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# EFFECTS OF TEMPERAMENT ON MILK RELATED TRAITS IN SIMMENTAL DUAL-PURPOSE COWS

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## ABSTRACT

The objective of the current study was to establish a possible link between cows' reactivity and milk-related traits. In addition, the study intended to examine changes in herd structure related to cow temperament over successive years. Between October 2016 and October 2021, 7600 data were collected from 1520 lactations for milk, fat, and protein yields, as well as milking speed based on cow temperament. The cow's temperament was classified as calm, moderate, and nervous. Most of the cows exhibited moderate reactivity (87.13%) compared to calm (5.24%) and nervous (7.63%). The one-way ANOVA protocol showed that cow's reactivity significantly influenced ($p$≤0.001) milk, fat and protein yields having more substantial effects ($p$≤0.001) on the milking speed for nervous ones. The calm cows produced more milk (5766.86±130.98 kg), fat (239.12±5.24 kg) and protein (201.56±4.3 kg) compared to moderate (-309.7, -19.73, -15.3 kg, $p$≤0.01) and nervous cows (-707.9, -32.2, -28 kg, $p$≤0.01). Significantly higher milking speed was recorded for calm cows (2.36 kg/min.) compared to moderate (2.28 kg/min., $p$≤0.05) and nervous cows (2.21 kg/min., $p$≤0.01). Over successive years a significant increased ($p$≤0.001) trend in calm (from 3.34 to 8.92%) was observed to the detriment of the nervous cows (from 5.45 to 2.32%) and moderate ones (from 91.21 to 88.76%). The current findings highlight that calmer cows produce more milk, fat and protein yields compared to nervous ones despite the controversial relationship between temperament and milk related traits.

**Key-words:** milk related traits, milking speed, Simmental breed, temperament



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## INTRODUCTION

Temperament is a distinguishing feature of every individual. Although there is considerable interest in this subject, the origin and sources of variation are not well understood. Studies regarding cattle temperament have been performing on for over 100 years, the initial belief being that this represents the behavioural reaction related to human manipulation, a reaction that appeared out of fear. The implication of the term "temperament" involves an association with one of the emotional states such as the fear that appears in relation to a direct threat or the anxiety which describes a response to a potential threat (Öhman, 2010). The specific temperament also makes its presence felt related to novelty elements (within the exploratory behaviour), related to playful challenges or intraspecific social relations (Réale *et al.,* 2007). Temperament is generally defined as an animal reaction to environmental and social stimuli (Haskell *et al.,* 2014) with persistence over time in various contexts (Dall *et al.,* 2004; Kunowska-Slósarz and Slósarz, 2008). Persistence of temperament in time is due to a relatively moderate genetic determinism ranging between 0.07 (Hiendleder *et al.,* 2003), 0.13 (Sewalem *et al.,* 2011) and 0.36 (Burrow, 1997), according to different authors. The importance of temperament resides in its induced effect on productivity, reproductive performance, well-being and health, as well as the willingness to interact with counterparts and caretakers with direct economic implication. In the current breeding programs, the cows' temperament is already integrated as a selection index in dairy cattle (Adamczyk *et al.,* 2013) while in beef cattle, temperament is recognized as an important trait for economic efficiency and frequently assessed, but its use in selection is uncommon (Sant'Anna *et al.,* 2013). Reason for this situation is the possible negative and competitive relationship between temperament and production traits (Oltenacu and Broom, 2010). The difficulty in the assessment of temperament often resides in the subjectivity of the human observer. In this respect,

significant differences were recorded and presented in the literature. Despite these difficulties, many efforts are being made in order to assess the cow's temperament and relate it to individual performance indexes (Keyserling *et al.,* 2009; Hoppe *et al.,* 2010). Generally, some unanimously accepted tests are used in order to assess the temperament of cows as human-animal interactions, flight distance, flight speed or novel objects test. A very usual and common test is restraining cows during weighing test (Foris *et al.,* 2018). These tests are safe, quick and easy to apply in farms, but are also subjective and strongly dependent by human observer.

