CHAPTER VI

EFFECT OF IODINE SUPPLEMENTATION ON THE MILK YIELD OF COWS IN A COMMUNAL DAIRY SCHEME

INTRODUCTION

Communal dairy schemes in Zimbabwe are a result of a policy effort to encourage small-holder farmers to contribute to commercial agricultural production, thereby enhancing their income earning capacity as well as improving local milk supplies for household and community nutritional and/ or food security. Personal experience of the small-holder dairy production sector is that it is a low input entreprise that attempts to minimise production costs for the low numbers of producer animals. The scheme selected for this study, Chikwaka, is located in the part of a zone that had earlier been identified in other studies (Dent et al., 1968) to be endemically deficient for iodine in human populations. This communal area is in region 2b, which was found to have indicatively lower levels of pasture iodine than other natural regions (Chapter IV). Dent et al., (1968) had also shown that water in that study area of the district contained only one microgram of iodine per litre. During a field cross-sectional study, it was also noted that a number of very young goat kids in the area had visible, palpable goitre. Practising veterinarians aften recommend iodine fortified feeds and iodised common salt for correction of clinical conditions appearing to be hypothyroidism. This study was therefore planned with an hypothesis that cattle were exposed to an endemically low iodine environment which could be corrected by supplementation with iodine in the feed, resulting in an increase in milk production, among other effects related to production and productivity.

AIM

To evaluate the effect of iodised mineral block supplementation of cows on milk yield in a communal dairy scheme.

MATERIALS AND METHODS

Study design

The design followed was a single blinded field "clinical" trial of supplementary nutritional formulations (Martin et al., 1987). A purposive sample of thirty-one farmers, participating in the Chikwaka Communal Dairy Scheme, was selected into this study. Selection of farmers was premised on the following:

1. potential to comply with conditions of the study based on information from the local Veterinary Assistant (VA).
2. good record keeping and regular submission to the dairy centre
3. accessibility of herd records by the Veterinary Assistant.
4. non-use of mineral-containing commercial supplements

The number of milking cows owned by the participating farmers was collectively, 68. The milking cow was the basic unit of study. The cows were predominantly cross-breeds of high-producing milk breed lines (jerseys, red danes and frieslands), indigenous lines (sanga) and bos indicus (brahman). The animals were assigned into 3 treatment groups by simple randomisation of the farmers (Martin et al., 1987). All cows belonging to a selected farmer were assigned to the same treatment group. The treatment group A, made up of 23 cows were given supplement blocks manufactured by *SAFCO (Ltd), Zimbabwe. These blocks were formulated as follows:

*Speciality Animal Food Company Private Limited, Zimbabwe

Constituent		% in block
Molasses		14%
Sunflower Cake	(33% crude protein)	10%
Limestone flour		9.6%
Monocalcium phosphate		19.1%
Coarse salt		20%
Slaked lime		4%
Iodine premix (FG1004)		0.05%
Maize bran (11% crude protein)		11.3%
Wheat feed		12%

These stated nutrient values were assumed to be specific as commercial feed manufactures are required to follow good manufacturing practices and must comply with registration requirements under the Farm Feeds, Fertilisers and Remedies Act. No independent validation was therefore sought.

Group B, consisting of 21 cows, received a similar formulation but with no iodine premix and no common salt.

Group C, with 24 cows, received no supplementary feed at all, and served as the control group. In order to have Group C farmers comply with study requirements, they were given non-iodine containing drugs such as terramycin intra-mammary tubes, wound powders and tick grease for their cattle. The study was carried out over a 16-month period, July 2000 to October, 2001. All other management practices performed by these farmers remained the same.

Data Recording, management and analysis.

Following initial training of participating farmers by the principal investigator and the veterinary assistant, each farmer was provided with a data sheet for recording total daily milk yield. The veterinary assistant visited each participating farmer once every month, to inspect the data sheets, calculate the total monthly milk yields and enter them onto master data sheets. The master sheets were designed to enter the herd size, its structure, number of new births, number of cows being milked that month and the volume of milk produced in the month. These were then forwarded to the principal investigator for entry into a computerised database. A total of 262 measurements were recorded and transformed into average milk yields per cow per month across the 3 groups.

