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THE EFFECT OF ADDING MILK REPLACER PELLETS AND SPECIAL COMPLETE FEED ON CALF REARING RESULTS

Grzegorz Skrzyński[1], Elżbieta Sowula-Skrzyńska[2], Justyna Żychlińska-Buczek[1]

[1]University of Agriculture in Krakow, Faculty of Animal Sciences, Department of Cattle Breeding, Al. Mickiewicza 24/28, 30-059 Kraków, Poland
[2]National Research Institute of Animal Production, Department of Technology, Ecology and Economy of Animal Production, 32-083 Balice n. Kraków, Poland
e-mail: rzskrzyn@cyf-kr.edu.pl

Spośród wielu czynników najistotniejszym, wpływającym na właściwy rozwój cieląt jest ich żywienie. W pierwszych tygodniach życia cieląt następuje bardzo intensywny rozwój tkanek i narządów oraz kształtowanie się odporności organizmu decydujące o przystosowaniu zwierzęcia do życia. Żywienie powinno być tak prowadzone, by odchować zwierzęta zdrowe, silne, dające doskonałe efekty w opasie lub reprodukcji. Zgodnie z technologią odchowu cieląt, po okresie pojenia siarą, następuje okres pojenia mlekiem i preparatami mlekozastępczymi wraz ze stopniowym wprowadzaniem pasz treściwych. Wybór prepara- tu mlekozastępczego jest bardzo istotny, szczególną uwagę należy zwrócić na jego skład chemiczny i komponenty składowe. Od tego często zależą efekty odchowu oraz później- sza przydatność zwierzęcia w produkcji. Celem pracy była ocena efektów odchowu cieląt po zastosowaniu granulowanego preparatu mlekozastępczego oraz specjalistycznej mie- szanki wzmacniającej. Badania zostały przeprowadzone w ramach dwóch doświadczeń na łącznie 26 cielętach rasy polskiej holsztyńsko-fryzyjskiej odmiany czarno białej (HF). W pierwszym eksperymencie, po zakończeniu odpajania siarą, cielętom jednocześnie podawano specjalistyczną mieszankę wzmacniającą z dodatkiem witamin i mikroelementów oraz pełnoporcjowy preparat mlekozastępczy w formie granulatu. W drugim doświadczeniu cielętom podawano tylko specjalistyczną pełnoporcjową mieszankę. Na podstawie przeprowadzonych doświadczeń stwierdzono, że po zastosowaniu mieszanki i preparatu mlekozastępczego odnotowano dobre przyrosty masy ciała u cieląt niezależnie od płci wyjściowej masy urodzeniowej. Podobne wyniki uzyskano, gdy stosowano wyłącznie mieszankę. Cielęta, którym podawano preparat mlekozastępczy granulowany, wcześniej zaczęły pobierać pasze stałe oraz obserwowano zmniejszenie występowania biegunek.

Słowa kluczowe: odchów cieląt, preparat mlekozastępczy

The period of colostrum feeding in calves, which provides a calf with essential nutrients as well as antibodies and active immune components, is followed by transition to milk or milk replacer feeding. Farmers often choose to use milk replacers due to economic reasons. After 4 to 5 days of colostrum

feeding, calves are fed milk or liquid milk replacers, which is accompanied by a gradual introduction of calf starter concentrates. It is commonly known that before calves become ruminants, they should be fed a valuable and easily digestible feed, rich in protein of high biological value. Milk replacers meet this requirement and can be introduced immediately after colostrum feeding (Hill et al., 2010).

Milk replacers are defined as feed mixes given as solids or after reconstitution with liquid in proportion recommended by the manufacturer, designed for feeding young animals as a complement or replacer after the colostrum feeding period. Their composition should resemble mother's milk (Soszka, 2009). The choice of a milk replacer depends especially on its chemical composition and basic ingredients. In preparations for the youngest calves, the source of protein is important, namely, protein should derive from milk powder and whey. In the first 4 weeks of calf life, such preparation cannot be replaced by plant proteins because they are much more difficult for calves to digest. Lactose is a natural energy source occurring in milk and whey, thus high-quality preparations should contain a minimum of 45% lactose. Properly formulated milk replacer should also contain: a minimum of 20% protein, 1.7% lysine, 0.5% to 3% fiber, to 5% crude ash, 0.9% phosphorus, to 30 mg * kg^{-1} iron, and other minerals and vitamins (Kuczyńska, 2009).

