Haryana Vet. (June, 2019) **58(1),** 51-55

Research Article

EFFECTS OF BLACK PEPPER, JAGGERY AND FEED RESTRICTION ON CHEMICAL COMPOSITION AND SENSORY EVALUATION OF BROILER'S MEAT

NAVJOT SINGH SIDHU, UDEYBIR SINGH* and A.P.S. SETHI
Department of Animal Nutrition,
Guru Anged Dev Veterinary and Animal Sciences University, Ludhiana-141004, India

Received: 07.03.2018; Accepted: 14.02.2019

ABSTRACT

A study was conducted to assess the effects of black pepper, jaggery supplementation and feed restrictions on chemical composition and sensory evaluation of broiler's meat. In this growth study, 480 chicks were distributed randomly into 8 treatments having total 60 birds per treatment (4 replicates x 15 chicks in each replicate). (T_1- Control group fed ad-libitum as per ICAR specification, T_2- T_1 with feed restriction (8-10 hrs), T_3 - T_1 with 0.5 % black pepper (BP) supplementation, T_4 - T_1 with 0.5 % black pepper supplementation with feed restriction (8-10 hrs), T_5 - T_1 with 1% jaggery supplementation, T_6 - T_1 with 1% jaggery supplementation with feed restriction (8-10 hrs), T_7 - T_1 with 0.5% black pepper and 1% jaggery supplementation, T_8 - T_1 with 0.5% black pepper and 1% jaggery supplementation with feed restriction). From each treatment group, 4 birds were sacrificed and sample of meat from breast and thigh muscle were taken and analyzed for chemical composition and sensory evaluation. Non significant ($Pe \geq 0.05$) effect of BP supplementation on moisture, crude protein and fat thigh muscle and breast muscle composition was observed. But, fat percentage of breast muscle in T_4 and T_8 was observed significantly ($Pd \leq 0.05$) lower as compared to control. Significant ($Pd \leq 0.05$) difference in colour was observed in BP supplemented groups. So, it was concluded that fat percentage of breast muscle is reduced due to BP supplementation with feed restriction and BP + jaggery supplementation with feed restriction.

Key words: Black pepper, Feed restriction, Jaggery, Sensory evaluation

The egg production in India has gone up to 70 billion and the broiler production has gone to 3.8 million tones with the growth of 10-12% in broilers and 6-8% in layers per year. A profitable poultry production depends on better feed utilization, faster body weight gain, absence of diseases and low mortality (Kathirvelan *et al.*, 2016). This enhanced growth due to ad-libitum feeding is unfortunately accompanied by certain ill-effects like high metabolic rate, high mortality, increased body fat etc. So, feed restriction strategies have been introduced to reduce these metabolic problems and hence improve economy of broiler production. The benefits of early feed restriction are the savings obtained by improved feed efficiency (Malpotra *et al.*, 2017) and reduced incidents of sudden death syndrome (Bhat and Banday, 2000).

Black pepper (BP) as a supplement in broiler's feed was found to improve feed digestibility (Singh, 2014). The active ingredient of BP is piperine which can dramatically increase absorption of selenium, vitamin B complex, β carotene and curcumin as well as other nutrients (Tazi *et al.*, 2014). Piperine enhances the thermogenesis of lipids and accelerates energy metabolism (Al-Kassie *et al.*, 2011), and have antimicrobial (Reddy *et al.*, 2004) and anti-inflammatory properties. BP has been found to have antioxidant properties (Mittal and Gupta, 2000) and anticarcinogenic effect, especially when combined with chili (Vijayakumar and Nalini, 2006). Jaggery (Gur) is the coarse unrefined, pure sugar made from sugarcane juice and also a good source of minerals. It contains 60-85% sucrose, 5-15% glucose and fructose and about 20% moisture. Keeping in mind, the importance of feed restriction, BP and jaggery supplementation, here an effort was made to study the individual effect as well as combined effect of black pepper and jaggery supplementation and feed restrictions on carcass traits and blood profile of broilers.

