



## Effect of dietary supplementation of vitamin E and selenium on the growth, hemato-biochemical and endocrine profile of grower Ghungroo pigs

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### ABSTRACT

The aim of the current investigation was to find out the effectiveness of dietary supplementation of vitamin E and selenium on growth, hemato-biochemical and endocrine status in the healthy female grower Ghungroo pigs (*Sus scroffa domestica*). Healthy female grower Ghungroo pigs (n=18), aged 2–3 months age were selected for the experiment and randomly divided into three groups. The animals of the control group (n=6) are feed with basal diet, the treatment-1 (T1) group (n=6) of animals were given vitamin E, and the animals of treatment-2 (T2) group (n=6) were supplemented with selenium in accordance with NRC recommendations. The growth in terms of body weight and morphometric parameters was evaluated at 15 days interval along with blood sampling. A substantial reduction in the vitamin E concentration was recorded which could be restored after supplementation of vitamin E. A significant increase in hemoglobin, PCV, TEC and MCV were seen both vitamin E and selenium supplemented groups. Vitamin E alone increased blood glucose and thyroxine level and lowered AST, ALT and plasma cortisol level. On the other hand, selenium increased plasma total protein level. Therefore, it can be recommended to supplement vitamin E and selenium to improve vitamin E and selenium status together with better biochemical and endocrine response to support normal growth.

**Keywords:** Biochemical profile, Endocrine profile, Ghungroo pig, Hematology, Selenium, Vitamin E

The Ghungroo pig is a native to the eastern part of Sub-Himalayan region of West Bengal, India (Pan *et al.* 2005) It is known for high fecundity, body weight gain and feed conversion ability (Boro *et al.* 2021). The newborn piglets have poor plasma vitamin E concentration due to limited placental transfer but suckling piglets can fulfill their vitamin E requirements through colostrum (Nielsen *et al.* 1989). Thus, a declining pattern in the vitamin E concentration was reported from 1<sup>st</sup> week post-weaning till 2 months (Hakansson *et al.* 2001). As the maximum body weight gain in Ghungroo pigs were reported at 2-7 months of age (Patra *et al.* 2016), we hypothesized that supplementation vitamin E and selenium may ameliorate the deleterious effects of ROS produced during the growth phase (Nielsen *et al.* 1989, Hussain *et al.* 2024) and maintain a delicate redox that allow proper growth and development. Therefore, the present investigation was designed to assess the plasma concentrations of vitamin E and selenium in grower Ghungroo pigs and to evaluate the impact of vitamin E and selenium supplementation on their

growth performance, hemato-biochemical parameters, and endocrine profile.

### MATERIALS AND METHODS

*Study area:* The investigation was carried out at the Pig farm of ICAR-IVRI, Eastern regional station, Kalyani, Nadia, West Bengal, India from the month April to July during the year 2022.

*Ethical approval:* All experimental procedures were conducted in compliance with the guidelines of the Animal Ethics Committee of Indian Veterinary Research Institute (IVRI), ERS, Kolkata (Ref. No. F.42(A)/ERS/Kol/2022-23/386).

*Experimental animals and their management:* Eighteen healthy female grower Ghungroo pigs (*Sus scroffa domestica*), aged 2–3 months age were selected for the experiment. The animals had mean body weight of 19.5 ± 0.36 kg. All animals were clinically healthy and maintained under uniform conditions in dry, clean, and well-hygienic sheds with concrete flooring. Routine vaccinations were administered, and anthelmintic treatment was provided in feed twice annually. The animals were provided with a commercially prepared starter ration (4<sup>th</sup> to 8<sup>th</sup> week) and a grower ration (9<sup>th</sup> to 18<sup>th</sup> week). They were randomly assigned to three groups. The control group (n=6) received only the basal diet. The treatment-1 (T1) group (n=6)

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Table 1. Plasma concentration of vitamin E and selenium in control, vitamin E (T1) and selenium (T2) supplemented grower Ghungroo pigs

