IJAS Iranian Journal of Applied Animal Science

Behaviour of Cows in the Milking Parlour and Its Relationship with Milk Production and Type of Na

Research Article

I. Polupan[1], V. Siriak[1], R. Stavetska[2], O. Babenko[2] and M.R. Mohammadabadi[3*]

[1] Institute of Animal Breeding and Genetics nd. a. M.V.Zubets of National Academy of Agrarian Science, Kyiv, Ukraine
[2] Department of Animal Science, Bila Tserkva National Agrarian University, Bila Tserkva, Ukraine
[3] Department of Animal Science, Faculty of Agriculture, Shahid Bahonar University of Kerman, Kerman, Iran

Received on: 4 Oct 2020
Revised on: 25 Nov 2020
Accepted on: 15 Dec 2020
Online Published on: Dec 2021

*Correspondence E-mail: mrm@uk.ac.ir

Online version is available on: www.ijas.ir

ABSTRACT

The purpose of the research was to examine the behaviour of five hundred forty-two dairy cows in the 2 × 16 DeLaval parallel milking parlour. During ten milking sessions the consistency of the entrance order in the milking parlour was investigated, in particular group preference, side preference and standing position during milking and relationships of these behavioural elements with milk production and type of nervous activity (NA) of cows. The highest repeatability was characteristic of group preference (repeatability coefficient 0.47, P<0.001), lower repeatability was for side preference and standing position (0.17, P<0.001 and 0.09, P<0.05). Young cows preferred generally to be milked in the first group (average lactation number 1.7), they had lower milk yield compared with the average milk yield in the herd (305-d milk yield-7552 kg) and reactive type of NA.The third group for milking was preferable for older cows (2,3lactations) with higher milk yield (7827 kg) and inert type of NA. It has been established that 8-12% of cows consistently chose the right or left side in the milking parlour, 42% of cows did not show any side preference. There have not been found significant differences in age and milk production of cows depending on the side preference and standing position in the milking parlour. Using the own methodology, that based on the consistency of group preference and standing position in the milking parlour, cows were divided into three types of NA: reactive, balanced and inert. In the studied herd, reactive type of NA, balanced and inert contained 34%, 29% and 37% of cows, respectively. In cows of inert type of NA indicated some advantage in milk production. It can be assumed that with age the type of NA of cows changes from active (reactive) to calmer (inert). The proposed method of estimation of cows behavior in the milking parlour allows to group cows by type of NA, can improve cows welfare in the herd and optimize milk production.

KEY WORDS behavior, dairy cows, milk production, standing position, type of nervous activity.

INTRODUCTION

Modern technologies of dairy herd management make it possible to track changes in the milk production and reproductive performance of dairy cows (Norouzy *et al*. 2005; Kharrati Koopaei *et al*. 2012). It is difficult to keep under control all animals in the large herd (Nassiry *et al*. 2005; Barazandeh *et al*. 2016). However, if their places in social hierarchy and specific behavior are known, that depends greatly by the cows' temperament; we can control changes to make dairy cows keeping in herds more comfortable and to improve milk production. That is why temperament of animals is becoming an increasingly important part of their productivity, fertility, longevity and welfare (Szymik *et al*. 2015). Dairy cows are characterized by individual differences in temperament (Frondelius *et al*. 2015), which de-

pends on their reaction to keeping systems, milking, feeding, veterinary and zootechnical measures as well as varies stresses (Ebrahimi *et al*. 2021). Numerous studies have shown from moderate to high repeatability of scores of individual animals (e.g. reaction to novelty (Kilgour *et al*. 2006; Gibbons *et al*. 2009), aggression (MacKay *et al*. 2013) which can be classified as temperament traits. It is believed that animals which are not excessively fearful, not afraid of new objects or isolation from other animals, will better adapt to modern intensive dairy farming system than more reactive (sensitive) animals (Gibbons *et al*. 2009). Cows with nervous, excitable temperament showed increased stress responsiveness to any manipulations. They have increased adrenal function but the function of the basal pituitary is not increased, and they have a less pronounced reaction to the pharmacological stimulus (Curley *et al*. 2008). It should be noted that most of the Holstein-Friesian cows have a calm temperament probably to long-term selection for milk production (Sewalem *et al*. 2010).

Taking into account the temperament of cows in the process of milk production is important from the perspective that this trait seems stable over the time. That is why temperament is included in the selection indices of both dairy and beef cattle as numerous correlations have been found between temperament and economically important traits (Haskell *et al*. 2014). The methods determining the temperaments of dairy cows vary slightly between countries. Common factor is that cow's temperament is usually scored by the farmer or other farm staff. The temperaments of cows assesses by counting the steps of cow in the milking parlour, kicks or flinches the cow makes during the milking procedure (Breuer *et al*. 2000). In Ukraine for assessing cows temperament or types of high nervous activity (HNA) use the method called "familiar milkmaid – strange milkmaid", when the changes of milking speed in response of milkmaid replacement are analyzing (Kokorina, 1986), another method–the reflex of the movement of the animal to food (Nagel *et al*. 2020).

