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EFFECT OF TEMPERAMENT ON PERFORMANCE OF PRIMIPAROUS DAIRY COWS*

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Abstract

This study was designed to analyse the effect of milking behaviour (temperament) of primiparous dairy cows on their milk and reproductive performance as well as survival to the second lactation. Milk performance, reproductive performance and culling data on 12028 Polish Holstein-Friesian primiparous dairy cows were acquired from the SYMLEK database. Using the methodology of the Polish Federation of Cattle Breeders and Dairy Farmers, the temperament of the cows was assessed as: 1 – calm, 2 – normal, 3 – excitable or aggressive. Primiparous cows from the analysed population were characterized by averagely normal temperament and optimal milking speed. Daily and lactation yield depended ($P \leq 0.01$) on the temperament of cows. Excitable (aggressive) cows had higher daily and lactation yield compared to normal and calm cows. The temperament trait was found to correlate ($P \leq 0.01$) also with functional traits such as milking speed, survival to the second lactation, and culling level. As milking speed increased, the proportion of cows with calm temperament decreased and that of excitable (aggressive) primiparous cows increased. As the temperament score increased, so did the proportion of primiparous cows sold for further breeding. Excitable (aggressive) primiparous cows had the lowest chance of survival to the second calving.

Key words: primiparous, temperament, milk and reproductive performance, milking speed, survival

Production efficiency of dairy cows not only depends on their milk yield but is also heavily linked to functional traits, including the way cows respond to environmental stimuli, e.g. those associated with the enlargement of herds and introduction of new housing, feeding and milking technologies. There is a growing interest in behavioural traits associated with animal welfare and herd management, e.g. milkability traits such as milking speed and temperament (Szymik et al., 2015). These traits are particularly important during milking because they determine the time devoted to attending to the cows (Jakobsen et al., 2009). Nervous cows disrupt the premilking routine and more often kick off the milking unit, which increases the milking time.

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Cows with lively temperament represent considerable risk for the stockperson and other animals. The milking behaviour of cows, which reflects their response to the entire milking procedure, is called temperament and has been analysed for breeding purposes. It is scored on a point scale of 1 to 3 in the Czech Republic, Norway and Poland, on a scale of 1 to 5 in Germany, France, Finland and Canada, and on a scale of 1 to 9 in The Netherlands, Denmark and Sweden. In some countries (Canada, Germany, The Netherlands) this assessment is combined with evaluation of milking speed, while in others temperament is considered to reflect the animal's overall excitability (Adamczyk et al., 2013).

Although behavioural traits are more difficult to assess than production traits, they are increasingly used in the breeding programmes for different breeds worldwide (Miglior, 2004, Interbull: www.interbull.org/ib/geforms), due, among others, to the considerable role of cow milking behaviour in terms of milk production. Also in Poland, research is underway to estimate genetic parameters and develop a model for evaluating the cows' genetic merit in terms of milking speed and temperament (Szymik et al., 2015). Despite the problems in measuring temperament, an answer is sought to the question whether it affects cow performance (Juhas and Strapak, 2005; Szentleleki et al., 2008; Orban et al., 2011; Neja et al., 2015). According to Jakobsen et al. (2009), temperament and milking speed have an effect on culling levels. Calm cows and those with averagely high milking speed face a lower risk of culling compared to nervous and slow-milking cows (Berry et al., 2005; Sewalem et al., 2010).

The aim of the study was to analyse the effect of the milking behaviour (temperament) of primiparous cows on their milk and reproductive performance as well as survival to the second lactation.

Material and methods

The study material was acquired from SYMLEK (database of cows) and consisted of data on milk and reproductive performance, temperament, milking speed, and culling of 12028 Polish Holstein-Friesian first-calf heifers from the active population in Pomerania and Kujawy (about 10% of the national population of milk-recorded cows), which first calved in 2012. The average length of lactation was 378 days, and daily yield approximately 25 kg of milk.

Milking behaviour (temperament) was classified according to SYMLEK as: 1 – calm, 2 – normal, 3 – excitable or aggressive. Milking speed was classified according to SYMLEK as: 1 – very slow, 2 – slow, 3 – intermediate, 4 – fast, 5 – very fast.

The following parameters were considered for the first full production cycle of the cows:

1. milk performance: days of milking, daily and lactation yield (kg);
2. reproductive performance: length of calving interval (CI) – number of days between successive calvings; reproductive rest period (RRP) – number of days between calving and first insemination; service period (SP) – number of days between first and successful insemination; insemination index (II) – number of services per conception.

One factor variance analysis (GLM procedure of SAS, 2011) was used to evaluate the effect of temperament on indicators of milk and reproductive performance in the first production cycle. Significant differences were estimated with the Scheffe test.