Parameter	Group	Day				Mean	p value
		15 <sup>th</sup> day	30 <sup>th</sup> day	45 <sup>th</sup> day	60 <sup>th</sup> day		
Vitamin E ( $\mu\text{g}/\text{mL}$ ) in plasma	Control	4.02 <sup>bcy</sup> $\pm$ 0.90	3.29 <sup>b</sup> $\pm$ 0.62	1.76 <sup>as</sup> $\pm$ 0.18	2.45 <sup>abxy</sup> $\pm$ 0.40	2.88 <sup>s</sup> $\pm$ 0.33	0.046
	T1	4.61 <sup>y</sup> $\pm$ 0.80	4.31 $\pm$ 0.63	3.19 <sup>y</sup> $\pm$ 0.47	3.69 <sup>y</sup> $\pm$ 0.42	3.95 <sup>y</sup> $\pm$ 0.30	0.367
	T2	1.68 <sup>as</sup> $\pm$ 0.30	3.61 <sup>b</sup> $\pm$ 0.77	1.87 <sup>as</sup> $\pm$ 0.19	1.68 <sup>as</sup> $\pm$ 0.13	2.29 <sup>r</sup> $\pm$ 0.30	0.029
	p value	0.027	0.562	0.009	0.021	0.001	
Selenium (ppm) in the plasma	Control	0.014 <sup>a</sup> $\pm$ 0.001	0.015 <sup>a</sup> $\pm$ 0.001	0.031 <sup>y</sup> $\pm$ 0.013	0.016 <sup>a</sup> $\pm$ 0.001	0.019 <sup>a</sup> $\pm$ 0.003	0.236
	T1	0.016 <sup>a</sup> $\pm$ 0.002	0.012 <sup>a</sup> $\pm$ 0.001	0.012 <sup>a</sup> $\pm$ 0.002	0.012 <sup>a</sup> $\pm$ 0.002	0.013 <sup>a</sup> $\pm$ 0.001	0.154
	T2	0.026 <sup>a</sup> $\pm$ 0.002	0.025 <sup>a</sup> $\pm$ 0.003	0.054 <sup>a</sup> $\pm$ 0.04	0.023 <sup>a</sup> $\pm$ 0.003	0.023 <sup>a</sup> $\pm$ 0.009	0.575
	p value	0.0324	0.000	0.023	0.004	0.001	

Values are expressed as mean  $\pm$  SE. Means with common superscript within a row (a,b,c,d) do not differ significantly between days of supplementation. Means with common superscript within column (x,y) do not differ significantly between groups

was supplemented daily with vitamin E (as  $\alpha$ -tocopherol acetate) at 11 IU/kg of feed, while the treatment-2 (T2) group (n=6) received selenium (as sodium selenite) at 0.15 mg/kg of feed (basal diet) daily as per the National Research Council recommendation (NRC 1998).

*Collection of blood samples:* 7 mL of blood was drawn from the anterior vena cava using a sterile syringe and needle, and transferred into EDTA-coated vacutainer tubes, prior to morning feeding on days 15, 30, 45, and 60 of supplementation. The tubes were promptly placed in an ice box and carried to the laboratory for subsequent processing. A portion of each sample was reserved for hematological and immunological analyses, while the remainder was centrifuged to separate plasma.

*Recording of body weight and morphometric parameters:* The body weight and morphometric parameters (heart girth, linear length and height) of the individual pigs were recorded at weekly interval up to 2 months from the date of supplementation in early morning. Body weight

was recorded with the help of digital weighing balance. Body length was measured with a measuring tape from midpoint between the ears to the base of the tail. The heart girth was measured by wrapping the measuring tape tightly immediately behind the front legs and measures the circumference of the pig's girth. The height was measured by placing the tape from front hoof to the highest point at the top of front shoulder.

*Evaluation of hemato-biochemical parameters:* Hematological parameters were assessed following standard hematological procedures, while blood biochemical parameters were measured using commercially available kits from Transasia Bio-Medicals Ltd., India, in accordance with the manufacturer's instructions.

*Evaluation of endocrine parameters:* The hormones (triiodothyronine, thyroxine and cortisol) were estimated using commercially available species-specific enzyme-linked immunosorbent assay (ELISA) kits (Calbiotech, India) in accordance with the manufacturer's instructions.

