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Effect of vitamin C, E, organic chromium and its combination on carcass traits of Narmadanidhi birds in winter season

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Abstract
The present study was conducted to assess the effect of vitamin C (ascorbic acid), vitamin E, organic chromium and its combination on growth performance and economics of Narmadanidhi birds in winter season. A total of 240, day old coloured dual type Narmadanidhi chicks were distributed into 12 dietary treatment groups with 20 chicks in 2 replicates in each treatment. The chicks were housed in individual pens as per treatment groups and reared on litter system. Starter and finisher ration were prepared and fed up to 6 and 7 to 12 weeks of age respectively. Dietary treatment supplements in starter and finisher ration were C_0 control, C_1 (150 mg AA/kg), C_2 (250 mg AA/kg), E_1 (125 mg vit E/kg), E_2 (200 mg vit E/kg) Cr_1 (1.25 mg Cr-propionate/kg), Cr_2 (2.0 mg Cr-Propionate/kg). Combined supplements were C_2E_1, C_2E_2, C_2Cr_1, C_2Cr_2, and $C_2E_1Cr_2$. The data of body weight, feed intake and feed efficiency were recorded and measured on 6th week interval. Analysis (One way ANOVA) was carried out to study the effect of treatments on production performance. The gross economics of rearing the chicks for complete experimental period was also calculated. During winter season starved live weight shrinkage, blood loss and feather loss were not affected due to treatments. E_2, Cr_1, Cr_2 were significantly higher in eviscerated and total meat yield in both sexes. All combined supplement improved these traits with better effect in C_2Cr_2, $C_2E_1Cr_2$ than all treatments. Percent fat in C_2Cr_2 and $C_2E_1Cr_2$ were significantly lower than control.Finally it may be concluded that combined supplement C_2Cr_2, $C_2E_1Cr_2$ had better carcass trait than control in winter season.

Keywords: Vitamin C, vitamin E, chromium, Narmadanidhi, carcass traits, winter season

Introduction
Poultry sector is boosting the economy of India's agriculture sector and has emerged as most dynamic sector registering a remarkable growth in the past few decades. However, the industry is facing challenges like growing feed cost, emerging diseases and health problem which need to be addressed at priority. Apart from this, environmental stress (summer and winter) is another factor that affects the health status of poultry and growth of the industry. Though several literatures reported that supplementation of vitamin C, E and Chromium in diet ameliorates the adverse effect of heat stress in poultry (Sahin *et al.*, 2002 and Attia *et al.*, 2009) [9, 1], but very les literature is available on effect of winter season or stress. Carcass traits are considered important because these are the real parameter which affects the dressing percentage of the chickens.

Vitamin C (Ascorbic acid), is generally synthesized in the body and considered as not essential in chicken diets (Zeferino *et al.*, 2016) [14]. In concurrent, Fletcher and Cason (1991) [3] reported that treatment with AA at level of 973 mg /kg in diet during winter season has no effect on carcass processing yield. Biswas *et al.* (2008) [2] supplemented 0,100,200,400 mg AA/kg diet to broiler reared under cold condition at high attitude. They reported significantly improved percent eviscerated yield, breast, thigh and drumstick weight in 400 mg AA /kg diet in compared to control and lower AA levels. Vitamin E is generally not synthesized by the chickens so they are depends on dietary sources to meet their requirements (Tamehiro *et al.*, 2005). Kant *et al.* (2015) [5] supplemented 200 mg vit E/kg during winter season and reported significantly increased percent dressing yield. Heart, liver, gizzard and spleen weight were also significantly increased in compared to control group. Shank length and keel length were significantly higher in vit E supplementation. Dietary chromium has been reported to have beneficial effect on growth rate (Toghyani *et al.*, 2006) [12]. Lien *et al.* (1999) [7] reported significantly increased liver weight in chromium supplementation during cooler climate.

Tolimir *et al*. (2005) [13] reported increased breast muscle yield of broiler, supplemented chromium during winter season.

In view of the above facts and vital role of vitamin C, E and chromium on metabolism during environmental stress condition, the present study was planned to study the effect of vitamin C (ascorbic acid), vitamin E, organic chromium and its combination on carcass traits of Narmadanidhi birds in winter season.