In Norway, the Czech Republic and Poland cows temperament score on a point scale of 1 to 3, in Germany, France, Finland and Canada–on a scale of 1 to 5, and in the Netherlands, Denmark and Sweden–on a scale of 1 to 9 (Adamczyk *et al*. 2013). In Ukraine and some other countries of Eastern Europe the animals temperament is established on the basis of determining the tapes of high nervous activity. This methodology is based on the physiological teachings of Ivan P. Pavlov. According to the results of this assessment animals are divided into four types: I) strong balanced mobile, II) strong balanced inert, III) strong unbalanced mobile, IV) weak. The most appropriate for breeding and productive use are dairy cows of strong balanced mobile type, which characterized by high milk yield and fat percentage compared to other types of H (Shaposhnik *et al*. 2015; Karlova *et al*. 2018; Smirnov and Val'kovskaya, 2018). This is due to the fact that animals with a strong type of nervous system have better adaptability and higher compensatory and protective characteristic of the body which increases the resistance of animals to stress (Curley *et al*. 2008; Kovács *et al*. 2013).

About half of the costs on dairy farm are due to the milking. Cows enter the milking parlour and choose the side for milking in a certain order (Grasso *et al*. 2007). Some cows are very consistent in the choice of standing position in the milking parlour the others–more variable. Consistency in milking order to the milking parlour is an important feature of social hierarchy in dairy cattle (Grasso *et al*. 2007; Berry and McCarthy, 2012). It has been shown that many factors affect the standing position of dairy cows, including position in social hierarchy (Melin *et al*. 2006), health status (Flower *et al*. 2006; Grasso *et al*. 2007; Polikarpus *et al*. 2015), age (Grasso *et al*. 2007; Polikarpus *et al*. 2013), stage of lactation (Varlyakov *et al*. 2011; Polikarpus *et al*. 2013), milk production (Góreckiand Wójtowski, 2004), estrus, hunger etc.

Reddy and and Tripathi (1987) have reported a positive correlation between social hierarchy and milk yield in dairy cows and buffaloes. Similar results were obtained by Mittal *et al*. (1996) in free grazing Zebu cattle population and Sołtysiak and Nogalski (2010) in a herd of Polish Holstein-Friesian cattle. An entrance order in the milking parlour was more stable within day and across days, within lactation and more variable across lactations (Berry and McCarthy, 2012; Varlyakov *et al*. 2011; Polikarpus *et al*. 2015), Kendells coefficients ranged between 0.373-0.421 ($P<0.001$). It should be noted that buffaloes showed higher entrance order consistency and side preference than other domestic ruminants (Kendells coefficients of concordance 0.624-0.779 ($P<0.001$) (Polikarpus *et al*. 2013).

There have been numerous studies on the relationship between entrance order consistency of cows in the milking parlour and milk production (Reddy and and Tripathi, 1987; Mittal *et al*. 1996; Sołtysiak and Nogalski, 2010; Varlyakov *et al*. 2011; Polikarpus *et al*. 2015), stage of lactation (Polikarpus *et al*. 2013), age of a cow and lactation number (Grasso *et al*. 2007; Polikarpus *et al*. 2013), live weight (Reinhardt, 1973), somatic cell count (Grasso *et al*. 2007), health problems and time after the group formation (Polikarpus *et al*. 2015). During milking some cows prefer a certain side in the milking parlour (Górecki and Wójtowski, 2004; Grasso *et al*. 2007; Orban *et al*. 2011). Fahim *et al*. (2018) were found that side preference had significant effect on milk yield ($P<0.001$). Cows that were being milked in the non-preferred side increased duration of milking ($P<0.001$). The temperament score was signifi-

cantly higher in the non-preferred side of the milking parlour. The choice of side preference is also influenced by anxiety, fear, stress and sensitivity of animals (Prelle *et al.* 2004). It is believed that cows are more disturbed were being milked in the non-preferred side and this disturbance could lead to poor welfare. But Paranhos da Costa and Broom (2001), who have been estimated of cows reactivity during premilking udder preparation milk yield and duration of milking didn't find any evidence that cows were discomforted or stressed when they were milked in the non-preferred side of the milking parlour. It has been established that change monitoring in the entrance order of cows in the milking parlour can be useful tool for early diagnosis. However, cows who tended to enter first for milking had lower somatic cell count (r_s=0.25, P<0.10), it means their udder was healthier (Grasso *et al.* 2007). Cows with mastitis entered the milking parlour later (P<0.001), and cows with metritis, on the contrary, entered earlier (P<0.05) compared to these cows were healthy (Polikarpus *et al.* 2015). Thus, for fully express cows' genetic potential for productivity, early diagnosis of diseases there is a need to avoid frequent unreasonable regrouping, avoid situations when cows cannot freely choose preferable entrance order and side of milking. Present study was conducted to investigate the consistency of the entrance order in the milking parlour (group preference, side preference and standing position) and the relationships between the entrance order and some parameters of milk production and type of NA.

