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Effect of Different Stocking Density on Broiler Performance With and Without Ashwagandha Supplementation

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ABSTRACT

The present study was undertaken to assess the effect of different stocking density on performance of broilers with and without Ashwagandha supplementation. Two hundred seventy-day-old, commercial broiler chicks (Ven Cobb Strain) were used for five week experiment. The birds were allocated randomly to six treatment groups: T_1, T_2, T_3, T_4, T_5, or T_6, each of which had 45 birds and then subdivided into three replications of 15 birds each replicate. Chick was reared in deep litter system with free access to water and nourishment. The control (T_1) group had a basal diet with control space (1 sq. ft./bird), the T_2 group had a basal diet with 20% less space (0.8 sq. ft./bird), T_3 group had a basal diet with 20% more space (1.2 sq. ft./bird), while other treatment groups T_4, T_5 and T_6 having combinations such as control space (1 sq. ft./bird) with 1% Ashwagandha, 20% less space (0.8 sq. ft./bird) with 1% Ashwagandha, and 20% more space (1.2 sq. ft./bird) with 1% Ashwagandha, respectively. There were significant to a highly significant effect of different stocking density on broiler performance during fifth week on weekly body weight, average daily gain, feed consumption and non-significant on FCR and broiler performance index (BPI). However, the effect of Ashwagandha was found significant to highly significant on broiler performance during the fifth week on weekly feed consumption, average daily gain, body weight, broiler performance index, average feed conversion ratio. Supplementation of 1% Ashwagandha reduces stress of high stocking density and an increase feed consumption, weight gain, reduce FCR and ultimately affects the economics of broiler production. Hence, present study recommends the addition of 1% Ashwagandha in the basal diet of broiler production to get more profit in commercial broiler farming.

Key words: Ashwagandha, Body weight gain, Food conversion ratio, Stocking density

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INTRODUCTION

The poultry sector provides continuous flow of essential products for the human uses.This industry plays major role in national economy as well as livelihood.Now days, producers have raised the stocking density to boost farming profitability. However, due to animal welfare concerns, maximum stocking density limits are imposed in several nations. Increasing the stocking density of broilers is a management strategy for lowering labor, housing, and equipment cost. However, it is widely recognized facts that broiler performance, livability, immunity, and health are all negatively affected by high stocking densities (Pandurang et al., 2011). Due to rising returns with an increase in the number of broilers per unit area, stocking density has crucial positive modulations for the broiler production sector (Estevez, 2007). Now a day, we required to stocking density of broiler production can be increased without affecting welfare and performance with additional supplementation. Ashwagandha *(Withania somnifera)* is medicinal plants widely used in herbal medicine as a potential immune stimulator, antioxidant, anticarcinogenic, antimetastatic, (Sharma et al., 2010) and antibacterial (Owais et al.,

2005). Use of Ashwagandha has been mainly associated to its modulation effects on immune system (Gautam et al., 2004). Preparations obtained from the plant had been shown to enhance circulating antibody titers, increase in activity of lysosomal enzymes and increase phagocytosis (Agrawal et al., 1999). Ashwagandha belongs to the Solanaceae family, commonly known as Ashwagandha.It is a green woody shrub of 200-800 cm of height. The bright red fruits are harvested in the late fall and seeds are dried for planting in the following spring. The extract of this plant is Ashwagandha root powder contains 8.0% moisture, 2.0% crude protein, 5.05% crude fiber, 1.15% ether extract and 4.92% total ash along with macro minerals (%) viz. calcium (0.15), Phosphorus (0.13), magnesium (0.18), sodium (0.55) potassium (2.25) and micro minerals (in ppm) copper (25), zinc (37.5), iron (647), and manganese(42). Present study was undertaken to assess the effect of different stocking density on growth performance of broilers with and without Ashwagandha supplementation.

