Scientific Papers. Series D. Animal Science. Vol. LXIV, No. 2, 2021
ISSN 2285-5750; ISSN CD-ROM 2285-5769; ISSN Online 2393-2260; ISSN-L 2285-5750

ANALYSIS OF CALF MANAGEMENT PRACTICES IN DIFFERENT DAIRY CATTLE FARMS

Elena IRIMIA[1, 2], Ludovic Toma CZISZTER[3], Daniela-Mihaela GRIGORE[1, 2], Dinu GAVOJDIAN[2], Stelian BĂRĂITĂREANU[1], Livia VIDU[1]

[1]University of Agronomic Sciences and Veterinary Medicine of Bucharest, 59 Marasti Blvd, District 1, Bucharest, Romania
[2]Research and Development Institute for Bovine, km 21 Bucharest-Ploiesti Road, Balotesti, Ilfov, Romania
[3]Banat's University of Agricultural Sciences and Veterinary Medicine "King Michael I of Romania" from Timisoara, 119 Calea Aradului Street, Timisoara, Romania

Corresponding author email: ela.irimia91@yahoo.com

Abstract

Given the lack of knowledge on the effects of farm size on the rearing practices of calves, the aim of the current study was to evaluate husbandry practices in small (<25 heads), medium (26-100 heads) and large (>100 heads) sized dairy farms from Romania. The current survey was conducted online and/or via telephone interviews in 2020, on a number of 58 dairy farms, representing an overall number of 12.721 dairy cattle. Regarding calving pens, large dairy farms used them in a significantly higher proportion than small farms (75% vs. 30.43%, p≤0.01) or medium farms (75% vs. 40%, p≤0.05), respectively. Only 4.34% of the small farms were using colostrum banks, while these were used by 6.66% medium sized farms and 55% large farms. The use of colostrum banks was significantly lower in small farms compared to medium (p≤0.05) and large (p≤0.001) farms, with differences (p≤0.001) being observed between medium and large farms. Current results highlight the differences in rearing practices of dairy calves, based on farm size.

Key words*: colostrum, dairy calves, management practices, survey.*

INTRODUCTION

In dairy cattle farms, un-weaned calves represent the main vulnerable category due to the immunity assimilation, which occurs exclusively throughout colostrum feeding and the exposure to stressors after calving (Sadar et al., 2019). Previous studies outlined the high morbidity in pre-weaned calves, with reports up to 35% being affected (Windeyer et al., 2014). Morbidity and mortality in calves bring important negative aspects in the farm economy (Vasseur et al., 2010; Mohd Nor et al., 2012), good rearing and management strategies reducing the risks of developing diseases in calves (Mee, 2008; Irimia et al., 2020).

On the other hand, the rearing technologies adopted during the calves suckling period, have been shown to influence the productive and reproductive performances further in the animals' adult life. In this regard, researchers such as Vasseur et al. (2010a) demonstrated the existence of critical points in rearing technologies, starting from calving, colostrum feeding, cow-calf separation and calf housing. Over the time, various research groups from Europe and North America have studied the management implications on calf's health and behaviour, in order to improve the calf's overall welfare and the farm incomes (Vasseur et al., 2010; Stanek et al., 2014). Due to the development of new intensive agriculture systems, each country has adopted different practices in calves rearing, depending on their breed (EFSA, 2006) or their destination (veal calves, replacement, fattening). However, significant differences in the rearing practices can be observed within the same region or country (Svensson et al., 2006; Stanek et al., 2014). For instance, in the United States there are marked differences in calves rearing, most of the variables in the rearing systems being dependant on the size of the farms (USDA-APHIS, 2012). Thus, identifying the main risks in animal welfare is the first step in adopting different and effective practices for each farm (Whay, 2007; Stanek et al., 2014). Livestock

