Iodine deficiency: an emerging problem in New Zealand sheep flocks?

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ABSTRACT

Iodine supplementation before mating had a significant positive effect on ewe fertility in a Manawatu Romney flock, with 14% more lambs born to supplemented than to control mixed aged ewes.

The survival of newborn lambs was enhanced in the iodine-supplemented group when compared with the control group, accompanied by a significant difference between the thyroid:body weight ratios of dead newborn lambs in the supplemented and control groups (0.28 and 0.48 g/kg respectively)(p=0.005).

During the spring of 1997, high perinatal lamb mortality rates (25%, 50% and 66%), despite favourable lambing weather conditions and adequate ewe nutrition throughout pregnancy, were investigated in three other Manawatu sheep flocks. The mean lamb thyroid:body weight ratios of dead newborn lambs were greater than 0.4 g/kg and hyperplastic colloid goitre was identified histologically. Goitrogens in the pasture were believed to be an important predisposing factor. Modern varieties of white clover present in New Zealand pastures contain extremely high concentrations of thiocyanate goitrogen precursors, therefore, iodine deficiency may be an emerging problem.

Keywords: iodine deficiency; thyroid:body weight ratio; goitrogens; sheep.

INTRODUCTION

Severe iodine deficiency, where the thyroid glands of newborn lambs are obviously goitrous (thyroid weight >2.8g; thyroid: body weight ratio >0.7 g/kg), has been reported in many areas of New Zealand (Andrews & Sinclair, 1962), often associated with the prolonged feeding of brassica crops during late pregnancy. There are, however, an increasing number of reports in New Zealand to indicate that iodine deficiency may cause economically important, non-specific production losses in flocks with no history of clinical goitre in newborn lambs (Mulvaney, 1997; Sargison *et al*, 1997). Intramuscular injection of ewes with iodised oil before mating is the preferred method of iodine supplementation (Caple *et al*, 1982), but is both expensive and laborious due to the high viscosity of the product. There is a need for an accurate index of deficiency, in order to jusify this expense and inconvenience. Serum thyroxine (T_4) concentrations are used to assess flock iodine status, but may not be a useful predictor for a supplementation response because the current reference range is based only on observations from clinically healthy animals. The ratio of lamb thyroid: body weights has been proposed as alternative index of deficiency (Mulvaney, 1997).

MATERIALS AND METHODS

Controlled supplementation trial

Below-target lambing percentages were investigated in a commercial Romney flock in the Manawatu. In 1996, the twinning rate at docking was significantly higher in iodine supplemented (65.5%) than in control mixed-age ewes (36.8%) and the perinatal mortality rate in lambs born to supplemented ewes (9.9%) was significantly lower than in lambs born to control-mixed age ewes (23.5%) (Sargison *et al*, 1997).

In 1997 the controlled iodine supplementation trial was repeated. Three weeks before the start of mating, ewes were randomly allocated to groups of 500 iodine supplemented (1 ml i.m. Lipiodol; Merial) and 500 control animals. Foetal numbers were determined by ultrasound scanning 100 days after the introduction of rams. Supplemented and control ewes were mixed until set stocking before lambing. Ewes were counted into each paddock, dead lambs were collected and recorded, and ewes and lambs were counted out at docking. Seventy-two lambs were autopsied and their thyroid:body weight ratios were determined. Ewe and lamb serum samples and a composite pasture sample were collected at docking.

The investigation of high perinatal lamb mortality rates in Manawatu sheep flocks

During the spring of 1997, high perinatal lamb mortality rates were investigated in a number of Manawatu sheep flocks. For each flock, a proportion of the dead lambs was autopsied to determine the cause of death. The lambs were weighed and their thyroid glands were removed and weighed. Ewe and lamb serum samples and composite pasture samples were collected during the investigation.