MATERIALS AND METHODS

The study was carried out on the commercial dairy farm "Terezyne", which located in Kyiv region, Ukraine. The farm rearing more than 3000 dairy cattle of Holstein, Ukrainian Black and White and Ukrainian Red and White dairy breeds with 650 lactating cows. Cows were housed in an open-sided barn with cubicle beds in the lying area. They were milked with a 2 × 16 DeLaval parallel milking parlour, Sweden. The cows were monitored through an automatic animal identification system consisting of a neck transponder and ALPRO. Five hundred forty-two cows were involved in 10 milking session. These cows were kept in seven groups, 75-85 cows in each group. The groups were formed depending on a lactation stage and daily milk yield. The average milk yield for 305-day current lactation was 7697 ± 48.5 kg (range depends on the group=7568-7825 kg), milk fat percentage – 4.34 ± 0.006% (range=4.30-4.36%), milk protein percentage – 3,41 ± 0.003% (range=3.40-3.43%), fat yield – 334.0 ± 2.04 kg (range=326-340 kg), protein yield – 262.6 ± 1.63 kg (259-266 kg), daily milk yield – 23.0 kg (range=3.1-40.3 kg), they were on a lactation stage of 205 ± 5.2 days (7-709 days). Cows were kept in the separate groups according to their milk production, stage of lactation and health status. During the collection of data there weren't any regrouping of cows. Before each milking session all cows of each milking group were taking together to a waiting area. Cows were free to choose their position in the milking parluor without any involvement of the personnel. Both sides of the milking parlour were identical. The cows were milked twice a day, given the group preference, side preference and standing position of each cow in the milking parlour. The lactation number, stage of lactation, daily milk yield, milk yield for 305-day current and first lactations, fat yield and protein yield per lactation were also analyzed. For each milking session the entrance order in the milking parlour were divided into three groups: first, second and third, the maximum cows in each group–32. We recorded the side chosen by each cow during milking sessions. For converting qualitative trait into quantitative trait side preference (right or left) was indicated as1 or 2. Depending on the frequency of choosing right side for milking cows were divided into five groups: I) cows with preferable right side in 90-100 cases of milking, II) 70-80 %, III) 40-60%, IV) 20-30%, V) 0-10%. The standing position of cows in the milking parlour ranged from1to 16, and each milking group of cows divided into three groups: front, middle and back. The type of NA of cows was determined the authors' own methodology under which cows were divided into three types: I) reactive (active), II) balanced, III) inert (calm) (Table 1).

For determining the type of NA, two elements of cow behavior were used–group preference and standing position of cows in the milking parlour, which were determined on the basis of 10 adjacent milking. The combination of group preference and standing position has enabled to determine the type of NA of cows. Data were analysed with the Statistical Analysis System package Statistica 10 in module Basic Statistics (SAS, 2004) and Tables with comparison group average and calculate of Pearson correlation.

RESULTS AND DISCUSSION

The results of the present study demonstrated that the highest repeatability of elements of cows behavior in the milking parlour was typical for group preference (repeatability coefficient 0.47), much lower but significant-for side preference (0.17) and standing position (0.09) in the milking parlour (Table 2).

It has been established that the first group in the milking parlour is consistently chosen 26% of cows, the second–39%, the third group-35% (Table 3).

The first group for milking was preferable for young cows (their average lactation number 1.7) with lower milk production (milk yield per lactation-7552 kg, milk fat yield-329 kg, milk protein yield-258 kg).

Table 1 Methodology of determining the type of nervous activity (NA) of cows

Item	Group preference (on average), lim	Standing position (on average), lim	Type of NA (group on average), lim	Combinations[1]	Type of NA
I	1.0-1.3	1.9-6.9	1.0-1.5	I-I, I-II	Reactive
II	1.4-1.9	7.0-9.0	2.0	II-II, I-III	Balanced
III	2.0-2.8	9.1-13.4	2.5-3.0	II-III, III-III	Inert

[1] Possible combinations of group preference and standing position of cow in the milking parlour.
I: reactive (active); II: balanced and III: inert (calm).

Table 2 The repeatability of behavior of dairy cows in the milking parlour

Elements of behavior	Repeatability on avarage	P-value	Min	Max
Group preference	0.47	0.001	0.44	0.55
Side preference	0.17	0.001	0.07	0.24
Standing position	0.09	0.05	0.03	0.20

Table 3 Milk production and behavior of dairy cows depending on group preferencein the milking parlour (Mean±SE)

Parameters		Group[1]		
		First	Second	Third
n		192	214	136
Lactation number		1.7±0.07	2.0±0.09	2.3±0.13***
305-d current lactation, kg:	Milk yield	7552±76.2	7746±80.9	7827±97.9*
	Milk fat yield	329±3.1	335±3.5	339±4.1
	Milk protein yield	258±2.5	264±2.7	267±3.3*
Elements of behavior and type of nervous activity (NA)	Side preference	1.49±0.020	1.49±0.017	1.50±0.017
	Standing position	7.53±0.049	8.57±0.129***	8.49±0.144***
	Type of NA	1.23±0.030	2.26±0.050***	2.79±0.035***

*** (P<0.001) and * (P<0.05).

The cows that preferred the third group for milking compared to the cows of the first group, were older by an average of 0.6 lactation, they had a higher milk yield by 275 kg (P<0.05), more milk fat and milk protein yields-by 10 kg and 9 kg (P<0.05) respectively. No differences were found inside preference of cows in three groups. But a significant difference in the choosing of standing position in the milking parlour has been confirmed.

If for cows of the first group the average number of standing position was 7.53 while for cows of the second and third groups it was significantly higher (P<0.001) and ranged from 8.49 to 8.57. There has been found significant difference between second and third groups on type of NA (P<0.001). Cows of the first group had mainly reactive type of NA, for cows of the second group it was closer to the balanced type and for cows of the third group-to the inert type of NA.

Thus, calmer older cows with higher milk production preferred the second or third groups in the milking parlour and young active cows chose mainly the first group for milking. Analysis the side preference in the milking parlour showed that 8-12% of cows consistently chose the right or left side with a frequency of 90-100% (I and V groups), 17-21% of cows-with a frequency of 70-80% cases (II and IV groups) and 42% of cows did not have a preferable side in the milking parlour and they chose right or left side with approximately the same frequency (40-60%) (III group) (Table4).

