Effect of Adding Inorganic Selenium and Vitamin E on the Growth and Status of Lambs in Regions Containing Toxic Concentrations of Copper in Fodder

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SUMMARY

The influence of different levels of selenium and its combination with Vitamin E on the growth, health status and mortality of lambs has been investigated. The selenium, copper and zinc status of supplemented and unsupplemented lambs has been studied by the use of indicative organs. Increased concentration of Cu in the feed had a negative effect on the average daily gain of lambs. Lambs with Se-deficiency showed symptoms of Cu toxicity after the 30-th day. Significantly higher mortality has been observed among the unsupplemented lambs. The addition of Se had a positive effect on the normalization of its status and decreased significantly the accumulation of Cu in the liver. On the other hand toxic amounts of Cu deteriorated the Zn status. A significant reduction of Zn content in the liver and in the ribs has been measured.

INTRODUCTION

Much work in the last years concerned to the problem of Se deficiency due to the fact of disbalanced ecological equilibrium in some polluted regions. The industry provided a large number of Se antagonists (Cu, Pb, Cd, As and S) which have a negative influence on its utilization by the ruminants. The chemical similarity of Se and S invokes interaction between them (FRIEDEN,1984). The addition of S to the sheep ration increased the percentage of the newborn lambs with degenerative changes of the heart muscle (WHANGER et al.,1969).In USA is used the antagonism between Se and Cu to eliminate the Se toxicity (ABEL-RAHIM et al.,1985; STOWE,1980). The appearance of "Hepatosis dietetica" in ruminants due to the toxic amounts of Cu depends not only on the doses, but also on the animal species. Goats accepts more Cu, compared to sheep . The swine can accept 10 times more, so the rats - 25 times more Cu without visible symptoms of Cu poisoning (HENNIG,1972). Some lambs bred in New Zealand react even at a doses of only 12 mg Cu/kg feed (MERTZ, 1987). The main target pursued by present study is to determine the effect of various amounts of Se added in combination with Vit.E to the lambs diet on the health and growth. The investigations are oriented to find out a perfect way to reduce the negative effect of increased concentrations of Cu in some indicative organs. Finally we aim to explore the influence of antagonism between Cu and Zn in the animal organism.

MATERIALS and METHODS

Forty eight lambs were used with initial body weight 14.5-16 kg divided in 4 groups of 12 animals each. The animals were fed ad libitum with full diet mixture balanced in energy and protein. Copper content in the ration was 25 ppm, Zn-40 ppm, Se-0.078 ppm and that of S-3.2 g/kg DM. Group 1 did not received any Se, group 2 and 3 - 0.15 and 0.30 mg Se/kg DM, respectively and group 4 received 0.15 mg Se + 25 mg Vit.E/kg DM. The blood samples were taken at 1-st, 60-th and 103-th day and those of the internal organs at the beginning and at the end of the experiment. Copper and zinc content were determined by the use of

atomspectrofotometer. The Se was determined by Hg - system. The results of the study were processed biostatistically according to MIKOVSKY's recommendations (1974).

RESULTS and DISCUSSION

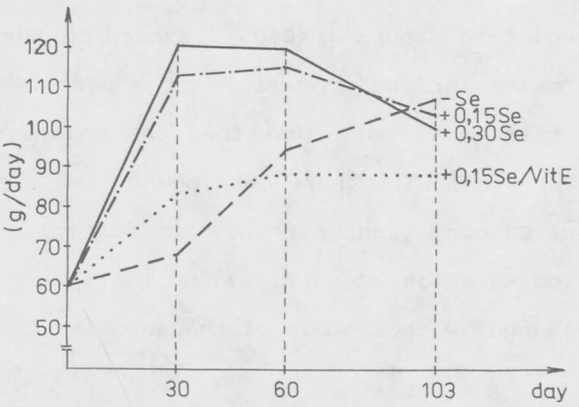
Feed consumption was controlled daily and recalculated each 30 days. No differences between the diverse groups have been observed. The data obtained during the experiment coincide with the results of ANKE et al.(1983) and ANGELOW (1987) with goats. Only some animal species showed higher feed consumption (BUNK et al.1980) when very low Se containing ration was fed (<30 µg Se/kg DM). The analyses of Se in blood serum and in internal organs showed at the beginning of the experiment an extremely low Se-status, which indicated, that the animals have been bred in high Se deficiency (Table 1).

