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Response of broiler chicken to diets containing different mixture powder levels of red pepper and black pepper as natural feed additive

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Abstract: The effect of feeding different mixture powder levels of red and black pepper as natural feed additives on productive performance, carcass characteristics and economical efficiency were studied. A total of one hundred and sixty one-day old, unsexed (Ross-308) broiler chicks were randomly divided into four experimental groups. Each group was further subdivided into five replicates at the rate of eight chicks per pen in complete randomized design. The birds were fed on two basal diets (starter and finisher diet). The red pepper (*Capsicum annum.L*) and black pepper (*Piper nigrum*.L) were added in different mixture levels to the basal diets resulting in four experimental groups. The first group (A) fed on basal diets without feed additives (control diet). The other groups (B), (C) and (D) were fed on basal diets supplemented with different mixture powder levels of 0.4% (0.2% red pepper + 0.2% black pepper), 0.6% (0.3% red pepper + 0.3% black pepper) and 1% (0.5% red pepper + 0.5% black pepper) respectively. The experimental diets were fed for 6-weeks duration. Health of the stock and performance parameters were recorded. At the end of the experiment, the birds were slaughtered, dressed then used for different parameters and economical evaluation were calculated. The results showed that, the diet with 1% mixture powder of red and black peppers had significantly ($P<0.05$) heaviest body weight gain, higher feed intake, best feed conversion ratio, highest dressing percentage, highest percentage of commercial cuts (breast, drumstick and thigh) with the highest percentages of liver and gizzard. The birds fed with the control diet produced significantly ($P<0.05$) highest abdnominal fat percentage. The mortality rate was not significantly affected by the inclusion of mixture of red and black peppers powder in broiler diet. The highest profitability ratio (1.81) was obtained by the diet supplemented with 1% mixture powder level. It was concluded that using a mixture as feed additives at level 1% enhance the overall performance and carcass quality of broiler chicken.

Keywords: Red Pepper, Black Pepper, Mixture Performance, Carcass Characteristics, Broiler, Feed Additives

1. Introduction

Recently, supplementation of natural components in poultry ration to improve production performance is widely adopted in the world. Herbs, spices have received an increasing attention as possible growth promoters additives references. There is an evidence suggests that some of these components have different active substances [1]. Additionally, they can have many benefits for the health of broilers and function such as anti-oxidant [2], antimicrobial activity [3], enhancing digestion by stimulating endogenous enzymes [4]. Pepper Species, commonly used in diet and traditional medicine, were assessed for their anti-oxidant potential. Red pepper (*Capsicum annum* L.) comes from fruits in the capsicum family. It is rich in vitamin C and pro-vitamin A (B- in particular). It is very high in potassium, magnesium and iron. The substances that give hot peppers their heat is capsaicin and several related chemicals collectively called capsinoids [5, 6]. The ripe fruit of red pepper is used by humans as an appetizer and remedy arthritis, rheumatism, toothache and sore throat and skin condition [7]. Black pepper (*Piper nigrum* L.) is known as spices due to its pungent quality [8]. It is a flowering vine in the family Piperaceae, genus Piper. It is improves digestibility [9]. Piperine is one of compound of black pepper which has antiache effect [10]. Additionally, the bioactive molecule, piperine, present in pepper has major pharmacological impact on neuromuscular system,

exercises and it can help in digestion [11; 12]. Piperine enhances the thermogenesis of lipid and accelerates [13], energy metabolism in the body and also increases the serotonin and beta-endorphin production in the brain. On the other hand, black pepper can be used for stomach disturbances, bronchitis and cancer by impact germs and cause the stomach to increase the flow of digestive juice. There is conflict evidence about its role in cancer [14]. Many researchers that proved an increase in body weight and best feed conversion ratio when using herbal plants in broiler diets [12; 15]. On the other hand, research on the use of herbal mixtures in bird's diets has produced inconsistent results.

The objective of this study was intended to gain more information about the effect of using different mixture powder levels of red pepper and black pepper on performance and carcass quality of broiler chicks.

2. Materials and Methods

A total of 160 one-day old unsexed (Ross-308) broiler chicks were randomly subdivided into 4 experimental groups of 40 chicks. Each group was further subdivided into 5 replicates at the rate of 8 chicks per each. The chicks of each replicate were housed in a pen (1 square meter) in an open-sided deep litter house.