*Corresponding author: udeybirchahal@gmail.com

MATERIALS AND METHODS

480 day- old unsexed meat type chicks (Vencobb) were reared under normal conditions after vaccination and wing banded at 0 day of age. All the birds were weighed individually and allocated to different treatments after removing heavy and light weight birds. Whole experiment was conducted in three phases i.e. starter (1st-14th day), grower (15th-21st day) and finisher (22nd-35th day) phase. In this growth study, 480 chicks were weighed individually at 1 day of age and distributed randomly into 8 groups having total 60 birds per treatment with 4 replicates having 15 chicks in each replicate representing different treatments: T_1- Control group fed ad-libitum as per ICAR-2013 specification i.e. starter diet (1st-14th day) i.e. 22% CP and 3000 Kcal/Kg ME, grower diet (15th-21st day) i.e. 21.5% CP and 3050 Kcal/Kg ME and Finisher diet (22nd-35th day) i.e. 19.5% CP and 3100 Kcal/Kg ME, T_2-$T_1$with feed restriction (8-10 hrs), T_3-T_1 with 0.5% BP supplementation, T_4-T_1 with 0.5 % BP supplementation with feed restriction (8-10 hrs), T_5-T_1 with 1% jaggery supplementation, T_6-T_1 with 1% jaggery supplementation with feed restriction (8-10 hrs), T_7-T_1 with 0.5% BP and 1% jaggery supplementation and T_8- T_1 with 0.5% BP and 1% jaggery supplementation with feed restriction (8-10 hrs).

Eight broilers diets were formulated for the study for all the three phases i.e. starter (1st-14th day), grower (15th-21st day) and finisher (22nd-35th day) phase as presented in table 1. The percent ingredient composition of all the treatments was kept as per ICAR (2013) specifications. The feeders were removed from for 8-10 hours during 8 pm to 6 am (next day) to apply feed restriction. Ad-libitum watering was done throughout the experimental period. Different ingredients used to formulate the diets and different diets formulated (starter, grower and finisher) were analyzed (AOAC, 2000) for proximate principles, calcium and phosphorus.

At the end of feeding trial, 4 birds of comparable body weight (2 male and 2 female) from each treatment were selected. The birds were off-fed for overnight to empty the intestinal content and sacrificed to assess the effect of various dietary treatments on the dressing per cent, abdominal fat and development of various vital organs i.e. the heart, gizzard, liver and breast and thigh muscle composition. The sample of thigh and breast muscle was taken to assess the chemical composition of the meat. Percentage of moisture, fat and protein were estimated in meat. Meat samples from sacrificed birds were sent to Department of Livestock products and Technology, GADVASU where sensory evaluation was conducted by expert panel of 7 analysts on 8-point Hedonic scale.

RESULTS AND DISCUSSION

Chemical composition of meat: The data pertaining to various parameters of chemical composition of thigh and breast muscle in terms of percent moisture, crude protein and fat have been given in table 2 & 3.

