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Study on Vitamins A, E, B1, B2, and Beta-Carotene Problems in Dairy Cattle

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ABSTRACT

From the study of the levels of Vitamin A, Beta-carotene, Vitamin E, Vitamins B1 and B2 in 197 serum samples of fertile and infertile dairy cows collected from 6 dairy cow raising centers, it is found that there was no significant difference in the levels of Vitamins A, E, and B2 in the serum under study and there should not be any problem about the levels of these vitamins.

As for the Vitamin B1 level calculated from the percentage of Thiamine Pyrophosphate Enzyme (TPPE) in problematical groups of dairy cows, it is found deficient in comparison to the normal level reported in humans since there has not been any report of a study of % TPPE in dairy cows. The level of Beta-carotene obtained from this study is questionable. Besides, the level of Beta-carotene differs distinctly in each serum sample including the samples taken from normal dairy cows raised in various regions. The conclusion is that there should be more detailed study on the problems of Vitamin B1 and Beta-carotene in dairy cows.

INTRODUCTION

Infertility in dairy cows is a result of many causes. Konermann (1968) and Muller (1966) concluded that 50% of the infertility in dairy cows was caused by nutritional deficiencies, inappropriate management and abnormality of the pituitary gland. Nutrition related to fertility in dairy cows includes proteins, energy, minerals and vitamins.

Vitamins and minerals are essential for bodily growth and strength. They also effect the function of the reproductive systems. The important vitamins are A, Beta-carotene, D, E and B. Limpoka *et al.*, (1984) conducted a study on the levels of minerals related to infertility in dairy cows at Nongpho, Rajaburi. Sukpuaram *et al.*, (1985) and Suksaithaichana *et al.*, (1985) conducted studies on the levels of minerals in cattle in the northeastern and southern provinces respectively. There has not been a report on the study of the levels of Vitamins in dairy cows in Thailand.

This report is on the study of the levels of Vitamin A, Beta-carotene, Vitamins E, B1 and B2 which may be related to the infertility of dairy cows in Thailand.

MATERIALS AND METHODS

Collection of blood samples

Blood samples were collected from dairy farms all over the country:

1. The Department of Animal Science, Kasetsart University at Kampaengsan, Nakhon Pathom, 10 samples
2. The Livestock Breeding Station at Tubkwang, Saraburi, 28 samples

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3. Dairy Cow Raising Center at Nongpho, Rajaburi, 24 samples

4. Dairy Cow Raising Center at Cha-am, Petchburi and Hua-Hin, Prachuabkirikhan, 45 samples

5. Dairy Cow Raising Center, Chiangmai, 55 samples

6. Dairy Cow Raising Center, Pattalung and Nakhon Srithammaraj, 35 samples

The 197 blood samples under study were divided into 6 groups according to the history of fertility, as follow: A. Normal and Healthy group: 67 samples. B. Abnormal reproductive system group: 11 samples. C. Repeat breeder (over 5 inseminations) group: 43 samples. D. Repeat breeder (under 5 inseminations) group: 47 samples. E. Repeat breeder with weak legs: 13 samples. F. Calves under 2 years old: 16 samples.

Analysis of blood samples

Each blood sample was analyzed to find the levels of Vitamin A, Beta-carotene, Vitamins E, B1 and B2 and the percentage of Packed Cell volume (PCV). The blood sample was centrifuged to seperate the serum and the precipitated blood was washed three times with 0.85% sodium chloride solution. Each part of the sample was separately frozen to be analyzed for each vitamin.

Vitamin A and Beta-carotene were analyzed according to the report of Neeld and Pearson (1963).

Vitamin E was analyzed according to the method reported by Duccan (1959) and Hanfen and Warwick (1966).

Vitamin B1 was analyzed by measuring the percentage of TPPE (Thiamine pyrophosphate enzyme) according to the method reported by Dreyfus (1962).

Vitamin B2 was analyzed by measuring the Erythrocyte $NADPH_2$-Dependent Glutathione Reductase Activity (EGR Activation Coefficient) according to the method discribed by Glatzle *et al.*, (1970).