According to the choice of ingredients, assimilability, quality and price, milk replacers are divided into three groups. The first one comprises preparations containing most of all components of animal origin. Milk powder and dried whey are sources of protein, while fat comes from milk fat, tallow or lard. Carbohydrates largely derive from lactose, while the content of crude fiber is very low. This group of preparations is often supplemented with probiotics or prebiotics which stimulate the immune system of the digestive tract, creating a better defense against harmful microorganisms and accelerating development of gastric mucosa. Preparations from this group are designed in particular for the youngest calves. The second group of preparations is the most popular due to a correct choice of ingredients and good price. These are intermediate preparations containing both animal and plant-derived ingredients in different proportions. Their assimilability and efficiency are equally beneficial as preparations from the first group. The third group is composed of the cheapest milk replacers on the market, based mostly on plant protein subjected to thermal and chemical processing which makes it better digestible and assimilable but, still to a lesser extent than animal protein. Animal fat is replaced principally by plant fat while milk sugar by sucrose and starch. Digestibility of both these ingredients is limited. A higher content of plant proteins and starch contributes to a significantly increased level of crude fiber (Soberon et al., 2012).

In the present studies, the assumption was made that more diverse and intense feeding will have a positive effect on growth performance of calves. Therefore, we decided to verify the effect of feeding neonate calves a milk replacer in the form of pellets and a special mix.

The aim of the study was to assess the effects of feeding calves a milk replacer pellets and a special energizing mix on calf performance.

Materials and methods

Housing and feeding of animals

The study was conducted on 26 Polish Holstein-Friesian calves of black-and-white variety (HF). Birth weight ranged from 37 to 44 kg. After birth calves were placed in individual hutches and fed colostrum. All hutches were equipped with a bucket for water, bucket for the tested milk replacer and starter feed CJ. After the first month, calves were transferred to group pens with shallow litter.

Health of animals was constantly monitored. Calves were weighed at the beginning and at the end of the experiment.

Experimental measurements

The following preparations were used for feeding calves:

1) Complete milk replacer for calves in the form of pellets (B)

Ingredients: whey powder, soy seeds, oat flakes, coconut oil, potato protein, brewer's yeast and supplements (per 1 kg): vitamin A 40,000 IU, vitamin D 5,000 IU, zinc 75 mg, iron 50 mg, copper 8 mg, *Enterococcus faecium* NCIMB 11,181 : 1.25×10^9 CFU

2) Special energizing feed for calves (A)

Ingredients: whey concentrate, palm-coconut oil, whey powder, partially delactosed whey powder, wheat gluten, milk powder, supplements (per 1 kg) probiotic *Lactiferm Enterococcus Faecium*, immunoglobulins, vitamin A, vitamin D_3, vitamin B_3, vitamin B_5, vitamin B_2, vitamin B_1, vitamin B_6, vitamin K_3, vitamin B_9, vitamin H, vitamin B_{12}, iron, zinc, manganese, copper, cobalt, iodine, selenium, lysine, methionine, phosphoric acid, citric acid, calcium formate, butyric acid salt.

The studies were carried out in two experiments:

– In the first experiment (conducted on 10 calves, including 5 head in the control group), after completion of colostrums feeding, calves were fed simultaneously the special energizing feed supplemented with vitamins and microelements and the complete milk replacer granulate;

– In the second experiments (conducted on 16 calves, including 8 in the control group) calves were fed only complete energizing feed.

Calves from control groups were fed in a standard way, i.e. colostrum feeding was followed by milk replacer and starter feed CJ, with constant access to water.

Table 1. Feeding scheme of calves from control group

The rearing of calves – control group	Up to 60 min after birth	24 hours after birth	Up to 4 days	From 5 to 30 days	From 30 days	From d 60 of age
Colostrum period	X					
Weaning the calf from cow		X				
Unlimited access to water and CJ concentrate mixture		X				
Colostrum twice a day			X			
Milk replacer twice a day				X		
Introduction of hay into the ration					X	
Weaning from milk replacer and feeding a concentrate mixture and water						X
Start of feeding other roughages – TMR						X

Table 2. Feeding scheme of calves from experimental groups

The rearing of calves – first experimental group	Up to 60 min after birth	24 h after birth	4th day	From d 4 to 9	From d 15	From d 18 to 21	22nd day	28th day
Colostrum period	X							
Weaning the calf from cow		X						
Unlimited access to water		X						
Introduction of mixture A			X					
Introduction of mixture B			X					
Mixture B 100 g/day			X					
Every day B intake increases				X				
B at 250 g/day					X			
Feeding A once a day					X			
B at 500 g/day						X		
B at 550 g/day							X	
Withdrawal of mixture A							X	
B at 1000 g/day								X

Table 2 contd.

