Economic value of mastitis incidence in dairy herds in the Czech Republic

M. Wolfová, M. Štípková and J. Wolf

Research Institute of Animal Production, P.O. Box 1, CZ 104 01 Praha–Uhříněves, Czech Republic, wolfova.marie@vuzv.cz.

Abstract

The calculations were based on data collected from 1996 to 2003 on five Holstein farms in the Czech Republic. Clinical mastitis (CM) incidences (number of CM cases) per cow-year at risk in the whole data set were 0.68, 1.00 and 1.27 for the 1st, 2nd and 3rd and subsequent lactations, respectively. The CM incidences per cow and year averaged over lactations on the individual farms ranged from 0.53 to 1.56. For the whole data set, a value of 0.94 was calculated for this trait. The economic value was defined as change of the total profit per cow and year when increasing the CM incidence by 0.1 cases. The part of the profit function influenced by CM included losses from discarded milk, costs for drugs, veterinary service and herdman´s time, cost for extra milking machine and cost for antibiotic drying of cows. The economic value of CM incidence ranged from -169 to -267 CZK (1 € ≈ 30 CZK) per 0.1 case of CM per cow and year. The economic value for the total data set was -186 CZK. The milk production level and the level of CM incidence had the largest impact on the economic weight for CM incidence.

Introduction

In the Scandinavian countries, clinical mastitis (CM) incidence is included directly into the total breeding values for dairy cattle. Experience from these countries as well as several simulation studies have shown that this procedure is more effective than the selection against somatic cell count (Kardamideen and Pryce, 2001, Heringstad et al., 2003a-b, Odegard et al., 2003).

Recently in many breeding programs, the breeding objective is expressed in economic terms by multiplying the genetic trait values of animals with the economic values of these traits (Sölkner et al., 2000). The inclusion of mastitis incidence into such breeding objectives premises the estimation of economic values for this trait (Nielsen, 1994). In a companion paper presented on this EAAP meeting (Štípková et al., 2005), the daily incidence rate of CM and the average CM incidence per cow and year were shown to be the most accurate estimators for mastitis susceptibility of cows. The aim of this study is therefore to estimate the economic values for CM incidence.

Material and methods

The economic impact of CM on farm profit was investigated on five Holstein farms in the Czech Republic from 1996 to 2003. Some basic characteristics of the farms and the CM incidence rate calculated in Štípková et al. (2005) are summarized in Table 1.

The total financial losses from CM per cow and year were calculated as follows:

$$Loss_{total} = Loss_{milk} + Cost_{vet} + Cost_{labour} + Cost_{other}$$

$$Loss_{milk} = Price_{milk}\left[365\sum_{l=1}^{3} Pcow_l\left(\frac{1}{CI_l}\sum_{i=1}^{CI_l-60} Milk_{li}DMI_{li}\right)\right]$$

$$Cost_{vet} = \left(Cost_{drug} + Lab_{vet}Price_{vet}\right)\sum_{l=1}^{3} YMI_l Pcow_l$$

$$Cost_{labour} = Lab_{herd}Price_{herd}\sum_{l=1}^{3} YMI_l Pcow_l$$

$$Cost_{other} = Cost_{mach} + 4Price_{dry}p_{dry}\left(365\sum_{l=1}^{3}\frac{Pcow_l}{CI_l}\right)$$

where

$Loss_{total}$	total financial loss from CM per cow and year
$Loss_{milk}$	losses of revenues for discarded milk during illness of cows per cow and year
$Cost_{vet}$	cost for drugs and veterinary service per cow and year
$Cost_{labour}$	labour cost for herdman's time dealing with CM per cow and year
$Cost_{other}$	other costs connected with CM per cow and year
$Price_{milk}$	price per kg milk
$Pcow_l$	proportion of cows on lactation l (l = 1, 2 or ≥ 3)
CI_l	calving interval in lactation l
$Milk_{li}$	milk yield (kg) on day i of lactation l; the lactation length is calculated as the difference between the calving interval and days dry (a value of 60 is assumed for days dry)
DMI_{li}	incidence of CM on day i of lactation l
$Cost_{drug}$	cost for drugs per CM case
Lab_{vet}	time of veterinary service (in hours) per CM case
$Price_{vet}$	price per hour of veterinary service
YMI_l	average mastitis incidence per cow and year in lactation l (number of CM cases per cow and year in lactation l)
Lab_{herd}	herdman's time (in hours) for dealing with one case of CM
$Price_{herd}$	price per hour of herdman's time
$Cost_{mach}$	depreciation cost for extra milking machine per cow and year
$Price_{dry}$	price per dose of antibiotics for drying cows
p_{dry}	proportion of cows that are dried with antibiotics per calving interval