In dairy cows, temperament is related to other traits, which makes it possible to evaluate them. Previous studies highlighted strong correlations between milking temperament and udder health (Santos *et al.,* 2018), milk yield (Chang *et al.,* 2019), milking speed (Kramer *et al.,* 2013) or availability for automated milking system (Wethal and Heringstad, 2019). As a result of the loss of many natural behavioural traits due to intensive production systems and the acceleration of technological processes, the precision in temperament evaluation has decreased as a result of the new living environment of the cows. This context has led to the emergence and acceptance of the resource allocation theory according to which in the case of limited resources for carrying out adaptation processes, individuals who invest more in one feature, allocate limited resources to other features (Beilharz *et al.,* 1993; Oltenacu and Broom, 2010). Rauw *et al.,* (1998) concluded that when a population is genetically driven towards high production, less resources will be left to respond to other demands like coping with stressors. Due to breeding programs that included temperament, the structure of the herds could be changed over time making possible an increase of desired reactivity classes (Café *et al.,* 2011).

The objective of the current study was to establish a possible link between cows' reactivity and milk-related traits. In addition, the study intended to examine changes in herd structure related to cow temperament over successive years.

## MATERIALS AND METHODS

***Location and animal management:*** All procedures performed in this study were approved by the Scientific and Ethics Committee of the Research and Development Station for Bovine Arad belonging to the Academy for Agricultural and Forestry Sciences, Decision no. 51 issued on November 11, 2015. Also, the research activities were performed in accordance with the European Union's Directive for animal experimentation (Directive 2010/63/EU).

The study was conducted at the Research and Development Station for Bovine Arad, Romania (location: 46° 10' 36" N, 21° 18' 4" E). Cows included in the current study were managed under a loose system with no grazing and were between 1st and 7th lactation. Cows were kept on straw bedding, with space allowance of 9 $m^2$ and free access to resources (forage, water and paddocks). They received a daily feed ration made of 30 kg of green fodder (alfalfa), 12 kg corn silage, 6 kg of alfalfa hay and 4 kg of concentrates starting from spring until late autumn, and a ration made of 35 kg of corn silages, 6 kg of alfalfa hay and 5 kg of concentrates during winter. Cows were fed twice per day. They were housed in groups of 70 animals. All cows were included in the Official Performance and Recording Scheme. Cows were milked twice per day (starting at 5:00 and 17:00) in a "herringbone" milking parlour (2 by 14 units).

***Data collection:*** The milking parlour was equipped with AfiMilk 3.076 A-DU software. Furthermore, all cows were fitted with AfiTag pedometers for production, reproductive traits and specific diseases detection. Production and milk quality data were collected from the results of the official performance recordings and also with the own recording system AfiMilk 3.076 A-DU software including data regarding milking speed.

Multiple data sets were recorded between October 2016-October 2021 from 304 cows resulting 7600 records (304 cows x 5 years x 5 traits) aimed cows' temperament score, milk, fat and protein yields and milking speed. Considered the successive lactations recorded, the data regarding to the productive traits were corrected for equivalent maturity with indices related to production at 305 days and cows' parity. Multiple data were collected and analysed for each cow individually and annually for the 5 targeted traits in order to establish the dynamics of the traits in succession of 5 years, especially the dynamics of the herd structure according to the temperament score and its implications on the productive traits (milk, fat, protein yields and milking speed). These assessment were performed annually in October to avoid extremes temperatures in summer or winter. Data regarding cows' identification, milk quantity and milking speed were obtained in the milking parlour using AfiTag pedometers system. Samples of milk (a sample of 200 mL from each cow) were taken after the milking and transported from the farm to the laboratory for testing by Official Performance and Recording Scheme crew. Data regarding the share of the different reactivity type were recorded related to successive years. For estimation of the effects that temperament has on milk production related traits and milking speed, the measurements were performed in October. In some countries (e.g. Canada, Germany, The Netherlands) this assessment is combined with the assessment of milking speed while in other countries temperament is regarded as the general excitability of animals (Fogh *et al.,* 2011).

