Effect of season on growth performance and economics of Cobb-430 chicks reared under deep litter system

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ABSTRACT

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| **Aims:** The study was conducted on broilers (Cobb-430) during summer (May- June), -post-monsoon season (September-October) and winter (December- January) Birds were weekly examined during the 0-35 days for body weight, feed consumption, feed conversion ratio and mortality.**Study design:** The study was conducted on Cobb-430 chicks at the Livestock farm complex, RPS College of Veterinary Sciences, Mahendergarh, Haryana. The study was conducted in three different seasons viz summer (May- June), post-monsoon season (September-October) and winter (December- January).**Methodology:** A total of 1020 day old chicks (Cobb-430) were procured from the hatchery for every seasonal experiment and reared under the same management practices till 35 days. The study was conducted during May, 2024 to January, 2025. The chicks were randomly divided into four replicates after arrival and reared under the same management conditions.**Results:** The body weight of birds (gram) on the 35th day during summer, post monsoon and winter seasons were 1898.75±17.21, 2003.75±19.87 and 1826.2±37.58 respectively, which varies significantly (P=0.05). The study revealed that season significantly affected the growth and body weight gain of birds. The highest weight gain was observed during the post-monsoon period followed by summer and winter. The highest mortality was observed during the winter period (5.7%) followed by summer (3.5%) and post-monsoon (4.4%). The feed conversion ratio during summer, post-monsoon and winter was 1.58, 1.54 and 1.71 respectively. **Conclusion:** The study concluded that more growth in broilers was observed during the monsoon season compared to the winter and summer seasons. |

***Keywords:*** *Poultry, Broiler, FCR, Seasonal effect and Economics*

1. INTRODUCTION

The poultry sector is characterized by rapid growth and broilers are preferred poultry reared worldwide for meat. A short life cycle, less capital investment and quick turnover make broilers different from other livestock rearing (Pareek et al., 2024; Mallick et al., 2020; Bhende, 2006). Selective breeding, feeding improvements and management modifications are responsible for efficient weight gain of broilers (Forseth et al., 2023). According to the UNO 2015 report, the world population will increase by 33% in 2050 calling for a 70% rise in food production. Since chicken is a cheap source of nutrition for people, there will probably be a greater need for poultry meat to fulfil the nutritional demand of the population (Thakur et al., 2013; Ramachandran, 2014).

Broilers are extensively selected for high productivity and quick growth, and they are extremely sensitive to environmental conditions. The birds need ideal environmental conditions in order to reach their full potential. Birds struggle to expel heat as temperatures rise above the thermoneutral zone, which impacts their physiological, biochemical, immunological, behavioural, reproductive, and productive abilities (Pawar et al., 2016). Therefore, suitable indoor climatic conditions are required for optimum growth of broilers. The growth of broilers is influenced by both environmental and genetic factors (Okere, 2014). Climatic changes, seasonal variations and extreme weather are major non-genetic factors affecting the productivity and profitability of broilers (El-Faham et al., 2017). Choosing the right season for broiler farming is important to increase productivity (Koknaroglu and Atilgan, 2007). Season influences the growth of broiler (Udeh and Ighebesuo, 2023) and the selection of season is important for optimum benefit (Samson et al., 2024).

India ranks 5th in global meat production with an annual growth rate of 10-12% in the broiler industry. Haryana has been growing in the poultry sector in last few years. The increasing demand for meat and eggs creates an opportunity for poultry farming in this area (Jha and Prasad 2013; Malik et al., 2022). With the exception of the monsoon season, when humid air from the ocean enters the area, the Mahendragarh district has a tropical steppe climate that is hot and semi-arid. Summers are typically quite hot and winters are chilly. A year has four distinct seasons. The hot weather season, which begins in mid-March and ends in the final week of June followed by monsoon, which lasts until September. The post-monsoon season is the time between September and October. Late November marks the beginning of winter, which lasts until the first week of March. The mean temperature of the experimental area in summer is 41°C (May-June) and in winter is 5.6°C (January) (cgwb.gov.in). This study aims to compare the growth of broilers during different seasons on commercial diets and to find suitable seasons for broiler rearing under these environmental conditions.

