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# Effect of stocking density vis-à-vis dietary protein supply on growth performance, immune-competence and cost economics of growing turkey poults

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ABSTRACT

A 10-week biological experiment was undertaken to evaluate the response of Beltsvilie Small White turkey poults to different floor space (0.6, 0.8, and 1.0 $ft^2$/bird) and dietary protein levels (22%, 24% and 26% with similar dietary energy) in terms of growth performance, immune response, and serum biochemistry, following 3 × 3 factorial design. Each treatment was allocated 4 replicates out of which one replicate was maintained for the replacement of the dead birds, if any, to maintain the required stocking density. The body weight gain (BWG), feed intake (FI) and performance index (PI) of poults was significantly higher in 1.0 $ft^2$ floor space during 0–4 weeks and 4–10 weeks of age. Similarly, higher BWG, FI, and PI were observed at 26% dietary protein level. The interaction effect between stocking density and protein levels during 0–4 week resulted in significantly higher FI at 0.8 $ft^2$ floor space with 26% protein level and 1.0 $ft^2$ floor space with 24% as well as 26% protein level. The feed conversion ratio (FCR), mortality pattern, immune response and immune organ weights of poults did not reveal any significant treatment effect. The feed cost/bird increased linearly with increasing floor space, and feed cost/kg weight gain and feed cost/kg meat increased linearly with increasing protein levels. However, profit potential per meter square decreased linearly with decreasing stocking density. The study concluded that increasing the stocking density and decreasing the dietary protein level decrease the performance of poults, but the profit potential per meter square increases with increasing stocking density. Thus, the study recommends either the floor space of 0.8 $ft^2$/bird with 26% dietary protein level or the floor space of 1.0 $sq^2$/bird with 24% dietary protein level for growing turkey poults.

**Key words**: Cost economics, Immunity, Poult performance, Protein level, Stocking density, Turkey poults

Turkey is a robust large bird raised mostly for meat production. The turkey meat, famous for its leanness and delicacy, is one of the favoured white meats as compared to other commercial avian species. The turkey diets require a narrower energy to protein ratio and to be strictly balanced for sustaining rapid growth and better feed efficiency as compared to chicken (Tyagi 2001). The requirement of protein and energy varies with the strain of turkey, stage of growth and also the environmental temperature. The dietary protein (28% and 26%) and energy (2800 and 2900 kcal/kg diet) values, recommended by NRC (1994) for starting (0–4 week) and grower phase (4–8 week), respectively are much higher than those for chicken. The higher protein levels are required to let birds grow properly though their feed intake is lower initially. Thus turkey rations are costlier and the readymade feed in not available in the market. However, maintaining this level of energy and protein is not possible without the addition of vegetable oil. Employing the lower protein levels in diets of turkey poults will help reduce the cost of turkey feed as well the reduction of ammonia production which will result in better welfare of birds.

On the other hand as result of increasing welfare certifications in poultry industry, welfare considerations pertaining to turkey production are becoming increasingly important (Kijowski *et al*. 2005). The stocking density is considered as a main factor reflecting on turkey welfare (Marchewka *et al*. 2013). For commercial turkeys reared for meat, the recommendation is that stocking density should not exceed 34 kg/$m^2$ (Pattison *et al*. 2008). Under high stocking density conditions, the birds suffer from heat stress because the ventilation at the level of the birds gets compromised resulting in lower body heat dissipation from the birds. Though, there are a few inconclusive and contrasting reports pertaining to effects of stocking density on turkey (Majumdar *et al*. 2003, Abdel-Rahman 2005, Bessei and Gunthner 2006) there has been hardly any systematic research on turkey management in tropical countries like India. Thus, there is a dearth of information on the influence of stocking density of turkey. To our knowledge there is no literature available pertaining to the

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Table 1. Ingredients and nutrient composition of pre-starter and starter ration of turkey poults

