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Survey of Vitamin A, β-Carotene, Calcium and Phosphorus Concentrations in Serum of Dairy Cows with Retained Placenta

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Abstract: Retained Placenta (RP) may result from a number of factors, such as abortion, forced labor, delayed gestation, early parturition, uterine atony, infections and seasonal and hormonal disorders. In addition, it is well known that deficiencies of some vitamins and minerals induce or predispose animals to RP. The objective of the present study was to investigate the between serum concentrations vitamin A, β-carotene, calcium and phosphorus and the development of RP in cows. The 25 cows were retained placenta; to wit they have not excreted their placenta after parturition. The 20 others have excreted their placenta normally after parturition. Blood samples were obtained from all understudying animals from tail vein by venoject. Samples were centrifuged and sera were prepared and amounts of vitamin A, β-carotene, calcium and phosphorus were measured. Data showed that there is no significant difference among vitamin A and β-carotene between two groups ($p>0.05$). While revealed that there is a significant difference in mean value of Ca and P among two groups.

Key words: Retained placenta, vitamin A, β-carotene, calcium, phosphorus, serum, cow

INTRODUCTION

Retained Placenta (RP) may result from a number of factors, such as abortion, forced labor, delayed gestation, early parturition, uterine atony, infectionsand seasonal and hormonal disorders. In addition, it is well known that deficiencies of some vitamins and minerals induce or predispose animals to RP (Hurley and Doane, 1989; Laven and Peters, 1996).

The physiological delivery of the placenta after parturition requires adequate and regular uterine contractions. The deficiency in secretions of PGF2a and oxytocin and serum Ca concentration which maintain adequate contraction of the uterus may cause RP, increase the risk of dystocia and delay the involution of the uterus (Hurley and Doane, 1989; McDowell, 1992; Morrow, 1980).

Some researchers (Shukla *et al*., 1983; Zhang *et al*., 1992) reported that a low serum Ca concentration plays an important role in the development of RP in cows while others (Lotthammer, 1983; Mutiga *et al*., 1993) found that the Ca concentration was at the physiological level, indicating that Ca has virtually no role in the development of RP.

Meanwhile, Carson *et al*. (1978) investigated the high incidence of dystocia, RP and puerperal metritis in a dairy herd. They found that when these animals were fed a ration enriched with supplemental bone meal for the previous 3 months the incidence of dystocia was reduced from 75-10%, the RP rate from 35-8% and the puerperal metritis rate from 70-10%. The serum Ca concentration in these cows was reported to increase from 8.98-10.26 mg dL^{-1} with this type of diet.

It has been reported that the low serum concentrations of various minerals including Zn, Mg and K in cows before parturition might cause or increase the risk of RP (Stancioiu and Constantinescu, 1983; Zhang *et al*., 1992).

Malnutrition is thought to be one of the most important factors in non-infectious abortion in cows and heifers. It may even lead to the development of abnormalities in the fetus and embryonic death in the early period of gestation. The inadequate supplementation of a ration with vitamins A and E, betacarotene, iodine, Se, Cu and Zn may also induce abortion in the advanced stage of gestation in cows (Allison and Laven, 2000; Graham *et al*., 1994).

The transition period for dairy cows is characterized by increased risk of several metabolic and infectious diseases. One important causal factor is impaired immune function in peripartum cows (Mallard *et al*., 1998) and cows' vitamin A and vitamin E status are component factors in immune function (NRC, 2001).

Peripartum immunosuppression is multifactorial but is associated with endocrine changes and decreased intake of critical nutrients (Goff and Horst, 1997). Circulating concentrations of vitamins A and E decrease around calving (Goff *et al*., 2002). Decreased

phagocytosis and intracellular killing by neutrophils occur in parallel with decreased DMI and decreased circulating vitamin E (α-tocopherol) concentration (Hogan *et al*., 1992). Vitamin E is a fat-soluble membrane antioxidant that enhances the functional efficiency of neutrophils by protecting them from oxidative damage following intracellular killing of ingested bacteria (Herdt and Stowe, 1991). Several studies (Weiss *et al*., 1990, 1992) have shown that dietary supplementation with 1000 IU of vitamin E/cow/day in the late dry period mitigates the peripartum drop in circulating α-tocopherol but this does not necessarily decrease the incidence of disease (Allison and Laven, 2000). β-carotene is the main dietary precursor of vitamin A (retinol) in dairy cattle. β-carotene that escapes rumen degradation is metabolized in the intestinal mucosa to retinol and absorbed and transported to the liver with fat (Chew, 1987). Vitamin A has numerous functions that are not fully understood. In peripartum dairy cows, it is reported to have a role in resistance to infectious disease, particularly mastitis (NRC, 2001). In dairy cattle, β-carotene may also exert an effect as an antioxidant, separate from its role as provitamin A (Chew, 1993).

