SELENIUM AND FORMALDEHYDE-TREATED SUNFLOWER SEED AS SUPPLEMENTS FOR LACTATING EWES AT PASTURE

J.P. LANGLANDS*, G.E. DONALD*, D.R. PAULL*, J.R. ASHES**, and G.S. SIDHU

SUMMARY

Thirty-five Merino ewes with wether lambs at foot grazed pasture with a low Se concentration and were given 0, 500 or 1000 g/week of a protected fat supplement containing 61% linoleic acid; 17 of the ewes had earlier been dosed with Se pellets. Growth rates, milk production, Se concentration and creatine phosphokinase activity in blood, and the composition of liver, and of milk and carcass fat were determined. Milk and tissue composition were modified but growth rates and milk production were not affected.

INTRODUCTION

Unsaturated fats in the diet can induce nutritional muscular dystrophy (NMD) and related disorders. This is attributed to breakdown products of lipid peroxides produced as a result of polyunsaturated fat autoxidation, which impair the function of cellular membranes. Both Vitamin E and selenium (Se) can protect animals from peroxide-induced disorders, and ruminants have additional protection because rumen microbes hydrogenate unsaturated fats (Garton 1960). Animal fats containing elevated levels of unsaturated fatty acids may be preferred by consumers for health reasons, and Scott et *al.* (1970) described a technique for the protection of unsaturated fats from hydrogenation which increases the proportion of unsaturated fatty acids in ruminant fat but may also increase the incidence of NMD particularly when Se and Vitamin E status are low.

Lactating ewes with lambs at foot were given a protected unsaturated fat supplement while grazing a pasture on which both lambs and weaner cattle had previously responded to Se supplementation; Se pellets containing 0.5 g elemental selenium (Kuchel and Godwin 1976) had earlier been given to approximately half the ewes.

MATERIALS AND METHODS

Thirty-five fine wool Merino ewes mated to Merino rams, which gave birth to single male lambs between October 3 and 7 were selected; the lambs were weighed and castrated at birth and the ewes were prepared with rumen fistulae on October 6 and 9 by the technique of Hecker (1969); All grazed an improved pasture, fertilized annually with 125 kg superphosphate/ha, and dominated by *Festuca arundinacea* and *Trifolium* spp. From October 17, three groups of six ewes that had not received a Se pellet were given 0 or 100 or 200 g formaldehyde-treated sunflower seed daily for five days each week directly into the rumen. Six, five and six ewes that had received Se, were allocated to the 0, 100 or 200 g treatments respectively. The supplement contained 90.9% OM, 44.8% ether extractables (61% linoleic acid), 4.73% N and 0.186 µg Se/g on a dry matter basis. Selenium content of the available green pasture averaged 0.019 µg Se/g OM.

* CSIRO Pastoral Research Laboratory, Armidale, N.S.W. 2350.
** CSIRO Ian Clunies Ross Laboratory, Prospect, N.S.W. 2149.

Lambs were weighed on Oct. 17, Nov. 20 and Dec.21; daily milk production was estimated on Nov. 21 and Dec. 21 by the technique of Corbett (1968). Milk fat, Se concentration (Brown and Watkinson 1977) and fatty acid composition (Jones and Davison 1965) were determined. Whole blood samples, taken from the ewes and lambs at milking, were analysed for Se; plasma from lambs was assayed for creatine phosphokinase (CPK) activity (Rosalki 1967). Ewes and lambs were slaughtered on Dec. 21; livers were removed, weighed, freeze dried and analysed for Se. The lamb carcasses were minced, and fat content and individual' fatty acids were determined.

RESULTS

Mean growth rate, milk production and its fat and Se concentrations and CPK activity in lamb's plasma (Table 1) did not differ significantly between treatments. Se concentrations in blood and liver were increased by Se supplementation, and sunflower seed'increased Se concentration in ewe's blood and in livers from both ewes and lambs.

