Effect of Vitamin E and Selenium Administration on the Reproductive Performance in Dairy Cows

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ABSTRACT : Incidence of retained placenta in dairy cows was investigated in 120 parturitions. Prior to calving, cows were allotted into four groups; 1) control, 2) the injection of Vitamin E (500 IU), 3) the injection of selenium (40 mg), and 4) the injection of Vitamin E (500 IU) and selenium (40 mg). Selenium (Se) and Vitamin E were injected intramusculary 20 d prior to the estimated calving date.

No effects of Se or Vitamin E administration alone was observed for number of service per conception, conception rate, and estrus rate ($p > 0.05$). But the Vitamin E administration with Se significantly ($p < 0.05$) reduced the incidence of retained placenta and the days required for calving the first service.

Incidence of retained placenta was not significantly ($p > 0.05$) influenced by parity, but it was significantly ($p < 0.01$) influenced by season, especially, increased during July and August. Concentration of Se in plasma was not significantly ($p > 0.05$) changed during peripartum period whether the treatment.

The results of this study on retained placenta suggest that this disorder will be reduced by the administration of Se and Vitamin E prior to calving in dairy cows.

(**Kew Words**: Vitamin E, Selenium, Reproductive, Performance, Dairy Cow)

INTRODUCTION

The management of dairy cows during the peripartum period is especially critical for health and subsequent performance (Shanks et al., 1981). Retained placenta can lower milk yield, market value, increase infection of the reproductive tract and affect productive life of the cows. And retained placenta results in the increase of indirect costs that are difficult to quantify (Joosten et al., 1988). Also retained placenta affects the involution of cervix, which is affected by parity and postpartum status (Oltenacu et al., 1983).

Retained placenta occurs sporadically (about 5% of calvings), it is often difficult to determine which, if any, of many factors is responsible. Whether the retained placenta is manually removed or not, affected cows are always slow to return to estrus and even then conception rate is only almost to 40%. It was also reported that the calving to conception interval in cows with retained placenta was in average 108 days for those that did conceive and 15% of cows were culled for infertility (see de Bois, in Karg and Schallenberger, 1982). And retained placenta condition is more detrimental to fertility than uterine discharge based on delayed onset of ovarian activity, initial increases in progesterone, services per conception, and days open (Holt et al., 1989).

Dairy cows chronically fed diets deficient of Vitamin E and Se result in increased incidence of disease associated with reproduction, i.e. retained placenta, metritis, and cystic ovaries (Harrison et al., 1984; Julien et al., 1976). And supplementation of Vitamin E and Se has been known to reduce many reproductive and health disorders, for instance, retained placenta, and mastitis, in dairy cattle (Harrison et al., 1986. Smith et al., 1980, 1984; Weiss et al., 1990). However, other studies have shown that retained placenta rate (Ishak et al., 1983), reproductive performance and incidence of clinical mastitis in dairy cows are not affected by Se supplementation (Kappel et al., 1984; Hidiroglou et al., 1987; Stowe et al., 1988; Hogan et al., 1990; Sasaki et al., 1991) Although it has not been proved, it may be worth giving controlled amounts of Se and Vitamin E by injection to cows prior to calving in herds where the incidence of retained placenta is high and no other cause can be found (Webster, 1993).

Therefore, objectives of this experiment were to examine 1) the influence of the parity or season on the retained placenta, 2) the change of Se concentration in blood plasma, and 3) the influence of prepartum Se or Vitamin E administration on postpartum reproductive

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performance.

MATERIALS AND METHODS

One hundred twenty Holstein dairy cows were allotted randomly into four groups (n = 30); 1) control 2) the injection of Vitamin E (500 IU), 3) the injection of Se (40 mg), and 4) the injection of Vitamin E (500 IU) and Se (40 mg). All cows were fed the same basal diet during the dry period, and water and trace-minerals salt were available at all times. Vitamin E and Se were injected intramusculary 20 d prior to the estimated calving. At calving, feed was changed from dry to lactating deit by milk production levels (table 1).

Table 1. Nutrient composition in the diets of dry and lactating cows

Nutrients	Dry period	Milk yield (kg/day)		
		A	B	C
DM (kg)	10.9	24.9	21.1	18.4
NE1 (kg)	1.39	1.79	1.76	1.57
CP (%)	11.8	18.3	16.9	13.8
ADF (%)	13.9	17.9	17.7	17.0
NDF (%)	14.5	21.9	19.2	17.7
UDF (%)	–	35.5	30.5	16.6
UDP (%)	2.9	7.1	6.4	3.56
Ca (%)	0.49	0.85	0.72	0.53
P (%)	0.29	0.55	0.45	0.40
Mg (%)	–	0.31	–	–

A: > 45 kg/day, B: 35-44 kg/day, C: 20-34 kg/day.

