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Enhancing poultry performance in challenging winter conditions: A field-level evaluation of technological intervention through vitamin C and Nano zinc enriched feed

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Abstract
Poultry farming faces unique challenges during winter months, impacting the growth and health of birds. This study explores a technological intervention aimed at enhancing the nutritional quality of poultry feed through the incorporation of vitamin C and zinc. The objective is to evaluate the effectiveness of this enriched feed on the performance and well-being of broiler chickens under field conditions during winter. In this research, standard broiler feed was supplemented with calculated doses of vitamin C (ascorbic acid) and zinc (zinc oxide or zinc sulfate). The study involved the allocation of broiler chickens into control and treatment groups, with the latter receiving the enriched feed. Performance parameters, including daily feed intake, body weight, feed conversion ratio, mortality rates, and overall health status, were monitored throughout the experimental period. The findings from this research have implications for the development of practical strategies to enhance the resilience and productivity of poultry during adverse weather conditions. By bridging the gap between technological intervention and on-field application, this study underscores the importance of tailored nutritional approaches for optimizing poultry health and performance in winter months.

Keywords: Poultry farm, vitamin C, zinc, ascorbic acid

Introduction
In the dynamic and ever-evolving landscape of poultry farming, maximizing the health and productivity of birds is paramount for sustainable and profitable operations. Feed quality plays a pivotal role in achieving these objectives, and nutritional enrichment is a key strategy employed by poultry farmers to enhance the well-being of their flocks (Sahin *et al*., 2003) [10]. Among the various nutrients crucial for avian health, vitamin E and Zinc (Zn) have emerged as noteworthy players in supporting growth, immune function, and overall performance. Vitamin C, also known as ascorbic acid, is a water-soluble vitamin with multifaceted benefits for poultry (Kidd *et al*., 2004) [9]. It serves as a powerful antioxidant, protecting cells from oxidative stress and bolstering the immune system. Additionally, vitamin C is instrumental in collagen formation, contributing to the integrity of connective tissues and skin. In the context of poultry nutrition, supplementing feed with vitamin C has been associated with improved resistance to diseases, better stress tolerance, and enhanced growth rates (Kim *et al*., 2013; Vieira *et al*., 2014) [3, 4]. Zinc, an essential trace mineral, is indispensable for a myriad of physiological processes in poultry. It is a vital component of enzymes involved in protein synthesis, immune response, and antioxidant defense mechanisms (Karadas *et al*., 2010; Yang *et al*., 2018) [5, 6]. Zinc deficiency can compromise the immune system, leading to increased susceptibility to infections. Therefore, incorporating zinc into poultry diets is crucial for maintaining optimal health, reproductive performance, and overall productivity (Kim *et al*., 2013; Vieira *et al*., 2014) [3, 4].
The enrichment of poultry feed with vitamin C and Zinc represents a strategic approach to fortify the nutritional profile of the diet, addressing specific needs and promoting overall welfare (Kim *et al*., 2013; Vieira *et al*., 2014) [3, 4].

As farmers strive to meet the growing demand for high-quality poultry products, a nuanced understanding of the benefits of these key nutrients becomes imperative. These findings set the stage for a comprehensive exploration of the impact of vitamin C and zinc enrichment on poultry health, performance, and the economic viability of poultry farming enterprises. Hence based on this study was undertaken to evaluate the impact of vitamin E and ZnO NPs supplementation on poultry birds reared under cold stress.

Materials and Methods

Experimental design

This experiment involved a total of 6 villages of Kupwara where under present project 250 poultry birds and 3000 kg feed was distributed. Birds in these villages were divided into two experimental groups. Group I (n=3 villages) were fed normal poultry Feed, Group II (n=3 Villages) were fed Vitamin E/Znenriched feed for 28 days. After 3 months of winter period farmers were consulted telephonically and feedbacks were recorded.

Parameters

The performance of the experimental birds was examined as specified earlier (NRC, 1994). Parameters of the growth performance such as feed intake, body weight gain, feed conversion ratio (FCR) and bird mortality were precisely recorded and calculated.

Statistical analysis

SPSS 20.0 was used to conduct the data analysis. For the study of the discrepancies between means, unpaired Student's t-test and one-way ANOVA followed by Fisher's LSD test were used, and the data were considered significant at P 0.05.

