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

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. ~~Total~~ A total of 72 day-old broiler chicks, were randomly distributed in three groups as treatments of stocking density, which ~~-~~were further ~~sub-divided~~subdivided ~~as~~ into xx replicates with eight chicks in each. ~~to serve as replicates.~~ The birds in different treatments of stocking density at 1 sq. ft., 1.33 sq. ft. and 2 sq. ft. per bird were evaluated. The results indicated that stocking density did not significantly affect feed consumption and Feed Conversion Ratio (FCR), with a trend suggesting that moderate stocking density (1.33 sq. ft./ bird) supported better feed utilization. These findings align with several studies which reported non-significant impact of stocking density on feed intake and FCR. While higher stocking densities can lead to concern regarding heat stress, the present study suggests that with appropriate heat stress management, good performance may be achieved, across different stocking densities. Effective management practices are crucial in optimizing feed efficiency and bird welfare in hot climates. This study highlights the importance of balancing stocking density and environmental conditions to achieve sustainable broiler production.

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Key words: *Heat Stress, FCR, Feed Consumption, Stocking Density and Summer Season*

Introduction

India is the world's ~~second-largest~~second-largest emerging economy. ~~Poultry~~ The poultry sector is one of the ~~fastest-growing~~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 % ~~for~~ in broiler production per annum. ~~Total~~ The total poultry population in India has increased by 16.81% (851.81 million in 2019) compared ~~than~~ to 729.21 million poultry in 2012. (**BAHS, 2019**). At present, the poultry industry is one of the ~~fastest-growing~~fastest-growing subsectors of animal husbandry in India. Indian broiler industry is growing at the rate of 7-8%. India stands ~~on~~ in 3rd position in egg production; however, it is still growing in terms of poultry meat production and stands ~~on~~ in 6th position in the world in

terms of broiler production. ~~Rise~~ 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 a person consuming it. Also, rearing ~~of~~ poultry involves low investment cost, less land and less risk as compared to other enterprises and produces quick ~~return~~ returns with good FCE and protein ~~source~~ 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, 1981; Deaton, 1983** and **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 do not ~~have the knowledge of~~know adequate stocking density to use **(Muniz *et al.*, ~~2006 and~~2006** and **Adebiyi *et al.*, 2011**). India ~~being~~ is in a sub-tropical region of the world where~~,~~ the prevailing macro-climatic conditions ~~is~~ 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**).

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.

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Materials and Methods

Experimental Design and Management

The study was carried out on 72 one-day-old broiler chicks raised in battery cages until they were five weeks old. These chicks were randomly assigned to three different treatments, with each treatment further divided into sub-groups with eight chicks in each 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, T_2 with 1.33 square feet per bird and T_3 with 1 square foot per bird.

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Data Collection

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

Statistical Analysis

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

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Results and Discussion

Feed consumption:

The data presented in Table 1 indicate that the average feed consumption of chicks was highest ~~in T~~in T_2 (523.54 g) followed by T_3 (504.67 g) and T_1 (491.27 g). However, there was a 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 ~~broiler~~ 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.

Table 1: Average feed consumption of ~~broilers~~ 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**

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Feed conversion ratio

The data presented in Table 2 indicate that the average feed conversion ratio of broiler chicks was highest in ~~the~~ 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 ~~non-~~ no significant effect on the feed conversion ratio in ~~broiler~~ broilers in different stocking ~~density~~densities. **Kumar *et al.*, (2016)** observed that upto five weeks, the feed conversion ratio remained non-significant. However, a 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.

Table 2: Average feed conversion ratio of ~~broilers~~ 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**

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Conclusion

The findings of the present study indicate that stocking density has a non-significant effect on feed consumption and feed conversion ratio (FCR) of caged broilers reared under hot climatic conditions. Broilers reared at a moderate stocking density showed a trend towards higher feed consumption and better feed conversion ratio compared to those reared at lower or 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 consistent with the idea that stocking density alone may not significantly influence feed intake or FCR when managed properly. With effective heat stress management strategies in place, good performance can be achieved 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.

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