The rearing of calves – second experimental group	Up to 60 min after birth	24 h after birth	From d 4 to 7	From d 7 to 29	From d 29 to 49	From d 50	From d 57 to 63
Colostrum period	X						
Weaning the calf from cow		X					
Unlimited access to water		X					
Giving preparation A twice a day 1.5 litres each			X				
Giving preparation A increases by an average of 0.5 litre/ week (twice a day)				X			
Giving preparation A at 3 litres twice a day					X		
Reducing the amount of preparation A to 2.5 litres (twice a day)						X	
Giving preparation A twice a day 2 litres each							X

A – special mixed feed for calves.
B – granulated milk replacer.

Experiment 1 (duration: 1 month)

Calves from the experimental group were fed colostrum for 3 days, and then pellets of energizing feed and milk replacer were introduced, initially at ca. 100 g (twice a day), the dose was gradually increased. At about 15 days of age calves were fed the energizing feed twice a day last time, while intake of milk replacer pellets was 250 g. In the subsequent days, the amount of milk replacer was raised by 50 g/day while feeding frequency of the energizing feed was reduced to once a day. Between day 18 and 21 calves consumed ca. 500 g of milk replacer daily. From day 22 when milk repalcer intake was 550 g, feeding the energizing feed was discontinued. On day 28 when calves consumed 1 kg of milk replacer, feeding with it was ceased. After completion of the experiment, calves were weighed and transferred to the next production group.

Experiment 2 (duration: 2 months):

Calves from the experimental group were fed colostrum from birth for three days and then the energizing feed was supplied in a liquid form. From day 4 to 7 calves were fed the energizing feed twice a day 1.5 l each time. In addition, a starter concentrate CJ was offered with constant access to water. On weekly average, the amount of the energizing feed increased by 0.5 l /day (fed twice per day). From day 29 to 49 of the experiment, the amount of the energizing feed was maintained at 3 l (2 ×/day). From day 50 the amount of energizing feed was reduced to 2.5 l (2 ×/day). From day 57 till the end of the experiment, i.e. till day 63, 2 l of the energizing feed were given twice a day. After completion of the experiment, animals were weighed and transferred to the next production group.

The feeding scheme of calves from the control and experimental groups is presented in Tab. 1 and Tab. 2. respectively.

Statistical analysis

Data were collected in a spreadsheet and analyzed using a descriptive statistics and Statistica 12 software.

Results

Tab. 3 presents data on the date of birth of calves from experimental groups and weight gain after completion of the experiment.

The results of experiment 1 demonstrated good weight gains in calves fed concomitantly the energizing feed and milk replacer pellets, regardless of calf sex and birth weight. Mean final weight of calves (after completion of experiment 1) was 55.2 kg. Animals were in vigorous condition, no cases of diarrhea or airway diseases were noted during the whole rearing period. It should be added that both preparations were fed only for one month.

Table 3. Characterisitcs of calves from experimental groups

No. of calf	Sex	Date of birth	Birth weight (kg)	Weight at the end of experiment (kg)	Weight gain (kg)
			Experiment 1		
1	B	16.04.2013	44	63	19
2	C	17.04.2013	44	58	14
3	C	19.04.2013	39	52	13
4	C	21.04.2013	40	52	12
5	B	21.04.2013	38	51	13
		Mean	41,0	55,2	14,2
		Min/max	38/44	51/63	12/19
		SD	2,83	1,30	5,17
			Experiment 2		
1	B	9.05.2013	40	63	23
2	B	11.05.2013	38	55	17
3	C	11.05.2013	38	54	16
4	C	13.05.2013	41	65	24
5	C	16.05.2013	42	58	16
6	B	17.05.2013	37	death on day 14	
7	C	21.06.2013	39	55	16
8	C	23.06.2013	37	52	15
		Mean	39,75	57,43	18,14
		Min/max	37/42	52/65	16/24
		SD	1,80	2,19	4,86

B – bulls, C – heifers

In the second experiment (Tab. 3), in which calves were fed only special energizing complete feed, final weight of calves was similar and averaged 57.4 kg. However, it should be mentioned that this experiment lasted two months, so monthly weight gains were at about 10 kg while in the first experiment they average 15 kg. It was also observed that the amount of 1.5 l fed in the first feeding period between day 4 and 7 was decidedly too small because earlier calves consumed more colostrum than the liquid feed.

