



ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; SP-11(6): 1908-1911
© 2022 TPI
www.thepharmajournal.com
Received: 09-04-2022
Accepted: 12-05-2022

Hemant Kumar JEDIYA
Ph.D. Scholar, Department of Animal Nutrition, College of Veterinary and Animal Science, Navania, Udaipur, Rajasthan University of Veterinary and Animal Sciences, Bikaner, Rajasthan, India

Monika Joshi
Assistant Professor and Incharge, Department of Animal Nutrition, College of Veterinary and Animal Science, Navania, Udaipur, Rajasthan University of Veterinary and Animal Sciences, Bikaner, Rajasthan, India

SK Sharma
Professor and Head, Department of Veterinary Medicine, College of Veterinary and Animal Science, Navania, Udaipur, Rajasthan University of Veterinary and Animal Sciences, Bikaner, Rajasthan, India

ML Gurjar
Assistant Professor, Department of Livestock Production and Management, College of Veterinary and Animal Science, Navania, Udaipur, Rajasthan University of Veterinary and Animal Sciences, Bikaner, Rajasthan, India

Hakim Manzer Aalam
Assistant Professor, Department of Veterinary Parasitology, College of Veterinary and Animal Science, Navania, Udaipur, Rajasthan University of Veterinary and Animal Sciences, Bikaner, Rajasthan, India

Kamal Purohit
Assistant Professor and Incharge, Department of Veterinary Pathology, College of Veterinary and Animal Science, Navania, Udaipur, Rajasthan University of Veterinary and Animal Sciences, Bikaner, Rajasthan, India

Corresponding Author
Hemant Kumar JEDIYA
Ph.D. Scholar, Department of Animal Nutrition, College of Veterinary and Animal Science, Navania, Udaipur, Rajasthan University of Veterinary and Animal Sciences, Bikaner, Rajasthan, India

Effect of phytobiotic feed additives garlic (*Allium sativum*), Ashwagandha (*Withania somnifera*) and Shatavari (*Asparagus racemosus*) on haematology in broiler chicks

Hemant Kumar JEDIYA, Monika Joshi, SK Sharma, ML Gurjar, Hakim Manzer Aalam and Kamal Purohit

Abstract

The present study was planned and carried out to ascertain the efficiency of different levels of Garlic powder, Ashwagandha root powder and Shatavari root powder alone and in combination as alternatives to antibiotic growth promoters in broiler ration to improve the performance of broiler chicks. A feeding trial of 42 days was conducted using 300, day-old broiler chicks (Cobb-400) randomly distributed in completely randomized design. The broiler chicks were divided randomly into ten treatment groups with three replicates under each treatment. The T₁ i.e. control group was fed on basal diet, while T₂ was supplemented with Oxy tetra cycline (OTC) powder @ 0.1g/kg feed. T₃ and T₄ were served as Basal diet supplemented with Garlic powder @ 0.75% and @ 1.50%. T₅ and T₆ were served as Basal diet supplemented with Ashwagandha root powder @ 0.75% and @ 1.50%. T₇ and T₈ were served as Basal diet supplemented with Shatavari root powder @ 0.75% and @ 1.50%. T₉ was served as Basal diet supplemented with Garlic powder @ 0.25%, Ashwagandha root powder @ 0.25% and Shatavari root powder @ 0.25%. T₁₀ was served as Basal diet supplemented with Garlic powder @ 0.50%, Ashwagandha root powder @ 0.50% and Shatavari root powder @ 0.50%. The supplementation of Garlic powder, Ashwagandha root powder and Shatavari root powder alone and in combination had highly significant ($P < 0.01$) effect was observed on Hb, PCV, TEC, TLC, Lymphocyte, Monocyte, heterophils, Eosinophil, Basophil, H/L ratio, albumin, globulin, total protein, A/G ratio, glucose, triglyceride, Cholesterol, AST, ALT, creatinine.