Table 1
Feed composition of different dietary treatments of broilers

Treatments Ingredients (kg/100 kg)	T_0	T_1	T_2	T_3	T_4	T_5	T_6	T_7
Starter diet								
Maize	54.2	54.2	54.8	54.8	55.3	55.3	54.8	54.8
Soybean Meal	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0
Groundnut Extraction	6.0	6.0	6.5	6.5	7.0	7.0	7.0	7.0
De-oiled Rice Bran	3.0	3.0	1.4	1.4	-	-	-	-
Black Pepper	-	-	0.5	0.5	-	-	0.5	0.5
Jaggery	-	-	-	-	1	1	1	1
Oil	3.0	3.0	3.0	3.0	3.0	3.0	2.9	2.9
Di-calcium Phosphate	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7
Limestone Powder	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
Grower diet								
Maize	58.5	58.5	56.9	56.9	57	57	56.5	56.5
Soybean Meal	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0
Groundnut Extraction	5.0	5.0	5.5	5.5	5.5	5.5	5.5	5.5
Black Pepper	-	-	0.5	0.5	-	-	0.5	0.5
Jaggery	-	-	-	-	1	1	1	1
Oil	3.0	3.0	3.5	3.5	3.2	3.2	3.2	3.2
Di-calcium Phosphate	1.3	1.3	1.4	1.4	1.7	1.7	1.7	1.7
Limestone Powder	1.6	1.6	1.6	1.6	1.0	1.0	1.0	1.0
Finisher diet								
Maize	62.3	62.3	61.8	61.8	61.3	61.3	60.8	60.8
Soybean Meal	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5
Groundnut Extraction	4.0	4.0	4.0	4.0	4.5	4.5	4.5	4.5
De-oiled Rice Bran	1.5	1.5	1.5	1.5	1.0	1.0	1.0	1.0
Black Pepper	-	-	0.5	0.5	-	-	0.5	0.5
Jaggery	-	-	-	-	1.0	1.0	1.0	1.0
Oil	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
Di-calcium Phosphate	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Limestone Powder	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5

* Additives (600gm) include Vit A 8,25,000 IU, Vit D3 1,20,000 IU/, Vit K 100 mg, Riboflavin 500 mg, Thiamine 80 mg, Pyridoxine 160 mg, Vit E 800 mg, Cynacobalamine 100 mcg, Niacin 1200 mg, Calcium pantothenate 80 mg, Manganeese sulphate 25 g, Ferrous sulphate 10 g, Copper sulphate 500mg, Zinc oxide 8g Potassium Iodide 100 mg, Coccidiostat 60g, Methionine 100gm, Salt 300gm.

Table 2
Effect of feed restriction, black pepper & jaggery on muscle composition

Variable	Effect of Feed Restriction		Effect of Black Pepper		Effect of Jaggery	
	No	Yes	No	Yes	No	Yes
			Thigh muscle			
Moisture (%)	71.13±0.31	70.32±0.29	70.85±0.31	70.6±0.36	70.58±0.24	70.87±0.4
Crude Protein (%)	18.04±0.09	17.88±0.11	17.95±0.09	17.97±0.13	17.97±0.12	17.95±0.09
Fat (%)	7.95±0.08	7.81±0.06	7.91±0.08	7.85±0.07	7.95±0.06	7.82±0.08
			Breast muscle			
Moisture (%)	70.96±0.26	70.8±0.23	70.88±0.24	70.87±0.25	70.83±0.27	70.92±0.22
Crude Protein (%)	17.93±0.11	17.85±0.04	17.86±0.1	17.92±0.06	17.88±0.09	17.9±0.08
Fat (%)	8.01±0.06[a]	7.82±0.03[b]	7.97±0.06	7.86±0.05	7.92±0.06	7.91±0.05

a, b = Means bearing different superscripts in a row differ significantly (P<0.05)

Table 3
Combined effect of feed Restriction, black pepper & jaggery supplementation on muscle composition

Variable	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8
				Thigh muscle				
Moisture(%)	70.68±0.56	70.25±1.01	70.83±0.38	70.58±0.04	71.73±0.42	70.75±0.1	71.31±1.21	69.7±0.8
Crude Protein (%)	17.83±0.08	17.97±0.13	18.38±0.03	17.71±0.4	18.16±0.06	17.85±0.35	17.82±0.14	17.99±0.12
Fat (%)	8.08±0.14	7.92±0.05	8±0.1	7.81±0.17	7.9±0.25	7.76±0.22	7.84±0.26	7.77±0.08
				Breast muscle				
Moisture(%)	70.21±0.64	71.21±0.34	70.86±0.65	71.07±0.75	71.45±0.25	70.67±0.31	71.32±0.22	70.25±0.4
Crude Protein (%)	17.83±0.38	17.75±0.11	18.05±0.07	17.88±0.03	18.04±0.2	17.82±0.13	17.81±0.27	17.94±0.04
Fat (%)	8.14±0.18[a]	7.9±0.01[ab]	7.89±0.09[ab]	7.76±0.05[b]	7.98±0.12[ab]	7.88±0.07[ab]	8.05±0.07[ab]	7.74±0.03[b]

a, b = Means bearing different superscripts in a row differ significantly (P<0.05)