TABLE 1 Least squares means for live weight, liveweight gain, milk production and blood and liver composition

		Supplement					Tests of significance	
		Selenium (Se)		Sunflower seed (g/week; Ss)				
		-	+	0	500	1000	Se	Ss
Live weight (kg) and liveweight gain (g/d) of lambs								
Weight	17 Oct	6.8	7.1	7.1	7.2	6.7	NS	NS
	20 Nov	13.5	15.0	13.8	14.8	14.1	NS	NS
	21 Dec	19.0	19.8	18.7	20.4	19.3	NS	NS
Gain	17/10-20/11	185	218	188	211	207	NS	NS
	20/11-21/12	175	157	157	180	162	NS	NS
Production (ml/d), fat (%) and selenium (µg Se/ml) content of milk								
Production	21 Nov	937	953	957	940	938	NS	NS
	21 Dec	625	635	593	672	623	NS	NS
Fat	21 Nov	7.2	6.2	6.8	6.5	6.7	NS	NS
	21 Dec	7.2	6.7	6.9	6.9	7.1	NS	NS
Selenium	21 Nov	0.009	0.011	0.008	0.011	0.011	NS	NS
	21 Dec	0.015	0.022	0.015	0.017	0.024	NS	NS
Whole blood Se and plasma CPK (µg Se/ml, u/l)								
Ewe Se	21 Nov	0.036	0.105	0.062	0.076	0.073	***	NS
	21 Dec	0.033	0.097	0.049	0.073	0.073	***	*
Lamb Se	21 Nov	0.044	0.099	0.056	0.083	0.074	***	NS
	21 Dec	0.037	0.078	0.044	0.061	0.068	***	NS
Lamb CPK	21 Nov	46.4	57.7	53.8	45.2	57.2	NS	NS
	21 Dec	49.4	64.8	35.5	73.7	62.0	NS	NS
Liver Se in ewes and lambs (µg/g DM)								
Ewes		0.237	0.467	0.253	0.409	0.394	***	*
Lambs		0.187	0.339	0.201	0.276	0.311	***	*

None of the Se x Ss interactions were significant.
* P<0.05; *** P<0.001.

Variability between animals in fatty acid composition of milk and lamb's carcasses (Table 2) was large and a number of trends suggested by the results were not statistically significant. There were significant differences in the 14:0, 16:0 and 18:2 fractions of milk fat and in the 18:0 fraction in carcass fat after supplementation with sunflower seed. Supplementation decreased 14:0 and 16:0 and increased 18:2 particularly at the Nov. 21 milking. Se increased

TABLE 2 Least squares means for fatty acid composition of milk and carcass fats

Fatty acid	Date (Month)	Selenium (Se)		Supplement Sunflower seed (Ss)			Tests of significance	
		-	+	0	500	1000	Se	Ss
Milk - 21 Nov & 21 Dec								
≤10:0	Nov	6.7	6.5	7.2	6.6	6.0	NS	NS
	Dec	10.0	11.0	11.5	10.5	9.6	NS	NS
12:0	Nov				-	-	NA	NA
	Dec	4.2	5.1	5.0	5.0	4.0	NS	NS
14:0	Nov	7.3	7.3	8.5	6.8	6.7	NS	*
	Dec	9.3	10.2	10.7	9.9	8.6	NS	*
16:0	Nov	18.8	19.3	20.6	18.6	17.9	NS	*
	Dec	22.9	23.9	23.5	24.3	22.4	NS	NS
16:1	Nov	2.4	2.4	2.7	2.3	2.2	NS	NS
	Dec	1.7	1.4	1.8	1.3	1.5	NS	NS
18:0	Nov	16.1	16.7	15.8	17.2	16.3	NS	NS
	Dec	13.5	12.7	13.3	12.1	13.9	NS	NS
18:1	Nov	29.7	28.3	30.3	28.3	28.4	NS	NS
	Dec	27.6	25.6	25.5	26.7	27.6	NS	NS
18:2	Nov	7.7	8.3	2.9	9.3	11.9	NS	*
	Dec	5.8	5.0	3.7	5.6	6.9	NS	*
18:3+	Nov	2.8	2.7	2.9	2.6	2.8	NS	NS
	Dec	1.9	1.5	1.7	1.6	1.8	NS	NS
Lamb carcass								
10:0		1.9	1.8	1.7	1.8	2.1	NS	NS
12:0		1.6	2.0	2.1	1.7	1.6	NS	NS
14:0		6.3	6.9	7.0	6.6	6.2	NS	NS
16:0		18.6	20.0	19.5	19.8	18.5	NS	NS
16:1		3.0	3.2	3.3	3.1	2.9	NS	NS
17:0		2.7	2.3	2.6	2.5	2.4	NS	NS
18:0		16.1	17.2	15.2	16.9	17.8	*	***
18:1		36.6	36.6	36.9	37.0	36.0	NS	NS
18:2		7.3	5.4	4.9	6.1	8.0	NS	NS
18:3		3.3	1.7	4.2	1.4	2.0	NS	NS