Distribution of after birth was observed every two hours and the reproductive status of the cows such as pregnancy status and ovarian cysts was determined by rectal palpation and estrus detection was observed twice a day.

Blood samples were taken from control cows and Vitamin E (500 IU) and Se (40 mg) injected cows one day prior to injection and 1 hr. 1 d, 3 d, and 6 d after injection, respectively. Concentration of Se in the plasma was analyzed by the methods described by Hogan et al. (1990).

Data on the retained placenta and other reproductive performance were analyzed by t-test.

RESULTS

It shown that 38.3% of after birth was observed less than 6 h after calving, and average of incidence of retained placenta was 22.5% (27/120) (table 2). Incidence of retained placenta in Control, Vitamin E (500 IU), Se (40 mg), and Vitamin E (500 IU) and Se (40 mg) injected cows were 30.0, 27.0, 20.0, and 13.3%, respectively. The incidence of retained placenta was not reduced in cows injected Vitamin E (500 IU) or Se (40 mg) alone. However, the incidence of retained placenta was significantly ($p < 0.05$) reduced in cows injected Vitamin E (500 IU) in combination with Se (40 mg).

Table 2. Distribution of after birth and incidence of retained placenta (%) of cows

Group / Hours after calving	I	II	III	IV	Total
< 6 h	26.7 (8/30)	36.7 (11/30)	46.7 (14/30)	43.3 (13/30)	38.3 (46/120)
7-11	30.0 (9/30)	30.0 (9/30)	26.7 (8/30)	33.3 (10/30)	30.0 (36/120)
12-18	13.3 (4/30)	6.7 (2/30)	6.7 (2/30)	10.0 (3/30)	9.1 (11/120)
> 24 h	30.0^{b} (9/30)	26.7^{ab} (8/30)	20.0^{ab} (6/30)	13.3^{a} (4/30)	22.5 (27/120)

^{a,b}: Means with different superscripts within the same row differ ($p < 0.05$).
Group I, II, III, IV represent control, the injection of Vit. E, the injection of Se, and the injection of Se and Vit. E, respectively.

Incidences of retained placenta at 1st, 2nd, 3rd and 4th parity were 16.7, 17.6, 34.6 and 29.4%, respectively (table 3). They were not significantly different, but older cows exhibited higher ($p < 0.10$) incidence of retained placenta than younger cows.

Table 3. Incidence of retained placenta by parity

Parity \ Group	I	II	III	IV	Total
1	31.6 (6/19)	18.8 (3/16)	– (0/12)	7.7 (1/13)	16.7^{NS} (10/60)
2	50.0 (1/2)	25.0 (1/4)	– (0/3)	12.6 (1/8)	17.6 (3/17)
3	33.3 (1/3)	28.6 (2/7)	50.0 (4/8)	25.0 (2/8)	34.6 (9/26)
4	16.7 (1/6)	66.7 (2/3)	28.6 (2/7)	– (0/1)	29.4 (5/17)

NS: not significantly ($p > 0.05$) different.
Group I, II, III, IV represent control, the injection of Vit. E, the injection of Se, and the injection of Se and Vit. E, respectively.

Seasonal variation of retained placenta was also observed. Incidences of retained placenta in Jan. & Feb., Mar. & Apr., May & Jun., Jul. & Aug., and Sep. & Nov. were 11.1, 21.9, 22.2, 32.2 and 8.3%, respectively (table 4). During July & August, it was significantly ($p < 0.01$) higher than figures of retained placenta Sep. & Nov.

Table 4. Incidence of retained placenta by season

Month	1-2	3-4	5-6	7-8	9-11
Incidence of retained placenta	11.1^{ab} (1/9)	21.9^{ab} (9/41)	22.2^{ab} (6/27)	32.2^{b} (10/31)	8.3^{a} (1/12)

^{a,b}: Means with different superscripts within the same row differ ($p < 0.01$).

Concentrations of Se in plasma of cows injected Vitamin E (500 IU) in combination with Se (40 mg) were not increased ($p > 0.05$) compared to control. Table 5 Se concentrations in plasma of cows injected Vitamin E (500 IU) and Se (40 mg) mostly were unchanged between 1 d prior to and 1 hr, 1 d, 3 d, and 6 d after treatment compared to control cows.

Table 5. Comparison of Se concentration in plasma of cows injected Vitamin E and Se 20 d prior to the estimated calving.

Conc. (μg/ml)	Days after injection				
	−1	0[a]	1	3	6
Control	0.06	0.06	0.07	0.10	0.06
Vit. E (500 IU) and Se (40 mg)	0.07	0.06	0.07	0.12	0.06

[a]: 1 hr after treatment.

Reproductive performance data are summarized in table 6. No effect of prepartum Se or Vitamin E treatment alone was observed for the number of services per conception, conception rate, and estrus rate ($p > 0.05$). But significant effects of Vitamin E administration in combination with Se has been observed for the incidence of retained placenta and interval between calving to first services ($p < 0.05$). Also, there was a tendency for the cows receiving Se (40 mg) to have the lower number of services per conception (1.2) and for the cows receiving Vitamin E (500 IU) and Se (40 mg) to have the higher conception (83.3%) and estrus rate (82.6%), respectively.