A little higher milk yield, milk fat and milk protein yields were observed in cows that chose right or left side with a frequency of 90-100%. They exceeded cows with a frequency of 70-80%, respectively by 197 kg, 9.5 kg i 6.5 kg but these differences were not significant.

Analyses of behavioral elements showed that cows which consistently chose right or left tended to enter the milking parlour earlier (average group preference-1.32 and 1.46, P<0.05 and P<0.001), their standing position was closer to the front of the milking parlour (average standing position-7.14 and 7.47, P<0.05 and P<0.01). The type of NA of cows that preferred right or left side in the milking parlour in 90–100 % of cases approached the reactive type of NA-1.72 i 1.62 (P<0.05 and P<0.01). There have been found significant differences for group preference (between II and V groups, P<0.01; IV and V groups, P<0.01) and type of NA (between IV and V groups, P<0.05). There was a trend towards the change the type of NA from reactive to inert with a decreasing in stability of side preference in the milking parlour. There have been identified three groups of cows (front, middle and back) in each group preference depending on the standing position in the milking parlour. The average standing position of cows in front group was 5.61, middle – 8.08, in back group-10.17 (Table 5).

Table 4 Milk production and behavior of dairy cows depending on side preference in the milking parlour (Mean±SE)

Parameters		Group of right side preference				
		I (90-100%)	II (70-80%)	III (40-60%)	IV (20-30%)	V (0-10%)
n		60	93	228	114	47
Lactation number		2.1±0.26	2.2±0.21	1.8±0.13	2.0±0.18	1.9±0.21
305-d current lactation, kg	Milk yield	7837±183.3	7647±186.1	7737±122.0	7564±137.8	7746±269.0
	Milk fat yield	340±7.5	331±7.7	336±5.2	327±5.9	337±11.2
	Milk protein yield	267±6.1	261±6.2	264±4.1	258±4.6	264±9.0
Elements of behavior and type of nervous activity (NA)	Group preference	1.46±0.075*	1.59±0.066	1.69±0.049	1.58±0.058	1.32±0.068***
	Standing position	7.47±0.415*	8.08±0.268	8.58±0.209	8.11±0.226	7.14±0.464**
	Type of NA	1.72±0.155*	2.01±0.123	2.19±0.091	2.06±0.113	1.62±0.163**

I group: right side for milking chosen by 90-100% of cows, left side-0-10% of cows; II group: right side-70-80%, left side-20-30 %; III group: right side-40-60%, left side-40-60%; IV group: right side-20-30%, left side-70-80% and V group: right side-0-10%, left side-90-100%.
*** (P<0.001); ** (P<0.01) and * (P<0.05).

Table 5 Milk production and behavior of dairy cows depending on standing position in the milking parlour (Mean±SE)

Parameters		Standing position		
		Front	Middle	Back
n		141	210	191
Lactation number		2.0±0.10	1.8±0.07	2.0±0.10
305-d current lactation, kg	Milk yield	7665±103.2	7769±76.6	7640±78.6
	Milk fat yield	333±4.3	338±3.2	331±3.3
	Milk protein yield	261±3.4	265±2.6	261±3.6
Elements of behavior and type of nervous activity (NA)	Group preference	1.46±0.041	1.61±0.030**	1.67±0.028***
	Side preference	5.61±0.100	8.08±0.038***	10.17±0.061***
	Standing position	1.50±0.024	1.49±0.017	1.50±0.016
	Type of NA	1.20±0.034	1.90±0.053***	2.77±0.030***

*** (P<0.001) and ** (P<0.01).

No important differences in milk production of cows depending on their standing position in the milking parlour have been detected. In particular the lactation number ranged from 1.8 to 2.0 (maximum difference between groups was 10 %), milk yield-7640-7769 kg (difference 1.7 %), milk fat yield-331-338 kg (difference 2.1%), milk protein yield-261-265 kg (difference 1.5%). In contrast of milk production the influence of standing position of cows in the milking parlour on the elements of behavior was more significant. The first to the milking parlour mainly entered the cows with active (reactive) type of NA, the last – calmer animals with inert type of NA. The differences between the cows that entered the first and the last in the milking parlour by the group preference was 0.21 (P<0.001), by the type of NA-1.57 (P<0.001). More trait differences were significant between middle and back standing position on side preference (P<0.001) and type of NA (P<0.001). Thus, while cows chose group preference and milking position in the milking parlour a similar trend was observed – the first entered for milking the cows with reactive type of NA, the last-the cows with inert type of NA.

It has been established that type of NA of cows depends on the elements of behavior in the milking parlour and type of NA had some influence on the milking production of cows.

Cows with inert type of NA compared to reactive type, were on average 0.4 lactation older (P<0.01), their milk yield was higher by 111 kg, milk fat yield-by 3 kg, milk protein yield-by 4 kg (Table 6). The differences in group preference and standing position were significant (P<0.001 in all cases).

There have been found significant differences between balanced and inert type of NA on lactation number (P<0.01), group preference (P<0.001) and side preference (P<0.001). If group preference of cows with reactive type of NA was an average 1.20, whereas group preference of balanced cows was 1.90, inert cows-2.54. Standing position of cows in the milking parlour depending on type of NA ranged from 6.50 (reactive type) to 9.60 (inert type). Side preference of cows was not related to the type of NA and remained almost constant in cows of different NA types (1.49-1.50). So it was not used for determining the type of NA.