The data were analysed using an analysis of co-variance (ANCOVA) module for repeated measures (Daniel, 1983) in SPSS version 10 for Microsoft Windows (2000), to assess variations of milk yield due to treatment and season. The analysis centred on the average milk yield per cow per month based on milking cow-herd-size per month. Data were also summarised further by season classifying them by dry and wet season. The dry season extended from July to October, 2000 and April to October 2001, and wet season, from November 2000 to March 2001. The study period was from July 2000 to October 2001. Milk yields were analysed for effects of treatment using time and season as covariates.

RESULTS

The summary statistics showed that Group B had the highest average (550 ± 34 litres/cow/month) followed by Group A, the iodine supplemented group, with 305 ± 34 litres/cow/month. Group C, the control group, had the lowest average of 186 ± 25 litres/cow/month (Table 6.1). Data for May, 2001 were not collected for groups B and C, and were treated as missing data in the analysis (Fig. 6.1).

Table 6.1: Average monthly milk yield per cow by treatment. Chikwaka dairy iodine supplementation field trial, 2000-2001.

Treatment Group	**Type of treatment**	**Mean monthly milk yield per cow (litres) ± standard error**
A	Iodised block supplement treatment group	305.3 ± 34.29*
B	Non-iodised block supplement treatment group	550.1 ± 34.27**
C	Unsupplemented placebo group	185.9 ± 24.87***

Treatment means with different number of superscripts are significantly different ($p<0.01$).

The general analysis implied significant effects on the corrected model ($p<0.0001$). Time was not a significant covariate ($p=0.131$). Season was shown to be a significant factor in the experiment, with the wet season registering a higher mean than the dry season ($p=0.011$) (Table 6.2).

There was also a significant interaction between treatment effects and season effects ($p= 0.003$). Stratification of data by season and treatment indicated that the possible source of this interaction was the sharp directional difference in response by treatment B due to season (Table 6.2; Fig 6.1). Although treatment B resulted in the highest average milk yield in both seasons, the increase was higher in the wet season (Table 6.2).

Table 6.2: Average monthly milk yield (litres±standard deviation) per cow by season and treatment. Chikwaka dairy iodide supplementation field trial, 2000-2001.

	Season	
Treatment	**Dry**	**Wet**
A	306.3 ±38.01^{1a}	304.4±57.20^{1a}
B	411.0±38.03^{1b}	689.3±57.20^{2b}
C	182.2±31.73^{1c}	189.6±38.53^{1c}

