# BLOOD PLASMA MINERALS AND FERTILITY OF DAIRY COWS IN CENTRAL THAILAND

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## Summary

Blood plasma minerals and their effects towards the fertility in 136 cows randomly selected from 26 dairy farms in central Thailand were studied. An average of 8.60 mg% Ca, 5.97 mg% P, 2.45 mg% Mg, 85.9 μg% Cu, and 160.9 μg% Zn in plasma was observed. Compared to the critical deficient values, 24.3, 10.3, 11.8, 28.7 and 0.0% of the surveyed cows obtained the respective elements in plasma below the standard levels. No significant difference ($p > .05$) in plasma concentrations of Ca, P, Mg and Zn for the low fertile (conception rate > 3) and fertile (conception rate < 3) cows was found. However, plasma Cu of the low fertile cows (averaged 77.2 μg%) was lower ($p < .01$) than that of the fertile ones (averaged 91.12 μg%). Additionally, it is observed that 47.1% of the cows with the low fertility problem obtained plasma Cu below the 65.0 μg% critical deficient value.

(**Key Words** : Plasma Minerals, Fertility, Cows)

## Introduction

Dairy production in Thailand is generally in the hands of small holders. Under existing feeding and management practices in combination with the warm and humid environment, the animals usually are low in productivity. Besides relatively low milk yield, infertility is a common problem of dairy cows in the country. It is believed that deficiency of minerals is one of the nutritional constraints limiting the cows' reproductivity. According to McDowell et al. (1993) dairy cows are more prone to mineral deficiencies due to their increased requirement for lactation. In addition, insufficiency of Ca, P, Mg, Zn, Cu, Fe, Co, Mn, Se, I or F may lead to the fertility problem in cattle. The limited mineral research revealed potential widespread deficiencies of phosphorus, sodium and copper (Falvey, 1980; Suksaithaichana et al., 1985; and Vijchulata et al., 1991). Since the extent of mineral deficiencies and their influence on the fertility of lactating cows in Thailand is still largely unknown, further investigation is needed.

## Materials and Methods

Blood samples were randomly collected through jugular vein from 136 dairy cows belonging to 26 small-holders around the dairy areas of Saraburi and Lopburi provinces in central Thailand. Collection of the blood was carried out during early dry and cool season (October to January). Owing to the relatively low temperature and available green forages during this period, the cows' milk yield parallel to their nutrient demands normally increased. Together with blood samples, data from farm records on reproduction of the cows were also collected. The cows with a conception rate recorded over 3 are classified as having low fertility problem. Handling and analysis of plasma Ca, Mg, Zn and Cu were conducted using atomic absorption following the procedure outlined by Fick et al. (1979). Autoanalyzer was used to determine plasma P following the procedure of Attanun and Chanjaroensuk (1989). Statistical effect of plasma minerals on fertility was conducted using general linear model (SAS, 1985).

## Results

According to the observation, all dairy cows in the areas received about 30 kg per day of poor to moderate quality roughages. They were normally provided with commercially available concentrates at the rate of about 1 kg for every 2 kg of milk produced. All cows in the survey received mineral supplement in the concentrates as well as free choice mineral block or meal. Of the 136

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dairy cows randomly selected, a total of 85 cows, representing 65%, obtained a conception rate less than 3, while the remaining 51 cows, representing 35%, were over 3. The comparative profile of blood plasma minerals of the cows is illustrated in table 1. Mean plasma Ca, P, Mg, Cu and Zn of all cows were 8.60, 5.97, 2.45 mg%, 85.90 and 160.86 μg% respectively. Plasma mineral concentrations of the cows with the conception rate over 3 were 8.42, 5.80, 2.39 mg%, 77.22 and 160.24 μg% while those of the fertile cows were 8.71, 2.48, 6.07 mg%, 91.12 and 161.24 μg%, respectively. With the exception of Cu, all plasma minerals analyzed in the two groups of dairy cows were not significantly different ($p > .05$). As for Cu, the fertile cows obtained a higher ($p < .01$) value (averaged 91.12 μg%) than that of the low fertile ones (averaged 77.22 μg%).

TABLE 1. LEAST SQUARE MEANS (± STANDARD DEVIATION) OF PLASMA MINERALS OF THE DAIRY COWS[1]

| Fertility | Number | Ca | P | Mg | Cu | Zn |
|---|---|---|---|---|---|---|
| | | mg% | | | μg% | |
| Low | 51 | 8.42 ± 0.12 | 5.80 ± 0.26 | 2.39 ± 0.06 | 77.22 ± 3.72[b] | 160.24 ± 5.23 |
| Normal | 85 | 8.71 ± 0.01 | 6.07 ± 0.15 | 2.48 ± 0.05 | 91.12 ± 2.88[a] | 161.24 ± 4.13 |
| Average | 136[2] | 8.60 ± 0.08 | 5.97 ± 0.12 | 2.45 ± 0.04 | 85.90 ± 2.34 | 160.86 ± 3.25 |

[1] Critical deficient values are Ca 8.00 mg%, P 4.50 mg%, Mg 2.00 mg%, Cu 65.00 μg% and Zn 80.00 μg% (McDowell et al., 1993).

[2] Total number of cows.

[ab] Number with different supercripts in the same column differed significantly ($p < 0.01$).

## Discussion

Mean plasma mineral concentrations of Ca, P, Mg and Zn of the cows from this study are similar to those reported in the cattle from northern (Vijchulata et al., 1991), central (Wattanakul et al., 1984; Vijchulata et al., 1983) and southern Thailand (Suksaithaichana, 1985) and are all above the critical deficient values stipulated at 8.00, 4.55, 2.00 mg% and 80.00 μg% respectively for the above minerals (McDowell et al., 1993). Average plasma Cu observed in the low fertile cows in this study is similar to the mean serum Cu of 70.15 μg% of dairy cows from Saraburi as reported by Phichaicharnnarong et al. (1988). However, the copper level is still above the 65.0 μg% critical value as suggested by McDowell et al. (1993). Table 2 illustrates the number and percentage of dairy cows having plasma mineral below the standard critical values. Of the 136 cows studied, 24.3, 10.3, 11.8, 28.7 and 0.0% obtained plasma Ca, P, Mg, Cu and Zn below the critical levels. However, when compared to the percentage of cows with plasma minerals below the standard levels between the two fertility groups, it is evident that the fertility problem is not related to the plasma Ca, P, Mg or Zn. Contrary to this, Cu seems to be one of the contributing factors. Although not conclusive, this is derived from the fact that 17.7% of all the cows or 47.1% of the low fertile cows, as compared to 11.0% of all the cows or only 17.7% of the fertile cows, obtained plasma Cu below the standard critical value. Additionally, since 10.3 to 24.3% of the surveyed cows also obtained Ca, P and Mg in the plasma below the critical values, quality of the mineral premixes as well as the mineral blocks or mineral meals commercially available in the areas needs to be further evaluated.

TABLE 2. THE NUMBER OF COWS WITH PLASMA ELEMENTS LOWER THAN THE CRITICAL DEFICIENT VALUES[1]

| Fertility | Number | Ca | P | Mg | Cu | Zn |
|---|---|---|---|---|---|---|
| Low | 51 | 14 (10.3) | 7 (5.2) | 7 (5.2) | 24 (17.7) | 0 (0) |
| Normal | 85 | 19 (14.0) | 7 (5.2) | 9 (6.6) | 15 (11.0) | 0 (0) |
| Total | 136 | 33 (24.3) | 14 (10.3) | 16 (11.8) | 39 (28.7) | 0 (0) |

[1] Number in parentheses are percent of the total number of cows.

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