



## Ovarian diseases in Holstein dairy cows, factors determining their occurrence and impact on reproduction traits and breeding costs

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### ABSTRACT

The aim of this study was to assess the factors determining ovarian disorders occurrence and quantify the influence of ovarian diseases occurrence on fertility traits and breeding costs in selected herd of dairy cows. Holstein cows (67) calved between 1 January 2012 and 30 August 2012 were monitored. Since 80 days postpartum cows with BCS higher than 2.5 and increasing BCS tendency were included into the synchronization program. Higher parity and summer calving season caused higher ovarian disease occurrence. Only slight nonsignificant relationship between cystic ovarian disease and energy balance was observed. Cows with detected cystic ovarian disease (COD) had significantly longer days open period for 24 days, longer calving to first service interval for 17 days and higher number of services per conception for 0.2 than cows without COD. Owing to higher number of services per conception in cows with COD, the breeding costs increased significantly for 258 CZK (14.25 USD). Energy balance traits did not differ significantly in relationship with COD occurrence, only slight decrease in otherwise higher BCS was detected in the first month of lactation in cows with COD occurrence.

**Key words:** Breeding costs, Energy balance, Fertility traits, Holstein cattle, Ovarian diseases

Increased capacity for milk production in dairy cows has been associated with a decline in fertility (Butler 2003). The incidence of ovarian dysfunction in high-producing dairy cows increase together with milk production (López-Gatiús 2003). Anestrus, repeat breeding, cystic ovarian degeneration, uterine and tubal disorders are observed as the most common reproductive disorders in dairy cattle and major causes of sub-fertility (Garverick 1997, Silvia *et al.* 2002, Agarwal *et al.* 2005). Ovarian cysts in dairy cattle are generally defined as follicular structures of at least 2.5 cm in diameter that persist for at least 10 d in the absence of a corpus luteum. The incidence of ovarian cysts is reported to be from 10 to 13% (Garverick 1997). The primary cause of ovarian cyst development is not yet fully understood. A commonly accepted hypothesis is that the ovarian cystic condition is induced by the inability of the hypothalamus to release a surge of GnRH in response to the rise in oestradiol and, consequently, the anterior pituitary gland fails to release a pre-ovulatory surge of LH. The pre-ovulatory follicle fails to ovulate and becomes cystic (Peter 2004). The factor responsible for this hypothalamic defect may be progesterone (Silvia *et al.* 2002). Persistent corpus

luteum causes interference with the production or release of PGF 2 $\alpha$  (Naokes *et al.* 2009). In cattle it usually occurs postpartum in association with uterine disorders, such as fetal mummification, endometritis or pyometra (MacLachlan 1987). Also mastitis (Nguyen *et al.* 2011) and negative energy balance (Zulu *et al.* 2002) can cause a higher incidence of a prolonged luteal phase. Indeed, the lifespan of the corpus luteum can be prolonged for at least 145 days. Ovarian cysts and persistent corpus luteum result in a prolonged interval from calving to conception and decrease in pregnancy rates after first insemination (Isobe 2007). It also increases the risk of culling (Emanuelson and Oltenacu 1998). Therefore, this condition causes significant economic losses to the dairy industry (Isobe 2007).

The hypothesis that cyst occurrences deteriorates fertility and adversely increases breeding costs was presumed on the basis of the facts determined from the cited literature. The aim of this work was to detect factors determining ovarian disorders occurrence and quantify the impact of this disorders on fertility traits and breeding costs.

### MATERIALS AND METHODS

The data presented in this study were collected on the Holstein dairy farm of the Czech University of Life Sciences Prague in Czech Republic. Only cows (67) calved between 1 January 2012 and 30 September 2012 and got pregnant before 200 days in milk (DIM) were monitored. Cows were

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housed in free stable with straw bedded resting boxes, fed twice a day with TMR and milked in Herringbone parlour twice a day.

Fertility traits (calving to first service interval, number of services per conception and days open period length) and milk yield in first 100 days of lactation (kg) were recorded from farm evidence program (ALPRO Windows 6.65, DeLaval©) in all observed dairy cows. Fat (F,%), protein (P,%), and fat-to-protein ratio (F/P) were recorded during the first month of lactation from the milk recording system applied under ICAR requirements. Body condition score (BCS) was evaluated at calving and then monthly during first 6 month of lactation with a difference of  $\pm 1$  day. For this purpose methodology used was valid for Holstein cattle - 5 point scale with 0.25 point increments (Parker 1989). Changes of body condition score (CHBCS) between calving and first month of lactation was also evaluated.