Experiment details

The study was conducted on two hundred seventy- straight run day-old broiler chicks (Ven Cobb strain) bought from a commercial hatchery. The trial was conducted for 5 weeks from 26th November to 31st December 2019 because in commercial farm, mostly broiler check sale out at this week. Six treatment groups with three replicates of 15 broiler chicks were assigned at random to the broiler chicks. Broilers were maintained under deep litter system with standard managemental practices regarding brooding, feeding and watering throughout the trial period. According to Vasanthakumar et al. (2014),1 % Ashwagandha was used in feed of poultry which reduced the heat stress and improve performance of broiler. The following are the various treatments and their designations utilized in the experiment:

Processing of Ashwagandha roots

Good quality 'A-grade solid cylindrical roots having a minimum length of 7 cm and diameter of 1-1.5 cm with a smooth external surface and pure white from inside were procured from the local market of Jaipur (Rajasthan) in the needed amount. The roots are then sun-dried and crushed through a 1mm filter before being kept in airtight plastic containers to be used later.

1. T_1 - Basal diet + Control space (1 sq. ft/ bird)
2. T_2 - Basal diet + 20% less space (0.8 sq. ft/ bird)
3. T_3 - Basal diet + 20% more space (1.2 sq. ft/ bird)
4. T_4 - Basal diet + Control space (1 sq. ft/ bird) + 1 % Ashwagandha
5. T_5 - Basal diet + 20% less space (0.8 sq. ft/ bird) + 1 % Ashwagandha
6. T_6 - Basal diet + 20% more space (1.2 sq. ft/ bird) + 1 % Ashwagandha

MATERIALS AND METHODS

The experimental trial performed in the present study at the Poultry Farm, Livestock Farm Complex, PGIVER (Post Graduate Institute of Veterinary Education and Research) Jamdoli, Jaipur (Latitude - N 26°53'31", Longitude - E 75°52'17"). Jaipur has a semi-arid climate.

Ethical approval

Research work on "Effect of Different Stocking Density on Broiler Performance with and without Ashwagandha Supplementation has been approved by institutional animal ethical committee (Approval No: PGIVER/IAEC/19-13).

Performance parameters

The live body weights of all birds are observed on the day of their procurement and wing banded then regularly weighed at weekly intervals for 5 weeks.Regular observations were recorded for the incidence of deaths in experimental broiler birds for estimating mortality related to experimental group.

The broiler performance index (BPI) was estimated by live weight gain divided by FCR

Statistical analysis

The experimental design was a single factor design, a 1-way analysis of variance (ANOVA) model andt-test are used to assess the experimental data statistically (SPSS Ver. 24.0) The one-way ANOVA and the. DMRT (Duncan's Multiple Range Test) is performed for comparing the mean values (Duncan, 1955). The data were reported means ± SD. Statistical significance was set at the level of P δ 0.05

RESULTS AND DISCUSSION

Effect of stocking density on weekly body weight

The weekly body weight of broilers subjected to various treatment groups (T_1, T_2 and T_3) recorded at weekly intervals presented in Table 1. The analysis of variance (ANOVA) revealed highly significant (P<0.01) effect of different stocking density on weekly body weight of broiler. The Post hoc DMRT analysis revealed significant (P<0.01) difference between T_1, T_2 and T_3 groups at 2nd, 3rd, 4th and 5th week. High stocking densities resulted in decreased growth performance and induce stress which reduceslive weight gain performance of broilers. Dozier et al. (2005) and Tong et al. (2012) suggested that the final body weight rose considerably (P<0.05) when the stocking density was reduced.

Effect of Ashwagandha on weekly body weight

The mean body weight of broilers subjected to various treatment groups (T1, T2, T3, T4, T5 and T6) recorded at weekly intervals presented in Table 2. Analysis of variance revealed highly significant effect of Ashwagandha on the weekly body weight of broiler chicken at 2nd, 3rd, 4th, and 5th weeks between T1 - T4 group, T2 - T5 group, and T3 - T6 groups, respectively. Ashwagandha is one of the well-recognized medicinal herbs which are widely used herbal medicine for stress management. It contains many active principles reported to possess immunomodulatory and general tonic. Stocking density affects performance parameters like body weight gain. Supplementation of 1 % Ashwagandha reduces the stress of high stocking density and increases weight gain. Mishra et al. (2000), Gupta et al. (2007) and Kumar et al. (2015) reported that Ashwagandha plant has anti-inflammatory, antitumor, anti-stress, antioxidant, immunomodulatory, and adaptogenic properties. Due to anti-stress and antioxidant properties of Ashwagandha weekly body weight of broiler chicken might have resulted higher in T_4, T_5,T_6 groups as compared to T_1,T_2,T_3 groups. The results about significantly higher weight gains indicates high feed efficiency on Withania-based diets which are consistent with results found by Shisodiya et al. (2008) who also observed considerably higher body weight in broilers on feed containing Withania as a

