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Vitamins and Stress

LITERATURE REVIEW OF RESPONSES IN CATTLE TO FAT-SOLUBLE VITAMINS A, D AND E

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SUMMARY

No documentary evidence was found in the scientific literature on the efficacy of injections (of vitamins A, D and E) on the alleviation of stress and the prevention of weight loss in export cattle. Research work on fat soluble vitamin supplementation of cattle at pasture suggests that animals rarely need or benefit from vitamin supplementation except perhaps in situations of prolonged droughts when vitamin A deficiency may be a problem. A short period on a 'green pick' or a mineral block with vitamin A will eliminate the need for this vitamin.

INTRODUCTION

This review of the literature was undertaken in response to a request from a large cattle station involved in the live cattle export business. They were concerned about the stressful effects of sea transport on cattle, particularly the likelihood of weight losses. Some manufacturers of injectable vitamin supplements claim, among other things, that they offset stress in cattle. Some exporters claim that these vitamins give good responses in the prevention of weight loss in cattle during sea transport. However, they do not have documentary evidence to support such claims. The objective of this review was to evaluate from published material in the scientific literature: the effect of vitamins A, D and E on cattle both under normal farm conditions and in stressful situations.

REQUIREMENTS FOR VITAMINS A, D AND E

The fat-soluble vitamins (A,D,E,K) fulfil specific and independent functions in ruminant animals. Each vitamin is required for specific metabolic reactions within the cells. When a particular vitamin is omitted from the diet, the respective biochemical reaction in which the vitamin participates cannot take place and specific symptoms of an avitaminosis are produced.

Such absolute vitamin deficiencies may not occur under practical farming conditions, but rather marginal deficiencies may lead to non-specific symptoms, such as loss of appetite, unthrifty appearance, reduced growth and feed utilisation. These symptoms may lead to losses in weight.

Vitamin A

Supply of vitamin A to ruminants appears to be more critical than that of any other vitamin, and it is the only vitamin which may be deficient to cattle under farm conditions (Bondi 1988). Vitamin A is necessary for vision, reproduction, development of epithelia, growth and health.

Vitamin D

Vitamin D is required for the regulation of calcium and phosphorus metabolism and consequently for the calcification of growing bones. There is no need for a dietary source where animals are exposed to sunlight for at least a short time during the day since ultraviolet light converts the steroids ergosterol and 7-dehyrocholesterol present in the skin to vitamin D_2 and D_3 respectively. Vitamin D_2 occurs commonly in sun cured hay. Vitamin D is unstable to oxidation occurring during storage of feed.

Deficiency symptoms of vitamin D in adult cattle are rare. However, since the vitamin D content of hays may be variable, it is possible that vitamin D supplementation may be desirable, especially with young growing animals or pregnant animals on winter diets.

Vitamin E

Vitamin E was discovered in the early twenties in vegetable oils, as a factor required for reproduction in rats. It was given the name tocopherol. Later research revealed that vitamin E together with selenium played a major role as an antioxidant. It protects cell membranes and nutrients, such as polyunsaturated fatty acids and vitamin A from destructive oxidation. Vitamin E is associated with selenium to protect vital phospholipids from oxidative damage. Vitamin E content is high in green plants and germs of cereals. Under farm conditions, deficiencies of vitamin E in cattle are rare, except where feeds high in polyunsaturated fatty acids are used. A deficiency of vitamin E in young cattle gives rise to the occurrence of muscular dystrophy.

VITAMIN TREATMENTS FOR 'STRESS'

Background

In recent times some pharmaceutical companies have been promoting the use of injectable fat soluble vitamins (A,D,E) to increase resistance to stress, and induce a greater immune response to disease. The implication, in practical terms, is that fat soluble vitamin supplementation stops - or at least reduces - death and animal weight losses due to "stress" such as on ships in the live cattle export trade, where conditions of overcrowding, poor ventilation, alien feed and shortage of drinking water may prevail. Such claims are supported even by some cattle exporters.

What is the experimental evidence?

No documented experimental work was found in the literature on the effect of vitamin supplementation of cattle prior to shipping. There are however, a number of reports of work on the effect of vitamin supplementation on cattle weight gains:

1) Hartman et al (1976) gave alternate cows in nine Holstein-Friesian herds on pasture (a total of 957 cows), weekly injections of 5 ml of a preparation supplying vitamin A 500 000 USPU, cholecaliferol (vitamin D_3) 100 000 USPU and vitamin E 50 iu. There was no significant beneficial effect on production, reproduction or health.

