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THE EFFECT OF BETA-CAROTENE ON FERTILITY AND PROGESTERONE LEVEL OF DAIRY COWS

(With 2 Tables & 5 Figs.)

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تأثير البيتاكاروتين على الخصوبة ومستوى هرمون البروجستيرون في لبن الأبقار الحلوب

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شمل البحث دراسة تأثير البيتاكاروتين على الخصوبة ومستوى هرمون البروجستيرون في لبن الأبقار الحلوب وذلك من خلال التغلية عن طريق الفم بمعدل ٦٠٠ مجم / بقرة يوميا لمدة ثلاثة شهور . وقد أظهرت الدراسة أن ٤ (٨٠٪) بقرات من الخمس بقرات محل التجربة قد ثبت أنها عشار بعد تناولها المركب . كما أوضح إختبار قياس الإشعاع المناعى وجود زيادة معنوية في مستوى البروجستيرون في لبن الأبقار بعد تناولها البيتاكاروتين . كذلك فقد لوحظ وجود زيادة معنوية في مستوى الهرمون في لبن الأبقار العشار عن الغير عشار بقيمة ١٩٫٠٧٥ ± ٢٫١٣٩ مجم / ملى و ٦٫٢٧ ± ١٫٥ مجم / مل بالترتيب .

SUMMARY

The effect of beta-carotene on the fertility and milk progesterone level of dairy cows was studied through the oral administration of 600 mg/cow/day of a patent preparation of beta-carotene for a period of 3 months. Four (80%) of the five experimental cows conceived and proved to be pregnant, following the consumption of the preparation. The Radio-immunoassay (RIA) of the milk progesterone revealed the presence of a significant (P/ 0.005) increase of the hormone level after the intake of beta-carotene. A significant (P/ 0.005) increase of milk progesterone level was also observed in the pregnant than non-pregnant cows with values of 19.075±2.139 ng/ml and 6.27±1.5 ng/ml respectively.

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INTRODUCTION

Vitamins are fundamental factors in cellular metabolism and vitamin requirements will generaly be met by the natural feeds plus microbial synthesis in the rumen (EASTER, 1986 and SIMONS and HAND, 1986). They added that vitamin A is an exception, especially when fresh forage or hay containing adequate concentration of beta-carotene is not available. Beta-carotene has not only importance as a precursor of vitamin A, but has an additional specific action on the function of the reproductive process in female cattle (HOLNESS, 1975). LOTTHAMMER, et al. (1976); LOTTHAMMER (1979) and SIMONS and HAND (1986) revealed that vitamin A deficiency in breeding bulls may lead to a decline in sexual activity and semen quality. In breeding cows, estrus may not be impaired, but conception rates are reduced due to delayed ovulation. Embryonic death at 6 to 7-weeks gestation, early abortion, secretion of poor quality colostrum and increased incidence of retained placenta, are also observed.

Morever, AHLSWEDE and LOTTHAMMER (1978) pointed out that the corpus luteum of cattle contains the highest concentration of beta-carotene ever found in animal tissue.

SCHULTZ, et al., (1974) and ANWANDTER (1974) found that the progesterone rhythm was much less pronounced and the progesterone concentration in the corpora lutea was lower in cows with low blood levels of beta-carotene. In addition, LOTTHAMMER, et al., (1978) declared that after conception, the progesterone concentration in the blood serum of cows, which did not receive supplements of beta-carotene, was markedly lower than that of the supplemented group of cows.

The present work was carried out to detect the effect of oral administration of beta-carotene on the fertility and milk progesterone level of dairy cows.

MATERIAL and METHODS

Five Friesian dairy cows were used to study the effect of in-ration administration of 600 mg/day for 3 Months of a patent preparation of beta-carotne on the fertility, conception rate and milk progesterone level. These cows gave birth at the beginning of September and they were kept on a ration devoid of beta-carotene up to March. By the beginning of March, the animals were given a daily dose of 600 mg beta-carotene in ration for a period pf 3 months. Drinking water was allowed ad libitum. All cows were kept under close observation and those showed signs of estrus were artificially inseminated. Milk samples were collected from these cows every other day starting 29 to 80 days after parturition and sampling was continued until the cow was proved to be pregnant by both milk progesterone assay and rectal palpation. The collected milk samples were stored at -20^{o}C until the time of progesterone estimation using the radioimmunoassay (RIA) and following the techinques of HEAP et al., (1976) and using progesterone RIA kit supplied by the International Atomic Energy Agency, Vienna, Austria.