Materials and Methods

The present experiment was conducted at All India Co-ordinated Research Project on Poultry Breeding, Department of Poultry Science, N.D.V.S.U. Jabalpur, (M.P.). A completely randomized design (CRD) was utilized to conduct present experiment. A total of 240, day old coloured dual type Narmadanidhi sexed chicks (75% Jabalpur colour and 25% native kadaknath inheritance) with equal numbers of male and females were distributed into 12 dietary treatment groups with each consisting 20 chicks in 2 replicates. The chicks were housed in individual pens as per treatment groups and reared on litter system. Starter ration was prepared containing 21% CP with 2800Kcal ME/kg and fed up to 6 weeks. Finisher ration was prepared containing 19% CP with 2900 Kcal ME/kg and fed 7 to 12 weeks of age. Dietary treatment supplements in starter and finisher ration were C_0 control, C_1 (150 mg AA/kg), C_2 (250 mg AA/kg), E_1 (125 mg vit E/kg), E_2 (200 mg vit E/kg) Cr_1 (1.25 mg Cr-propionate/kg), Cr_2 (2.0 mg Cr-Propionate/kg). Combined supplements were C_2E_1, C_2E_2, C_2Cr_1, C_2Cr_2, and $C_2E_1Cr_2$.

At 12th week of age two males and two females from each replicate group were randomly selected and sacrificed, bleeding done for 2 minutes, scalded at 58ºC for 90 seconds and feathers were plucked out mechanically to determine the blood and feather loss. Head and leg were separated from carcass by cutting at atlanto-occipital and hock joint respectively. Evisceration was carried out by removing trachea, oesophagus and viscera. Eviscerated carcasses were cleaned, drained and weighed. Giblet included gizzard without mucosa and ingesta, heart without pericardium and liver were cleaned and weighed.

The fat was separated from gizzard, carcass and viscera and weighed as abdominal fat. Eviscerated carcass along with giblet constituted total meat yield.

$$\text{a. Eviscerated weight (\%)} = \frac{\text{Eviscerated weight (g)}}{\text{Live weight (g)}} \times 100$$

$$\text{b. Giblet weight (\%)} = \frac{\text{Giblet weight (g)}}{\text{Live weight (g)}} \times 100$$

$$\text{c. Abdominal fat (\%)} = \frac{\text{Abdominal fat weight (g)}}{\text{Live weight (g)}} \times 100$$

d. Total meat yield = Eviscerated weight - Giblet weight

Analysis (One way ANOVA) was carried out to study the effect of treatments on carcass traits (Snedecor and Cochran, 1994) [10].

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	
T0	Control	C_0	Basal diet	10	10	20
T1	Ascorbic Acid	C_1	150	10	10	20
T2	Ascorbic Acid	C_2	250	10	10	20
T3	Vitamin E	E_1	125	10	10	20
T4	Vitamin E	E_2	200	10	10	20
T5	Chromium Propionate	Cr_1	1.25	10	10	20
T6	Chromium Propionate	Cr_2	2.0	10	10	20
T7	Ascorbic acid+ VitaminE	C_2E_1	250+125	10	10	20
T8	Ascorbic acid + Vitamin E	C_2E_2	250+200	10	10	20
T9	Ascorbic acid + Cr Propionate	C_2Cr_1	250+1.25	10	10	20
T10	Ascorbic acid + Cr propionate	C_2Cr_2	250+2.0	10	10	20
T11	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

Carcass traits of pooled sex birds at 12 week of age

Carcass traits of pooled sex birds during winter season are presented in table no. 3

Starved weight (g): Pooled sex body weight of Cr_2, C_2Cr_2 and $C_2E_1Cr_2$ were similar and non-significantly different from Cr_1, C_2E_2 and C_2Cr_1 whereas significantly higher from control and all other treatment groups. Starved weight in control C_0, C_1, C_2, E_1, E_2, Cr_1, C_2E_1, C_2E_2 and C_2Cr_1 were non-significantly different.

Shrinkage (%): Percent shrinkage was not affected due to treatment and ranged between 1.70% to 1.76%

Blood loss (%): Effect of treatment on blood loss was not observed and ranged between 2.76% to 2.84%.

Feather loss (%): Percent feather loss was also not affected due to treatment and ranged between 6.68% to 6.72%

Eviscerated yield (%): Percent eviscerated yield in C_2Cr_2 (62.88%±0.03) and $C_2E_1Cr_2$ (62.87%±0.02) were non-significantly different and these were significantly higher than control and all other treatment groups. Following higher yield recorded for Cr_2 (62.66%±0.05) and C_2E_2 (62.66%±0.05) with significantly different from control and all other treatment groups. Eviscerated yield in C_0, C_1 and E_1 were non-significantly different and significantly lower than all other treatment groups.