Effect of feed restriction on chemical composition of meat of broilers: The effect of feed restriction on thigh muscle composition and breast muscle composition were observed as represented in table 2. Moisture was not affected by feed restriction. Numerically lower crude protein (CP) and fat values for thigh muscle composition were observed but these were statistically non significant (Pe ≥ 0.05). Malpotra (2017) reported significantly higher CP in second week feed restriction as compared to control and other restriction groups. The carcass fat significantly (Pd ≤ 0.05) was lower in second week restriction group than other groups including control as reported by Malpotra (2017).

For breast muscle, CP was not affected by feed restriction conditions and decreased fat content were also observed for breast composition (Table 2). Malpotra (2017) observed that in breast muscle, CP gave non-significant results while fat was significantly decreased. These results are in line with the findings of Omosebi *et al.* (2014) who also found highest CP content and lowest crude fat content with 40% feed restriction for 6 weeks duration. Similar results were also observed by Butzen *et al.* (2015) with time restriction and Zhan *et al.* (2007).

Effect of black pepper on chemical composition of meat of broilers: Effect of BP on thigh muscle composition and breast muscle composition were observed as represented in table 2. Non significant (Pe ≥ 0.05) effect of black pepper supplementation on moisture, CP and fat thigh muscle and breast muscle composition was observed. However, numerically value of fat in groups with BP supplemented groups decrease but statistically it was non-significant.

Effect of jaggery on chemical composition of meat of broilers: As represented in table 2, effect of jaggery on thigh muscle composition and breast muscle composition were observed. However, values of groups with jaggery supplementation on moisture, crude protein and fat thigh muscle and breast muscle composition were differing non-significantly (Pe ≥ 0.05). No similar references were available but, Dhore *et al.* (2013) reported significantly higher weight when jaggery was supplemented in drinking water at the rate of 2g/l along with basal diet as compared to control.

Combined effect of feed restriction, black pepper & jaggery supplementation on meat composition of thigh muscle and breast muscle: As represented in table 3, no

Table 4
Effect of feed restriction, black pepper &jaggery on sensory parameters

Variable	Effect of Feed Restriction		Effect of Black Pepper		Effect of Jaggery	
	No	Yes	No	Yes	No	Yes
Color	6.98±0.06	7.06±0.07	7.11±0.07[b]	7.14±0.05[a]	7.03±0.07	7.01±0.06
Flavor	7.19±0.07	7.12±0.07	7.15±0.07	7.16±0.06	7.12±0.06	7.2±0.08
Texture	7.12±0.05	7.1±0.05	7.06±0.06	7.16±0.05	7.1±0.05	7.12±0.05
Juiciness	7.13±0.05	7.12±0.06	7.1±0.07	7.15±0.05	7.13±0.06	7.12±0.05
Overall	7.14±0.06	7.14±0.05	7.17±0.06	7.21±0.05	7.16±0.06	7.11±0.05

a, b = Means bearing different superscripts in a row differ significantly (P<0.05)

Table 5
Combined effect of feed Restriction, black pepper & jaggery supplementation on sensory parameters