Keywords: Broiler, garlic, ashwagandha, shatavari, oxy tetra cycline (OTC)

Introduction

Feed is a significant segment, influencing net income from the poultry business, in light of the fact that 80% of the absolute consumption is in term of money spent on feed buy (Asghar *et al.*, 2000; Farooq *et al.*, 2002) [8, 17]. The poultry production systems have led to marked increase in the production of poultry meat and eggs worldwide (Baker & Armstrong, 1986) [9]. It has triggered the discovery and widespread use of a number of "feed additives". The main objective of adding feed additives is to boost animal performance by increasing their growth rate, better feed conversion efficiency, greater livability and lowered mortality in poultry birds. These feed additives are termed as "growth promoters" and often called as non-nutrient feed additives (Singh and Panda, 1992) [43]. Growth promoters broadly can be categorized as Antibiotic growth promoters (AGP) and Non-Antibiotic growth promoters (NAGP). Antibiotic growth promoters have been helpful in improvement of growth performance and feed conversion ratio in poultry (Miles *et al.*, 2006; Dibner and Buttin, 2002 and Izat *et al.*, 1990) [29, 16, 22]. However, constant treatment of poultry by antibiotic may result in residues of these substances in poultry products and bacteria resistance against treatments in human body. Due to such threats to human health, use of antibiotics in poultry is banned in many countries (Owens *et al.*, 2008; Alcicek *et al.*, 2004; Botsoglou and Fletouris 2001 and Hinton, 1988) [35, 4, 13]. To mitigate the growth deficit, solutions to AGP (Antibiotic growth promoters) need to be sought. Herbs and their components have been recognized since ancient times with their varying degrees of antimicrobial action, (Juven *et al.*, 1994) [24]. More recently, extracts of medicinal plants have been developed and introduced as natural antimicrobials for use in food (Mau and Hsieh 2001) [28]. On the other hand use of NAGP (Non-Antibiotic Growth Promoters) is commonly regarded as favorable alternatives to AGP (Antibiotic Growth

Promoters) in poultry production. Addition of NAGP to feeds of poultry may have a number of beneficial effects, including rapid development of a healthy gut microflora and stabilization of digestion along with improved feed efficiency. Use of herbal plant is considered safe without side effects to improve bird's performance due to their suitability and choice, lower production costs, lower toxicity risk, minimal health hazards and environmental friendliness, herbs could be assumed to be used as feed additives (Devegowda 1996) [15].

Garlic (*Allium sativum*) is considered as wonder spice and medicine in Ayurveda due to its pharmacological effects attributed to its organo-sulphur compound allicin (Puvaca *et al.* 2013) [38]. Garlic possesses antibacterial, antifungal, antiparasitic, antiviral (Ankri and Mirelman 1999) [5]. It has antibacterial, antifungal, anti-inflammatory and hepatoprotective properties.

Ashwagandha contains many active principles such as withanolides, somnitalglucose, inorganic salt, with anone, dihydroxykaempferol-3 and rutinoides (Murthy *et al.*, 2009 and Pal *et al.*, 2012) [32, 36]. These active principles have been reported to possess immuno modulatory, general tonic, hepato-protective, anti-stress, growth promoter and antioxidant properties (Ansari *et al.*, 2008; Singh *et al.*, 2010; Kushwaha *et al.* 2012; Varma *et al.*, 2012) [6, 41, 27, 46] beside antibacterial and anti-fungal properties (Punetha *et al.*, 2010) [37].

Shatavari possesses nutritive, antistress, adaptogenic, immunomodulatory, galactogogue, anabolic and performance enhancing properties and are used in various medicinal preparations Shatavari is the one of most commonly used herb in traditional medicine due to presence of steroidal saponins and sapogenins in various part of plant (Krishana *et al.*, 2005) [26].

Material and Methods

This experiment was done on 300, day old chicks. Each bird was weighed individually on arrival and randomly distributed Ten different dietary treatments groups (T₁ – T₁₀) using completely randomized design (CRD). The body weight of chicks has kept similar in all the groups. Each random treatment has three replicates (R₁ –R₃) having 10 birds in each replicate. The feeding was done in three phases, broiler pre starter (0-7 days), broiler starter (8-21days) and broiler finisher (22-42 days). Diet T₁ served as control while diet T₂ was supplemented with Oxy tetra cycline (OTC) powder @ 0.1g/kg feed. T₃ and T₄ were served as Basal diet supplemented with Garlic powder @ 0.75% and @ 1.50%. T₅ and T₆ were served as Basal diet supplemented with Ashwagandha root powder @ 0.75% and @ 1.50%. T₇ and T₈ were served as Basal diet supplemented with Shatavari root powder @ 0.75% and @ 1.50%. T₉ was served as Basal diet supplemented with Garlic powder @ 0.25%, Ashwagandha root powder @ 0.25% and Shatavari root powder @ 0.25%.