Cows since 80 days postpartum with BCS higher than 2.5 and increasing BCS tendency, were included into the synchronization program. During regular sonographic examinations, performed after 80 days of lactation to conception, ovarian cysts and persisting corpus luteum occurrences were detected.

The selected factors, determining ovarian disorders occurrence (persisting corpus luteum occurrence (CL) and cystic ovarian disease occurrence (COD) in cows in %) were parity, calving season and energy balance. Parity-wise cows were sorted into 2 groups – first lactating cows in one group and second and higher lactating cows in second group. According to calving season cows were sorted into 2 groups (calved from January to April and from May to September). The impact of energy balance on ovarian diseases occurrence was determined sorting cows into 3 groups according F/P ratio in first month of lactation, as selected indicator of negative energy balance. The relationships between ovarian diseases occurrence, reproduction efficiency, energy balance and breeding costs were determine sorting cows into 3 groups according to sonographic examinations results - cows without cystic ovarian diseases occurrence (WOD), cows with persisting corpus luteum occurrence (CL), and cows with cystic ovarian disease occurrence (COD).

Results were statistically processed in the statistical

program SAS 9.4 (2012) with GLM procedure using the model equations with fixed effects and regression.

$$Y_{ijkl} = \mu + P_i + S_j + E_k + \beta (Y100_{ijkl} + Y100_{0000}) + e_{ijk}$$

where,  $Y_{ijkl}$ , measured value of dependent variables (days open, calving to first service interval, number of services per conception, breeding costs (CZK/USD), BCS in calving, BCS change in 1<sup>st</sup> month, F/P in 1<sup>st</sup> month in milk,% of cows without ovarian disease,% of cows with CL or % of cows with COD);  $\mu$ , overall mean of dependent variables;  $P_i$ , fixed effect of parity  $i$  (2 levels) ( $i = 1^{\text{st}}$ ,  $n = 30$ ;  $2^{\text{nd}}$  and higher,  $n = 37$ );  $S_j$ , fixed effect of calving season  $j$  (2 levels) ( $j = \text{January} - \text{April}$ ,  $n = 37$ ;  $\text{May} - \text{September}$ ,  $n = 30$ );  $E_k$ , fixed effect of ovarian diseases occurrence  $k$  (3 levels) ( $k = \text{WOD}$ ,  $n = 20$ ;  $\text{CL}$ ,  $n = 24$ ;  $\text{COD}$ ,  $n = 23$ ), or fixed effect of F/P ratio  $k$  (3 levels) ( $k = < 1.2$ ,  $n = 22$ ;  $1.2 - 1.4$ ,  $n = 24$ ,  $> 1.4$ ,  $n = 21$ );  $\beta (Y100_{ijkl} + Y100_{0000})$ , regression on the average 100 days milk yield;  $e_{ijk}$ , random residual effect.

The differences between the variables estimated were tested at the levels of significance  $P < 0.05$ . Synchronization program scheme, costs of used drugs and veterinarian applications are demonstrated in Table 1 (1 USD = 19.65 CZK). Breeding service costs included the costs of synchronization program, insemination doses, the use of drugs and their application according to the veterinarian price list. Breeding service costs are listed in Table 2.

## RESULTS AND DISCUSSION

Parity significantly ( $P < 0.05$ ) affected ovarian disease occurrence (Fig. 1). First parity cows suffer less with ovarian diseases. COD occurrence was 38% significantly ( $P < 0.05$ ) lower. On the other hand persisting CL occurred in first lactating cows more (for 18%). Also according to Nelson *et al.* (2010) COD increased with increasing parity.

