Journal of Animal and Feed Sciences, 14, Suppl. 1, 2005, 299–302

Performance of calves as related to the proportion of plant protein in milk replacer and to feeding frequency

S. Osięgłowski[1], B. Niwińska[2], J.A. Strzetelski[2,3] and K. Bilik[2]

National Research Institute of Animal Production,
[1]Experimental Station
64-122 Pawłowice, Poland
[2]Department of Animal Nutrition and Feed Science
32-083 Balice, Poland

ABSTRACT

Forty-two Black-and-White bull calves 8-11 days of age were divided into two equal groups and fed two types of milk replacer to 120 days of age. In the control group (C) the milk replacer (MR) contained 40%, in the experimental group (E), up to 87% crude protein. Whey protein supplement made up the level of protein in both groups to 100%. Liquid feed was given once, twice or three times daily, and concentrate was provided *ad libitum.* Prior to weaning, group E calves and those given liquid feed once daily consumed slightly more concentrate than bulls from group C or those offered liquid feed twice or three times daily. Throughout the whole experimental period, concentrate consumption was not affected by either the frequency or the type of milk replacer (P>0.05). Group C calves showed a faster growth rate and better feed conversion.

KEY WORDS: calves, performance, milk replacer, plant protein, feeding frequency

INTRODUCTION

Plant protein as a component of milk replacer is more poorly digested than milk protein and can negatively affect the absorptive capacity of intestinal mucosa (Montagne et al., 2000) and thus the growth of calves. The rearing efficiency of calves can also depend on the frequency of liquid feeding (Laerke et al., 2000; Strzetelski et al., 2001; Nussbaum et al., 2002). It is still not known how much benefit frequent feeding of liquid feeds with a high plant protein content has on the rearing performance of calves. The aim of this study was to determine the effects of feeding milk replacers with different proportions of plant protein once, twice or three times daily on the intake of solid feed and growth of calves.

[3] Corresponding author: e-mail: jstrzet@izzo.krakow.pl

MATERIAL AND METHODS

Forty-two Black-and-White bull calves from 8-11 to 120 days of age were divided into two groups taking into account initial liveweight and age. In the control group (C) 40% crude protein (CP) of the milk replacer (MR) was derived from soya protein concentrate, whereas in the experimental group (E) the milk replacer contained additional protein from linseed and dried brewer's yeast, reaching 87% CP. A whey protein supplement made up the protein level in both groups to 100%. Liquid feed (LF) was given in both groups up to day 56 of age in the same proportion but with different frequency: once, twice or three times daily. LF and solid feed were offered individually according to IZ-INRA (2001) standards. Refusals were recorded daily. Pelleted (ø 8 mm) concentrate (PC) was given *ad libitum,* meadow hay, in the amount of 0.1 to 0.3 kg/day. PC contained, %: wheat grain 23, barley grain 20, soyabean meal 20, oat grain 15, wheat bran 12.6, rapeseed meal 3, molasses 3, mineral-vitamin supplement 3, pellet binder 0.3 (Lignobond), mycotoxin binder 0.1 (Mycobond). The chemical composition of the feed was determined using AOAC procedures (1990). The results were analysed statistically by two-way variance analysis using the GLM procedure of the SAS packet (1989). Differences among treatments were determined using the LSM method.

RESULTS

One kg dry matter of both milk replacers contained on average 237.5±5 g crude protein (CP), 214.5±0.6 g total digestible protein (TDP) and 1.575±0.005 UFL. One kg of each liquid feed contained 0.194 UFL and 26.5 g TDP. Prior to weaning, calves of group E consumed, more concentrate and derived mainly from liquid feed DM, CP and UFL (Table 1). Calves fed milk replacers once daily, compared to those frequently given MR consumed slightly more ($P>0.05$) concentrate and nutrients, but the intake DM and CP from liquid feed was significantly higher ($P=0.03$ and $P=0.02$). Calves receiving milk replacer C had higher ($P<0.05$) daily weight gains than in group B (Table 2) and showed better ($P<0.06$) feed conversion (Table 3). Calves receiving liquid feed twice daily had tendency to faster rate of growth than those fed once or three times daily and showed better feed conversion ($P<0.06$).

DISCUSSION

The lower weight gains of calves in group E than in group C suggest that 87% of plant protein in CP of MR and its somewhat different composition negatively affect protein digestibility (Toullec et al., 1994). Once daily

feeding with MR probably provoked the interest of calves in solid feed and they consumed more concentrate. However, the digestive tract was not completely ready to digest solid feeds, conversion was low and consequently calves showed poorer growth rate and feed conversion (Laerke, 2000).

