Table 3: Productive performance $\left(\overline{X} \pm SE\right)$ of Inshas layers as affected by different sources and levels of dietary zinc from 24 to 36 weeks of age.

Items	Zinc sources		Sig.	Zinc levels (mg/kg)				Sig.
	Zinc oxide	Bioplex Zn		35	70	105	140	
Body weight (g)), (weeks)								
24	1423.92±6.14	1437.18±4.86	**NS**	1419.15±7.08	1428.80±8.81	1432.58±5.33	1441.67±9.84	**NS**
28	1467.29±8.35	1472.04±7.75	**NS**	1478.20±12.99	1470.03±11.57	1464.41±8.55	1466.02±13.30	**NS**
32	1512.76±12.03	1503.74±9.76	**NS**	1514.33±16.16	1516.50±16.71	1512.12±12.62	1490.05±16.77	**NS**
36	1540.63±13.94	1536.50±12.46	**NS**	1547.32±17.70	1543.52±19.24	1541.69±15.87	1521.73±22.95	**NS**
Feed intake(g/hen/day), (weeks)								
24	102.30±0.78	100.88±1.01	**NS**	103.26±1.04	101.60±1.45	100.39±1.71	101.10±0.74	**NS**
28	104.18±1.71	103.85±1.62	**NS**	106.02±2.58	104.23±2.30	102.10±2.28	103.72±2.38	**NS**
32	119.35±1.59	117.34±0.71	**NS**	119.42±1.76	118.48±1.67	117.22±1.42	118.26±2.39	**NS**
36	108.61±0.90	107.35±0.56	**NS**	109.56±1.33	108.11±0.64	106.57±0.78	107.69±1.24	**NS**
Feed conversion (g Feed/g Egg mass), (weeks)								
24	3.90±0.08 ^{a}	3.68±0.07 ^{b}	*****	4.03±0.10 ^{a}	3.84±0.12 ^{ab}	3.58±0.09 ^{b}	3.71±0.08 ^{b}	*****
28	3.34±0.11	3.28±0.12	**NS**	3.77±0.13 ^{a}	3.28±0.10 ^{b}	3.08±0.12 ^{b}	3.12±0.12 ^{b}	******
32	4.35±0.11	4.10±0.07	**NS**	4.34±0.08	4.27±0.16	4.06±0.12	4.24±0.18	**NS**
36	3.85±0.08 ^{a}	3.64±0.08 ^{b}	*****	4.09±0.08 ^{a}	3.77±0.07 ^{b}	3.51±0.06 ^{b}	3.62±0.11 ^{b}	******
Egg production (%), (weeks)								
24	61.01±0.66 ^{b}	63.13±0.71 ^{a}	*****	59.88±0.75 ^{c}	61.43±0.91 ^{bc}	64.11±0.74 ^{a}	62.86±1.04 ^{ab}	******
28	71.28±1.27	72.86±1.76	**NS**	66.25±1.73 ^{b}	72.44±1.89 ^{a}	74.58±1.25 ^{a}	75.00±1.82 ^{a}	******
32	63.99±1.28	66.19±1.18	**NS**	64.29±1.17	64.70±2.13	66.61±2.21	64.76±1.70	**NS**
36	65.43±0.87	67.39±0.90	**NS**	63.47±0.62 ^{b}	66.19±1.28 ^{ab}	68.43±0.97 ^{a}	67.54±1.38 ^{a}	*****
Egg weight(g), (weeks)								
24	43.17±0.38	43.55±0.52	**NS**	42.91±0.35	43.13±0.49	43.86±0.73	43.53±0.91	**NS**
28	44.00±0.47	43.93±0.40	**NS**	42.66±0.39	44.02±0.81	44.66±0.35	44.52±0.53	**NS**
32	43.12±0.42	43.37±0.42	**NS**	42.83±0.33	43.19±0.59	43.61±0.47	43.36±0.80	**NS**
36	43.43±0.24	43.61±0.26	**NS**	42.80±0.16	43.45±0.29	44.04±0.27	43.80±0.45	**NS**
Egg mass(g/hen), (weeks)								
24	26.34±0.42 ^{b}	27.48 ±0.40 ^{a}	*****	25.70±0.45 ^{c}	26.50±0.51 ^{bc}	28.10±0.43 ^{a}	27.35±0.66 ^{ab}	*****
28	31.39±0.76	32.03±0.91	**NS**	28.24±0.66 ^{b}	31.90±1.05 ^{a}	33.31±0.67 ^{a}	33.39±0.90 ^{a}	******
32	27.61±0.65	28.68±0.48	**NS**	27.53±0.50	27.90±0.75	29.02±0.88	28.13±1.13	**NS**
36	28.43±0.48	29.39±0.44	**NS**	27.17±0.34 ^{b}	28.75±0.51 ^{a}	30.13±0.29 ^{a}	29.60±0.77 ^{a}	******

Means having different letters at the same row are significantly ($P \leq 0.05$) different.

