quails (*Coturnix coturnix Japonica*). *Ankara Üniversitesi Veteriner Fakültesi Dergisi*, 62(3): 229-236.

Toledano, M.M.Á., Merinas-Amo, T., Fernández-Bedmar, Z., Font, R., del Río-Celestino, M., Pérez-Aparicio, J., Moreno-Ortego, A., Alonso-Moraga, A., Moreno-Rojas, R., 2019. Physicochemical characterization and biological activities of black and white garlic: In vivo and in vitro assays. *Foods*, 8(6): 220.

Tzima, K., Makris, D., Nikiforidis, C.V., Mourtzinos, I., 2015. Potential use of rosemary, propolis and thyme as natural food preservatives. *J. Nutr. Health*, 1(6).

Willis, S., Sunkara, R., Hester, F., Shackelford, L., Walker, L.T., Verghese, M., 2019. Chemopreventive and anti-inflammatory potential of select herbal teas and cinnamon in an in-vitro cell model. *Food and Nutrition Sciences*, 10(9): 1142-1156.

Zahra, G., Maryam, T., Sara, S., Amir, M., Sayed, M., 2013. Healthful characteristics of pennyroyal essential oil. *Journal of Paramedical Sciences*, 4(4): 102-107.

To Cite: Özkök, A.O., 2023. The Effects of Plant-Based Feed Additives on Productive and Reproductive Performans in Poultry. *MAS Journal of Applied Sciences*, 8(4): 830–838.
DOI: http://dx.doi.org/10.5281/zenodo.8411096.