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Original paper

Indirect determination of colostrum quality to assess the individual consumption according to the colostrum composition

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Abstract Assessing the colostrum quality at calving is essential because the colostrum contains the nutrients, immunological components and the growth factors of the organs, essential for the normal development of the calf. After assessing the colostrum quality, it's necessary to calculate the individual calf need, to assure a serum immunoglobulin concentration of at least 20 mg IgG/ml, as a protection factor against the potential pathogens. The surveillance of the passive or active immunity is the key in the calf care.

Keywords Colostrum, immunoglobulin, growth factors, immunity transfer.

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Introduction

Colostrums is the first fluid obtained from the mammary gland of the mammals, after parturition and is destined for the newborn ingestion in the first six hours of life (XU R, 1996). There are an important number of scientific proofs showing that if a calf doesn't receive a good quantity and quality of colostrums, it will be more vulnerable to environmental pathogens, resulting in higher morbidity, abnormal development and mortality. (DELOUIS C, 1978; SCHAMS D, 1991).

Colostrum formation in the pregnant cow is initiated approximately 3-4 weeks before calving when a limited amount of fluid containing small amounts of growth factors and other substances is synthesized and developed in mammary tissue (FORSYTH IA, 1983).

The process is regulated by a number of other hormones, one of the most important being progesterone, which attaches to special receptors on the cells of the mammary gland and prevents them from secreting any fluid in the gland during the long period of gestation (BARRINGTON GM and col., 1999).

Approximately two weeks before calving, these substances influence the appearance of specific receptors on the surface of mammary gland cells, which will facilitate the transfer of cow's blood component into the mammary gland, including the immunoglobulins (antibodies) required to pass the passive immunity to the calf after birth and various hormones and growth promoters necessary to induce and support the development of the newborn calf (TROTZ-WILLIAMS L, 2006; LAWRENCE HS, 1996).

Approximately 2 days before calving, the hormonal balance begins to change. Initiating production of abundant secretions and switching on the ability of cells in the mammary tissue to synthesize various substances, including lactose. (AKERS RM, 1985; BARRINGTON GM and col, 2000)

At parturition, when the placenta is eliminated, the progesterone level decreases dramatically in the udder and its secretory inhibitory control is removed (TYLER JW, 1996). At the same time, a protein-based substance develops in the cells of the mammary gland, which essentially blocks any extra transfer of substances from the mother's blood to the cow's udder (SAITO H, 1997; JOHNSON JL, 2007).

Colostrum at the first milking also contains substances that inhibit the action of some enzymes (FOLEY JA, 1978). Therefore, these conditions work in favor of having biologically active substances in the complete colostrum process through the stomach of his calf in the upper portion of the small intestine, without being broken down. During the first 6-8 hours of life, an area located in the upper duodenum site specializes where biologically active substances can be absorbed and transported directly into the calf's blood stream (TUCKER HA, 1994; QUIGLEY JD and col. 2002).

Material and Method

The research was carried out on a cow farm with a total of 720 heads. The breed structure consists of cows belonging to the Holstein Friesian breed. The cows are grouped according to the physiological and productive state depending on the productive period (gestation at different stages, breast restitution).

The calves that were the subject of the research were divided into four lots L1-L4. After parturition, they were separated from their mother and fed to a colostrum bottle in the first 24 hours of life, then with transitional milk for the next 2 days. Beginning with the fourth day of life, they were fed with mixed milk.

The first administration of colostrum was done within the first 2 hours after parturition, and the second mandatory one until the 6^{th} hour of life. The method for determining colostrum quality is indirect and consists of measurements using an optical or digital Brix refractometer.

The Brix refractometer is a valuable tool that can be easily used on the farm to measure the amount of colostrum immunoglobulin. The scale on this instrument is designed to measure the amount of sucrose in a solution, but the Brix values can be related to IgG content in colostrum. A Brix value of 22% corresponds to 50 mg/ml IgG. The advantages of using a refractometer for colostrometry are the fact that the refractometer results are not temperature dependent. Colostrum quality: a 22% brix value is equivalent to an IgG concentration of 50 g/l. Any colostrum used for the first feed should be $\geq$ 22% Brix. (BIELMANN et al, 2010).

In order to achieve the goal of this work, we have proposed the following: Collection of colostrum within 30 minutes after parturition by manual milking and measurement of the quantity of colostrum (without the first milking), indirect evaluation of colostrum quality (refractometry with Brix Refractometer) and transformation of the obtained values in total dry substance content, the determination of the colostrum to be removed from consumption, the determination of the individual consumption requirement according to the colostrum quality and the body weight of the calf for administration of the colostrum during the first 2 hours and up to the 6^{th} hour of life.