welfare and animal health can be monitored by using sensor tehnologies which is widely adopted in dairy farms (Kelemen et al., 2016; Mihai et al., 2020).
Good practices should be implemented in all farms, although, significant differences in management exist, particularly when conventional and organic farms and compared (Klein-Jobstl et al., 2015; Pempek et al., 2017).
Klein-Jobstl et al. (2014) found the size of farms to be among the risk factors for calves to contract disease, with a strong correlation between farm size and the incidence of the main infectious diseases.
In Romania the majority of dairy farms (roughly 90%) is represented by small family farms (≤25 heads) (EC, annual report, 2019). Between 2005 and 2016, the largest reductions in farm numbers within the EU-27 was recorded in Romania, with a reduction of 0.8 million farms, representing roughly 20% of the total number of farms (EC, annual report, 2019).
The Romanian cattle sector has 1,241,059 breeding cows, with a total number of 1,914,602 cattle (Eurostat, 2020). The percentage of birth rates in dairy cows in Romania ranges based on our estimates from 80 to 85%, regarding the reproduction efficiency of each individual farm, with an estimated number of 990,000 calves being born annually.
Given the lack of knowledge on the effects of farm size on the rearing practices of calves, the aim of the current study was to evaluate husbandry practices in small (<25 heads), medium (26-100 heads) and large (>100 heads) sized dairy farms from Romania.

MATERIALS AND METHODS

Study population
The survey was conducted across Romania between May and November 2020, on a number of 58 dairy farms, representing an overall number of 12,721 dairy cows. The survey was focused on the following indicators: the general herd descriptors; cow-calf separation; existence and use of birth pens; colostrum quantity and quality; colostrum bank; navel hygiene; weaning methods and strategies; calves' milk, hay, water and concentrates administration.

Questionnaire design
The online questionnaire was disseminated throughout the use of iSondaje.ro platform (iSondaje, 2020).
The questionnaire had 39 questions and was divided into five sections containing 8, 10, 4, 10 and 13 questions, respectively.
Section 1 was focused on herd description with questions designed to capture general farm details, such as herd size, breed(s) composition of the herd, time for pasture allowance/year and the geographic position (lowland, hill or mountain), etc.
Section 2 was focused on the organization of the farm around calving, including existence of infrastructures such as calving pens, colostrum banks, quality colostrum checks, cow-calf separation and naval disinfection practices.
Section 3 was focused on housing, section 4 was describing the feeding regime of un-weaned calves, section 5 followed health indicators and veterinary care in dairy calves.
Results from sections 1, 2, 3 and 4 are being presented in the current paper, a comparative study based on the farms size being employed.
The questions were multiple choice, open questions, semi-closed and closed questions, dependant on the specificity of each of the indicators studied. The initial testing and validation of the questionnaire was performed on a number of 3 farms, for a good clarity and conciseness of the questions addressed.

Data analyses
A total of 71 farmers answered the questionnaire, 4 filled-out questionnaires were removed due to inconsistences and 9 questionnaires were described rearing practices of beef calves, as a result, data from a total of 58 farms were used in the final analysis.
Chi-square test of independence was performed to determine the relationships between the farm size and calving management, housing and feeding practices.
Decisions about the acceptance or rejection of the statistical hypothesis have been made at the 0.05 level of significance.

RESULTS AND DISCUSSIONS

Use of colostrum banks, colostrum quality and colostrum administration

Results concerning colostrum management in the studied farms are summarised in Table 1. In the majority of the surveyed farms (56.89%), the time from calving to the first colostrum administration was one hour, while 34.48% of farms administered the first colostrum between 1 and 4 hours after calving. A smaller percentage of farms, 3.44% and 5.17% administered colostrum after 4 hours and 6 hours *postpartum*, respectively. The farm size had no significant influence ($p>0.05$) on the moment of colostrum administration.

Current results suggest that Romanian farmers are aware of the importance of the correct time for colostrum administration, which is in accordance with the recommendations from the technical and scientific literature. Colostrum management practices in Romania are in line and comparable with recent research studies from the Czech Republic (Stanek et al., 2014) and Austria (Klein-Jobstl et al., 2015). Furthermore, according to a study conducted by Fisher et al. (2018), the IgG absorption levels were the most effective during the first 45 minutes after calving.

Regarding the use of colostrum banks, overall, 22.41% of the farms included in the study implemented colostrum freezing in their farms, conversely to data from the Czech Republic, where 73.5% of the farmers used frozen stocks of colostrum (Stanek et al., 2014).

In small and medium size farms, the existence of frozen colostrum banks is a minority practice, while on large farms, over half of the farmers are implementing this practice. This indicator is of high importance for feeding orphaned calves with good quality colostrum, ensuring higher survival rates throughout the immunological contribution of colostrum (Campbell et al., 2007; Godden et al., 2019). However, in the current study, a disparity was observed for the existence of colostrum banks among small and medium sized farms ($p\leq0.05$) and medium and large sized farms ($p\leq0.001$).

