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European Journal of Experimental Biology, 2013, 3(3):642-646

ISSN: 2248 –9215
CODEN (USA): EJEBAU

The effects of different levels Certiselen-E supplementation on performance and immune response of laying hens during high environmental temperature

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ABSTRACT

The aim of this study was to determine effects of liquid supplement of vitamin E and Selenium (Certiselen E®) on performance and immune response of laying hens during high environmental temperature. A total number of 144 white Lohman LSL-Lite laying hens at 63 weeks of age divided into 24 cages. Four levels of Certiselen-E supplement including zero (T_1 or control), 0.5 (T_2), 0.75 (T_3) and 1.0 (T_4) ml per liter of drinking water with 6 replicates (n=6) were used during 4-week trial period. The hens performance including hen-day egg production % , feed intake, egg mass (g/hen/day) and feed conversion ratio (FCR, g feed: g egg) was measured. Antibody production against sheep red blood cells (SRBC) also was measured. The general linear model procedure of SAS software was used for data analysis and differences among treatment means determined using the Duncan's multiple-range test. The results showed that the inclusion of Certiselen-E had a significant effect on production performance of laying hens ($P<0.05$). In addition Certiselen-E supplements improved immune response of laying hens and a more positive effect was observed when 1 ml/L added to the drinking water. From the results of the present experiment it could be concluded that utilisation of Certiselen-E in drinking water were effective for improving the performance and immune system of laying hens.

Key words: Certiselen-E, Productive performance, Immune response, Laying hens

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INTRODUCTION

Heat stress in laying hens reduces feed intake, feed efficiency, production and quality of eggs. In hot environment, hens exert an effort to maintain their body temperature within a normal range. This challenge is associated with behavioral, physiological, hormonal and molecular reactions to heat stress [21]. Stress increases mineral and vitamin mobilization from tissues and their excretion, thus may exacerbate a marginal vitamin and mineral deficiency or an increased mineral and vitamin requirement [21]. The aim of food researchers and producers is to increase the nutritional value of food without decreasing sensory quality or consumer's acceptability. Human health may be improved with increasing intake of biologically valuable ingredients [18].Vitamins and minerals are vital nutrients that are involved in both metabolic and physiological processes, which are critical for human and animal health and animal feed production. It has been well-documented that in formulating feed, nutritionists have to take into account several factors including stress management and immunity enhancement [16,

21]. In birds, free radical generation and lipid peroxidation are responsible for the development of various diseases as well as for a decrease in bird's productivity and product quality [17, 38]. Vitamin E, a fat soluble vitamin, functions as a chain breaking antioxidant which prevents free radical induced oxidative damage by trapping reactive oxyradicals in biological membranes [27, 33]. Trace elements function as parts of proteins, hormones, enzymes or as cofactors that activate specific enzymes. Selenium is an essential component of selenium dependent glutathione peroxidese enzymes, which are antioxidant enzymes that destroy free radicals produced during normal metabolic activity [28]. Selenium has a profound impact on immune function, health and productivity and is associated with protein in animal tissues [42] and selenium is on one hand toxic at high doses. On the other hand, Se deficiency is a global problem related to an increasing susceptibility of animals and humans to various diseases [12]. Generally, a deficiency of selenium and/or vitamin E has little effect on the magnitude of the total or the specific antibody responses of domestic species [8]. Because selenium is a trace element and add to ration very little, and in powder form not mixes well, in result may some animals use more that is poisoning and some other use lower that causing deficiency. Supplement used in this experiment named Certiselen-E that was in liquid form that added daily to water in different levels. This supplement was contained 100000 mg vitamin E in form of α-Tocopheryl acetate and 225 mg selenium in form of sodium selenite per liter. The present study was conducted to evaluate the effect of different levels of Certiselen-E supplement on performance and immune response of laying hens during high environmental temperature.

MATERIALS AND METHODS

This study was conducted in the Rezvan junior college aviculture farm in Kerman province (latitude 25^0 55 / N, longitude 53^0 26/ E, altitude 1755m) from April to June 2011. A total number of one hundred and forty four 63-week old single comb white LSL-Lite Lohman laying hens, were divided into 24 cages. The hens were selected from a large herd so that their body size and egg production were almost similar. Experiment was conducted based on a completely randomized design. After a week of adaptation, hens were randomly allocated to one of the four experimental groups including zero (T_1), 0.5 (T_2), 0.75 (T_3) and 1.0 (T_4) ml Certiselen-E supplement per liter of drinking water. Hens were randomly assigned to cages and each experimental group was assigned to hens of six replicates. Each replicate consisted of 2 adjoining cages with 3 hens per individual cage (n=6). All birds were fed on diet was formulated to cover the nutrient requirements of laying hens based on Lohman catalogue. During the experiment, hens fed approximately 120 (gr/day) and water was offered *ad-libitum*. The hens performance including hen-day egg production %, feed intake and egg mass (g/hen/day) was measured. Feed conversion (FCR, g feed: g egg) was also calculated as the ratio of gram of feed consumed per gram of egg weight produced. At the 3^{th} week of the experiment, 6 hens were randomly selected from each group (1 from each replicate) and injected with 0.2 ml of 9% suspension of sheep erythrocytes (SRBC) in phosphate buffer saline. One week after SRBC injection, 3 mL blood was taken from selected hens using jugular venipuncture, and serum was separated and evaluated for antibody titer. Haemagglutination inhibition (HI) test was used for determining antibody titer sera.

