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原　著

分娩後乳牛の繁殖性に及ぼすアルファルファサイレージの影響

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Effects of alfalfa silage on the fertility of postpartum dairy cows

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Summary

In Hokkaido, feeding of alfalfa silage is beginning to get high milk production in dairy cows. The objective of this study was to clarify the effects of alfalfa silage on the fertility in early lactation of postpartum dairy cows. Twenty-eight multiparous Holstein cows were assigned an alfalfa silage diet (Alfalfa Diet Group; n=14) or orchard grass silage diet (Grass Diet Group; n=14) from 3 weeks prepartum to 10 weeks postpartum. The content of crude protein of alfalfa silage was 14.7%. Roughage and concentrates were given as total mixed rations in ratio of 70:30 during prepartum and 50:50 during postpartum, respectively. Milk fever occurred in 2 cows in Alfalfa Diet Group just after parturition and one of them was excluded from the experiments because it did not recover after therapy. The interval from parturition to first ovulation was 35.1±18.4 days in Grass Diet Group and 37.2±18.7 days in Alfalfa Diet Group, respectively. The interval to first estrus and the interval to first AI were 63.7±21.7 days, 75.3±15.8 days in Grass Diet Group and 57.8±16.8 days, 72.5±12.1 days in Alfalfa Diet Group, respectively. The conception rate at first AI was 63.4% in Grass Diet Group and 30.8% in Alfalfa Diet Group, respectively. One cow of each group did not conceive for a long time and they were excluded from the experiments. The interval from the parturition to conception was 93.8±33.0 days in Grass Diet Group and 101.8±30.2 days in Alfalfa Diet Group, respectively. The number of times of insemination to conception was 1.4±0.4 in Grass Diet Group and 2.0±0.9 in Alfalfa Diet Group, respectively. There were not significant differences in the interval from parturition to first ovulation, the interval to first estrus, the interval to first AI, the conception rate at first AI, the interval from parturition to conception and the number of times of insemination to conception in both groups, respectively. It is concluded that alfalfa silage does not badly affect on the recovery of ovarian activities, but it is not clear whether alfalfa silage affects on the rate of conception in postpartum dairy cows. Furthermore, it is recommended that alfalfa silage should not be given before parturition to avoid milk fever.

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要　　約

分娩後の乳牛の繁殖性に及ぼすアルファルファサイレージの影響を明らかにするために，28頭の経産のホルスタイン雌牛を14頭ずつ２群に分け，分娩前３週から分娩後10週まで，アルファルファサイレージ（アルファルファサイレージ区）あるいはオーチャードグラスサイレージ（グラスサイレージ区）をそれぞれ給与した．アルファルファサイレージ区において，２頭が分娩直後に乳熱を発症した．分娩から初回排卵までの日数，初発情までの日数，初回人工授精までの日数，初回人工授精時の受胎率および分娩から受胎までの日数は，それぞれ，グラスサイレージ区で35.1±18.4日，63.7±21.7日，75.3±15.8日，64.3%および93.8±33.0日で，アルファルファサイレージ区で37.2±18.7日，57.8±16.8日，72.5±12.1日，30.8% および101.8±30.2日であった．これらの分娩から初回排卵までの日数，初発情までの日数，初回人工授精までの日数，初回人工授精時の受胎率は，いずれも両区において有意差は認められなかった．以上の結果から，アルファルファサイレージは，分娩後の卵巣機能回復には悪影響を及ぼさないことが示されたが，受胎への影響は明らかにできなかった．また，乳熱の発生を避けるために分娩前には給与しないほうが良いと結論づけられる．