Low and in most cases non significant correlation between elements of behavior and milk production of cows was found (Table 7). It was also revealed that direct but low significant correlation was between group preference and 305-d current lactation milk yield. Between current lactation number and group preference and type of NA was also identified a low direct significant correlation.

Table 6 Milk production and behavior of dairy cows depending on type of nervous activity (NA) (Mean±SE)

Parameters		Type of NA		
		Reactive	Balanced	Inert
n		185	156	201
Lactation number		1.8±0.08	1.8±0.09	2.2±0.10**
305-d current lactation, kg	Milk yield	7628±86.9	7725±88.5	7739±77.6
	Milk fat yield	332±3.6	335±3.7	335±3.3
	Milk protein yield	260±2.9	263±2.9	264±2.7
Elements of behavior and type of nervous activity (NA)	Group preference	1.20±0.029	1.90±0.054***	2.54±0.035***
	Side preference	6.50±0.121	8.35±0.119***	9.60±0.088***
	Standing position	1.49±0.022	1.50±0.018	1.50±0.016

*** (P<0.001) and ** (P<0.01).

Table 7 The correlation between elements of behavior of dairy cows in the milking parlour and milk production (r±SE)

Parameters	Elements of behavior			
	Group preference	Side preference	Standing position	Type of nervous activity (NA)
Lactation number	019±0.042***	-0.07±0.043	0.01±0.044	0.12±0.043**
Day of lactation	0.03±0.043	0.02±0.043	-0.02±0.043	0.01±0.043
305-d first lactation milk yield, kg	-0.05±0.044	-0.02±0.044	0.03±0.044	-0.02±0.043
305-d current lactation milk yield, kg	0.10±0.045*	-0.004±0.046	-0.01±0.046	0.04±0.046
Daily milk yield, kg	-0.03±0.043	-0.03±0.43	0.02±0.043	-0.01±0.043

*** (P<0.001); ** (P<0.01) and * (P<0.05).

It has been established that dairy cows have clear intra-group rank position for feeding and milking (Soch *et al.* 1997). Gadbury (1975) claimed that only 15-20% of cows had entered the milking parlour consistently, 80-85% of cows had entered for milking at random.

However, Beggs (2018) argued that entrance order of cows in the milking parlor was quite stable. Within a day a difference in milking order was less than 20% for 72% of cows and the position of cows at the beginning and the end of the milking was more consistent than cows in the middle. Correlation between standing position of cows in one month and the next month was high (r=0.88). Our study showed that the highest repeatability experienced group preference (repeatability coefficient 0.47), lower – side preference and standing position in the milking parlour (0.17 i 0.09, respectively).

According to Varlyakov *et al.* (2011) in the herd of dairy cattle depending on the milking order three groups of cows were formed. 16% of cows tended to enter the milking parlour the first, 18-25% were always the last, 50-66%-of cows formed middle or "tolerant" group. In our study slightly different results were obtained. The first group for milking consistently chose 26% of cows, the second group-39%, the third group-35% of cows. The first group was mainly chosen by young cows with average lactation number 1.7; average lactation number of cows in the second group was 2.1, in the third group-2.3.

Rathore (1982) and Gadbury (1975) have reported that cows with higher milk yield came earlier for milking and cows with lower milk yield came later regardless of the farm management system.

Similar results were obtained by Garcia *et al.* (2016), who claimed that daily milk yields of cows milked first was higher than those cows milked last in the order by 4.5 L/cow/day. For three farms differences in milk production between cows milked first and milked last ranged from 14 to 29%. In the view of Beggs (2018), cows milked first have more time for lying down, feeding *etc* and this is a basis for more efficient milk production. However, Grasso *et al.* (2007) came to a different conclusion. In their study highly productive cows entered the milking parlour in the last group, they considered that milking was a stress for cows during farming routine. Varlyakov *et al.* (2011) have obtained slightly different results: in their study highly productive cows were never among cows milked first or last, they entered the milking parlour in the middle «tolerant» group. We have found that cows with higher milk production entered the milking parlour later – in the second and third groups. This is consistent with the report of Grasso *et al.* (2007).

In our study 8-12% of cows were milked on the left or right side with a frequency of 90-100%, 17-21% of cows with a frequency of 70-80% of cases, and 42% of cows did not give preference to a particular side. This behavior in the milking parlor is more similar to the results of Grasso *et al.* (2007). However, there are no firm conclusions about correlations between temperament of cows and their economically important traits. Some scientists believed that higher live weight (Cziszter *et al.* 2016), milk production (milk yield, fat and protein yields, milking speed (Hoppe *et al.* 2010; Haskell *et al.* 2014; Neja *et al.* 2015; Cziszter *et al.* 2016), shorter calving interval (Cziszter *et al.* 2016), longer

lifespan, productive lifetime and more calves (Sewalem *et al*. 2010; Haskell *et al*. 2014; Neja *et al*. 2015) were observed in a cows with a calm temperament. According to researches of Polikarpus *et al*. (2013), 45.9% of cows preferred the right side in the milking parlour, 43.9%-the left side, 4.8%-showed no preference. Varlyakov *et al*. (2011) have reported that preference toward the milking side showed 50.2% of cows and their share increased over time after group formation. A bit different results were obtained by Grasso *et al*. (2007), in whose studies the right side chose 10.1% of primiparous, the left side-12.7%, indifferently used the right and the left side-77.2% of cows. In group of multiparous 28.3% of cows chose the right side, 71.7%-didn't show any preference for side in the milking parlour.

