Animal Feed Science and Technology 153 (2009) 77–87

Contents lists available at ScienceDirect

Animal Feed Science and Technology

journal homepage: www.elsevier.com/locate/anifeedsci

Selenium supplementation influences growth performance, antioxidant status and immune response in lambs

N. Kumar [a], A.K. Garg [a,*], R.S. Dass [a], V.K. Chaturvedi [b], V. Mudgal [a], V.P. Varshney [c]

[a] *Mineral and Vitamin Nutrition Laboratory, Centre of Advanced Studies in Animal Nutrition, Indian Veterinary Research Institute, Izatnagar 243122 (UP), India*
[b] *Division of Bacteriology and Mycology, Indian Veterinary Research Institute, Izatnagar 243122 (UP), India*
[c] *Division of Physiology and Climatology, Indian Veterinary Research Institute, Izatnagar 243122 (UP), India*

ARTICLE INFO

Article history:
Received 4 June 2008
Received in revised form 18 May 2009
Accepted 4 June 2009
Available online 1 July 2009

Keywords:
Lambs
Selenium
Growth
Antioxidant status
Blood metabolites
Immunity

ABSTRACT

To investigate and compare the effect of inorganic and organic Se supplementation, 18 male lambs (24.68 ± 2.89 kg mean body weight, about 8–9 months of age) were divided into three groups of six animals in each, following randomized block design. While animals in the control group (Gr I) were fed a standard TMR containing 195 g/kg crushed maize grain, 175.5 g/kg soybean meal, 260 g/kg wheat bran, 13 g/kg mineral mixture (without Se), 6.5 g/kg common salt and 350 g/kg wheat straw, animals in Gr II and Gr III were additionally supplemented with 0.15 mg Se/kg of diet through sodium selenite (inorganic Se) and Jevsel-101 (organic Se), respectively. Experimental feeding was done for a period of 90 days. To assess the humoral immune response, all the lambs were intramuscularly inoculated with a single dose (2 mL) of *Haemorrhagic septicaemia* oil adjuvant vaccine on day 0; and blood samples were collected on day 0, 30, 60 and 90. Supplementation of Se had no effect on serum total cholesterol, total protein, albumin, globulin, albumin:globulin ratio, T_3, T_4, T_4:T_3 ratio; serum Ca and P levels and SGOT and SGPT activity. However, there was a significant increase in the serum Se level, RBC GSH-Px activity and humoral immune response in both the Se supplemented groups as compared to control group. Average daily gain (g) was highest (110) in Gr III, followed by Gr II (98.2)

Abbreviations: ADF, acid detergent fibre; ADG, average daily gain; AOAC, Association of Official Analytical Chemist; BW, body weight; CP, crude protein; DM, dry matter; EE, ether extract; GSH-Px, glutathione peroxidase; aNDF, neutral detergent fibre; OM, organic matter; SGOT, serum glutamate oxaloacetate transaminase; SGPT, serum glutamate pyruvate transaminase; T_3, tri-iodothyronine; T_4, thyroxine; TMR, total mixed ration.

* Corresponding author. Tel.: +91 581 2301318; fax: +91 581 2303284.
E-mail address: garg@ivri.up.nic.in (A.K. Garg).

0377-8401/$ – see front matter
doi:10.1016/j.anifeedsci.2009.06.007

and lowest in Gr I (89.1). Thus, supplementation of organic as well as inorganic Se was found to improve the growth rate, humoral immune response and antioxidant status of the lambs; and between two sources, organic Se was more effective than inorganic Se.

1. Introduction

Selenium (Se) is essential for proper health, immunity and reproductive functions of animals. It is a component of glutathione peroxidase (GSH-Px) enzyme (Rotruck et al., 1973), which destroys free radicals in the cytoplasm (MacPherson, 1994) and protects the tissues against oxidative damage (Awad et al., 1994; Levander et al., 1995). Se has also been shown to improve immune responses (Sheffy and Schultz, 1979). It is required for the development and expression of non-specific humoral and cell mediated immune responses. Se is also a component of enzyme type I deiodinase, which is required for the conversion of thyroxine (T_4) in to more active tri-iodothyronine (T_3) hormone (Beckett et al., 1987).

Earlier, a level of 0.1–0.2 mg Se/kg dry matter (DM) was recommended for sheep by NRC (1985). As per current NRC (2007), the Se requirement for growing lambs (20 kg body weight, 100 g ADG) works out to be about 2 mg/kg DM. However, studies conducted by Oh et al. (1976) and Moksnes and Norheim (1983) suggest higher requirements of Se than above recommendations. Studies conducted in our laboratory have also shown significant improvement in growth performance in guinea pigs (Mahima, 2006) and immune status in buffalo calves (Mudgal et al., 2008) fed Se supplemented diets. Nicholson et al. (1991) also observed improved weight gain and gain:feed ratio in dairy and beef calves fed 1 mg Se/kg DM supplemented diet over control (0.26 mg Se/kg DM) group. At present, most common form of Se supplements are its inorganic salts, such as sodium selenite and sodium selenate. However, studies have shown that organic Se is better absorbed and utilized in ruminants as compared to its inorganic sources (Gunter et al., 2003; Guyot et al., 2007). In view of these facts, the present study was conducted on growing male lambs to find out the effects of Se supplementation and also to compare the inorganic and organic sources of Se on their performance.

2. Materials and methods

2.1. Animals, their management and feeding

Experiment approved by the "Committee for the Purpose of Control and Supervision of Experiments on Animals" (CPCSEA), India was conducted on 18 Muzaffarnagari male lambs (24.68 ± 2.89 kg mean body weight, about 8–9 months of age). These animals were divided into three groups of six animals in each in a randomized block design on the basis of their body weight. All the experimental animals were housed in a well-ventilated animal shed with cemented floor and provision of individual feeding and watering and vaccinated against sheep pox and *Pestedes Petits Ruminants* (PPR) as per the standard schedule. Deworming of the lambs was done for both endo and ectoparasites before start of the experiment and subsequently at regular intervals. Clean drinking water with no detectable amounts of Se was provided *ad libitum* twice (at 10 and 15 h) a day. While animals in the control group (Gr I) were fed a standard total mixed ration (TMR) containing 195 g/kg crushed maize grain, 175.5 g/kg soybean meal, 260 g/kg wheat bran, 13 g/kg mineral mixture (without Se), 6.5 g/kg common salt and 350 g/kg wheat straw, animals in the other two groups were additionally supplemented with 0.15 mg Se/kg of diet either through sodium selenite (inorganic Se, Gr II) or Jevsel-101, an organic source of Se prepared in our laboratory (Gr III). Animals were offered their TMR daily at 9.00 h to meet their nutrient requirements (Kearl, 1982). All the animals were offered about 100 g of the available green [oat (*Avena sativa*)/berseem (*Trifolium alexandrinum*)/maize (*Zea mays*)] fodder once a week to meet their vitamin A requirements. Experimental feeding was done for a period of 90 days, during which animals were weighed (consecutively for 2 days) at the start of the study and then regularly after every 15 days, before feeding and watering, on an electronic weighing balance (ATCO, India) to determine