More than half of the studied farms (53.44%) practice colostrum quality evaluation, with the most used method being represented by colostrometer, followed by visual assessment and, to a lesser extent, refractometry. Current results are in accordance with those reported for the Czech Republic (Stanek et al., 2014), however, divergent from the Austrian colostrum quality assessment practices, where less than 5% of the cattle farms are evaluating the colostrum quality (Klein-Jobstl et al., 2015). Farm size influenced the practice of colostrum quality check in our study, with large farms practicing the procedure to a significantly higher extent ($p\leq0.05$), when compared to small sized dairy farms. No statistical significances ($p>0.05$) for the use of colostrum quality assessment among small and medium sized farms and medium and large farms were found.

Karamaev et al. (2021) found that immunoglobulins can be traced in the sanguine circulation of calves one hour after consuming the first colostrum.

Table 1. Influence of farm size on colostrum administration, colostrum bank and colostrum quality check practices

Farm size	Time of first colostrum administration (%)				Colostrum bank (%)		Checking colostrum quality (%)	
	0-1h	1-4h	4-6h	>6h	Yes	No	Yes	No
Small farms (5-25 heads)	60.86	34.78	0	4.34	4.34	95.65	39.13	60.86
Medium farms (26-100 heads)	60	26.66	6.66	6.66	13.33	86.66	53.33	46.66
Large farms (>100 heads)	50	40	5	5	55	45	70	30
Total	56.89	34.48	3.44	5.17	24.13	75.86	53.44	46.55
Small vs. medium	NS (0.638)				* *(0.015)*		NS (0.168)	
Small vs. large	NS (0.712)				*** *(0.000)*		* *(0.042)*	
Medium vs. large	NS (0.731)				*** *(0.000)*		NS (0.137)	

*NS: $p>0.05$; *$p\leq0.05$; **$p\leq0.01$; ***$p\leq0.001$.*

Colostrum and milk administration methods

Data regarding colostrum and milk administration methods are showed in Table 2.

Colostrum artificial feeding, especially with the oesophageal tube, is regarded as the optional practice, also being recommended in the case of ill and weakened calves, which are unable to suckle themselves (Zwierzchowski et al., 2020). Therefore, in small and medium dairy farms from Romania, the administration of the first colostrum with the help of the oesophageal feeder is not practiced, while in large size farms this practice was found in a proportion of 25% respondents. Current results are in accordance with those of Stanek et al. (2014), where half of the investigated farmers described they are using an oesophageal tube for calves with a low viability.

Regarding colostrum administration methods, a significant difference ($p \leq 0.01$) was detected in small farms compared to large sized farms, in small farms the natural method is still used in large proportion, while in large farms the bucket and the natural method are used in equal proportions. This aspect, regarding the practice for colostrum administrations is attributed to the difference of rearing system adopted in small farms which are commonly traditional, while in large sized farms is predominantly intensive or semi-intensive. Moreover, the intensification of dairy farming, especially in large farms, where higher levels of mechanization and automation of technological practices are predominant, as outlined by Batanov et al. (2020) and Karamaev et al. (2021).

The significant differences between medium and large sized farms ($p \leq 0.05$) could be attributed to different technologies implemented to the farm level, including the lower number of calves in medium farms. Our data shows that in small, medium and large farms, teat buckets are most commonly used (65.2%, 73.3%, 55%, respectively) for colostrum administration, which contributes to the welfare of calves, satisfying their suckling innate behaviour. Current results are in accordance with previous studies by Stanek et al. (2014), who found that calves were fed using a teat bucket in a proportion of 77.1%.

The most commonly used practice to administer milk was teat bucket, with a percentage of 44.82%, followed by open bucket with 25.86%. Direct dam suckling is the third practice used in Romania, ranking with a percentage of 24.13%, and the feeding machine being the least encountered, used in 5.17% of farms.

Farm size significantly influenced ($p \leq 0.05$) the methods for milk administration in calves between small and large farms, in small farms the natural method is still used in large proportion, while in large farms the bucket and the natural method are used in equal proportions. This could be attributed to the availability of resources and the use of modern agricultural production practices in large farms, as previously published by Butanov et al. (2020). According to previous studies, the practice of calves feeding directly from their dams was adopted in proportion of 58.8%, while feeding from an open bucket had an average use of 41.2% in commercial dairy farms from the Czech Republic (Stanek et al., 2014).

