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Comparative Optimization of Hatch Brood for Efficient Growth and Survival Rate of Newly Hatched Chicks

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Abstract

Poultry plays a very important role in global food security, and economy due to its valuable contribution to the food economy through the meat and eggs component of their food. Practices in conventional brooding systems which include late provision of food and water upon hatching are however dangerous to ideal growth, chick survival and growth. The experiment was designed to evaluate the effect of a design with optimized design of hatch brood with special focus on access to feed and water early in the life of the chicks on growth performance, mortality and overall well being of the newly hatched chicks. Three treatments, i.e. Control Group (Traditional Floor Brooding) and Treatments A (Unoptimized Feeding and Watering) and B (Optimized Early Feeding and Watering with improvement of environmental conditions) were run in a controlled experiment. A total of 3,600 chicks were needed in the experiment with 1,200 chicks in each group of treatment. The primary parameters observed were weight gain, death rate, signs of dehydration and respiratory distress and at two times every day during a duration of 7 days behavioural observations were carried out. The result of the study indicated that the treated chicks in Treatment B were exponentially superior concerning weight gains, reduced deaths and lowered stress reactions, as compared to the Control Group and chicks in Treatment A. Supply of balanced feed and clean water early in the day were found to increase the metabolic activation and feed intake in the first hours, which resulted in a better growth performance and flock uniformity. The One-Way Analysis of Variance (ANOVA) was used to statistically analyze the data gathered in the experiment to determine whether it was significant or not that there were deviations among the treatment groups. The improvements observed in Treatment B proved to be statistically significant ($p < 0.05$); hence, early nutritional support was effective in hatch brooding systems.

Keywords: *Precision land levelling, water deficient management, soil texture, water use efficiency.*

Introduction

Poultry industry is a significant component of the agricultural sector as it is a source of national food security and income in the agricultural company because the industry produces high-quality protein in the form of meat and eggs (Khyber et al., n.d.). Poultry farming is one of the fastest-growing agricultural enterprises and substantially helps meet the increasing protein demands of the ever-increasing global population. As this demand for poultry products continues to grow, sustainable (Ullah et al, 2023) and more effective farming practice is required (Marmelstein et al., 2024). Commercial poultry production has contributed towards the use of technology which has enhanced higher efficiency and productivity. However, even after these inventions, various traditional practices are also present as well as huge potential remain unexplored in poultry production (Soviadan et al., 2024).

One of the most significant areas in which new technologies are needed to be implemented is the hatching of chicks, particularly when they are still in the brooding phase, which constitutes the first ten days of the life of a chick (Singh et al., 2023). This is the first step that is very important and decisively establishes the pace of survival, productive success, and overall productivity. Newly hatched chicks are immature thermoregulators and are very sensitive to external factors such as temperature, humidity, ventilation, and the availability of food and water (Molenaar et al., 2023). The traditional practices that delay provision of feed and water to chicks, believe that the remaining yolk sac can provide nutriment that they need within the initial 24-48 hours after hatching. However, according to the latest studies, this practice can lead to severe outcomes like, increased mortality rates, decreased rate of growth, and overall efficiency (Oke et al., 2020). Poor early nutrition and hydration can lead to dehydration, starvation, stress and diseases (Asmat et al, 2022), which eventually become expensive to poultry producers in terms of high feed conversion ratios and reduced productivity (Hollemans et al., 2018).

Feed and water as early nutrition help develop the guts (Rehman et al, 2023), enhance metabolism, and help the immune system in the chick, leading to an increased long-term growth potential (Özlü et al., 2022). Hatch brood designs should therefore be optimized to ensure that chicks receive the optimized environmental conditions, feed and water upon hatching (Noiva et al., 2014). Hatch brood designs should therefore be optimized to ensure that chicks receive the requisite environmental conditions, feed and water upon hatching.