χ square test of independence (SAS, 2011) was used to analyse the effect of milking behaviour (temperament) on the percentage of primiparous cows:

- with different levels of milk yield (≤ 7000 , 7001–9000, 9001–11000, > 11000 kg milk);
- with different milking speeds;
- sold, culled, or surviving to the second calving.

Results

Most of the cows showed a normal temperament (87.33%), followed by excitable (aggressive) (7.32%) and calm temperament (5.35%) (Table 3). Milk performance of the primiparous cows varied ($P \leq 0.01$) according to the temperament (Table 1). In cows with excitable (aggressive) temperament, first lactation milk yield was higher by 844 kg compared to cows with calm temperament and by 538 kg compared to cows with normal reactions. Because differences in lactation length were small (1–3 days), daily yield of the cows showed variation ($P \leq 0.01$). Excitable (aggressive) cows had an advantage of 1.8 and 1.3 kg/day over calm and normal cows, respectively.

Table 1. Milk performance of primiparous cows depending on their milking behaviour (temperament)

Parameter	Temperament			Significance of differences
	Calm	Normal	Excitable, aggressive	
	1	2	3	
No. of cows	643	10505	880	
First lactation milk yield (kg)	9055	9361	9899	1-3 xx 2-3 xx
Length of first lactation (days)	376	379	380	
Daily yield for first lactation (kg)	24.4	24.9	26.2	1-3 xx 2-3 xx

XX – $P \leq 0.01$.

The parameter that most often describes reproductive performance of the cows is CI, the first stage of which is RRP, when the reproductive system returns to normal size and function. The minimal RRP length is decided by the breeder who selects cows for insemination. RRP was found to last slightly over 90 days on average, regardless of the cow temperament. Analysis of the other fertility parameters (CI, SP and II) also showed no statistically significant differences in their values depending on the cow's temperament. The highest CI, RRP and II values, which reflect poorer fertility, were found in excitable (aggressive) cows (Table 2). Cows with more docile temperament, especially calm cows, tended to show better fertility. The slightly

longer CI in excitable (aggressive) cows was probably due to the greater number of inseminations (II) that had to be performed.

Table 2. Reproductive performance of primiparous cows depending on their milking behaviour (temperament)

Parameter	Temperament			Significance of differences
	Calm	Normal	Excitable, aggressive	
	1	2	3	
No. of cows	643	10505	880	
Calving interval (days)	412	408	413	NS
Reproductive rest period (days)	92	91	93	NS
Service period (days)	41	39	39	NS
Insemination index	1.91	1.95	1.96	NS

NS – not significant.

Table 3. Proportion of primiparous cows depending on milk yield level and milking behaviour (temperament)

Milk yield level (kg)	Total primiparous cows n/%	Proportion (%) of primiparous cows depending on temperament ($\chi^2 = 29.4$ xx)		
		Calm	Normal	Excitable, aggressive
		1	2	3
≤7000	2722/22.63	6.02	87.80	6.17
7001–9000	3163/26.30	5.69	88.18	6.13
9001–11000	2842/23.63	5.03	86.98	7.99
>11000	3301/27.44	4.73	86.46	8.82
Total	12028/100	5.35	87.34	7.32

xx – $P \leq 0.01$.

Table 4. Proportion of primiparous cows depending on milking speed and milking behaviour (temperament)

Milking speed (acc. to SYMLEK)	Total primiparous cows n/%	Proportion (%) of primiparous cows depending on temperament ($\chi^2 = 31.34$ xx)		
		Calm	Normal	Excitable, aggressive
		1	2	3
Very slow	196/1.63	76.53	20.41	3.06
Slow	451/3.75	11.09	81.37	7.54
Average	7575/62.95	4.38	91.03	4.58
Fast	3567/29.66	3.00	87.22	9.78
Very fast	242/2.01	1.65	38.84	59.50

xx – $P \leq 0.01$.

The proportion of primiparous cows in different lactation yield classes was equalized and ranged from 22.6 to 27.4% (Table 3). As the first lactation yield increased, there was a clear tendency ($P \leq 0.01$) for a decreasing proportion of cows with calm temperament (from 6.02% to 4.73%) and an increasing proportion of ex-

citable (aggressive) age mates (from 6.17% to 8.82%), as confirmed by the results in Table 1.

The overwhelming majority (62.95%) of primiparous cows were characterized by average milking speed (Table 4). There was also a high (29.66%) proportion of fast milkers. The proportion of primiparous cows representing the other milking speed classes ranged from 1.63% (very slow milkers) to 3.75% (slow milkers). Very large differences ($P \leq 0.01$) were observed for the proportion of cows depending on milking speed and temperament. In the group of primiparous cows with very slow milking speed, most of the cows had calm temperament (76.53%) and very few cows (3.06%) were excitable (aggressive). A completely different structure of cows with different temperaments was found among very fast milking primiparous animals: there were just 1.65% calm animals and as much as 59.60% excitable (aggressive) animals. In the other milking speed groups, most primiparous cows (81.37%–91.03%) had normal temperament, and there was also a downward tendency (from 11.09% to 3%) for primiparous cows with calm temperament.

