

EFFECT OF FARM AND BIRTH SEASON ON CALF BODY WEIGHT IN THE FIRST WEEK OF LIFE

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Abstract: The body weight of calves in the earliest period of their life (age from 0 to 7 days) is under the greatest influence of the farm and the season of birth. The farm manifests its influence most often through the conditions of nutrition and housing and the organization of the technological production process, while the influence of the birth season is manifested through microclimatic and nutritional conditions, as well. The most common deficiencies related to the nutrition of newborn calves are related to: inadequate colostrum supply in terms of quality, quantity and time of colostrum intake, which is closely related to the organization of the technological production process on the farm. Dietary deficiencies affect the body weight of calves at birth and at 8 days of age. In a study conducted over a year (4 seasons), the colostrum diet of newborn calves of the HF breed on two farms (A and B) with a tied housing system was analyzed. Calves were fed colostrum on both farms at intervals, usually up to 2 hours, less often up to 4 hours after birth. The colostrum consumed came from the mother, most often, and less often from the other cow, while on one of the farms it was also used frozen. However, the amount of colostrum consumed was deficient, it was 1-2 l on farm A, and 2.5 to 3 l on farm B. The occurrence of a deficient diet or other deficiencies in the diet of calves was indicated by the average body weight, measured at birth and at the age of 8 days. On farm A, a lower average body weight of calves (37.95 and 39.68 kg) was recorded than on farm B (40.00 and 41.80 kg) by age categories, respectively. The average body weight of calves was statistically significantly ($p < 0.01$) influenced by the farm and the season of birth, as well as their mutual interaction, but the effect of the farm was more pronounced.

Key words: calves, colostrum diet, body weight, season, farm

Introduction

There are numerous factors that affect the body weight of calves in intensive farming conditions. Some of them relate to the production conditions that are characteristic of each farm (farm impact). We can classify them into three groups: nutrition, housing conditions and organization of the technological process. The most common dietary deficiencies are: inadequate colostrum supply in terms of quality, quantity, and timing of colostrum intake, which is closely related to early separation from the mother; insufficient balance of whole milk diet and milk replacements, use of foods that contain allergens or are deficient in iron, excessive and deficient meals, etc. In addition to the farm, the birth season also affects the mentioned parameters through microclimate and feeding conditions.

Food is one of the key factors responsible for calf growth, both quantitatively and qualitatively. *Yang et al. (2015)* state that the best gain values are achieved by calves that consume full colostrum immediately after birth, in contrast to those that consume some type of whole milk instead of colostrum. *Ballou et al. (2013)* compare the body weight of calves of two breeds and two levels of nutrition. Regardless of the breed, higher growth and more efficient use of nutrients and energy from the meal is recorded in calves whose meal was richer in protein, fat and energy. Calves fed different diets, according to *Oververst et al. (2015)*, consume different amounts of dry matter from meals, spend more or less time in feeding and achieve different gain values in the period before and after weaning, depending on the type of meal. The correlation between the body weight of calves and the ability to consume a certain amount of milk in the first 2-4 days of life is pointed out by *de Passile et al. (2015)*. The amount of milk that calves consume ranges from 7.3% to 30.5% of body weight, or from 2.4 to 12 l/day. The correlation coefficient between body weight at birth and the amount of milk consumed is 0.33.

Material and Method

The study of the impact of the farm through breeding conditions and the season of birth on the body weight of calves in the period from 0 to 7 days of life, was conducted on two farms, A and B, which operated within the same production system with intensive production, capacity of about 1000 dairy cows. Both farms have a system where animals are kept tied. The calves were separated from the mother soon after birth. The number of calves included in the analysis was 596 on farm A and 572 on farm B.

During a period of one year divided into 4 seasons (autumn, winter, spring and summer), the colostrum diet of calves was followed immediately after birth.

The following were monitored: the amount of colostrum consumed, the origin (mother's or other cows') and the time period of consumption after birth.

After birth, the calves on both farms remained with their mothers for a very short time, 30-45 minutes, and then they were separated, on farm A on a specially prepared bed in the nursery, and on farm B in an individual box. After that, the calves were fed colostrum from a bucket for 1 to 4 hours. Where it was possible, calves received their mother's colostrum. If this was not feasible (death or illness of the mother, lack of milk, defective colostrum, etc.), on farm A they were fed colostrum from other cows, while on farm B there was a possibility for calves to get colostrum which was kept frozen. The amount of colostrum consumed was controlled by graduated buckets. The time when the calf received its first colostrum after birth, the type of colostrum obtained and the amount of colostrum consumed were duly recorded. Colostrum quality was controlled in only one way, organoleptically.