Introduction

In Japan it is the urgent issues to increase the rate of self-supplying of feed. And about 49% of dairy cows in Japan are reared in Hokkaido, northernmost area in Japan. Recently new breed of alfalfa that is suitable in Hokkaido region was developed (YAMAGUCHI *et al.*, 1995 a, b). Feeding of alfalfa silage is now beginning to get high milk production in dairy cows in Hokkaido region. The nutrient requirement of dairy cows increases with milk yield immediately after parturition, but cows in early lactation can not consume sufficient dry matter (DM) to support maximal milk yield (NRC, 2001). As a result, the cows are in negative energy balance. The interval from parturition to the beginning of recovery of energy balance is positively correlated with the interval from parturition to first ovulation (BUTLER et al., 1981; ZUREK et al., 1995). Alfalfa is suitable roughage for high producing cows because of the high protein content and high passage rate through the gut. Dry matter intake (DMI) may be increased by the use of alfalfa silage and the energy balance may be improved as well. As a result, it could be expected that the first ovulation after parturition can be accelerated. On the other hand, it is reported that the feed with high protein content cause the low fertility and that the follicular cyst occurs when the cows are given the feed with high protein for long time (ETO, 1996). The objective of this study was to clarify the effects of alfalfa silage on the fertility of postpartum dairy cows.

Materials and Methods

Twenty-eight multiparous Holstein cows were used and their parity ranged from 2 to 7. They were assigned an alfalfa silage diet (Alfalfa Diet Group; n=14) or orchard grass silage diet (Grass Diet Group; n=14) from 3 weeks prepartum to 10 weeks postpartum. Each diet in both groups was formulated to be equal in TDN and CP, respectively. Roughage and concentrates were given as total mixed rations in ratio of 70:30 during prepartum and 50:50 during postpartum, respectively. The diet were fed to meet 120% total digestible nutrients requirement of pregnant cows during prepartum, and the diet were fed ad libitum after parturition. Proportion of alfalfa silage in the alfalfa diet during prepartum was 35%. Alfalfa silage or grass silage were used for forage from one to ten weeks after parturition. The cows of both groups were fed orchard grass silage diet; namely conventional feed in Hokkaido National Agricultural Research Center, after ten weeks to dry. Grass hay was available ad libitum. They were fed according to the Japanese Feeding Standards (Agriculture, Forestry and Fisheries Research Council Secretariat, 1999) based on milk yield and body weight measured at every two weeks. The nutrient composition of the feed used is shown in Table 1. The content of crude protein of alfalfa silage used in the present study was 14.7 % and this content was less than in ordinary alfalfa silage. And the ingredients and the nutrient composition of each group are shown in Table 2.

Table 1　Nutrient composition of silage, concentrate, fish meal and soybean meal

	DM	OM	CP	ADF	NDF	K
Nutrient composition (% of DM)						
Alfalfa silage	54.5	90.5	14.8	46.7	54.7	3.3
Grass silage	24.4	91.9	11.4	41.5	68.5	1.9
Concentrate	87.1	95.4	18.9	9.3	16.7	0.8
Fish meal	91.2	86.5	71.6	2.0	5.7	0.9
Soybean meal	86.8	93.2	50.3	9.3	11.2	2.3

All values expressed on a DM basis except for DM. DM: Dry matter, OM: Organic matter, CP: Crude protein, ADF: Acid detergent fiber, NDF: Neutral detergent fiber, K: Potassium

Table 2 Ingredients and nutrient composition of the feed

	Prepartum (3 weeks)		Postpartum (1-10 weeks)	
	Alfalfa diet	Grass diet	Alfalfa diet	Grass diet
Ingredient (% of DM)				
Alfalfa silage	35	-	50	-
Grass silage	35	70	-	50
Concentrate	26	22	46	41
Fish meal	4	4	4	4
Soybean meal	-	4	-	5
Nutrient				
DM	53.9	43.4	71.0	55.9
OM	92.1	92.5	92.6	93.2
CP	16.9	17.0	19.0	18.8
DIP	9.1	9.3	11.0	9.7
ADF	33.4	31.5	27.7	25.1
NDF	47.7	52.3	35.3	41.9
K	2.1	1.6	2.1	1.4
TDN*	67.3	69.9	72.4	72.5

All values expressed on DM basis except for DM.
DM: Dry matter, OM: Organic matter, CP: Crude protein,
DIP: Degradable Intake Protein, ADF: Acid detergent fiber,
NDF: Neutral detergent fiber, K: Potassium, TDN: Total digestible nutrient
TDN is estimated by the standard tables of feed composition in Japan
(Agriculture, Forestry and Fisheries Research Council Secretariat, 1995)

The experiments were conducted from year 1998 to 2001. The cows were managed in individual tie stall from 3 weeks prepartum to 10 weeks postpartum. During the parturition period, they were managed in the parturition pen individually from 7 days before the expected day of parturition to 7 days after parturition. From 11 weeks postpartum they were managed in a free-stall paddock equipped with the computer-controlled feeding machine, which make possible to feed and measure the feed intake of individual cattle. They were fed equal amount at 8:30 and 18:00h. They were milked at 8:45 and 19:00h. and milk weights were recorded.