T₁₀ was served as Basal diet supplemented with Garlic powder @ 0.50%, Ashwagandha root powder @ 0.50% and Shatavari root powder @ 0.50%.

Blood samples were collected from wing vein of each of the three randomly selected birds from each replication (nine birds/treatment) at 42 day of experiment for the estimation of different haemato-biochemical/ immunological parameters. Using an automated haematology analyzer, half of the blood was transferred to sterilized EDTA containing vacutainer tubes for the measurement of haemoglobin (Hb), packed cell volume (PCV). The residual blood sample was transferred to non-EDTA tubes for serum restoration. The serum was collected and processed for examination under deep freezing temperature, as per the normal protocol.

Results and Discussion

The effect of Garlic, Ashwagandha and Shatavari on Hematobiochemical Profile are shown in table-1 & II. It showed that supplementation of garlic, Ashwagandha and Shatavari alone and in combination at different levels as alternatives to Antibiotic growth promoters might have highly significant (P<0.01) effect on haemoglobin level, packed cell volume (%), Total Erythrocyte Count. The findings of the present research study are in accordance with the findings of Alagbe (2019) [3]; Dar *et al.*, (2014) [14]; Jameel *et al.*, (2014) [23]; Oleforuh-okoleh *et al.*, (2015) [34]; Khan *et al.*, (2017) [25]; Islam *et al.*, (2017) [21]; Singh *et al.*, (2019) [42] and Belal *et al.*, (2018) [10] who observed significant increase in Hb, PCV and TEC level in broilers fed Garlic supplemented diet as compared to control group. Similarly, Mushtaq *et al.*, (2012) [33]; Abdallah O.A. *et al.*, (2016) [1]; Singh *et al.*, (2016); Biswas *et al.*, (2020) [12] reported that significant increase in Hb, PCV and TEC level in broilers fed Ashwagandha supplemented diet as compared to control group. Similarly, Sashi Kant *et al.*, (2014) [40]; Rekhate *et al.*, (2010) [39]; Subaihawi (2021) [45]; reported that significant increase in Hb, PCV and TEC level in broilers fed Shatavari supplemented diet as compared to control group. Haemoprotective effect of *W. somnifera* in broiler chicks might have been due to its positive influence on haemopoiesis through stimulation of stem cell proliferation and increase in bone marrow cellularity (Aphale *et al.*, 1998; Mishra *et al.*, 2000) [7, 31]. Ashwagandha is also highly rich in iron content which might be a reason for the better availability of iron for hemoglobin synthesis. (Gupta and Rana, 2007) [19]. This positive effect of Hb, PCV and TEC may be attributed to the vital function of the bioactive compounds in the root of the plant that offers multiple health Asparagus benefits owing to containing flavonoids, phenolic, alkaloids, saponins, and tannins compounds, which own strong antioxidant properties (Minh *et al.* 2019) [30], hence higher values indicate a greater potential for these function and a better state of birds health, which reflects positively on increasing hematological attributes.

Table 1: Effect of garlic powder, ashwagandha root powder and shatavari root powder on haemoglobin, PCV and TEC in broiler chicks

