

FACTORS AFFECTING RETENTION OF PLACENTA AND ITS INFLUENCE ON POSTPARTUM REPRODUCTIVE PERFORMANCE AND MILK PRODUCTION IN FRIESIAN COWS

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ABSTRACT

A total of 1243 records of 585 dairy Friesian cows collected through 8 years (1997-2004) were used to study factors affecting retention of placenta and its influence on reproductive performance and milk production. The obtained results showed that the percentage of retained placenta averaged 24.90%, the highest percentage was in the year 1998 (46.3%) and it increased significantly ($P < 0.05$) with increasing body weight of cows, parity and body weight of calves born. The percentage of retained placenta was significantly higher ($P < 0.05$) in spring and summer seasons (28.0 and 27.70%, respectively) and also with twinning in comparison to single calving (37.90 vs. 24.20%, respectively). There were no significant differences in the percentage of retained placenta between winter and summer feeding as well as between male or female birthings.

Retained placenta resulted in an increase ($P < 0.05$) in the period from parturition to first estrus (25.90 vs. 20.50 days) and first service (56.90 vs. 47.20 days), service period (57.70 vs. 46.10 days), open days (106.90 vs. 92.70 days), number of services per conception (3.50 vs. 2.60) and calving interval (395.20 vs. 372.90 days). Moreover, it reduced the conception rate (66.70 vs. 74.10%) and average daily milk yield (13 vs. 14 kg) compared to normally calved cows.

Key words: Friesian cows, retention of placenta, reproductive performance, milk production

INTRODUCTION

Retention of fetal membranes from 6 to 24 hours post parturition is defined as retained placenta (Swiefy, 2003). Premature induction of parturition with glucocorticoids and/or prostaglandins increases the cases of placenta retention (Carroll, 1974 and Echternkamp et al., 1987). Moreover, it may be caused as a result of low plasma estrogen concentration (Chew et al., 1978). Deficiency in vitamin E and selenium also has an impact on retention of placenta (Ishak et al., 1983). The causes of the lower incidence in the fall season compared to hot season are due to the environmental and nutritional differences, e.g. temperature and concentrate to forage ration in the diet (Echternkamp and Gregory, 1999). Such seasonal differences in nutrition may influence placental development; placental growth (i.e., mass and net cellular

proliferation) in the first half of gestation period (Ehrhardt and Ball, 1995). Calf birth weight and placental weight have been reported to be correlated positively in cattle (Echternkamp, 1993).

Placental retention is usually accompanied by delayed involution of the uterus (Peters and Ball, 1995), and adversely affects reproductive performance (Swiefy, 2003). Cows with reproductive disorders had longer intervals from calving to first service and to conception and required more services per conception and lower pregnancy rate and conception to first service (Shiferaw et al., 2005). The intervals from calving to first service and conception were prolonged in the group with retained placentas compared to the control group (Han and Kim, 2005). Milk yield was suppressed for about 4 weeks after calving with retained placenta (Lucey et al., 1986).

The objective of this study was to investigate

factors affecting the incidence of retained placenta and its effects on postpartum reproductive performance and milk production in Friesian cows.

MATERIAL AND METHODS

Experimental data

A total number of 1243 records (934 for normally calved and 309 for parturition accompanied by retained placenta) of 585 dairy Friesian cows, reared in Sakha Animal Production Research Station (Animal Production Research Institute, Agricultural Research Center, Ministry of Agriculture, Egypt) were used in the present study. Cows had body weight between 350 and 650 kg, with age of 3-13 years and 1-8 parities. Collected records cover the period from 1997 to 2004 (8 years).

Collected data included the periods from parturition to first estrus, postpartum service interval, conception rate, open days, calving interval, number of services per conception and conception rate (number of conceived cows/total number of inseminated cows x 100) as reproductive traits in addition to average daily milk yield as productive trait.