In the study, body weight was measured immediately after birth and at the age of 8 days. Calibrated livestock scales, located in the nursery were used on both measuring farms.

Results and Discussion

On both farms, calves received colostrum by feeding from a bucket, without the use of bottles or any other equipment. Colostrum, on farm A, was given exclusively fresh, from the mother or from another freshly calved cow. On farm B, in addition to fresh colostrum, there was a possibility of freezing excess quality colostrum, so that, in the absence of fresh, calves received colostrum which was thawed and heated to a temperature of about 39-40°C, and whose quality prior to its use was checked only by visual inspection. Colostrum intake time is very important due to the possibility of resorption of all nutrients in the calf's digestive tract. The most efficient use of colostrum is in the first few hours of life. On both farms, all calves received colostrum in the first 4 hours. On farm A, calves drank 0.5 to 2 liters of colostrum, usually 1-2 liters, and very rarely 2.5 liters. On farm B, the situation was somewhat better because calves usually received 2.5-3 l of colostrum, and in exceptional cases less (minimum 1 l) or more than 4 l (5 or 6 l).

The analysis of the results related to colostrum nutrition on farms A and B reveals several important facts. The largest number of calves received colostrum from their mother, which should have enabled the best absorption of immunoglobulins, as reported by numerous studies (*Arthington et al., 2000; Conneely et al., 2014; Yang et al., 2015*). However, the quality of colostrum is not controlled on farms, except organoleptically, therefore it is not possible to know with certainty what the concentration of antibodies was in the colostrum. The time of feeding of calves with colostrum in most cases was in the interval up to 4 h after

birth, which is in line with the recommendation of numerous authors (Vasseur et al., 2009; 2012; Conneely et al., 2014; Klein-Jöbstl, 2015), who state that the optimal time to take colostrum is up to 6 h, and even up to 8 h after birth. Fewer calves received colostrum in the first 2 h, which is in concordance with the results of Godden et al., (2012) and Relić et al., (2014). Taking into account the way calves were fed colostrum (bucket feeding), too early feeding with colostrum cannot be recommended. Namely, immediately after birth, when calves are still tired and exhausted from calving and not strong enough to stand for a long time, they are not able to consume a sufficient amount of colostrum from a bucket. It may therefore be recommended that tired and exhausted calves not be fed immediately after birth and given sufficient time to recover. Also, mothers should be allowed to lick the calves, in order to clean and dry the hair, which establishes normal thermoregulation. The biggest deficiency in colostrum supply was observed in the amount of colostrum consumed. Although it is considered that the amount of colostrum consumed should be 8-10% of the body weight of calves (Jonić and Mirilović, 2007; Conneely, 2014), i.e. 3-4 l, and even more (Weaver et al., 2000; Vasseur et al., 2009; 2010; Osaka et al., 2014; Klein-Jöbstl, 2015), the amount that calves drank on farms A and B was lower, especially on farm A. Similar data, in their research, were also provided by Vasseur et al., (2009; 2010) and Relić et al., (2014).

Table 1. Average body weight of calves by birth season

Farm	Season	Body weight of calves, kg ($\bar{x} \pm S\bar{x}$)	
		Age	
		0	8
A	Autumn	38.64±0.156	40.38±0.166
	Winter	38.75±0.177	40.21±0.197
	Spring	37.29±0.213	39.04±0.230
	Summer	36.94±0.095	38.92±0.144
	$\bar{x} \pm S\bar{x}$	37.95 ^a ±0.091	39.68 ^a ±0.098
	Cv (%)	5.74	5.94
B	Autumn	39.17±0.222	40.92±0.230
	Winter	40.03±0.137	41.95±0.137
	Spring	40.42±0.191	42.02±0.217
	Summer	40.65±0.185	42.62±0.197
	$\bar{x} \pm S\bar{x}$	39.99 ^b ±0.098	41.80 ^b ±0.106
	Cv (%)	5.75	5.92

^{a,b}= statistically significant differences ($p < 0.05$) between values with different letters in the same column

There are no statistically significant differences between the values marked with the same letters ($p > 0.05$)

Table 1 shows the average body weight of calves on farms A and B by rearing seasons at birth and after the first seven days. In addition to the average value, data for standard error are given, as well as an indicator of relative variability (coefficient of variation). It can be noticed that the samples were homogeneous, as the defined coefficients of variation had a lower value, i.e. did not exceed 7%.