Table 1. Average weekly body weight (g/bird) of broilers in various treatment groups (T1, T2 and T3)

Age (week)	Body Weight(g/bird) Treatment Groups			Sig. Level
	T1	T2	T3	
Day zero	44.4	43.8	44.1	NS
1st week	149±2.93	144±2.79	150±2.46	NS
2nd week	351±6.56^b	311± 10.45^a	376±6.60^c	**
3rd week	758±9.21^b	696±5.68^a	795±3.10^c	**
4th week	1294±16.61^b	1203±13.98^a	1344±14.13^c	**
5th week	1902±27.18^b	1774±15.81^a	1970±11.93^c	**

**Highly Significant (p<0.01), NS:Non-significant

feed additive. Akotkar et al. (2007) recorded significant (P<0.05) progress in the broiler's performance fed ashwagandha root powder for six weeks. Similarly, Khobragade (2003) reported that the body weight gain of broiler birds wasmore in the Ashwagandha supplemented group. Comparable results provided by Srivastava et al. (2012) with feed formulation containing 2% Ashwagandha, tested for growth effect on body weight of Ven cobb 400 broilers in the summer season.

Table 2. Average weekly body weight (g/bird) of broilers in various treatment groups (T1, T2, T3 T4, T5 and T6)

Age (Weeks)	Body Weight(g/bird) Treatment Groups								
	T_1	T_4	Sig. Level	T_2	T_5	Sig. Level	T_3	T_6	Sig. Level
DayZero	44.4	44.3	NS	43.8	44.7	NS	44.1	43.8	NS
1st week	149±2.93	153±2.68	NS	144±2.79	150 ±2.58	NS	150±2.46	153±2.24	NS
2nd week	351±6.56^a	441±6.02^b	**	311±10.45^a	381±3.22^b	**	376±6.60^a	449±4.71^b	**
3rd week	758±9.21^a	990±7.66^b	**	696±5.68^a	932±8.02^b	**	795±3.91^a	1056±6.03^b	**
4th week	1294±16.61^a	1533±18.18^b	**	1203±13.98^a	1530±21.49^b	**	1344±14.13^a	1696±19.3^b	**
5th week	1902±27.18^a	2282±15.55^b	**	1774±15.81^a	2181±16.30^b	**	1970±11.93^a	2367±16.9^b	**

**Highly Significant (P<0.01), NS:Non-significant

Average daily gain

Effect of stocking density

The average daily gain of broilers in T_1, T_2 and T_3 groups are 28.83±0.79, 23.85±1.44 and 32.38±0.95 at 2nd week, 58.14 ±1.51, 54.91 ±1.69 and 59.83 ±1.08 at 3rd week, 76.52±2.67, 72.43±1.95 and 78.34±2.02 at 4th week, 86.81±4.37, 81.65±3.12 and 89.41±2.66 at 5th week, respectively. The analysis of variance demonstrated significant (P<0.05) effect of different stocking density on an average daily gain of broiler chicken at 3rd week, and very significant at (P<0.01) at 2nd week, and non-significant at 1st, 4th and 5th weeks between T_1, T_2 and T_3 groups. The Post hoc DMRT analysis revealed that significant difference between T1, T2 & T3 groups respectively at 2nd week and at 3rd week, T_2 group was found significantly differed from T_3 group, whereas T_1 group non-significantly differed from T_2 and T_3 groups. Findings of this research were consistent with those of Dozier et al.(2005) and Guardia et al. (2011). Tong et al. (2012), who observed that daily weight gain decreased with increasing stocking density.