Table 2. Influence of farm size on colostrum and milk administration methods in un/weaned calves

Farm size	Colostrum administration method (%)				Milk administration method (%)			
	Esophageal tube feeder	Teat bucket	Open bucket	Natural sucking	Open Bucket	Teat bucket	Automated milk feeder	Natural sucking
Small farms (5-25 heads)	0	65.21	4.34	30.43	17.39	39.13	0	43.47
Medium farms (26-100 heads)	0	73.33	13.33	13.33	33.33	40	6.66	20
Large farms (>100 heads)	25	55	10	10	30	55	10	5
Total	8.62	63.79	8.62	18.97	25.86	44.82	5.17	24.13
Small vs. medium	NS (0.101)				NS (0.105)			
Small vs. large	** *(0.009)*				* *(0.020)*			
Medium vs. large	* *(0.023)*				NS (0.190)			

*NS: p>0.05; *p≤0.05; **p≤0.01; ***p≤0.00*

Individual housing period, calving pens and cow-calf separation

Data on calves individual housing period, existence of calving pens and cow-calf separation are given in Table 3.

Across all surveyed farms in the current study (53.44%) the most widespread practice regarding calves housing was in individual pens up to 3 months of life, for 1-2 weeks in 22.41% of farms and 12.06% more than three months of age, while 12.06% of farms do not use individual calf pens. Farm size seemed to significantly influence ($p \leq 0.05$) the individual housing period of calves. This could be attributed to the need of farmers to minimize viral and bacteriological infections in the un-weaned calves (Bertoni et al., 2021). Moreover, European legislation, through Council Directive 119/2008, does not recommend the individual maintenance of calves over 8 weeks of age, which supports the results obtained by us. On the other hand, pair housing can be considered as a good option for calves rearing, because can develop a higher behavioural flexibility for environmental changing and future mixing and grouping of calves after weaning (Mahendran et al., 2021). Current results are similar to those of previous studies, where individually housing in dairy calves is a common practice, being used in proportion of more than 95% (Stanek et al., 2014).

Over the last decade, many researches have been focused on issuing recommendations about individual or group housing of dairy calves. Reducing the risk of spreading pathogens, weight gaining and avoiding cross-suckling were the main reasons for recommending the rearing of calves in individual pens (Mahendral et al., 2021).

In our survey, the existence of calving pens was adopted in 48.27% of the farms. This is in accordance with previous studies where 47.0 % of the farms has available calving pens (Vasseur et al., 2010; Klein-Jobstl et al., 2015). Furthermore, the use of individual calving pens is a common practice for German dairy farming, where it is being encountered in all commercial enterprises (Heuwieser et al., 2010). However, a significant difference ($p \leq 0.01$) was noticed between small and large farms, in large farms the proportion of calving pen is higher than in small farms. These findings are in accordance with those of Klein-Jobstl et al. (2015). Significant differences ($p \leq 0.05$) could be observed between medium farms and large farms which was using calving pens in a higher proportion than the medium farms. This being attributed to the modern agricultural practices implemented in large farms, compared to smaller ones, as previously reported by Butanov et al. (2020). Moreover, to reduce the stress after birth and for a good farm sanitation, is it recommended to use calving pens in the farm. However, proper hygiene and regular surveillance of the calving pens are recommended (Vasseur et al., 2010).

Table 3. Influence of farm size on individual housing period, calving pens and cow-calf separation

Farm size	Individual housing period (%)				Existence of calving pens (%)		Cow-calf separation (%)					
	1-2 weeks	≤ 3 months	> 3 months	No	Yes	No	≤2h	After 2h	After 12h	>12h	After 7days	Other
Small farms (5-25 heads)	4.34	56.52	26.08	13.04	30.43	69.56	30.43	17.39	0	0	13.04	39.13
Medium farms (26-100 heads)	20	60	0	20	40	60	40	20	0	13.33	6.66	20
Large farms (>100 heads)	45	45	5	5	75	25	60	20	5	15	0	0
Total	22.41	53.44	12.06	12.06	48.27	51.72	43.10	18.96	1.72	8.62	6.89	20.68
Small vs. medium	* *(0.019)*				NS (0.067)		NS (0.105)					
Small vs. large	** *(0.003)*				** *(0.003)*		** *(0.003)*					
Medium vs. large	* *(0.025)*				* *(0.013)*		NS (0.080)					

*NS: p>0.05; * p≤0.05; ** p≤0.01; *** p≤0.001.*

Over the last years, the separation of calf from the dam has constituted the subject of a great deal of studies, with a focus on animal welfare and implications of cow-calf contact systems (Knierim et al., 2020). Our results shows that the cow-calf separation is most frequently implemented immediately after calving, with 43.10% after 2 h *post-partum*, while 6.89% of

farmers separate the calves from their dams after the age of 7 days.