The objective of the present study was to investigate the relationship between blood serum concentrations of vitamin A, β-carotene, Calcium and Phosphorus and the development of RP in cows.

MATERIALS AND METHODS

Researchers used of 45 cows for this study which are divided into two groups as follow: The 25 of them were retained placenta; to wit they have not excreted their placenta after parturition. The 20 others have excreted their placenta normally after parturition. Blood samples were obtained from all understudying animals from tail vein by venoject. Samples were centrifuged and sera were prepared. Vitamin A and β-carotene measured by N-hexane Method and Ca and P of sera were measured by Calorimetric Method and by using of Zeist-Chemistry Co. kits. Data were recorded and analyzed by SPSS software.

RESULTS AND DISCUSSION

Data showed that there is no significant difference among vitamin A and β-carotene between two groups ($p>0.05$). While revealed that there is a significant difference in mean value of Ca and P among two groups (Table 1 and Fig. 1-4).

In a research (Shukla *et al*., 1983; Zhang *et al*., 1992) carried out on blood samples taken from cows prior to parturition, 24 h after parturition and postpartum 1st week, it is suggested that the serum Ca concentration of RP

Table 1: Mean value of vitamin A, caLcium, β-carotene and phosphorus in two groups

Parameters	Unit	Groups	No. of samples	Mean±SD	p-values
Vitamin A	mg dL^{-1}	1*	25	24.65±4.08	>0.05
		2**	20	25.34±6.21	
β-carotene	mg dL^{-1}	1	25	13.72±2.83	>0.05
		2	20	14.13±3.12	
Ca	mg dL^{-1}	1	25	8.21±0.03	<0.05
		2	20	9.35±0.07	
P	mg dL^{-1}	1	25	4.80±0.02	<0.05
		2	20	6.47±0.04	

*Retained placenta; **Without retained placenta

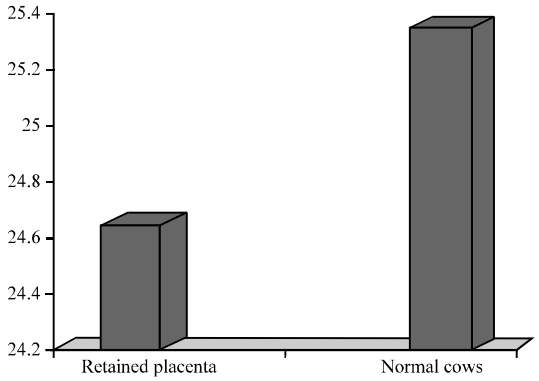

Fig. 1: Comparison of mean value of vitamin A in two groups

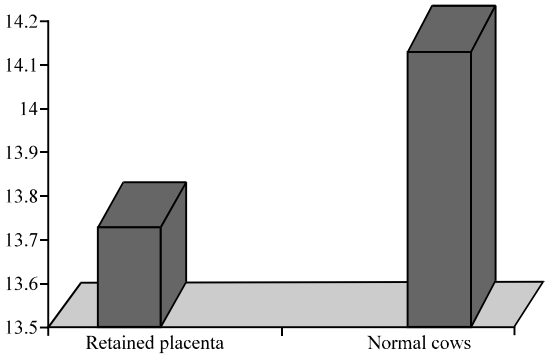

Fig. 2: Comparison of mean value of β-carotene in two groups

animals (6.27±0.18 mg dL^{-1}) was lower than that in postpartum cows without RP (7.40±0.18 mg dL^{-1}). Some researchers (Lotthammer, 1983; Mutiga *et al*., 1993) indicate that a significant difference is not seen between animals with and without RP. Lotthammer (1983) stated that Ca affected the development of RP and the serum Ca concentration was 6.89, 6.65 and 6.37 mg dL^{-1} 1 week before during and 12 h after parturition, respectively in cows with RP. On the other hand, these values were reported as 9.09, 8.61 and 8.53 mg dL^{-1}, respectively in cows without RP. The average serum Ca concentrations in cows with RP were lower than the values of those without RP in the research. This finding is in agreement