The obtained results were statistically analysed according to the procedures of MINIUM and CLARKE (1982).

RESULTS

The Radioimmunoassay (RIA) of milk progesterone revealed that the mean values of the hormone in the milk of cows before beta-carotene administration was 7.67±1.97 ng/ml milk. The corresponding figure following beta-carotene administration was 18.2± 2.53 ng/ml milk (Table 1).

A significant (P/ 0.005) increase of progesterone level was also observed in the milk of the cows, that has been proved to be pregnant, than non-pregnant animal with values of 19.08±2.14 and 6.27±1.5 ng/ml milk, respectively (Table 2).

Moreover, two of the cows (Fig. 2&4) conceived before beta-carotene administration and the progesterone level was markedly increased in their milk, following the consumption of beta-carotene. The other two cows (Fig. 1&3) were inseminated 16 and 10 days after beta-carotene administration respectively and were proved to be pregnant. The remaining cow (Fig. 5) failed to conceive and its milk progesterone level was lower than that of the pregnant cows.

DISCUSSION

Under field conditions, fertility and reproduction are subject to the influence of various factors including management, hygiene and nutrition. The role of beta-carotene as a precursor of vitamin A in animal reproduction has been established by LOTTHAMMER, et al. (1976) AHLSWEDE and LOTTHAMMER (1978), MINGAZOV (1977a,b) and COOKE and COMBEN (1978). The obtained significant (P/ 0.005) increase of milk progesterone of beta-carotene supplemented cows than before the consumption of the preparation, is strongly supported by the findings of LOTTHAMMER (1979), who revealed that the corpora lutea of beta-carotene-deficient cows developed more slowly after estrus and remained smaller than those of supplemented animals.

Concerning the milk progesterone level of pregnant and non-pregnant cows, the obtained level in the present work of 19.08 ng/ml and 6.27 ng/ml respectively, coincides with the values recorded previously by BOOTH, et al. (1979) and HOLDSWORTH, et al. (1980).

Moreover, HEAP and LAING (1974), HEAP, et al. (1976) and REIMERS, et al. (1980) concluded that the mean milk progesterone concentration was significantly greater in pregnant than in non-pregnant cows.

The markedly increased progesterone level in the milk of the two cows (Fig. 2&4), that conceived before beta-carotene administration, following the intake of the preparation is in agreement with the findings of LOTTHAMMER, et al. (1978) that progesterone level was higher in the milk of beta-carotene supplemented cows than non-supplemented animals. Moreover, SCHULTZ (1956); BRUGGEMANN and NIESAR (1957); SCHULTZ, et al. (1973) and LOTTHAMMER (1979) revealed that beta-carotene deficiency resulted in higher rate of embryonal mortality between 37 and 45 days of gestation and that the milk progesterone levels of the cows with interrupted pregnancy beyond the third week (24-26 days) were low and differed significantly from cows which remained pregnant.

The cow (Fig. 5) that failed to conceive following the consumption of beta-carotene explains the presence of other factors which are involved in the control of reproduction and not only the nutritional factor. These other factors were previously reviewed by ZINTZEN (1974), HOLNESS (1975) and ROWLANDS, et al. (1977). They pointed out that reproductin is subject to potential influence of many factors including genetical, environmental and nutritional causes.