In this current study the cow's temperament was assessed using *"weigh crate"* method described by Cafe

*et al.,* (2011) due to the existing correlations between the temperament evaluation methods described by Sewalem *et al.*, (2011), while a phenotypic correlation was calculated between temperaments and milking speed. The 2 observers were placed at 4 m laterally to the weighing crate, in order to detect movements made by cows during the 30-second of restrain. A total of 6 observers were presented over the 6 years period as some evaluators were not able to return for all years of the study. A team of 2 observers was used in the first 2 years, another team was active in the 3rd year, and respectively another team carried out the evaluations in years 4th and 5th. In all 3 teams one of the observers was permanently present. At the end of the study, a test evaluation of the similarity of the observations was carried out to establish the degree of correlation of the observers' evaluations. A similarity of the evaluations of 98.22% was calculated, which mean that from 1520 temperament records out of 1493 were similar, the generated error due the change of observers being statistically insignificant ($p \leq 0.05$). Cow's reactivity was recorded using a 5-point score scale at weighing, while spending 30 seconds in the weighing crate: 1 calm, no movement; 2 calm, with occasional movements; 3 moderately movements; 4 abrupt movements; 5 permanent movements. Based on temperament scores recorded, cows were classified as calm (scores 1 and 2), moderate (score 3) or nervous (scores 4 and 5).

***Statistical analyses:*** Data were cleaned by human recording errors (outliers), redundant and incomplete entries observations. Cows with parity greater than 7 were eliminated from the analysis, as well as cows with no information for studied traits. Grubbs' test (Grubbs, 1969) was employed in order to detect outliers in a univariate data set that follows an approximately normal distribution:

$G=(\bar{y}-ymin)/s$ $G=(\bar{y}-ymax)/s$

where: $\bar{y}$=sample mean; s=standard deviation; ymin=minimum value; ymax=maximum value

In case of more than one outlier, the Tietjen-Moore test (Tietjen and Moore, 1972) was applied in order to reject them:

$$Lk=\frac{\sum_{i-1}^{n-k}(yi-yk)^2}{\sum_{i-1}^{n}(yi-\bar{y})^2}$$

where: k=exactly *k* outliers in the data set; n=number of data points sorted from smallest to largest; yi=the *i*th largest data value; $\bar{y}$=mean of the full sample; $\bar{y}k$=sample mean with largest *k* point deleted.

The data recorded regarding productive parameters proved to be normally distributed based on the Kolmogorov test for big data base ($p \leq 0.05$). Cow temperament is a categorical trait, the data not being normally distributed.

Comparison between temperament types on the milk related traits was assessed using one –way ANOVA protocol with categorical factor being "cow's temperament". Differences were tested using Tukey test:

$y_{ij}=\mu+a_i+eij$

where:

$y_{ij}$ value of the milk trait considered milk yield, fat yield, protein yield and milking speed

$\mu$- general mean

$a_i$ – effect of temperament, $_i$=1-5

eij – random error

The analysed data were expressed as least square means and standard error of mean. All the statistical processes were carried out using the software package Statistica (Hill and Lewicki, 2007). Decisions about the acceptance or rejection of statistical hypothesis have been made at the 0.05 level of significance.

Phenotypic correlations between cows' temperament and milk, fat and protein yield and milking speed were estimated using the analysis of variance (Grosu and Oltenacu, 2005). To determine the effects of temperament, the trait of interest would be set up as the dependent variable and the milk related traits as independent variables in the model.

## RESULTS

***Herd structure:*** At the initial observation, the cows din not seem to be stressed. The daily routine, including technological processes (milking, feeding, movement, veterinary operations and interaction with congeners or stockholders) occurred without creating a stress condition in the herd. The standard mean ratio of cows' temperament is generally accepted to be 10%:90% for scores 1-3 compared to 4-5 in all breeds. The average temperament score calculated for the studied herd was 2.02. The share of cows according to temperament group based on five-points scale was 2.1%, 3.14%, 87.13%, 4.27% and 3.36% for scores 1 to 5. The desired scores were found in 92.37% animals (scores 1-3), with nervous cows accounting for only 7.63% (scores 4-5) according to a method described by Madalina *et al* (2021). The current findings highlighted a decreased share of calm and nervous cows, as well as an increased proportion of moderate ones compared to those obtained by Madalina *et al.,* (2021) in a study conducted on Romanian Black Spotted cows. Similar outcomes were recorded by Neja *et al.,* (2015). A significant share of 86.8% of calm cows was recorded by Czako, (1978) also, in Simmental breed. These previous results were confirmed in time by other studies conducted on different dairy breeds (Budzyńska *et al.,* 2005; Szentléleki *et al.,* 2008; Sewalem *et al.*, 2010). Comparative studies related the herds' structure in terms of temperament according to breeds highlighted contradictory outcomes. Thus, even if dairy breeds as Holstein Friesian were considered more docile, Orban *et al.,* (2011) reported an increased share of 15.9% of aggressive cows in Holstein compared to Jersey which