Effect of Ashwagandha

Table 3 shows the mean ADG of broilers subjected to different treatment groups observed at weekly intervals. At 2nd, 3rd, and 5th weeks, the data demonstrated a very significant (P<0.01) impact of Ashwagandha on an average daily gain between T_1 - T_4 groups. Between T2 - T5 groups, significant (P<0.05) impact at 5th week, and very significant (P<0.01) at 2nd, 3rd, and 4th weeks, and has found non-significant at 1st week. Between T_3 - T_6 groups, very significant (P<0.01) at 2nd, 3rd& 4th weeks, and non-significant at 1st and 5th weeks. Higher growth in T_4, T5 and T6 groups as compared to T1,T2 and T3 groups may be attributed to the presence of substances like with anolides and an antistress factor which jointly could have sustained the body growth (Bhardwaj et al.,2012).

Table 3. Average Daily Gain (g) of broilers in various treatment groups (T1, T2, T3, T4, T5 and T6) at weekly interval

Age (Weeks)	Average Daily Gain (g) Treatment Groups								
	T1	T4	Sig. Level	T2	T5	Sig. Level	T3	T6	Sig. Level
1st week	15.0±0.39	15.6±0.33	NS	14.4±0.36	15.1±0.35	NS	15.1±0.32	15.6±0.27	NS
2nd week	28.8±0.79[a]	41.0±0.92[b]	**	23.8±1.44[a]	32.9±0.57[b]	**	32.3±0.95[a]	42.3±0.75[b]	**
3rd week	58.1±1.51[a]	78.4±1.22[b]	**	54.9±1.69[a]	78.7±1.20[b]	**	59.8±1.08[a]	86.6±1.19[b]	**
4th week	76.5±2.67	80.4±2.98	NS	72.4±1.95[a]	85.4±3.19[b]	**	78.3±2.02[a]	91.3±2.84[b]	**
5th week	86.8±4.37[a]	104.1±3.26[b]	**	81.6±3.12[a]	92.9±4.49[b]	*	89.4±2.66	95.8±4.04	NS

** Highly Significant (P<0.01), * Significant (P<0.05), NS:Non-significant

Weekly feed consumption

Effect of stocking density

Table 4 shows average feed consumption of different treatment groups (T1, T2 & T3). Analysis of variance of data demonstrated significant (P<0.05) impact of varying stocking density on average feed consumption of broiler chicks at 5th week, and very significant (p<0.01) at 2nd, 3rd, 4th weeks and overall cumulative feed consumption. The Post hoc DMRT analysis of data at 2nd week revealed that a significant (P<0.01) difference between T1, T2 & T3 groups respectively. We observed T_2 group was significantly differed from T1 and T3 groups at 3rd, 4thand 5th week respectively, whereas, a non-significant difference was noted between T_1 and T_3 groups. On comparing cumulative feed consumption, significant (p<0.01) difference was seen between T1, T2 and T3 groups respectively. Marewad et al. (2016) revealed that increasing floor space or decreasing stocking density lead to increase cumulative feed consumption.

Table 4. Average weekly feed consumption (g/bird) of broilers in various treatment groups (T1, T2 and T3)

Age (week)	Feed Consumption (g/bird) Treatment Groups			Sig. Level
	T1	T2	T3	
1st week	151±4.42	148±5.49	155±9.13	NS
2nd week	320±6.41[b]	266±5.60[a]	352±7.28[c]	**
3rd week	571±23.32[b]	515±12.72[a]	606±8.21[b]	**
4th week	836±8.17[b]	790±16.11[a]	865±11.30[b]	**
5th week	969±18.93[b]	898±21.94[a]	1000±13.98[b]	*
Cumulative	2850±47.70[b]	2619±27.07[a]	2980±8.09[c]	**