NA - A significant ($P<0.05$) Se x Ss interaction was present for 12:0 in milk on Nov. 21. Mean values are not an appropriate description of treatment effects in this situation.

18:0 in the carcass fat and there was a Se x sunflower seed 'interaction in the 12:0 fraction of milk on Nov. 21; this resulted from a lower proportion of 12:0 in milk from animals supplemented with Se but not sunflower seed (mean 3.0) than in the group which did not receive either (mean 4.4). The difference was not observed in milk from ewes which received sunflower seed.

DISCUSSION

There was no evidence of depressed productivity or NMD or any disorder which elevated CPK activity, in lambs of ewes not receiving Se or receiving sunflower seed. Milk and carcass fat compositions were affected by sunflower seed, and the changes were consistent with the results of Scott *et al.* (1970) and others; in brief the proportion of linoleic acid (18:2) in milk was increased and fatty acids with chain lengths ≤16:0 were depressed when ewes were given supplement. The ability of lambs with a low Se status to consume milk with elevated levels of unsaturated fatty acids without ill effects, may be attributable to the high Se content of sunflower seed. The supplement contained 10 times more Se than the available pasture and increased hepatic Se in both ewes and lambs. Higher concentrations would be associated with increased glutathione peroxidase activity, and peroxides formed during the autoxidation of unsaturated fats could be detoxicated by this enzyme. It is not known whether the observed concentration of Se in the protected sunflower seed is representative of the material available commercially.

Se supplementation of the ewes increased Se concentration in blood and liver of both ewes and lambs, and there was a small but not significant increas in milk. Blood Se concentrations in lambs whose dams did not receive Se, were greater than in the previous year when responses in growth rate to Se supplementation were observed, and this may explain our failure to observe a response here. Changes in fatty acid composition of milk and carcass fats following Se supplementation were small, consistent with the results of Pendell *et al.* (1969). Larger changes would be anticipated if lambs had suffered from NMD.

ACKNOWLEDGEMENTS

We thank Messrs J.E. Bowles and A.J. Smith for skilled technical assistance, and the Rural Credits Development Fund of the Reserve Bank of Australia for financial assistance.

REFERENCES

BROWN, M.W. and WATKINSON, J.H. (1977). Analytica Chim. Acta 89: 29.
CORBETT, J.L. (1968). Aust. J. Agric. Res. 19: 283.
GARTON, G.A. (1960). Nutr. Abstr. Rev. 30: 1.
HECKER, J.F. (1969). Aust. Vet. J. 45: 293.
JONES, E.P. and DAVISON, V.L. (1965). J. Am. Oil Chem. Soc. 42: 121.
KUCHEL, R.E. and GODWIN, K.O. (1976). Proc. Aust. Soc. Anim. Prod. 11: 389.
PENDELL, H.W., MUTH, O.H., OLDFIELD, J.E. and WESWIG, P.H. (1969). J. Anim. Sci. 29: 94.
ROSALKI, S.B. (1967). J. Lab. Clin. Med. 69: 696.
SCOTT, T.W., COOK, L.J., FERGUSON, K.A., McDONALD, I.W., BUCHANAN, R.A. and LOFTUS HILLS, G. (1970). Aust. J. Sci. 32: 291.