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Comparative profitability of supplementation of vitamin C, vitamin E and organic chromium and its combination in Narmadanidhi birds during summer season

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Abstract

The current investigation aimed to evaluate the economic viability of supplementing vitamin C (ascorbic acid), vitamin E, organic chromium, and their combinations in Narmadanidhi birds reared under summer stress conditions. A total of 240 day-old, coloured dual-purpose Narmadanidhi chicks were randomly assigned to 12 dietary treatments, with each group consisting of 20 chicks in two replicates. Birds were housed in individual pens and managed under a deep litter system. Starter and finisher diets were formulated and offered from 0–6 weeks and 7–12 weeks of age, respectively. The dietary treatments included: C_0 (control), C_1 (150 mg/kg ascorbic acid), C_2 (250 mg/kg ascorbic acid), E_1 (125 mg/kg vitamin E), E_2 (200 mg/kg vitamin E), Cr_1 (1.25 mg/kg chromium propionate), Cr_2 (2.0 mg/kg chromium propionate), and combination groups: C_2E_1, C_2E_2, C_2Cr_1, C_2Cr_2, and $C_2E_1Cr_2$. Body weight gain and feed intake were recorded for three phases: 0–6 weeks, 7–12 weeks, and the overall 0–12 weeks. Based on the feed consumption and prevailing market prices, cost per kg of feed and total feeding cost per bird were calculated for each period. Subsequently, the income from bird sales and gross profit over feeding cost were estimated. Results revealed that the C_2Cr_1 group achieved the highest gross profit per bird (₹44.20) and per kg live weight (₹35.08) compared to all other treatments. The next most profitable group was $C_2E_1Cr_2$. Among the single supplement groups, C_2, E_2, and Cr_2 outperformed their lower-level counterparts (C_1, E_1, Cr_1) in terms of both profit per bird and per kg live weight. In conclusion, supplementation with vitamin C, vitamin E, and organic chromium, particularly the combination C_2Cr_1, significantly improved the economic return in Narmadanidhi birds under summer stress conditions.

Keywords: Vit C, Vit E, Cr, Narmadanidhi, profitability, summer

Introduction

Poultry production is highly vulnerable to environmental stressors, particularly during the summer season when elevated ambient temperatures adversely affect bird performance, immunity, and overall productivity. Heat stress leads to oxidative damage, suppressed immune response, reduced feed intake, poor growth, and increased mortality, ultimately impacting the profitability of poultry enterprises (Zheng *et al*., 2016 and Sahin *et al*., 2009) [8,6]. Nutritional interventions through dietary supplementation of antioxidants and stress-relieving agents have emerged as practical strategies to alleviate the negative effects of thermal stress in poultry. Among the nutritional supplements, Vitamin C (ascorbic acid) plays a crucial role in enhancing thermo-tolerance and immune function due to its potent antioxidant properties and involvement in adrenal function under stress conditions (McKee and Harrison, 1995) [4]. Vitamin E a fat-soluble antioxidant helps maintain cellular membrane integrity and enhances resistance against oxidative stress-induced tissue damage (Sahin *et al*., 2002) [7]. On the other hand, organic chromium an essential trace mineral, has been reported to improve growth performance, reduce corticosterone levels, and enhance glucose metabolism in birds under heat stress (Al-bandr *et al*., 2010) [1].

Narmadanidhi is a dual-purpose colored bird developed for backyard poultry production in India. However, like other breeds, it is also susceptible to environmental stress, which can compromise both its productive and economic performance. Although individual supplementation of Vitamin C, Vitamin E, and organic chromium has shown promising results under heat stress, limited information is available on their comparative efficacy and economic feasibility, especially in Narmadanidhi birds during the summer season.

Hence, the present study was designed to evaluate the comparative profitability of dietary supplementation of Vitamin C, Vitamin E, organic chromium, and their combinations in Narmadanidhi birds during the summer season. The findings aim to provide scientifically backed recommendations to improve bird performance and profitability under heat stress conditions.