The colostrum was harvested at 30 minutes after parturition. Previously, the calf was identified and separated from the cow. Prior to the individual harvesting of each colostrum specimen in the experimental groups, the cow's udder and teats were washed, then dried with a disposable towel and disinfected (MCMARTIN S, 2006). The first jets of secretion were removed from each teat, and then milked with individual milking machine.

Results

The amount of colostrum resulted in the first milking revealed a difference between the four batches as follows:

Batch 1 includes heifer cows with an average of 5.14 liters of colostrum, which represents 81.20% of the batch 2 batch, 72.08% of the average quantity in batch 3 and 69.45% of the average quantity of batch 4. We note that all colostrum samples (100%) can be used for calf consumption.

Batch 2 includes cows at the second parturition and records an average amount of 6.33 liters of colostrum with 123.15% more than batch 1, 88.77% of the mean value of batch 3 and 85.54% of the value of batch 4. We note that all samples of colostrum (100%) may be used for the calves consumption.

Batch 3 includes cows at third parturition and records an average of 7.13 liters, representing 138.71% of batch 1, 112.63% above the average of batch 2 and representing 96.35 * of the average value of batch 4. Of the 10 samples from lot 3 can be administered to calves only 8 samples of colostrum since two cows have given more than 8 liters of colostrum (8.4 and 8.8 liters respectively). In this batch three cows had a colostrum secretion that exceeds 8 liters (8.8, 8.9 and 8.4 liters) and could not be used to feed the calves.

Batch 4 includes cows at the fourth lactation and records an average of 7.4 liters of colostrum, compared to the other batches: 143.96% more than batch 1, 116.90% more than batch 2 and 103.78% more than batch 3 cows.

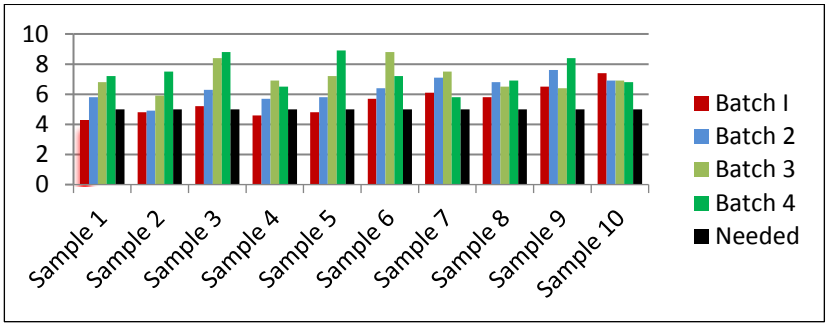

Figure 1. Colostrum quantity in the four batches (litres).

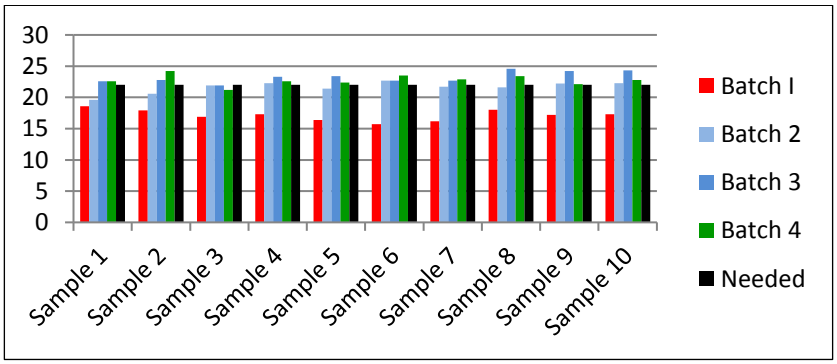

Figure 2. The value of Brix drgrees for the four batches (%).

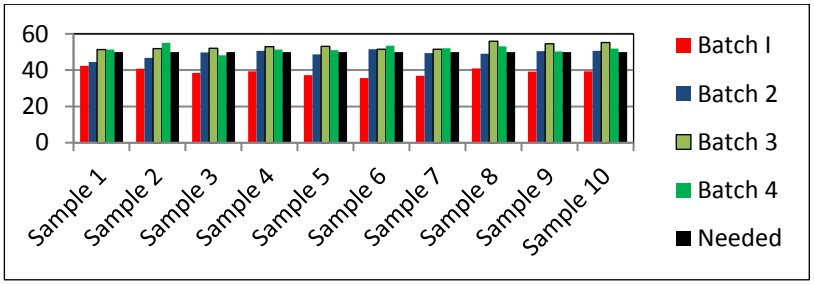

Figure 3. IgG level in the four batches (mg/dl).