recorded no aggressive individuals. Similar results are available for Holstein Friesian compared to Brown Swiss, a favourable average temperament score being recorded for Brown breed (Gergovska *et al.,* 2012). The differences regarding cows' temperament are real, well-known and accepted by researchers. Cows' reactivity could be influenced by breed, age, previous experience gained through the cognitive processes related to the technological routine or of the social interactions with congeners or stockholders, but also by the productive trait improvement process or environment adaptation. In this respect, Lanier *et al.,* (2000) considered dairy cows to be more sensitive compared to beef or dual-purpose breeds. One of the influential factors in this sense could be the intensity of selection for milk production. Significant differences regarding cow's temperament were also found between beef breeds (Hereford, Angus) that turned out to be calm breeds and the much more responsive Simmental breed (Hoppe *et al.,* 2010). Different reactivity could be recorded between the various varieties belonging to the same breed, which probably also emerged because of the selection pressure exerted on a certain phenotype. Toszer *et al*., (2003) reported different proportions of calm cows in Red Angus (92%) compared to Black Angus (50%). The cows' previous experience and implicitly the reactivity are subject to changes in time. Cognitive processes play an essential role in the relationship that cows have with the environment and its influencing factors. Previous studies conducted in this respect have a history of decades and have scientifically proven that there are significant differences in the score of temperament according to the age of cows. Roy and Nagpaul, (1984) concluded that optimal age in order to exhibit a good temperament score is between 4 and 6 lactations, once cows reached the morphological maturity, being in the productive fullness and the cognitive processes related to the daily routine are finalized. Multiparous cows proved to be less reactive compared to primiparous according to Toszer *et al.,* (2003), who recorded an improved temperament score by 0.42 for the former. However, this topic is not completely accepted as long as there are surveys which found no significant correlation between the temperament score and the age of the cows (Visscher and Goddard, 1995), but confirming the herd structure with 80% moderate cows, as found also in the current study (Aleksandra and Jan, 2016). Also, recent outcomes found an increased reactivity in over 6 lactation-aged cows compared to young ones. A large proportion of young cows in the herd could improve the average temperament score of the herd. According to Karamfilov, (2022) the temperament score in Aberdden Angus breed increase related to age of cows, with cows ranged 1$^{st}$-4$^{th}$ calving being more docile compared cu cows ranged over 6$^{th}$ calving.

***Productive traits:*** The productive level of cohort is in accordance with other results obtained by Pantelic *et al.,* (2011) and Jeretina *et al.,* (2013). The current results clearly suggest that cows' reactivity (DF=2, DF residual=1521) significant influenced the milk (F=3.46, p≤0.001), fat (F=4.11, p≤0.001), protein (F=3.97, p≤0.001) yields as well as the milking speed (F=2.68, p≤0.05).

**Table 1. Least squares means (±SEM) for milk related traits based on cows' temperament**

| Temperament/Trait | Milk (kg) | Fat (kg) | Protein (kg) | Milking speed |
|---|---|---|---|---|
| Calm | 5766.8±130.98$^{a}$ | 239.1±5.24$^{a}$ | 201.5±4.3$^{a}$ | 2.36±0.02$^{a}$ |
| Moderate | 5457.1±108.78$^{b}$ | 219.37±4.35$^{b}$ | 186.2±3.57$^{b}$ | 2.28±0.01$^{b}$ |
| Nervous | 5058.9±3.21$^{c}$ | 206.9±1.24$^{c}$ | 173.5±1.05$^{c}$ | 2.21±0.05$^{b}$ |
| *Cohort* | *5208.34±81.4* | *214.25±3.16* | *155.8±2.14* | *2.26±0.02* |