2. material and methods

**2.1 Location and duration of work**

The study was conducted at the Livestock farm complex, RPS College of Veterinary Sciences, Mahendergarh, Haryana. The study was conducted in three different seasons viz summer (May- June), post-monsoon season (September-October) and winter (December- January).

**2.2 Experimental birds and management practices**

A total of 1020 day-old chicks (Cobb-430) were procured from the hatchery for every seasonal experiment and reared under the same managemental practices till 35 days. The study was conducted during May, 2024 to January, 2025. The chicks were randomly divided into four replicates after arrival. The birds were reared under a deep litter system. From day one chicks are provided with *ad libitum* feed and water. All birds are fed with commercial feed formulated according to the Bureau of Indian Standards (BIS), 2007. Chicks from day 1-10 were fed with pre-starter ration (CP%-23, ME-3000 Kcal/Kg), from day 11-20 birds were fed with a starter ration (CP%-22, ME-3100 Kcal/Kg), and from day 21 to 35 birds were fed with finisher ration (CP%-20, ME-3200 Kcal/Kg). The birds were vaccinated against New Castle disease (Lasota strain) on the 7th day and Infectious bursal disease (IBD) on the 14th day.

**2.3 Recording of growth traits**

To obtain average body weight twenty-five chicks were weighed individually from each replicate at weekly intervals up to 35 days. The feed intake of birds was measured throughout the experimental period. Feed conversion ratio (FCR) was calculated by following the formula

FCR= (Feed intake (Kg))/(Body weight of birds (Kg))

Mortality percentage was calculated by dividing the number of dead chicks during an experimental period by the number of total chicks multiplied by a hundred.

**2.4 Calculation of economics**

The calculation of economics and benefit-cost ratio was calculated according to Belewu et al. (2018).

**2.5 Statistical analysis**

The statistical analysis of data was done by SPSS software. The data is expressed in the form of Mean± SE. The significant difference between means was calculated at P=0.05.

3. results and discussion

**3.1 Body weight, Feed Conversion ratio (FCR) and Mortality rate**

The average body weight of broilers from the first day to 35 days is presented in Table 1. The mean body weight of day-old chicks was similar among all seasons. At the age of seven days the mean body weight of chicks significantly differed (p<0.05) among the seasons and the average body weight (gram) was 182.37, 185.25 and 180.25 for summer, post-monsoon and winter season. The body weight of birds at the age of 14 days was found 429.75, 458.25, and 368.25 grams for summer, post-monsoon and winter seasons respectively. A significant difference (p<0.05) in body weight during a different season was found at age of 28 days and 35 days. At the 28th day body weight during winter was the least (1292.5 gm) followed by summer (1497.1 gm) and post-monsoon (1652.5). On the 35th day average body weight during summer, post-monsoon and winter was 1898.75, 2000.3 and 1856.2 grams. The graphical representation of growth patterns among different seasons is presented in Figure 1.



**Fig. 1. Graph presenting the growth pattern of birds during different seasons**

The body weight of broilers was significantly affected by seasons. The lowest body weight was observed during the winter season followed by summer. The highest body weight was observed during post-monsoon season. The results of this study are in agreement with Ozel and Bozkurt, 2023 who studied the growth of broilers during different seasons and found that the highest growth was observed in spring and autumn seasons. Thermoneutral zone is required for the comfortable living of broilers. Comfortable environment cause an increase in voluntary feed intake, better survivability and less FCR (Sartori et al., 2001). In our study highest average body weight, least mortality and FCR are observed in post-monsoon season. Similar results were reported by Oliveria et al., 2006 who stated that ambient temperature above 26.3°C and below 24°C negatively affects the weight gain of birds. Heat-stressed birds gained 16% less body weight compared to birds reared in the thermoneutral zone. High temperature also increased the FCR by 19% in birds (Baracho et al., 2018). The optimum rearing temperature for broilers is 18-22 °C (Charles, 2002), any deviation from this range especially upper temperature leads to heat stress in birds (Pawar et al., 2016). Birds try to cope with high temperature by panting. The buccal cavity cannot perform feeding and panting together (Chowdhury et al., 2012; Mack et al., 2013). As a result, birds spent more time on panting rather than feeding. Less weight gain can be attributed to less feed consumption during summer because of heat stress. Birds eat to meet their energy level. Energy generated from feed is partly used to generate heat. As the ambient temperatures are high, birds will eat less to avert more heat being generated from feed. Oakley et al., 2018 and Kumar et al., 2005 stated that the microflora of broilers' intestine varies with season hence reflects in nutrient absorption, gut health and body weight.