Also seasonal effect on ovarian diseases incidence was identified (Fig. 2). Cows calved in months with lower air temperature (from January to April) had 24% higher persisting CL occurrence, but significantly ( $P < 0.05$ ) 26% lower COD occurrence than cows calved in months with hot temperature (from May to September). López-Gatius *et al.* (2002) found that cows calving in the summer are 2.6 times more likely to develop COD than cows calving in the winter. Nelson *et al.* (2010) showed that autumn calving increases COD occurrence, compared to calving in winter,

Table 1. Synchronization program scheme and costs

Day	Drug	Package cost CZK/USD	Package size (ml)	Dosage (ml)	Dosage cost CZK/USD	Applic. cost CZK/USD	Total cost CZK/USD
0	supergestran	618/31.46	20	3	92.7/4.72	40/2.04	133/6.77
7	supergestran	618/31.46	20	3	92.7/4.72	40/2.04	133/6.77
14	oestrophan	228/11.61	10	3	68.4/3.48	40/2.04	108/5.50
16	supergestran	618/31.46	20	3	92.7/4.72	40/2.04	133/6.77
17	insemination					120/6.11	120/6.11
	overall cost						627/31.91

USD – American dollars, CZK – Czech crowns, (1 USD = 19.65 CZK).

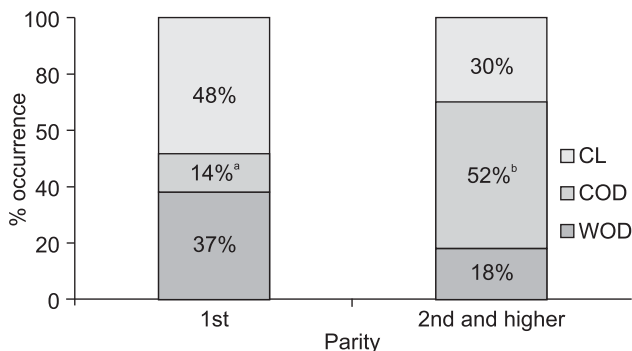


Fig.1. The occurrence of ovarian diseases (%) in relationship to parity; a, b superscript means significant difference (P < 0.05); WOD, cows without ovarian diseases occurrence; COD, cows with cystic ovarian disease occurrence; CL, cows with persisting corpus luteum occurrence.

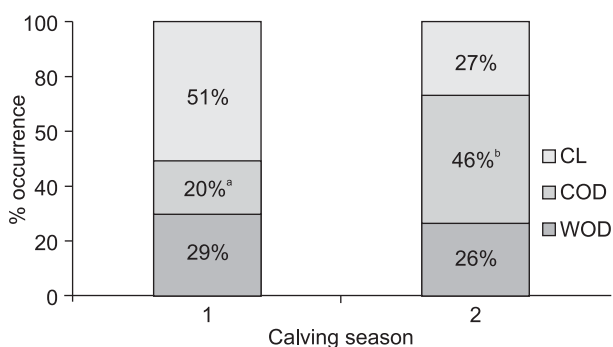


Fig. 2. Occurrence of ovarian diseases (%) in relationship to calving season; a, b superscript means significant difference (P < 0.05); WOD, cows without ovarian diseases occurrence; COD, cows with cystic ovarian disease occurrence; CL, cows with persisting corpus luteum occurrence.

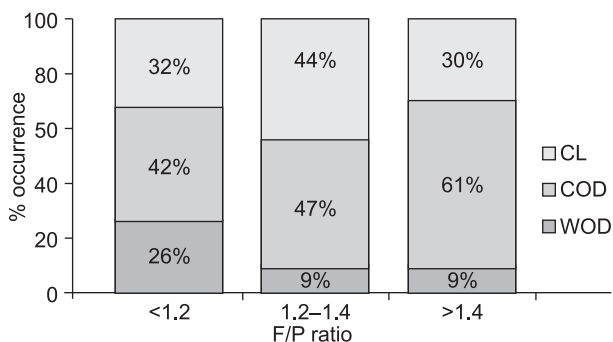


Fig. 3. Occurrence of ovarian diseases (%) in relationship to fat to protein ratio in first month of lactation; WOD, cows without ovarian diseases occurrence; COD, cows with cystic ovarian disease occurrence CL; cows with persisting corpus luteum occurrence; F/P fat to protein ratio in first month of lactation.

spring and summer.