Giblet yield (%): Percent giblet yield in Cr_2 (5.82%±0.02), C_2E_2 (5.82%±0.01), C_2Cr_2 (5.85%±0.02) and $C_2E_1Cr_2$ (5.84%±0.03) were non-significantly different and these were significantly higher in giblet than control and all other treatment groups. Giblet yield % in C_2 and E_2 were similar and non-significantly different from C_2Cr_1 and significantly higher than control and all other treatments. Control C_0, C_1, E_1 was non-significantly different from Cr_1, C_2E_1 and significantly lowers in % giblet than all other treatment groups.

Total meat yield (%): Among single supplement TMY of Cr_2 (68.49%0.04) was significantly higher than C_0, C_1, C_2, E_1, E_2 treatment. TMY in combined supplements, C_2Cr_2 (68.73%±0.03) and $C_2E_1Cr_2$ (68.71%±0.03) significantly improved TMY over control and all other treatment groups. Treatment C_2 and E_2 were higher in TMY than control C_0, whereas C_0, C_1, E_1 had significantly lower meat yield than all other treatment groups.

Abdominal fat (%): Percent abdominal fat in Cr_2 (0.37%±0.00), C_2Cr_2 (0.36%±0.00) and $C_2E_1Cr_2$ (0.37%±0.00) were non-significantly different and these were significantly lower in % abdominal fat than all other treatment groups. Percent abdominal fat in C_0, C_1, C_2, E_1, E_2, Cr_1, C_2E_1, C_2E_2 and C_2Cr_1 were non-significantly different.

Table 3: Effect of vitamin C, E, organic chromium and its combination on carcass traits of Narmadanidhi birds (pooled sex) in winter season

Treatments	Starved weight (g)	Shrinkage %	Blood loss %	Feather loss %	Eviscerated meat yield %	Giblet yield%	Total meat yield %	Abdominal fat %
C_0	1240.00^{b}±5.00	1.70±0.01	2.78±0.02	6.69±0.01	62.30^{e}±0.02	5.66^{d}±0.01	67.96^{f}±0.03	0.38^{a}±0.00
C_1	1246.00^{b}±6.00	1.71±0.02	2.76±0.03	6.69±0.01	62.31^{e}±0.02	5.67^{d}±0.02	67.98^{f}±0.04	0.40^{a}±0.00
C_2	1254.50^{b}±2.50	1.72±0.02	2.76±0.03	6.72±0.01	62.37^{e}±0.04	5.71^{cd}±0.02	68.08^{f}±0.05	0.38^{a}±0.00
E_1	1245.00^{b}±3.00	1.73±0.02	2.81±0.01	6.70±0.01	62.33^{e}±0.01	5.66^{d}±0.01	67.99^{f}±0.02	0.39^{a}±0.01
E_2	1253.50^{b}±3.50	1.72±0.02	2.83±0.02	6.68±0.01	62.57^{c}±0.01	5.76^{b}±0.01	68.33^{c}±0.02	0.40^{a}±0.00
Cr_1	1260.00^{ab}±5.00	1.76±0.04	2.79±0.02	6.71±0.02	62.51^{cd}±0.02	5.70^{cd}±0.01	68.21^{de}±0.02	0.38^{a}±0.00
Cr_2	1292.00^{a}±4.00	1.72±0.02	2.83±0.02	6.70±0.01	62.66^{b}±0.05	5.76^{bc}±0.02	68.49^{b}±0.04	0.38^{a}±0.00
C_2E_1	1245.50^{b}±1.50	1.71±0.02	2.81±0.02	6.68±0.01	62.45^{d}±0.06	5.70^{cd}±0.02	68.15^{e}±0.07	0.39^{a}±0.00
C_2E_2	1266.00^{ab}±1.00	1.70±0.02	2.84±0.02	6.69±0.01	62.66^{b}±0.05	5.82^{a}±0.01	68.48^{b}±0.05	0.39^{a}±0.00
C_2Cr_1	1268.50^{ab}±3.50	1.72±0.02	2.78±0.01	6.70±0.01	62.53^{cd}±0.02	5.73^{bc}±0.02	68.29^{cd}±0.02	0.38^{a}±0.00
C_2Cr_2	1291.50^{a}±36.50	1.71±0.02	2.79±0.02	6.68±0.01	62.88^{a}±0.03	5.85^{a}±0.02	68.73^{a}±0.03	0.36^{b}±0.00
$C_2E_1Cr_2$	1292.00^{a}±5.00	1.73±0.02	2.81±0.01	6.69±0.01	62.87^{a}±0.02	5.84^{a}±0.03	68.71^{a}±0.03	0.37^{b}±0.00