A significant difference ($p \leq 0.01$) for cow-calf separation moment was found between small and large sized farm, in large farms there is a higher proportion in the case of cow-calf separation earlier, while in small farms a larger proportion for later separation. Moreover, this could be attributed to disease transmission risk management and colostrum administration practices that are implemented in larger farms (Trotz-Williams et al., 2008). However, if this practice of cow-calf separation is adopted soon after calving, it is recommended to maintain calves in a clean and disinfected pen to prevent infections. On the other hand, this practice deprives the animals of emotional bonds and reduces the stress of separation (Pempek et al., 2017).

Milk feeding regime and quantity

Milk feeding regime and administrated quantity is presented in Table 4.

Across all surveyed farms, almost three quarters of the farms (71.41%) feed the calves with whole milk, 25.86% with milk replacer and just 1.72% with mixed (replacer + whole) milk. According to previous studies, in the Czech Republic, 35.3% of calves were fed with milk replacer (Stanek et al., 2014), a higher percentage than in our study. Significant differences were observed between large and medium farms ($p \leq 0.001$) and between large and small farms ($p \leq 0.01$), respectively. In large farms being preferred to use whole milk in dairy calves feeding. According to the literature, the results from our survey are similar with previous studies where milk replacer was significantly more often fed on large farms (Klein-Jobstl et al., 2015), the difference could be attributed to the fact that it is easier to handle and has optimal balanced nutrients (Vasseur et al., 2010).

In one third of farms (32.75%) milk was offered 8 litres/day, followed by *ad libitum* practices with 27.58% and 18.96% with 4 l/day, respectively. Significant differences between small and medium farm ($p \leq 0.05$), between small and large farms ($p \leq 0.05$), and between medium and large farms ($p \leq 0.05$) were found. These results are not supported by findings of previous studies, were milk or milk replacer feeding at herd level had a median of 6 l/day in two meals (Stanek et al., 2014).

Calves feeding practices during the first weeks of life, with the optimal amounts of milk or milk replacer, has an important role both for their growth and development (OIE, 2017), and for expressing the natural suckling behaviour (Miller-Cushon & DeVries, 2015). Milk feeding level has great potential to influence the development of feeding behaviour during the preweaning period (Miller-Cushon et al., 2013).

Table 4. Influence of farm size on milk quality and milk type based on farm size

Farm size	Milk feeding regime (%)			Milk quantity (litres) (%)				
	Whole	Replacer	Mixt	*Ad libitum*	≤2	4	6	8
Small farms (5-25 heads)	86.95	13.04	0	47.82	0	14.39	13.04	21.73
Medium farms (26-100 heads)	93.33	6.66	0	20	6.66	13.33	6.66	53.33
Large farms (>100 heads)	53.33	55	5	10	0	25	35	30
Total	72.41	25.86	1.72	27.58	1.72	18.96	18.96	32.75
Small vs. medium	NS (0.054)			* *(0.027)*				
Small vs. large	** *(0.001)*			* *(0.028)*				
Medium vs. large	*** *(0.000)*			* *(0.021)*				

*NS: $p>0.05$; * $p \leq 0.05$; ** $p \leq 0.01$; *** $p \leq 0.001$.*

Water, hay and concentrates feeding

Details regarding access to water, hay and the concentrates protein percentage are presented in Table 5.

In order for the calves to develop the rumen mucosa and functions, is important to have free access to water, hay and concentrates earlier in life. According to previous studies, a large number of farms adopt free access to hay and concentrates (84.9 and 60.5 %, respectively) for calves, starting with first three weeks after calving (Klein-Jobstl et al., 2015).