Although we did not observe any significant relationships between ovarian diseases occurrence and F/P ratio (Fig. 3), in cows with F/P ratio higher than 1.4 were observed the highest occurrence of COD (61%). It was 14% higher than in cows with F/P ratio 1.2 – 1.4 and 19% higher than that in cows with F/P ratio lower than 1.2 in the first

month of lactation. Also Hooijer *et al.* (2003) did not find any significant relations between milk fat and protein ratio and the incidence of COD. According to Heuer *et al.* (2000) the F/P ratio is the test parameter with the greatest sensitivity to NEB (49%). Optimal F/P ratio ranged from 1.2 to 1.4, higher than 1.4 is associated with negative energy balance (NEB). Vanholder *et al.* (2006) supposed that severe negative energy balance negatively influence follicle growth and cyst development.

Results determining relationships between ovarian diseases occurrence, reproduction efficiency, energy balance and breeding costs are presented in Table 3. Cows with detected cystic ovarian disease (COD) had significantly (P < 0.05) longer days open period than cows without COD for 24 days and longer calving to first service interval for 17 days. Fourichon *et al.* (1999) found that cystic ovarian disease was associated with a 6 to 11 day increase in the calving to first service interval, and a 20 to 30 day increase in days open. Impaired fertility was observed also by Borsberry and Dobson (1989), who stated that each occurrence of ovarian cysts has been estimated to add between 22 and 64 additional days open. According to Laporte *et al.* (1994) results, the days open period was 49 days longer and the total milk yield was 1,222 kg higher in cows with COD. In addition, the milk production per day of lactation was 0.3 kg higher in the COD animals.

Table 2. Breeding costs

	Cost (CZK/USD)
Sonographic examination	45/2.29
Synchronization program	627/31.91
Oestrophan treatment	108/5.50
Sonography confirmation of pregnancy	45/2.29
Artificial insemination doses	260/13.23 – 690/35.12

USD – American dollars, CZK – Czech crowns, (1 USD = 19.65 CZK).

Table 3. Fertility, energy balance traits and reproduction costs in cows with or without ovarian disease occurrence

	WOD	CL	COD
Days open (days)	109 <sup>a</sup>	123	133 <sup>b</sup>
Calving to first service interval (days)	88	101	105
Number of services per conception	1.34	1.36	1.53
Breeding costs (CZK/USD)	1 472/ 74.93 <sup>a</sup>	1 534/78.08	1 730/88.06 <sup>b</sup>
BCS in calving	3.69	3.70	3.67
BCS change in 1 <sup>st</sup> month	0.57	0.59	0.69
F/P in 1 <sup>st</sup> month in milk	1.22	1.24	1.30

a, b superscript means significant difference (P < 0.05); BCS, body condition score, WOD, cows without ovarian diseases occurrence; CL, cows with persisting corpus luteum occurrence; COD, cows with cystic ovarian disease occurrence, F/P fat to protein ratio.

Owing to a higher number of services per conception in cows with COD for 0.20, we detected the breeding costs in these cows for 258 CZK (14.25 USD) significantly ( $P < 0.05$ ) higher than in cows without COD. Bartlett *et al.* (1986) estimated the economic loss for the average lactation with cystic follicles at approximately 137 USD considering the effects on reproduction, culling, medical costs and labour. A Swedish study reported that COD decreased the net return between 470 SEK (71.62 USD) and 720 SEK (109.73 USD) per cow per lactation (Emanuelson and Oltenacu 1998).

BCS as well as BCSCCH did not differ significantly, but in BCSCCH was observed slightly higher loss in cows with COD than in cows without cystic ovarian disease. López-Gatius *et al.* (2002) found that low BCS, or a high BCS loss over time, has been associated with an increased risk for cystic ovarian disease. Cows that undergo a body condition loss during the prepartum period and cows overconditioned at drying off are also more likely to develop cystic ovarian disease and reproductive problems (Markusfeld *et al.* 1997).

From factors determining ovarian disorders occurrence were statistically significant ( $P < 0.05$ ) parity and calving season. Higher parity and summer calving caused higher ovarian disease occurrence. Only slight nonsignificant relationship between cystic ovarian disease and energy balance was observed. Highest occurrence of cystic ovarian disease was found in cows with fat to protein ratio in the first milk recording higher than 1.4. Cows with cystic ovarian disease had higher body condition decrease in first month of lactation and higher fat to protein ratio in milk. Occurrence of ovarian cysts has been estimated to add 24 days open, 17 days to first insemination, 0.20 more services per conception and cost of 258 CZK (14.25 USD) in breeding service and veterinary expenses. Thus, there is economic justification to develop effective preventative measures and treatments for ovarian cysts prevention.

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