Feeding and management

Cows were housed in semi-open yards and fed basically during summer on concentrate feed mixture, berseem hay, rice straw; while in winter berseem hay was replaced by fresh ones. Cows were fed in groups and the nutritional requirements were offered based on their body weight, milk yield and reproductive status (Animal Production Research Institute Recommendation, 1997). Water was made available for animals all the day round. Cows were artificially inseminated within 14 hours after onset of estrus until conceived for 150 days postpartum.

Statistical analysis

The obtained data were statistically analyzed using general linear models procedure adapted by SPSS (2004) for user's guide. Duncan test within program SPSS was done to determine the degree of significance between means. The data on factors affecting retention of placenta were analyzed using the following model:

$$Y_{ijklmno} = u + A_i + B_j + C_k + D_l + F_m + G_h + P_n + R_o + (ABCD FPR)_{ijklmnq} + E_{ijklmno}$$

$Y_{ijklmno}$ = the intended recorded performance value for each individual cow.

where,

U = the overall mean;

A_i = the effect of calving year;

B_j = the effect of cow's weight;

C_k = the effect of parity;

D_l = the effect of weight of calves born;

F_m = the effect of calving season;

G_h = the effect of feeding system;

P_n = the effect of calf sex;

R_o = the effect of type of birth;

(ABCD FPR) $ijklmnq$ = the interactions among the factors;

$E_{ijklmno}$ = a random term associated with each observation assumed to be independent and randomly distributed.

The data of reproductive performance of normal cows and those with retained placenta were analyzed using the following model:

$$Y_{ij} = u + T_i + E_{ij};$$

where:

Y_{ij} = the observation ij ; u = overall mean;

T_i = treatments (1 for cows normal calved and 2 for cows with retained placenta);

E_{ij} = experimental error associated with i and j observations assumed to be randomly distributed.

RESULTS AND DISCUSSION

Some factors affecting on the incidence of retained placenta

1. Year of calving

The effect of year of calving on the percentage of retained placenta is shown in Table 1. There were significant differences ($P < 0.05$) in the percentage of retained placenta among the different calving years. The highest percentage of retained placenta was detected in the year 1998 (46.30%), while the lowest percentage was in the year 2004 (14.20%). The incidence of retained placenta seems to be extremely variable from year to year in the same farm (El-Naggar, 1977).

Table 1: Effect of year and season of calving and feeding system on the percentage incidence of retained placenta in Friesian cows

Item	No. of records	Retained placenta	
		N	Incidence %
Calving year			
1997	148	46	31.10 ^c
1998	95	44	46.30 ^a
1999	92	36	39.10 ^{ab}
2000	203	35	17.20 ^d
2001	169	29	17.20 ^d
2002	227	51	22.50 ^{cd}
2003	175	49	28.00 ^c
2004	134	19	14.20 ^d
Calving season			
Winter	425	106	24.90 ^{ab}
Spring	311	87	28.00 ^a
Summer	249	69	27.70 ^a
Autumn	258	47	18.20 ^b
Feeding system			
Green feeding	736	193	26.20
Dry feeding	507	116	22.90
Overall mean	1243	309	24.90

^{a, b, c, d} Means in the same column with different superscripts differ significantly ($P < 0.05$)

2. Calving season

The highest percentages ($P < 0.05$) of incidence of retained placenta were detected in spring and summer seasons (28.0 and 27.70%, respectively), while the lowest percentage ($P < 0.05$) was noticed in autumn season (18.20%), as shown in Table 1. After calving, the fetal membranes were expelled from the uterus by continued contraction waves. Beside reducing the size of the uterus and aiding in forcing the placenta to birth canal, probably this markedly reduced the amount of blood circulating in the endometrium (Roberts, 1971). Similar results were obtained by Atalah (1993), Deyab (2000) and Gabr et al. (2005).

3. Feeding system

Results in Table 1 revealed that no significant differences were found in the percentage incidence of retained placenta during green (winter) and dry (summer) feeding (26.20% vs. 22.90%), respectively. These results are in accordance with those obtained by Deyab (2000) and Gabr et al. (2005): they found non-significant differences between feeding system in the percentage of retained placenta.