Table 1: **Selenium content in internal organs of lambs**

Organ	1-st day	Normal status *
blood serum (µg/l)	35	70 - 100
muscle (µg/kg DM)	65	300 - 350
heart	200	900 - 1200
liver	222	1000 - 1500
kidney	650	3000 - 5000

* Recently ANGELOW et al. (1990), ANKE et al. (1983).

Figure 1: **Cumulative growth of lambs**

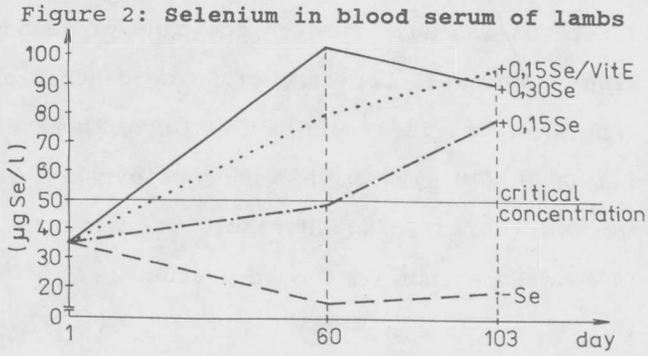


The addition of Se to the feed of the 2-nd, 3-rd and 4-th groups had a positive effect on the average daily gain of the animals (Figure 1). The differences between groups 1 and 2 and groups 1 and 3 were significant. Toxic amounts of Cu caused the death of about 40% of the lambs from the 1-st group. Only the most healthy and heavy animals survived till the 103-th day. The above results demonstrated that the high quantities of Cu reduced the animal growth independently from the Se content. However the addition of Se was a very important condition for animal health and longevity (Table 2). The first symptoms of Cu poisoning were observed between the 50-th and 60-th day and can be detect by the increased content of Cu in the blood serum. Extremely sensitive were the lambs from the 1-st group. High Cu concentrations (8.9 and 12.2 mg Cu/l) were measured in two cases just before death. During the whole experiment high mortality among the unsupplemented lambs (58.3%) has been registered. The inclusion of the blood serum to the Se-status diagnostic provided an additional information about the increased mortality of the lambs from the second group -16.7% (Figure 2).

Table 2: **Influence of copper on the mortality**

Groups	Number of lambs	Death	%
1 (-Se)	12	7	58.3
2 (+0.15 mg Se)	12	2	16.7
3 (+0.30 mg Se)	12	0	0.0
4 (+Se/Vit. E)	12	1	8.3

Figure 2: **Selenium in blood serum of lambs**



During the whole period the supplemented animals showed significantly higher concentration of Se in blood serum in comparison with the unsupplemented lambs ($p<0.001$).

Some indicative organs could be include in the analyses in order to estimate the necessary supply. We tested 4 organs (muscle, heart, liver and kidney) and the heart turned out to be the most appropriate one (Figure 3). The animals slaughtered at the beginning of the experiment contained only 20% of the Se in normal supplied animals. The low Se status is a result of their intrauterinely depletion.

Selenium and Vit. E supplementation in course of 103 days results a significant increasing of the Se content in the heart muscle ($p<0.001$). Levels of 900-1000 ppb indicated that the used amounts are sufficient for complete restoration of the Se status. The liver is the best indicator for Cu poisoning (Figure 4). The high level of Cu in feed combined with Se deficiency increased significantly Cu accumulation in the liver in comparison with the 3-rd and 4-th groups ($p<0.05$). Exceeding the critical concentration (500 mg Cu/kg DM liver) is a reason for the appearance of a heamolytic crisis. Se prevented the total accumulation of Cu in the liver and sustained the homeostatic control in this organ. These results correlated very well with those obtained by ANGELOW et al. (1990) in previous experiments. Toxic amounts of Cu can affect not only the absorption and accumulation of Se in the organism but also the accumulation of Zn in some indicative organs (Figure 5). The content of Zn in the liver changed with the age of the animals. Cu had a negative influence on the Zn resorption.

