Journal of Achievements in Materials and Manufacturing Engineering
VOLUME 49
ISSUE 2
December
2011

Automatic and conventional system for feeding calves

M. Janzekovic*, B. Mursec, I. Janzekovic
Faculty of Agriculture and Life Sciences, University of Maribor,
Pivola 10, 2311 Hoce, Slovenia
* Corresponding author: E-mail address: marjan.janzekovic@uni-mb.si

Received 12.10.2011; published in revised form 01.12.2011

Manufacturing and processing

ABSTRACT

Purpose: The study proved automatic feeding to be more suitable for farms with large number of calves as it could substantially reduce working hours.
Design/methodology/approach: The experiment comprised 20 calves which were monitored from birth until the age of 10 weeks. On specific days (1st, 8th, 29th, 50th and 71st) calves were weighed and their height of wither, height of rump and body length were measured.
Findings: The comparison between feeding using bucket teat or automatic feeding system showed significant differences ($p < 0.05$) in the body weight during the period between 50th and 71st day of age (13.30 kg and 9.90 kg), in height of wither in the period between 8th and 29th day of age (1.80 cm and 2.70 cm) and in height of rump in the period between 29th and 50th day of age (1.70 cm and 2.70 cm).
Research limitations/implications: On the first farm "A", calves of Simmental breed were fed with milk replacer using a bucket teat (conventional feeding). On the second farm "B" calves of Holstein-Friesian breed were given milk replacer using an automatic milk feeding.
Practical implications: The aim of our study was to find out which feeding strategy is more suitable for the calves and for the farmer.
Originality/value: We studied different feeding strategies for calves on two farms. Significant differences were ($p \leq 0.001$) in body length during the period between 50th and 71st day of age (2.80 cm and 1.50 cm).
Keywords: Technological devices and equipment; Calves; Feeding systems; Milk replacer

Reference to this paper should be given in the following way:
M. Janzekovic, B. Mursec, I. Janzekovic, Automatic and conventional system for feeding calves, Journal of Achievements in Materials and Manufacturing Engineering 49/2 (2011) 566-572.

1. Introduction

The primary objective of breeding calves is their survival. Other objectives are related to the health condition and growth of calves. As the calves are born without passive protection, since the passage of biologically active substances through placenta is prevented, the first objective can be met only by providing the calves in time with colostrum because due to anatomical and physiological reasons that is the first food the calf may and must consume. The colostrum is a mixture of blood plasma and milk produced by the cow immediately after calving and is important for the newborn calves. It contains an abundant concentration of immunoglobines and more vitamins than ordinary milk [1]. If the calf is not given a sufficiently large quantity of colostrum after birth enough promptly, its survival and health are jeopardized [2].

About 80% of all calves lost on calving are anatomically normal. Most of them die due to injuries or suffocation as a consequence of difficult or delayed calving [3].

The growth of calves since birth to age goes through several stages. The first period is called adaption to new mode of life during which the newborn calf must adapt itself to life outside the mother's body, to new protection mechanisms, to changes of

enzyme processes; it must get used to different food and to a number of new and changeable environment influences. This is followed by the suckling period, when the calves suck large or smaller quantities of milk either from udder or they are fed with milk. Usually, endeavors are made to wean the calves soonest possible and to accustom them to voluminous food, however, milk is of great importance for the calf growth until weaning in the 7th to 8th week of age [2].

For feeding the calves with milk and for preparation of milk replacers the hygienic standards must be strictly met. The fact is that newborn animals are concerned for which the hygiene of the environment and feeding with milk is as important as for children.

Okada et al [4] suggests the possibility that frequent feeding of milk replaced causes incomplete hydrolysis of kappa-casein as well as curd formation, thus reducing the digestibility compared to the feeding of the milk replacer twice per day or frequent feeding of fresh milk. Diarrheas can be caused by different strains of bacteria, viruses or parasites. The most common infectious diarrhea causers are E. coli, rota viruses, corona viruses and cryptosporidia; further, the clostridia, Salmonellas and other strains of micro-organisms and parasites [5]. As a rule, the diarrheas in calves are a consequence of errors in food [6]; of course, also specific infections causing diarrheas are possible [7]. Stress due to weaning can predispose the calves to diseases and can provisionally reduce the daily growth, but correct management and a little patience can prevent harmful consequence and allow trouble-free transition into the next stage of growing [8].