In addition, calves fed milk replacer pellets earlier started to consume solid feed and also diarrhea incidence was observed to be reduced.

Tab. 4 presents data for claves from control groups for experiment 1 and 2, including birth weight and final weight.

Table 4. Data for calves from control groups

No. of calf	Sex	Date of birth	Birth weight (kg)	Weight on day 60 (kg)	Weight gain (kg)
			Experiment 1		
1	B	12.04.2013	38	62	24
2	C	14.04.2013	37	63	26
3	C	15.04.2013	39	63	24
4	B	15.04.2013	40	65	25
5	B	18.04.2013	40	66	26
		Mean	38,8	55,2	25
		Min/max	37/40	62/66	24/26
		SD	1,30	5,17	1,64
			Experiment 2		
1	C	10.05.2013	37	64	27
2	C	14.05.2013	39	64	25
3	B	25.05.2013	40	67	27
4	B	28.05.2013	37	64	27
5	B	1.06.2013	42	68	26
6	C	3.06.2013	39	63	24
7	C	5.06.2013	41	65	24
8	C	6.06.2013	43	64	21
		Mean	39,75	57,43	25,13
		Min/max	37/43	63/67	21/27
		SD	2,19	4,86	1,73

B – bulls, C – heifers

Table 5. Intake of milk replacer and mixture by the calves

Number of experiment	Duration (days)	Mixture for calves (l)	Granulated milk replacer (kg)	CJ concentrate mixture for calves and heifers (kg)
Experiment 1	28	255,5	9,5	3,2
Experiment 2	63	306,5	-	8,5

Observations collected in Tab. 5 indicate that when only the energizing mix was used (experiment 2), intake of starter feed CJ increased.

Discussion

Conventional feeding of dairy calves, most of all, requires feeding high doses of whole milk or liquid milk replacer till 90 days of age. Hay is introduced from day 5 and a starter concentrate CJ at controlled amounts in the second week. This system has advantages, like quickly raising body weight of calves and supplementation of bioactive components in milk, beneficial for calf development and health. Disadvantages include higher costs, risk of pathogenic bacterial infection, delayed rumen development (Adamski et al., 2004).

In the so-called shortened calf feeding system, colostrum feeding is followed by feeding liquid milk replacers instead of whole milk at 4 – 4.5 l/day on average till 45 days of age. Starter feed pellets are offered simultaneously. According to Krzyżewski (2008), addition of only a starter concentrate to calf diet speeds up rumen development. If the amount of milk replacer fed to calves is limited, intake of solid feed increases. When a calf consumes 1 kg of starter concentrate, milk replacer feeding is ceased and till 3 months of age calves are fed only the starter concentrate. The main advantage of this feeding program is a significantly reduced cost of calf rearing.

As reported by Kowalski et al. (2009), raising healthy and well-grown calves is the foundation for cattle farming and use. The first month of calf's life is crucial for intense development of tissues and organs, especially rumen and maturation of the immune system decisive for animal's adaptation to the environment. Proper management of calves has an impact not only on growth and health of animals but also on development of organs which are essential for later utility value in productive age. The period of liquid feeding is vital when calves do not have fully developed rumen and enzymatic activity of the digestive tract is limited.

Accelerated rearing program, i.e. intensified feeding system is used most of all in the USA and some EU countries. In this method, calves are fed a maximum amount of liquid feed, i.e. 8–10 l/day till 55–60 days of age. The amount of milk replacer is increased with calf's age. Starter feed is offered to calves *ad libitum*, its consumption increases when the supplied amount of milk replacer is reduced, i.e. 2 weeks before weaning. In the intensified feeding system, daily weight gains are around 1 kg. The aim of this system is to raise heifers ready to be bred already at 12–13 months of age. On the one hand, intensive feeding of calves in the first rearing period is beneficial for future milk yield, but on the other there is a risk of deterioration of health status after transition to solid feeds. Disadvantages of this system include composition of

milk replacers, protein content increased by 28% and fat content reduced by 20% (Neja & Bogucki, 2009; Kowalski, 2015).

Colostrum is a rich source of nutrients for developing digestive tract, especially bowels. Compared with cow milk, colostrum produced immediately after birth contains 18 times more albumins and globulins, but their content drops by half six hours postpartum. Among them, gamma-globulin faction is of special significance due to high content of antibodies. They are absorbed to calf's blood and provide it with passive immunity acquired in a natural way. Colostrum feeding immediately after birth is a priority because permeability of the intestinal wall to antibodies in the neonate calf constantly decreases (Osaka et al., 2014). In colostrum-fed calves, small intestine mucosa develops much faster than in animals fed colostrum replacers with similar chemical composition. Therefore, correct colostrum feeding in calves is important not only for supply of immunoglobulins but also for normal gastrointestinal tract development (Żukowski, 2006).