Extreme hot and cold weather significantly affect the growth, production and reproduction of livestock and poultry (Vandana et al., 2021). The results of this study are in agreement with Ipek and Sahan, 2006 who stated that cold stress affects feed intake, FCR and weight gain. Lower temperature increases energy metabolism and basal metabolism rate which increase energy utilization. The increased energy demand for heat generation is the main reason for less body weight gain (Chen et al., 2014; Yang et al., 2014). Similar findings were reported by Sarma et al., 2019 and Zhou et al., 2021 who reported high FCR in winters compared to other seasons, suggesting the distribution of nutrients for thermoregulation instead of growth. In contrast Fardos and Reda, 2021 reported that the most favourable season for rearing broiler is winter where lower FCR and more final body weight are observed. Contrary results were reported by Nembilwi, 2002 and Thirumalesh et al., 2012 who stated that seasons have no effect on the growth of broilers. Sneha et al., 2024 conducted a study to find an effect of heat stress on broilers and native chicken, the study revealed that there was a significant reduction in the market weight of broilers during heat stress while no significant reduction in the market weight of native chicken was observed.

**Table 1 Effect of season on body weight of broilers.**

|  |  |  |  |
| --- | --- | --- | --- |
| **Age** | **Body weight (gm) Summer** | **Body weight (gm) Post-monsoon** | **Body weight (gm) Winter** |
| **Day old chicks** | 42.75±0.83 | 44.87±1.18 | 44.62±1.12 |
| **7th day** | 182.37±2.06a | 185.25±1.58b | 180.25±2.88a |
| **14th day** | 429.75±4.57a | 458.25±7.75a | 368.25±3.75b |
| **21st day** | 878.71±11.88a | 995.71±17.11b | 782.85±13.98c |
| **28th day** | 1497.12±30.03a | 1652.5±28.79b | 1292.5±26.81c |
| **35th day** | 1898.75±17.21a | 2003.75±19.87b | 1856.2±37.58c |

a,b,c values within a row with different superscripts differ significantly at (*P* = .05)

**Table 2 Effect of season on FCR of birds.**

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Summer** | **Post-monsoon** | **Winter** |
| **Feed Intake (gm) during 35 days** | 3015±38.06 | 3098±29.81 | 3138±51.54 |
| **Weight**  | 1898.75±17.21 | 2003.75±19.87 | 1826.2±37.58 |
| **FCR** | **1.58** | **1.54** | **1.71** |

The mortality rates during different seasons were ranging between 3.5-5.7 % (Table 3). The highest mortality rate was observed during summer (5.7%) and the lowest mortality rate was observed in post-monsoon season (3.5%). Least mortality was observed during post-monsoon season (3.5%). Low liveability in summer can be attributed to heat stress, poor immunity resulting in heat stroke, high chances of infection and ultimately death (Sarma *et al.*, 2014). High mortality in winter was reported by Hassan and Reda, 2021. Although seasons have no significant effect on mortality, slightly high mortality was observed in winter and spring (Petracci *et al.*, 2006).

**Table 3 Effect of season on mortality% of birds.**

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Summer**  | **Post-monsoon** | **Winter** |
| **Mortality%** | 5.7% | 3.5% | 4.4% |
| **Number of birds left at selling day** | 961 | 984 | 977 |