| Feed ingredient | Pre-starter (0–4 week) | | | Starter (4–10 week) | | |
|---|---|---|---|---|---|---|
| Maize | 51.81 | 46.73 | 39.64 | 51.99 | 45.11 | 37.59 |
| DORB | 1.70 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Soybean | 42.40 | 48.90 | 55.30 | 43.20 | 49.50 | 55.90 |
| Oil | 0.00 | 0.50 | 1.45 | 1.20 | 2.10 | 3.30 |
| Limestone | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| DCP | 1.95 | 1.95 | 1.85 | 1.70 | 1.60 | 1.55 |
| Salt | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 |
| DL-methionine | 0.15 | 0.12 | 0.10 | 0.05 | 0.03 | 0.00 |
| Lysine | 0.33 | 0.14 | 0.00 | 0.19 | 0.00 | 0.00 |
| TM. pre-mix* | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 |
| Vit. premix 2** | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 |
| B complex*** | 0.015 | 0.015 | 0.015 | 0.015 | 0.015 | 0.015 |
| Ch. chloride | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 |
| Toxin binder | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 |
| Total | 100 | 100 | 100 | 100 | 100 | 100 |
| *Chemical composition* (%) | | | | | | |
| Crude protein | 22.03 | 24.01 | 26.01 | 22.05 | 24.03 | 26.00 |
| Metabolizable energy (kcal/kg) | 2800.6 | 2801.5 | 2801.8 | 2899.1 | 2899.4 | 2906.9 |
| Calcium | 1.10 | 1.11 | 1.10 | 1.03 | 1.02 | 1.01 |
| Available phosphorus | 0.50 | 0.50 | 0.50 | 0.45 | 0.45 | 0.45 |
| Lysine | 1.60 | 1.60 | 1.65 | 1.50 | 1.50 | 1.66 |
| Methionine | 0.55 | 0.55 | 0.55 | 0.45 | 0.45 | 0.45 |
| Threonine | 1.00 | 1.10 | 1.20 | 1.01 | 1.11 | 1.20 |

*Each g contained 15 mg copper, 250 mg iron, 6 mg iodine, 300 mg manganese and 300 mg zinc. **Each g contained 82.5 IU vitamin A, 50 mg vitamin $B_2$, 1200 IU vitamin $D_3$ and 10 mg vitamin K.***Each g contained 8 mg vitamin $B_1$, 16 mg vitamin $B_6$, 80 g vitamin $B_{12}$, 80 mg vitamin E, 120 mg niacin and 80 mg calcium pantothenate.

effects of floor space *vis-a-vis* dietary protein supply on the performance of turkey poults under Indian conditions. Keeping in view these facts, the present study was conducted to examine the effects of floor space and dietary protein levels on growth performance, immune-competence and cost economics of growing turkey poults.

## MATERIALS AND METHODS

The experimental procedures carried out on the birds were approved by Institute Animal Ethics Committee (402/01/ab/CPCSEA). Following a 3×3 factorial design, a total of 288 straight run day-old Beltsville Small White poults of uniform body weight were randomly distributed into 9 experimental groups with 4 replicate in each group in electrically operated battery brooder cages (2.5ft × 2.5ft). The total number of birds housed in each cage was 10, 8, and 6 to attain the three stocking density levels (0.6, 0.8 and 1.0 $ft^2$/bird). Each stocking density level was used against three dietary protein levels (22, 24, & 26%) forming a total of nine treatments. Out of the four replicates assigned to each treatment one replicate was kept for the replacement of the dead birds in other 3 replicates, if any, so as to keep the effective floor space constant throughout the experimental period. The ingredient and chemical composition of different experimental diets for pre-starter and starter phases are given in Table 1 (NRC 1994).

The body weight (BW) and feed intake (FI) were recorded on biweekly basis to arrive at overall weight gain, feed intake and feed conversion ratio (FCR). Daily monitoring of birds was done to record the mortality as and when it occurred. The performance index (PI) of birds during 0–4 week and 4–10 week of age was calculated as per the following formula (Bird 1955):

$$PI = \frac{(\text{Body weight gain})^2}{\text{Feed intake}}$$

The cell mediated immune (CMI) response (foot web index to Phytohaemagglutinin, lectin from *Phaseolus Vulgaris*- PHAP) and humoral immune response (haemagglutination- HA titer to Sheep red blood corpuscles-SRBC) were studied at $31^{th}$ and $44^{th}$ day of age by using 10 poults from each treatment. At the end of experimental period, 10 birds from each treatment were selected randomly and slaughtered after 12 h of fasting with *ad lib.* drinking water for evaluation of immune organ weight on % live weight basis. The feed cost per bird, per kg weight gain, per kg meat produced, and profit potential per meter square (PPM) constituted the cost economic analysis of turkey production. The PPM was calculated as follows:

PPM (₹) = (Cost of meat produced – Initial cost of poults – Cost of feed consumed)/$m^2$

The data obtained from the study were subjected to 2 way ANOVA (Snedecor and Cochran 1989) using SPSS software package (v17.0). The significant mean differences were tested by Duncan's multiple range test (Duncan 1955).