Blood parameters	Treatment Groups										SEM
	T ₁	T ₂	T ₃	T ₄	T ₅	T ₆	T ₇	T ₈	T ₉	T ₁₀	
	C	0.1 g/Kg OTC	0.75% ASP	1.5% ASP	0.75% WSP	1.5% WSP	0.75% ARP	1.5% ARP	0.25% ASP + 0.25% WSP + 0.25% ARP	0.50% ASP + 0.50% WSP+0.50% ARP	
Hb (g/dl)	7.68 ^e	7.98 ^e	8.65 ^c	8.56 ^{cd}	8.90 ^{bc}	8.63 ^c	8.57 ^c	9.45 ^{ab}	9.57 ^a	9.60 ^a	0.186
PCV (%)	24.40 ^e	25.03 ^{de}	25.74 ^{cd}	26.01 ^c	26.53 ^b	26.38 ^{bc}	27.03 ^b	27.38 ^{ab}	27.91 ^a	28.35 ^a	0.409
TEC (10 ⁶ /cumm)	2.83 ^h	2.95 ^{gh}	3.10 ^{fg}	3.25 ^{ef}	3.35 ^{de}	3.43 ^d	3.40 ^d	3.74 ^{bc}	3.85 ^{ab}	3.95 ^a	0.055

Means with different superscripts in a row differ significantly

C= Control, OTC = Oxytetracycline, ASP= *Allium sativum* Powder

WSP = *Withania somnifera* Powder, ARP= *Asparagus racemosus* Powder

The statistical analysis of data on total leucocyte count, lymphocyte (%), monocyte (%), heterophils count, eosinophils count, basophils (%) and H/L ratio revealed highly significant ($P < 0.01$) effect of garlic, Ashwagandha and Shatavari powder alone and in combination. The findings of the present research study are in accordance with the findings of Ademola *et al.*, (2011) [2]; Latif *et al.*, (2013); Gharieb *et al.*, (2014) [18]; Belal *et al.*, (2018) [10] who observed significant increase TLC and Lymphocyte level in broilers fed Garlic supplemented diet as compared to control group. Similarly, Mushtaq *et al.*, (2012) [33]; Abdallah O.A. *et al.*, (2016) [1]; Singh *et al.*, (2016) who observed increase TLC and Lymphocyte level in broilers fed Ashwagandha supplemented diet as compared to control group. Similarly, Subaihawi (2021) [45]; reported that significant increase in TLC level in broilers fed Shatavari supplemented diet as compared to control group. Increased lymphocytes in

Ashwagandha treated groups are due to anti-stress activity of *W. somnifera*. (Bhardwaj *et al.*, 2012) [11] and Increase in TLC may be also due to stimulating effect of *W. somnifera* on the bone marrow Cells. (Bhardwaj *et al.*, 2012) [11]. This positive effect of TLC may be attributed to the vital function of the bioactive compounds in the root of the plant that offers multiple health Asparagus benefits owing to containing flavonoids, phenolic, alkaloids, saponins, and tannins compounds, which own strong antioxidant properties (Minh *et al.* 2019) [30], hence higher values indicate a greater potential for these function and a better state of birds health, which reflects positively on increasing hematological attributes. Increased lymphocytes in Ashwagandha treated groups are due to anti-stress activity of *W. somnifera*. (Bhardwaj *et al.*, 2012) [11] and Increase in TLC may be also due to stimulating effect of *W. somnifera* on the bone marrow Cells. (Bhardwaj *et al.*, 2012) [11]

Table 2: Effect of garlic powder, ashwagandha root powder and shatavari root powder on TEC, lymphocyte, monocyte, heterophils, eosinophils, basophils and h/l ratio in broiler chicks