The red pepper (*Capsicum annum.L)* and black pepper (*Piper nigrum.L*) were purchased from local market, ground separately to a fine powder and then added in different mixture levels to basal diets resulting in four experimental groups. The first group (A) fed on basal diet without feed additives (control diet) the other groups (B), (C) and (D) were fed on basal diet supplemented with different mixture powder levels 0.4% (0.2% red pepper + 0.2% black pepper), 0.6% (0.3% red pepper + 0.3% black pepper) and 1% (0.5% red pepper + 0.5% black pepper) respectively. All the experimental diets were formulated to meet the nutrient requirements of broiler chicks according to [16] which was formulated from the local feed ingredients commonly used for poultry feeding in the Sudan. The experimental diets were fed for 6-weeks duration where two phases of feeding program involved in supplying starter (1-21 days of age) and finisher (22-42 days of age). Calculated analysis of the experimental basal diets was done according to feedstuff analysis outlined by [17], while determined chemical analysis was conducted by the method of [18]. Formulation and proximate analysis and calculated analysis for the experimental basal diets are shown in Tables (1 and 2) respectively, while chemical composition of the super concentrate used in the basal diets is shown in Table (3). Feed and water were offered ad-libitum. The light was continuous throughout of the experimental period. The performance of the experimental birds in term of feed intake, live weight gain and feed conversion ratio were recorded weekly. Health of the experimental stock and mortality rate were closely observed and recorded daily. At the end of 6^{th} week the experimental birds were individually weighed after overnight fast (except for water) then slaughtered without stunning. They were then scalded, manually plucked, washed and allowed to drain on wooden tables. Evisceration was performed by a ventral cut and visceral as well as thoracic organs were removed. After evisceration internal organs (heart, liver and gizzard) were removed, weighed individually and expressed as percentage of slaughtered weight. Eviscerated carcasses were weighed and then chilled in a refrigerator for 24 hours at 4^{o}C. Cold carcasses were recorded. All the slaughtered birds were used for dissection. The breast, thigh and drumstick of the left side of each carcass were dislocated, weighed and expressed as percentages of cold carcass weight. Statistical analyses were made by analysis of variance for a completely randomized design, according to [19].

Table (1). *Formulation and proximate analysis of the experimental basal diets (percent as fed).*

Ingredients (%)		Starter diet	Finisher diet
A:	Formulation:		
	Grain sorghum	51	63
	Wheat bran	7	5
	Groundnut meal	14	13
	Sesame meal	16	7
	Super concentrate	5	5
	Oyster shell	2.75	2.75
	Common salt	0.25	0.25
	Vegetable oil (corn)	4	4
	Total	100	100
B:	Determined analyses		
	Dry matter	96.40	94.63
	Crude protein (N% x 6.25)	23.00	20.69
	Ether extract	6.73	6.80
	Crude fibre	6.20	5.00
	Ash	9.94	7.86
	Nitrogen free-extract	50.53	53.75

Table (2). *Calculated analysis of the experimental basal diets dry matter basis (DM).*

Item	Starter diet	Finisher diet
Metabolizable energy (Kcal/kg)	3051	3138
Crude fat%	9.86	8.33
Crude protein%	23.12	20.09
Lysine%	1.14	1.05
Methionine%	0.52	0.43
Cystine%	0.33	0.27
Methionine + cystine%	0.87	0.71
Calcium%	1.10	0.93
Available phosphorus%	0.71	0.64
Caloric-protein ratio	132	156
ME Kcal/kg: protein %		

Metabolizable energy: calculated according to Ellis (1981)

Table (3). *Chemical composition of the super concentrate used in the experimental diets formulation (Hendrix broiler concentrate).*

Metabolizable energy	1900 (Kcal/kg)
Crude protein	32.00%
Lysine	11.00%
Methionine	2.80%
Methionine + cystine	2.25%
Calcium	8.00%
Available phosphorus	5.00%

3. Results

The effect of feeding different mixture powder levels of red and black peppers on broiler's performance is shown in Table (4). Final body weight, body weight gain, total feed intake and feed conversion ratio were increased significantly (P<0.05) as the mixture powder level of red and black peppers was increased. The diet with the highest mixture powder level (1%) recorded significantly (P<0.05) highest body weight gain and feed intake with the best feed conversion ratio compared to the other experimental diets. All the chicks were apparently health and the morality was not significantly affected by the experimental treatments.