Table (1)

Average milk progesterone values (ng/ml milk) 24-26 days before and after beta-carotene administration

Time of sampling	No. of animals	No. of cycles	No. of samples/ cycles	Total No. of samples	Mean values of progesterone 24-26 days
Before beta-carotene administration	5	11	11	234	7.67±1.67
After beta-carotene administration	3	3	3	136	18.2 ±2.53***

± Standard Error *** Very highly significant (P/ 0.005)

Table (2)

Average milk progesterone values (ng/ml milk) 24-26 days in pregnant and non-pregnant cows

Reproductive status of animals	No. of animals	No. of cycles	No. of samples/ cycles	Total No. of samples	Mean values of progesterone 24-26 days
Pregnant	4	4	4	126	19.08±2.14***
Non-pregnant	3	10	10	172	6.27±1.5

± Standard Error

*** Very highly significant (P/ 0.005)

REFERENCES

Ahlswede, L. and Lotthammer, K.H. (1978): Untersuchungen Uber eine spezifische, vitamin vitamin A unabhangige wirkung des B-Carotins auf die fertilitat des rindes. 5. Mitteilung: Organ untersuchungen (Ovarien, Corpora Lutea, Leber, Fettgewebe, Uterussekret, Nebennieren) Gewichts und Gehaltsbestimmungen. Deutsche Tierarztl. Wochenschr., 85, 7-12.

Anwandter, Q.C.G. (1974): Progesterone und B-Carotin-gehalt des bovinen corpus luteum wahrend der verschiedenen phasen des sexualzyklus in abhangigkeit von der Jahres-zeit. Dissertation Tierarztl. Hochschule, Hannover.

Booth, J.M.; Davies, J. and Holdsworth, R.J. (1979): Use of the milk progesterone test for pregnancy determination. Brit. Vet. J., 135: 478-488.

Bruggemann, J. and Niesar, K.H. (1957): Uber die bezeihungen der vitamin A und E and des B-Carotins Zum Weiblichen sexualzyklus des rindes und schweines unter besond-erer berucksichtingung der zyklussterilitat. Vit. U. Horm., 7: 10.

Cooke, B.C. and Comben, N. (1978): A study of the relationship between beta-carotene and fertility problems in dairy cows. Meeting British Soc. Anim. Prod. March 13.

Easter, R.A. (1986): Vitamins in food animal nutrition. PP. 286-292. In Current Veterinary Therapy. Food Animal Practice 2, Edited by Howard, J.L., Saunders Comp., Philadelphia.

Heap, R.B.; Holdsworth, R.J.; Gadsby, J.E.; Laing, J.A. and Walters, D.E. (1976): Pregnancy diagnosis in the cow from milk progesterone concentration. Brit. Vet. J., 132: 445-464.

Heap, R.B. and Laing, J.A. (1974): pregnancy diagnosis in cows, progress report on the use of progestagen concentration in milk. British Cattle Breeders Club Digest., 29.

Holdsworth, R.J.; Booth, J.M.; Sharman, G.A.M. and Rattray, E.A.S. (1980): Measurement of progesterone levels in whole and fore-milk from dairy cows. Brit. Vet. J., 136: 546-554.

Holness, D.H. (1975): Bovine infertility in relation to plane of nutrition. Rhodesian Vet. J., 5: 66-73.

Lotthammer, K.H. (1979): Importance of B-Carotene for the fertility of dairy cattle. Feedstuffs., 51: 16-50.

Lotthammer, K.H.; Ahlswede, L. and Meyer, H. (1976): Studies on a specific vitamin A-unrelated effect of beta-carotene on the fertility of cattle. I. Further clinical findings and conception rates (Experiment III). Deutsche Tierarzt - Wochenschr., 83: 353-354, 356-358.

Lotthammer, K.H.; Schams, D. and Scholz, H. (1978): Untersuchungen uber die spezifische, vitamin A-unabhangige wirkung des B-Carotins auf die fruchtbarkeit von Laktieren-den milchkuhn. Fachgruppentagung Deutsche Veterinarmed. Ges., "Fortpflanzung und deren storungen" Giessen., 16: 2.

Mingazov, T.A. (1977 a): Effect of Vitamin E on the assimilation of carotene from micro-bial preparations and on the reproductive function of cows. Vestn. S-Kh. Nauki Kaz., 20: 68-71. (Cited by Lotthammer, 1979).