Blood parameters	Treatment Groups										SEM
	T ₁	T ₂	T ₃	T ₄	T ₅	T ₆	T ₇	T ₈	T ₉	T ₁₀	
	C	0.1 g/Kg OTC	0.75% ASP	1.5% ASP	0.75% WSP	1.5% WSP	0.75% ARP	1.5% ARP	0.25% ASP + 0.25% WSP+ 0.25% ARP	0.50% ASP + 0.50% WSP+ 0.50% ARP	
TLC (10 ³ /cumm)	48.21 ^g	48.64 ^{fg}	49.93 ^{ef}	51.06 ^{de}	51.37 ^d	48.65 ^f	51.67 ^d	54.63 ^{bc}	55.61 ^{ab}	56.54 ^a	0.503
Lymphocyte (%)	52.14 ^f	55.04 ^c	57.10 ^{de}	57.65 ^d	57.89 ^d	59.48 ^{cd}	60.93 ^{bc}	61.38 ^b	62.07 ^{ab}	63.73 ^a	0.705
Monocyte (%)	5.62 ^e	5.89 ^{cd}	6.03 ^{bc}	6.17 ^{ab}	6.37 ^a	6.03 ^{bc}	5.89 ^{cd}	6.18 ^a	6.03 ^b	6.11 ^b	0.078
Heterophils (%)	38.34 ^a	35.18 ^b	33.03 ^c	32.41 ^{cd}	31.73 ^{de}	30.47 ^{ef}	29.13 ^{fg}	28.37 ^{gh}	27.81 ^{hi}	26.10 ^j	0.429
Eosinophils (%)	1.87 ^h	1.92 ^{sh}	2.01 ^{fg}	2.07 ^f	2.18 ^e	2.37 ^d	2.48 ^c	2.52 ^{bc}	2.60 ^{ab}	2.63 ^a	0.034
Basophils (%)	2.03 ^a	1.97 ^b	1.83 ^c	1.70 ^d	1.83 ^c	1.65 ^{de}	1.57 ^f	1.55 ^g	1.49 ^h	1.43 ⁱ	0.018
H/L ratio	0.73 ^a	0.63 ^b	0.57 ^c	0.56 ^{cd}	0.54 ^{de}	0.51 ^f	0.47 ^g	0.46 ^{gh}	0.44 ^{hi}	0.40 ^j	0.008

Means with different superscripts in a row differ significantly

C = Control, OTC = Oxytetracycline, ASP = *Allium sativum* Powder, WSP = *Withania somnifera* Powder, ARP = *Asparagus racemosus* Powder

Reference

1. Abdallah OA, Omnia Killany E, Heba El-gharib E, Raghda Mohamed F. Hematological and Growth Performance Studies after *Withania somnifera* Supplementation in Broilers. SCVMJ, 2016, 21(1).
2. Ademola SG, Sikiru AB, Akinwumi O, Olaniyi OF, Egbewande OO. Performance, yolk lipid, egg organoleptic properties and haematological parameters of laying hens fed cholestyramine and garlic oil. Global Veterinaria. 2011;6(6):542-546.
3. Alagbe JO, Oluwafemi RA. Performance and hematological parameters of broiler chicks given different levels of dried lemon grass (*Cymbopogon citratus*) and garlic (*Allium sativum*) extract. Research in: Agriculture and Veterinary Sciences. 2019;3(2):102-111.
4. Alcicek A, Bozkurt M, Cabuk M. The effect of a mixture of herbal essential oils, an organic acid or a probiotic on broiler performance. S. Afr. J Anim. Sci. 2004;34:217-222.
5. Ankari S, Mirelman D. Antimicrobial properties of allicin from garlic. Microbial infection. 1999;2:125-29.
6. Ansari JZ, Ahsan-ul-Haq, Muhammad Y, Ahmad T, Khan S. Evaluation of different medicinal plants as growth promoters for broiler chicks. J Agri. 2008;24:323-329.
7. Aphale AA, Chhiba AD, Kumbhkaran NR, Mateenuddin M, Dahat SH. Subacute toxicity study of the combination of Ginseng (*Panax ginseng*) and Ashwagandha (*Withania somnifera*) in rats: a safety assessment. Indian J Physiol. Pharmacol. 1998;42(2):299-302.
8. Asghar A, Farooq M, Mian MA, Khurshid A. Economics of broiler production in Mardan division. J Rural Dev. Adm. 2000;32(3):56-65.
9. Baker A, Armstrong E. Poultry and egg statistics. 1986, 1960-85, (No. 1487-2016-122425).
10. Belal SA, Uddin MN, Hasan MK, Islam MS, Islam MA. Effect of ginger (*Zingiber officinale*) and garlic (*Allium sativum*) on productive performance and hematological parameters of broiler. EPH-International Journal of Agriculture and Environmental Research. 2018;4(1):12-23.
11. Bhardwaj RK, Bhardwaj A, Gangwar SK. Efficacy of Ashwagandha (*Withania somnifera*) supplementation on hematological and immunological parameters of Japanese quails. Int. J Sci. Nat. 2012;3:476-478.
12. Biswas P, Sharma RK, Biswas A, Kar I. Effect of Ashwagandha (*Withania somnifera*) and Vitamin C on Hematological Profile and Carcass Traits of Broiler Birds. Int. J Curr. Microbiol. App. Sci. 2020;9(10):783-791.
13. Botsoglou NA, Fletouris DJ. Drug Residues in Foods: Pharmacology, Food Safety and Analysis. Marcel Dekker, Inc. Publ., New York, USA, 2001.
14. Dar SA, Verma P, Ashfaque M, Zargar AA, Mir IA. Effect of garlic extract on haemato biochemical changes in *Eimeria tenella* infected broiler chicken. National Academy Science Letters. 2014;37(4):311-316.
15. Devegowda G. Herbal medicines, an untapped treasure in poultry production. Proc. 20th World Poult. Congr. New Delhi, India. Fuller, R. Probiotics in man and animals. The J of applied bacteriology. 1996;66(5):365-378.