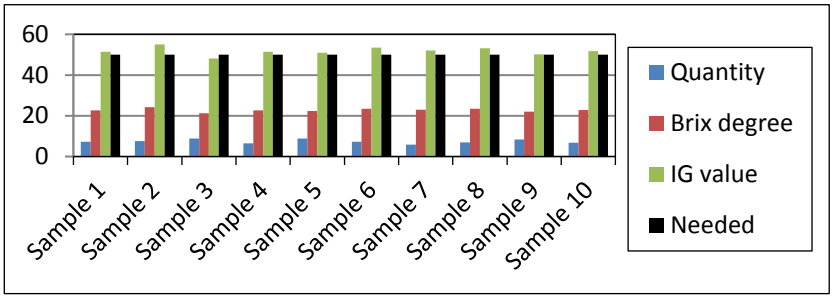

Figure 4. Comparative data of the colostrum quantity and IgG level.

Table 1. Average values in the batches 1-4

Batch	Colostrum quantity	Refractometer value (%)	IgG level (mg/ml)
Lactation 1	5.14	17.15	38.97
Lactation 2	6.33	21.63	49.15
Lactation 3	7.13	23.25	53.02
Lactation 4	7.4	22.77	51.74

Following the centralization of the values found at refractometry directly correlated with the IgG level in colostrum, we can conclude that:

The highest average value of the total dry matter is found in third lactation of cows, which is 23.25 Brixdegrees, which corresponds to 53.02 mg/dl of IgG.

In second place we have the fourth lactation batch with a mean value of 96.51% of that of the third group, having 22.77 Brixdegrees with 51.74 mg/dl of IgG.

The third place is the second lactation batch with an average value of 93.03% of that of the third batch, having 21.63 Brix degrees with 49.15 mg/dl of IgG.

On the last place is the batch, of first lactation cows with an average value of 73.76% of that of thread batch, having 17.15 degrees Brix and 38.97 mg/dl of IgG.

Discussion

Following the study, the amount of colostrum resulted in the first milking, there was a difference between the four lots, namely: Batch 1 with cows at first parturition with an average amount of 5.14 liters of colostrum, which is the smallest amount, insufficient to ensure the need for calf's consumption during parturition. Batch 2 comprises cows at the second calving and records a mean amount of 6.33 liters of colostrum with 123.15% more than batch 1 and 88.77% of the average value of batch 3 and 85.54% of the value of batch4 having the highest production.

After analyzing the colostrum from the 4 batches at the refractometer we find that the differences between the batches are high, the highest value was recorded in batch 3 of 23.25 (100%) degrees, followed by batch 4, with a value of 22.77 (97.93) degrees. Batch 2 with a value of 21.63 (93.03%) refractometric degrees, and the last place was batch 1 with an average value of 17.15 degrees which represents (73.76%) of the maximum value. The only valuable colostrum is found in batch 3 as it exceeds 23 degrees of refractometry. The colostrum from batches 4 and 2 may be used in conditions where it is administered in larger quantities, depending on the body weight of the calf that benefits from it.

The highest average of dry matter is found in third lactation cows corresponding to 53.02 mg/dL IgG, followed by cows from the fourth lactation to an average of 51.74 mg/dL IgG (96.51%) of that of batch three. The third batch ranks the second lactation batch with an average of 93.03% of that of the third batch, containing 49.15 mg/dl of IgG, and the last place is the batch of cows from the first lactation with an average IgG value of 38.97 mg/dL.

Calculating the amount of colostrum required for a 50-60 kg body calf, for a serum concentration of 20 mg IgG/ml , the volume is 4.5 liters of colostrum containing 50 mg IgG/dl in the first two hours of life. If the calf benefits from colostrum after 6 hours of parturition, the need grows to 10.8 liters, which is 240%. With regard to the colostrum content in IgG during the first two hours of parturition, a 50 mg IgG colostrum requires 4.5 liters of colostrum, and when the colostrum contains 30 mg/dl IgG, 7.4 liters is required, which is 160% of the amount of a corresponding colostrum.

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