Table (4). *The effect of feeding different mixture levels of red and black pepper on performance of broiler chicks (1-42 days).*

Parameter	A	B	C	D	SEM
Initial live weight (g/chick)	45.13	45.15	45.13	45.02	-
Final body weight (g/chick)	1743.30^{d}	1880.50^{c}	1984.12^{b}	2186.35^{a}	9.76
Body weight gain (g/chick)	1698.17^{d}	1835.35^{c}	1938.99^{b}	2141.33^{a}	9.65
Total feed intake (g/chick)	3498.23^{d}	3578.93^{c}	3742.25^{b}	4068.52^{a}	9.82
Feed conversion ratio	2.06^{a}	1.95^{b}	1.93^{c}	1.90^{d}	0.006
Mortality %	0.001	0.00	0.00	0.00	0.001^{NS}

A: Control (without feed additives)
B: 0.4% mixture powder (0.2% red pepper + 0.2% black pepper)
C: 0.6% mixture powder (0.3% red pepper + 0.3% black pepper)
D: 1.0% mixture powder (0.5% red pepper + 0.5% black pepper)
SEM: Standard error of the means
N.S. Not statistically significant (P>0.05)
Means on the same raw with the same superscripts are not significantly different (P>0.05).

Table (5) shows the effect of feeding different mixture powder levels of red and black peppers on carcass characteristic of the broilers. All the measured parameters were significantly (P<0.05) affected by the experimental treatments. The diet with (1%) mixture powder level gave significantly (P<0.05) highest hot and cold dressing percentages and highest commercial cuts percentages (breast, drumstick and thigh) compared to other experimental diets. Although, the differences between diets 0.4 and 0.6% mixture powder levels were insignificant (P>0.05) for all these values.

Table (5). *Means values for dressing carcass percentages and commercial cut of broiler carcasses.*

Parameters	A	B	C	D	SEM
Hot dressing percentage	68.32^{c}	69.20^{b}	69.80^{b}	70.03^{a}	0.16
Cold dressing percentage	67.81^{c}	68.73^{b}	69.22^{b}	69.81^{a}	0.11
Breast as % of cold carcass	24.52^{c}	25.73^{b}	25.91^{b}	26.25^{a}	1.26
Drumstick as % of cold carcass	14.29^{c}	15.50^{b}	15.83^{b}	16.25^{a}	0.24
Thigh as % of cold carcass	15.23^{c}	16.66^{b}	16.72^{b}	17.83^{a}	0.02

A: Control (without feed additives)
B: 0.4% mixture powder (0.2% red pepper + 0.2% black pepper)
C: 0.6% mixture powder (0.3% red pepper + 0.3% black pepper)
D: 1.0% mixture powder (0.5% red pepper + 0.5% black pepper)
SEM: Standard error of the means
Means on the same raw with the same superscripts are not significantly different (P>0.05).

Table (6) shows the effect of feeding different mixture powder levels of red and black peppers on abdominal fat and giblets (liver, heart and gizzard) as percentage of body weight. All the measured parameter were significant (P<0.05) except the heart percentage. The addition of mixture powder levels of red and black peppers to broiler diets significantly (P<0.05) decreased the abdominal fat percentage and increased the liver and gizzard percentages compared to the control diet.

Table (6). *Body weight and organ proportions of broiler chickens.*

Parameters	A	B	C	D	SEM
Final body weight (g/chick)	1743.30^{d}	1880.50^{c}	1984.12^{b}	2186.25^{a}	9.76
Abdominal fat as % of body weight	2.24^{a}	1.95^{b}	1.93^{b}	1.92^{b}	0.013
Liver as % of body weight	2.02^{b}	2.56^{a}	2.58^{a}	2.63^{a}	0.02
Heart as % of body weight	0.52	0.50	0.53	0.55	0.01^{NS}
Gizzard as % of body weight	2.23^{b}	2.57^{a}	2.59^{a}	2.66^{a}	0.03

A: Control (without feed additives)
B: 0.4% mixture powder (0.2% red pepper + 0.2% black pepper)
C: 0.6% mixture powder (0.3% red pepper + 0.3% black pepper)
D: 1.0% mixture powder (0.5% red pepper + 0.5% black pepper)
SEM: Standard error of the means
N.S. Not statistically significant (P>0.05)
Means on the same raw with the same superscripts are not significantly different (P>0.05).