## RESULTS AND DISCUSSION

*Growth performance:* The results (Table 2) of body weight gain (BWG), feed intake (FI), and feed conversion (FCR) revealed no significant interaction effect between the stocking density and the dietary protein levels except for the FI of 0–4 week of age, where the combination of 0.8 $ft^2$/bird with 26% protein and 1.0 $ft^2$/bird with 24% and 26% resulted in highest FI of birds. In general, significantly ($P<0.01$) higher BWG and FI was observed at the floor space of 1.0 $ft^2$/bird, lowest at 0.6 $ft^2$/bird, and intermediate at 0.8 $ft^2$/bird. Similar trend was observed in BWG and FI with respect to different dietary protein levels. However, no effect of either floor space or dietary protein levels was observed on the FCR of turkey poults.

The higher BWG of poults kept at 1.0 $ft^2$ floor space may be due to greater space which provides more opportunity for free movements of birds for feeding and watering. High stocking density could increase the ambient temperature, ammonia level and reduce ventilation and heat dissipation from birds (Houshmand *et al.* 2012). These factors could contribute to lower growth performance of birds. Thus high stocking density causes lower BWG in

Table 2. Effect of floor space vis-à-vis dietary protein supply on growth performance of growing turkey poults

| Interaction effect | | Body weight gain (g/b) | | | Feed intake (g/b) | | | Feed conversion ratio | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Floor space (sq. ft) | Protein level (%) | 0–4 week | 4–10 week | 0–10 week | 0–4 week | 4–10 week | 0–10 week | 0–4 week | 4–10 week | 0–10 week |
| 0.6 | 22 | 234.3 | 1317.1 | 1551.4 | 481.3$^{a}$ | 3319.2 | 3800.5 | 2.06 | 2.52 | 2.45 |
| | 24 | 291.6 | 1310.2 | 1601.8 | 628.2$^{b}$ | 3293.0 | 3921.2 | 2.16 | 2.51 | 2.45 |
| | 26 | 308.5 | 1379.4 | 1688.0 | 616.3$^{b}$ | 3524.2 | 4140.5 | 2.00 | 2.56 | 2.45 |
| 0.8 | 22 | 215.2 | 1397.4 | 1612.5 | 465.5$^{a}$ | 3510.5 | 3976.0 | 2.15 | 2.51 | 2.47 |
| | 24 | 293.3 | 1439.3 | 1732.6 | 605.1$^{b}$ | 3608.4 | 4213.5 | 2.06 | 2.51 | 2.43 |
| | 26 | 326.7 | 1520.8 | 1847.5 | 704.1$^{c}$ | 3678.5 | 4382.5 | 2.16 | 2.42 | 2.37 |
| 1.0 | 22 | 262.8 | 1452.2 | 1715.0 | 536.9$^{b}$ | 3627.2 | 4164.1 | 2.04 | 2.50 | 2.43 |
| | 24 | 333.2 | 1475.1 | 1808.3 | 707.1$^{c}$ | 3907.1 | 4614.2 | 2.12 | 2.66 | 2.56 |
| | 26 | 344.2 | 1526.6 | 1870.8 | 751.9$^{c}$ | 3959.9 | 4711.8 | 2.18 | 2.60 | 2.52 |
| Pooled SEM | | 8.84 | 19.13 | 24.72 | 19.28 | 47.26 | 61.41 | 0.02 | 0.02 | 0.02 |
| *Main effect* | | | | | | | | | | |
| Floor space (sq. ft) | | | | | | | | | | |
| 0.6 | | 278.2$^{m}$ | 1335.6$^{m}$ | 1613.7$^{m}$ | 575.3$^{m}$ | 3378.8$^{m}$ | 3954.1$^{m}$ | 2.07 | 2.53 | 2.45 |
| 0.8 | | 279.0$^{m}$ | 1452.5$^{n}$ | 1730.8$^{n}$ | 591.6$^{m}$ | 3599.1$^{n}$ | 4190.7$^{n}$ | 2.13 | 2.48 | 2.42 |
| 1.0 | | 312.4$^{n}$ | 1484.6$^{n}$ | 1798.0$^{n}$ | 665.3$^{n}$ | 3831.4$^{o}$ | 4496.7$^{o}$ | 2.12 | 2.59 | 2.50 |
| Protein level (%) | | | | | | | | | | |
| 22 | | 237.4$^{x}$ | 1388.9 | 1626.3$^{x}$ | 494.6$^{x}$ | 3485.6$^{x}$ | 3980.2$^{x}$ | 2.09 | 2.51 | 2.45 |
| 24 | | 306.1$^{y}$ | 1408.2 | 1714.2$^{y}$ | 646.8$^{y}$ | 3602.8$^{xy}$ | 4249.6$^{y}$ | 2.12 | 2.56 | 2.48 |
| 26 | | 326.5$^{z}$ | 1475.6 | 1802.1$^{z}$ | 690.8$^{z}$ | 3720.9$^{z}$ | 4411.6$^{z}$ | 2.11 | 2.52 | 2.45 |
| *Significance* | | | | | | | | | | |
| Floor space | | P<0.01 | P<0.01 | P<0.01 | P<0.01 | P<0.01 | P<0.01 | NS | NS | NS |
| Protein level | | P<0.01 | NS | P<0.01 | P<0.01 | P<0.01 | P<0.01 | NS | NS | NS |
| Interaction | | NS | NS | NS | P<0.05 | NS | NS | NS | NS | NS |