4. Live body weight of cows

The effect of live body weight of Friesian cows on the percentage of retained placenta is shown in Table 2. The percentage of retained placenta increased significantly ($P < 0.05$) with increasing live body weight of cows, which varied from 20.70% at body weight of 350-400 kg to 31.20% at body weight of 600-650 kg with an average of 24.90%. These results may be attributed to the increment in fat adipose tissues as increasing weight may result in trapping the steroid sex hormones, which are known to be fat-soluble. These results are in accordance with those obtained by Deyab (2000) and Gabr et al. (2005).

Table 2: Effect of live body weight and parity of cows on the percentage incidence of retained placenta in Friesian cows

Item	No. of records	Retained placenta	
		N	Incidence %
Cow's weight			
350-400 kg	145	30	20.70 ^c
400-450 kg	254	57	22.40 ^{bc}
450-500 kg	424	105	24.80 ^{bc}
500-550 kg	196	52	26.50 ^{abc}
550-600 kg	163	46	28.20 ^{ab}
600-650 kg	61	19	31.20 ^a
No. of parity			
1	402	57	14.20 ^c
2	295	54	18.30 ^{dc}
3	187	50	26.70 ^d
4	115	44	38.30 ^c
5	97	39	40.20 ^{bc}
6	89	37	41.60 ^{bc}
7	36	16	44.40 ^b
8	22	12	54.60 ^a
Overall mean	1243	309	24.90

^{a, b, c} Means in the same column with different superscripts differ significantly ($P < 0.05$)

5. Number of parity

Results in Table 2 revealed that the effect of parity on the percentage of incidence of retained placenta in Friesian cows increased significantly ($P < 0.05$) from 14.20% for 1st parity to 54.60% for 8th parity. It could be explained on the basis of the uterine muscles. These results are in accordance with those obtained by Karen (1996), Deyab (2000) and Gabr et al. (2005). They reported that the incidence of retained placenta increased in old cows with parity over fourth.

6. Birth weight of calves

The percentage of incidence of retained placenta increased significantly ($P < 0.05$) with increasing weight of born calves (Table 3). The increases in percentage of incidence of retained placenta with the increase in fetal birth weight may be due to an expected pressure of the fetus on the placenta and fetal membrane, so that the attachment between the cotyledons and the fetal membrane become stronger. Many investigators reported increase in the incidence of retained placenta with increasing weight of born calves (Joosten et al., 1988; Deyab, 2000 and Gabr et al., 2005).

Table 3: Effect of weight at birth of calves on the percentage incidence of retained placenta in Friesian cows.

Item	No. of records	Retained placenta	
		N	Incidence %
Weight at birth			
>20 kg	44	9	20.50 ^c
21-25 kg	157	35	22.30 ^{bc}
26-30 kg	312	72	23.10 ^{bc}
31-35 kg	363	91	25.10 ^{bc}
36-40 kg	308	85	27.60 ^{ab}
<40 kg	59	17	28.80 ^a
Sex of calves			
Male	623	165	26.50
Female	620	144	23.20
Type of birth			
Single	1185	287	24.20 ^b
Twining	58	22	37.90 ^a
Overall mean	1243	309	24.90

^{a, b, c} Means in the same column with different superscripts differ significantly ($P < 0.05$)

7. Sex of calves

The percentage of incidence of retained placenta in Friesian cows was insignificantly higher with born male rather than female calves (26.50 vs. 23.20, respectively; Table 3). The slight increase in percentage of retained placenta observed with male born calves may suggest that the fetal androgenic hormone from the fetal testes might have partially affected process of placenta retention. These results are in agreement with those obtained by

Deyab (2000) and Gabr et al. (2005). They found that the percentage of retained placenta tended to increase with born male than female.

8. Type of birth

Results in Table 3 indicated that the percentage of incidence of retained placenta in Friesian cows was significantly higher ($P < 0.05$) with twinning birth than single (37.90 vs. 24.20%, respectively). These results agree with those obtained by Deyab (2000) who found that twinning birth led to the high percentage of retained placenta.