Calf feeders imitate natural rearing and provide relaxed and stress-free feeding. Because the calves are group housed, they benefit from increased activity, social stimulation and enhanced growth. But most importantly they suckle from a teat, which provides many advantages compared with bucket feeding [9]:

- promotes natural sucking behaviour,
- reduces cross-sucking,
- increases saliva production,
- makes calves drink more slowly and
- prevents milk from entering the rumen.

Little is known about the behavioural changes associated with the onset of disease in dairy calves, especially changes in feeding and resting behaviour. The study of Fernandos [10] dissertation examined the effect of milk feeding level on the feeding and resting behaviour of group-housed dairy calves fed with an automated feeding system. In his experiments, calves allowed high levels of milk (ad libitum milk replacer and 12 l/d milk) showed reduced frequency of visits to the milk feeder with visits spread throughout the day and a low intake of concentrate until weaning. Low-fed calves (4 l/d milk or milk replacer) had a high frequency of visits to the milk feeder, however the majority of these visits (~ 90%) were unrewarded (i.e. no milk was served) and resulted in increased milk feeder occupancy times compared to high fed calves. Calves fed low levels of milk also spent less time lying down at 4 to 5 weeks of age than high fed calves, probably due to the increased number of visits to the milk feeder. No differences in the incidence of illness were found between treatments. These results provide evidence that milk feeding level affects the expression of feeding behaviour, so it must be considered when assessing behavioural changes related to illness. Monitoring reductions in milk intake and visits to the automatic feeder in high milk fed calves may be a useful measure in identifiying sick calves. In contrast, other behavioural indicators of activity level, such as standing or lying down, may be more sensitive when identifying sick calves fed low levels of milk.

The aim of this research was to illustrate two different types of calf feeding in the suckling period. As it is known, different modes of feeding require different qualification and all methods are not convenient for all farmers. Further, our aim was to find out which are the advantages and disadvantages of the particular feeding method. The test was performed in farms A and B. In each farm, the test covered 10 calves, i.e., the first 10 calves born since 1.3.2010. In farm A with calves of Simmental breed the calves were fed with milk replacer by means of bucket teat; in farm B with calves of Holstein-Friesian breed the calves were fed with the milk replacer by an automatic calf feeder. The question was, which feeding method was more convenient for calves and, from the point of view of workload, for the farmer.

2. Description of the approach, work methodology, materials for research, assumptions, experiments etc.

In two farms the growth of 10 calves in each group was monitored during 10 weeks. The calves were weighed and the height of withers, the height of cruppers and the body length were measured. The first measurement was performed one day after birth and the second measurement on the 8th day after completion of feeding with colostrum. Afterwards, still three measurements were performed, i.e., every 21 days (29th, 50th, 71st day).

Description of test in farm A

The farm A comprised a herd of 30 milking cows. In the period from 1.3.2010 to 14.6.2010 ten calvings occurred giving 5 newborn calves of female sex and 5 ones of male sex. The calves were fed by means of a bucket teat. During the first week they were given colostrum twice to thrice daily and then the milk replacer during 9 weeks twice daily in 125 g/l concentration (Table 1). The quantity of the milk replacer was increased with age. Throughout, the calves had available water and hay.

Table 1.
Quantity of milk replacer and frequency of calf feeding

Age of calves	The amount of milk replacer (l/day)	Frequency of feeding per day
2 week	4	twice
3 week	6	twice
4-10 weeks	8	twice

Description of test in farm B

The farm B comprised a herd of 100 milking cows. In the period between 1.3.2010 and 3.5.2010 ten calvings occurred giving 5 animals of female sex and 5 animals of male sex. The

calves were fed by means of automatic calf feeder CF500 Kombi [9, 11]. This calf feeder has a very user friendly hand held terminal located on the machine close to the calves for best possible overview (Figure 1).