The milk samples were collected every two days until 70 ~90 days postpartum and the concentration of progesterone were measured to examine the ovulation. Progesterone concentrations in milk were determined by ELISA. The ovulation and the pregnancy diagnosis were also checked with rectum palpation and ultrasonography. Rectum palpation was conducted several times when it was necessary and ultrasonography examination was conducted every two days. Pregnancy diagnosis was conducted with ultrasonography 35~50 days after artificial insemination. Artificial insemination was conducted at third ovulation or at the first estrus after a voluntary waiting period of 60 days after parturition. Cows was supposed to ovulate 5 days before the day when progesterone concentration elevated more than 5 ng/ml. Cows were observed four times daily for 20~30 minutes in an exercise field to detect estrus. Cows which showed the standing was considered at estrus. In two cows which showed the difficulty to stand up after parturition, the blood samples were collected several times and analyzed plasma minerals.

Two sample t-tests were performed to analyze differences in mean values on the reproductive performances between the two treatment groups. Chi-squared test was performed to analyze differences of the conception rate at first AI in both groups.

Results and Discussions

Milk fever occurred in two cows in Alfalfa Diet Group just after parturition. Plasma calcium and inorganic phosphorous were decreased in the both cows after parturition. One cow recovered by the treatment of calcium injection; however another cow did not recover and was excluded from the experiments. The occurrence of milk fever was described in detail in the previous report (NAKAMURA *et al.*, 2002). It is recommended that alfalfa silage should not be given to avoid the milk fever.

The reproductive performances after parturition and milk quantity of both groups are summarized in Table 3. There was not a significant difference in the milk quantity in both groups. The interval from parturition to first ovulation ranged from 12 to 80 days in Grass Diet Group and from 19 to 79 days in Alfalfa Diet Group, respectively. The mean interval was 35.1±18.4 days in Grass Diet Group and 37.2±18.7 days in Alfalfa Diet Group, respectively. There was not a significant difference in both groups in the mean interval from parturition to first ovulation. The interval in the present study was the same result of BUTLER *et al.* (1981). But it was longer than that

Table 3 Reproductive performances after parturition

	Alfalfa diet	Grass diet
Parity	3.6±1.6(13)	3.4±1.6(14)
305-day milk quantity (kg)	10946±985(13)	10647±1127(14)
Interval to first ovulation (days)	37.2±18.7(13)	35.1±18.4(14)
Interval to first estrus (days)	57.8±16.8(13)	63.7±21.7(14)
Interval to first AI (days)	72.5±12.1(13)	75.3±15.8(14)
Conception rate at first AI (%)	30.8%(13)	64.3%(14)
Interval to conception (days)	101.8±30.2(12)	93.8±33.0(13)
Numbers of AI	2.0±0.9(12)	1.4±0.7(13)

of YOSHIMEKI et al. (1986) and that of our previous study (KADOKAWA and YAMADA, 1999). The causes of these differences are not clear. It is possible that high milk quantity in the present study affect the resumption of ovarian activity. The interval from parturition to first estrus ranged from 31 to 97 days in Grass Diet Group and from 28 to 87 days in Alfalfa Diet Group, respectively. The mean interval was 75.3±15.8 days in Grass Diet Group and 72.5±12.1 days in Alfalfa Diet Group, respectively. There was not a significant difference in both groups. There were not significant differences in the interval to first ovulation, the interval to first estrus in both groups. Considering from these results, it is suggested that the alfalfa silage does not badly affect on the recovery of ovarian activities.