Methodology

The experiment was conducted at the All India Coordinated Research Project (AICRP) on Poultry Breeding, Department of Poultry Science, Nanaji Deshmukh Veterinary Science University (NDVSU), Jabalpur, Madhya Pradesh. A completely randomized design (CRD) was employed for the study. A total of 240 day-old, coloured dual-purpose

Narmadanidhi chicks, comprising 75% Jabalpur Colour and 25% Kadaknath genetic inheritance, were randomly assigned into 12 different dietary treatment groups, with each group containing 20 chicks in two replicates, as outlined in Table 01. The chicks were raised in individual pens under a deep litter system, corresponding to their treatment groups. Two different feed formulations were prepared for the study. The starter diet, provided from 0 to 6 weeks of age, was formulated to contain 21% crude protein (CP) and 2800 kcal metabolizable energy (ME)/kg, while the finisher diet, offered from 7 to 12 weeks, contained 19% CP and 2900 kcal ME/kg (see Table 02 for details).

The birds were subjected to the dietary treatments as C_0: Control (no supplement), C_1: 150 mg/kg ascorbic acid, C_2: 250 mg/kg ascorbic acid, E_1: 125 mg/kg vitamin E, E_2: 200 mg/kg vitamin E, Cr_1: 1.25 mg/kg chromium propionate, Cr_2: 2.0 mg/kg chromium propionate, Combination treatments: C_2E_1, C_2E_2, C_2Cr_1, C_2Cr_2, and $C_2E_1Cr_2$.

Body weight and feed intake data were collected at different growth phases: 0–6 weeks (starter phase), 7–12 weeks (finisher phase), and 0–12 weeks (overall period). Based on these records, the cost of feed per kilogram and the total feeding cost per bird for each phase were computed for all treatment groups. Subsequently, using prevailing market rates, revenue from the sale of birds was estimated. This allowed for the calculation of gross profit per bird by subtracting the feeding cost from the sale income. Profitability analysis was conducted for each treatment to determine economic performance under summer season conditions.

Table 1: Distribution of chicks as per experimental design and treatments

S. No.	Treatments		Concentration in diet (mg/kg)	No. of chicks per replicate		No. of chicks/treatment
				R1	R2	
T_0	Control	C_0	Basal diet	10	10	20
T_1	Ascorbic Acid	C_1	150	10	10	20
T_2	Ascorbic Acid	C_2	250	10	10	20
T_3	Vitamin E	E_1	125	10	10	20
T_4	Vitamin E	E_2	200	10	10	20
T_5	Chromium Propionate	Cr_1	1.25	10	10	20
T_6	Chromium Propionate	Cr_2	2.0	10	10	20
T_7	Ascorbic acid+ VitaminE	C_2E_1	250+125	10	10	20
T_8	Ascorbic acid + Vitamin E	C_2E_2	250+200	10	10	20
T_9	Ascorbic acid + Cr Propionate	C_2Cr_1	250+1.25	10	10	20
T_{10}	Ascorbic acid + Cr propionate	C_2Cr_2	250+2.0	10	10	20
T_{11}	Ascorbic acid + Vitamin E + Cr propionate	$C_2E_1Cr_2$	250+125+2.0	10	10	20
Total						240

Table 2: Composition of basal diet and ingredients used

S. No	Ingredients (part/100kg)	Starter diet (0-6 week) CP 21%, 2800 kcal ME/kg	Finisher diet (7-12 week) CP 19%, 2900 kcal ME/kg
1.	Maize	47.5	55
2.	Deoiled rice polish	14.5	12
3.	Soyabean meal	35.0	30
4.	Mineral mixture	1.50	1.50
5.	Vitamins mixture	0.25	0.25
6.	Limestone powder	0.35	0.35
7.	Dicalcium phosphate	0.40	0.40
8.	Salt	0.30	0.30
9.	Coccidiostat (diclazuril)	0.10	0.10
Total		100	100

Calculated composition of diet- 21% CP and 2800 Kcal ME/ Kg in starter ration and 19% CP and 2900 K cal ME/ Kg in finisher ration