Flock 1 was made up of 20 Romney cross English Leicester ewes. 20 out of 40 lambs born died during the first week of life, despite the ewes being in excellent body condition (body condition score at docking 3.5 - 4.0), an abundance of pasture (estimated >1600 kg/ha) and favourable lambing weather conditions. *Flock 2* consisted of 4 ewes, grazed on lush clover-dominant pasture. 4 of 6 lambs born died. *Flock 3* was made up of approximately 1000 mixed breed commercial ewes. Based on comparison of

scanning and docking data, the lamb perinatal mortality rate was 25%, despite flat country, an abundance of pasture and good lambing weather.

Serum samples were analysed for T_4 concentrations using a Diagnostic Products Counts Coat radioassay kit (TT4P: DPC RIA, manufacturer's procedure). Pasture iodine concentrations were determined using a semi automated method. Proportions were compared between treatment groups using chi-squared analyses.

RESULTS

Controlled supplementation trial

Iodine supplementation had a significant positive effect on ewe fertility. The twinning rate at scanning in the supplemented ewes (64%) was significantly higher than in the control ewes (56%) ($p=0.015$), and 14% more lambs born to supplemented than to control mixed aged ewes ($p<0.0001$). The survival of newborn lambs was enhanced in the supplemented group when compared with the control group. The perinatal mortality rates in lambs born to supplemented and control mixed aged ewes were 6.7% and 8.9% respectively. There was a significant difference in the thyroid:body weight ratios of lambs born to control and supplemented ewes (0.28 and 0.48 g/kg respectively) ($p=0.005$) (Figure 1). The pasture iodine concentration at docking was 0.31 mg/kg DM. The mean T_4 concentrations of 7 supplemented ewes and 6 lambs at docking were 35 and 94 nmol/l respectively. The mean T_4 concentrations of 10 control ewes and 7 lambs at docking were 67 and 98 nmol/l respectively. (Laboratory low reference value; 46 nmol/l.)

The investigation of high perinatal lamb mortality rates in Manawatu sheep flocks

Flock 1: The mean thyroid:bodyweight ratio was 1.14 g/kg (Figure 1) and hyperplastic colloid goitre was identified histologically in 3 lambs. The pasture iodine content at docking was 4.03 mg/kg DM. The mean serum T4 concentrations of 20 ewes and 20 lambs at docking were 53.3 and 91.3 nmol/l respectively.

Flock 2: One of a pair of stillborn twins had scant hair-like wool, was "pot bellied" and had thyroid glands measuring 80 x 40 x 50 mm each. The other twin had a more normal coat, but had thyroid glands measuring 55 x 35 x 25 mm each. Both lambs in another set of twins also died. Only one was examined. The 3.42 kg lamb died from starvation and bacteraemia, and its thyroid glands weighed 19 g. The mean serum T4 concentrations of 4 ewes and 2 lambs at docking were 27 and 11 nmol/l respectively.

Flock 3: The mean thyroid: body weight ratio was 0.42 g/kg (Figure 1) and goitre (thyroid: body weight ratios >0.7 g/kg) was identified in 10 lambs (Figure 2). The pasture iodine content at docking was 0.44 mg/kg DM. The mean serum T_4 concentrations of 9 ewes and 15 lambs at docking were 37.6 and 87.8 nmol/l respectively.

FIGURE 1: Relationship between perinatal lamb mortality rates and lamb thyroid:body weight ratio.