Materials and Methods

Experimental Design and Setup

The experiment was done in Faisal Chicks, a well established chicken farming facility with a modern hatchery that was able to supply the required samples due to their conformity with industry standards relating to hygiene, environmental regulation and bio security that limited the effect of extraneous factors on the outcome. A Randomized Complete Block Design (RCBD) (Ali et al, 2021) was employed to reduce the impact of uncontrolled variables and isolate the effects of the treatments. Three groups of treatment were involved in the study to compare various approaches to early management. The Control Group followed traditional floor brooding practices where feed and water were withheld for the first 24-48 hours post-hatch (Naqvi et al, 2023). Treatment A provided unoptimized access to feed and water, representing an unoptimized hatch brood system. In treatment B, a fully optimized hatch brood system was employed wherein there was direct and instant access to feed and water, as well as improved environmental controls.

A total of 3,600 commercial layer chicks, sourced from the Faisal Hatchery Unit, were used for the experiment. They were separated into three treatment groups, and 1200 chicks per treatment were placed in three replications. On arrival, a health screening was done on all chicks and a sample of chicks (selected randomly) was weighed to set a baseline data. The healthy chicks were then distributed randomly into their different treatment groups to remove selection bias. The hatch brood units applied had a capacity to contain 39,600 chicks per unit and made of hygienic material so that they provide favorable conditions of survival and growth.

During the study, strict biosecurity was maintained, such as restricting individuals in access, where only authorized persons were involved and these individuals adhered to high standards of sanitation and regular health checks. The schematics of the experimental procedure are shown in Figure 1.

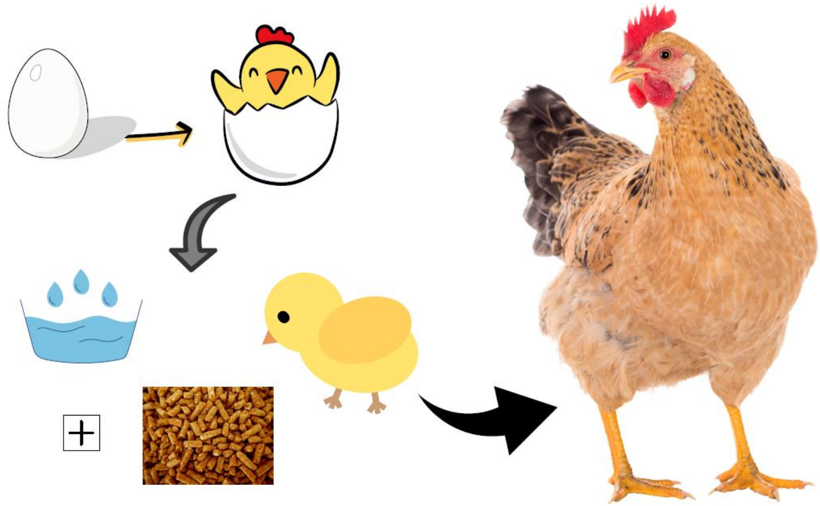

Figure 1: Schematic diagram of experimental procedure

Environmental and Nutritional Management

Various environmental factors were carefully controlled among the treatments to help maintain steady and ideal conditions. Temperature was maintained based on the age of the chicks, 32-34°C on the first three days then reduced gradually. Relative humidity too was initially kept at 55-65% and also decreased with time. Ventilation was regulated to maintain the velocity of air to avoid respiratory problems with the level of carbon dioxide at no more than 3,000 ppm and the level of ammonia at no more than 10 ppm. Implementation of a certain lighting scheme was used with the first 48 hours on continuous light to facilitate the early feeding and water and followed by the 20 hours of light, 4 hours of dark to promote natural resting periods.

The feeding and watering protocols were the primary difference between the groups. As noted, the Control Group chicks were deprived of feed and water for the initial 24-48 hours. In Treatment A, chicks were given immediate but unoptimized access, while Treatment B provided immediate and fully optimized access with strategically placed feeders and drinkers for easy availability. For the groups receiving feed, a commercial pre-starter crumble feed with 23-24% crude protein was used.