The interval from parturition to first artificial insemination (AI) ranged from 49 to 105 days in Grass Diet Group and from 61 to 108 days in Alfalfa Diet Group, respectively. The mean interval was 75.3±15.8 days in Grass Diet Group and 72.5±12.1 days in Alfalfa Diet Group, respectively. There was not a significant difference in both groups. The result of present study is similar to those of SHRESTHA *et al.* (2004). The numbers of cows conceived at first, second and third inseminations are shown in Figure 1. The conception rate at first AI was 64.3 % in Grass Diet Group and 30.8 % in Alfalfa Diet Group. While the conception rate in Alfalfa Diet Group was less than that of Grass Diet Group, there was not a significant difference. ELROD and BUTLER (1993) reported that excess degradable protein decreased the uterine pH and decreased the conception rate at first AI in heifers. In the present study, the conception rate at first AI was less in Alfalfa Diet Group than in Grass Diet Group, but there was not a significant difference. In our study, the content of crude protein of alfalfa silage was 14.7 % and this value was lower than in the ordinary alfalfa silage. Furthermore, the content of CP was formulated to be equal in both groups and the content of DIP was not different so much in both groups. The high content of CP in feed may affect on the rate of conception. Therefore, to clarify the effects of alfalfa silage on the conception rate, further research is necessary.

One cow in each group did not concept for a long time and they were excluded from the experiments. They were not treated. Furthermore, follicular cyst did not occur in any cow in both groups. ETO (1996) reported that follicular cyst occurred at significantly higher rate in the cows that was given the forage with higher CP content for

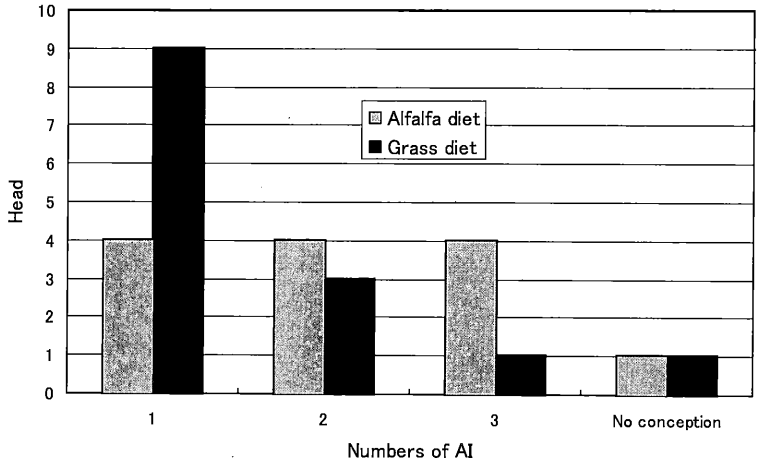

Fig. 1 Numbers of cows conceived at first, second or third artificial insemination

a long period. In our study, the CP content was equal in both groups and alfalfa diet was given ten weeks after parturition, namely in early lactation. Therefore, it may be the reason that follicular cyst did not occur. The interval from parturition to conception ranged from 50 to 168 days in Grass Diet Group and from 64 to 138 days in Alfalfa Diet Group, respectively. The mean interval was 93.8± 33.0 days in Grass Diet Group and 101.8±30.2 days in Alfalfa Diet Group, respectively. There was not a significant difference in both groups in the mean interval from parturition to conception. The mean numbers of times of insemination to conception was 1.4±0.4 in Grass Diet Group and 2.0±0.9 in Alfalfa Diet Group. There was not a significant difference in both groups in the mean numbers of times of insemination to conception.

As mentioned above, there were not significant differences in the interval from parturition to first ovulation, the interval from the parturition to the first estrus, the interval from the parturition to first AI, conception rate at first AI, the interval from parturition to conception and the number of times of insemination to conception in both groups, respectively. It is concluded that alfalfa silage does not badly affect on the recovery of ovarian activities. But it was not clear whether alfalfa silage badly affect on the rate of conception or not. Furthermore, it is recommended that alfalfa silage should not be given before parturition to avoid milk fever.

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