Values bearing different superscripts within the column differ significantly; NS, Non-significant.

turkey (Davidson and Leighton 1984), quail (Seker *et al*. 2009, Bhanja *et al.* 2006) and reduced final BW in broiler chicken (Simitzis *et al*. 2012, Dozier *et al.* 2006, Thomas *et al*. 2004). However, in contrast to our findings, Houshmand *et al.* (2012) and Buijs *et al*. (2009) reported that BW and BWG were not affected by stocking density of birds in broiler chicken. Similar to the present study, Majumdar *et al*. (2002) reported that the poults receiving higher protein and higher energy (26% CP and 3000 kcal/ kg) had significantly higher BWG. Similarly, Hassan *et al.* (2011) and Houshmand *et al.* (2012) reported that low protein diets resulted in lower BWG and final BW in broiler chicken as compared to normal protein diets. Yausef and Singh (1989) also reported no interaction effect of stocking density and protein levels on body weight of broiler chicks. However, in contrast to our observation, Houshmand *et al.* (2012) reported significant interaction effect between the dietary protein level and stocking density on the BWG of broiler chicken.

In the current study, the FI of birds revealed the trend similar to that of BWG. This observation was supported by Majumdar *et al*. (2003) in turkey poults, and Feddes *et al.* (2002), Al-Homidan and Robertson (2007) in broiler chicken, and Seker *et al*. (2009) in Japanese quail. Similarly, Majumdar *et al*. (2002) and Yausef *et al.* (1989) reported improved FI with increasing dietary protein levels in turkey poults and broiler chicken respectively.

In this study it can be postulated that the increase in FI might have led to corresponding increase in BWG of turkey poults without affecting the FCR of the birds. Though, Majumdar *et al*. (2003) had reported better FCR in poults reared at higher stocking density during pre-starter period but no significant effect was observed during starter period. However, in contrast to the present findings, Nahashon *et al*. (2011) reported lower feed efficiency in pearl gray guinea fowl birds at high stocking density. Similarly, Majumdar *et al*. (2002) reported that the FCR of turkey poults is not influenced by dietary protein levels. Further, Houshmand *et al*. (2012) also observed no interaction effect of stocking density and protein levels on the FCR of broiler chicks.

*Mortality and performance index* (*PI*)*:* The results of the mortality and performance index of turkey poults are presented in Table 3. There was no significant effect of stocking density, dietary protein levels or their interaction on the mortality pattern of turkey poults. Similar to the observations of the present study, no significant effect of stocking density had been reported on the mortality pattern of poults (Majumdar *et al.* 2003), Japanese quail (Seker *et al.* 2009), and broiler chicken (Feddes *et al.* 2002, Beg *et al.* 2011). Further, Yung *et al.* (2001) observed that the dietary protein levels also do not influence mortality rate in broilers.

The PI of turkey poults showed significant (P<0.05) effect of stocking density with higher mean value at floor space of 1 $ft^2$/bird and lower at 0.6 $ft^2$/bird. It is because higher BWG was observed at floor space of 1 $ft^2$/bird. Similarly, the 26% dietary protein level yielded highest mean value of 4–10 week PI, which was statistically similar to 24% protein level and lowest value was observed at 22% protein level. No