Table 5. Influence of farm size on access to hay, water and concentrates in un-weaned calves

Farm size	Access to hay (%)			Access to water (%)			Concentrates protein (%)					
	1-3w	4-8w	>8w	Ad libitum	2l/day	5l/day	<14%	14-16%	16-18%	18-20%	20-22%	>22%
Small farms (5-25 heads)	34.78	34.78	30.43	95.65	0	4.34	17.39	13.04	39.13	21.73	0	8.69
Medium farms (26-100 heads)	40	53.33	6.66	100	0	0	13.33	33.33	6.66	26.66	13.33	6.66
Large farms (>100 heads)	50	35	15	95	5	0	0	5	40	25	15	15
Total	41.37	39.65	18.96	96.55	1.72	1.72	10.34	15.51	31.03	24.13	8.62	10.34
Small vs. medium	NS (0.143)			*NS (0.396)*			NS (0.062)					
Small vs. large	NS (0.271)			*NS (0.233)*			NS (0.102)					
Medium vs. large	NS (0.280)			*NS (0.344)*			**(0.033)*					

*NS: p>0.05; * p≤0.05; ** p≤0.01; *** p≤0.001.*

Our data shows a non-significant (p>0.05) difference for access to hay and water between the three different farms size categories. Water was in 96.55% of the farms offered *ad libitum*, while less than 4% of the farms offered restricted 2 l/day and 5 l/day, respectively. Data concerning calves' access to water, were in accordance with previous studies.

Water access of calves is an overall disputed topic, given that many farmers do not give access to water for calves for a long period after birth (Relic et al., 2020). On small farms, for example, in the USA, calves have first access to water between day 15 and day 20 of life (USDA, 2016). Consuming water immediately after birth could improve calf's growth and rumen development, and thus increasing nutrient digestibility (Wickramasinghe et al., 2019). Moreover, there is the believe among farmers that milk contains enough water, and the calves during suckling do not need to consume additional water to the milk diet.

In contrast, access to concentrates is regarded as a crucial need for successful calf rearing (Khan et al., 2011). Our data shows a preference of farmers (31.03%) to use concentrates with a 16-18% protein content (PB) for calves feeding, followed by 24.13% which use 18-20% protein content for the concentrates and 15.51% administer 14-16% PB, respectively. However, across all surveyed farms, we obtained a significative difference between medium and large sized farms (p≤0.05), lower PB concentration in medium farms, while higher PB concentration in large farms preferred. The practice changes among farms could be attributed to the different economic weights and implications in calves feeding (Batanov et al., 2020). In a study conducted by Stamey et al. (2021) testing 3 different concentrates with protein ranging between 21.5% and 26%, no influence of the feeding regime on body weight and starter intake up to the age of weaning was found.

Practices, such as naval disinfection was common in all farms (42%), however, we found no significant difference (p>0.05) based on the farm size. In contrast, in countries such as the Czech Republic navel disinfection has higher importance, being practiced in 88.2% of the farms, using methods such dipping or spraying (Stanek et al., 2014). Compared with other studies from different countries, calves were usually weaned between week 7 and 10 (Vasseur et al., 2010; Stanek et al., 2014), in Romania farmers adopted the same practice and they were weaning the calves around three months of age. Age of calves at weaning was not influenced (p>0.05) by the farm size in our study.

CONCLUSIONS

Regarding the use of certain infrastructures on farms, calving pen use is low in small and medium sized farms, compared to large sized farms. The verification of colostrum quality prior to calf administration is being performed on almost a half of the small and medium sized farms, being widely used in large farms.

Colostrum banking does not represent a common practice in Romanian dairy farms, with significant disparities being found between small and larger farms.

Cow-calf separation is most frequently done immediately after calving or after 2 hours *post-partum*, a minority of farms practicing the cow-calf contact during the sub-colostral period (first 5-7 days after calving), respectively.

The most widespread practice regarding calves housing was in individual pens up to 3 months of age, which poses animal welfare concerns and could lead to significant post weaning stress in dairy calves, with negative consequences on their immune functions and growth rates.

The milk feeding regime and milk quantity presents the furthermost differences between small, medium and large farm. With large farms adopting the most economical practices for calves rearing, which is represented by the use of milk replacers. The use of milk replacers is not recommended under organic production systems, although, it is allowed according to the European Directive for organic production.

Access to water, hay, concentrates and weaning age of calves was similar to other European countries and generally respect the conventional rearing practices.

Our initial hypothesis that differences in rearing practices of dairy calves can exist, based on farm size is partly supported by the results.

Results obtained in this study provide data on calf practice management in dairy farms from Romania and this data could help to further point out levels and practices to be improved at farm level. Furthermore, significant differences could be determined between small, medium and large sized Romanian farms, suggesting a higher degree of specialisation on large farms.

REFERENCES

Batanov, S.D., Starostina, O.S., & Baranova, I.A. (2020). Genetic parameters of productivity and exterior traits of dairy cattle. IOP Conference Series: *Earth and Environmental Science*, 548(3), 032023.

