Optimizing the structure of calf diets focusing on IDP quality

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Abstract

60 calves, organized in a monofactorial (with complete and randomized blocks) experimental design were used to test the effect of replacing corn with wheat + barley + oats, in diets based on gramineous hay. This led, on the background of similar ingesta of diets ingredients, to a higher supply of limiting digestible amino acids for the experimental group. The energetic supply was similar in both groups. Under these conditions, the daily average weight gain of the experimental blocks was higher; the difference (80 g/animal) being statistically significant.

Keywords: *calves, IDP, amino acids, requirements*

Introduction

An important role in ruminant nutrition is nitrogen nutrition, particularly under the conditions in which protein ingredients are expensive and hard to obtain. It is also known that the protein sources commonly used in ruminant nutrition (meals) are highly degradable in the rumen. The real amount of protein of the meals (including the essential amino acids) is rapidly and largely degraded (most of it to NH_3). On the other hand, ear corn, ingredient in most diets cross-country, although is less degradable, has a much lower content of amino acids (particularly essential amino acids).

The major source of variation of the individual amino acids available in the intestine is the IDPA, if we agree that microbial protein has a rather constant composition, independent of the diet.

Changing compound feed formulation, mainly the less degradable ingredients, we may obtain different IDP variants with different amino acids profiles. The variant, which at the same protein level brings a better uptake of essential amino acids, may result in higher weight gains.

The IDP system used currently does not take into consideration the amino acid profile of the absorbable protein. There are however, preoccupations for the improvement of this system (Rulquin, 1992 a and b) and of the protein nutrition in general (Oldham 1994). Thus, the system was already used on the first essential amino acids (lysine, methionine, etc.)

Material and method

The calves were assigned to two groups according to their age, weight and origin. The initial body weight difference between groups was revealed as not significant (P=0.539) by ANOVA variance analysis.

Within each of the two groups, after data analysis, three experimental blocks were formed: block A with calves immediately after weaning, block B including same type of calves raised in another area and block C with calves of other origin; a monofactorial experimental design in complete and randomized blocks was used (Sandu, 1995).

The number of animals and the duration of the experiment were as follows:

- block A: 10 animals, 56 days
- block B: 10 animals (the same), 35 days
- block C: 10 animals, 47 days

The animals from the experimental blocks A and C were kept outdoors, in glass fiber cages fitted with individual paddocks, the experiment taking place during the warm period of the year. The calves from block B (transferred from the experimental block A) were kept in a house for cattle raising and fattening, fitted with collective stalls, on concrete slats.

The calves from both groups were given average quality barley hay in limited amounts, 0.85 kg/calf/day during the first part of the experiment and 1.3 kg during the second part. The animals had free access to compound feed. The compound feed for the control group was based on ear corn and that for the experimental group was based on cereal grains (wheat, barley, oats). Table 1 shows the compound feeds for both groups.

Table 1 *Compound feed formulations (%)*

	Compound feed	
	Control	Experimental
Ear corn	57.6	-
Wheat	-	27.1
Barley	-	16.3
Oats	-	16.3
Sunflower meal	17.3	16.3
Soybean meal	20.2	19.0
Dicalcium phosphate	1.5	1.5
Calcium carbonate	1.5	1.5
Salt	1	1
Vitamin-mineral premix T1	1	1

The monitored parameters were:

- diet ingredients intake (hay, compound feed)
- body weight evolution
- animal state of health

Results and discussion

Throughout the experiment, the calves had a good state of health (they were selected by observation before the experimental period) and only 4 animals, 2 from each group, were removed from the experiment due to causes independent of the experiment.

Average samples of the dietary ingredients were collected and analyzed by Weende.

Table 2 shows the chemical composition and the nutritive value of the used feeds calculated with the equations and constants of Burlacu et al.(1991, 1996); we also used elements of the system of norms and nutritive values of INRA (1988).