Bilik et al. (2011) also underlined that the time of first colostrum feeding was of paramount importance due to high content of immunoglobulins, constituting the main anti-infectious barrier. Their levels are getting lower with every hour to reach only a half of the birth level at 12 hours postpartum.

According to Górka & Kowalski (2007), milk replacers provide significant economic benefits over conventional feeding. However, a large group of calf raisers decide to continue with milk feeding for the first 7–14 neonatal days. Nevertheless, milk replacers currently available on the market can also ensure very satisfactory calf performance, provided that the best is used. There are many factors influencing the final effect of milk replacer feeding in calf rearing. Quality of milk replacer, most of all its ingredients, plays a key role in feeding the youngest group of calves, i.e. under the age of 3 weeks. In this period calves are particularly vulnerable to all feeding errors. For this reason, milk replacer to be fed in this period should not contain, or if so, to contain only a slight amount of plant-derived ingredients (in particular soy protein). This ingredient is very often included in milk replacers for calves in the second production phase, i.e. for older calves. Its use in the earlier period, in spite of lower prices, significantly worsens calf performance.

Pastoret (2006) indicated that prophylactic measures, like preventive vaccination (immunization) of cows (dams) was a key to complete elimination or minimization of calf deaths and guaranteed satisfactory calf performance.

Our present experiments demonstrated that when calves were fed only special energizing feed (experiment 2), the intake of starter feed CJ increased. Similar results were obtained by Soberon et al. (2012) tested the effects of increasing expenditures on rearing calves and its quality. Those authors compared growth performance of calves fed in a standard way (average daily gain was 390 g/day) and calves fed liquid feed at increased doses and obtained average daily gains of 820 g. Intakes of the preparation significantly differed, namely calves on standard feeding program consumed 32.6 kg of the preparation (powder) over 54

days of rearing (AVG 600 g/day) while those fed intensively consumed 69.5 kg (AVG 1300 g/day). During the whole rearing period, starter feed intake in claves fed in a standard way was 6.7 kg and in those fed intensively 1.9 kg.

Summary and conclusions

Based on the obtained results, the following conclusions can be drawn:

1) Transition from colostrum feeding to milk replacer granulate (in liquid form) had no negative impact of weight gains in calves.

2) The use of both preparations improved vigorous status of calves, no diarrhea cases were noted.

3) Intake of milk replacer did not influence the amount of colostrum consumed in the first day of life.

4) If only milk replacer was used, intake of starter concentrate CJ increased.

5) When the energizing feed and milk replacer pellets were fed in combination, good weight gains were noted in calves, independently of sex and birth weight.

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GRZEGORZ SKRZYŃSKI, ELŻBIETA SOWULA-SKRZYŃSKA,
JUSTYNA ŻYCHLIŃSKA-BUCZEK

The effect of adding milk replacer pellets and special complete feed on calf rearing results

SUMMARY

Among the many factors contributing to normal development of calves, nutrition is the most important. During the first weeks of life, the tissues and organs of calves intensively develop as does their immunity, which adapts them to the environment. Feeding should be carried out in such a way as to make the reared animals healthy, strong and efficient in fattening or reproduction. In keeping with calf rearing technology, the colostrum feeding period is followed by feeding milk and milk replacers, which are gradually replaced with concentrates. The choice of milk replacer is essential and special attention should be given to its chemical composition. This is often crucial for rearing performance and the animal's sub- sequent usefulness for production.

The aim of the study was to evaluate rearing results of calves following the use of milk replacer pellets and special energizing feed. The study was performed as part of two experiments with a total of 26 Polish Holstein-Friesian calves of black-and-white variety (HF). In the first experiment, after colostrum feeding calves received a special energizing feed fortified with vitamins and trace elements as well as complete milk replacer pellets. In the second experiment, calves received special complete feed only. It is concluded from the present study that the use of the mixture and milk replacer resulted in good weight gains of calves regardless of sex and birth weight. Similar results were obtained when only the mixture was fed. Calves that received milk replacer pellets were earlier to consume solid feeds and showed a reduced incidence of diarrhoea.

Key words: calf rearing, milk replacer