Table 2. Growth parameters in control, vitamin E (T1) and selenium (T2) supplemented grower Ghungroo pigs

Parameter	Group	Day				Mean	p value
		15 <sup>th</sup> day	30 <sup>th</sup> day	45 <sup>th</sup> day	60 <sup>th</sup> day		
Body weight (Kg)	Control	19.65 <sup>a</sup> $\pm$ 1.66	28.66 <sup>b</sup> $\pm$ 1.82	39.76 <sup>c</sup> $\pm$ 1.68	54.37 <sup>d</sup> $\pm$ 1.46	35.61 $\pm$ 2.81	0.000
	T1	20.29 <sup>a</sup> $\pm$ 1.32	28.05 <sup>b</sup> $\pm$ 1.06	37.02 <sup>c</sup> $\pm$ 0.91	52.10 <sup>d</sup> $\pm$ 1.57	34.37 $\pm$ 2.53	0.000
	T2	19.34 <sup>a</sup> $\pm$ 1.25	32.08 <sup>b</sup> $\pm$ 2.04	42.04 <sup>c</sup> $\pm$ 2.16	55.30 <sup>d</sup> $\pm$ 2.58	37.19 $\pm$ 2.91	0.000
	P value	0.891	0.225	0.136	0.501	0.769	
Heart girth (cm)	Control	59.00 <sup>a</sup> $\pm$ 1.95	67.50 <sup>b</sup> $\pm$ 1.59	76.17 <sup>c</sup> $\pm$ 0.91	87.00 <sup>d</sup> $\pm$ 1.06	72.42 $\pm$ 2.27	0.000
	T1	60.33 <sup>a</sup> $\pm$ 1.43	68.00 <sup>b</sup> $\pm$ 0.93	75.17 <sup>c</sup> $\pm$ 0.60	86.17 <sup>d</sup> $\pm$ 0.54	72.42 $\pm$ 2.03	0.000
	T2	59.00 <sup>a</sup> $\pm$ 0.86	69.17 <sup>b</sup> $\pm$ 1.96	76.00 <sup>c</sup> $\pm$ 1.59	86.00 <sup>c</sup> $\pm$ 1.06	72.54 $\pm$ 2.16	0.000
	P value	0.767	0.742	0.796	0.720	0.999	
Linear length (cm)	Control	63.17 <sup>a</sup> $\pm$ 1.90	76.50 <sup>b</sup> $\pm$ 1.06	84.50 <sup>c</sup> $\pm$ 1.23	93.67 <sup>d</sup> $\pm$ 1.56	79.46 $\pm$ 2.43	0.000
	T1	62.33 <sup>a</sup> $\pm$ 1.33	76.50 <sup>b</sup> $\pm$ 2.38	82.33 <sup>b</sup> $\pm$ 2.56	90.17 <sup>c</sup> $\pm$ 3.10	77.83 $\pm$ 2.41	0.000
	T2	63.67 <sup>a</sup> $\pm$ 2.58	77.00 <sup>b</sup> $\pm$ 1.48	85.17 <sup>c</sup> $\pm$ 1.19	97.67 <sup>d</sup> $\pm$ 2.35	80.88 $\pm$ 2.74	0.000
	p value	0.894	0.973	0.516	0.124	0.698	
Height at shoulder (cm)	Control	43.50 <sup>a</sup> $\pm$ 1.57	45.17 <sup>a</sup> $\pm$ 1.30	47.33 <sup>ab</sup> $\pm$ 1.02	50.17 <sup>b</sup> $\pm$ 1.04	46.54 $\pm$ 0.78	0.008
	T1	44.50 <sup>a</sup> $\pm$ 1.77	46.50 <sup>ab</sup> $\pm$ 0.56	48.67 <sup>b</sup> $\pm$ 0.80	52.83 <sup>c</sup> $\pm$ 1.25	48.13 $\pm$ 0.85	0.001
	T2	43.83 <sup>a</sup> $\pm$ 0.98	46.17 <sup>ab</sup> $\pm$ 1.08	49.17 <sup>b</sup> $\pm$ 1.40	53.50 <sup>c</sup> $\pm$ 1.75	48.17 $\pm$ 0.98	0.000
	p value	0.889	0.643	0.495	0.228	0.331	

