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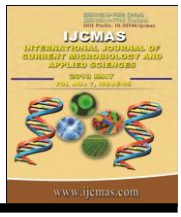

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A Comparison between Organic and Inorganic Selenium: 1. Effect on Body Weight, Laying Performance, Hatchability in Broiler Breeder

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A B S T R A C T

One hundred and forty four numbers of 40th week-old coloured broiler breeder hens were randomly distributed into 6 dietary treatments with three replicates with 8 chicks per replicate. The dietary treatments were: T_1 (Control group): Basal diet; T_2: Basal diet with 0.3 ppm of inorganic Se (SS-0.3); T_3: Basal diet with 0.6 ppm inorganic selenium (SS-0.6); T_4: Basal diet with 0.3 ppm of organic selenium (SY-0.3); T_5: Basal diet with 0.6 ppm of organic selenium (SY-0.6); and T_6: Basal diet with 0.3ppm sodium selenite+0.3 ppm selenium yeast (SS-0.3+SY-0.3). The supplementation was continued for 12 weeks. The body weight, hen day egg production (%), hatchability (%) was recorded at 6wk interval. There was no significant difference in body weight, laying performance of broiler breeder hen between the treatments. Hatchability study in 52nd week birds supplemented with both in organic and inorganic selenium groups showed significantly higher percentage control groups. No significant difference found in egg weight and other egg quality parameters. From the above experiment it was concluded that feeding of organic selenium at both the doses to the coloured broiler breeder hens improved the egg hatchability in comparison with inorganic selenium. Therefore it is recommended that 0.3ppm of organic selenium should be supplemented to the broiler breeder hen.

Introduction

Selenium is an essential trace element in poultry nutrition. The essentiality of selenium in poultry was first reported in the year 1957 for the prevention of exudative diathesis (Patterson *et al.*, 1957). Selenium deficiency in poultry manifests itself in many diseases and dysfunctions including liver necrosis, muscular dystrophy, microangiopathy, exudative diathesis, pancreatic fibrosis, poor feathering, immune deficiency, reduced hatchability and many others (Edens, 1996). Low level of selenium supplementation causes

delayed immune development in chick along with impaired feathering and subsequent energy loss leading to increased embryo and bird mortality and reduced egg production (Finch and Turner, 1996; Surai, 2000; Edens, 2002) and encephalomalacia. In poultry selenium deficiency is mainly related to its antioxidant property through the enzyme glutathione peroxidase (GSHPx). Selenium supplementation can be done in two forms organic and inorganic forms. Sodium selenite and sodium selenate are the two inorganic sources whereas selenium enriched yeast and plant derived selenomethionine provide the organic forms (Torrent, 1997). In June 2000, selenium yeast was approved by the USFDA (Federal Register, 2000) as a source of feed supplemented organic selenium for chickens. Organic selenium has shown many advantages over inorganic sources.

The main and foremost advantage is its bioavailability. Organic selenium can be utilised to synthesize selenoproteins and excess selenium can be stored in a protein pool for different applications. But in case of inorganic forms are utilised for synthesis of selenoproteins and the excess selenium is excreted. Secondly organic selenium improves the antioxidant properties by increasing the GSH-Px and tissue selenium concentration in comparison to inorganic sources (Payne and Southern, 2005). Thirdly organic selenium fails to undergo pro-oxidation unlike inorganic selenium as it already exists in an organic form (Mahan, 1995).

Though some literature is available for commercial broiler breeder birds in Indian content, but a few research works has been carried out in coloured broiler breeder hens in India to find the optimum requirement. The objective of this research was to evaluate the effect of inorganic and organic selenium on body weight, laying performance and hatchability of broiler breeder hen.

Materials and Methods

Location of research work

The present experiment was conducted at the Department of Animal Nutrition in collaboration with the Poultry Complex, Faculty of Veterinary Science and Animal Husbandry, Orissa University of Agriculture and Technology, Bhubaneswar. The details of the materials and methods followed are described below.

Selections of birds and dietary treatments

A total number of 144 synthetic coloured broiler breeder hens of 40 wk age were selected from the poultry farm of Orissa Veterinary College according to their production record. The synthetic broiler breeder birds were developed by the All India Coordinated Research Project (AICRP) on Poultry Improvement. Vaccination against Newcastle disease (R2B strain) was done 20 days prior to the beginning of the experiment.

Experimental design

All the selected breeder birds are randomly allocated to six dietary treatments. Each treatment group had 3 replicates containing 8 chicks (7 female and male) in each replicate. The birds were housed in different cages leaving a gap of two cages between groups. The birds were supplemented with inorganic or organic selenium for 12wks starting from 40^{th} to 52^{nd} wk of age.