A- iodised block supplement treatment group

B- non-iodised block supplement treatment group

C- Unsupplemented placebo group

Row means with different number superscript are significantly different

Column means with different letter superscript are significantly different

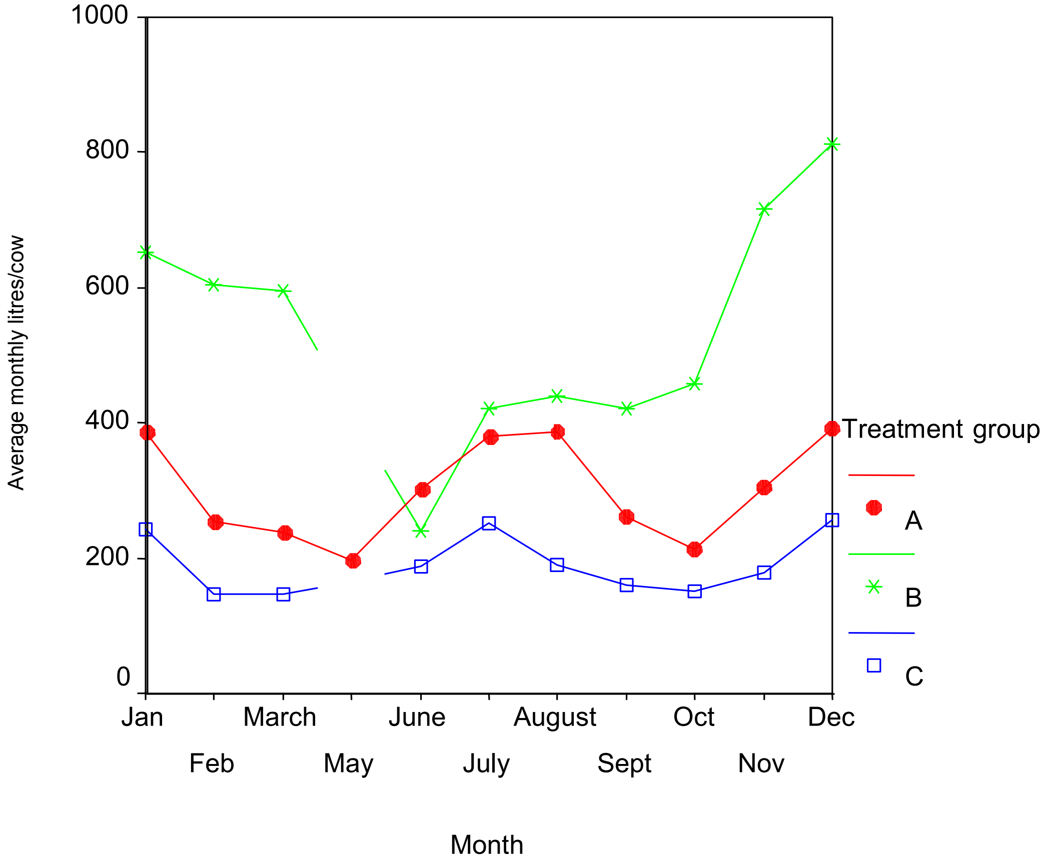

Fig. 6.1 Average monthly milk yields per cow in a field trial in the Chikwaka communal area. Iodine supplementation field trial, 2000-2001.

A- iodised block supplement treatment group

B- non-iodised block supplement treatment group

C- Unsupplemented placebo group

DISCUSSION

The results of this study suggest that feed supplementation of dairy cows in milk under communal conditions leads to a significant rise in milk yield. This was in contrast to cows, which did not receive any feed supplement. This difference was expected, as feed conditions under communal grazing are usually not optimal. The supplementation rate at 0.05% iodine, while having been taken as true, was 0.02% higher than that documented to prevent goitre in sheep by Rudert and O'Donovan (1974). Rodel (1971) also recorded a 10-fold increase in available iodine to marginally reduce, but not eliminate goitre in livestock. In the present study, the increase recorded in the iodine supplemented group was not as high as the increase recorded in group B which received the blocks without iodine. This implies that iodine supplementation actually depressed milk yields. This effect needs to be studied further as it was contrary to the study hypothesis.

Previous work by other authors (Odiawo et al., 1992; Ushewokunze-Obatolu, 1987) has shown that levels of minerals such as phosphorus can be limiting factors in production under communal conditions. Higher response in milk yield per cow in groups A and B could therefore be attributed to supplementation with phosphorus containing licks among other block components, rather than to iodine.

While no direct association between the low milk yield and oestrus was established in this study, Ogaa et al., (1992) noted a high rate of acyclicity in a neighbouring communal area. Iodine deficiency was noted by McDowell (1997) to cause anoestrus or oestrus irregularity, and infertility has an effect on milk production. While this effect could explain the response in the control group C, it is not adequate to explain the highly positive response of group B. However, milk yields alone without considering other aspects such as milk quality may not be fully informative.