Values are expressed as mean  $\pm$  SE. Means with common superscript within a row (a,b,c,d) do not differ significantly between days of supplementation. Means with common superscript within column (x,y) do not differ significantly between groups

Table 3. Hematological parameters in control, vitamin E (T1) and selenium (T2) supplemented grower Ghungroo pigs

Parameter	Group	Day				Mean	p value
		15 <sup>th</sup> day	30 <sup>th</sup> day	45 <sup>th</sup> day	60 <sup>th</sup> day		
Hemoglobin (g%)	Control	10.61 <sup>x</sup> ±0.31	11.12±0.38	11.27±0.59	12.48 <sup>x</sup> ±0.60	11.37 <sup>x</sup> ±0.27	0.078
	T1	12.65 <sup>y</sup> ±0.23	10.89±0.32	12.29±0.76	11.51 <sup>x</sup> ±0.65	11.84 <sup>xy</sup> ±0.29	0.123
	T2	11.27 <sup>ax</sup> ±0.43	11.16 <sup>a</sup> ±0.82	12.68 <sup>a</sup> ±0.66	13.86 <sup>abz</sup> ±0.50	12.24 <sup>y</sup> ±0.37	0.018
	p value	0.002	0.937	0.336	0.038	0.013	
PCV (%)	Control	44.56 <sup>axy</sup> ±1.36	42.72 <sup>ax</sup> ±0.49	46.22 <sup>abx</sup> ±0.93	46.42 <sup>bx</sup> ±0.35	44.98 <sup>x</sup> ±0.51	0.025
	T1	46.18 <sup>ay</sup> ±0.94	45.63 <sup>ay</sup> ±0.71	48.20 <sup>abxy</sup> ±0.40	48.07 <sup>ax</sup> ±0.72	47.02 <sup>y</sup> ±0.41	0.042
	T2	41.91 <sup>ax</sup> ±0.57	43.68 <sup>ax</sup> ±0.60	50.36 <sup>by</sup> ±1.01	52.73 <sup>by</sup> ±1.31	47.17 <sup>y</sup> ±1.03	0.000
	p value	0.028	0.013	0.011	0.000	0.000	
TEC (X106/μL)	Control	6.47±0.30	6.95 <sup>y</sup> ±0.29	6.41 <sup>x</sup> ±0.13	6.72 <sup>x</sup> ±0.14	6.64 <sup>x</sup> ±0.12	0.343
	T1	6.85 <sup>b</sup> ±0.19	5.92 <sup>ax</sup> ±0.25	7.35 <sup>by</sup> ±0.21	7.03 <sup>by</sup> ±0.11	6.78 <sup>xy</sup> ±0.14	0.000
	T2	6.24 <sup>a</sup> ±0.24	6.82 <sup>aby</sup> ±0.28	7.10 <sup>by</sup> ±0.21	7.47 <sup>by</sup> ±0.16	6.91 <sup>y</sup> ±0.14	0.008
	p value	0.240	0.040	0.008	0.006	0.018	
TLC (X103/μL)	Control	13.01 <sup>x</sup> ±0.37	12.20 <sup>x</sup> ±0.27	17.67±0.39	18.68±0.38	16.88 <sup>x</sup> ±0.53	0.000
	T1	16.16 <sup>xy</sup> ±0.41	17.88 <sup>by</sup> ±0.69	18.47 <sup>b</sup> ±0.61	17.83 <sup>b</sup> ±0.40	17.59 <sup>y</sup> ±0.31	0.040
	T2	16.68 <sup>xy</sup> ±0.46	18.15 <sup>aby</sup> ±0.77	18.50 <sup>b</sup> ±0.65	17.79 <sup>b</sup> ±0.30	16.29 <sup>x</sup> ±0.55	0.000
	p value	0.000	0.000	0.510	0.183	0.034	
MCV (fL)	Control	29.02±2.13	29.73±1.49	29.59 <sup>x</sup> ±0.50	31.22 <sup>x</sup> ±0.84	29.89 <sup>x</sup> ±0.67	0.716
	T1	31.68 <sup>b</sup> ±1.46	26.93 <sup>a</sup> ±0.84	35.38 <sup>by</sup> ±0.85	33.81 <sup>abx</sup> ±0.90	31.95 <sup>y</sup> ±0.83	0.000
	T2	26.10 <sup>a</sup> ±0.91	29.77 <sup>b</sup> ±1.30	35.70 <sup>cy</sup> ±0.94	39.35 <sup>dy</sup> ±1.06	32.73 <sup>xy</sup> ±1.18	0.000
	p value	0.074	0.212	0.000	0.000	0.000	
MCH (pg)	Control	39.15 <sup>b</sup> ±1.42	31.92 <sup>ax</sup> ±2.24	32.36 <sup>b</sup> ±2.67	39.17 <sup>b</sup> ±1.10	38.15±1.21	0.009
	T1	37.59 <sup>a</sup> ±1.32	37.96 <sup>by</sup> ±4.09	35.96 <sup>a</sup> ±2.45	38.44 <sup>a</sup> ±0.74	39.99±1.52	0.012
	T2	37.84±3.38	34.62 <sup>x</sup> ±2.66	31.31±3.00	30.81±2.63	38.65±1.48	0.369
	P value	0.872	0.005	0.235	0.611	0.835	
MCHC (g/dL)	Control	23.97±1.17	26.05±0.97	24.39±1.23	26.86±1.17	25.32±0.59	0.261
	T1	27.45±0.78	23.89±0.69	25.58±1.79	23.99±1.48	25.23±0.67	0.193
	T2	26.94±1.26	25.59±2.00	25.12±0.95	26.42±1.38	26.02±0.69	0.813
	Mean	26.12±0.70	25.17±0.76	25.03±0.75	25.76±0.79	25.52±0.37	0.644
p value	0.082	0.504	0.827	0.299	0.714		