* = $P<0.05$; ** = $P<0.01$; NS= Not significant.

Table 4. Productive performance $\left(\overline{X} \pm SE\right)$ of Inshas layers as affected by interaction between sources and levels of dietary zinc from 24 to 36 weeks of age.

Items	Zinc oxide (mg/kg)				Bioplex Zn (mg/kg)				Sig.
	35	70	105	140	35	70	105	140	
Body weight (g), (weeks)									
24	1408.56±3.01	1423.10±13.81	1425.54±1.74	1438.48±20.04	1429.73±11.39	1434.50±12.82	1439.61±9.47	1444.87±8.52	**NS**
28	1468.07±14.72	1470.90±22.07	1465.73±10.43	1464.48±26.63	1488.33±22.91	1469.17±13.50	1463.08±15.96	1467.57±13.14	**NS**
32	1507.83±22.30	1524.82±31.13	1521.83±19.85	1496.55±32.63	1520.83±27.69	1508.19±18.95	1502.41±17.54	1483.54±17.31	**NS**
36	1540.91±31.28	1543.97±30.59	1550.74±16.32	1526.89±44.06	1553.73±23.40	1543.07±30.23	1532.64±30.19	1516.57±25.80	**NS**
Feed intake(g/hen/day), (weeks)									
24	103.82±1.58	102.03±2.13	101.96±1.78	101.37±1.21	102.69±1.63	101.17±2.40	98.82±3.01	100.83±1.08	**NS**
28	106.20±4.60	104.27±4.89	102.60±2.89	103.67±2.75	105.83±3.47	104.20±1.61	101.60±4.18	103.77±4.57	**NS**
32	121.09±3.07	118.25±3.73	119.26±2.06	118.81±5.05	117.74±1.82	118.71±0.01	115.18±1.30	117.71±1.64	**NS**
36	110.37±2.65	108.18±0.71	107.94±1.08	107.95±2.64	108.75±1.09	108.03±1.24	105.20±0.07	107.44±0.79	**NS**
Feed conversion (g feed/g egg mass, (weeks)									
24	4.13±0.19	3.97±0.16	3.64±0.15	3.85±0.02	3.92±0.08	3.72±0.16	3.52±0.14	3.56±0.11	**NS**
28	3.72 ± 0.27^{ab}	3.31 ± 0.03^{abc}	3.15 ± 0.20^{bc}	3.19 ± 0.16^{bc}	3.81 ± 0.10^{a}	3.25 ± 0.22^{abc}	3.00 ± 0.15^{c}	3.05 ± 0.21^{c}	*
32	4.52±0.01	4.29±0.29	4.22±0.17	4.37±0.37	4.16±0.01	4.25±0.21	3.89±0.12	4.11±0.11	**NS**
36	4.11 ± 0.16^{a}	3.83 ± 0.10^{abc}	3.63 ± 0.05^{bcd}	3.76 ± 0.16^{bcd}	3.97 ± 0.03^{ab}	3.71 ± 0.11^{bcd}	3.45 ± 0.03^{d}	3.54 ± 0.09^{cd}	**
Egg production (%), (weeks									
24	59.40 ± 1.19^{c}	60.00 ± 0.00^{c}	63.69 ± 1.31^{ab}	60.95 ± 1.04^{bc}	60.36 ± 1.09^{bc}	62.86 ± 1.44^{abc}	64.52 ± 0.93^{a}	64.76 ± 0.86^{a}	**
28	67.62 ± 2.77^{bc}	71.43 ± 1.79^{abc}	72.98 ± 1.57^{ab}	73.10 ± 3.49^{ab}	64.88 ± 2.32^{c}	73.45 ± 3.69^{ab}	76.19 ± 1.67^{a}	76.90 ± 0.86^{a}	*
32	62.26±1.14	64.52±2.30	65.36±3.92	63.81±3.39	66.31±1.21	64.88±4.18	67.86±2.73	65.71±1.44	**NS**
36	63.09±1.14	65.32±1.36	67.34±1.59	65.95±2.53	63.85±0.69	67.06±2.36	69.52±1.00	69.13±0.80	**NS**
Egg weight(g), (weeks)									
24	42.41±0.54	42.90±0.80	44.12±0.96	43.23±0.70	43.40±0.27	43.37±0.72	43.60±1.31	43.83±1.89	**NS**
28	42.48±0.68	44.06±1.20	44.85±0.65	44.62±0.94	42.83±0.52	43.98±1.34	44.47±0.39	44.42±0.70	**NS**
32	42.99±0.55	42.97±0.51	43.49±0.85	43.05±1.56	42.68±0.47	43.40±.21	43.72±0.61	43.67±0.84	**NS**
36	42.63±0.21	43.31±0.32	44.15±0.45	43.63±0.52	42.97±0.22	43.58±0.55	43.93±0.37	43.98±0.85	**NS**
Egg mass(g/hen), (weeks)									
24	25.21 ± 0.81^{b}	25.74 ± 0.48^{b}	28.09 ± 0.77^{a}	26.34 ± 0.18^{ab}	26.19 ± 0.33^{ab}	27.26 ± 0.72^{ab}	28.11 ± 0.58^{a}	28.37 ± 1.07^{a}	*
28	28.69 ± 0.90^{bc}	31.51 ± 1.60^{abc}	32.75 ± 1.17^{ab}	32.61 ± 1.62^{ab}	27.79 ± 1.06^{c}	32.28 ± 1.68^{ab}	33.88 ± 0.75^{a}	34.17 ± 0.89^{a}	*
32	26.77±0.70	27.72±0.95	28.38±1.41	27.55±2.30	28.29±0.41	28.08±1.38	29.66±1.21	28.70±0.90	**NS**
36	26.90 ± 0.58^{c}	28.30 ± 0.79^{abc}	29.72 ± 0.47^{ab}	28.80 ± 1.35^{abc}	27.44 ± 0.42^{bc}	29.20 ± 0.68^{abc}	30.53 ± 0.21^{a}	30.40 ± 0.72^{a}	*