Column means with different superscript differ significantly at $p<0.05$

The calmer cows produced more milk (+309.7 kg, F=27.54, p≤0.01), fat (+19.73 kg, F=33.1, p≤0.001) and protein yield (+15.3 kg, F=22.4, p≤0.01) compared to moderate cows. In terms of the nervous cows, the differences became more obvious for milk (+707.9 kg, F=26.54, p≤0.001), fat (+32.2 kg, F=31.2, p≤0.001) and protein yield (+28 kg, F=21.5, p≤0.001). In the current research the correlation matrices highlighted a strong and negative link between temperament and the milk-related traits (r=-0.4 and r=-0.38 for fat and protein yield). The impact of temperament on milk-related traits based on phenotypic correlation indices proved to be controversial. The milk composition observed in the current study was within the normal range and it was in accordance with results found earlier by Mandal *et al., (*2016) or Sahu *et al., (*2018).

The scientific community approached this subject from different points of view aimed reaching a unanimous accepted conclusion, but this goal has not been achieved. In the current study, a strong link was found related to temperament-milk yield relationship, the differences being significant (p≤0.001). These results are in accordance with previous findings documented by Sutherhand and Dowling, (2014) or Chang *et al.,* (2019). Comparative studies performed on different breeds found significant correlations between temperament and milk yield, excepted Jersey breed (Bagnato *et al.,* 2007). Conversely results were documented by Keyserling *et al.,*

(2009) and Orban *et al.,* (2011) whose studies found no significant correlations between temperament and milk production. It is generally accepted that a higher production capacity characterizes the calmer cows compared to the nervous ones (Hedlund and Hanne, 2015; Abdel –Hamid *et al.,* 2017). This statement is not unanimous accepted since there are studies which found that nervous cows had a higher milk yield (Rousing *et al.,* 2004; Gergovska *et al.,* 2012). Sawa *et al.,* (2017) documented an increased milk yield for nervous cows compared to calm cows (+844 kg) or moderate ones (+538 kg) in Holstein Friesian breed. The rank in the herd hierarchy could be used to support the hypothesis that nervous cows produce more milk (Maffei *et al.,* 2006). Due to increased reactivity, cows could achieve high social rank in herd hierarchy and implicitly a wide access to resources (food, water, comfortable resting spots). The prolonged duration of food intake could contribute to the increase of milk production in nervous cows. Generally, these cows are removed from the herd for the sake of the manoeuvrability and farmers' safety. However, due to the high milk yield, these cows are more often kept in herd, the level of production compensating for the damage caused (Praxedes *et al.,* 2009). The relationship between temperament and production is managed at three levels, namely: 1. Animal-technology relationship (Maria *et al.*, 2020); 2. Animal-novelty environment (Less *et al.,* 2020); and 3. Animal-stockholders relationship (Muller and Keyserling, 2006; Haskell *et al.,* 2014). The influence of these stressors the oxytocin concentrations reach a lower level with negative effects on milk production.

In the current study, the increased proportion of calm and moderate cows compared to nervous ones is mostly due to the previous mentioned influential factors. The cows included in the study ranged between 1$^{st}$ and 7$^{th}$ lactation and in this respect, we could consider that learning process related to the daily routine (milking, moving, weighing, veterinary operations and social human-cow interactions) are finished. Also, the cows were treated gently in order to not feel fear or anxiety, which increased the level of oxytocin at the milking, being an important factor in the productive level.

The controversial results obtained related to temperament-milk production relationship may also be caused by the intensity of selection to which the breeds have been subjected over the time. The intensity of the selection proved the ability to act on the variability of the characters by modifying them within a breed or a herd. Improving milk production and cow manoeuvrability implemented especially in dairy breeds could be the cause of reduced variability in Holstein Friesian compared to Simmental or Scandinavian Red. Also, an increased heritability allows the unwanted individual to be easily removed from the herd (Adamczyk *et al.,* 2013). The Simmental breed shows an increased variability within the breed and implicitly a highly flexibility in terms of reactivity, dependent on numerous factors (environment, technology, human interactions and daily routine). This emotional response translates into the ability to involuntarily (hormonal, genetically) or voluntarily (cognitive process) control the sensations of fear, anxiety or irritation in relation to the living environment. The novelty of the living environment, social isolation or social rejection in the herd are factors that are poorly correlated with temperament and therefore may go unnoticed although it exerts a certain degree of influence on the cows' reactivity. The social isolation, even at an early age of life, exert a certain influence on temperament, but more often it is not investigated in relation with milk production (Reenen *et al.,* 2004). The inconsistency of the obtained results does not solve the problem, due to poorly explained correlations between temperament and milk related traits. More studies including a large number of influential factors are needed.