Table 3. Effect of floor space vis-à-vis dietary protein supply on immune organs (% live weight), immune response, mortality and performance index of growing turkey poults

| Interaction effect | | Immune organ weight | | | Immune response | | Mortality (%) | Performance index | |
|---|---|---|---|---|---|---|---|---|---|
| Floor space (sq. ft) | Protein level (%) | Spleen | Bursa | Thymus | Foot web index (mm) | HA titre ($\log_2$) | 0–10 week | 0–4 week | 4–10 week |
| 0.6 | 4.35 | 0.111 | 0.128 | 0.124 | 0.92 | 8.90 | 4.67 | 114.4 | 522.8 |
| | 4.34 | 0.122 | 0.128 | 0.141 | 0.95 | 9.10 | 3.33 | 135.7 | 521.5 |
| | 4.36 | 0.146 | 0.125 | 0.169 | 0.96 | 9.20 | 4.67 | 154.5 | 540.0 |
| 0.8 | 3.92 | 0.117 | 0.119 | 0.135 | 1.00 | 9.00 | 4.17 | 100.0 | 556.3 |
| | 3.96 | 0.121 | 0.124 | 0.142 | 0.96 | 9.10 | 4.17 | 142.2 | 574.3 |
| | 3.69 | 0.122 | 0.139 | 0.160 | 1.01 | 9.30 | 4.17 | 151.6 | 629.0 |
| 1.0 | 3.84 | 0.129 | 0.126 | 0.152 | 0.99 | 9.10 | 3.00 | 128.6 | 582.4 |
| | 3.76 | 0.145 | 0.135 | 0.147 | 1.02 | 9.30 | 4.56 | 157.2 | 559.9 |
| | 3.60 | 0.145 | 0.134 | 0.178 | 1.05 | 9.40 | 4.56 | 157.6 | 589.0 |
| Pooled SEM | | 0.06 | 0.004 | 0.004 | 0.021 | 0.101 | 1.18 | 11.12 | 14.37 |
| *Main effect* | | | | | | | | | |
| Floor space (sq. ft) | | | | | | | | | |
| 0.6 | | 0.126 | 0.127 | 0.145 | 0.94 | 9.07 | 4.56 | $134.9^{m}$ | $528.1^{m}$ |
| 0.8 | | 0.120 | 0.127 | 0.146 | 0.99 | 9.13 | 3.17 | $131.3^{m}$ | $586.5^{n}$ |
| 1.0 | | 0.140 | 0.132 | 0.159 | 1.02 | 9.27 | 3.70 | $147.8^{n}$ | $577.1^{n}$ |
| Protein level (%) | | | | | | | | | |
| 22 | | 0.119 | 0.124 | 0.137 | 0.97 | 9.00 | 3.61 | 553.8 | $114.3^{x}$ |
| 24 | | 0.129 | 0.129 | 0.143 | 0.98 | 9.17 | 4.35 | 551.9 | $145.0^{Y}$ |
| 26 | | 0.138 | 0.132 | 0.169 | 1.00 | 9.30 | 4.46 | 586.0 | $154.6^{y}$ |
| Significance | | | | | | | | | |
| Floor space | | NS | NS | NS | NS | NS | NS | P<0.05 | P<0.05 |
| Protein level | | NS | NS | NS | NS | NS | NS | NS | P<0.01 |
| Interaction | | NS | NS | NS | NS | NS | NS | NS | NS |

Values bearing different superscripts within the column differ significantly; NS, Non-significant.

interaction effect was observed on the PI of poults. Agrawal *et al*. (2003) reported the better performance index of quail at 5th week of age reared at higher floor space. However, in contrast to this, Majumdar *et al.* (2003) reported better PI of poults reared at lower floor spaces (<1.0 sq. ft) during pre-starter period but not during the starter period. No literature is available pertaining to the effect of dietary protein levels on the PI of turkey poults

*Immunity:* The results of immune organ weights and immune response as affected by stocking density and dietary protein levels in turkey poults are given in Table 3. The immune response (cell mediated as well as humoral) revealed no significant effect of stocking density, protein levels or their interaction. Similarly, it had been reported that stocking density does not have significant effect on heamagglutinin titres to SRBC in broilers (Patterson and Siegel 1998, Heckert *et al.* 2002), and immune response in broilers against Newcastle disease (ND) (Mehmet 2008). Similarly, different dietary protein levels were observed to have no effect on the humoral (HA titer to SRBC) (Kadam *et al.* 2007) and cellular (foot pad index to PHA-P) immune response (Kadam *et al.* 2007) in broiler chicken. Also, Houshmand *et al.* (2012) did not found any significant difference in antibody titer against ND due to protein levels or interaction between protein level and stocking density in broilers.