The 4 in the last equations comes from the fact that the price is for treating one quarter.

Losses of income caused by permanently reduced yield following mastitis in the rest of the lactation and in coming lactations (as reported e.g. by Schepers and Dijkhuizen, 1991 or Houben and Dijkhuizen, 1993) were not included into the calculation to avoid double counting as milk production is always included into the breeding goal.

The costs for drugs were calculated for each farm and together for all farms on the base of the known type and the number of applied doses per each case of CM. The price per dose of a drug was set the same for all farms and corresponded approximately to the prices of veterinary drugs in the Czech Republic in 2003. The average charge for veterinary service was set to 300 CZK per hour (CZK = Czech crowns, 1 € ≈ 30 CZK). The veterinarian time spend per average case of CM was expected to be 0.5 hour.

The herdman´s time dealing with an average CM case (treatment, separate milking) was set to 1 hour with a value of 140 CZK per hour. The depreciation cost for a separate milking machine was calculated assuming one machine was purchased for 20000 CZK, was sufficient for 100 cows and had a service life of 8 years. The price of antibiotics for drying cows was

taken as the price of Orbenin for drying cows (60 CZK/quarter). The milk price was set to 7.80 CZK/kg.

Table 1. Some farm characteristics used for the calculation of economic losses from CM

Variable	Farm					
	1	2	3	4	5	Total
Average number of cows	1000	800	200	200	200	
Average milk production						
lactation 1	8030	6625	6360	5903	8179	7253
lactation 2	8729	7095	6713	7321	9621	8013
lactation ≥3	7785	6750	6234	6682	8841	7287
Proportion of cows on						
lactation 1	0.44	0.35	0.44	0.41	0.37	0.42
lactation 2	0.29	0.28	0.13	0.23	0.33	0.31
lactation ≥3	0.27	0.37	0.43	0.36	0.30	0.27
Average calving interval						
lactation 1	420	414	431	418	399	417
lactation 2	419	411	427	412	414	415
lactation ≥3	411	410	415	415	406	411
Proportion of cows dried with antibiotics	0.7	1.0	1.0	1.0	1.0	0.9
Mastitis incidence per cow-year at risk in						
lactation 1	0.35	1.45	0.39	0.41	0.56	0.68
lactation 2	0.77	1.62	0.49	0.73	1.01	1.00
lactation ≥3	1.24	1.63	0.69	0.77	1.43	1.27

The economic values for mastitis incidence were defined as the change in the total profit per cow and year which is equal to the change in the financial loss from CM per cow and year ($Loss_{total}$) when increasing the average mastitis incidence in the herd (number of mastitis cases per cow and year) by 0.1 case. No correlated response in reproduction traits or cow survival were taken into account when increasing mastitis incidence as these traits were also assumed to be included in the breeding goal for dairy cattle in the Czech Republic.

The impact of a change in the main factors influencing costs for mastitis (average mastitis incidence, veterinary costs and milk production level) on the economic value for mastitis was also studied.

Results and Discussion

The main numerical values needed in the equation for the calculation of total costs for CM are given in Table 2. The costs for drugs per CM case differed substantially between farms. This was caused by the different severity in CM (e.g. the proportion of CM that occurred in all quarters varied from 0.15 to 8%), the different average length of illness (5.4 to 8.9 days) and the intensity of treatment (use of one drug only was in the range from 37 to 99% of all cases in dependence on the farm). The incidence rate of CM (number of cases per cow-year at risk) was 0.94 on average, varied from 0.53 to 1.56 and did not seem to be influenced by the herd size.