Data Collection

Data on key performance indicators were collected systematically throughout the seven-day experimental period. To measure weight gain, chicks were weighed individually at the start of the experiment and subsequently every three days. Mortality was tracked by recording any deaths twice daily, from which a mortality rate was calculated for each group. Furthermore, detailed physical observations were conducted twice a day to assess chick well-being, specifically noting signs of dehydration, any symptoms of respiratory distress, and significant behavioral changes as shown in Figure 2. The performance of the chicks in each group was monitored to evaluate the effects of the different brooding management strategies.

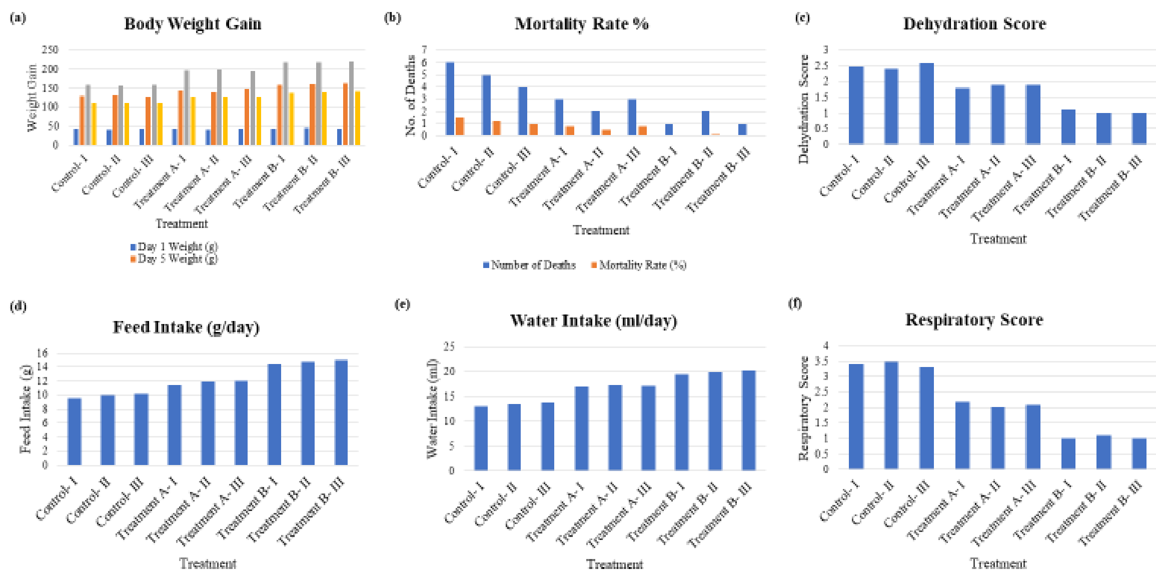

Figure 2: Analysis of chick **(a)** Body Weight **(b)** mortality Rate % **(c)** Dehydration Score **(d)** Feed Intake % **(e)** Water Intake **(f)** Respiratory score

Statistical Analysis

The data collected from the experiment were analyzed using a single-factor Analysis of Variance (ANOVA) at a 5% significance level. This statistical method was chosen to compare the means of the different performance parameters across the three treatment groups (Badar et al., 2024). The null hypothesis (H_0) was that the optimization of the hatch brood design has no statistically significant effect on chick survival, growth, or health. The alternative hypothesis (H_1) was that the optimization does have a statistically significant effect. The analysis was performed using Microsoft Excel.

Results

Body Weight Gain

Chicks in Treatment B showed the highest cumulative weight gain, with an average of 219 grams. The Treatment A group had an average weight gain of 198 grams, while the Control group had the lowest average at 110 grams as shown in Table 1.

Table 1: Body Weight Gain of Chicks by Treatment and Replication (g)

Treatment	Day 1 Weight (g)	Day 5 Weight (g)	Day 10 Weight (g)	Cumulative Weight Gain (g)
Control- I	42	130	159	110
Control- II	41	132	158	110
Control- III	42	128	160	110
Treatment A- I	42	145	198	128
Treatment A- II	41	140	200	127
Treatment A- III	42	148	195	128
Treatment B- I	42	159	218	139
Treatment B- II	45	161	219	141
Treatment B- III	43	163	220	142

Mortality Rate

The mortality rate was highest in the Control group, with an average of 1.25%. Treatment A had a lower average mortality rate of 0.67%, and Treatment B had the lowest at just 0.075% as shown in Table 2.