Table (7) shows calculation of total cost, revenues and net profit for the experimental groups. The results obtained from the economic study indicated that, treatment (D) with 1% mixture powder level (0.5% red pepper + 0.5% black pepper) showed the highest profitability ratio (1.81) compared to the control group.

Table (7). *Total cost, revenues and net profit of broiler chicks fed on different mixture levels of red and black pepper.*

Parameters	A	B	C	D
Cost (SDG)				
Chick purchase	6.00	6.00	6.00	0.06
Management	4.00	4.00	4.00	4.00
Feed	11.70	11.75	11.85	12.00
Total cost	21.70	21.75	21.85	22.00
Revenues				
Average eviscerated carcass weight (kg)	1.19	1.30	1.38	1.53
Price (SDG/kg)	23.00	23.00	23.00	23.00
Total revenues	27.37	29.90	31.74	35.19
Net profit				
Total revenues	27.37	29.90	31.74	35.19
Total cost	21.70	21.75	21.85	22.00
Net profit / bird	5.67	8.15	9.89	13.19
Net profit / Kg meat	4.76	6.27	7.17	8.62
Profitability ratio/kg meat	1.00	1.31	1.50	1.81

(SDG):Sudanese pounds

4. Discussion

The effect of feeding graded mixture powder levels of red and black peppers on productive performance of broiler chicks is shown in Table (4). The inclusion of different mixture powder levels of red and black peppers significantly ($P<0.05$) enhanced the body weight, feed intake and feed conversion ratio in comparison with control diet. The diet with 1% mixture powder (0.5% red pepper + 0.5% black pepper) showed significantly the heaviest body weight gain and highest feed consumption with best feed conversion ratio among experimental treatments. These may be due to digestibility characteristics of black pepper included in the diet or it might be to the active compound (capsaicin) rich in vitamin C that improves feed consumption which is reflected on body weight improvement [20]. These results were in line with the finding of [21] who reported that, black pepper increases digestion through arousing digestive liquids of stomach and eradication infectious bacteria. It affects the absorption power, decrease material transit velocity and increase digestive enzymes acts and increased chicks dietary and weight gain. Additionally, [22] found that, according to the level of black pepper used that reflect the high activity of Piperazine citrate included in the broiler's diet which may have affected the flow of digestive juices across the stomach. These results are in agreement with those reported by [6] who stated that, chicks fed on hot pepper diets had significantly ($P<0.01$) higher body weight and digestion coefficient of crude protein, nitrogen free extract, total digestible nutrients and metabolizable energy than those fed the control diet. [23] confirms that, the carbohydrate oxidation rate was gradually increased after a meal containing hot pepper and there was significant difference between the hot pepper diet and control diet. The best feed conversion ratio that obtained by the birds fed with the highest mixture powder level (1%) may explained the growth improvement of this group as the result of increase in feed intake and superiored body weight gain in comparison with the other experimental groups. Additionally, this result can be explained by the finding of [24] who indicated that, the pungent compound of (*piper nigrum.L)* especially piperine increases the production of saliva and gastric secretion. Furthermore, the ingestion of peppercorn increases the production and activation of salivary amylase. The digestive enzymes production by the ingestion of (*piper nigrum.L)* probably stimulates liver to secrete bile, which further digests food substance [25, 26]. The experimental treatments had no significant effect on the mortality rate which was within the normal range (>3.33%). Birds were kept in clean disinfected environment following all hygiene regulation programs. The birds died in the experiment were not related to experimental treatments. The result coincided with the finding of [27] who reported that, red hot pepper powder at levels 1.5, 3, 6 and 12% of diet had no significant effect on mortality rate of broiler chicks. This result was confirmed by [6] who found that hot pepper fed to broiler chicks at dietary doses of 1, 1.5 and 2% had no any significant cumulative toxicity at doses administrated.