Table 1. Daily intake of liquid feed, concentrate and nutrients before weaning (56 days of age)

Item	Milk replacer		P	Feeding frequency			LS	Mean	SE
	C	E		1	2	3			
Concentrate mixture, kg	0.34	0.39	0.21	0.40[a]	0.36[b]	0.34[b]	0.56	0.36	0.02
Total DM, kg	1.18	1.26	0.11	1.25	1.21	1.20	0.67	1.22	0.02
DM of liquid feed, kg	0.82	0.84	0.02	0.82[a]	0.83[b]	0.84[b]	0.03	0.83	0.03
Crude protein, g	260	283	0.01	276	270	268	0.30	279	4.78
CP of liquid feed, g	190	204	< 0.01	194[a]	198[b]	198[b]	0.02	197	1.17
PDIN, g	222	234	0.58	231	227	226	0.82	228	3.16
PDIE, g	219	231	0.05	226	224	223	0.85	224	2.91
UFL	1.67	1.74	0.11	1.73	1.70	1.69	0.79	1.70	0.02

P - level of significance; [a,b] - P<0.05; interaction was not statistically significant (P>0.05)
C - control group (40% plant protein in MR); E- experimental group (87% plant protein in MR)

Table 2. Body weight and weight gains of calves

Item	Milk replacer		P	Feeding frequency			P	Mean	SE	Inter-action
	C	E		1	2	3				
Body weight, kg										
initial	47.8	49.6	0.17	47.8	48.4	49.9	0.39	48.7	0.65	NS
at weaning	72.4	69.6	0.05	68.8	71.2	73.9	0.19	70.3	1.17	NS
final	143.5	137.2	<0.06	136.4	143.8	142.1	0.35	138.8	1.87	NS
Body weight gains, g/day										
before weaning	511	428	<0.02	443	481	485	0.56	473	17.4	NS
after weaning	1112	1056	<0.05	1056	1116	1078	0.20	1086	14.7	x
whole experi-mental period	854	791	0.01	796	846	824	0.23	825	12.98	x

P - level of significance; P>0.05 and NS - differences were not statistically significant (P>0.05)
x - P<0.05

Table 3. Feed conversion rate (per 1 kg of gain) in the whole experimental period

Item	Milk replacer		P	Feeding frequency			P	Mean	SE
	C	E		1	2	3			
Concentrate, kg	2.46	2.69	0.01	2.61	2.47	2.66	0.14	2.59	0.04
Dry matter, kg	2.76	3.02	<0.001	2.94[a]	2.76[b]	2.97[a]	0.06	2.90	0.04
Crude protein, g	566	623	<0.001	605[a]	569[b]	611[a]	0.06	597	8.75
PDI, g	375	411	<0.001	400[a]	376[b]	402[a]	0.06	395	5.5
UFL	3.12	3.40	0.001	3.34[a]	3.15[b]	3.37[a]	0.06	3.28	0.04

P- level of significance; P>0.05 - differences were not statistically significant; interaction was not significant

A significant interaction between kind of milk replacer and frequency of feeding MR obtained for daily weight gains suggests that 40% of plant protein in milk replacer and administration of liquid feed twice daily probably have the most beneficial effect on the development of digestive function in calves (Laerke et al., 2000).

CONCLUSIONS

A lower content of plant protein in milk replacer ensures better utilization of nutrients by calves. Twice daily feeding of calves with milk replacers containing plant protein seems to be a reasonable feeding system for calves.

REFERENCES

AOAC, 1990. Association of Analytical Chemists, Official Methods of Analysis. 15th Edition. Arlington, VA

IZ-INRA, 2001. Standards of Cattle, Sheep and Goat Nutrition (in Polish). National Research Institute of Animal Production, Kraków (Poland)

Laerke H.N., Leśniewska V., Hedeman M.S., Jensen B.B., Pierzynowski S.G., 2000. Aspects of gastrointestinal motility in relation to the development of digestive function in neonates. Livest. Prod Sci. 66, 133-139

Montagne L., Toullec R., Formal M., Lalles J.P., 2000. Influence of dietary protein level and origin on the flow of mucin along the small intestine of preruminant calf. J. Dairy Sci. 83, 2820-2828

Nussbaum A., Schiessler G., Hammon H.M., Blum J.W., 2002. Growth performance and metabolic and endocrine traits in calves pair-fed by bucket or by automate starting in the neonatal period. J. Anim. Sci. 80, 1545-1555

Strzetelski J., Niwińska B., Kowalczyk J., Jurkiewicz A., 2001. Effect of milk replacer feeding frequency and level on concentrate intake and rearing performance of calves. J. Anim. Feed Sci. 10, 413-420

Toullec R., Lalles J.P., Bouchez P., 1994. Replacement of skim milk with soya bean protein concentrates and whey in milk replacers for veal calves. Anim. Feed Sci. Tech. 50, 101-112

STRESZCZENIE

Wyniki odchowu cieląt przy różnej częstotliwości podawania preparatu mlekozastępczego o różnej zawartości białka roślinnego

42 buhajki rasy cb w wieku od 8. do 11. dnia życia podzielono na dwie grupy: kontrolną - C, w której 40% preparatu mlekozastępczego stanowiło białko roślinne, w grupie E-87%, pozostałą część białka ogólnego stanowiło białko serwatkowe. Doświadczenie trwało do 120 dnia życia cieląt. Paszę płynną skarmiano 1, 2 lub 3x/d, a mieszankę treściwą (MT) do woli. Przed odsadzeniem cielęta z grupy E lub pojone 1x/d pobierały nieco więcej MT niż buhajki z grupy C oraz pojone 2 i 3x/d. Po odsadzeniu oraz w ciągu całego doświadczenia na pobranie MT nie wpłynął ani rodzaj ani częstotliwość skarmiania preparatu mlekozastępczego. Cielęta z grupy C rosły szybciej i lepiej wykorzystywały paszę.