RESULTS AND DISCUSSION

Vitamin B1

The result of the study of the level of vitamin B1 in dairy cow serum obtained by measuring the percentage of TPPE (Thiamine pyrophosphate enzyme) is shown in Table 1. From the study of the % TPPE in humans (Dreyfus, 1962) it was found that if the TPPE rate was between 0-15% it was considered normal, 16-20% was low, and over 20% meant vitamin B1 deficiency. This report showed that % TPPE in normal dairy cows = 12.21 $\pm$ 6.8 which was normal in comparison to the report in humans. In young calves group the % TPPE = 18.9 $\pm$ 7.7 which was also normal. In problem groups the % TPPE in repeat breeder with weak legs group was highest = 34.64 $\pm$ 14.34. Next were 29.43 $\pm$ 10.46, 27.82 $\pm$ 13.56 and 25.33 $\pm$ 10.56 in abnormal reproductive system group, repeat breeder (over 5 inseminations) group and repeat breeder (under 5 inseminations) group respectively. The % TPPE in dairy cow serum from these four problem groups showed vitamin B1 deficiency, the degree of which varied according to the % TPPE found in each group as shown in table 1.

Vitamin B2

The result of the level of vitamin B2 in dairy cow serum obtained by measuring the EGR activation coefficient rate is shown in table 2 by dividing the samples into 6 groups as in the study of the level of vitamin B1. The report on the study of the EGR activation coefficient rate in humans (Glatzle *et al.*, 1970) showed that if the EGR activation coefficient rate was higher than 1.4, vitamin B2 deficiency occurred. If it was between 1.2-1.4 it was below normal and if it was lower than 1.2 it was normal.

Table 2 showed that the EGR activation coefficients of normal and problem dairy cow groups were lower than 1.2 which meant that the animals under study had no vitamin B2 problems.

Table 3 showed the % PCV in different groups of dairy cows under study. The % PCV

in each group was between 31.58 ± 34.22 except in repeat breeder (over 5 inseminations) and young calves groups. The-% PCV found were 27.78 and 29.5 respectively.

Vitamin A

The result of the level of vitamin A in serum is shown in table 4. Rosenberger (1970) and Nickle (1971) reported that in mature cows the normal level of vitamin A in the blood should be between 25-65 microgram/100 ml. If the level was between 10-25 microgram/100 ml it was considered deficient, and if lower than 10 microgram/100 ml the animal showed distinct symptoms of vitamin A deficiency. From table 4 the average level of vitamin A under study was normal. The level found was between 25.73-42.32 microgram/100 ml in normal and problem groups.

Beta-carotene

The level of Beta-carotene in the serum is shown in table 5. Rosenberger (1970), Nickle (1971) and Lotthammer *et al.*, (1978) demonstrated that the normal level of beta-carotene in dairy cow should be between 150-500 microgram/100 ml. If it was between 60-150 microgram/100 ml it was considered low. If lower than 60 microgram/100 ml there was a distinct symptom of deficiency. Friesecke (1978) reported that the normal level of Beta-carotene in dairy cow should be over 300 microgram/100 ml. If the level was between 200-300 microgram/100 ml it was suspected. Between 100-200 microgram/100 ml was considered lower than normal and between 0-100 microgram/100 ml would be deficient.

The level of Beta-carotene in the serum shown in table 5 was between 207.37-279.71 microgram/100 ml except in the young calves group in which the level of Beta-carotene = 127.37 microgram/100 ml. The average level of Beta-carotene in dairy cow blood from all groups under study was at a suspected level but not yet deficient according to Friesecke (1978). Table 7 showed the Beta-carotene level in normal dairy cow serum from various regions. If could be seen that the level of Beta-carotene collected from different regions differed distinctly. Beta-carotene found in the samples taken from Cha - am was 543 ± 175.25 microgram/100 ml, from Hua-Hin was 73.51 ± 33.9 microgram/100 ml. The samples from Tubkwang, Saraburi, Kampaengsaen, Nakhon Pathom and Nongpho, Rajaburi were in the same levels between 177.24-194.18 microgram/100 ml of blood. The problems of Beta-carotene in dairy cows should be studied in detail since the levels of Beta-carotene in dairy cows raised in various parts differed distinctly, as shown in table 7.