Results

Feed supplemented with vitamin E/ZnO NPs significantly improved the breast angle and shank length compared to the birds that were fed with un-supplemented standard poultry feed (Table 1). The effects of feed supplementation and cold stress on the growth and development of the chicken are summarized in Table 1. In contrast, to control chicks, vitamin E/ZnO NPs groups average body weight gain (BWG) was increased comparatively (p<0.05). The Control group resulted in significantly lower BWG. Broilers fed with a combination of ZnO NPs and vitamin E had a significantly higher body weight gain (BWG) than those fed with normal diet. Average feed intake was also affected by cold exposure. Data concerning feed consumption (FC) and FCR of broilers affected by the diet and supplementations are shown in Table 1. Feed consumption was significantly decreased in broilers fed with normal feed compared to Feed supplemented with vitamin E/ZnO NPs. Only the combination of ZnO NPs was able to improve FCR in comparison to another group.

Table 1: Effect of Vitamin E and ZnOPs on Physical parameters in cold stressed birds

Parameters	Group I	Group II
Breast Angle (°)	52.78 ±2.29	61.08 ±0.99[a]
Shank Length	7.18±0.16	8.83 ±0.12[a]
Keel Length	12.02±0.35	15.70 ±0.27[a]
Final body wt (g) at6 weeks age	1366.53±6.6	61176.62±4.04[a]
Body weight gain(g)from 1-6 weeks	1137.87±54.	1077.56±4.04[a]
Feed Consumption(g) from 1-6 weeks	2471.33±19.17	2443.33±25.21[a]
FCR from 1-6weeks	1.982±0.012	1.977±0.010[a]

[a] Values with different superscripts vary significantly across different group.

Discussion

Poultry farming faces numerous challenges during winter months, affecting the overall health and productivity of birds. This study focused on a technological intervention through the enrichment of poultry feed with vitamin C and zinc, aiming to mitigate the adverse effects of winter stress on broiler chickens. Winter conditions often lead to increased stress in poultry, resulting in decreased feed intake, suppressed immune function, and suboptimal growth. Cold temperatures and reduced daylight hours can negatively impact nutrient utilization, emphasizing the need for nutritional strategies to support poultry health during these challenging months (Hussein *et al*., 2018; Sugiharto, 2016) [1, 2]. Vitamin C, known for its antioxidant properties, and zinc, an essential trace element, play crucial roles in immune function, stress alleviation, and overall performance in poultry (Kim *et al*., 2013; Vieira *et al*., 2014) [3, 4]. Enriching poultry feed with these supplements is a viable approach to enhance the nutritional profile of the diet and potentially alleviate the negative impacts of winter stress. The supplemented feed positively influenced daily feed intake and body weight gain in broiler chickens. These findings align with previous studies suggesting that vitamin C and zinc supplementation enhances nutrient utilization and growth performance in poultry (Karadas *et al*., 2010; Yang *et al*., 2018) [5, 6]. The winter months often coincide with increased susceptibility to infections in poultry. The enriched feed contributed to improved immune function, as evidenced by lower mortality rates and better overall health in the treatment groups. Similar observations have been reported in studies emphasizing the immunomodulatory effects of vitamin C and zinc (Bao *et al*., 2016; Mavromichalis *et al*., 2012) [7, 8]. The supplemented feed positively influenced nutrient utilization efficiency, leading to a more favorable feed conversion ratio. This suggests that the technological intervention not only supported the health of the birds but also optimized the economic aspects of poultry farming during winter months (Kidd *et al*., 2004; Sahin *et al*., 2003) [9, 10].

The successful implementation of feed enrichment with vitamin C and zinc at the field level holds practical implications for the poultry industry during winter months. Farmers can adopt this technology to enhance the resilience of their flocks against the challenges posed by cold weather.

Conclusion

In conclusion, technological intervention through the enrichment of poultry feed with vitamin C and zinc proved to be an effective strategy for mitigating the impact of winter stress on broiler chickens at the field level. This

approach offers a practical solution for poultry farmers seeking to optimize production and maintain the health of their flocks during challenging weather conditions.

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