Mingazov, T.A. (1977 b): Effect of microbial carotene on reproductive function of cows. Zhivotnovodstvo, No. 4, 59-60. (Cited by Lotthammer, 1979).

Minium, E.W. and Clarke, R.B. (1982): Elements of Statistical Reasoning. 1st Ed., John willey, Sons Inc. New York.

Reimers, T.J.; Smith, R.D. and Foote, R.H. (1980): Milk progesterone testing to determine reproductive status of cows. XI. Intern. Congr. on diseases of Cattle, Tel Aviv, 606-913.

Rowlands, G.J.; Little, W. and Kitchenham, B.A. (1977): Relationship between blood composition and fertility in dairy cows. A field study. J. Dairy Res., 44: 1-7.

Schultz, H. (1956): Der vitamin A und B-Carotin gehalt in leber, ovarien und plasma des weiblichen rindes und deren beziehungen zum ovarialzyklus und zur sterilitat. Munchen. Med. Vet. Diss.

Schults, G.; Ahlswede, L. and Grunert, E. (1973): B-Carotingehalt in Corpora Lutea von rindern vei unterschiedlichen haltungsbedingungen. Zuchthygiene, 8: 89.

Schultz, G.; Horstmann, G.; Anwandter, C. and Grunert, E. (1974): B-Carotin und progesterongehalt der corpora Lutea des rindes nach weide und stallfutterung. Zeitschr. Tierphysiol., Tierernahrung, Futtermittelk., 33: 214.

Simons, J.C. and Hand, M.S. (1986): Special dietary management in lactation and gestation. PP. 218-239. In Current Veterinary Therapy. Food. Animal Practice 2., Edited by Howard, J.L., Saunders Comp. Philadelphia.

Zintzen, H. (1974): Fertility and nutrition in dairy Cows. Information Service, F. Hoffmann La Roche & Co. Ltd., Basle.

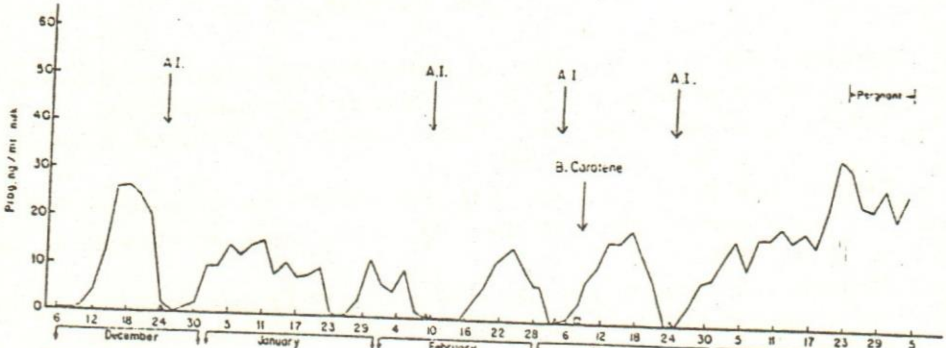

Fig.(1) Cow No. 1

A.I. = Artificial insemination.

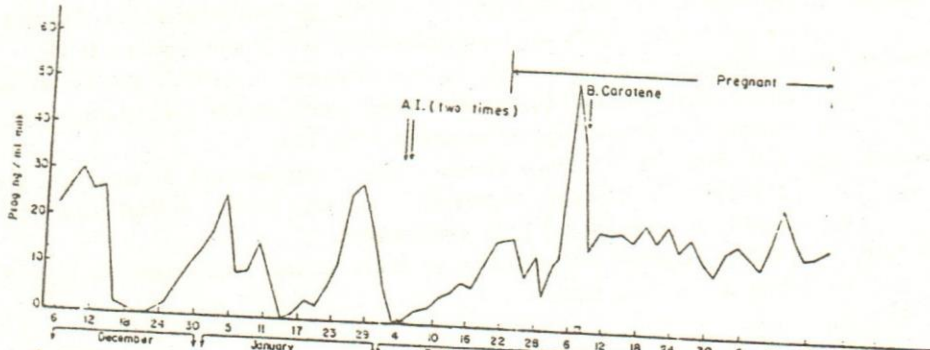

Fig.(2) Cow No. 2

A.I. = Artificial insemination.