Figure 3: **Selenium in heart muscle of lambs**

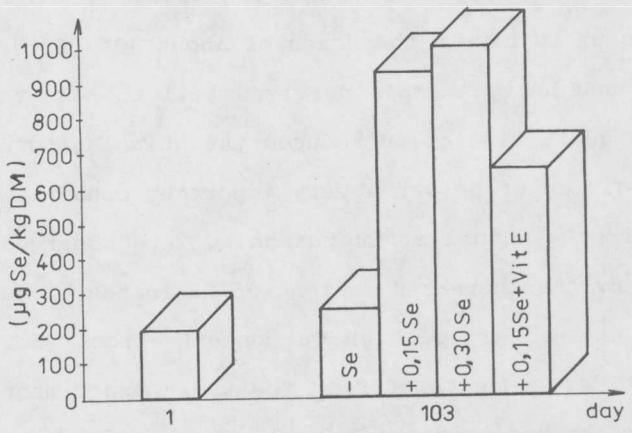
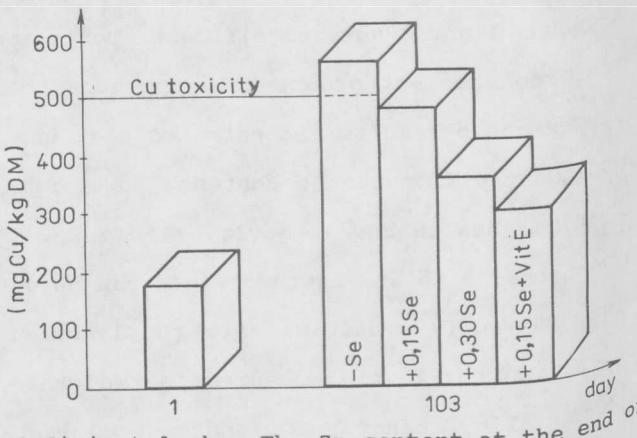


Figure 4: **Copper content in liver of lambs**



These changes were well pronounced with the Se deficient lambs. The Zn content at the end of experiment was about 50% of that, measured at the beginning (340 mg Zn/kg DM vs 172 mg Zn/kg DM). The fluctuations of the Zn level in 2-nd, 3-rd and 4-th groups were insignificant. The Zn status was sustained in the case of secondary Zn deficiency by mobilization of the Zn from ribs (Figure 6). Decrease of Zn concentration was determined in all groups.

The Zn level in the animals, fed without Se was below the critical value, proposed by ANKE and GRÜN (1982), which was considerably lower than the optimum quantity for this animal species (90 mg Zn/kg DM ribs). The above results demonstrate that the high levels of Cu had an adverse effect on the Zn status.

Figure 5: **Zinc content in liver of animals**

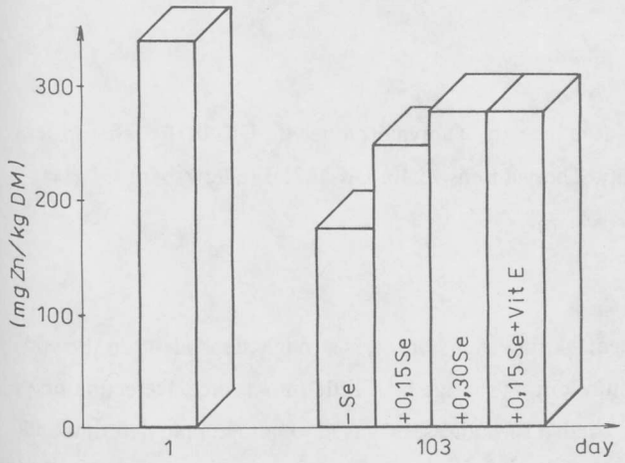
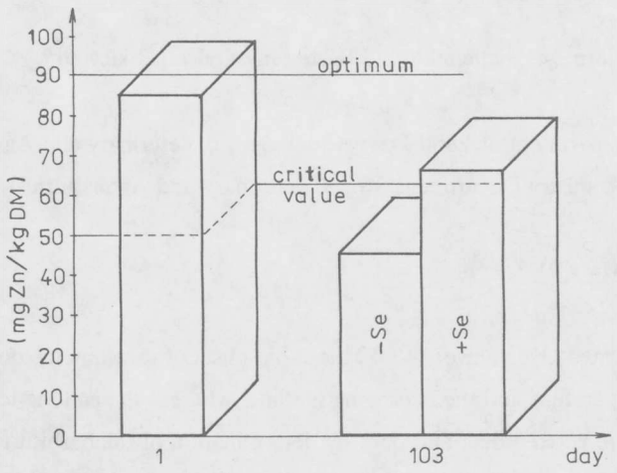


Figure 6: **Zinc content in ribs of lambs**



CONCLUSIONS

Adding different levels of Se had a positive effect in the initial growth of lambs. At the end of experiment the Se status has been completely restored. The high Cu concentrations required 2-2.5 times increased amounts of Se. The existing antagonism between Cu and Zn required correction of the Zn content 3-3.5 times above the minimum (40 ppm Zn). The used indicative organs for Zn, Cu and Se reflected most exactly the mineral status of the animals.

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