**3.2 Effect of season on cost of production and economics**

The cost of production and economics of the broiler is presented in Table 4. Regarding economics, the highest profit per bird (Rs. 22.45) was observed during post-monsoon season followed by summer (Rs. 13.05) and the least profit per bird was observed during winter (Rs. 9.11). The highest profit per bird during the post-monsoon season can be attributed to good growth, least mortality and FCR among the seasons. The cost of broiler production varies according to management practices adopted at the farm, season and geographical locations (Iqpal et al*.*, 2012). Hassan and Reda, 2021 reported more profit, weight gain, and lower cost of production during winter. The demand for broilers is high during winter which causes high market prices during winter and is responsible for high profits during winter season Ramadur et al*.*, 2010. Similar results were reported by Sarma et al*.*, 2019 who stated that the highest cost of production was observed during the monsoon season followed by the winter season. Mcdowell *et al.*, 1972 reported a high cost of production during summer which could be attributed to high FCR. Haque et al*.*, 2011 reported that a better benefit-cost ratio (BCR) was obtained during post-monsoon season because of better FCR and price during this season. Contrary to this, Sarma et al*.*, 2019 reported that maximum gross profit was highest in the winter season and minimum during the monsoon season. The profit was attributed to the high price. The variation in data may be because of differences in geographical location, management practices, and prices of feed and live birds.

**Table 4 Effect of season on cost of production and economics of broilers**

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Summer**  | **Post-monsoon** | **Winter** |
| **Cost of chicks @ 35 rs/chick**  | 35000 | 35000 | 35000 |
| **Cost of rearing of birds from day 1 to 35** |
| Pre-starter ration (day 1-10)25 gm per chick for 10 days = 250 kg @ 42 Rs/Kg | 10500 | 10500 | 10500 |
| Starter ration (day 11-20) 125 gm per chick for 10 days =1250 kg @ 42 Rs/Kg | 52500 | 52500 | 52500 |
| Finisher ration (days 21-35) | 1515 kg @ 42 Rs/kg = 63630 | 1598 kg @ 42 Rs/kg = 67116 | 1638 kg @ 42 Rs/kg = 68796 |
| Miscellaneous @ 2 Rs/bird | 2000 | 2000 | 2000 |
| **A. Total expenses/Cost of production** | **163630** | **167116** | **168796** |
| Income from the sale of 35 days old birds  | 1.898 Kg x 961 birds @97 Rs/kg live weight | 2.003 Kg x 984 birds @96 Rs/kg live weight  | 1.856 Kg x 977 birds @98 Rs/kg live weight |
| **B. Gross income**  | 176180 | 189211 | 177704 |
| **Net Income (B-A)** | **12550** | **22095** | **8908** |
| Profit/bird | 13.05 | 22.45 | 9.11 |

4. Conclusion

Suitable macro and micro environments both are equally important for the growth of broilers. This study highlights how season impacts growth, FCR and mortality of birds which ultimately affects the economy of farms. The study revealed that post-monsoon season is most profitable for broiler rearing which can be attributed to good growth, low mortality and FCR.

**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.

References

Baracho, M, S., Nääs, I, D, A., Betin, P, S, and Moura, D, J. (2018). Factors that influence the production, environment, and welfare of broiler chicken: A systematic review. Brazilian Journal of Poultry Science, 20(03), 617-624.

Belewu, K. Y., Ibrahim, H. K., Ajibade T. B. and Adewusi, O. G. (2018). The cost benefit analysis of incorporating fungus treated Castor seed cake (FTCSC) (Ricinus communis) in the diet of (WAD) GOAT. Applied Tropical Agriculture, 23(2), 77-81.

Bhende MJ. (2006). Production and cost of broiler meat: a case study. Karnataka Agricultural Development and Rural Transformation Center, Research Report. Institute for Social and Economic Change, Bangalore

cgwb.gov.in/old\_website/District\_Profile/Haryana/Mahendragarh.pdf

Charles DR. (2002). Responses to the thermal environment. In: Charles DA, Walker AW (eds) Poultry environment problems, a guide to solutions. Nottingham University Press, Nottingham, pp 1–16

Chen, X.Y., Li, R., Wang, M. and Geng, Z.Y. (2014). Identification of differentially expressed genes in hypothalamus of chicken during cold stress. Molecular Biology Reports, 41, 2243–2248.

Chowdhury, V.S., Tomonaga, S., Nishimura, S., Tabata, S. and Furuse, M. (2012). Physiological and behavioral responses of young chicks to high ambient temperature. The Journal of Poultry Science, 49(3), pp.212-218.