Means having different letters at the same row are significantly ($P \leq 0.05$) different.

* = $P<0.05$; ** = $P<0.01$; NS= Not significant.

Table 6. Semen characteristics $\left(\overline{X} \pm SE\right)$ of Inshas layers as affected by different sources and levels dietary zinc and their interactions at 36 weeks of age.

Items		Semen ejaculate volume(ml)	Hydrogen-ion concentration (pH)	Sperm motility (%)	Dead spermatozoa (%)	Sperm abnormalities (%)	Sperm cell concentration (X 10^9/ml)
Zinc sources		**	NS	**	**	NS	**
Zinc oxide		0.64 ± 0.02 [b]	7.41 ± 0.10	69.17 ± 2.20[b]	20.67 ± 1.27 [a]	12.25 ± 0.95	3.92 ± 0.17 [b]
Bioplex Zn		0.73 ± 0.04 [a]	7.48 ± 0.10	75.42 ± 2.85 [a]	15.08 ± 1.81 [b]	9.92 ± 1.14	4.52 ± 0.14 [a]
Zinc levels (mg/kg):		**	NS	**	**	**	**
35		0.58 ± 0.01 [b]	7.30 ± 0.11	60.83 ± 1.54 [c]	24.33 ± 0.61 [a]	14.67 ± 1.41 [a]	3.62 ± 0.22 [b]
70		0.64 ± 0.03 [b]	7.63 ± 0.16	72.50 ± 2.14 [b]	19.17 ± 1.96 [b]	11.50 ± 1.31 [ab]	3.95 ± 0.19 [b]
105		0.78 ± 0.05 [a]	7.40 ± 0.17	80.00 ± 2.89 [a]	12.33 ± 2.04 [c]	8.00 ± 0.77 [b]	4.72 ± 0.12 [a]
140		0.74 ± 0.05 [a]	7.45 ± 0.14	75.83 ± 3.00[ab]	15.67 ± 1.87 [c]	10.17 ± 1.33 [b]	4.58 ± 0.15 [a]
Interaction effects:							
Zinc sources	**Zinc levels**	**	NS	**	**	*	**
Zinc oxide	**35**	0.57 ± 0.01[c]	7.37 ± 0.19	60.00 ± 2.89 [e]	24.67 ± 0.88 [a]	15.00 ± 2.08[a]	3.23 ± 0.15 [e]
	70	0.62 ± 0.04 [c]	7.60 ± 0.31	70.00 ± 2.89 [cd]	22.67 ± 2.33 [a]	13.67 ±0.88[abc]	3.57 ± 0.03 [ed]
	105	0.70 ± 0.03 [bc]	7.43 ± 0.23	75.00 ± 2.89 [bc]	15.67 ± 2.33 [bc]	8.33 ± 0.88[cd]	4.53 ± 0.03 [abc]
	140	0.66 ± 0.06 [c]	7.23 ± 0.15	71.67 ± 4.41 [bc]	19.67 ± 0.88 [ab]	12.00 ± 1.15[abcd]	4.33 ± 0.17 [bc]
Bioplex Zn	**35**	0.58 ± 0.02 [c]	7.23 ± 0.15	61.67 ± 1.67 [de]	24.00 ± 1.00 [a]	14.33 ± 2.33[ab]	4.00 ± 0.29 [cd]
	70	0.66 ± 0.03 [c]	7.67 ± 0.17	75.00 ± 2.89 [bc]	15.67 ± 1.20 [bc]	9.33 ± 1.76[cd]	4.33 ± 0.17 [bc]