Vitamin E

The analysis of the level of Vitamin E in the serum as shown in table 6 the levels of Vitamin E in all groups of dairy cows under study were over 1 microgram/100 ml of blood except in the young calves and repeat breeder with weak legs groups which were 0.71 and 0.65 microgram/100 ml of blood respectively. The report in humans showed that the level of Vitamin E in blood should not be lower than 0.7 microgram/100 ml of blood. From the reports of Caravaggi (1969) and Kolb (1971) it was found that the normal level of Vitamin E in cow serum was between 0.2-10 microgram/100 ml of blood. If lower than 0.1 microgram/100 ml there would be Vitamin E deficiency. In young calves, if the level was lower than 0.7 microgram/100 ml, Vitamin E deficiency would occur. However, the problems of Vitamin E in animals involve many factors such as the level of Selenium in the body, the level of Vitamin E in the tissues and some organs, or the transport of Vitamin E in the body (Kolb, 1971).

Table 1 % TPPE in dairy cow serum under study

	A	B	C	D	E	F
% TPPE*	12.12 ± 6.8	29.43 ± 10.46	27.82 ± 13.56	25.33 ± 10.56	34.64 ± 14.34	18.9 ± 7.7
Number of samples	32	8	27	20	10	9

A Normal and healthy group
B Abnormal reproductive system group
C Repeat breeder (over 5 inseminations) group
D Repeat breeder (under 5 inseminations) group
E Repeat breeder with weak leg group
F Calves under 2 years old

*TPPE = thiamine pyrophosphate enzyme
Acceptable = 0 – 15%
Low = 16 – 12%
B1 Deficiency = > 20%

Table 2 EGR activation coefficient rate in dairy cow serum under study

	A	B	C	D	E	F
EGR* activation coefficient	1.04 ± .177	0.98 ± .11	1.12 ± .23	1.06 ± .15	1.08 ± .16	1.01 ± .13
Number of samples	41	9	37	29	13	12

EGR = Erythrocyte $NADPH_2$ - Dependent glutathione Reductase Activity
*Acceptable = 1.2
Low = 1.2 – 1.4
B_2 Deficiency = > 1.4

Table 3 % PCV in different groups of dairy cows under study

	A	B	C	D	E	F
% PCV*	32.06 ± 5.49	34.22 ± 2.57	27.78 ± 4.8	31.58 ± 6.61	72.84 ± 4.74	29.5 ± 5.53
Number of samples	48	9	37	29	13	12

PCV = Packed Cell Volume
*Healthy cattle = 30-40%

Table 4 Vitamin A level in dairy cow serum under study

	A	B	C	D	E	F
Vitamin A*	25.73	42.32	40.56	36.80	35.97	33.35
μg/dl	±13.30	±6.27	±9.96	±14.86	±21.14	±2.01
Number of samples	46	8	17	14	13	4

*Acceptable = 25-65 ug/dl
Deficiency possible = 10-25 ug/dl

Table 5 Beta-carotene level in dairy cow serum under study

	A	B	C	D	E	F
Beta-carotene*	279.71	223.15	232.03	207.37	249.69	127.37
μg/dl	±182.7	±31.7	±93.4	±62	±159.9	±23.1
Number of samples	27	8	13	14	13	4

*Acceptable = > 300 ug/dl
Suspect = 200-300 ug/dl
Critical = 100-200 ug/dl
Deficient = 0-100 ug/dl

Table 6 Vitamin E in dairy cow serum under study

	A	B	C	D	E	F
Vitamin E*	1.03	1.10	1.05	1.07	0.65	0.71
μg/dl	±.47	±.17	±.44	±.71	±.4	±.43
Number of samples	59	11	42	31	13	16

*Acceptable = 0.7
Deficient = 0.5

Table 7 Beta-carotene level in normal dairy cow serum collected from various regions

	Tubkwang Saraburi	Kampaengsan Nakhon Pathom	Cha-am Petchburi	Hua-Hin Prachub kirikhan	Nongpho Ratchaburi
Beta-carotene*	177.24	194.18	543	73.51	191.43
μg/dl	±61.28	±93	±157.25	±30.9	±74.66
Number of samples	10	10	7	8	9

*Acceptable = > 300 ug/dl
Suspect = 200-300 ug/dl
Critical = 100-200 ug/dl
Deficient = 0-100 ug/dl

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