Table 5. Proportion of primiparous cows sold, culled or surviving to the second calving, depending on their milking behaviour (temperament)

Item	Total % of primiparous cows	Proportion (%) of primiparous cows depending on temperament ($\chi^2 = 85.01xx$)		
		Calm	Normal	Excitable, aggressive
		1	2	3
No. of cows		643	10505	880
Sold for further breeding in the first production cycle	0.62	0.31	0.40	3.41
Culled in the first production cycle	18.77	19.91	18.65	19.43
Surviving to the second calving	80.61	79.78	80.95	77.16

xx – $P \leq 0.01$.

The chance of survival until the next calving was lower for calm cows, and especially for excitable (aggressive) cows compared to those with normal temperament (Table 5). As the temperament score increased (from 0.31% to 3.41%), so did the proportion of cows sold for further breeding in the first production cycle.

Discussion

Domesticated cattle not only have higher yields than their ancestors but are also more submissive (Mignon-Grasteau et al., 2005). The gentle disposition of dairy cattle during the milking process is a trait that has been selected informally or formally for generations, which is why extreme behaviour of the cows is rare. In our study, there were 5.35% of cows with calm temperament and 7.32% with excitable (aggressive) temperament. According to Szymik et al. (2015), among the Polish Holstein-Friesian cows of the Black-and-White variety born in 2010–2012, there were

5.21% cows with calm temperament and 7.32% cows with excitable temperament. Budzyńska et al. (2005) classified 91.6% of cows as quiet (temperament scores 1–3) and only 8.4% as excitable (temperament scores 4–5). Sewalem et al. (2010) found 89.15% of Holstein cows to have the desired temperament. It appears that Holstein Friesian cows are generally calm, probably due to their long selection in milk production.

Analysis of cow behaviour is increasingly used in breeding practice, also in the context of its relationship with production traits (Adamczyk et al., 2011). The results of our study indicate that temperament is a trait related not only to the milk performance of primiparous cows but also to functional traits such as milking speed, survival to the second calving, and culling level. Excitable (aggressive) cows were found to achieve higher daily and lactation yields compared to normal and calm cows. According to Sullivan and Burnside (1988), nervous cows are more aggressive during feed intake, which makes them ingest more feed and thus achieve higher performance. Maffei et al. (2006) demonstrated that more aggressive cows were more reactive and more motile with higher hierarchical rank in the groups. According to Gergovska et al. (2012), the average milk yield of nervous and very nervous cows is higher than that of the medium to very calm ones. This difference is greater in Holstein cows (744.8 kg) compared to Brown Swiss cows (445.2 kg). Correlations between the ranks of bulls for breeding value for milk yield and temperament and for percentage of daughters with desirable temperament have low and negative value ($r_s = -0.10$ and -0.20), which shows that in selection for milk yield only there is a risk of increasing the number of animals with undesirable milking temperament. Milking temperament scores had a substantial effect on test-day milk yields (Gergovska et al., 2012). Nervous cows exhibited higher test-day milk yields both in the beginning and throughout the lactation compared to calm cows, but lactation curves were irregular. Calm cows had smooth lactation curves but their milk yields were lower in early and peak lactation by 1.0 and 1.7 kg respectively as compared to nervous cows. Praxedes et al. (2011) observed a close relationship between temperament and milk yield, namely cows with intricate, nervous temperament had the highest milk yields (6546.67 kg) whereas those with calm temperament had low milk yields (3406.45 kg). The authors attribute the cause for keeping bad-tempered animals in the herds to their good productivity. Higher costs for handling nervous animals are therefore compensated by their high productivity. Kruszyński et al. (2013) estimated positive correlations between temperament and the yield of milk ($r_G = 0.07$), fat ($r_G = 0.08$) and protein ($r_G = 0.09$).

Kunowska-Słószarz and Słószarz (2008) hold that selection for calm temperament may guarantee higher profits from milk production. The findings of Breuer et al. (2000) suggest that cows with calm temperament have higher yields. Taken together, the results of Hedlund and Løvlie (2015) support a relationship between behavioural responses and milk production, where cows showing signs of nervousness produce less milk. However, observed relationships are dependent on the milk measure used, behaviour, and breed investigated, supporting the conjecture that the relationship between behaviour and production traits is not straightforward. Rushen et al. (2001) documented lower plasma oxytocin concentrations in unfamiliar milking parlours

confirming a negative effect of novelty on milk production, whereas Sutherland et al. (2012) found higher oxytocin concentrations and a drop in milk yield after milking in novel environments. They discussed variations in the activation of the sympathetic nervous system as causal physiological mechanisms for disturbances in milk letdown by peripheral inhibition of oxytocin effects, as it is suggested by Van Reenen et al. (2002).