Effect of retained placenta on reproductive performance

1. First estrus

Retention of placenta increased ($P < 0.05$) the interval from parturition to the first postpartum estrus of Friesian cows by about 5 days (Table 4). Data also indicated that about 72 % of the normally calved cases displayed their first heat within 25 days. The corresponding percentage for those delivered with retained placenta was 63%. These results are in agreement with those obtained by Shiferaw et al. (2005) indicating that cows with retained placenta had longer intervals from calving to first estrus.

2. Postpartum service interval

The period from parturition to the first service was longer ($P < 0.05$) in cows exhibiting retained placenta compared to normal ones by about 10 days. These results can be explained by the fact that the higher percentage of normal cows (46%) received their first service in an interval of ≤ 42 days, while 37.1% of cows exhibiting retained placenta were served within the same period (Table 5). These results are in agreement with those obtained by Shiferaw et al. (2005) indicating that cows with retained placenta had longer intervals from calving to first service. Han and Kim (2005) reported that the mean interval from calving to first service was prolonged in the group of Holstein cows with retained placenta compared to the control group.

3. Service period

The service period was longer ($P < 0.05$) in cows exhibiting retained placenta compared to normally calved ones by about 11 days (Table 6). These results attributed to the fact that 77% of normally calved cows had service period of < 61 days. The corresponding percentage of cows exhibiting retained placenta was about 57%. These results are in accordance with those obtained by Han and Kim (2005) in Holstein cows.

Table 4: Post-partum estrous interval (Mean \pm S.E) of Friesian cows as affected by retention of placenta

Interval (days)	Cows normally calved			Cows exhibiting retained placenta		
	N	%	Mean \pm SE	N	%	Mean \pm SE
≥ 15	154	16.50	10.40 \pm 0.1 ^b	46	14.90	14.60 \pm 0.1 ^a
16-20	275	29.40	16.50 \pm 0.1 ^b	65	21.00	19.80 \pm 0.2 ^a
21-25	266	28.50	23.90 \pm 0.2 ^b	84	27.20	27.70 \pm 0.2 ^a
≤ 26	239	25.60	27.90 \pm 0.3 ^b	114	36.90	32.70 \pm 0.5 ^a
Overall mean	934	100.00	20.50 \pm 0.4 ^b	309	100.00	25.90 \pm 0.6 ^a

^{a, b} Means within the same row with different superscripts differ significantly ($P < 0.05$)

Table 5: Post-partum service interval (Mean \pm S.E) of Friesian cows as affected by retention of placenta

Interval (days)	Cows normally calved			Cows exhibiting retained placenta		
	N	%	Mean \pm SE	N	%	Mean \pm SE
≥ 21	152	16.30	15.50 \pm 0.1 ^b	48	15.50	19.60 \pm 0.2 ^a
22-42	277	29.70	37.00 \pm 0.2 ^b	67	21.60	40.70 \pm 0.4 ^a
43-63	263	28.10	51.00 \pm 0.4 ^b	81	26.20	56.40 \pm 0.6 ^a
≤ 64	242	25.90	74.60 \pm 1.2 ^b	113	36.60	82.70 \pm 1.6 ^a
Overall mean	934	100.00	47.20 \pm 0.6 ^b	309	100.00	56.90 \pm 1.2 ^a

^{a, b} Means within the same row with different superscripts differ significantly ($P < 0.05$)

Table 6: Service period (Mean \pm S.E) of Friesian cows as affected by retention of placenta

Interval (days)	Cows normally calved			Cows exhibiting retained placenta		
	N	%	Mean \pm SE	N	%	Mean \pm SE
≥ 20	169	18.10	13.6 \pm 0.2 ^b	58	18.80	17.80 \pm 0.3 ^a
21-40	283	30.30	26.7 \pm 0.4 ^b	72	23.30	32.50 \pm 0.6 ^a
41-60	266	28.50	50.7 \pm 0.7 ^b	78	25.20	57.40 \pm 0.9 ^a
≤ 61	216	23.10	91.4 \pm 2.4 ^b	101	32.70	98.70 \pm 3.2 ^a
Overall mean	934	100.00	46.1 \pm 0.9 ^b	309	100.00	57.70 \pm 1.9 ^a