Fig. 1. DeLaval calf feeder CF500 [12]

During the first week they were given colostrum twice to thrice daily and then the milk replacer during 9 weeks in 125 g/l concentration. In the automatic calf feeder the daily number of rations based on beverage quantity, which was increased with age, and the minimum and maximum saved quantity of beverages were calculated. Throughout, the calves had available water and hay.

Advantages of automatic feeding system

Effective calf feeding and related management can minimize future herd health problems, lower costs, maximize income and create a stable basis for the growth of farmer business. The optimal approach is to feed calves often, with small individually adapted portions. This method allows the calves to properly digest their feed, promotes good growth and limits feed wastage.

Calves need to be fed little and often in order to assimilate their food properly. The abomasum can only hold 2 litres of milk, so it is better 2 to split the daily ration into small portions. DeLaval automated calf feeders help to maximise the health, growth and future potential of all calves by providing the right feeding programme for each animal.

The benefits include:

- fast weight gain,
- good health and
- speedy development of the animal as a ruminant.

The automated calf feeder also allows to wean animals off milk gently, making the experience far less traumatic for them [9].

Rearing healthy calves

Calf feeders CF500 offer a whole host of possibilities for professional calf rearing. There models are durable, low maintenance and provide a range of functions for advanced calf management. But while they look the same from the outside, there are several differences inside - depending on needs.

Feeders are designed to deliver precise portions of milk for each calf, in small amounts around the clock, meeting its needs naturally. Each calf can be fed with cow's milk, milkreplacer or a combination of both, and if we choose to change the type of milk, we can do so gradually. For example, we may choose to provide youngest calves with milkreplacer, gradually switching to cow's milk as they mature. Another option might be to feed male calves cow's milk, and female calves milk replacer.

As soon as a calf enters a milk station, it is recognised by its electronic transponder and, according to the calf's feeding plan, the calf feeder decides if it is allowed to drink, and how much. A minimum and maximum portion of milk per visit can be set for each calf. Providing the calf is allowed to drink, the calf feeder immediately prepares a fresh portion of milk at predetermined temperature for example at 39°C the calf feeder constantly measures the ambient air temperature and adjusts the boiler temperature if a change is detected [9]. In Table 2 is a plan of calf feeding.

Table 2.
Standard plan of feeding in automatic calf feeder

Number of days	The amount of milk replacer (l/day)
3 days	3.5-4.5
14 days	4.5-7.5
18 days	7.5-7.5
42 days	7.5-8.0

Options for DeLaval CF500

DeLaval concentrate station

By adding DeLaval concentrate stations to calf feeding system, we can enjoy simple and efficient calf rearing with the automatic weaning function, helping save expensive milkreplacer costs. By measuring how much concentrate each calf eats, we have the option of automatically reducing the milk ration for calves that display a high feed intake at a young age. Calves that develop more slowly can simply continue on the normal feed plan. Automatic early weaning could save in the region of 10 kg of milk-replacer for each calf [9]. Figure 2 shows concentrate station.

Fig. 2. DeLaval concentrate station [9]

Additive dosers

Additive dosers (Figure 3) allow to add nutritional supplements to the feed of specific calves.

Farmer can add Feedtech™ electrolytes or other Feedtech™ products. Precision dosers are available for powder additives and dosing pumps for liquid additives.

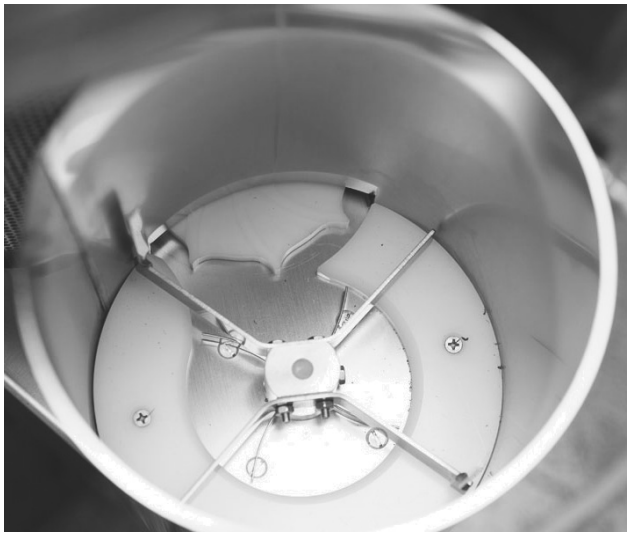

Fig. 3. Aditive doser [9]