Budzyńska *et al*. (2005) reported that 91.6% of cows had a calm temperament, 8.4% had an excitable temperament. In our study slightly different results were obtained. We classified the inert or quiet type of NA in 37% of cows, this discrepancy can be partly explained by using of different methods for assessing the temperament of cows. Neja *et al*. (2015) noted that cows with a calm temperament were characterized 621 kg higher first-lactation milk yield compared to cows with a normal temperament and 329 kg higher compared to the milk yield of excitable (aggressive) cows. Cziszter *et al*. (2016) believed that the selection of cows with calm temperament would increase milk yield, milk fat and milk protein yields, as well as decrease the calving interval and improve the milking speed.

Other researchers have found that higher daily milk yield and milk yield per lactation (Praxedes *et al*. 2011; Gergovska *et al*. 2012; Sawa *et al*. 2017), higher milking speed (Sawa *et al*. 2017), but irregular lactation curves (Gergovska *et al*. 2014) were observed in cows with a nervous temperament. Cows with a nervous temperament had significantly higher milk yield (6546.67 kg) compared to animals with a calm temperament (3406.45 kg) (Praxedes *et al*. 2011). Gergovska *et al*. (2012) reported that milk yield of the nervous and very nervous cows is higher than in cows with medium and very calm temperament by 744.8 kg in the Holstein cows and by 445.2 kg in Brown Swiss ones. We did not find a significant difference in milk yield, milk fat and milk protein yields in cows of different types of NA. Milk yield ranged from 7628 kg in reactive cows to 7739 kg in cows with inert type of NA, milk fat yield ranged from 332 to 335 kg, milk protein - from 260 to 264 kg. This coincides with the results of research Cziszter *et al*. (2016), Orban *et al*. (2011), Gergovska *et al*. (2012) who did not establish relationships between the temperament of cows and milk yield (Orban *et al*. 2011), milk composition traits (Gergovska *et al*. 2012), fat percentage, somatic cell count, body condition score, cleanliness of udder and cleanliness of hindquarter, days open, number of inseminations per gestation (Cziszter *et al*. 2016). Numerous studies have investigated the relationship between the entrance order of cows in the milking parlor and other traits. Berry and McCarthy (2012) found a significant ($P<0.001$) but weak correlation between entrance order and milk yield ($r=0.04$) and fat content ($r=0.01$); negative correlation-between entrance order and protein content ($r=-0.02$), and somatic cell count ($r=-0.05$).

In the view of Reinhardt (1973) and Gadbury (1975) between entrance order and last recent calving there was a significant relationship than those not having calved for a long period. Cows with later stages of lactation entered the milking parlour latterly ($r_s=0.334$, $P<0.05$). Between entrance order and parity of cows were found negative correlations ($r_s=-0.319$-0.325, $P<0.05$) (Polikarpus *et al*. 2013). Grasso *et al*. (2007) have not been established correlation between entrance order and age of cows, they have reported that the Kendells coefficients of concordance both for primiparous and multiparous cows were approximately the same-0.36 ($P<0.001$). The entrance order for milking was rather higher influenced by the stage of lactation ($r=0.330$, $P<0.01$), daily milk yield ($r=0.398$, $P<0.001$) (Varlyakov *et al*. 2011) and lactation milk yield ($r_s=0.22$, $P<0.05$) (Grasso *et al*. 2007). The Kendells coefficients increase with time after forming the group. After changing in group cows established themselves into a stable position within two days (Polikarpus *et al*. 2015). It should be noted that Polikarpus *et al*. (2015) and Reinhardt (1973) came to a different conclusion. Age, live weight, number and stage of lactation, milk production and duration of milking didn't affect the milking order relationship. We have been established a significant correlation between the group preference and lactation number ($r=0.19$, $P<0.001$), as well as between group preference and milk yield for the current lactation ($r=0.10$, $P<0.05$). There was no significant relationship ($r=-0.07…0.03$) between the standing position, side preference and age of cows and milk yield.

CONCLUSION

In this study, it was found that cows with higher milk production tended to enter the milking parlour in the last group, they preferred right or left side for milking more stable and chose standing position closer to the front part of the milking parlour. Cows with inert type of NA showed higher milk production. We can assume that with age the type of NA of cows changes from reactive to inert. Cows get used to the daily routine, to machine milking, so become older they react more calmly to external stimuli. At the same time cows with excessively excitable temperament can prematurely culled from the herd.

ACKNOWLEDGEMENT

We would like to thank our universities to provide animal breeding units as well as equipment needed.

REFERENCES

Adamczyk K., Pokorska J., Makulska J., Earley B. and Mazur M. (2013). Genetic analysis and evaluation of behavioural traits in cattle. *Livest. Sci*. **154,** 1-12.

Barazandeh A., Mohammadabadi M.R., Ghaderi M. and Nezamabadipour H. (2016). Predicting CpG Islands and their relationship with genomic feature in cattle by hidden Markov model algorithm. *Iranian J. Appl. Anim. Sci.* **6,** 571-579.

Beggs D.S. (2018). Milking order consistency of dairy cows in large Australian herds. *J. Dairy Sci.* **101,** 603-608.