Values are expressed as mean ± SE. Means with common superscript within a row (a,b,c,d) do not differ significantly between days of supplementation. Means with common superscript within column (x,y) do not differ significantly between groups

**Statistical analysis:** All analyses were performed using the SYSTAT software package. Statistical significance was determined through two-way ANOVA, with groups and days considered as factors. Data from various experiments are expressed as mean±SE.

## RESULTS AND DISCUSSION

**Concentration of vitamin E and selenium in plasma:** A significant ( $p<0.05$ ) decrease in vitamin E concentration was reported in control pigs from 30<sup>th</sup> day (Table 1). In selenium supplemented pigs, a decrease in vitamin E concentration was recorded on 15<sup>th</sup> day which significantly increased on day 30. From day 45<sup>th</sup>, the concentration of vitamin E decreased significantly and remained unchanged till the end of the experiment. Vitamin E supplemented

animals maintained a steady level of vitamin E throughout the experimental period. Selenium concentrations were significantly higher ( $p<0.001$ ) in the selenium-supplemented groups across the entire experimental period.

The concentration of vitamin E and selenium in the control animals were similar to the reports of Meyer *et al.* (1981), Hakansson *et al.* (2001) and Sivertsen *et al.* (2007) in crossbred and Norwegian pigs of 2-3 months age and all findings demonstrated a steady decline in vitamin E with age, especially after weaning as colostrum is a potential source of vitamin E for the piglets due to limited placental transfer (Lauridsen *et al.* 2002). Pigs supplemented with vitamin E maintained a steady level of vitamin E compared to control, which corroborated the earlier reports of Meyer *et al.* (1981) and Bonnette *et al.* (1990). Supplementation

Table 4. Biochemical parameters in control, vitamin E (T1) and selenium (T2) supplemented grower Ghungroo pigs