Fourichon et al. (2001) gave a similar average incidence rate per cow-year (0.44 with a minimum of 0.03 and a maximum of 1.38 cases) in 205 farms of western France. They also did not find an impact of the herd size on the CM incidence. But in their study, milk yield was shown to influence mastitis incidence, which was not observed in our study.

Table 2. Some characteristics needed for the calculation of total costs for CM case, total cost of CM per cow and year and the economic value of CM in the investigated farms

Variable	Farm					
	1	2	3	4	5	Total
Average number of CM cases in the herd per cow and year	0.71	1.56	0.53	0.61	0.97	0.94
Proportion of cows dried with antibiotics per cow and year	0.61	0.89	0.86	0.87	0.90	0.79
Costs for drugs (CZK per CM case)	344	326	176	274	309	320
Depreciation costs for extra milking machine (CZK per cow and year)	25	25	25	25	25	25
Average amount of discarded milk (kg per cow and year)	108	221	127	104	255	150
Losses of revenues for discarded milk (CZK per cow and year)	842	1724	991	811	1989	1170
Total cost of CM (CZK per cow and year)	1488	2923	1469	1389	2811	1959
Total cost per average case of CM	2096	1874	2772	2277	2898	2084
Economic value of CM (CZK per increasing the number of CM per cow and year by 0.1 case)[1]	-206	-169	-237	-184	-267	-186

Esslemont and Kossaibati (1996) found an incidence rate of 0.33 cases per cow-year (from 0.02 to 2.15) in 90 Holstein-Friesian farms in England. High differences in CM incidence, in the length of treatment and in the milk production level caused the high differences in revenue losses for discarded milk in our calculation. Milk losses amounted from 57% to 66 % of the total loss and the cost for drugs and veterinary service as second main source of losses made up between 15% and 25% of the total loss (see Fig. 1).

Nielsen (1994) referred for Danish dairy herds a higher proportion of veterinary costs than for milk losses (46% vs 38%), but the average length of illness was 5 days and the calculated losses were for the 1st lactation only. Similar losses for discarded milk as proportion of the total losses for CM case were given by Sasidhar et al. (2002) for Indian dairy herds. On the other hand, De Graves and Fetrov (1993) or Kossaibati and Esslemont (1997) referred a proportion of milk revenue losses on the total mastitis cost higher than 60% in comparison to veterinary and medicine costs (27 and 34%). No calculations in the literature include other than veterinary, medicine, labour costs and losses for discarded milk. In our calculation, the costs for an extra milking machine and antibiotic drying of cows were included in the total mastitis costs.

Economic values for increasing the average CM incidence in the herds by 0.1 cases per cow and year are given in the last row of Table 2. The average value calculated across the farms was -186 CZK per 0.1 case, cow and year, varying between farms from -169 to -267 CZK.

In most countries, the total losses of mastitis are taken as the economic value of mastitis incidence. The economic value of CM incidence calculated here is similar but not the same as the total cost per average case of CM (see the last but one row of Table 2). The reason for this is the fact that the other costs of mastitis (antibiotic drying, extra milking machine) do not change when changing the incidence of mastitis as in most farms nearly all cows are dried by antibiotics. Perhaps, thinking in long term, these costs should be lowered too.