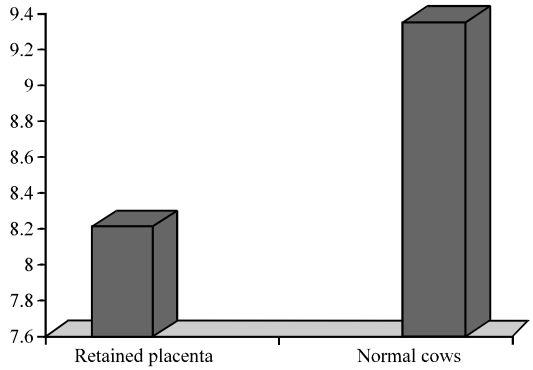

Fig. 3: Comparison of mean value of Ca in two

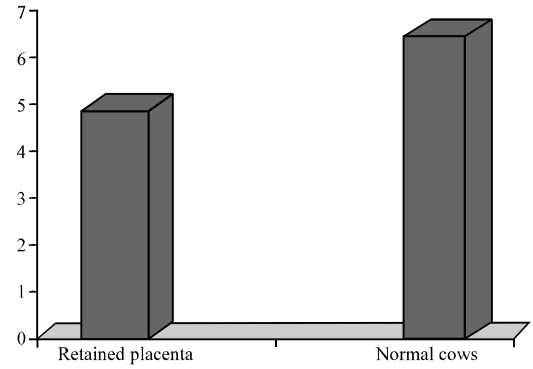

Fig. 4: Comparison of mean value of P in two

with the results of some other researchers (Bari *et al*., 1996; Shukla *et al*., 1983; Zhang *et al*., 1992). Bari *et al*. (1996) stated that Mg concentration was 1.75 and 2.84 mg dL^{-1} and the differences were significant. Zhang *et al*. (1992) suggested that Zn and Mg concentrations of the blood serum in the RP group prior to parturition and after parturition were lower than those in the control animals. Other researchers (Darmono and Sudibyo, 1990; Graham *et al*., 1995; Sevcik *et al*., 1980) indicated that low levels of minerals lead to a predisposition to RP in cows. It was suggested in many studies (Correa *et al*., 1990; Laven and Peters, 1996; Samad and Islam, 1989) that dystocia in cows increased RP incidence. Sevcik *et al*. (1980) stated that the blood serum Ca, Na and K concentrations did not differ between normal cows and those with dystocia. On the other hand, Bostedt (1974) indicated that the serum Ca and Mg concentrations in cows and heifers after dystocia were higher than those in cows with normal parturition. In this research, no differences were seen in respect of Ca, Zn, Mg, K or Na levels between the RP and control groups depending on the parturition type. These results are consistent with previous research (Sevcik *et al*., 1980).

Mutiga *et al*. (1993) indicated that calf sex in RP cows had no effect on plasma Ca levels. Ocal stated that the serum Ca level in cows having a male calf with RP was higher than that in cows having a female calf (9.39 and 8.68 mg dL^{-1}). In the present research, no difference was determined among Ca, Zn, Mg, K or Na levels depending on calf sex in the RP and control groups. Some researchers (Laven and Peters, 1996; Stevenson and Call, 1983) suggest that there is a relation between the age of the animal and RP thus RP incidence increases with age. In research conducted by Erb and Martin (1980) on 1401 cows, it was stated that the RP rate in 2 years old cows was lower than that in cows 4 years old. Ocal reported that cows 2-3 years old with RP had higher serum Ca (9.41 and 8.72 mg dL^{-1}) levels than cows 3-6 years old.

CONCLUSION

With respect to determinants of peripartum serum concentrations of α-tocopherol, β-caroteneand retinol, major factors such as DMI and the level of dietary supplementation were not measured in this study. Dry matter intake and diet composition similarly have significant influence on metabolites such as NEFA and cholesterol. However in alarge, multi-herd field study with the cow as the unit of interest, it was not feasible to collect detailed information on diets.

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