Anti-freezing kit

If calf feeder is exposed to subzero temperatures in winter, we will benefit from the installation of this heating cable, to keep the water in calf feeder from freezing.

Fully automatic cleaning with detergent pump

A detergent pump can be added to the automatic cleaning system of the DeLaval CF500 to implement a thorough cleaning cycle. Farmers don't need to be there - cleaning starts at a preset time and the detergents are added automatically. Figure 4 shows automatic cleaning system.

Fig. 4. Automatic cleaning system [9]

Double milk options

On large dairy farms, there are special sections for rearing calves, which are fed with milk replacer through the machine with double feed places (Figure 5).

With this double milk option farmer can save time by feeding even more calves. This has two milk stations giving him a higher milk feeding capacity.

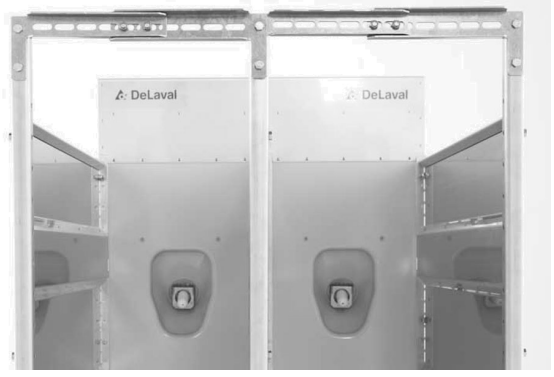

Fig. 5. Double milk feeder [13]

CalfManager is a PC program that is ideal if we have large groups of calves. It can be linked to one or more calf feeders and gives a clear overview and easy control of all calves from the comfort of PC. For example, we can manage feeding programmes, move calves from one calf feeder to another and see whether any animals have drunk insufficient milk or drunk their milk slowly. Farmer can also generate reports and graphs that show milk rations and consumption over specific periods.

An optional fly door is available for calf feeder CF500 which prevents insects from entering the unit and contaminating the milk or milk-replacer powder.

Optional extras for all calf feeders

A swing gate works well to enable calves grouped by age to use one milk station. In this way, calves from both groups can use the same station without the older calves dominating the younger ones.

Automatic closing (Figure 6) gate prevent calves from being harassed by others while drinking, a special gate closes automatically behind them. This application is recommended for certain more aggressive breeds.

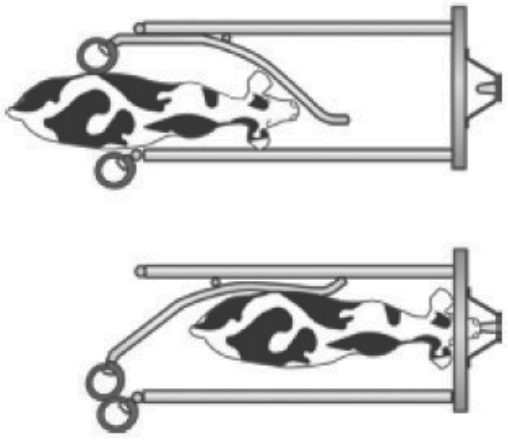

Fig. 6. Automatic closing [9]

Statistical analysis

The basic statistical parameters in our experiment for all values were calculated in the data table of the Microsoft Office program Excel 2007. Then the data were statistically processed by the package for statistical analyses SPSS 15.0 for Windows [14] by using T-test (analyze, compare means, independent - simple T-test).

3. Description of achieved results of own researches

During the test various properties of calves were monitored: body mass, height of withers, height of rump and body length. The measurements were carried out on the 1st, 8th, 29th, 50th and 71st day (Table 3).