Berry D.P. and McCarthy J. (2012). Genetic and non-genetic factors associated with milking order in lactating dairy cows. *Appl. Anim. Behav. Sci*. **136,** 15-19.

Breuer K., Hemsworth P.H., Barnett J.L., Matthews L.R. and Coleman G.J. (2000). Behavioural response to humans and the productivity of commercial dairy cows. *Appl. Anim. Behav. Sci.* **66,** 273-288.

Budzyńska B., Ceglińska A., Kamieniak J., Krupa W. and Sapula M. (2005). Behaviourof dairy cows during premilking udder preparation. *Pp.* 33-35 in Proc. 4th Int. Congr. Ethol. Anim. Prod., Nitra, Slovak Republic.

Curley K.O., Neuendorff D.A., Lewis A.W., Cleere J.J., Welsh T.H. and Randel R.D. (2008). Functional characteristics of the bovine hypothalamic-pituitary-adrenal axis vary with temperament. *Horm. Behav.* **53,** 20-27.

Cziszter L.T., Gavojdian D., Neamt R., Neciu F., Kusza S. and Ilie D.E. (2016). Effects of temperament on production and reproductive performances in Simmental dual-purpose cows. *J. Vet. Behav*. **15,** 50-55.

Ebrahimi B., Taghizadeh A. and Mehmannavaz Y. (2020). Milk production, milk fatty acid profiles and blood metabolites in Holstein dairy cows fed diets based on dried citrus pulp. *Iranian J. Appl. Anim. Sci.* **10(4),** 623-629.

Fahim A., Kamboj M.L., Bhakat M., Mohanty T.K. and Gupta R. (2018). Preference of side and standing in relationship with milking characteristics and temperament score of crossbred dairy cows in an 8 × 2 herringbone milking parlour. *Turkish J. Vet. Anim. Sci.* **42,** 49-54.

Flower F.C., Sanderson D.J. and Weary D.M. (2006). Effects of milking on dairy cow gait. *J. Dairy Sci.* **89,** 2084-2089.

Frondelius L., Järvenranta K., Koponen T. and Mononen J. (2015). The effects of body posture and temperament on heart rate variability in dairy cows. *Physiol. Behav*. **139,** 437-441.

Gadbury J.C. (1975). Some preliminary field observations on the order of entry of cows into herringbone parlous. *Appl. Anim. Ethol*. **1,** 275-281.

Garcia S., Islam M. and Clark C. (2016). Milk yield and milk composition varies with milking order for pasture-based dairy cattle. Pp. 7-10 in Proc. Australasian Dairy Sci. Symp. Conf., Sydney, Australia.

Gergovska Z., Marinov I., Penev T. and Angelova T. (2014). Effect of milking temperament on productive traits and SCC in Black-and-White cows. *Int. J. Curr. Microbiol. App. Sci.* **3,** 1-11.

Gergovska Z., Miteva T., Angelova T., Yordanova D. and Mitev J. (2012). Relation of milking temperament and milk yield in Holstein and Brown Swiss cows. *Bulgarian J. Agric. Sci.* **18,** 771-777.

Gibbons J., Lawrence A.B. and Haskell M.J. (2009). Responsiveness of dairy cows to human approach and novel stimuli. *Appl. Anim. Behav. Sci*. **116,** 163-173.

Górecki M.T. and Wójtowski J. (2004). Stability of milking order in goat over a long period (short communication). *Arch. Tierz.* **47,** 203-208.

Grasso F., De Rosa G., Napolitano F., Di Francia A. and Bordi A. (2007). Entrance order and side preference of dairy cows in the milking parlour. *Italian J. Anim. Sci.* **6,** 187-194.

Haskell M.J., Simm G. and Turner S.P. (2014). Genetic selection for temperament traits in dairy and beef cattle. *Front. Genet*. **5,** 368-375.

Hoppe S., Brandt H.R., König S., Erhardt G. and Gauly M. (2010). Temperament traits of beef calves measured under field conditions and their relationships to performance. *J. Anim. Sci*. **88,** 1982-1989.

Karlova L.V., Gavrilina O.G., Alekseeva N.V. and Peretyatko O.V. (2018). Typological features of the nervous system of cows depending on the reactivity and stress resistance.*Ukrainian J. Ecol*. **8,** 149-159.

Kharrati Koopaei H., Mohammad Abadi M.R., Ansari Mahyari S., Tarang A.R., Potki P. and Esmailizadeh A.K. (2012). Effect of DGAT1 variants on milk composition traits in Iranian Holstein cattle population. *Anim. Sci. Pap. Rep.* **30,** 231-240.

Kilgour R.J., Melville G.J. and Greenwood P.L. (2006). Individual differences in the reaction of beef cattle to situations involving social isolation, close proximity of humans, restraint and novelty. *Appl. Anim. Behav. Sci.* **99,** 21-40.

Kokorina E.P. (1986). Conditioned Reflexes and Animal Production. Nauka, Moscow, Russian.

Kovács L., Bakony M., Tőzsér J. and Jurkovich V. (2013). The effect of milking in a parallel milking parlor with non-voluntary exit on the HRV of dairy cows. *J. Dairy Sci*. **96,** 7743-7747.

MacKay J.R.D., Turner S.P., Hyslop J., Deag J.M. and Haskell M.J. (2013). Short term temperament tests in beef cattle relate to long term measures of behavior recorded in the home pen. *J. Anim. Sci*. **91,** 4917-4924.