16. Dibner JJ, Buttin P. Use of organic acid as a model to study the impact of gut microflora on nutrition and metabolism. *J Appl. Poultry Res.* 2002;11:453-463.
17. Farooq M, Gul N, Chand N, Durrani FR, Khurshid A, Ahmed J, *et al.* Production performance of backyard chicken under the care of women in Charsadda, Pakistan. *Livest. Res. Rural Dev.* 2002;14(1):27-34.
18. Gharieb MM, Youssef FM. Effect of *Echinacea purpurea* and garlic on growth performance, immune response, biochemical and hematological parameters in broiler chicks. *Veterinary. Medicine. Journal.* 2014;60(140):218-228.
19. Gupta GL, Rana AC. *Withania somnifera* (Ashwagandha): A Review. *Pharmacognosy Reviews.* 2007;1:129-136.
20. Hinton MH. Antibiotics, poultry production and public health. *World Poultry Sci. J.* 1998;44:67-69.
21. Islam MF, Haque MN, Parvin A, Islam MN, Alam MN, Sikder MH. Effect of dietary supplementation of garlic on feed conversion ratio, carcass physiognomies and haematological parameters in broilers. *Bangladesh Journal of Veterinary Medicine.* 2017;15(1):7-11.
22. Izat AL, Colberg M, Reiber MA, Adams MH. Effects of different antibiotics on performance, processing characteristics, and parts yields of broiler chickens. *Poultry Sci.* 1990;69:1787-1791.
23. Jameel YJ, Abed AR, Al-Shimmmary FO. Influence of Adding Garlic and Thyme and their Combination on Immune Response and Some Blood Parameters in Broiler. *Sci. Agri.* 2014;6 (2):102-106.
24. Juven BJ, Kanner J, Schved F, amp Weisslowicz H. Factors that interact with the antibacterial action of thyme essential oil and its active constituents. *J of applied bacteriology.* 1994;76(6):626- 631.
25. Khan MSI, Prodhon MS, Islam MS, Hasan MN, Islam MS. Effect of garlic extract on growth performances and hematological parameters of broilers. *Asian Journal of Medical and Biological Research.* 2017;3(3):317-322.
26. Krishana L, Swarup D, Patra RC. An overview prospects of ethano-veterinary medicine in India. *Indian J Anim. Sc.* 2005;75(12):1481-1491.
27. Kushwaha S, Agatha B, Chawla P. Effect of ashwagandha (*Withania somnifera*) root powder supplementation in treatment of hypertension. *J Ethnobiol. Ethnomedicine.* 2012;6:111-115.
28. Mau JL, Chen CP, Hsieh PC. Antimicrobial effect of extracts from Chinese chive, cinnamon, and cornifrutus. *Journal of Agricultural and Food Chemistry.* 2001;49(1):183-188.
29. Miles RD, Butcher GD, Henry PR, Littell RC. Effect of antibiotic growth promoters on broiler performance, intestinal growth parameters, and quantitative morphology. *Poultry Sci.* 2006;85:476-485.
30. Minh NP, Them LT, Dang NC, Ho TP, Hieu NT, Luan LQ. Investigation of shoot size and drying *Asparagus officinalis* affecting to herbal tea production. *Journal of Pharmaceutical Sciences and Research.* 2019;11(2):267-272.
31. Mishra SJ Amp, Singh DS. Effect of feeding root powder of *Withania somnifera* (L.) Dunal (Aswagandha) on growth, feed consumption, efficiency of feed conversion and mortality rate in broiler chicks. *Bioved.* 2000;11(1/2):79-83.