***Milking speed:*** Scientific concerns mostly aimed the correlations between temperament and milking speed, the effects of milking speed on animal welfare and health status and heritability of it in order to improve the genetic structure of herds, respectively. Workability related traits, such as milking speed, are important especially for dairy producers.

In the current study, the milking speed recorded an average value of 2.26 kg/minute in the herd (Table 1). A strong and negative correlation was calculated also between temperament and milking speed (r=-0.28), the calmer cows had an increased milking speed compared to their nervous counterparts. Significant differences ($p \leq 0.05$) were calculated regarding milking speed between calm and moderate and nervous cows. No significant difference was found between moderate and nervous cows. Decreased reactivity associated to calmer cows allowed an increase in milking speed by 6.36% compared to nervous counterparts.

The obtained results are in accordance with those found by Szentléleki *et al.,* (2015) on Holstein, Prasad and Jayalaxmi, (2014) on Murrh buffaloes or Ajit, (2019) on Jersey and local Indian crossbree. Lower values were calculated by Dodenhoff *et al.,* (1999) for Brown breed (1.83-2.05 kg/min.) or Fleckvieh (1.66-1.7 kg/min.) and Antalik and Peter, (2010) for Pinzgau breed (1.76 kg/min), respectively.

Slow milked cows are considered undesirable due to disrupt or extend the milking process. Also, the slow milking speed is considered the 2$^{nd}$ cause of culling in dairy cows (Neerhof *et al.,* 2000; Carlén *et al.*, 2005; Vliegher *et al.,* 2005). Sewalem *et al.,* (2011) calculated that cows with slow milking speed have 26% higher chance of slaughter than those with moderate speed. Also, Doormal, (2009) calculates a 2% increase in the

replacement rate of animals due to the elimination from the herd of minus variants or the necessary sacrifices caused by milk retention. High milking speed increases the risk of udder infections by increasing SCC based on a strong and positive correlation range between 0.11-0.5 ( Govignon *et al.,* 2016; Marete *et al.,* 2018). The udder infections caused by higher milking speed are responsible for about 19.9% of the slaughter according to Aleksandra and Jan, (2016). The cows' temperament often influences total milking time which can be misperceived by inexperienced evaluators and associated with milking speed. In this respect, the nervous cows will most often be associated with a reduced milking speed. This current association is caused by the prolonged time intervals necessary for the preparation for milking of the nervous cows that kick, hit the cups, require long cleaning any many more (Visscher and Goddard, 1995). A calm temperament avoid the mechanical injuries having the capacity to ensure the udder health even for a high milking speed (Bakke and Heringstad, 2015). In the current study desired temperament reached 92.37% (groups 1-3 on a five point scale) with an average milking speed of 2.32 kg/minute. Comparing to cohort (2.26 kg/min) or nervous cows (2.21 kg/min) we conclude that a higher milking speed was associated to a calmer temperament which in these context is considered desired milking speed. The results are inconsistent, Wiggans *et al.,* (2007) not findings significant correlations between milking speed and udder health.

There are numerous studies aiming to quantify the phenotypic correlations between temperament, milking speed, udder health or milking efficiency. Thus, were identified strong correlations between nervous temperament, high milking speed and leakage, range between -0.65 and -0.84 (Luttinen and Juga, 1997; Bakke and Heringstad, 2015). The differences regarding the values of these correlations are caused by the milking system used. Thus, in traditional systems with 2 daily milking rounds, strong correlations were calculated based on a higher udder pressure. Use of automatic milking system (AMS) facilitates a higher milking frequency, a reduced udder pressure and implicitly a decreased in milk dropping, generating weaker correlations (Wethal *et al.,* 2020).

The milking system used can also influence the correlation between temperament and milking speed. In the current study, we considered a small milking parlous (2x14 places in which the cows are in daily and prolonged contact with stockholders. Thus, the traditional systems used in small or medium size farms allow individuals identification and assessment. This situation is almost impossible in big size farms that use AMS due to a hugh labour amount, cows being associated to a farm average score for temperament and milking speed.