Further, the differences in particular values from one to the other measurement were found out by statistical analysis. The results are presented in Figs. 7, 8, 9 and 10. Statistically significant differences are designated by * ($p<0.05$) and *** ($p\leq0.001$).

As far as the body mass is concerned, the calves fed by bucket teat and the calves fed by automatic feeder significantly differed only in the period between 50th and 71st day of age (13.90 kg and/or 9.90 kg), whereas the calves of the groups studied in the periods between the 8th and 29th day and 29th and 50th day gained equal body mass (Fig. 7).

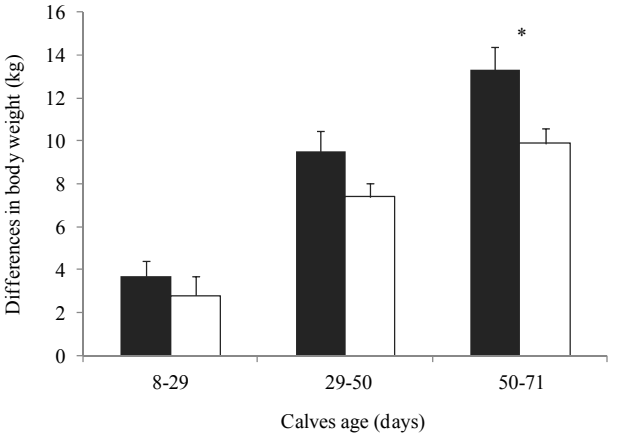

Fig. 7. Difference in body mass from one to the other measurement (■ feeding by bucket teat; □ feeding by automatic feeder)

Table 3.
Calculated arithmetic means and standard deviations for measured values

	Day 1	Day 8	Day 29	Day 50	Day 71
	$\bar{x}$ (SD)	$\bar{x}$ (SD)	$\bar{x}$ (SD)	$\bar{x}$ (SD)	$\bar{x}$ (SD)
			Bucket teat		
Weight (kg)	50.7 (2.5)	54.4 (3.9)	58.1 (4.9)	67.6 (5.7)	80.9 (8.6)
Daily gain (g)		592 (381)	176 (103)	452 (144)	633 (159)
Height of wither (cm)	76.7 (2.3)	76.7 (2.3)	78.5 (2.1)	80.2 (2.9)	82.8 (2.8)
Height of rump (cm)	83.0 (1.2)	83.0 (1.2)	84.6 (1.5)	86.3 (1.8)	88.4 (2.3)
Body length (cm)	64.0 (1.5)	64.0 (1.5)	66.3 (2.3)	69.3 (2.1)	72.1 (2.4)
			Automatic calf feeder CF500		
Weight (kg)	42.7 (6.9)	44.3 (6.6)	47.1 (4.9)	54.5 (4.8)	64.4 (3.9)
Daily gain (g)		229 (254)	133 (140)	352 (96)	471 (104)
Height of wither (cm)	75.4 (3.9)	75.4 (3.9)	78.5 (3.7)	80.8 (2.7)	82.7 (2.8)
Height of rump (cm)	81.2 (4.4)	81.2 (4.4)	83.2 (3.9)	86.0 (3.9)	87.7 (4.1)
Body length (cm)	63.7 (4.6)	63.7 (4.6)	65.0 (4.0)	67.2 (4.3)	68.7 (3.9)

As far as the height of withers is concerned, the calves fed by bucket teat and the calves fed by automatic feeder significantly differed only in the period between the 8th and 29th day of age (1.80 cm and/or 2.70 cm), while in periods between the 29th and 50th day and the 50th and 71st day the calves gained equal height of withers (Fig. 8).