The weight of immune organs (spleen, thymus and bursa) showed no significant effect of stocking density, dietary protein levels or their interaction. Similarly, Heckert *et al.* (2002), Thomas *et al.* (2004), and Buijs *et al*. (2009) reported that stocking density have no effect on immune organ weights of broiler chicken. Kidd *et al.* (2001) and Cheema *et al.* (2003) also reported that the relative lymphoid organ weights are not significantly affected by high dietary protein diets (22%) in broilers. Houshmand *et al.* (2012) reported that stocking density or interaction action between protein level and stocking density had no significant effect on bursa and spleen weights.

*Cost economics:* The results pertaining to the cost economics of turkey production are presented in Table 4. The feed cost per bird significantly (P<0.01) increased linearly with increasing floor space and dietary protein levels. Similarly, the feed cost per kg weight gain and feed cost per kg meat produced significantly (P<0.01) increased linearly with increasing dietary protein levels and no effect of stocking density was observed on them. Further, the profit potential per meter square (PPM) was significantly (P<0.01) highest at floor space 0.6 $ft^2$/bird followed by 0.8 $ft^2$/bird and lowest at 1.0 $ft^2$/bird and no effect of dietary protein level was observed on PPM. None of these cost economics parameters have revealed any interaction effect between stocking density and dietary protein levels. Similar to the results of the present study, Jackson *et al.* (1982) reported that feed cost per kilogram live weight and returns over

Table 4. Effect of floor space vis-à-vis dietary protein supply on cost economics of turkey production

| Floor space (sq. ft) | Protein levels (%) | Feed cost/ bird | Feed cost/ kg wt. gain | Feed cost/ kg meat | PPM (₹) |
|---|---|---|---|---|---|
| Interaction effect | | | | | |
| 0.6 | 22 | 101.72 | 65.56 | 83.35 | 2729.72 |
| | 24 | 111.04 | 69.36 | 88.53 | 2718.47 |
| | 26 | 125.28 | 74.22 | 94.63 | 2763.51 |
| 0.8 | 22 | 106.44 | 66.01 | 85.21 | 2218.66 |
| | 24 | 119.34 | 68.94 | 87.71 | 2434.58 |
| | 26 | 132.57 | 71.75 | 92.52 | 2490.81 |
| 1.0 | 22 | 111.45 | 65.07 | 84.60 | 1792.64 |
| | 24 | 130.67 | 72.45 | 91.83 | 1981.72 |
| | 26 | 142.53 | 76.26 | 97.24 | 1853.85 |
| Pooled SEM | | 2.60 | 0.82 | 0.99 | 75.33 |
| *Main effect* | | | | | |
| Floor space (sq. ft) | | | | | |
| 0.6 | | 112.68$^{m}$ | 69.71 | 88.84 | 2737.23$^{o}$ |
| 0.8 | | 119.45$^{n}$ | 68.90 | 88.48 | 2381.35$^{n}$ |
| 1.0 | | 128.22$^{o}$ | 71.26 | 91.23 | 1876.07$^{m}$ |
| Protein levels (%) | | | | | |
| 22 | | 106.54$^{x}$ | 65.55$^{x}$ | 84.39$^{x}$ | 2247.00 |
| 24 | | 120.35y$^{y}$ | 70.25$^{y}$ | 89.36$^{y}$ | 2378.26 |
| 26 | | 133.46$^{z}$ | 74.07$^{z}$ | 94.80$^{z}$ | 2369.39 |
| *Significance* | | | | | |
| Floor space | | P<0.01 | NS | NS | P<0.01 |
| Protein level | | P<0.01 | P<0.01 | P<0.01 | NS |
| Interaction | | NS | NS | NS | NS |

Values bearing different superscripts within the column differ significantly; NS, Non-significant.

feed costs per bird were significantly (P<0.01) affected by dietary protein and energy levels. The lower final body weight is compensated by the production of more number of birds or higher quantity of meat per unit area. Thus the high stocking density results in more profit than the low stocking density (Agrawal *et al*. 2003, Yausef Al-Ribdawi and Singh 1989, Ahuja *et al*. 1998).

The study concluded that increasing the stocking density and decreasing the dietary protein level increase the body weight gain, feed intake and performance index of poults without affecting their feed efficiency, mortality pattern, and immunity. Though, the feed cost increases with decreasing stocking density and increasing dietary protein level, the profit potential per meter square increases with increasing stocking density. Thus, the study recommends either the floor space of 0.8 $ft^2$/bird with 26% dietary protein level or the floor space of 1.0 $sq^2$/bird with 24% dietary protein level for better performance of growing turkey poults without compromising the welfare of birds.

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