Variable	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8
Color	6.84±0.14[b]	6.97±0.18[b]	7.19±0.09[a]	7.17±0.08[ab]	7.12±0.12[ab]	7.09±0.12[ab]	7.05±0.11[ab]	7.16±0.07[ab]
Flavor	7.18±0.11	6.91±0.13	7.23±0.11	7.16±0.11	7.3±0.2	7.22±0.13	7.06±0.12	7.2±0.17
Texture	7.03±0.1	7.09±0.14	7.21±0.08	7.07±0.09	7.06±0.13	7.05±0.08	7.18±0.1	7.17±0.11
Juiciness	7.11±0.15	7.22±0.16	7.13±0.05	7.07±0.12	7.17±0.1	6.91±0.1	7.12±0.12	7.27±0.08
Overall	7.07±0.14	7.12±0.12	7.25±0.1	7.21±0.1	7.07±0.11	7±0.1	7.17±0.11	7.21±0.11

a, b, c = Means bearing different superscripts in a row differ significantly (P<0.05)

significant (Pe ≥ 0.05) difference in moisture and crude protein was reported in thigh muscle and breast muscle due to feed restriction, BP and jaggery supplementation. Malpotra (2017) also concluded similar non significant results due to feed restriction. But, fat value of breast muscle in T4 (BP supplementation with feed restriction) and T8 (BP + jaggery supplementation with feed restriction) was observed significantly (Pd ≤ 0.05) lower as compared to control. Abou Elkhair *et al.* (2014) reported that dietary supplements with BP enhanced the performance and health status of broilers. But no significant (Pe ≥ 0.05) difference in fat values of thigh muscle was reported due to feed restriction, BP and jaggery supplementation.

Effect of feed restriction on sensory evaluation of meat: As shown in table 4, no significant (Pe ≥ 0.05) effect was observed in feed restricted groups as compared to non restricted groups on sensory parameters. Malpotra (2017) reported that odour was unaffected by feed restriction while colour, texture, juiciness and overall acceptability were found significantly higher for 2nd week feed restricted group as compared to control.

Effect of black pepper on sensory evaluation of meat: Significant (Pd ≤ 0.05) difference in colour was observed in BP supplemented groups. However non significant (Pe≥0.05) difference was observed in other sensory parameters like flavor, texture, juiciness and overall acceptability (Table 4). Singh (2014) reported that overall acceptability score was highest in groups with 1.5% BP supplementation as compared to groups with control, 0.5% BP and 1% BP supplementation. However, dietary treatments failed to significantly (P<0.05) effect the flavor and juiciness. Meghwal and Goswmi (2012) observed in their study that the improvement in meat quality might be due to presence of antioxidants like vitamin C, phenolic amides and flavenoids and antimicrobial properties, reducing lipid oxidation during storage (Velasco and Williams, 2011).

Effect of jaggery on sensory evaluation of meat: Jaggery supplementation did not affect any of the parameters of sensory evaluation i.e. colour, odour, texture, juiciness and overall acceptability significantly (Pe ≥ 0.05).

Combined effect of feed restriction, black pepper & jaggery supplementation on carcass parameters: Significant better (Pd ≤ 0.05) color was observed in T_3 (BP supplementation) as compared to control groups. But, T_3 had no significant difference from other treatments. Singh (2014) also reported better colour in BP fed group. However, other sensory parameters flavor, texture, juiciness did not show any significant (Pe ≥ 0.05) change due to feed restriction, BP supplementation, jaggery supplementation and BP + jaggery supplementation with or without feed restriction. Similar results were reported by Malpotra (2017).

ACKNOWLEDGEMENTS

Authors are thankful to Head, Livestock Product Technology, College of Veterinary Science, Ludhiana for to provide facilities for sensory evaluation of broilers meat.

REFERENCES

Abou-Elkhair, R., Ahmed, H.A. and Selim, S. (2014). Effects of black pepper (Piper nigrum), turmeric powder (Curcuma longa) and coriander seeds (Coriander sativum) and their combination as feed additives on growth performance, carcass traits, some blood parameters and humoral immune response of broiler chickens. *Asian Australasian J. Anim. Sci.* **27(6)**: 847-854.