**Highly Significant (P<0.01), NS:Non-significant

Effect of Ashwagandha

Table 5 shows average feed intake of broilers assigned to different treatment groups. Increase in body weight invariably reflects towards correlated increase in feed intake. Data indicated a significant (P<0.05) effect of Ashwagandha on consumption of feed by broiler chicken at 5th week, and very significant (P<0.01) at 2nd, 3rd weeks and overall cumulative feed consumption, and non-significant at 1st and4th weeks between T1 - T4 group. Significant (P<0.01) effect of Ashwagandha on consumption of feed at 2nd, 3rd weeks and total cumulative feed consumption, and non-significant at 1st, 4th and 5th weeks between T2 - T5 groups and T3 - T6 groups was found. The positive effect of Ashwagandha supplementation on feed intake has been attributed to its effect on digestibility of feed. A significantly highest feed intake was reported in broilers chicks by Mushtaq et al. (2011) and Rindhe et al. (2012).

Table 5. Average weekly feed consumption (g/bird) of broilers in various treatment groups (T1, T2, T3, T4, T5 and T6)

Age (Weeks)	Feed Consumption (g/bird) Treatment Groups								
	T1	T4	Sig. Level	T2	T5	Sig. Level	T3	T6	Sig. Level
1st week	151±4.42	153±5.20	NS	148±5.49	149±1.34	NS	155±9.13	158±2.23	NS
2nd week	320±6.41	391±11.81	**	266±5.60[a]	330±5.91[b]	**	352±7.28[a]	437±4.44[b]	**
3rd week	571±23.32[a]	773 ±6.11[b]	**	515±12.72[a]	764±32.12[b]	**	606±8.21[a]	808±5.89[b]	**
4th week	836±8.17[a]	921±37.35[b]	NS	790±16.11	861±22.47	NS	865±11.30	919±57.57	NS
5th week	969±18.93[a]	1048±11.00[b]	*	898±21.94	956±38.42	NS	1000±13.98	1013±31.46	NS
Cumulative	2850±47.70[a]	3288±36.16[b]	**	2619±27.07[a]	3062±49.12[b]	**	2980±8.09[a]	3337±45.53[b]	**

** Highly Significant (P<0.01), * Significant (p<0.05), NS:Non-significant

Weekly feed conversion ratio (FCR)

Effect of stocking density

The FCR (amount of feed intake/unit live weight gain) ultimately decides the economics of the broiler industry. Cumulative FCR of broilers are 1.53±0.01, 1.51±0.05 and 1.54±0.02 in T_1, T_2 and T_3 group respectively. The analysis of variance demonstrated a non-significant effect of different stocking densities on feed conversion ratio of broiler chicken at all weeks and overall cumulative FCR.Comparable conclusions have been provided by Feddes et al. (2002) and Tong et al. (2012) who have found that feed conversion ratio was not affected by stocking density.

Effect of Ashwagandha

The cumulative feed conversion ratio (FCR) of broilers is 1.53±0.01 and 1.46±0.01 in T1 and T4, 1.51±0.05 and 1.43±0.00 in T2 and T5, 1.54±0.02 and 1.43±0.02 in T_3 and T_6, respectively. The analysis of variance revealed very significant (p<0.01) effect of Ashwagandha on feed conversion ratio of broiler chicken at overall cumulative feed conversion ratio, and non-significant at 1st, 3rd, 4thand 5th weeks between T1 - T4 groups. Between T2 - T5 groups, significant (P<0.05) effect at 4thweek.Between T3 – T6 groups, significant (P<0.05) effect at 4th week and overall cumulative feed conversion ratio, and non-significant at 1st, 2nd, 3rd and 5th weeks. Ashwagandha plants have antistress and antioxidant properties. It might be due to these properties of Ashwagandha feed conversion ratio of broiler chicken was found higher in T_4, T_5,T_6 groups as compared to T_1,T_2,T_3 groups. Sanjyal and Sapkota (2011); Srivastava et al. (2012) revealed improved

FCR during most weeks in a comparative study on Withania root powder in broilers.