Generally, the farmers aimed to eliminate the extreme milking speed scored cows related to farm activity efficiency. In this respect, numerous studies were performed aiming both to establish the heritability of it and feasibility of using in breeding programs. Successive studies were calculated a low heritability for milking speed, range between 0.11 and 0.15 (Boettcher *et al.,* 1998; Zwald *et al.,* 2005; Sewalem *et al.,* 2011). Contradictory, higher values range between 0.2 and 0.5 were calculated in others studies conducted by Kaposvár *et al.,* (2006), Amin, (2007) or Wiggans *et al.,* (2007).

Moderate values of both temperament and milking speed and mostly correlation between its, 0.247 according to Sewalem *et al.,* (2011), suggests that cows with calm or moderate temperament let down their milk quicker and have a reduced total milking time compared to nervous cows. According to the heritability of these parameters, significant modifies could be achieve to the breeding programs in order to reduce reactivity and achieve a satisfied, secure and efficient milking speed.

**Table 2. Dynamics of proportion (%) of cows according to their temperament and milk production in successive years.**

| Year/Temperament | No. of cows | Milk yield (kg) | Calm (%) | Moderate (%) | Nervous (%) |
|---|---|---|---|---|---|
| 2016 | 239 | 5117±148 | 3.34 | 91.21 | 5.45 |
| 2017 | 244 | 5491±201 | 4.09 | 89.75 | 6.16 |
| 2018 | 301 | 5671±196 | 3.98 | 89.37 | 6.65 |
| 2019 | 268 | 5678±134 | 4.85 | 88.94 | 6.21 |
| 2020 | 259 | 5699±214 | 6.94 | 89.16 | 3.9 |
| 2021 | 213 | 5818±209 | 8.92 | 88.76 | 2.32 |

In this respect, the current study aims to analyse the structural dynamics of the herd related to milk production and cows' temperament. Over successive study years, the milk production recorded a total increase by 13.69% with an annual average by 2.73%. The milk production dynamics proved to be ascendant in the entire studied period. The breeding program for improving the milk yield performance led to changes in the herd structure related to temperament. In this sense, there were increased proportions of calm cows by 5.58%, in parallel

with a decrease of moderate by 9.06% and nervous cows by 3.13% (Table 2). The obtained results registered a partial similar trend to those obtained by Neja *et al.,* (2015) who calculated an increase in calm (from 2.98 to 6.85%) and nervous (7.5 to 8.27%) in Polish Holstein Friesian cows, as well as a decreased proportion of moderate cows from 89.52 to 84.74%.

This analysis confirms what is described above and is based on two possible explanations. On the one hand, the fast habituation and detachment with which the cows with reduced reactivity approach the relations with living environment allowed to obtain high milk production, fact for which the improvement of this parameter allows and wants to increase their proportion in herds. On the other hand, aging induces a change in the cows' reactivity due to the cognitive processes and approach to the living environment as suggested by other previously studies conducted by various authors (Roy and Nagpaul, 1984; Tőzsér *et al.,* 2003; Karamfilov, 2022).

**Conclusions:** In conclusion, it can be stated that the studied herd showed a significant proportion of the desired temperament. The analysis performed related to the correlations between the temperament of cows and the milk, fats and proteins yields and the milking speed respectively, highlighted a strong and negative relationship. Higher milk, fat and protein yields have been associated with calmer cows. Also, the breeding program to improve the performance of milk production has led to changes in the herd structure related to temperament, increasing the share of calmer cows by eliminating the highly reactive ones. The obtained results are not unanimously accepted in this field, being influenced by numerous external factors depending on the environment, technology or animals. In this respect, such of this analyse must be related to a farm or a herd and must be performed punctually.

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**Author's contribution:** The idea for the article was conceived by Neamt I. Radu. The experiments were designed by Neamt I. Radu and Ludovic T. Cziszter. The experiments and data collection were performed by Săplăcan I. Silviu, Mihali V. Ciprian, Mizeranschi E. Alexandru and Daniela E. Ilie. The data were analyzed by Săplăcan I. Silviu and Mizeranschi E. Alexandru. The article was written by Neamt I. Radu, Daniela E. Ilie and Ludovic T. Cziszter.

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