The results presented in Table 1 show that statistically significantly higher values for body weight of calves were found on farm B compared to farm A ($p < 0.01$).

To test the difference in body weight of calves on farms by rearing seasons, the method of two-factor analysis of variance with repeated measuring was used (Table 2).

Table 2. Value of the multivariate Wilks' lambda test

Source	Value	df	F	Significance	Partial eta square coefficient
Farm	0.7776	3	106.0	0.000	0.2224
Season	0.9562	9	5.6	0.000	0.0182
Farm x Season	0.8980	9	13.6	0.000	0.0432

The multivariate Wilks' test recorded statistically very significant differences in the achieved values of body weight of calves of different ages between farms A and B, as well as statistically significant differences in the dependence of weight on the calving season ($p < 0.01$). Thus, the main effects of farm and rearing season factors showed statistical significance, which confirms the initial hypothesis that rearing conditions and birth season have an impact on calf body weight in the first month of life. Factor interaction (farm x season) also showed statistical significance ($p < 0.01$), (Table 3). Based on the guidelines proposed by *Cohen (1988)* (0.01 = low impact, 0.06 = moderate impact, 0.14 = high impact), it can be said that the farm had high impact on calf body weight and the season was low impact. Namely, the effect of the farm on the change in body weight of calves was 22.24%, season 1.82%, while the effect of their interaction was 4.32%. Thus, the farm with its properties and microclimate had a significantly greater impact on the change in body weight than the rearing season.

The influence of the birth season on the body weight of calves (Duncan test) is given in Table 3.

Table 3. Analysis of the influence of the birth season on the body weight of calves (Duncan test)

Season	Average body weight of calves (kg)	
	Age 0	Age 8
Autumn	38.905 ^b	40.649 ^{ab}
Winter	39.371 ^a	41.057 ^a
Spring	38.744 ^b	40.425 ^b
Summer	38.787 ^b	40.763 ^{ab}

^{a,b}= statistically significant differences ($p < 0.05$) between values with different letters in the same column

There are no statistically significant differences between the values marked with the same letters ($p > 0.05$).

The season had a statistically significant effect on the change in body weight of calves, as follows:

- at birth of calves (initial age) in the winter period (season 2) the weight of calves (39.371 kg) was statistically significantly higher than the weight of calves born in autumn (38.905 kg), $p < 0.05$, and statistically very significantly higher in relation to the weight of calves born in the spring (38.744 kg) and summer (38.787 kg) seasons, ($p < 0.01$).
- at the age of eight days, the highest average body weight value in the winter period (second season) of 41.057 kg was recorded again. However, it was statistically significantly higher only than the body weight of calves of the same age born in the spring period (third season) ($p < 0.01$), while in relation to the body weight of calves born in the autumn and summer period it was not statistically significantly higher ($p > 0.05$).

Analyzing the average body weight of calves on farms A and B, it is observed that it did not deviate from the value stated for the Holstein Frieian breed by *Olson et al. (2009)* and *Ballou et al. (2013)*, but the obtained values were lower compared to values reported by *Heins et al. (2010)*. However, analyzed by farms, it was observed that the average body weight of calves, at all ages measured on farm B, was statistically significantly higher than the values recorded on farm A, which confirms the initial hypothesis that rearing, feeding and housing conditions of calves affect BW in the first 8 days of life. These results were consistent with a number of studies related to rearing conditions (*Tapki et al., 2006; Wojcik et al., 2012; Costa et al., 2015; Bazeley et al., 2016*); nutrition (*Thickett et al., 1981; Kertz et al., 1987; de Passillé et al., 2015*) and the breeder's attitude toward calves (*Lürzel et al., 2015*). In addition to the significant influence exerted by the farm, the body weight of calves was statistically significantly affected by the birth season through the action of climatic factors on food consumption and calf growth, which is also in line with the initial hypothesis that rearing conditions, i.e. farm, and the birth season influence the body weight of calves in the first week of life, as

evidenced by other authors in their studies (Coleman *et al.*, 1996; Silanikove, 2000; Avendaño-Reyes *et al.*, 2006).

