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CERTAIN TRACE ELEMENTS IN THE FEEDS, ORGANS, AND TISSUES OF A SELECTED GROUP OF REPEAT BREEDING COWS IN NORTHEASTERN WISCONSIN[1]

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In laboratory animals sub-minimal ingestion of certain trace elements, especially manganese, has led to infertility and reproductive failures (13, 4, 10, 3, 8). The possibility of a trace element deficiency as a likely cause of infertility in cattle is pertinent in view of the variable concentration of some of the trace elements present in feeds. Unpublished data have shown that samples of Wisconsin grown alfalfa contain from 7 to 72 ppm. of manganese. Often farmers producing low-manganese hay are troubled with repeat breeding cows; hence, an effort was made to ascertain the concentrations of trace elements in the feeds of troublesome repeat breeding cows from a widely scattered area of northeastern Wisconsin. It also was found possible to estimate liver and blood concentrations as well as a few vitamin determinations on the blood samples.

METHODS AND PROCEDURES

The farms from which these cattle came were classified by the inspector as two poor, eleven fair, thirteen good and five excellent. The majority of these farms used pastures of fair to good quality. Their hay was fair to good while the silage was good to excellent in most instances. Samples of hay, silage and grain mixtures were obtained from 33 farms in ten northeast counties of Wisconsin. These were analyzed for their cobalt and manganese content. Repeat breeding cows were selected from these farms on the basis of (a) a minimum of four infertile services, (b) at least had given birth to one living calf, (c) the cattle were under 10 yr. of age, (d) not more than two cows from any given farm, (e) cattle with no genital abnormalities, (f) cows free from purulent discharges, (g) normal estrus cycles and (h) normal intervals between breeding. These cattle were handled and slaughtered as described by Tanabe and Casida (11) for those cattle obtained in 1947 and 1948. A second lot of cattle obtained in 1948 and 1949 were similarly selected and experimentally treated as in the first lot of cattle.

Liver and ovarian tissues were analyzed for manganese, while blood plasma was analyzed for vitamins A and C and carotene. The method used for the

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ascorbic acid analyses was that of Mindlin and Butler (7), while the Kimball procedure (6) was used for vitamin A determinations. Manganese determinations were made by the AOAC periodate method when samples were ample and the microbiological method of Bentley *et al.* (2) was used for blood and ovarian analyses.

RESULTS

Manganese and cobalt content of the feeds on these farms which had repeat breeder cow difficulties are presented in table 1. The data from 29 farms

TABLE 1

Data on the average manganese and cobalt of feeds fed repeat breeder cows and liver manganese concentrations from cows selected from farms with the repeat breeder problem

	Mn content (ppm.)			Co content (ppm.)		
	No. of samples	Range	Av.	No. of samples	Range	Av.
Hay	29	8.9–48.5	23.3	18	0.02–0.08	0.042
Silage	26	18.8–66.0	31.7	18	0.03–0.16	0.09
Grain	18	.....	.....	17	0.02–3.28	0.63
				13	.....	0.12
Liver	29	6.5–11.3	8.6	.....	.....	.....

showed average values of 23.2 ppm. as the manganese content of the hays with a range of 8.9 to 48.5 ppm. Twelve farms had hay below 20 ppm. which seems to be on the low side. Since a variable amount of silage is fed in this area, these hays might reasonably expect to have an influence upon the manganese ingestion and subsequently upon the breeding performance of the cattle fed thereon.

Twenty-six samples of silage from 26 farms were obtained and the manganese content ranged from 18.8 to 66 ppm. with an average of 31.7 ppm. Only eight of these samples were below 20 ppm. of manganese. It is quite evident from these figures that the manganese content of the feeds on farms from which these repeat breeder cows came was quite variable.

The cobalt content of 18 samples of hay gave an average of .042 and .09 ppm. in silage with a variable content of cobalt in the grain portion of the ration. Estimating a third of the total digestible nutrients from hay, silage and grain each we find that three farms in Door County were definitely low in cobalt intake and five were definitely low in Shawano County. The others were marginal or adequate. Four samples of grain mixtures contained 1 to 3.38 ppm. cobalt. If these four high values are eliminated on the assumption that they were the result of cobalt supplements the average content of the grain rations fed by 13 farms was 0.12 ppm. of cobalt. Apparently, the grain portion of the ration supplied many of the supplements needed to support these rations. It has been reported that 0.05 ppm. of cobalt (12, 5) was necessary for normal performance of cattle grazing on herbage low in cobalt. From these observations it would seem that cobalt was a more critical element in this region of Wisconsin than manganese.

It is interesting that 29 livers from these cattle coming to slaughter averaged 8.6 ppm. of manganese with a very narrow range in variation—namely 6.5 to 11.3 ppm. The livers were rather constant in their manganese content irrespective of the dietary intake. It is evident that the manganese content of the liver is difficult to influence by dietary means or else this organ harbors its manganese very tenaciously.

The ascorbic acid content of the blood plasma was on the low side, averaging .296 mg. per cent. This value is slightly low for Holstein cattle (9) and since the group of experimental cattle used in these studies was composed roughly of 50 per cent Guernseys and 50 per cent Holsteins, the value would be still further reduced since normal Guernseys averaged 0.4 to 0.5 mg. per cent. As would be expected, variation in the ascorbic acid content of these blood plasmas, varied from the extreme of .1 to .8 with the majority of them confined to the narrow limits of .2 to .4 mg. per cent. The blood plasma vitamin A and carotene contents averaged 0.30 to 6.02 γ per gram, respectively, values which are adequate.

Analyses of the liver, ovary and blood for manganese content indicate that there was breed difference in the manganese content of these tissues and organs

TABLE 2

Manganese content of certain tissues of repeat breeder cows

Breed	No. of animals	Range		Av.
H	41	Liver	6.4–23.0	9.5 μg./g.
G	18	"	6.1–11.3	8.8 "
H	8	Blood	2.5–13.0	6.7 μg./100 cc.
G	8	"	2.5– 9.0	5.2 "
H	5	Ovary	1.5– 1.9	1.6 μg./g.
G	3	"	1.8– 3.1	2.3 "

as shown in table 2. Liver consistently presented a higher average manganese content than the other organs studied—averaging 9.5 μg. per gram in the Holstein as against 6.7 μg. per 100 cc. in blood and 1.6 μg. per gram in the ovary. The manganese values for similar tissues in Guernsey cattle ran lower except in the ovary. In the ovary the manganese content was higher than that of the Holsteins.

The manganese content of the ovaries of these cattle are below the normal levels found by Bentley (1) in experimental animals fed known quantities of manganese supplements. In Bentley's experiments where adequate manganese was fed, a content of 2 to 3 μg. of manganese or more per gram was found in the ovary, whereas ovaries from the cattle used in these studies contained on the average distinctly less.

SUMMARY

In an effort to determine the relationship of trace minerals to the repeat breeding cow problem, a study of the distribution of manganese and cobalt in the feeds fed the cows from problem herds and the distribution of cobalt and manganese in certain tissues and organs of problem cows has been made. It is

evident that no single cause was responsible for the repeat breeder cow from these herds. Low blood plasma ascorbic acid values were found to exist. There was definite evidence of low or marginal cobalt intake associated with many of these problem herds. The manganese concentrations of the feeds from these farms was on the low side of the normal range, while ovarian concentrations were definitely low. It appears from these data that trace minerals have little if any direct relationship to the repeat breeding cow problem, although this possibility is not precluded by the data.

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