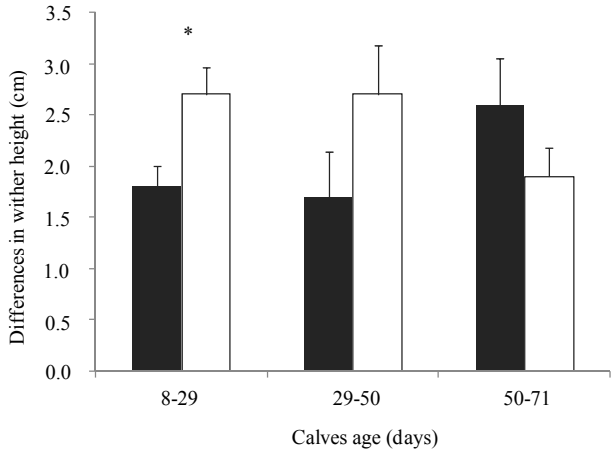

Fig. 8. Difference in height of withers from one to the other measurement (■feeding bybucket teat; □ feeding by automatic feeder)

As far as the height of rump is concerned, the calves fed by bucket teat and the calves fed by automatic feeder significantly differed only in the period between the 29th and 50th day of age (1.70 cm and/or 2.70 cm), while the calves of the groups studied in the periods between the 8th and 29th day and between the 50th and 71st day gained equal height of rump (Fig. 9).

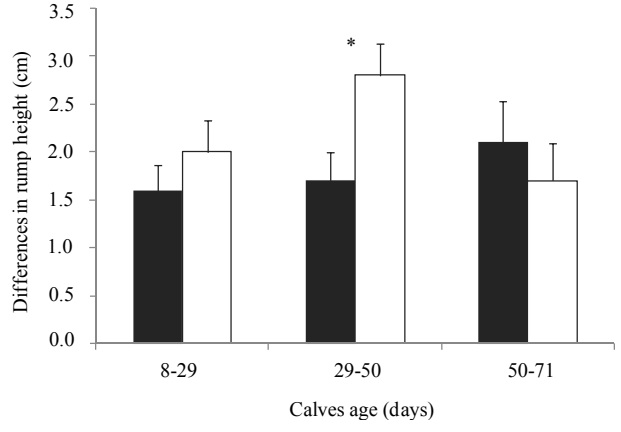

Fig. 9. Difference in height of rump from one to the other measurement (■ feeding by bucket teat; □ feeding by automatic feeder)

In the body length the calves fed by bucket teat and the calves fed by automatic feeder significantly differed only in the period between the 50th and 71st day of age (2.80 cm and/or 1.50 cm), while the calves of the groups studied in the periods between the 8th and 29th day and between the 29th and 50th day gained equal body length (Fig. 10).

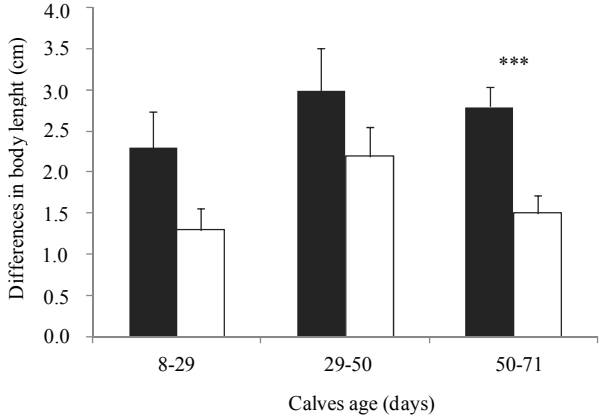

Fig. 10. Difference in body length from one to the other measurement (■ feeding by bucket teat; □ feeding by automatic feeder)

The results show that in some cases there are significant statistical differences, but they are few. This is comparable with the results of the author Hepola [15] who states that there are no outstanding differences in the degree of growth of calves from birth to weaning in different groups. In her research the calves fed by bucked teat gained 0.66 kg and 0.71 kg daily and the calves fed by automatic feeder 0.50 kg and 0.53 kg daily. In our research the daily gains are somewhat lower, i.e., 0.42 kg for calves fed by bucket teat and 0.32 kg for calves fed by automatic feeder. Svensson and Liberg [16] state that the use of automatic calf feeder may cause increased risk of diseases and lower growth degree in comparison with hand feeding.

The free-suckling calves ate less solid feed, rested more and exhibited fewer non-nutritive oral and abnormal behaviours compared to the calves fed milk substitute from an automatic feeder, and some calves often suckled on other cows [17-18].