Campbell, J.M., Russell, L.E., Crenshaw, J.D., Weaver, E.M., Godden, S., Quigley, J.D., Coverdale, J., & Tyler H. (2007). Impact of irradiation and immunoglobulin G concentration on absorption of protein and immunoglobulin G in calves fed colostrum replacer. *Journal of Dairy Science*, 90, 5726–5731.

EFSA (European Food Safety Authority). (2006). EFSA Panel on Animal Health and Welfare (AHAW): Opinion on "The risks of poor welfare in intensive calf farming systems. An update of the Scientific Veterinary Committee Report on the Welfare of Calves". http://www.efsa.europa.eu/en/efsajournal/doc/366.pdf. [Accessed March 30, 2021].

European Commission. TRACES Annual report 2019. https://ec.europa.eu/food/audits-analysis/country_profiles/details.cfm?co_id=RO [Accessed February 26, 2021].

Eurostat, 2020 https://appsso.eurostat.ec.europa.eu/nui/submitViewTableAction.do. [Accessed in 20 February 2021].

Fisher, A.J., Song, Y., & He, Z. (2018). Effect of delaying colostrum feeding on passive transfer and intestinal bacterial colonization in neonatal male Holstein calves. *Journal of Dairy Science*, 101, 3099–3109.

Godden, S.M., Lombard, J.E., & Woolums, A.R. (2019). Colostrum management for dairy calves. *Veterinary Clinics: Food Animal Practice*, 35, 535–556.

Heuwieser, W., Iwersen, M., Gossellin, J., & Drillich, M. (2010). Short communication: survey of fresh cow management practices of dairy cattle on small and large commercial farms. *Journal of Dairy Science*, 93, 1065–1068.

Irimia, E., Grigore, D.M., Nicolae, I., Gavojdian, D., Baraitareanu, S., & Vidu, L. (2020). Preliminary study regarding the environmental and genetic factors affecting dairy calves health. *Scientific Papers: Series D, Animal Science,* 63 (2).

iSondaje (2020) Create a survey using iSondaje.ro. http://www.isondaje.ro/create/

Karamaev, S., Karamaeva, A., & Bakaeva, L. (2021). Features of the formation of the immune status in calves with different methods of feeding with colostrum. *XXII International Scientific Conference Energy Management of Municipal Facilities and Sustainable Energy Technologies* (EMMFT-2020). E3S Web of Conferences 244, 02052.

Kelemen, A., Marginean, G.E., & Vidu, L. (2016). Practical and theoretical aspects regarding the precision dairy farming concept in Romania. *Scientific Papers: Series D, Animal Science,* 59.

Khan, M.A., Weary, D.M., & Von Kyserlingk, M.A.G. (2011). Effects of milk ration on solid feed intake, weaning, and performance in dairy heifers. *Journal of Dairy Science*, 94, 1071–1081.

Klein-Jobstl, D., Arnholdt, T., Sturmlechner, F., Iwersen, M., & Drillich, M. (2015). Results of an online questionnaire to survey calf management practices on dairy cattle breeding farms in Austria and to estimate differences in disease incidences depending on farm structure and management practices. *Acta Veterinaria Scandinavica*, 57, 44.

Klein-Jobstl, D., Iwersen, M., & Drillich, M. (2014). Farm characteristics and calf management practices on dairy farms with and without diarrhea: a case-

control study to investigate risk factors for calf diarrhea. *Journal of Dairy Science*, 97, 5110–5119.

Knierim, U., Wicklow, D., Ivemeyer, S., & Möller, D. (2020). A framework for the socio-economic evaluation of rearing systems of dairy calves with or without cow contact. *Journal of Dairy Research,* 87 (S1), 128–132.

Mahendran, S.A., Wathes, D.C., Booth, R.E., & Blackie, N. (2021). The health and behavioural effects of individual versus pair housing of calves at different ages on a UK commercial dairy farm. *Animals*, 11, 612.

Mee, J.F. (2008). Newborn dairy calf management. *Veterinary Clinic North America Food Animal Practice*, 24, 1–17.

Mihai, R., Mărginean, G.E., Marin, M.P., Hassan, A.A.M., Marin, I., Fintineru, G., & Vidu, L. (2020). Impact of precision livestock farming on welfare and milk production in montbeliarde dairy cows. *Scientific Papers: Series D, Animal Science,* 63 (2), 308-313.

Miller-Cushon, E.K., Bergeron, R., Leslie, K.E., & DeVries, T.J. (2013). Effect of milk feeding level on development of feeding behavior in dairy calves. *Journal of Dairy Science*, 96(1), 551-564.