In turn, no effect of temperament on daily yield of cows was observed by Orban et al. (2011). Likewise, Szentleki et al. (2015) found no relationship between the temperament of primiparous cows and their lactation yield. The inconsistent findings may at least partly result from methodological differences (breed, age and many other factors that affect the temperament).

Our study revealed no statistically significant effect of temperament in primiparous cows on their fertility. The weak correlation between cow temperament and fertility parameters is supported by other authors. According to Haskell et al. (2014), associations between temperament and reproductive traits are poorly studied but appear to be weak and variable in their direction. According to Haile-Mariam et al. (2004), the coefficient of genetic correlation between temperament and calving interval is 0.05, and interval from calving to first service 0.00. It must be concluded, however, that the weak relationships suggest either that the traits are largely independent, or that selection for reproductive traits is likely to have favourable but small effects on temperament (Haskell et al., 2014). Temperament is often described as an individual trait influencing an animal's behavioural response to handling (Gibbons et al., 2009). According to Phocas et al. (2006), genetic estimates between temperament and reproduction traits showed a positive correlation. Burrow et al. (1988) found that calm cows were more likely to show behavioural signs of oestrus in the presence of a human observer than excitable cows. According to Cooke (2011), excitable temperament is a fear-related behavioural response that has detrimental effects on reproductive function of beef heifers and cows, independently of breed type. Temperament may influence cattle reproduction indirectly by decreasing nutritional status, and directly by altering the physiological mechanism required for ovulation and conception. These results suggest that excitable temperament and consequent elevated cortisol concentrations (Curley et al., 2008) are detrimental to reproductive function of cows.

The largest group were cows with optimal temperament score (over 87%) and with desired milking speed, i.e. average and fast milkers (over 91%) (Tables 3 and 4). A similar distribution of scores for both traits in different breeds of dairy cattle was also reported by Sewalem et al. (2010) and Szymik et al. (2015). According to Sewalem et al. (2010), the average and fast milkers and cows with optimal temperament form around 85% of the population.

In our study, we showed considerable differences ($P \leq 0.01$) in the proportion of primiparous cows depending on temperament and milking speed, similarly to Van Reenen et al. (2002), who revealed that young cows' behaviour recorded during milking was unrelated to ease of milk removal. The very high (59.50%) proportion of excitable (aggressive) primiparous that we observed in the group of very fast milkers is related to the fact that very fast milking cows may be at increased risk

for mastitis (Zwald et al., 2006) because they are exposed to the risk of mechanical injuries of the udder (Sewalem et al., 2010).

The lower chance of survival to the second calving among excitable (aggressive) cows compared to those with calm and normal temperament (Table 5) supports the findings of Neja et al. (2015), who observed no statistically significant effect of temperament on cow longevity measured by different indicators, but found that cows with calm temperament were characterized by the longest lifespan, the longest productive life, and the largest number of calvings. According to Haile-Mariam et al. (2004) and Sewalem et al. (2010), calmer cows face a lower risk of culling. Sewalem et al. (2010) found a statistically significant relationship between milking temperament and functional longevity. Very nervous cows were 26%, 23%, and 46% more likely to be culled than very calm cows in Holstein, Ayrshire, and Jersey breeds, respectively. Similarly, very slow milkers were 36%, 33%, and 28% more likely to be culled than average milkers in Holstein, Ayrshire, and Jersey breeds, respectively.

The increase that we found in the proportion of primiparous cows sold for further breeding (from 0.31% to 3.41%) together with a higher temperament score is consistent with the results reported by Mark (2004) and Jakobsen et al. (2009), which show that cows with nervous temperament interfere with the operation of the popular milking parlour system.

Conclusions

In summary, it can be stated that primiparous cows from the analysed population were characterized by averagely normal temperament as well as optimal, desired milking speed. Daily and lactation yield of the primiparous cows was dependent on their temperament. Excitable (aggressive) cows achieved higher daily and lactation yield compared to normal and calm cows. Excitable (aggressive) primiparous cows had the lowest chance of survival to the second calving. The temperament trait was found to be also related to functional traits such as milking speed, survival to the second lactation, and culling level. As milking speed increased, the proportion of cows with calm temperament decreased and that of excitable (aggressive) primiparous cows increased. As the temperament score increased, so did the proportion of primiparous cows sold for further breeding.

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