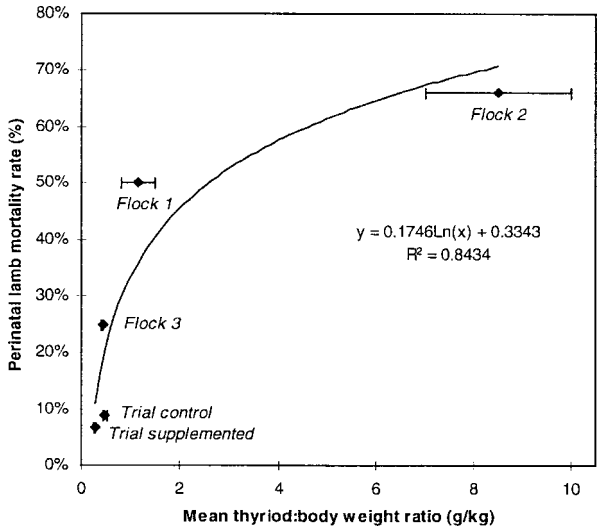
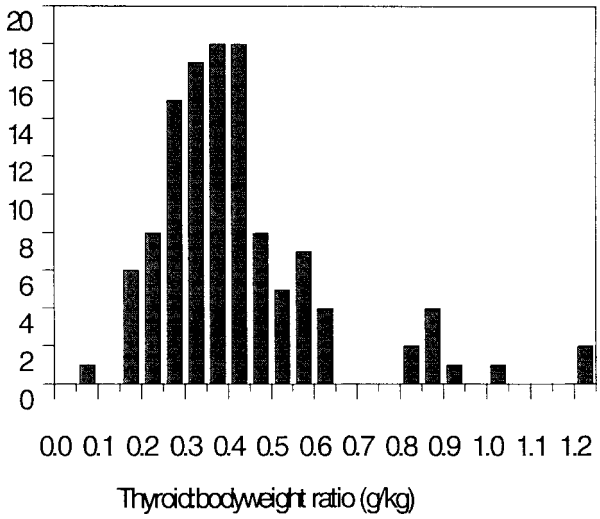


FIGURE 2: Distribution of thyroid: body weight ratios in flock 3.



DISCUSSION

Iodine supplementation in the commercial Romney flock resulted in a significant increase in the total numbers of lambs born. Iodine deficiency appeared to have the greatest effect on ewe reproductive performance during the first third of pregnancy. If the effect had occurred later, resorbing foetuses would have been identified at scanning. Furthermore, it is unlikely that supplementation with a slow-release, oil-based product within two weeks of mating would significantly affect ovulation.

The effects of iodine deficiency on perinatal lamb survival are well documented. Iodine deficient lambs have a low metabolic rate and impaired suckling behaviour (Potter *et al*, 1982). During cold and wet seasons, many of these lambs die from starvation-mismothering-hypothermia, but when conditions are favourable and shepherding is good, many survive. Thus, if the Manawatu weather during the 1997 lambing period had changed to become less favourable, the lamb losses due to iodine deficiency could have been substantially higher.

Neither serum T_4 concentrations, nor pasture iodine concentrations provided consistent diagnostic information, despite iodine deficiency being confirmed on each property by the identification of goitre. Severe goitre can be by diagnosed by palpation of the thyroid gland, and is easily confirmed at post mortem examination. The diagnosis of iodine deficiency as a cause of the high perinatal lamb mortality rates in *flocks 1* and *2* was clear-cut, but in *flock 3* the ten clinically goitrous lambs (Figure 2) could easily have been be overlooked. Data collected during these investigations and from several other studies around New Zealand (Mulvaney 1997) indicate that a production response to iodine supplementation is likely when the ratio of thyroid:body weights of newborn lambs exceeds 0.4 g/kg. Careful dissection and accurate weighing of the lamb and its thyroid glands are required in order to identify thyroid:body weight ratios of less than about 1g/kg. The study of *Flock 3* indicates that the post mortem examination of about 15 lambs is required to provide a good indication of the flock iodine status.

During 1997 iodine deficiency was reported from a number of other properties in the Manawatu and elsewhere in New Zealand. The mild 1997 winter favoured the growth of white clover, which in common with many New Zealand pasture species contains high concentrations of thiocyanate precursors. Thiocyanates act as goitrogens by blocking the uptake of inorganic iodine by the thyroid gland, and are believed to be an important cause of iodine deficiency in New Zealand. The selection of clover cultivars with high hydrogen cyanide levels (Crush & Caradus, 1995) has probably improved their resistance to slug and insect predation, but may have inadvertently resulted in an emerging problem of iodine deficiency in sheep flocks.

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