Table (5) showed the effect of feeding different mixture powder levels of red and black peppers on hot and cold dressing percentages and percentages of commercial cuts (breast, thigh and drumstick) of broilers. The birds fed on the highest mixture powder level (1%) of red and black peppers produced significantly ($P<0.05$) the highest hot and cold percentages while the control group produced the lowest percentages. Similar results have obtained by [20] who reported that, the inclusion of mixture of hot red pepper and black pepper at level 0.75 and 1% in the diets improved significantly ($P<0.05$) the dressing percentage of broilers. The percentages of commercial cuts (breast, drumstick and thigh) were significantly ($P<0.05$) effected by the addition of different mixture powder levels of red and black peppers to broiler diets. Birds fed on the highest mixture powder level (1%) produced significantly ($P<0.05$) the highest percentages of the commercial cuts (breast, thigh and drumstick) while the lowest percentages of these cuts produced by the control group. These results inline with the finding of [28] who stated that, drumstick and breast percentages were increased significantly ($P<0.05$) when broiler fed with mixture level of red and black peppers (0.01% red pepper + 0.01% black pepper) in the diet in comparison to control diet.

Table (6) showed the effect of feeding different mixture powder levels of red and black peppers on the percentages of abdominal fat and edible giblets (heart, liver and gizzard). The inclusion of different mixture powder levels of red and black peppers significantly ($P<0.05$) reduced the abdominal fat percentage. The highest percentage of abdominal fat recorded by the control diet. This result is in line with the finding of [28] who found that the lowest percentage of abdmominal fat was produced by the diet

with the mixture level of 0.2% (0.01% red pepper + 0.01% black pepper) in comparison with control diet. The inclusion of different mixture powder levels of red and black peppers significantly ($P<0.05$) improved the percentages of liver and gizzard with exception of the heart percentage which was insignificant. These results are in agreement with those reported by [28] who mentioned that, inclusion of mixture of red and black peppers at 0.2% level significantly increase the liver and gizzard percentages. This result disagreed with the finding of [19] who reported that, the inclusion of mixture of hot red pepper and black pepper had no significant ($P>0.05$) difference in the edible giblets (liver, heart and gizzard).

The economical evaluation indicated a highest economic values represented by the diet which is supplemented with the highest mixture powder level (1%) of red and black peppers. This might be due to the higher return of the weight gains recorded by this group of chicks.

In conclusion, the supplementation of mixture powder of red pepper and black pepper at level 1% enhanced growth, productive performance and meat quality of broiler chicken.

References

[1] Al-Kassie, G.A.M. and Witwit, N.M. (2010). A comparative study on diet supplementation with a mixture of herbal plants and dandelion as a source of prebiotics on the performance of broilers. Pakistan Journal. of Nutrition 9(1): 67-71.

[2] Hui, Y.H. (1996). Oleoresins and essential oils. In: Hui, YH, editor. Bailey's industrial oil and fat products. New York, Wiley-Interscience Publication, Cap. 6. pp: 145-153

[3] Dorman, H.J.D. and Deans, S.G. (2000). Antimicrobial agents from plants: Anti-bacterial activity of plant volatile oils. J. Appl. Microbiol., 88: 308-316.

[4] Brugalli, I. (2003). Alimentacao atlernativa: an utilizacao de fitoterapicos ou nutraceuticos comomoduladores da imunidade e desempenho animal. Anais do Simposio sobre Manejo e Nutr Cad de Aves e Suinos; Campinas, Sao Paulo., Brasil. Campainas: (BNA) pp. 167-182

[5] Boyunaga, H. and Celik (1995). Kirmiziaci biber (capsaicin) bitkiselilac kaynagi mi. Billi Teknik Tubitak (6): 331.

[6] El Husseiny, O., Shalash, S.M. and Azouz, H.M. (2002). Response of broiler performance to diets containing hot pepper and/or fenugreek at different metabolizable energy level. Egypt Poult. Sci. (11): 387-406.

[7] Tagelsir, K. (1995). Studies on capsicum frutescent. M.V.Sc. Thesis, University of Khartoum, Sudan.

[8] Hassan, M.S.H.; Abo Taleb, A.M.; Wakwak, M. and Yousef, B.A. (2007). Productive, physiological and immunological effects of using some natural feed additives in Japanese quail diets. Egyptian Poultry Science, J. 27(11): 557-588.

[9] Moorthy, M.; Ravikumar, S.; Viswanathan, K. and Edwin, S.C. (2009). Ginger, pepper and curry leaf powder as feed additive in broiler diet. Inter. Journal of Poultry Science, 8: 779-782.

[10] Mahady, G.B,.; Pendl, S.L.; Yun, G.S.; Lu, Z.Z. and Stoia (2008). A. ginger (Zingiber officinale) and the gingerols inhibit the growth of Cag A + sstrains of Helicobacter pylori. Anticancer Research, 23: 3699-3702.