2) Herve et al (1974) investigated the effect of injectable vitamins A, D and E on weight gain of young grazing cattle. Two groups of five animals average weight 500 kg were used. Group A was the control. Group B animals received injections of 5 ml each of a solution containing 300 000 units retinyl acetate (vitamin A) 100 000 units cholecalciferol (D_3), and 10 mg alpha tocopherol (vitamin E). The groups grazed on the same pasture for 126 days. Daily liveweight gains for the two groups for the whole period were: A 0.99 kg and B 0.94 kg.

In a second experiment the dose of vitamins A and E were increased to 500 000 units retinyl acetate, and 50 units vitamin E. Vitamin D was reduced to 75 000 units cholecalciferol (D_3) in groups of animals weighing 270 kg and 340 kg. Average daily gains in the heavier groups were 0.43 kg and 0.54 kg; and in the lighter groups 0.48 kg and 0.53 kg for the control and supplemented animals respectively. The differences were not statistically significant.

3) McDowell et al (1990) reported that when stressed dairy cattle were supplemented with vitamin E-Selenium injections in areas where Se concentration in the soil and pastures was low, tissue levels of Se increased compared to non-treated animals. They concluded that Se intake should be increased in areas where tissue and dietary Se concentrations are low and where there was a history of white muscle disease. No effect on weight gain due to vitamin supplementation was reported.

4) A study in the vitamin status of export cattle in New Zealand found no deficiency symptoms (Rammell et al 1983).

5) An Australian authority in the health and welfare area of export animals has found no evidence to justify a need to recommend the use of vitamin supplementation in cattle bound for export (D.F. de Fredrick 1983).

6) The Australian Bureau of Animal Health: Standards for the preparation and carriage of cattle by sea has made no recommendation for the use of vitamins A, D and E in export cattle (Canberra 1984).

Some authorities warn that in the monsoonal and arid zones grazing ruminant livestock may suffer from vitamin A deficiency towards the end of prolonged dry seasons (Williamson and Payne 1978). Professor R.A. Leng states that "stock that are not productive because of a low level of feeding, require few vitamins or minerals. Vitamin A may become deficient in drought feeding, but any 'green pick' will eliminate the need for this vitamin. It probably takes 12 months for the liver resources of vitamin A to be used up and injections of vitamin A could be used at intervals of six months in prolonged droughts".

CONCLUSIONS

1. No studies were found in the literature on the efficacy of injectable vitamins A, D and E in reducing weight losses in cattle during shipping.

2. Cattle do not appear to suffer from deficiencies of vitamins A, D and E when they have been on green feed prior to stressful situations.

3. Deficiency symptoms are unlikely to appear within a few months in stressed cattle except when they have been on dry pasture in the previous six months or more.

4. No evidence was found to suggest that fat soluble vitamin supplementation either improved weight gains in cattle or reduced weight losses in stressed cattle.

REFERENCES

Australian Bureau of Animal Health (1984): Standards for the Preparation and Carriage of Cattle by Sea. Australian Government Publishing Service, Canberra.

Bondi, A. 1988 Animal Nutrition; John Wiley and Son, New York.

de Fredrick, D.F. (1983) Export of Cattle: meeting specifications and health requirements. Australian Veterinary Journal 60:9,5.

Hartman, D.A., Natzke, R.P. and Everett, R.W. (1976) Injectable vitamins A,D and E: a field study. Journal of Dairy Science 59(1):91-96.

Herve, A., Stehr W., Sanhuenza, M. and Fernandez, H. (1974) Effects of diethylstilboestrol and of an injectable vitamin A,D and E complex on weight gain of young grazing cattle. Agro Sur 2(2)50-53. English Summary in Nutrition Abstracts and Reviews 1976.

Leng, R.A. (1986) Drought Feeding Strategies - Theory and Practice. Penambul Book, Armidale p.131.

McDowell, L.R., Salih, Y., Hentges, J.F. and Wilcox, C.J. (1990) Selemium supplementation and concentrations of selenium in cattle tissues and fluids. Nutrition Research: 10(7):793-800.

Rammel, G.G. and Cunliffe, B. (1983) Vitamin E status of cattle and sheep 2. Survey of liver from clinically normal cattle and sheep for alpha tocopherol. N.Z. Veterinary Journal 31:11, 203-204.

Williamson, G. and Payne, W.J.A. (1978) An Introduction to Animal Husbandry in the Tropics. Longman, London.