	105	0.86 ± 0.07 [a]	7.37 ± 0.30	85.00 ± 2.89 [a]	9.00 ± 2.08 [d]	7.67 ± 1.45[d]	4.90 ± 0.21 [a]
	140	0.83 ± 0.04 [ab]	7.67 ± 0.17	80.00 ± 2.89 [ab]	11.67 ± 0.88 [cd]	8.33 ± 2.03[cd]	4.83 ± 0.17 [ab]

Means having different letters at the same row are significantly (P≤0.05) different.
* = P<0.05; ** = P<0.01; NS= Not significant.

Table 8. Economic efficiency $\left(\overline{X} \pm SE\right)$ of Inshas layers as affected by different sources and levels of dietary zinc and their interactions at 36 weeks of age.

Items		Egg number	Price/ egg (LE)	Total revenue hen (LE)[1]	Total feed intake/hen (kg)	Price/Kg feed (LE)	Total feed cost/ hen LE)	Fixed hen (LE)[2]	Total cost hen (LE)	Net revenue/ hen (LE)[3]	Economic efficiency (EEf)[4]
Zinc sources											
Zinc oxide		54.96	0.5	27.48	9.123	1.714	15.63	2	17.63	9.85	55.85
Bioplex Zn		56.61	0.5	28.31	9.018	1.721	15.52	2	17.52	10.79	61.6
Zinc levels (mg/kg):											
35		53.32	0.5	26.66	9.203	1.713	15.76	2	17.76	8.9	50.11
70		55.6	0.5	27.8	9.081	1.716	15.58	2	17.58	10.22	58.15
105		57.48	0.5	28.74	8.952	1.722	15.41	2	17.41	11.33	65.07
140		56.73	0.5	28.37	9.046	1.719	15.55	2	17.55	10.82	61.66
Interaction effects:											
Zinc sources	**Zinc levels**										
Zinc oxide	**35**	53	0.5	26.5	9.271	1.711	15.86	2	17.86	8.64	48.35
	70	54.87	0.5	27.44	9.087	1.713	15.57	2	17.57	9.87	56.18
	105	56.57	0.5	28.29	9.067	1.716	15.56	2	17.56	10.73	61.09
	140	55.4	0.5	27.7	9.068	1.714	15.54	2	17.54	10.16	57.9
Bioplex Zn	**35**	53.63	0.5	26.82	9.135	1.714	15.66	2	17.66	9.16	51.86
	70	56.33	0.5	28.17	9.074	1.718	15.59	2	17.59	10.58	60.13
	105	58.4	0.5	29.2	8.837	1.727	15.26	2	17.26	11.94	69.16
	140	58.07	0.5	29.04	9.025	1.723	15.55	2	17.55	11.48	65.44

1- Total revenue = Egg number / hen X Price/egg (LE)

2- Fixed hen (LE) = Rearing cost .

3-Net revenue/hen (LE) = Total revenue - Total cost/hen.

4-EEf = Net revenue/hen (LE) / Total cost/hen (LE).