Mortality

Effect of stocking density

The overall nil mortality was observed between T1 and T3, whereas, mortality rates were 0.45 percent in T2 group. T2 group of broilers came under stress because these were reared under the high stocking density. Stress conditions can be attributed to mortality in T_2 group and are in agreement as reported by Hall et al. (2001) and Skrbic et al. (2009) showed a significant increase in mortality with the increase of stocking density.

Effect of Ashwagandha

Ashwagandha offers significant protective effects to broilers in terms of reduction in mortality due to disease-related stress and exerts a considerable level of early recovery from infection. Overall nil mortality was observed in T1, T3, T4, T5 and T6 groups, whereas 0.45 percent mortality was recorded in T_2 group. Mishra et al. (2000); Gupta et al. (2007); Kumar et al. (2015) reported that Ashwagandha plant has anti-stress, anti-oxidant, immunomodulatory, and adaptogenic properties. Inclusion of Ashwagandha at 1% level in T_5 group of broilers feed material reduces the stress on broilers, reared under the high stocking density, due to anti-stress and immunomodulatory property of this herb. Hence, inclusion of 1% Ashwagandha in broilers diet reduces the mortality under high stocking density recorded in T_5 group as compared to T_2 group.

Broiler performance index (BPI)

Effect of stocking density

The BPI of broilers is 382±32.84, 372±74.30 and 392±25.31 in T1, T2 and T3 at 5th week respectively. Analysis of variance revealed a non-significant effect of different stocking densities on BPI at all weeks. Similar findings are reported by Mehmood et al. (2014) who suggested that the performance index was not affected by phase feeding at different stocking densities in sexed broilers.

Effect of Ashwagandha

The broiler performance index (BPI) of broilers subjected to various treatment groups recorded at weekly interval are presented in table 6. Analysis of variance revealed significant (P<0.05) effect of Ashwagandha on BPI at 3rd and 5th weeks, and very significant effect (P<0.01) at 2nd week, and non-significant effect was recorded at 1st and 4th weeks between T1 - T4 groups. Between T2 - T5 groups, significant (P<0.05) effect at 2nd and 3rd weeks, and in 4th week very significant (p<0.01) effect was found, whereas non-significant observations recorded at 1st and 5th weeks. Between T3 – T6 groups, significant (P<0.05) effect was recorded at 2nd week, and very significant (P<0.01) effect recorded at 3rd week, whereas at 1st, 4th and 5th weeks, non-significant observations were found.The antistress and adaptogenic activity of ashwagandha reduced the severity and helped in the early recovery of the broilers. It might be, due to these properties of Ashwagandha broiler performance index of chicks was higher in T4, T5, T6 groups as compared to T1, T2, T3 groups.

Table 6. Broiler Performance Index (BPI) of T_1, T_2, T_3, T_4, T_5 and T_6 Groups at weekly interval

Age (Weeks)	Broiler Performance Index (BPI) Treatment Groups								
	T1	T4	Sig. Level	T2	T5	Sig. Level	T3	T6	Sig. Level
1st week	73.2±5.10	77.8±1.54	NS	68.9±1.99	75.1±4.25	NS	73.0±5.24	76.1±2.38	NS
2nd week	127±6.42	211±12.22^b	**	105±17.58^a	161±6.98^b	*	146±15.49^a	200±11.31^b	*
3rd week	292±26.10^a	390±9.53^b	*	288±32.27^a	398±13.06^b	*	290^a±25.62^a	455±4.99^b	**
4th week	349±62.13	343±10.38	NS	325±3.59^a	415±18.67^b	**	348±17.61	444±39.85	NS
5th week	382±32.84^a	507±25.21^b	*	372±74.30	442±40.77	NS	392±25.31	446±56.20	NS

** Highly Significant (P<0.01), * Significant (P<0.05), NS:Non-significant

CONCLUSION

Present study concludes that the stocking density affectsthe broiler performance negatively. However, supplementation of 1% Ashwagandha reduces the stress of high stocking density and resulted in an increase feed consumption, weight gain, reduces FCR, and ultimately affected the economics of broiler production positively. Hence, present study recommends addition of 1% Ashwagandha in the basal diet of broilers production to get more profit for commercial broiler farming.

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