Table 2: Mortality per 400 Chicks per Replication

Treatment	Number of Deaths	Mortality Rate (%)
Control- I	6	1.5
Control- II	5	1.25
Control- III	4	1.00
Treatment A- I	3	0.75
Treatment A- II	2	0.50
Treatment A- III	3	0.75
Treatment B- I	1	0.05
Treatment B- II	2	0.1
Treatment B- III	1	0.075

Feed and Water Intake

Feed and water intake were highest in the Treatment B group, with an average daily feed intake of 14.8 grams and an average daily water intake of 19.9 ml. The Control group had the lowest intake for both as shown in Table 3.

Table 3: Average Daily Feed and Water Intake per Chick by Replication (g)

Treatment	Feed Intake (g/day)	Water Intake (ml/day)
Control- I	9.5	13.0
Control- II	10.0	13.5
Control- III	10.2	13.8
Treatment A- I	11.5	17.0
Treatment A- II	11.9	17.3
Treatment A- III	12.0	17.2
Treatment B- I	14.5	19.5
Treatment B- II	14.8	20.0
Treatment B- III	15.0	20.2

Dehydration and Respiratory Distress Scores

Dehydration and respiratory distress scores were lowest in the Treatment B group, indicating better overall health. The Control group had the highest scores, reflecting the negative impact of delayed feed and water access.

Table 4: Dehydration Scores (1 = None, 3 = Severe) and Respiratory Distress Scores (1 = None, 5 = Severe) per Chick by Replication

Treatment	Dehydration Score	Respiratory Score
Control- I	2.5	3.4
Control- II	2.4	3.5
Control- III	2.6	3.3
Treatment A- I	1.8	2.2
Treatment A- II	1.9	2.0
Treatment A- III	1.9	2.1
Treatment B- I	1.1	1.0
Treatment B- II	1.0	1.1
Treatment B- III	1.0	1.0

Discussion

The findings of this experiment indicate clearly the remarkable value of an optimized hatch brood condition on hatched chicks (Lingens et al., 2021). Treatment B, which provided immediate access to feed and water along with controlled environmental conditions, lead to better performance overall on the considered parameters against the traditional and unoptimized procedures (Ravindran & Reza Abdollahi, 2021).

The increased weight gain in Treatment B corresponds to the results of previous studies which indicate that post hatch feeding contributes to early growth and early development (de Jong et al., 2020). The elevated feed and water intake in this category also suggests that feeding behavior and improved metabolism will be facilitated by an optimized environment at the early stage (Métayer-Coustard et al., 2021).

The fact that the mortality of Treatment B was significantly reduced also highlights the importance of early nutrition and that stable environment is crucial to enhance the survival of chicks (Adaszyńska-Skwirzyńska et al., 2025; Arevan et al., 2023). The reduced dehydration and respiratory distress scores in this group further support the conclusion that optimized brooding conditions minimize physiological stress and promote better health (Apalowo et al., 2024).

The enhanced Feed Conversion Ratio (FCR) in Treatment B also gets great economic considerations of the poultry industry. A more efficient conversion of feed to body weight translates directly to lower production costs and higher profitability (Arevan et al., 2023).

Conclusion

This study gives strong results that the nest construction of hatch brood that enables the new chicks to have immediate access to food and water, and specific control of the environment, contributes greatly to the growth, survival, and health of newly hatched chicks (Lingens et al., 2021). The results prove that shifting to new and less conventional forms of delayed feeding will significantly increase the efficiency and profitability of poultry production (Molenaar et al., 2023). Efficient hatch brood systems, including the one compared in Treatment B, are one of the major steps towards more sustainable and successful poultry farming (Marmelstein et al., 2024).

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