[11] Ferreira, S.R.S.; Nikolov, Z.L.; Dorauswamy, L.K.; Meireles, M.A.A. and Petenate, A.J. (1999). Supercritical fluid extraction of black pepper (Piper nigrum) essential oil. J. Supercritical Fluids, 14: 235-245.

[12] Great, H.H. (2003). Plants and plant extracts for improving animal productivity. Proc. Nutr. Soc., 62: 279-290.

[13] Malini, T.; Arunakaran, J.; Aruldhas, M.M. and Govindarajulu, P. (1999). Effect of piperine on the lipid composition and enzymes of the pyruvatemalate cycle in the testis of the rat in vivio. Biochemistry and Molecular Biology International, 47: 537-545.

[14] Turner and Jack (2004). Black pepper and white pepper. http/en,Wikipedia; org/wiki/Black pepper.

[15] Iqbal, Z.; Nadeem, Q.K.; Khan, M.N. Akhtar, M.S. and Waraich, F.N. (2011). In vitro anthelmintic activity of Allium sativum, Zingiber officinale, Curcurbita mexicana and Ficus religiosa. Int. J. Agric. Bio., (3): 454-457.

[16] NRC (National Research Council) (1994). Nutrient requirements of poultry. (9th Rev. ed) National Academy Press, Washington, DC. U.S.A.

[17] Ellis, N. (1981). The nutrient composition of Sudanese animal feed. Bulletin 1: Northern and Central Sudan, Central Animal Nutrition Research Laboratory, Kuku Research Centre, Khartoum North, Sudan.

[18] AOAC (1995). Official methods of analysis (13th ed). Association of Official analytical Chemists, Inc. Washington, D.C., USA.

[19] Steel, R.G.D. and Torrie, J.H. (1986). Principles and procedures of statistics. A Biometrical Approach (2nd ed.) McGraw Hill Book Company, Ins. NY, USA.

[20] Al-Kassie, G.A.M., Ghassan, Y. Butris; Saba, J.A. and Ajeena, J. (2012). The potency of feed supplemented mixture of hot red pepper and black pepper on the performance and some hematological blood traits in broiler diet. International Journal of Advanced Biological Research, 2(1): 53-57.

[21] Hosseini, N.M. (2011). Comparison of using different levels of black pepper with probiotic on performance and serum composition on broilers chickens. J. Basic Appli. Sci. Res., 1(11): 2425-2428.

[22] Al-Kassie, G.A.M.; Mamdooh, A.M.; Al-Nasraw, Saba and Ajeena, J. (2011). Use of black pepper (Piper nigrum) as feed additive in broiler diet. Research Opinions in Animal and Veterinary Science, 1(3): 169-173.

[23] Yoshioka, M.; Lim, K.; Kikuzato, S.; Kiyonnage, A.; Tanka, H.; Shindo and Suzuki, M. (1995). Effect of red pepper diet on the energy metabolism in men. Journal of Nutrition Science and Vitaminnology. 41: 647-650.

[24] Herati and Marjuki (2011). Effect of feeding red ginger as phytobiotic on broiler slaughter weight and meat quality. Inter. J. Poult. Sci., 10(12): 983-986.

[25] Yoshikawa, M.S.; Yamagashi, K.; Kumini, H.; Matsuda, Y.; Okuno, J. and Urakami, N. (1994). Stomachic principle in a ginger-Anti-ulcer principle, 6-ginge-suflonic acid and three mono Acyl digalactosyglycerols ginger glycolipids A, B and C, from zingiber rhizome originating in Taiwan. Chem. Pharma. Bull. Tokyo, 2: 226-230.

[26] Sarica, S.A.; Ciftci, E.; Demir, K.; Kiline and Yildirim, Y. (1995). Use of antibiotic growth promoter and two herbal natural feed additives with and without exogenous enzymes in wheat based broiler diet. S. Afr. J. Anim. Sci., 35: 61-72.

[27] William, M. and Klenholz, W. (1974). The effect of chilli curry and black pepper powder in diet for broiler chicks. Poultry Science, 53:2232-2234.

[28] Shahverdi, A.; Kheiri, F.; Faghani, M.; Rahimian, Y. and Rafiee, A. (2013). The effect of use red pepper (Capsicum annum L.) and black pepper (Piper nigrum L.) on performance and hematological parameters of broiler chicks. Euro. J. Zool. Res., 2(6): 44-48.