Melin M., Hermans G.G.N., Pettersson G. and Wiktorsson H. (2006). Cow traffic in relation to social rank and motivation of cows in an automatic milking system with control gates and an open waiting area. *Appl. Anim. Behav. Sci*. **96,** 201-214.

Mittal S.P., Kaushik S.K. and Prasad S. (1996). Dominance pattern in free grazing zebu cattle. *Indian J. Anim. Prod. Manag.* **12,** 99-103.

Nassiry M.R., Shahroodi F.E., Mosafer J., Mohammadi A., Manshad E., Ghazanfari S., Mohammad Abadi M.R. and Sulimova G.E. (2005). Analysis and frequency of bovine lymphocyte

antigen (BoLA-DRB3) alleles in Iranian Holstein cattle. *Russian J. Genet.* **41,** 664-668.

Neja W., Sawa A., Jankowska M., Bogucki M. and Krężel-Czopek S. (2015). Effect of the temperament of dairy cows on lifetime production efficiency. *Arch. Anim. Breed*. **58,** 193-197.

Norouzy A., Nassiry M.R., Shahrody F.E., Javadmanesh A., Abadi M.R.M. and Sulimova G.E. (2005). Identification of bovine leucocyte adhesion deficiency (BLAD) carriers in Holstein and Brown Swiss AI bulls in Iran. *Russian J. Genet.* **41,** 1409-1413.

Orban M., Gall K., Pajor F., Szentleleki A., Poti P., Tozer J. and Gulyas L. (2011). Effect of temperament of Jersey and Holstein Friesian cows on milk production traits and somatic cell count. *Arch. Tierz*. **54,** 594-599.

Paranhos da Costa M.J. and Broom D.M. (2001). Consistency of side choice in the milking parlour by Holstein-Friesian cows and its relationship with their reactivity and milk yield. *Appl. Anim. Behav. Sci*. **6,** 177-186.

Nagel C., Aurich J. and Aurich C. (2020). Prediction of the onset of parturition in horses and cattle. *Theriogenology*. **150,** 308-312.

Polikarpus A., Grasso F., Pacelli C., Napolitano F. and De Rosa G. (2013). Milking behaviour of buffalo cows: Entrance order and side preference in the milking parlour. *J. Dairy Res*. **81,** 1-6.

Polikarpus A., Kaart T., Mootse H., De Rosa G. and Arney D. (2015). Influences of various factors on cows' entrance order into the milking parlour. *Appl. Anim. Behav. Sci.* **166,** 20-24.

Praxedes V., Verneque R., Pereira M., Pires M., Machado M. and Peixoto M. (2011). Evaluation of Factors Influencing Milk Ejection in the Brazilian Gyr Dairy Cattle. Brazilian Agricultural Research Corporation (EMBRAPA), Brazil.

Prelle I., Phillips C.J.C., Paranhos da Costa M.J., Vandenberghe N.C. and Broom D. M. (2004). Are cows that consistently enter the same side of a two-sided milking parlour more fearful of novel situations or more competitive? *Appl. Anim. Behav. Sci*. **87,** 193-203.

Rathore A.K. (1982). Order of cow entry at milking and its relationships with milk yield and consistency of the order. *Appl. Anim. Ethol*. **8,** 45-52.

Reddy A.O. and Tripathi V.N. (1987). Studies on leadership patterns and social dominance in Murrah buffaloes in relation to their physical and production traits. *Indian J. Anim. Prod. Manag.* **3,** 20-23.

Reinhardt V. (1973). Contributions on the social rank and milking order in cows. *Z. Tierpsychol.* **32,** 281-292.

SAS Institute. (2004). SAS®/STAT Software, Release 9.4. SAS Institute, Inc., Cary, NC. USA.

Sawa A., Bogucki M., Neja W. and Krężel-Czopek S. (2017). Effect of temperament on performance of primiparous dairy cows. *Ann. Anim. Sci.* **17,** 863-872.

Sewalem A., Miglior F. and Kistemaker G. (2010). Analysis of the relationship between workability traits and functional longevity in Canadian dairy breeds. *J. Dairy Sci*. **93,** 4359-4365.

Shaposhnik B.M., Sapachova M.A. and Tsarenko T.M. (2015). Productivity of Ukrainian black-and-white dairy cows depending on the type of higher nervous activity (in Ukrainian). *Sci. Bull. Vet. Med*. **2,** 117-122.

Smirnov A.D. and Val'kovskaya N.V. (2018). The interrelation between the higher nervous activity type of the Kholmogory breed cows and their milk productivity. *Agris*. **226,** 60-65.

Soch M., Kolarova P., Rehout V., Kosvanec K., Hajic F. and Citek J. (1997). Effect of dairy cows moving from tie-stall to loose housing system on their production and behaviour. *Sborník ZF JU*, *Rada Zootec*. **14,** 77-86.

Sołtysiak T. and Nogalski Z. (2010). The effects of social hierarchy in a dairy cattle herd on milk yield. *Polish J. Natur. Sci*. **25,** 22-30.

Szymik B., Topolski P. and Jagusiak W. (2015). Phenotypic characteristics of workability traits in the population of Polish Black-and Red-and-White Holstein-Friesian, Simmental and Polish Red cows (in Polish). *Rocz. Nauk. Zootec.* **42,** 3-16.

Varlyakov I., Radov I., Slavov T. and Grigorova N. (2011). Behaviour of cows in milking parlour. *Agric. Sci. Technol*. **3,** 107-111.