Al-Kassie, G.A.M., Mamdooh, A.M., AL-Nasarwi and Saba, J.A. (2011). Use of black pepper (Piper nigrum) as feed additive in broilers diet. *Res. Opin. Anim. Vet. Sci.* **1**: 169-173.

AOAC. (2000). Official Methods of Analysis, (16th edn.) Associations of Official Ananlytical Chemist, Washington, DC.

Bhat, G.A. and Banday, M.T. (2000). Effect of feed restriction on the performance of broiler chickens during the winter season. *I. J. Poult. Sci.* **35**: 112-14.

Butzen, F.M., Vieira, M.M., Kessler, A.M., Aristimunha, P.C., Marx, F.R., Bockor, L. and Ribeiro, A.M.L. (2015). Early feed restriction in broilers. II: Body composition and nutrient gain. *J. App. Poult. Res.* **24**: 198-205.

Dhore, R.N., Patil, L.V., Dhok, A.P. and Ghawat, P.G. (2013). Effect of probiotics supplementation through drinking water on performance, haemoimmuno-biochemical profile and intestinal microflora of broilers. *Indian J. Poult. Sci.* **48**: 297-302.

ICAR. (2013). Nutrient Requirements of Animals - Poultry (ICAR-NIANP) (3rd edn.) Krishi Bhawan. New Delhi.

Kathirvelan, K., Purushothaman, M.R., Janani, S.R. and Banupriya, S. (2016). Effect of herbal lysine supplementation on broiler performance. *I. J. Anim. Nutr.* **33**: 442-447.

Malpotra, K. (2017). Effects of phased feed restriction and additional fat supplementation on broiler performance: M.V.Sc. Thesis submitted to GADVASU, Ludhiana.

Malpotra, K., Singh, U., Sethi, A.P.S., Singh, P. and Hundal, J.S. (2017). Growth performance of broiler chicken as affected by phased feed restriction and fat supplementation. *I. J. Anim. Nutr.* **34**: 329-337.

Meghwal, M. and Goswami, T. K. (2012). Chemical composition, nutritional and functional properties of black pepper: A review. *Open Access Scientific Reports*. **1**: 1-5.

Mittal, R. and Gupta, R.L. (2000). In vitro antioxidant activity of piperine. *Methods Find Exp. Clin. Pharmacol.* **22**: 271-274.

Omosebi, D.J., Adeyemi, O.A., Sogunle, O.M., Idowu, O.M.O. and Njoku, C.P. (2014). Effects of duration and level of feed restriction on performance and meat quality of broiler chickens. *Arch. de Zoote.* **63**: 611-621.

Reddy, S. V., Srinivas, P.V., Praveen, B., Kishore, K. H., Raju, B.C., Murthy, U. S. and Rao, J.M. (2004). Antibacterial constituents from the berries of Piper nigrum. *Phytomedicine.* **11(7-8)**: 697-700.

Singh, J. (2014). Herbal feed additives as alternatives to antibiotic growth promoters in broilers: Ph.D. Thesis submitted to GADVASU, Ludhiana.

Tazi, S.M.A.E., Mukhtar, M.A., Mohamed, K.A. and Tabidi, M.H. (2014). Effect of using Black pepper as natural feed additives on performance and carcass quality of broiler chicks. *Glob. Adv. Res. J. Agri. Sci.*, **3**: 13-18.

Velasco, V. and Williams, P.(2011). Improving meat quality through natural antioxidants. *Chilean J. Agri. Res.* **71(2)**: 313-322.

Vijayakumar, R.S. and Nalini, N. (2006). Piperine, an active principle from Piper nigrum, modulates hormonal and apo lipoprotein profiles in hyperlipidemic rats. *J. Basic. Clin. Physiol. Pharmacol.* **17**: 71-86.

Zhan, X. A., Wang, M., Ren, H., Zhao, R. Q., Li, J. X. and Tan, Z. L. (2007). Effect of early feed restriction on metabolic programming and compensatory growth in broiler chickens. *Poult. Sci.* **86**: 654-660.