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Effect of Stocking Density on Feed Efficiency of Caged Broilers under Hot Climatic Conditions

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The present study investigates the effect of stocking density on feed consumption and feed conversion ratio (FCR) in caged broilers under hot climatic conditions. A total 72 day-old broiler chicks, were randomly distributed in three groups as treatments of stocking density which, were further subdivided into eight sub-group to serve as replicates. The broiler chicks in different treatments of the stocking density at 1 sq. ft. per chick, 1.33 sq. ft. per chick and 2 sq. ft. per chick were evaluated. The results revealed that stocking density did not have any significant impact on

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the feed consumption and feed conversion ratio (FCR). However, a trend showed that broilers at moderate stocking density (1.33 sq. ft. per chick) supported the better feed utilization. These findings are in agreement with several studies which reported non-significant impact of stocking density on feed intake and FCR. While higher stocking densities may raise issues related to heat stress during summer season, the present experiment suggests that with proper heat stress and pre-summer management practices, good performance may be obtained, across different stocking densities. Effective management practices are essential for enhancing the feed efficiency and bird welfare in hot climates. This experiment highlights the importance of balancing stocking density and environmental conditions to achieve sustainable broiler production.

Keywords: Heat Stress; FCR; feed consumption; stocking density; summer season.

1. INTRODUCTION

India is the world's second-largest emerging economy. The poultry sector is one of the fastest growing-sectors in India. It has an immense scope for better income generation. India has witnessed an average growth rate of 6 % in egg production and 12 % in broiler production per annum. The total poultry population in India has increased by 16.81% (851.81 million in 2019) compared to 729.21 million poultry in 2012. (BAHS, 2019). At present, the poultry industry is one of the fastest-growing subsectors of animal husbandry in India. Indian broiler industry is growing at the rate of 7-8%. India stands in 3rd position in egg production; however, it is still growing in terms of poultry meat production and stands in 6th position in the world in terms of broiler production. A rise in consumer demand for poultry is responsible for driving the recent growth of the Indian poultry sector (BAHS, 2018).

Poultry meat provides good quality protein, minerals and vitamins to the diet of person consuming it. Also, rearing poultry involves low investment cost, less land and less risk as compared to other enterprises and produces quick returns with good feed conversion efficiency and protein sources (Bhagat, 2016). Commercial poultry producers frequently consider increasing the stocking density of breeding birds per pen as a strategy to minimize costs associated with housing, equipment and labour. However, existing literature suggests that elevated stocking densities adversely impact both the economic viability and welfare standards of poultry production. Adverse outcomes associated with high stocking densities include increased mortality rates, higher prevalence of leg disorders and disruptions to normal resting behavior. Moreover, chickens reared under such conditions exhibit slower growth rates, reduced egg production, and elevated mortality (Van Kampen, 1982; Deaton, 1983; Hall, 2001).

High stocking densities have been associated with reduced growth rates, impaired feed conversion efficiency, increased mortality and behavioural issues such as reduced resting time and aggression (Estevez, 2007). These challenges are exacerbated in hot climates, where heat stress further compromises bird performance and welfare. Heat stress disrupts thermoregulation, leading to decreased feed intake, reduced nutrient absorption and heightened susceptibility to diseases (Cahaner *et al.,* 2008). The overcrowding are mostly done in an attempt to cover the costs incurred in housing, feeding and medication of poultry birds, also, most farmers know adequate stocking density to use (Muniz *et al.,* 2006; Adebiyi *et al.,* 2011). India in a sub-tropical region of the world where,- the prevailing macro-climatic conditions are mostly congenial to poultry production. Among the many sub-sectors of agriculture, the livestock sector is gaining momentum in India and within the livestock sector, poultry occupies a premium position (Prabakaran, 2012). Water resources, grasslands, and livestock are thus likely to be vulnerable to climate change in this region. Climate change affects animal health mainly through heat stress and increases in vector-borne diseases (Ramamneh, 2023). Understanding the interaction between stocking density and environmental factors, such as temperature, is crucial for optimizing feed efficiency in broiler production. Feed efficiency, a key economic indicator in poultry farming, is directly influenced by stocking density through its effects on feed intake, body weight gain, and energy expenditure (Dozier et al*.,* 2006). Therefore, this study aims to evaluate the effect of stocking density on the feed efficiency of caged broilers reared under hot climatic conditions.

2. MATERIALS AND METHODS

2.1 Experimental Design and Management

The present experiment was carried out on 72 one-day-old broiler chicks raised in battery cages until they were five weeks old during summer season. These chicks were randomly assigned to three different treatments, with each treatment further divided into eight sub-groups to serve as replicates. These chicks were housed in 24 cages, each measuring 2 feet by 2 feet, providing 4 square feet of space per cage. The treatments were as follows: T_1 with 2 square feet per bird (2 chicks in each cage), T_2 with 1.33 square feet per bird (3 chicks in each cage) and T_3 with 1 square feet per bird (4 chicks in each cage).

