127-I levels in bulk milk and its association with groundwater, milking management, and other risk factors.

C. Rogerson, D. Kelton, V. Osborne, S. Hamilton
Department of Population Medicine, University of Guelph, Ontario

INTRODUCTION

Bovine milk and dairy products can provide over 50% of the recommended dietary allowance of iodine in humans[4,5]. Iodine content in milk at Canada's farm gates is closely monitored with regular milk screening tests and results indicate a rising trend in milk iodine levels. A recent study determined that on average the milk sold in Canadian retail stores contains 304± 8.4 µg I/kg, with an even higher average of 345 µg I/kg for Ontario milk[2].

Milk iodine levels are influenced by various feed components, and by the use, application and removal strategies of iodine-based teat disinfectants. While the contributions of certain milking disinfectants and feeds have been established and controlled for, many herds continue to produce milk with iodine levels above the upper limit of 500 ppb[7]. The role of water as a source of increased milk iodine has not been evaluated. Data from the DFO and OGS indicate that regions of Ontario with high groundwater iodine significantly overlap areas with herd producing milk with high iodine levels. In order to maintain the quality and safety of Ontario's milk, potential risk factors including water consumption by the lactating herd must be further investigated.

OBJECTIVES

Part I: To determine the iodine concentration in milk and groundwater sampled from 80 commercial dairy farms located in Ontario.

Part II: To identify if the water consumed by the milking herd, along with other risk factors, are associated with higher bulk milk iodine (BMI) levels.

MATERIALS & METHODS

Part I:

- 80 herds with normal, elevated, and high BMI levels located in eastern ON (n=58) and southwestern ON (n=22) were enrolled
- Samples of the bulk tank milk and water consumed by the milking herd were collected on each farm and submitted to the Animal Health Laboratory, University of Guelph for I-127 analysis
- Producers completed a risk assessment survey providing details about the milking cow water source(s), milking management and nutrition. These data were entered and stored in Excel for statistical evaluation.

Part II:

- Descriptive statistics were generated in Stata13 to detect herd-level trends, and univariable analyses were conducted to identify significant associations between predictor variables and BMI levels
- A linear regression model was built to determine which of the herd level factors were most strongly associated with milk iodine levels

RESULTS

Part I

The concentration of bulk milk iodine (BMI) ranged from 8 ppb to 1,144 ppb, with a median concentration of 219 ppb and mean of 284 ppb, respectively (Table 1). Of the 80 milk samples collected, the majority of herds produce milk containing normal levels of iodine (<350 µg/L), however 20 herds (4 southwestern, 16 eastern ON) had BMI levels considered elevated (350-500 µg/L) or high (>500 µg/L) . Regional variations in BMI levels were evident, however a significant association with BMI levels was not assessed. The BMI levels ranged from 8 ppb to 1144 ppb with a mean of 303.9 ppb in eastern ON, while southwestern ON levels ranged from 74-558 with a mean of 232.9 ppb.

	% of Farms	Average Milk Iodine (µg/L)	<350 µg/L	350-500 µg/L	>500 µg/L
Total (n=80) herds	100%	284	75%	12.5%	12.5%
Eastern ON (n=58) herds	72.5%	303.9	72.4%	12.1%	15.5%
Southwestern ON (n=22) herds	27.5%	232.9	81.8%	13.6%	4.5%

Table 1. Demographics of BMI in the study population and according to region, based on DFO limits where <350 µg/L is normal, 350-500 µg/L is elevated and flagged for trace back testing, and >500 µg/L is considered in the high range[3].

Part II

The final regression model, with the log of BMI as the outcome, included the following predictor variables: log of water 127-I content, post dip used, and post-dip coverage goal. This model explains 41% (R^2) of the variation in the data and significantly predicts BMI concentration ($p<0.001$). The level of 127-I in water has a significant and positive linear correlation with the BMI level (Figure 1). A significant positive correlation was also found with the use of a post milking teat disinfectants containing iodine at 0.5% or less (p=0.03) and 1% or greater (p=0.02). The overall teat coverage goal of a post milking teat disinfectant also contributed to increased iodine levels in milk, however a significant effect was only evident with coverage including the full teat and udder base (p=0.001).

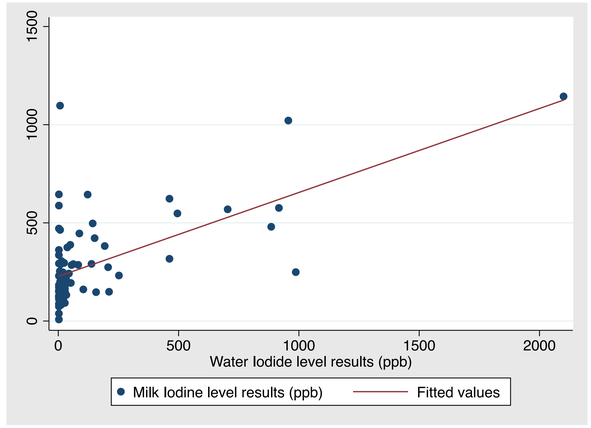

Figure 1. Two-way scatter plot suggesting a positive linear correlation between bulk milk iodine (BMI) level and 127-I content in water consumed by the lactating herd.

DISCUSSION AND CONCLUSIONS

The results of this study suggest that the iodine content in milk is influenced by a variety of risk factors. The mean values of BMI content reported are fairly comparable to recent Canadian studies [2,3]. Regional differences in the average milk iodine levels were assessed, but proved to have no significant influence on BMI concentrations. The relatively small number of farms visited in each region may explain this lack of regional significance.

Not surprisingly, the use of iodine-containing post milking teat disinfectants and the overall coverage goal of post disinfectants also has a significant effect on BMI, which was also observed in other studies[1,5,6,7]. The 127-I content in water has a significantly positive linear relationship with the BMI results. As hypothesized, this finding suggests that milk iodine levels may be significantly increased when lactating dairy cattle consume water containing high levels of iodide.

Further research, possibly in the form of controlled experiments, is required to confirm the presence of a causal relationship between water consumption and its contribution to raw milk iodine levels.

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