While treatment effects could fully explain the low yields of group C, they could have been compounded by a response bias by farmers. A number of group C farmers were refusing to fully co-operate with data submission mainly because they were not receiving supplementary feed blocks. It would therefore have been necessary to switch the treatments at some point in the study in order to get rid of this bias. Blinding of the treaments of groups A and B ruled such an effect out, for those two groups. The veterinary assistant responsible for distributing the blocks could only identify them by farmer names inscribed by the principal investigator, who was the only person who knew the differences between iodised and uniodised blocks. This information about the blocks came from the manufacturer and was presumed to be the fact. The differences between the two groups could therefore only be due to treatment with iodine. Enquiries in the field during a related field survey (Chapter III), indicated that milking cows in the general communal cattle population, usually gave not more than 2 litres of milk a day. This appeared to be twice the one litre a day recorded in non-dairy communal cows by Perry et al., (1987) in the Chinamhora communal area located in a similar agro-ecological region. The present study seems to indicate an improved effect due to breed or improved nutrition by virtue of being a dairy production scheme. This is because at the very least, control cows were yielding around 6 litres a day year round. Supplementary feeding with blocks appeared to improve this output about twice or thrice in the dairy scheme; and by about six times to 10 times or more in the general communal cattle population, with the iodised blocks and uniodised blocks, respectively. Iodine treatment as provided in this study, while possibly being beneficial to milk production, may therefore to some extent be anti-nutritive. Interaction with other minerals and other macronutrients could also result in such an outcome. Although not measured in this study, low total blood protein and albumin especially in the dry season (Odiawo et al., 1992), may limit iodine uptake, and therefore thyroxine formation. This is against the finding in Chapter IV that region 2b in which Chikwaka lies, has lower pasture iodine levels. Low iodine levels may compound the problem further. By implication, the goitre in Chikwaka goat kids observed during the field cross-sectional study (Chapter III), might be due to simple iodine deficiency as a result of these factors. However, it might also be due to either hereditary factors or to goitrogens. The present study did not cover issues such as iodine uptake, protein levels and milk quality versus volume. These could enrich the information on the responses obtained, especially that iodine is important in mechanisms regulating metabolism. Further, additional information from indicators such as calf survival, calving intervals and oestrus which could not be processed as they were outside the scope of the study, might provide greater insights into performance related responses.

The apparently non-optimal effectiveness of iodine supplementation as measured by milk volume, seems to be consistent with results obtained in an experimental supplementation study of station calves (Chapter V) where treatment with potassium iodate failed to show any effect on weight gain. As supplementation is recorded as the most reliable method of confirming mineral deficiency (Underwood, 1981), these findings indicate that supplementation regimes may therefore need to take account of other factors of low performance, for example the multi-nutrient interactions, and seasons, if they should be expected to be effective. The results also appear to be consistent with the findings of a national survey (Chapter III) in which smaller, slower-growing cattle in the wetter higher lying areas exposed to lower pasture iodine levels, had higher thyroxine hormone levels. While those in the lower lying dryer regions where iodine levels in forages were much higher (Chapter IV) had lower thyroxine. This paradox could also be associated with the form in which supplementary iodine is presented and perhaps the way it is metabolised in inorganic form. It may also be the result of interactions with levels of other micro-nutrients such as selenium, cobalt and magnesium (Underwood, 1971), among others.

These results suggest that in contrast to the effectiveness of iodine supplementation in the human population in Zimbabwe, iodine supplementation to cattle in areas where human endemic iodine deficiency is known to occur, and as performed in this study, may not easily translate into productivity gains assessed through cow milk productivity.

CONCLUSION

Inspite of the establishment through human and animal clinical observations and pasture iodide studies that the Chikwaka area is low in iodine (Dent et al.,1968; Mutamba, 1993), feed iodine containing supplementation under "farmer conditions" failed to increase milk productivity to levels achieved by supplementing other macronutrients without iodine. Supplementation with iodide may actually depress milk production and negatively influence the positive effect other nutritional additives could have, in known iodine deficient areas. It is necessary to evaluate other productivity performance measures for the effect of such iodide supplementation, for accurate information to be generated.