2.2 Data Collection

Data of feed consumption and feed conversion ratio were collected on a weekly basis in the early morning. Feed consumption per bird was calculated by sum of daily feed consumption divided by seven whereas feed conversion ratio was calculated by dividing the total feed consumed by birds with body weight gain. The data were collected from each replicates within the treatments.

2.3 Statistical Analysis

The data collected were analysed statistically using Analysis of variance (ANOVA) technique as per Snedecar & Cochran (2004).

3. RESULTS AND DISCUSSION

3.1 Feed Consumption

The data presented in Table 1 indicate that the average feed consumption of chicks was highest in T_2 (523.54 g) followed by T_3 (504.67 g) and T_1 (491.27 g). However, there was non-significant difference in feed consumption of broiler chicks among different treatments of stocking density. Chicks in T_2 (1.33 sq. ft per bird) exhibited significantly higher average feed consumption compared to those in T_1 (2 sq. ft per bird) and T_3 (1 sq. ft per bird). However, Wenjia *et al.,* (2019) reported that stocking density did not have any significant impact on feed consumption of caged broilers at 15 birds /m^2 and 18 birds /m^2. Bruno *et al.,* (2017) observed that during the first week of age, the feed consumption of broiler chicks was found to be non-significant. This may be attributed to lower feed consumption during the brooding period, adequate feed space, low ammonia levels, and reduced microbial load during the initial period. Whereas, Nawarathne *et al.,* (2010) reported that the increasing stocking density resulted in a decrease in average feed intake. However, following the brooding period, when uniform conditions were provided across all treatments, no significant differences ($p > 0.05$) in feed intake were observed among the three treatment groups.

3.2 Feed Conversion Ratio

The data presented in Table 2 indicate that the average feed conversion ratio of broiler chicks was highest in T_3 (1.40) followed by T_2 (1.37) and T_1 (1.37). There were non-significant differences in the average mean feed conversion ratio of broiler chicks among different treatments of stocking density. Chicks in T_2 (1.33 sq. ft per bird) exhibited a significantly higher average feed conversion ratio compared to those in T_1 (2 sq. ft per bird) and T_3 (1 sq. ft per bird). In a comparable study, Vanhonacker *et al.,* (2009) reported that consumer perceptions on broiler welfare and noted that increasing stocking density did not significantly impact weekly feed conversion ratio. Silas *et al.,* (2014) found that stocking density had no significant effect on the feed conversion ratio in broilers in different stocking densities. Sujeet *et al*., (2016) observed that up to five weeks, the feed conversion ratio remained non-significant. However, a significant

Table 1. Average feed consumption of broiler chicks

Treatments	Weekly average feed consumption of broilers (g.)					
	Week 1	Week 2	Week 3	Week 4	Week 5	Mean
T_1	123.75	333.3	495.37	613.75	889.62	491.27
T_2	142.87	330.5	544.87	690.5	909	523.54
T_3	143	339.37	530.37	628.62	882	504.67
Mean	136.54	334.58	523.53	644.29	893.54	506.49
Results	S*	NS**	S*	NS**	NS**	NS**

** Significant*
*** Non-significant*

Table 2. Average feed conversion ratio of broiler chicks

Treatments	Weekly average feed conversion ratio of broilers (g.)					
	Week 1	Week 2	Week 3	Week 4	Week 5	Mean
T_1	1.11	1.2	1.16	1.45	1.96	1.37
T_2	1.22	1.15	1.19	1.46	1.87	1.37
T_3	1.21	1.14	1.24	1.35	2.07	1.40
Mean	1.18	1.16	1.19	1.42	1.96	1.38
Results	NS**	S*	S*	NS**	S*	NS**

** Significant*
*** Non-significant*

difference was observed in the weekly mean feed conversion ratio. Whereas, some other studies reported conflicting results compared to this study. Petek *et al.,* (2014) reported a non-significant difference in the feed conversion ratio ($P > 0.05$) among groups with different stocking densities. On the other hand, Qaid *et al.,* (2016) found that birds housed at lower stocking densities significantly converted feed more efficiently compared to those stocked at higher densities.

4. CONCLUSION

The findings of the present experiment suggest that stocking density has a non-significant impact on the feed consumption and feed conversion ratio (FCR) of caged broilers under hot climatic conditions. Broiler chicks at a moderate stocking density showed a trend towards higher feed consumption and better feed conversion ratio compared to chicks in lower and higher densities. Although statistically non-significant differences were observed in different treatments of stocking density in present study and the results revealed that moderate stocking density provides an optimal balance between resource utilization and bird welfare. The results are in consistent with the idea that stocking density alone may not significantly influence feed intake or FCR when managed properly. With proper heat stress management practices, it may help to achieve good performances even at higher stocking densities. Optimizing management practices under hot climatic conditions is essential to ensure efficient feed utilization and maintain sustainable broiler performance across varying stocking densities.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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