Statistical analysis

The general linear model procedure of SAS software was used for data analysis and differences among treatment means determined using the Duncan's multiple-range test. All statements of significance are based a probability of less than 0.05.

RESULTS AND DISCUSSION

The effect of different levels of supplemental Certiselen-E in drinking water on egg production and egg mass of laying hens during the entire 4-week period of the study are presented in Table The results indicated that inclusion of Certiselen-E in drinking water had a significant effect on egg production and egg mass ($P<0.05$). Egg production was higher in T_4 treatment compared with other treatments. Egg mass was higher in T_4 treatment compared with that of other treatments. Egg production and Egg mass increased with increasing the levels of Certiselen-E.

The effects of different levels of supplemental Certiselen-E in drinking water on feed intake and feed conversion ratio of laying hens during the entire 4-week period of the study is shown in Table 2. The results indicated that inclusion of Certiselen-E in drinking water had a significant effect on feed conversion ratio ($P<0.05$). Results from this table showed that inclusion of Certiselen-E had not a significant effect on feed intake ($P>0.05$). Feed intake was lower in T_4 treatment compared with other treatments. In addition supplementation with Certiselen-E significantly decreased feed conversion ratio. Feed conversion ratio decreased with increasing the levels of Certiselen-E.

Table 1: Effects of adding vitamin E and selenium as liquid supplement Certiselen-E in drinking water on egg production (EP) and egg mass (EM) of laying hens

Traits	Egg production (%)		Egg mass (g egg/hen/day)	
Weeks	1-2	3-4	1-2	3-4
Treatments				
T_1	73.03±1.13^{b}	75.19±1.12^{b}	49.33±0.89^{b}	50.65±1.25^{c}
T_2	74.09±1.03^{b}	76.63±0.88^{b}	50.72±1.07^{b}	52.77±1.47^{bc}
T_3	76.91±0.89^{ab}	78.91±0.95^{b}	51.63±1.19^{b}	54.33±1.09^{ab}
T_4	78.43±1.35^{a}	81.62±1.43^{a}	51.35±1.37^{b}	57.77±1.98^{a}
SEM	0.543	0.632	0.448	0.639
P-Values	0.024	0.031	0.067	0.027

Means (±SD) within a column showing different superscripts are significantly different (P<0.05).

Table 2: Effects of adding vitamin E and selenium as liquid supplement Certiselen-E in drinking water on feed intake (FI) and Feed conversion ratio (FCR) of laying hens

Traits	Feed intake (g Feed/hen/day)		Feed conversion ratio (FCR)	
Weeks	1-2	3-4	1-2	3-4
Treatments				
T_1	117.33±1.22^{b}	117.08±1.02^{b}	2.32±0.85^{b}	2.12±1.32^{b}
T_2	117.51±1.01^{b}	116.32±0.95^{b}	2.28±0.91^{b}	2.09±1.12^{b}
T_3	117.32±1.19^{b}	117.04±1.03^{b}	2.18±0.89^{b}	1.98±0.94^{a}
T_4	118.67±1.38^{b}	117.36±1.26^{b}	2.07±1.04^{b}	1.75±1.53^{a}
SEM	0.789	0.565	0.389	0.462
P-Values	0.151	0.238	0.349	0.029

Means (±SD) within a column showing different superscripts are significantly different (P<0.05).

The effects of different levels of supplemental Certiselen-E in drinking water on egg weight and antibody titer against SRBC of laying hens during the entire 4-week period of the study is shown in Table 3. Results from this table indicated that inclusion of Certiselen-E in drinking water had a significant effect on egg weight and antibody titer against SRBC (P<0.05). Egg weight was higher in T_4 treatment compared with that of other treatments. Egg weight increased with increasing Certiselen-E supplement. The hens receiving the 1ml/L Certiselen-E had significantly higher titers of total, IgM and IgG antibodie compared with that of other treatments (P<0.05). The titer of total antibody, IgM and IgG significantly increased with increasing Certiselen-E supplement.