El-Faham, A,I., Ibrahim, S, A., El-Safty, S, A., Hussanien, M, S., Ali, G, M. and Rayan, G, N. (2017). Field study for seasonal effect on productive performance of broiler breeder chickens. Egyptian Journal of Nutrition and Feeds 20(2): 131-137. https://doi.org/10.21608/ ejnf.2017.104072

Forseth, M., Moe, R, O., Kittelsen, K., Skjerve, E., & Toftaker, I. (2023). Comparison of carcass condemnation causes in two broiler hybrids differing in growth rates. Scientific Reports, 13(1), 4195.

Haque A. (2011). Seasonal effect on performance of broiler at different management regime and its impact on farmer’s profitability. Fifth Biennial Report: 17- 18. Sher-e-Bangla Agricultural University RES.

Hassan, F. A. M. and Reda, R. (2021). Seasonal impact on growth performance, economic feasibility, hematological indices, and blood biochemical composition of broiler chickens. Journal of Animal Health and Production, 9(4), 471-478.

Ipek, A. and Sahan, U. (2006). Effects of cold stress on broiler performance and ascites susceptibility. Asian-Australasian Journal of Animal Sciences, 19(5), 734-738.

Iqpal, J., Ashgar, A, M., Tanveer, A., Shamsul, H. and Sohail, H, K. (2012). Comparative performance of different economic traits of four imported broiler strains under local conditions of Pakistan. Pakistan Journal of Agricultural Research. 25(1):76-82. http://www. pjar.org.pk/

Jha, D, K. and Prasad, S. (2013). Production performance of improved varieties and indigenous breed of chicken in Jharkhand. Indian Journal of Poultry Science, 48(1), 109-112.

Koknaroglu, H. and Atilgan, A. (2007). Effect of season on broiler performance and sustainability of broiler production. Journal of Sustainable Agriculture. 31(2): 113-124. https://doi. org/10.1300/J064v31n02\_08.

Kumar, M., Choudhary, R, S. and Vaishnav, J. K. (2005). Effect of supplemental prebiotic, probiotic and turmeric in diet on the performance of broiler chicks during summer. Indian Journal of Poultry Science, 40(2), 137-141.

MacDowell, R, E. (1972). Improvement of livestock production in warm climates. W. H. Freeman, San Francisco. http://aims. fao.org/node/122535

Mack, L, A., Felver-Gant, J, N., Dennis, R, L. and Cheng, H, W. (2013). Genetic variations alter production and behavioral responses following heat stress in 2 strains of laying hens. Poultry Science. 92(2):285–294. https:// doi.org/10.3382/ps.2012-02589

Malik, D. P., Kundu, K, K. and Nimbrayan, P. K. (2022). Economic Cost and Profit Analysis of Poultry Industry in Mahendergarh District of Haryana. Journal of Agriculture Research and Technology, 47, 27-31.

Mallick, P., Muduli, K., Biswal, J, N. and Pumwa, J. (2020). Broiler poultry feed cost optimization using linear programming technique. Journal of operations and strategic planning. 3(1): 31-57. https:// doi.org/10.1177/2516600X19896910

Nembilwi D. (2002). Evaluation of broiler performance under small-scale and semi-commercial farming conditions in Northern Province. Dissertation, Degree of Magister Technologiae Agriculture in the Departement of Agricultural Management at Port Elizabeth Technikon, George Campus, Port Elizabeth.

Oakley, B, B., Vasconcelos, E, J., Diniz, P, P., Calloway, K, N., Richardson, E., Meinersmann, R, J., Cox, N, A. and Berrang, M, E. (2018). The cecal microbiome of commercial broiler chickens varies significantly by season. Poultry Science, 97(10), 3635-3644.

Okere I. (2014). Growth traits, breast meat yield and quality of broiler genotypes under hot conditions. Iranian Journal of Applied Animal Science. 4(1): 159-164.

Oliveira, R, F, M, D., Donzele, J, L., Abreu, M, L, T, D., Ferreira, R, A., Vaz, R, G, M, V., and Cella, P, S. (2006). Efeitos da temperatura e da umidade relativa sobre o desempenho e o rendimento de cortes nobres de frangos de corte de 1 a 49 dias de idade. Revista Brasileira de Zootecnia, 35, 797-803.