32. Murthy SM, Mamatha B, Shivananda TN. Photochemistry and medicinal uses of *Withania somnifera* (L.) Dun. *Biomed.* 2009;4:123-129.
33. Mushtaq M, Durrani FR, Imtiaz N, Sadique U, Hafeez A, Akhtar S, *et al.* Effect of administration of *Withania somnifera* on some hematological and immunological profile of broiler chicks. *Pak Vet J.* 2012;32(1):70-72.
34. Oleforuh-Okoleh VU, Ndofor-Foleng HM, Olorunleke SO, Uguru JO. Evaluation of growth performance, haematological and serum biochemical response of broiler chickens to aqueous extract of ginger and garlic. *Journal of Agricultural Science.* 2015;7(4):167.
35. Owens B, Tucker L, Collins MA, McCracken KJ. Effects of different feed additives alone or in combination on broiler performance, gut microflora and ileal histology. *Brit. Poultry Sci.* 2008;49:202-212.
36. Pal A, Mahadeva N, Farhath K, Bawa AS. In-Vitro studies on the antioxidant assay profiling of root of *Withania somnifera* L. (Ashwagandha) Dunal. *Agric. Conspec. Sci.* 2012;77:95-101.
37. Punetha A, Muthukumaran J, Hemrom AJ, Arumugam N, Jayakanthan M, Sundar D. Towards understanding the regulation of rubber biosynthesis: Insights into the initiator and elongator enzymes. *J Bioinform. Seq. Anal.* 2010;2:1-10.
38. Puvaca N, Stanacev V, Glamocic D, Levic J, Peric L, Stanacev V, *et al.* Beneficial effect of phytoadditives in broilers nutrition. *World's Poultry Science Journal.* 2013;69:27-34.
39. Rekhate DHtyuop, Smita U, Mangle LN, Deshmukh BS. Effect of dietary supplementation of Shatavari (*Asparagus racemosus* wild) on heamato biochemical parameters of broilers. *Vet. World.* 2010;3(6):280-281.
40. Shashi Kant, Nazim Ali, Gulab Chandra, Riyaz Ahmad Siddique. Effect of shatavari and vitamin E on hemato-biochemical profile of broilers during winter season, *Veterinary World.* 2014;7(11):948-951.
41. Singh B, Chandan BK, Gupta DK. Chemistry of garlic (*Allium sativum*) with special reference to allin and alliin- a review. In: Effect of dietary inclusion of plant extracts on the growth performance of male broiler. *Poult. Sci.* 2010;S:43-S.
42. Singh J, Kaur P, Sharma M, Mehta N, Singh ND, Sethi APS, *et al.* Effect of combination of garlic powder with black pepper, cinnamon and aloe vera powder on the growth performance, blood profile and meat sensory qualities of broiler chickens. *Indian Journal of Animal Sciences.* 2019;89(12):1370-1376.
43. Singh KS, Panda B. Feed additives. *Poultry nutrition,* 1992, 134-143.
44. Singh VP, Sahu DS, Kumar S, Chauhan SH. Effect of dietary supplementation of ashwagandha (*Withania somnifera*), selenium and their combination on production performance of broiler chicks. *Trends in Biosciences.* 2017;10(19):3597-3602.
45. Subaihawi. Evaluation of the Efficacy of *Asparagus officinalis* (L.) Root Powder and Aqueous Extract on the Physiological and Immunological Performance of Broilers. *Indian Journal of Ecology.* 2021;48(5):1551-1556.
46. Varma N, Kataria M, Kumar K, Jyoti S. Comparative study of Lasparaginase from different cytotypes of *Withania somnifera* (L.) Dunal and its purification. *J Nat. Prod. Plant. Resours.* 2012;2:475-481.