Results and Discussion

Economics of rearing Narmadanidhi birds upto 12 weeks of age

Economics of rearing birds during summer season is presented in table 03 to 05. Feed consumption during starter and finisher phases is presented in table 03. Treatment wise per kg cost of formulated feed and feeding cost during starter, finisher and total rearing period is presented in table 04. Income on sale of birds and gross profit over feeding cost is presented in table 05

Feeding cost per bird during different phases

Feeding cost during 0-12 week period was higher in $C_2E_1Cr_2$ (Rs. 214.50), following higher feeding cost was recorded in C_2Cr_2 (Rs. 212.79). Feeding cost was lowest in C_1 (Rs. 195.21). During starter phase cost of feeding 0-6 weeks period was higher in $C_2E_1Cr_2$ (Rs. 82.43) than C_2Cr_2 (Rs. 81.11) and lowest in C_0 control (Rs. 66.58). Feeding cost during 7-12 weeks period was highest in C_2E_2 (Rs. 134.31) than $C_2E_1Cr_2$ (Rs. 132.07) and lowest in C_1 (Rs. 127.54) and E_1 (Rs. 128.00).

Income on sale of birds

Income on sale of birds at 12 weeks of age was highest in $C_2E_1Cr_2$ (Rs. 258.00) than C_2Cr_2 (Rs. 256.00) and C_2E_2, C_2Cr_2 (Rs. 252.00) and lowest in C_0 control, C_1 and E_1 (Rs. 232.00).

Gross Profit per kg live weight at 12 weeks of age

Gross profit per kg live weight over feeding cost at 12 week

of age was highest in C_2Cr_1 (Rs. 35.08) than $C_2E_1Cr_2$ (Rs. 34.04) and Cr_2 (Rs. 34.26). Gross profit per kg live weight over feeding cost was lowest in C_0 control (Rs. 31.00) and E_1 (Rs. 31.61), C_1 (Rs. 31.83).

Gross Profit per bird at 12 weeks of age

Gross profit per bird was highest in C_2Cr_1 (Rs. 44.20) than $C_2E_1Cr_2$ (Rs. 43.91) and lowest in C_0 Control (Rs. 35.96) than E_1 (Rs. 36.67)

Table 3: Body weight and feed intake of Narmadanidhi during starter and finisher period in summer season

Treatments	Body wt 0-6 wk (g)	Body wt 7-12 wk (g)	Body wt 0-12 wk (g)	Feed Intake 0-6 wk (g)	Feed Intake 7-12 wk (g)	Feed Intake 0-12 wk (g)
C_0	514.0	646.5	1160.5	1390.0	2903.8	4293.8
C_1	523.0	637.7	1160.7	1409.4	2859.9	4269.3
C_2	563.0	665.5	1228.5	1503.0	2956.4	4459.4
E_1	521.5	637.7	1159.2	1402.0	2863.8	4265.8
E_2	544.2	642.0	1186.2	1444.3	2886.2	4330.5
Cr_1	549.5	636.7	1186.2	1461.3	2868.7	4330.0
Cr_2	555.7	654.5	1210.2	1476.2	2928.8	4405.0
C_2E_1	583.2	643.8	1227.0	1544.9	2945.9	4490.8
C_2E_2	607.0	654.7	1261.7	1596.3	2983.7	4580.0
C_2Cr_1	611.0	652.0	1263.0	1608.6	2938.4	4547.0
C_2Cr_2	645.5	644.2	1289.7	1686.3	2946.7	4643.0
$C_2E_1Cr_2$	650.7	640.5	1291.2	1706.2	2941.8	4648.0

Table 04: Treatment wise per kg feed cost and feeding cost of birds during different growth period under summer season