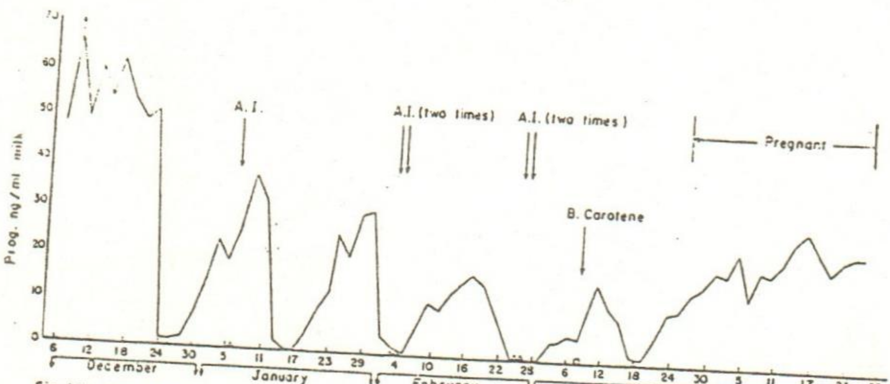

Fig.(3) Cow No. 3

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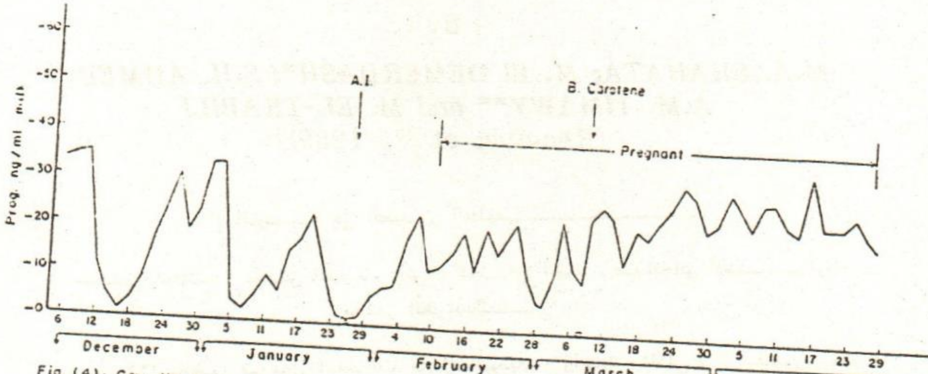

Fig. (4)- Cow No. 4

A.I. = Artificial insemination.

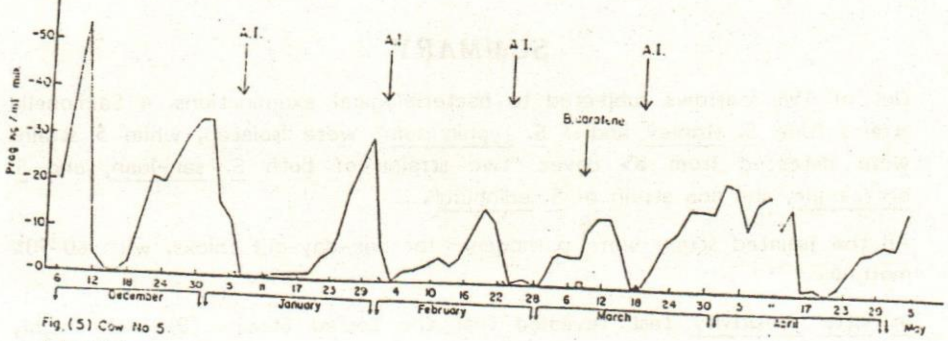

Fig. (5) Cow No 5

A.I = Artificial insemination.

Figures (1, 2, 3, 4 & 5): Illustrate the milk progesterone level (ng/ml) during different phases of estrus cycles before and after beta-carotene administration of cows No. 1, 2, 3, 4 and 5 respectivley.