Table 6. Effects of Vitamin E, Se or both on the reproductive performance of cows

Reprod. performance \ Group	I	II	III	IV
Retained placenta (>24 h), % (No.)	30.0^{b} (9)	27.0^{ab} (8)	20.0^{ab} (6)	13.3^{a} (4)
Services per concention	1.7^{NS}	1.6	1.2	1.4
Conception rate (%)	70.6^{NS}	71.4	80.0	83.3
Estrus rate (%)	76.0^{NS}	78.6	81.4	82.6
Calving to first service (day)	102.7^{b}	80.7^{ab}	78.3^{ab}	59.5^{a}

^{a,b}: Means with different superscripts within the same row differ ($p < 0.05$).
NS: not significantly ($p > 0.05$) different.
Group I, II, III, IV represent control, the injection of Vit. E, the injection of Se, and the injection of Se and Vit. E, respectively.

DISCUSSION

It was reported that Se or Vitamin E supplementation had no effect on milk production or feed intake (Weiss et al., 1990[b]). Also cows fed diet containing approximately 0.3 ppm of Se and 110 IU/kg of Vitamin E during the entire dry period plus 50 mg of Se and 300 IU of Vitamin E prior to 21 d the estimated calving maintained adequate activities of glutathione peroxidase in whole blood and concentration of Se in plasma (Hidiroglou et al., 1987).

The Vitamin E supplementation rate of 500 IU/cow per day, with or without supplemental Se, which was appropriate to the requirement of mature dairy cows and the same rate of Vitamin E supplementation reduced the incidence of retained placenta (Harrison et al., 1984). And 1,000 IU of supplemental Vitamin E per cow a day during the dry period and only 400 to 600 IU per day during lactation were recommended for the reduction of the clinical mastitis (Smith, 1995).

Inadequate dietary antioxidants may increase oxidative stress, production of lipid peroxides, and incidence of retained placenta in dairy cows. It was also reported that cows with retained placenta ≥ 12 h had lower fast-acting antioxidants in plasma and glutathione peroxidase in red blood cells up to 2 weeks before calving than animal that shed fetal membranes < 12 h (Brzezinska Slebodzinska et al., 1994).

In the experiment, the older cows generally exhibited

a greater incidence of retained placenta, and this result agreed with those reported by Segerson et al. (1981) on the incidence of retained placenta. Effects of season on the incidence of retained placenta was also observed. Especially in July and August a significantly ($p < 0.01$) higher incidence of retained placenta was shown than in September and November. These differences probably could be appreciated with hot and humid summer in Korea.

Se plus Vitamin E administration to prepartum cows did reduce the incidence of retained placenta and calving to first service, but did not improve the estrus rate, a number of services per conception, and conception rate of the dairy cows. Incidence of retained placenta can be reduced by a combination of Se and Vitamin E injection to cows marginally deficient in Se in prepartum period but not in cows either adequate or very deficient in Se (Segerson et al., 1981). A combination of Se injections and daily oral Vitamin E supplementation may be effective for the decrease of incidence of metritis and cystic ovaries (Harrison et al., 1984). Also, a positive relationship between Se level in serum and services per conception and between Se level in serum and days open were reported (Larson et al., 1980). In this experiment, however, there was no relation between Se level in the serum and the incidence of retained placenta, which was also reported many researchers (Hidiroglou et al., 1987; Stowe et al., 1988; Ishak et al., 1983).

Other relation between Se, Vitamin E and Se plus Vitamin E have been observed. The mechanism by which Se affects uterine involution is not known; however, it was reported that Se-Vitamin E treatment increased uterine contraction in ewes (Segerson et al., 1980) and days to involution of uterine were significantly reduced in cows affected by metritis and Se treated when compared with cows with metritis (Harrison et al., 1986). And there may be some indications that Se may be involved in physiological functions of the genitial tract of the female ruminant (Hidiroglou et al., 1987).

We measured concentration of Se in blood plasma, but there was no significant difference in the Se profiles of cows with or without Se plus Vitamin E injection. Se concentrations in plasma of control cows and Vitamin E (500 IU) and Se (40 mg) injected cows were in the range of 0.06-0.12, which were usually considered adequate or border line (Segerson et al., 1981). Therefore, it is considered that administration of Vitamin E (500 IU) and Se (40 mg) exerts the synergistic effects on the incidence of retained placenta and other reproductive performance.

Nevertheless, it should be remembered that these elements (Vitamin E and Se) are also extremely toxic when it is excess and the safe margin between deficiency (less than 0.1 mg/kg DM) and toxicity (over 5 mg/kg DM) may be extremely narrow.

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