Özel, F. and Bozkurt, Z. (2023). The Effect of Season on the Performance, Health, and Welfare of Broilers. Harran Üniversitesi Veteriner Fakültesi Dergisi, 12(2), 196-201.

Pareek, A., Khan, A., Brahma, B. and Konwar, D. (2024). Laying Performance of Kadaknath Chicken under Deep Litter System. Journal of Animal Research, 14(01): 67-70.

Pawar, S, S., Sajjanar, B., Lonkar, V, D., Kurade, N, P., Kadam, A, S., Nirmal, A, V., Brahmane, M, P. and Bal, S, K. (2016). Assessing and mitigating the impact of heat stress on poultry. Advances in Animal and Veterinary Science. 4(6): 332–41.

Petracci, M., Bianchi, M., Cavani, C., Gaspari, P. and Lavazza, A. (2006). Preslaughter mortality in broiler chickens, turkeys, and spent hens under commercial slaughtering. Poultry Science, 85(9), 1660- 1664.

Ramachandran R. (2014). Current and future reproductive technologies for avian species. Journal of Advances in Experimental Medicine and Biology. 752: 23-31. https://doi.org/10.1007/978-1-4614-8887-3\_2.

Ramdur, A, J., Khan, H, S, S., Martur, M, D. and Mahajanshetti, S, B. (2010). An analysis of seasonality and growth trends in marketing of poultry eggs and chicken in Dharwad district. Karnataka Journal of Agricultural Science. 23: 632-634.

Samson, A, D, E., SANUBI, O, J., OSUZOKA, E, N., & IGHOBESUO, O, B. (2024). Comparative evaluation of seasonal variation on growth performance and morphometric traits in broiler chicken strains raised in the tropics. Journal of Agriculture, Food, Environment and Animal Sciences, 5(1), 70-79.

Sarma, M., Borah, M, K., Kalita, K., Mahanta, J., Kalita, N., Talukdar, J., Deka, P., Amonge, T. and Islam, R. (2019). Effect of Season on Performance of Broiler Chicken Under Deep Litter System of Management in Assam. International Journal of Livestock Research. 9(7): 246- 253. https://doi.org/10.5455/ijlr.20181029040524.

Sartori, J, R., Gonzales, E., Dal, Pai, V., Oliveira, H, N, D. and Macari, M. (2001). Efeito da temperatura ambiente e da restrição alimentar sobre o desempenho e a composição de fibras musculares esqueléticas de frangos de corte. Revista Brasileira de Zootecnia, 30, 1779-1790.

Sneha, K., Dash, S, K., Dubey, P, P., Malav, O, P., & Malhotra, P. (2024). Effect of heat stress on growth, carcass and sensory parameters in synthetic broiler and native cross chicken.

Thakur, D., Sharma, A, K., Ravikumar, R, K. and Katoch, S. (2012). Status of backyard poultry farming in Himalayan regions of India. Indian Journal of Poultry Science, 47(1), 102-105.

Thirumalesh, T., Ramesh, B, K. and Suresh, B, N. (2012). Influence of season on nutrient intake and performance of broilers in arid region of Karnataka. Indian Journal of Animal Research. 46(1):78-81.

Udeh, I., Ezebor, P, O., Akporahuarho, P, N. (2023). Growth performance and carcass yield of three commercial strains of broiler chickens raised in a tropical environment. Growth, 5(2): 62-67.

Vandana, G, D., Sejian, V., Lees, A, M., Pragna, P., Silpa, M, V. and Maloney, S, K. (2021). Heat stress and poultry production: impact and amelioration. International Journal of Biometeorology, 65, 163-179.

Yang, X., Luo, Y, H., Zeng, Q, F., Zhang, K, Y., Ding, X, M., Bai, S, P. and Wang, J, P. (2014). Effects of low ambient temperatures and dietary vitamin C supplement on growth performance, blood parameters, and antioxidant capacity of 21-day-old broilers. Poultry Science. 93, 898–905

Zhou, H, J., Kong, L, L., Zhu, L, X., Hu, X, Y., Busye, J. and Song, Z, G. (2021). Effects of cold stress on growth performance, serum biochemistry, intestinal barrier molecules, and adenosine monophosphate-activated protein kinase in broilers. Animal, 15(3), 100138.