Conclusion

Colostrum consumption on farms A and B was performed during the first four hours after birth, in most cases up to 2 hours after birth of calves. On farm A, calves consumed colostrum most often from the mother, and less from other newly calved cows; on farm B, the mother's colostrum was also most often used to feed newborn calves, but calves also received colostrum from other cows, as well as frozen colostrum. The amount of colostrum consumed on farms A and B was less than that recommended by calf feeding technology, as well as the amounts reported in the studies of other authors. The problem was especially pronounced on farm A, where calves consumed 1-2 l of colostrum most often in the first feeding, while on farm B they received between 2.5 and 3 l of colostrum. Colostrum quality was assessed by organoleptic method, while laboratory analyzes of chemical composition and biological values of colostrum were not performed. The colostrum feeding period lasted for the first four days after the birth of calves on both examined farms.

The body weight of calves was measured at birth and at 8 days of age, on both observed farms. On farm A, a lower average body weight of calves (37.95 and 39.68 kg) was recorded than on farm B (40.00 and 41.80 kg) by age categories, respectively. The farm and the season of birth had a statistically very significant effect on the average body weight of calves ($p < 0.01$), but the influence of the season was less pronounced compared to the influence of the farm. The difference in average body weight between farms was statistically highly significant ($p < 0.01$) at both ages, while the difference between seasons was statistically highly significant ($p < 0.01$) at birth only.

Regarding the nutrition of calves with colostrum, it is necessary to solve a number of problems, starting with training breeders on the importance of colostrum feeding and enhanced control of the feeding process, through determining the quality of colostrum and forming a colostrum supply, to changing the way colostrum is given (artificial pacifiers, probes, etc.), in order for calves to consume a sufficient amount of high quality colostrum in a timely manner. A better diet with colostrum would inevitably lead to an improvement in the body weight of calves in the first days of life.

Uticaj farme i sezone rođenja na telesnu masu teladi u prvoj nedelji života

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Rezime

Telesna masa teladi u najranijem periodu života teladi (uzrast od 0 do 7 dana) je pod najvećim uticajem farme i sezone rođenja. Farma svoj uticaj ispoljava najčešće kroz uslove ishrane i držanja i organizaciju tehnološkog procesa proizvodnje, dok se uticaj sezone rođenja ispoljava kroz mikroklimatske i uslove ishrane, takođe.

Najčešći nedostaci vezani za ishranu novorođene teladi odnose se na: neadekvatno napajanje kolostrumom u smislu kvaliteta, količine i vremena uzimanja kolostruma, što je u tesnoj vezi sa organizacijom tehnološkog procesa proizvodnje na farmi. Nedostaci u ishrani odražavaju se na telesnu masu teladi na rođenju i sa 8 dana života.

U ispitivanju sprovedenom tokom 2013-2014 godine (4 sezone) analizirana je ishrana kolostrumom novorođenih teladi HF rase na dve farme (A i B) sa vezanim sistemom držanja.

Telad su napajana kolostrumom na obe farme u intervalu, najčešće do 2 sata, ređe do 4 sata nakon rođenja. Konzumirani kolostrum je poticao od majke, najčešće, a ređe od druge krave, dok se na jednoj od farmi koristio i zamrznut. Međutim, količina konzumiranog kolostruma bila je deficitarna, iznosila je 1-2 l na farmi A, a 2,5 do 3 l na farmi B.

Na postojanje deficitarne ishrane ili drugih propusta u ishrani teladi ukazivala je prosečna telesna masa, merena na rođenju i u uzrastu od 8 dana života. Na farmi A je zabeležena manja prosečna telesna masa teladi (37,95 i 39,68kg) nego na farmi B (40,00 i 41,80kg) po starosnim kategorijama, redom. Na prosečnu telesnu masu teladi statistički veoma značajno ($p < 0,01$) su uticali farma i sezona rođenja, kao i njihova međusobna interakcija, ali je efekat farme bio izraženiji.

Ključne reči: telad, ishrana kolostrumom, telesna masa, sezona, farma

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