However, since hand feeding is used particularly for calves standing separately or in small groups, those findings can be explained to a large extent by the difference in the size of the group; it means that the health of calves fed by automatic feeder can be improved by reducing the group. In our research no pathological states were observed either in calves fed by automatic feeder or in the group fed by bucket teat.

4. Conclusions

The test was performed in 2010 to compare the conventional and automatic mode of calf feeding. It was found that there were some significant statistical differences between the two feeding modes. In the body mass statistically significant differences ($p<0.05$) occur in the period between the 50th and 71st day of age (13.30 kg and 9.90 kg), in the height of withers they occur in the period between the 8th and 29th day of age (1.80 cm and 2.70 cm) and in the height of cruppers in the period between the 29th and

50th day age (1.70 cm and 2.70 cm). Statistical differences ($p \leq 0.001$) in the body length in the period between the 50th and 71st day of age (2.80 cm and 1.50 cm) are also significant.

As far as the automatic feeding is concerned, the daily gains are somewhat lower than in calves fed by milk replacer from bucked teat (0.32 kg and/or 0.42 kg), however, according to some researchers, that can be improved by reducing the calf group in automatic feeder. Automatic feeding is very convenient in farms with a lot of calves, since the time required to feed one calf is ten times smaller than the time consumed for one calf fed by bucket teat.

References

[1] C.J.C. Philips, Principles of cattle production, The UK by Cambridge University Press, 2010, 154-160.

[2] A. Lavrencic, T. Pirman, The importance of colostrum in rearing calves, Kmecki glas 49 (2009) 8-9.

[3] JC. Whittier, JG. Thorne, Assisting the beef cow at calving time, 2007.

[4] K. Okada, J. Kato, T. Miyazaki, S. Sato, J. Yasuda, The effect of frequent milk feeding on abomasal curd formation of Holstein calves, Animal Science Journal 81 (2010) 85-88.

[5] M. Acko, Diarrhea in newborn calves, Agricultural actual news 23 (2008) 12-13.

[6] M. Janzekovic, M. Repic, Effect of concentrate exchange on dairy farm, Mljekarstvo 59 (2009) 33-41.

[7] A. Oresnik, A. Kermauner, Nutrition of farm animals, Part 2, Domzale, Biotechnical faculty, Department of Animal Science, 2000, 1-24.

[8] J. Hay, How to wean a calf, http://www.helium.com/items/1497423-how-to-wean-calves (16th January, 2011)

[9] DeLaval, A good start for your future high yield cows, DeLaval calf feeders (2011) 8.

[10] B. T. Fernando, Illness and milk feeding level effects on calf behaviour, https://circle.ubc.ca/handle/2429/12519 (5th October, 2011).

[11] DeLaval, DeLaval automat for feeding calves CF 500 Kombi. Instructions for use (2005) 61-79.

[12] http://www.delaval.com/en/-/Product-Information1/Feeding/Products/Distribution/feeding-sta-tions/DeLaval-calf-feeder-CF500/ (8th November, 2011)

[13] http://www.delaval.com/en/-/Product-Information1/Feeding/Products/Distribution/Accessories/CF150X-double-milk/ (10th November, 2011).

[14] SPSS 15.0 for Windows, Statistical license program at the University of Maribor.

[15] H. Hepola, Milk feeding systems for dairy calves in groups: effects on feed intake, growth and health. Animal Behavior Science 80 (2003) 233-243.

[16] C. Svensson, P. Liberg, The effect of group size on health and growth rate of Swedish dairy calves housed in pens with automatic milk-feeders, Preventive Veterinary Medicine 73 (2006) 43-53.

[17] S. Froberg, L. Lidfors, Behaviour of dairy calves suckling the dam in a barn with automatic milking or being fed milk substitute from an automatic feeder in a group pen, Applied Animal Behaviour Science 117 (2009) 150-158.

[18] M. Janzekovic, B. Mursec, P. Vindis, F. Cus, Energy saving in milk processing, Journal of Achievements in Materials and Manufacturing Engineering 33 (2009) 197-203.