Fig. 1. Total costs caused by CM per cow and year in individual farms and total

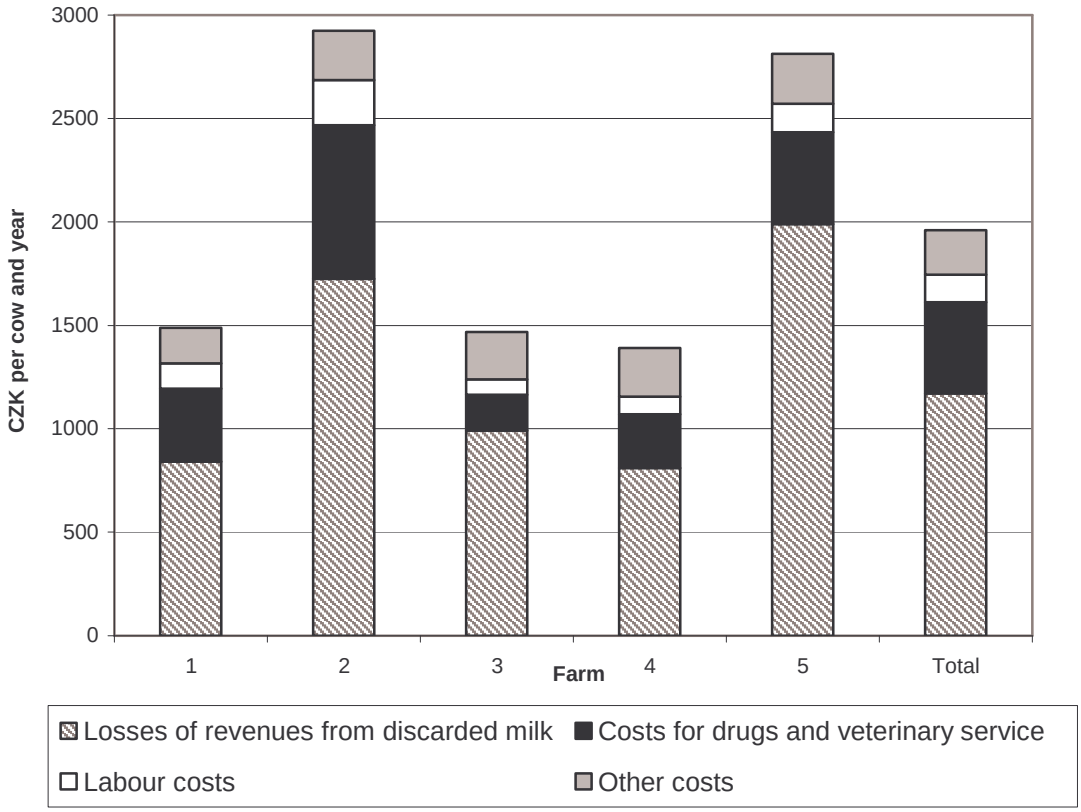

Table 3. Economic value for mastitis incidence (CZK per increasing the number of cases per cow and year by 0.1) in the complete data set for different levels of input parameters

Variable	Change	Economic value	Change[1]
Base level of all variables	0	-186	0
Average number of CM case per cow and year	+20%	-138	-26%
	-20%	-185	-0.5%
Milk production in all lactations	+20%	-211	+13%
	-20%	-161	-13%
Veterinary costs (drugs and veterinary service)	+20%	-195	+5%

[1]Change in the absolute value of the economic value

The relative importance of mastitis in the total merit index of Norwegian cattle was the same as the relative importance of the complex of milk production traits (21%) (Heringstad et al., 2001). Rogers (2002) reported a net economic value of CM (expressed per genetic standard deviation) as high as 25% of the economic value of milk yield in US circumstances. Taking the total economic value of CM (-186 CZK/0.1 case, cow and year) and assuming a genetic standard deviation of CM incidence of 0.08 (according to Nielsen, 1994), the economic value of CM will reach about 10% of the economic value of milk yield under Czech conditions (for the Holstein breed and a situation with milk quota, see Wolfová et al., 2001).

The factors with the greatest impact on the economic value of mastitis are the average mastitis incidence in the herd (number of CM cases per cow-year) and the milk production level (Table 3).

Conclusions

The study showed the high economic importance of clinical mastitis in the investigated herds independent of the herd size. The economic value of mastitis incidence per assumed genetic standard deviation reached 10% of the economic value for milk yield which justifies the incorporation of this trait into the breeding goal for dairy cattle in the Czech Republic. For this purpose it will be necessary to establish a data base for mastitis incidence in dairy herds under milk recording and to estimate genetic parameters for this trait. The calculation of the economic weights should then be repeated for the complete data set from the whole population. The algorithm for the calculation of the economic value for mastitis incidence will be a part of the program ECOWEIGHT (Wolf et al., 2003).