Treatments	Per kg cost of Starter feed (Rs.)	Per kg cost of Finisher feed (Rs.)	Feeding cost 0-6 week (Rs.)	Feeding cost 7-12 week (Rs.)	Feeding cost 0-12 week (Rs.)
C_0	47.90	44.59	66.58	129.49	196.08
C_1	48.02	44.59	67.68	127.54	195.21
C_2	48.09	44.68	72.29	132.09	204.37
E_1	48.11	44.69	67.45	128.00	195.45
E_2	48.24	44.82	69.67	129.36	199.03
Cr_1	47.91	44.49	70.00	127.63	197.63
Cr_2	47.94	44.52	70.75	130.35	201.10
C_2E_1	48.30	44.89	74.62	132.23	206.86
C_2E_2	48.43	45.01	77.31	134.31	211.61
C_2Cr_1	48.10	44.68	77.37	131.29	208.66
C_2Cr_2	48.10	44.69	81.11	131.67	212.79
$C_2E_1Cr_2$	48.31	44.90	82.43	132.07	214.50

Table 05: Income on sale of birds and gross profit over feeding cost in summer season

Treatments	Body wt at 12week age (Kg)	Income on sale of bird (Rs. 200/Kg live wt) (Rs.)	Feeding cost up to 12 weeks of age (Rs.)	Gross profit/ bird over feed cost (Rs.)	Gross profit per kg body wt over feed cost (Rs.)
C_0	1.16	232.00	196.04	35.96	31.00
C_1	1.16	232.00	195.08	36.92	31.83
C_2	1.23	246.00	204.31	41.69	33.89
E_1	1.16	232.00	195.33	36.67	31.61
E_2	1.18	236.00	197.69	38.31	32.47
Cr_1	1.18	236.00	197.28	38.72	32.81
Cr_2	1.21	242.00	200.55	41.45	34.26
C_2E_1	1.22	244.00	206.32	37.68	30.89
C_2E_2	1.26	252.00	211.08	40.92	32.48
C_2Cr_1	1.26	252.00	207.80	44.20	35.08
C_2Cr_2	1.28	256.00	212.60	43.40	33.91
$C_2E_1Cr_2$	1.29	258.00	214.09	43.91	34.04

Effect of treatments on economics of rearing Narmadanidhi birds

During summer season, treatment C_2Cr_1 has higher gross profit /bird (Rs 44.20) and gross profit /kg live weight (35.08) than all other treatment groups. In compared to C_0 control group, gross profit/bird and gross profit/kg live wt of C_2Cr_1 was increased by Rs 8.24 and Rs. 4.08 respectively. Following higher profit was recorded in $C_2E_1Cr_2$.

Considering single supplement groups, gross profit/birds and per kg live weight was higher in C_2, E_2, Cr_2 than lower levels of C_1, E_1, Cr_1 respectively. Gross profit/kg live weight in C_2 (33.89), E_2 (32.47) and Cr_2 (Rs.34.26) was found to be increased over C_0 by Rs. 2.89, Rs 1.47 and Rs 3.26 respectively. Profit/kg live weight was found higher in Cr_2 than C_2 and lower in E_2.

Chougule *et al.* (2018) [2] reported higher net profit/kg live weight in supplementation of 2.5 mg Cr/kg diet compared to 250 mg vit C/kg diet. The higher profit in Cr propionate supplementation during summer season was in corroboration with the finding of Chougule *et al.* (2018) [2].

Chowdhury *et al*. (2003) [3] and Mohammed *et al*. (2014) [5] reported higher total return in chromium supplementation in compared to control group during summer season. Increased profit in supplementation of 250 mg Vit C /kg diet as compared to control group was in line with the finding of Chougule *et al*. (2018) [2]. Combined supplement group C_2Cr_1 was proven better in respect to economic return during summer season.

Conclusion

The findings of this study concluded that supplementing the diets of Narmadanidhi birds with vitamin C (ascorbic acid), vitamin E, and organic chromium, particularly in the C2Cr1 combination, resulted in significantly enhanced economic returns. This treatment group demonstrated the highest gross profit per bird and per kilogram of live weight under summer rearing conditions, indicating its potential as a cost-effective nutritional strategy during heat stress periods.

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Conflict of interest

The authors affirm that there are no conflicts of interest related to this study.

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