^{a, b} Means within the same row with different superscripts differ significantly ($P < 0.05$)

Table 7: Number of services per conception (Mean ± S.E) of Friesian cows as affected by retention of placenta

Interval (days)	Cows normally calved			Cows exhibiting retained placenta		
	N	%	Mean ± SE	N	%	Mean ± SE
≥ 60	192	20.60	1.70 ± 0.1 ^b	60	19.40	2.50 ± 0.1 ^a
61-90	297	31.80	2.40 ± 0.1 ^b	78	25.20	3.20 ± 0.1 ^a
91-120	256	27.40	3.00 ± 0.1 ^b	84	27.20	3.70 ± 0.1 ^a
≤ 121	189	20.20	3.50 ± 0.1 ^b	87	28.20	4.20 ± 0.1 ^a
Overall mean	934	100.00	2.60 ± 0.1 ^b	309	100.00	3.50 ± 0.1 ^a

^{a, b} Means in the same row with different superscripts differ significantly (P<0.05)

Table 8: Open days (Mean ± S.E) of Friesian cow as affected by retention of placenta

Period (days)	Cows normally calved			Cows exhibiting retained placenta		
	N	%	Mean ± SE	N	%	Mean ± SE
≥ 60	192	20.60	42.50 ± 0.2 ^b	60	19.40	51.10 ± 0.6 ^a
61-90	297	31.80	76.70 ± 0.6 ^b	78	25.20	86.00 ± 0.9 ^a
91-120	256	27.40	104.80 ± 1.3 ^b	84	27.20	115.40 ± 1.6 ^a
≤ 121	189	20.20	152.20 ± 2.8 ^b	87	28.20	165.40 ± 4.7 ^a
Overall mean	934	100.00	92.70 ± 1.6 ^b	309	100.00	109.60 ± 3.1 ^a

^{a, b} Means within the same row with different superscripts differ significantly (P<0.05)

4. Number of service per conception

Number of service per conception for cows exhibiting retained placenta was higher (P<0.05) as compared to normal cows (3.5 vs. 2.6; Table 7). These results might be due to the longer service period as well as the lower conception rate of cows exhibiting retained placenta, which required more services (Tables 8 and 12). Similar results were obtained by Shiferaw et al. (2005) and Han and Kim (2005), who reported that the number of services per conception was higher in cows with the incidence of retained placenta. Holt et al. (1989) found that control cows had fewer services per conception (1.6) than cows with retained placenta (2.5).

5. Open days

Open days was longer (P<0.05) in cows exhibiting retained placenta as compared to normal cows by about 17 days (Table 8). This is because about 52% of normally

calved animals had days open within the three months post-partum, while only 45% of cows exhibiting retained placenta conceived within the same period. This is in addition to 28.20% of the later group which had more than 120 days open. The same results were obtained by Shiferaw et al (2005). Holt et al (1989), who found that control cows had fewer days to conception (97) than cows with retained placenta (134).

6. Calving interval

Calving interval was longer (P<0.05) in cows exhibiting retained placenta as compared to normal cows by about 20 days (Table 9). About 57% of the normally calved animals had calving interval of >375 days, while only 44% of cows exhibiting retained placenta recorded open days of the same duration. These results are in agreement with those obtained by Swiefy (2003) and Han and Kim (2005) reporting similar trend.

Table 9: Calving interval (Mean ± S.E) of Friesian cows as affected by retention of placenta

Period (days)	Cows normally calved			Cows exhibiting retained placenta		
	N	%	Mean ± SE	N	%	Mean ± SE
≥ 345	219	23.50	333.50 ± 0.8 ^b	60	19.40	342.00 ± 1.1 ^a
346-375	310	33.20	360.00 ± 0.8 ^b	75	24.30	371.30 ± 1.7 ^a
376-405	257	27.50	384.80 ± 0.9 ^b	82	26.50	396.20 ± 1.2 ^a
≤ 406	148	15.80	437.30 ± 1.9	92	29.80	448.50 ± 2.8
Overall mean	934	100.00	372.90 ± 1.6 ^b	309	100.00	395.20 ± 3.1 ^a