Table 3: Effects of adding vitamin E and selenium as liquid supplement Certiselen-E in drinking water on egg weight (EW) and antibody titer against SRBC of laying hens

Traits	Egg weigh (g)		Antibody titer against SRBC		
Weeks	1-2	3-4	IgM	IgG	Total
Treatments					
T_1	59.38±1.16^{b}	55.58±1.42^{c}	2.11±1.41^{b}	3.21±1.42^{b}	3.17±1.04^{c}
T_2	63.42±1.46^{ab}	59.79±1.61^{b}	3.19±0.98^{b}	4.34±1.37^{ab}	5.53±0.88^{b}
T_3	65.29±0.97^{a}	61.24±0.93^{b}	3.33±1.19^{b}	5.08±0.79^{a}	6.69±1.03^{b}
T_4	67.07±1.28^{a}	63.43±1.42^{a}	5.47±1.38^{a}	7.23±1.05^{a}	8.44±1.18^{a}
SEM	0.438	0.512	0.349	0.284	0.387
P-Values	0.032	0.023	0.0036	0.039	0.017

Means (±SD) within a column showing different superscripts are significantly different (P<0.05).

Results from current study indicated that inclusion of Certiselen-E in drinking water had a significant effect on production performance of laying hens (P<0.05). These results were in agreement with those of Nasiroleslami and Torki [24] who demonstrated that the diet supplementation by vitamin E have beneficial effect on performance of laying hens during the period of 71-81 week of age. Moradi Kor et al. [21] demonstrated that under heat stress vitamin E and selenium supplementation decreased FCR in laying hens. Our results are in contrast with the finding of Osman et al. [26] who reported that the dietary organic selenium supplementation had no significant effect on egg production in laying hens. In addition, puthpongsiriporn et al. [30] reported that under environmental stress, feed intake, egg production was decreased in birds fed with vitamin E and C. Grobas et al. [9] using two levels of Vitamin E (13 and 263 mg/kg) observed no difference in egg production, egg weight, feed conversion and shell thickness in ISA brown laying hens. Mohiti asli et al. [19] reported that diet inclusion of vitamin E did not

significantly affect egg weight and FCR. Mohiti asli et al. [20] found that FCR and egg production were not significantly influenced by vitamin E and organic and inorganic selenium supplementation during heat stress. Scheideler and Froning [35] supplemented layer (Babcock B-300) diet with 50 mg/kg Vitamin E and observed 2% improvement in egg production during peak production. The differences between previous reports and the present study may be partly related to differences in hens' age and environmental condition. The effect of dietary selenium and vitamin E and their different combination on body weight gain, food consumption, food conversion efficiency, leucocyte migration inhibition and antibody production was studied in broilers [39, 40, 41]. It was reported that the dietary supplementation of selenium significantly increased the egg production and hatchability and decreased the percentage of infertile eggs and early dead embryos. As selenium and vitamin E have been increasingly recognized as an essential element in biology and medicine. Diet supplementation by Immunofin and vitamin E did have beneficial effect on performance of laying hens during the period of 71-81 week of age [24]. It has been demonstrated that vitamin E is an antioxidant because it scavenges free radicals generated in cell membranes [2], and forms selenocysteine, part of the active center of the glutathione peroxidase enzyme [15]. The differences between previous reports and the present study may be partly related to differences in hens' age and environmental condition. Antibody production against SRBC in laying hens that fed high level of Certiselen-E supplementation was greater than that of the other treatment ($p<0.05$). Serological data from the present study showed that the effectiveness of Certiselen-E supplementation on systemic immunity. The results of this experiment was similar to finding of Mohiti Asli et al. [19] who indicated that vitamin E could stimulate a protective immune response sufficiently to enhance resistance to microbial pathogens. Dietary selenium and vitamin E stimulates immune response in poultry against bacterial and viral infections [22], improve reproductive performance [3] of broiler breeders as well as increasing economic returns [10]. Selenium and Vitamin E have been found to alter immuncompetence in various species. The etiology of their stimulatory roles in the immune response is unknown; however, it may be related directly to their antioxidant properties [11]. Spallholz et al. [37] demonstrated that high dietary selenium enhanced serum immunoglobulin G (IgG) and immunoglobulin M (IgM) antibody titers in mice challenged with sheep red blood cells. Vitamin E has been implicated in stimulation of serum antibody synthesis, particularly IgG antibodies [11].

CONCLUSION

The present investigation suggested that Certiselen-E at a level of 1 ml/L can improve production performance and immune responses of laying hens during high environmental temperature. Thus, supplementation Certiselen-E at levels above recommended as nutritional requirements for inprove humoral and cellular immunity. In addition, improving performance and immune responses of laying hens by Certiselen-E supplementation is relatively a novelt results, so the antioxidative effect of Certiselen-E could be the subject of further investigations.

Acknowledgements
The authors are grateful to staff of aviculture laying hens for their useful and kind helps. Also we would like to have a special thank to the director of the Rezvan junior college for providing a friendly environment and research facilities.

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