Parameter	Group	Day				Mean	p value
		15 <sup>th</sup> day	30 <sup>th</sup> day	45 <sup>th</sup> day	60 <sup>th</sup> day		
Glucose (mg/dL)	Control	87.59 <sup>b</sup> ± 2.62	85.93 <sup>ab</sup> ± 2.18	63.41 <sup>a</sup> ± 2.93	65.39 <sup>a</sup> ± 5.62	75.58 ± 2.88	0.000
	T1	85.76 <sup>b</sup> ± 2.68	92.83 <sup>ab</sup> ± 0.73	61.84 <sup>a</sup> ± 2.41	69.69 <sup>a</sup> ± 6.43	77.53 ± 3.10	0.000
	T2	80.81 <sup>c</sup> ± 2.19	88.22 <sup>cd</sup> ± 1.29	67.23 <sup>b</sup> ± 1.00	59.72 <sup>a</sup> ± 2.27	73.99 ± 2.47	0.000
	p value	0.175	0.018	0.254	0.405	0.677	
Total protein (g/dL)	Control	6.29 <sup>a</sup> ± 0.15	6.34 <sup>a</sup> ± 0.17	7.25 <sup>b</sup> ± 0.15	5.93 <sup>ax</sup> ± 0.12	6.45 ± 0.12	0.000
	T1	6.20 <sup>a</sup> ± 0.20	6.07 <sup>a</sup> ± 0.15	7.52 <sup>b</sup> ± 0.28	5.93 <sup>ax</sup> ± 0.28	6.43 ± 0.17	0.000
	T2	5.75 <sup>a</sup> ± 0.15	5.99 <sup>a</sup> ± 0.26	7.54 <sup>b</sup> ± 0.23	6.94 <sup>by</sup> ± 0.26	6.56 ± 0.18	0.000
	p value	0.085	0.458	0.617	0.010	0.844	
Albumin (g/dL)	Control	3.56 <sup>a</sup> ± 0.23	4.22 <sup>ab</sup> ± 0.26	4.51 <sup>b</sup> ± 0.35	3.53 <sup>a</sup> ± 0.16	3.96 ± 0.15	0.033
	T1	3.36 <sup>a</sup> ± 0.16	3.76 <sup>a</sup> ± 0.20	4.63 <sup>b</sup> ± 0.23	3.57 <sup>a</sup> ± 0.23	3.83 ± 0.14	0.002
	T2	3.00 <sup>a</sup> ± 0.19	3.46 <sup>ab</sup> ± 0.34	4.85 <sup>d</sup> ± 0.36	4.21 <sup>bc</sup> ± 0.25	3.88 ± 0.20	0.001
	p value	0.163	0.165	0.749	0.077	0.864	
Globulin (g/dL)	Control	2.73 ± 0.09	2.11 ± 0.23	2.74 ± 0.31	2.40 ± 0.15	2.50 ± 0.11	0.149
	T1	2.84 <sup>b</sup> ± 0.12	2.31 <sup>a</sup> ± 0.16	2.89 <sup>b</sup> ± 0.10	2.36 <sup>a</sup> ± 0.18	2.60 ± 0.09	0.015
	T2	2.75 ± 0.13	2.53 ± 0.09	2.65 ± 0.32	2.73 ± 0.10	2.67 ± 0.09	0.836
	p value	0.773	0.266	0.824	0.200	0.471	
A:G ratio	Control	1.33 ± 0.14	2.18 ± 0.16	1.85 ± 0.18	1.52 ± 0.16	1.72 ± 0.15	0.188
	T1	1.19 ± 0.08	1.69 ± 0.19	1.61 ± 0.07	1.56 ± 0.16	1.51 ± 0.07	0.069
	T2	1.12 ± 0.13	1.40 ± 0.21	2.12 ± 0.13	1.56 ± 0.12	1.55 ± 0.16	0.147
	p value	0.457	0.144	0.645	0.984	0.502	
AST (IU/L)	Control	48.62 ± 1.01	48.69 ± 1.79	47.88 ± 2.16	48.28 ± 2.07	50.46 <sup>y</sup> ± 1.04	0.988
	T1	53.22 ± 1.72	50.14 ± 1.16	47.45 ± 2.50	51.04 ± 2.44	46.57 <sup>x</sup> ± 0.86	0.278
	T2	47.52 ± 1.96	46.18 ± 1.37	46.11 ± 1.70	46.46 ± 2.18	48.37 <sup>xy</sup> ± 0.85	0.942
	p value	0.057	0.188	0.833	0.369	0.014	
ALT (IU/L)	Control	17.30 ± 0.20	18.07 ± 0.27	17.42 ± 0.50	17.46 ± 0.19	17.56 <sup>y</sup> ± 0.16	0.335
	T1	16.92 ± 0.24	17.32 ± 0.26	16.52 ± 0.44	17.02 ± 0.39	16.94 <sup>x</sup> ± 0.17	0.438
	T2	17.70 ± 0.25	17.39 ± 0.32	17.53 ± 0.18	16.83 ± 0.43	17.36 <sup>xy</sup> ± 0.16	0.249
	p value	0.084	0.151	0.178	0.454	0.028	
Cholesterol (mg/dL)	Control	60.63 ± 2.81	67.85 ± 3.15	66.62 ± 2.52	69.08 ± 4.86	66.05 ± 1.75	0.344
	T1	63.77 ± 6.12	69.20 ± 3.49	70.02 ± 1.32	71.95 ± 1.64	68.73 ± 1.83	0.455
	T2	65.78 ± 4.42	71.68 ± 3.49	71.74 ± 2.33	72.91 ± 1.38	70.53 ± 1.57	0.389
	p value	0.737	0.724	0.253	0.663	0.186	
Creatinine (mg/dL)	Control	0.92 ± 0.07	0.87 ± 0.07	0.92 ± 0.05	0.94 ± 0.08	0.91 ± 0.03	0.922
	T1	0.85 ± 0.05	0.95 ± 0.10	0.96 ± 0.05	0.94 ± 0.10	0.93 ± 0.04	0.719
	T2	1.01 ± 0.07	1.07 ± 0.08	0.92 ± 0.06	0.98 ± 0.12	1.00 ± 0.04	0.633
	p value	0.233	0.279	0.786	0.934	0.242	