^{a, b} Means within the same row with different superscripts differ significantly (P<0.05)

Table 10: Conception rates (Mean \pm S.E, %) of Friesian cows as affected by retention of placenta

Period (days)	Cows normally calved			Cows exhibiting retained placenta		
	N	%	Mean \pm SE	N	%	Mean \pm SE
≥ 60	192	20.60	15.20 \pm 1.5 ^a	60	19.40	12.90 \pm 2.5 ^b
61-90	297	31.80	23.60 \pm 1.4 ^a	78	25.20	16.80 \pm 2.4 ^b
91-120	256	27.40	20.40 \pm 1.3	84	27.20	18.10 \pm 2.2
≤ 121	189	20.20	14.90 \pm 1.24 ^b	87	28.20	18.80 \pm 2.1 ^a
Overall mean	934	100.00	74.10 \pm 1.4 ^a	309	100.00	66.70 \pm 2.7 ^b

^{a,b} Means within the same row with different superscripts differ significantly ($P < 0.05$)

Table 11: Average daily milk yield (Mean \pm S.E, kg) of Friesian cows as affected by retention of placenta

Milk yield (kg)	Cows normally calved			Cows exhibiting retained placenta		
	N	%	Mean \pm SE	N	%	Mean \pm SE
≥ 5	58	15.30	4.10 \pm 0.2 ^a	28	17.80	3.90 \pm 0.1 ^b
6-10	142	32.70	7.40 \pm 0.2 ^a	55	30.70	6.90 \pm 0.2 ^b
11-15	335	28.50	12.90 \pm 0.4 ^a	95	27.20	11.70 \pm 0.3 ^b
16-20	286	15.20	17.20 \pm 0.4 ^a	84	15.20	16.80 \pm 0.4 ^b
≤ 21	113	8.40	22.40 \pm 0.5 ^a	47	9.10	21.60 \pm 0.5 ^b
Overall mean	934	100.00	14.00 \pm 0.5 ^a	309	100.00	13.00 \pm 0.5 ^b

a, b: Means in the same row with different superscripts differ significantly ($P < 0.05$)

7. Conception rate

As shown in Table (10), retention of placenta resulted in a reduction ($P < 0.05$) of conception rate by about 7%, (74.10 vs. 66.70%, respectively). The conception rate of normally calved animals and those exhibiting retained placenta were 15.20 and 12.90% prior to 60 days, 23.60 and 16.80% for 61-90 days, 20.40 and 18.10% for 91-120 days, 14.90 and 18.80% for more than 120 days post-partum, respectively. Moreover, the highest percentage of normal cows (31.80%) were conceived during the period from 61 to 90 days after parturition, while the highest percentage of cows with retained placenta (28.20%) were conceived at more than 120 day after parturition. These results are in accordance with those obtained by Echterkamp and Gregory (1999, 2002) and Shiferaw et al. (2005) reporting similar trend of reducing conception rate of cows exhibiting retained placenta particularly compared to normally calved ones.

8. Effect of retained placenta on milk yield

Average daily milk yield for cows exhibiting retained placenta was lower ($P < 0.05$) than the normal cows. For cows exhibiting retention of placenta, average daily milk yield decreased by 1 kg as compared to normal cows for all the lactation seasons (Table 11). Retained placenta had a significant negative effect on milk yield for 5 weeks after calving, which is in agreement with results of Lucey et al. (1986), who reported that retained placenta reduced peak yield, but also had more lasting negative effect. Simerl et al. (1992) found that milk yield was depressed with retained placenta. Rajala and

Gro (1998) showed that retained placenta significantly affected milk yield. Bar and Ezra (2005) found that milk yield decreased by 172, 232 and 302 kg with retained placenta for parity 1, parity 2 and parity 3, respectively.

CONCLUSION

From these results, it could be concluded that year and season of calving, cow's weight, number of parity, sex, weight of calves born, type of birth and feeding system had pronounced effects on incidence of retained placenta and it showed adverse effects on reproductive performance and milk yield of Friesian cows.

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