Miller-Cushon, E.K., & DeVries, T.J. (2015). Invited review: development and expression of dairy calf feeding behaviour. *Canadian Journal of Animal Science*, 95, 341-350.

Mohd, N.N., Steeneveld, W., Mourits, M.C., & Hogeveen H. (2012). Estimating the costs of rearing young dairy cattle in the Netherlands using a simulation model that accounts for uncertainty related to diseases. *Preventive Veterinary Medicine*. 106, 214–224.

OIE 2017. Terrestrial Animal Health Code. Section 7. Animal Welfare. http://oie.int/international-standard-setting/terrestrial-code. [Accessed in 30 March 2021].

Pempek, J.A., Schuenemann, G.M., Holder, E., & Habing, G.G. (2017). Dairy calf management – A comparison of practices and producer attitudes among conventional and organic herds. *Journal of Dairy Science*, 100, 8310–8321.

Relic, R., Staric, J., & Jezek, J. (2020). Management practices that influence the welfare of calves on small family farms. *Journal of Dairy Research*, 87(S1), 93–98.

Stamey, L.J., McKeith, F.K., Janovick, N.A., Molano, R.A., Van Amburgh, M.E., & Drackley, J.K. (2021). Influence of starter crude protein content on growth and body composition of dairy calves in an enhanced early nutrition program. *Journal of Dairy Science*, 104(3), 3082-3097.

Stanek, S., Zink, V., Dolezal, O., & Stolc, L. (2014). Survey of preweaning dairy calf rearing practices in Czech dairy herds. *Journal of Dairy Science*, 97, 3973–3981.

Svensson, C., Linder, A., & Olsson, S.O. (2006). Mortality in Swedish dairy calves and replacement heifers. *Journal of Dairy Science*, 89, 4769–4777.

Trotz-Williams, L.A., Leslie, K.E., & Peregrine A.S. (2008). Passive immunity in Ontario dairy calves and investigation of its association with calf management practices. *Journal of Dairy Science*, 91, 3840–3849.

USDA (2016) Dairy 2014: Health and Management Practices on U.S. Dairy Operations, 2014. *USDA–APHIS–VS–CEAH–NAHMS*, Fort Collins, CO. https://www.aphis.usda.gov/animal_health/nahms/dairy/downloads/dairy14/Dairy14_dr_PartIII.pdf [Accessed in 10 March, 2021]

USDA-APHIS (Animal and Plant Health Inspection Service). (2012). Dairy Heifer Raiser, 2011. #613.1012. USDA-APHIS-Veterinary Services, Centers for Epidemiology and Animal Health), National Animal Health Monitoring System (NAHMS), Fort Collins, CO. https://www.aphis.usda.gov/animal_health/nahms/dairy/downloads/dairyheifer11/HeiferRaiser_1.pdf [Accessed in 10 March, 2021]

Vasseur, E., Borderas, F., Cue, R.I., Lefebvre, D., Pellerin, D., Rushen J., Wade, K.M., & de Passillé, A.M. (2010). A survey of dairy calf management practices in Canada that affect animal welfare. *Journal of Dairy Science*, 93, 1307–1315.

Vasseur, E., Rushen, J., de Passille, A.M., Lefebvre, D., & Pellerin, D. (2010a). An advisory tool to improve management practices affecting calf and heifer welfare on dairy farms. *Journal of Dairy Science*, 93, 4414–4426.

Whay, H.R. (2007). The journey to animal welfare improvement. *Animal Welfare*, 16, 117–122.

Wickramasinghe, H.K.J.P., Kramer, A.J., & Appuhamy, J.A.D.R.N. (2019). Drinking water intake of newborn dairy calves and its effects on feed intake, growth performance, health. *Journal of Dairy Science*, 102(1), 377–387.

Windeyer, M.C., Leslie, K.E., Godden, S.M., Hodgin, D.C., Lissemore, K.D., & LeBlanc, S.J. (2014). Factors associated with morbidity, mortality, and growth of dairy heifer calves up to 3 months of age. *Preventive Veterinary Medicine*, 113, 231–240.

Zwierzchowski, G., Micinski, J., Wojcik, R., & Nowakowski, J. (2020). Colostrum-supplemented transition milk positively affects serum biochemical parameters, humoral immunity indicators and the growth performance of calves. *Livestock Science*, 234, 103976.