Values are expressed as mean ± SE. Means with common superscript within a row (a,b,c,d) do not differ significantly between days of supplementation. Means with common superscript within column (x,y) do not differ significantly between groups

of selenium increased plasma selenium concentration in our findings, which was in agreement with the reports of Mahan and Moxon (1978) but, in contrary to the findings of Oliveira *et al.* (2017). It was further interesting to note decreased vitamin E concentration in selenium supplemented groups on day 15 which contradicted the earlier observations (Bertinato *et al.* 2007).

*Growth and morphometric parameters:* Body weight (kg), heart girth (cm), linear length (cm) and height at shoulder (cm) of grower Ghungroo pigs did not differ substantially between treatments (Table 2). But all the parameters increased significantly ( $p < 0.001$ ) with age in all the animals, irrespective of groups.

We didn't find any significant effect of vitamin E and

Table 5. Endocrine parameters in control, vitamin E (T1) and selenium (T2) supplemented grower Ghungroo pigs

Parameter	Group	Day				Mean	p value
		15 <sup>th</sup> day	30 <sup>th</sup> day	45 <sup>th</sup> day	60 <sup>th</sup> day		
Cortisol (ng/mL)	Control	47.93 <sup>b</sup> ±1.23	37.04 <sup>a</sup> ±3.27	38.34 <sup>a</sup> ±2.00	38.93 <sup>ay</sup> ±4.42	40.79±1.57	0.023
	T1	44.82 <sup>b</sup> ±1.36	41.45 <sup>b</sup> ±1.45	39.04 <sup>b</sup> ±2.31	28.09 <sup>ax</sup> ±2.99	38.35±1.64	0.000
	T2	47.85 <sup>b</sup> ±1.62	42.51 <sup>a</sup> ±1.06	41.95 <sup>a</sup> ±1.21	39.98 <sup>ay</sup> ±2.61	43.07±1.01	0.027
	p value	0.240	0.197	0.385	0.028	0.065	
Triiodothyronine (T3) (ng/mL)	Control	1.80 <sup>ax</sup> ±0.06	2.50 <sup>by</sup> ±0.22	1.87 <sup>a</sup> ±0.07	1.83 <sup>a</sup> ±0.27	2.00±0.10	0.035
	T1	2.73 <sup>by</sup> ±0.46	2.50 <sup>by</sup> ±0.14	1.46 <sup>a</sup> ±0.16	1.65 <sup>a</sup> ±0.19	2.09±0.17	0.008
	T2	1.72 <sup>y</sup> ±0.25	1.80 <sup>a</sup> ±0.09	1.61±0.11	1.94±0.42	1.74±0.09	0.767
	p value	0.040	0.009	0.085	0.771	0.173	
Thyroxine (T4) (µg /dL)	Control	3.06±0.51	3.82±0.21	2.74±0.48	3.14±0.58	3.19 <sup>aby</sup> ±0.23	0.438
	T1	3.24±0.42	3.94±0.22	3.07±0.31	3.76±0.26	3.50 <sup>by</sup> ±0.16	0.189
	T2	2.02 <sup>a</sup> ±0.41	3.68 <sup>b</sup> ±0.25	2.07 <sup>a</sup> ±0.34	3.36 <sup>b</sup> ±0.31	2.70 <sup>ax</sup> ±0.23	0.004
	p value	0.150	0.731	0.204	0.584	0.034	