^{a,b,c} Means bearing different superscripts in a column differ significantly ($p<0.05$)

Table 4: Means sum of squares for carcass traits of Narmadanidhi birds (pooled sex) in winter season

Source	DF	Starved weight (g)	Shrinkage %	Blood loss %	Feather loss %	Eviscerated meat yield %	Giblet yield%	Total meat yield %	Abdominal fat %
Treatment	11	21667.03**	0.00	0.01	0.00	0.31**	0.04**	0.56**	0.00**
Error	84	840.99	0.00	0.00	0.00	0.01	0.00	0.01	0.00
Total	95								

Discussions

Effect of Vitamin C on carcass traits

During winter season ascorbic acid supplementation shown non-significant effect on percent eviscerated yield, giblet yield, total meat yield and abdominal fat yield. Fletcher and Cason *et al.* (1991) [3] reported that AA supplementation at level of 973 mg/kg diet during winter season has no effect on carcass processing yields and percent fat yield. Kutlu and Forbes (1994), Fratzer *et al.* (1996) [6, 4] reported non-significant effect of AA supplementation in growth traits and carcass yields of broilers in absence of heat stress. In the present study result non-significant effect of vit C on carcass traits and percent abdominal fat during winter season was in collaboration with the result of Fletcher and Cason (1991), Kutlu and Forbes (1993) and Fratzer *et al.* (1996) [3, 6, 4].

Effect of Vitamin E on carcass traits

During winter season, E_1 lower level vitamin supplementation did not influence percent eviscerated, giblet, total meat yield and abdominal fat. However, E_2 higher level supplementation

significantly improved carcass traits and non-significant effect was observed for percent fat yield in compared to control group. Kant *et al*. (2015) [5] reported significant effect of 200 mg vit E/kg diet on percent eviscerated and dressing yield. Percent heart, gizzard and liver weight (giblet) were also improved over control group. The result obtained in the present study was in agreement with the finding of Kant *et al*. (2015) [5] which showed significantly improved carcass traits in higher dose of vit E supplementation.

Effect of chromium on carcass traits

During winter season percent eviscerated and total meat yield in both sexes were significantly higher in chromium supplementation, Cr_1 and Cr_2 were non-significantly different. Growth promoting effect of supplemental Cr is related to up-regulation of skeletal muscle protein has been reported (Zhao *et al*., 2009) [15]. Lien *et al*. (1999) [7] reported higher carcass weight in chromium supplementation during cold season. Rajalekshmi *et al*. (2014) [8] reported significantly increased breast meat yield of broiler in supplementation of increasing chromium propionate level in diet during winter season. The finding of experiment was in agreement to these authors. Giblet yield was non-significantly different in between control and Cr_1 whereas significantly higher in Cr_2 supplementation in both sexes. Higher liver weight in chromium was reported by Lien *et al*. (1999) [7]. However adverse effect of higher Cr was not observed on carcass yield and overall performance of bird in both seasons. Percent abdominal fat was not influenced due to chromium supplementation in winter season in both sexes.

Effect of Combined supplements on carcass traits

During winter season C_2E_1, C_2E_2, C_2Cr_2, $C_2E_1Cr_2$ were significantly higher in percent eviscerated and total meat yield than control and their individual supplement groups. Combined supplement C_2Cr_1 improved over C_2 and non significant from Cr_1 treatments. Among all treatment C_2Cr_2 and $C_2E_1Cr_2$ were significantly higher in carcass yield. Percent abdominal fat was significantly lower in C_2Cr_2 males and C_2Cr_1 females in compared to control and C_2 vitamin and it was similar to Cr_1 and Cr_2 chromium groups respectively. All other treatments were non-significant from control. Results in winter season could not be compared due to untraceable of references on chromium and vitamin C, E for combined supplement effect in winter season.

Conclusions

It may be concluded that during winter seasonin single supplements E_2, Cr_1, Cr_2 were significantly higher in eviscerated and total meat yield. All combined supplement improved these traits with better effect in C_2Cr_2, $C_2E_1Cr_2$ than all treatments. Percent fat in C_2Cr_2 and $C_2E_1Cr_2$ were significantly lower than control in winter season.

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Conflict of interest

All authors declare no conflict of interest.

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