Selenium sources of the experiment

In this research two selenium sources were taken, inorganic selenium (Sodium Selenite, HIMEDIA) and organic selenium. Selenium yeast was prepared by growing *Saccharomyces cerevisiae* (yeast cells) in Potato Dextrose Broth at 37°C in the

Department of Microbiology, OUAT. Then 700 ppm of sodium selenite was added and incubated in incubator shaker for 48hrs at 100 rpm at 30^0C to get optimum yeast harvest which was centrifuged and filtered to collect the selenium yeast. Then it was oven dried at 40^0C to collect the dry biomass.

Parameters

Body weight was recorded individually three times i.e. 40th wk, 46th wk and 52nd wk by using a top pan electric weighing machine. Mortality, hen day egg production, hatchability were recorded up to 12th week of study period. Egg quality parameters like egg weight, egg length, breadth, shell thickness, yolk weight, height, width and albumen weight, height, width were recorded at 40th wk, 46th wk and 52nd wk to see the effect of selenium source.

Statistical analysis

The data obtained from the study were statistically analysed according to Snedecor and Cochran (1994) and tabulated. The data were also analysed for analysis of variance (ANOVA) and DMR test (Duncan, 1995) was used to test the difference between treatment means wherever necessary.

Results and Discussion

The importance of selenium in poultry is very much known and a good number of researches have been conducted during last 10yrs indicating the dietary form of selenium is a major determinant for its efficiency (Table 1–3).

In the present experiment two levels of inorganic selenium in the form of sodium selenite and two levels of organic selenium with including a mixed form were supplemented for a period of 12wks in the coloured broiler breeder bird.

Body weight

The body weight at 40th week varies from 3009.24 to 3244.17g. In 46th and 52nd weeks there was some increase in the body weight in most of the groups. The body weight of the birds was not statistically significant among the supplemented groups and between the 3 periods of age. Yoon *et al.,* (2007) and Rao *et al.,* (2013) also reported that by giving different doses of organic selenium from 100-400µg/kg of the diet on the commercial broiler birds didn't find any significant difference among the groups where Rajashree *et al.,* (2014) found improvement in the body weight in the organic selenium supplemented groups at a rate of 0.3 to 0.5ppm than inorganic selenium supplementation and control groups in commercial broiler breeder birds at 29th and 34th week of age but not in 39th week. In the present experiment no change in the body weight was seen as these birds have attended more than 40 weeks of age.

Laying performance

The egg laying performance of the breeder birds was between 55 to 60% throughout the experimental period without any effect of the selenium supplementation. Ort *et al.,* (1978) by feeding sodium selenite from 0.1 to 5ppm didn't find any change in the egg production performance.

Rajashree *et al.,* (2014) didn't find any improvement of egg production performance at 29th wk but higher egg production was seen in 34th and 39th week of age with supplementation of organic selenium w.r.t inorganic and control. In the present experiment the birds have already attended peak production that's why the production performance of the breeder birds didn't improve over the weeks. But by feeding selenium the consistency was maintained up to 52nd week. The production level of coloured broiler breeder birds in the present experiment

is lower than white commercial breeder birds as reported by Rajashree *et al.,* (2014).

Hatchability

At 40th wk of age the hatchability %age of the eggs on total egg set basis was 80.462 to 82.79% in different groups. The hatchability of the birds increases with the feeding of organic selenium at 52nd week of age which was statistically significant with the lower level of inorganic supplemented groups and control. Both the levels of inorganic supplementation (SS-0.3, SS-0.6) the hatchability increases w.r.t. control one. Rajashree *et al.,* (2014) reported that the hatchability improved upon feeding organic selenium at a rate of 0.3 to 0.5ppm w.r.t. inorganic and control at 34 weeks of age and organic have higher hatchability than control. But Yuan *et al.,* (2011) didn't find any significant effect on hatchability of the Lingnan Yellow broiler breeder by supplementing either inorganic or organic selenium enriched yeast.

Table.1 Proximate composition of experimental rations

Proximate composition	Percentage on DM basis
Moisture	9.24
Crude protein	18.01
Ether Extract	4.16
Crude fibre	4.92
Total ash	10.54
Acid insoluble ash	2.66
Nitrogen free extract*	53.82
Calcium	2.97
Available phosphorus	0.57
Metabolisable energy*(Kcal/kg)	2805
Lysine	1.39
Methionine	0.64

*Calculated value

Table.2 Selenium sources and levels supplemented in diets (mg/kg)

Treatment	Diet	Se level (ppm)	
		Supplemented	Final total
Control	Basal diet	0.0	0.028
SS-0.3	Basal diet +SS	0.3	0.315
SS-0.6	Basal diet +SS	0.6	0.605
SY-0.3	Basal diet +SY	0.3	0.307
SY-0.6	Basal diet +SY	0.6	0.606
SS-0.3+SY-0.3	Basal diet +SS+SY	0.6	0.598

Table.3 Effect of selenium sources on body weight, laying performance and hatchability