Acknowledgment

Thanks are due to the farms and to V. Čermák for making available the data of mastitis and the milk recording data, respectively. P. Šafus, P. Košař, and K. Košař gave advice in veterinary problems, L. Zavadilová and E. Němcová. helped in computing and P. Řezáčová and M. Krejčová did the data collection. Thanks to all of them. The research was supported by the Ministry of Agriculture of the Czech Republic (Projects MZE 0002701401 and 0002701402).

References

De Graves, J., Fetrow, J., 1993. Economics of mastitis and mastitis control. Vet. Clin. N. Am.: Food Anim. Pract., *9*, 421-434.

Esslemont, R. J., Kossaibati, M. A., 1996. Incidence of production diseases and other health problems in a group of dairy herds in England. Vet. Rec., *139*, 486-490

Fourichon, C., Beaudeau, F., Bareille, N., Seegers, H., 2001. Incidence of health disorders in dairy farming systems in Western France. Livest. Prod. Sci., *68*, 157-170.

Heringstad, B., Klemetsdal, G., Ruane, J., 2001. Responses to selection against clinical mastitis in the Norwegian cattle population. Acta Agric. Scand., Sect. A – Anim. Sci., *51*, 15-20.

Heringstad, B., Klemetsdal, G., Steine, T., 2003a. Selection responses for clinical mastitis and protein yield in two Norwegian dairy cattle selection experiments. J. Dairy Sci., *86*, 2990-2999.

Heringstad, B., Rekaya, R., Gianola, D., Klemetsdal, G., Weigel, K.A., 2003b. Genetic change for clinical mastitis in Norwegian cattle: a threshold model analysis. J. Dairy Sci., *86*, 369-375.

Houben, E.H.P., Dijkhuizen, A.A., Van Arendonk, J.A.M., Huirne, R.B.M., 1993. Short- and long-term production losses and repeatability of clinical mastitis in dairy cattle. J. Dairy Sci., *76*, 2561-2578.

Kadarmideen, H N., Pryce, J.E., 2001. Genetic and economic relationships between somatic cell count and clinical mastitis and their use in selection for mastitis resistance in dairy cattle. Anim. Sci., *73*, 19-28.

Kossaibati, M. A., Esslemont, R. J., 1997. The costs of production diseases in dairy herds in England. Vet. J., *154*, 41-51.

Nielsen, U.S., 1994. Economic weights in Danish total merit index. In: Workshop “Economic weights in dairy cattle”. 16-17 February, Futterkamp, Germany.

Odegard, J., Klemetsdal, G., Heringstad, B., 2003. Genetic improvement of mastitis resistance: Validation of somatic cell score and clinical mastitis as selection criteria. J. Dairy Sci. 86, 4129-4136.

Rogers, G. W., 2002. Aspects of milk composition, productive life and type traits in relation to mastitis and other diseases in dairy cattle. Proceedings of the 7th WCGALP, (CD-

ROM), Montpellier, Com. No. 09-18.
Sasidhar, P. V. K., Reddy, Y. R., Rao S.B., 2002. Economics of mastitis. Indian J. Anim. Sci., *72*, 439-440.
Schepers, J.A., Dijkhuizen, A.A., 1991. The economics of mastitis control in dairy cattle: a critical analysis of estimates published since 1970. Prev. Vet. Med., *10*, 213-224.
Sölkner, J., Miesenberger, J., Willam, A., Fuerst, CH., Baumung, R., 2000. Total merit indices in dual purpose cattle. Arch. Tierz. *43*, 597-608.
Štípková, M., Wolfová, M., Wolf, J., 2005. Possible characteristics for mastitis incidence in dairy herds in the Czech Republic. 56th Annual Meeting of the EAAP, Uppsala, Poster M4.21.
Wolf, J., Wolfová, M. Krupa, E., 2003. Users Manual for the program ECOWEIGHT (a C program for calculating economic weights in livestock), Version 1.0.22. Research Institute of Animal Production, Prague-Uhříněves and Research Institute of Animal Production, Nitra, 82 pp..
Wolfová, M., Přibyl, J. Wolf, J., 2001. Economic weights for production and functional traits of Czech dairy cattle breeds. Czech J. Anim. Sci., *46*, 421-432.