Values are expressed as mean ± SE. Means with common superscript within a row (a,b,c,d) do not differ significantly between days of supplementation. Means with common superscript within column (x,y) do not differ significantly between groups

selenium of body weight and morphometric parameters in Ghungroo pigs. The findings corroborated with the earlier report of Zhu *et al.* 2022.

**Hematological parameters:** There were significantly highest level of hemoglobin ( $p<0.05$ ), PCV ( $p<0.001$ ), TEC ( $p<0.05$ ) and MCV ( $p<0.001$ ) in both vitamin E and selenium supplemented groups (Table 3), which were corroborated with the earlier reports of Morrison and Chavez (1983) as both vitamin E and selenium had stimulatory effect on hematopoietic process (Chow and Tappel 1974) and membrane protection of erythrocytes and leukocytes. On the other hand, noticeably greater TLC ( $p<0.001$ ) only in selenium supplementation. The other parameters remained unchanged after supplementation of vitamin E and selenium. In contrary to our findings, Fontaine *et al.* (1977) and Morrison and Chavez, (1983) didn't find any change in the PCV values in pigs supplemented with vitamin E and selenium.

**Biochemical parameters:** After 30 days of supplementation, blood glucose levels showed a significant increase ( $p<0.05$ ) in the vitamin E supplemented groups (Table 4). There was a significant ( $p<0.01$ ) increase in plasma protein concentration on 60 days of selenium supplementation. AST and ALT decreased significantly ( $p<0.05$ ) in vitamin E supplemented group after 60 days of supplementation. But in contrary to our findings, Zhu *et al.* (2022) reported that vitamin E and selenium in pigs had little effect on the plasma glucose and albumin concentrations. This may be due to the fact that the study Zhu *et al.* (2022) is limited for 28 days but, in our investigation higher glucose and total proteins increased after 30<sup>th</sup> day and 60<sup>th</sup> day of supplementation. Lower AST and ALT had been reported in pigs supplemented with vitamin E and selenium was reported earlier (Batra *et al.* 1995) which may be due to membrane stabilizing effects of vitamin E that prevent enzyme leakage.

**Endocrine parameters:** Supplementation of vitamin E significantly ( $p<0.05$ ) lowered cortisol concentration and improved thyroxine concentration after 60 days of supplementation (Table 5). This might be due to the fact that antioxidants like vitamin E suppressed hypothalamic-pituitary adrenocortical axis (Dhanalaskshmi *et al.* 2006). Improved thyroxine level upon vitamin E supplementation could be attributed by protecting microsomal membrane in which ID-I stored (Chaurasia and Kar 1997).

In this present investigation, we reported a substantial ( $p<0.05$ ) reduction in the vitamin E concentration during accelerated growth phase of Ghungroo pigs which can be restored after supplementation of vitamin E. A significant increase in hemoglobin, TEC, MCV, blood glucose and thyroxine level and decreased plasma cortisol were also seen on vitamin E and selenium supplementation.

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