Weeks	Control	SS-0.3	SS-0.6	SY-0.3	SY-0.6	SS-0.3 + SY-0.3	SEM	*p-value*
Body weight								
40th	3135.34 ±22.80	3158.42 ±26.53	3133.80 ±23.04	3088.27 ±22.82	3009.24 ±39.95	3244.16 ±28.16	49.06	0.20
46th	3259.25 ±14.61	3095.04 ±38.80	3157.02 ±40.63	3262.65 ±38.11	3263.21 ±25.82	3184.82 ±22.04	78.97	0.73
52nd	3347.06 ±24.28	3359.13 ±33.63	3350.13 ±46.31	3399.03 ±43.04	3396.34 ±38.62	3373.84 ±43.71	56.52	0.42
Mean	3247.22 ±18.52	3204.20 ±22.23	3213.65 ±32.67	3249.98 ±31.84	3222.93 ±35.23	3267.61 ±26.28		0.176
Laying performance								
40-42nd	57.09 ±0.71	57.57 ±0.87	58.74 ±1.00	57.21 ±0.65	58.32 ±0.85	58.47 ±0.29	0.78	0.55
42-44th	57.46 ±0.90	57.02 ±1.52	58.68 ±0.22	57.79 ±0.90	57.43 ±0.72	56.59 ±0.22	0.89	0.65
44-46th	55.54 ±0.84	54.61 ±0.44	57.31 ±0.58	56.5 ±0.46	57.29 ±0.68	55.54 ±0.91	0.69	0.09
46-48th	56.95 ±0.63	54.59 ±0.31	56.72 ±0.99	56.20 ±0.21	55.04 ±0.27	55.18 ±0.88	0.84	0.12
48-50th	54.94 ±1.18	54.90 ±1.02	55.49 ±0.52	54.68 ±1.01	54.85 ±0.95	55.34 ±1.17	1.03	0.99
50-52nd	54.40 ±1.04	55.57 ±0.15	55.55 ±0.51	54.94 ±0.95	56.09 ±1.22	54.68 ±0.12	0.44	0.09
Mean	56.06 ±0.42	55.88 ±0.42	57.08 ±0.40	56.22 ±0.37	56.50 ±0.52	55.97 ±0.39		0.128
Hatchability								
40th	80.46 ±1.70	82.79 ±0.71	82.48 ±0.85	81.61^{B} ±1.01	81.79^{B} ±0.62	81.93^{B} ±0.79	0.97	0.67
46th	82.40 ±0.67	83.56 ±0.47	83.05 ±0.83	84.64^{AB} ±1.06	85.48^{AB} ±1.37	84.97^{AB} ±1.28	0.96	0.24
52nd	81.63^{c} ±2.07	83.95^{b} ±0.66	84.54^{ab} ±0.40	86.32^{aA} ±0.87	87.15^{aA} ±0.99	86.26^{aA} ±0.84	0.76	0.01
Mean	81.49^{b} ±0.88	83.43^{ab} ±0.36	83.36^{ab} ±0.44	84.19^{ab} ±0.71	84.81^{a} ±0.78	84.39^{ab} ±0.69		0.003

^{a,b},.... means with no common superscripts within a row vary significantly (P<0.05)
^{A,B},....means with no common superscripts within a column vary significantly (P<0.05)

External egg parameters

The egg weight of the breeder birds during the experimental periods was between 58 to 62g. At 52nd week higher level of organic supplementation (SY-0.6 and SS-0.3+SY-0.3) showed significantly higher egg weight than other groups and control. Our findings are in agreement with Rutz *et al.,* (2013) and Skrivan *et al.,* (2006) who found heavier eggs in organic

selenium supplemented groups than control hence receiving sodium selenite supplemented diets. Pavlovic *et al.,* (2009) found no significant difference in egg weight in the Shaver hens for feeding either inorganic or organic selenium for a period of 16 week.

Rajashree *et al.,* (2014) reported higher egg weight at the organic selenium supplemented groups than inorganic and control birds in the commercial broiler breeder. In the present experiment the egg weight of the coloured birds are higher than the commercial white birds as reported by Pavlovic *et al.,* (2009) and Rajashree *et al.,* (2014).

Other external egg quality parameters like egg length, egg width, shell thickness and shell weight was not significantly different among the inorganic, organic and mixed groups. Paton *et al.,* (2000) reported increasing shell breaking strength of eggs due to feeding selenium enriched yeast while Payne *et al.,* (2005) is opposite. Our results of the shell thickness and shell weight do not vary with the treatment as the birds are in the decline phase of the egg production and lay heavier eggs.

Internal egg parameters

No significant effect on all internal egg parameters albumen and yolk height, width, weight was seen among the birds due to supplementation of either inorganic or organic selenium. Invernizzi *et al.,* (2013) reported increased egg surface area by feeding both inorganic and organic selenium than the control. But no effect of egg shell breaking strength was also increased with the organic selenium supplemented groups.

From the above experiment it was found that feeding of organic selenium at both the doses to the coloured broiler breeder hens improved the egg hatchability in comparison with inorganic selenium. Therefore it is recommended that 0.3ppm of organic selenium should be supplemented to the broiler breeder hen for achieving optimum.

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