Table 2 *Chemical composition (g/kg DM) and nutritive value of the dietary ingredients*

	Barley hay	Ear corn	Barley grains	Wheat grains	Oats grains	Soybean meal	Sunflower meal
DM	846.2	868.0	891.0	901.5	917.0	924.0	923.0
CP	87.4	89.1	90.0	125.1	102.1	464.8	312.6
EE	19.5	37.1	18.8	22.0	51.0	20.0	20.6
CF	24.5	37.8	57.1	32.0	141.4	74.2	242.0
Ash	77.2	14.0	30.0	19.0	38.0	56.0	70.0
NFE	570.9	822	804.1	801.9	667.5	385.0	354.8
UFV	0.68	1.27	1.162	1.185	0.98	1.10	0.73
UFL	0.58	1.25	1.165	1.179	1.03	1.117	0.64
IDPA	23.1	56.4	22.1	34.3	23.7	176.4	67.8
IDPN	54.4	73.5	59.0	85.6	68.1	331.2	201.9
IDPE	70.8	103.8	73.1	84.6	71.3	211.7	111.9

Compound feed (the only feed ingredient with free access) intake of the two groups was similar in all experimental blocks, which resulted in a similar dry matter intake (Table 3).

Table 3 *Compound feed and barley hay intake*

	Control			Experimental		
	CF	Barley hay	Total	CF	Barley hay	Total
Block A						
gross	2.79	0.85		2.76	0.85	
DM	2.48	0.72	3.20	2.51	0.72	3.23
Block B						
gross	2.95	1.3		2.95	1.3	
DM	2.62	1.1	3.72	2.68	1.1	3.78

Block C						
gross	2.84	1.3		2.85	1.3	
DM	2.53	1.1	3.63	2.59	1.1	3.69

Because the control group consumed more than the expected amount, the energetic regulation of ingesta not functioning in this case, the nutrient supply are higher in this group than in the experimental group:

Experimental block A

Control: 3.03 UFL and 357 g IDP (of which 60.8% IDPA and 39.2% IDPM)

Experimental: 2.91 UFL and 317 g IDP (of which 54.3% IDPA and 45.7% IDPM)

Experimental block B

Control: 3.56 UFL and 401 g IDP (of which 59.1% IDPA and 40.9% IDPM)

Experimental: 3.41UFL and 362 g IDP (of which 52.8% IDPA and 47.2% IDPM)

Experimental block C

Control: 3.46 UFL and 390 g IDP (of which 58.9% IDPA and 41.1% IDPM)

Experimental: 3.33 UFL and 353 g IDP (of which 52.7% IDPA and 47.3% IDPM)

It can be observed that corn replacement by cereal grains decreased the participation of food protein to IDP in favor of the microbial protein, positive aspect, if we take into account that the microbial protein has a higher nutritive value.

Calculating the supply of essential amino acids (lysine, methionine, threonine, tryptophan) we can observe a systematic increase of participation in the absorbed protein (Table 4).

The increase is sufficient to exceed the thresholds determined by literature: 6.7% lysine and 2% methionine in IDP are the warning levels; the optimal levels are considered 7.3 and 2.5% respectively (Rulquin 1992 a, b; Hussein and Berger, 1995; Kung, 1996). It is considered that if the two amino acids participate in a lower proportion to the intestinally available protein, the productions are not at the expected levels.

Table 4 *IDP composition in the first four essential amino acids, %*

	Lysine	Methionine	Threonine	Tryptophan
Block A				
C	5.89	2.13	5.01	1.98
E	7.08	2.30	5.66	2.51
Block B				
C	5.94	2.12	5.02	2.01
E	7.06	2.28	5.64	2.51

Block C				
C	5.94	2.12	5.01	2.02
E	7.05	2.29	5.64	2.51

Although IDP supply is higher in the control group, due to a better amino acids profile of the compound feed administered to the experimental group, the supply of essential amino acids is higher in the latter. This correlates with a higher gain of the diet with cereal grains-based compound feed.
Table 5 shows the body weight gain.

Table 5 *Body weight gain*

	Initial live weight, kg	Final live weight, kg	Average daily gain g/animal*/day
Block A			
C	80.3	131.1	907.1
E	80.1	135.2	983.9
Block B*			
C	131.1	168.8	1077.1
E	135.2	175.5	1151.4
Block C			
C	115.4	164.6	1046.7
E	114.4	168.8	1136.2

C = control group
E = experimental group
* = same animals as in experimental block A

Throughout the experiment the experimental group gained more (about +80 g/animal/day) than the control group, the difference being significant ($p=0.032$).

Conclusions

The replacement of compound feed ear corn by cereal grains (wheat, barley, oats) in a diet with gramineous hay as bulk feed, with restricted administration, had the following effects on the weaned calves:
- the compound feed intake did not differ, although the compound feed with corn had a higher energy and protein level;
- although the experimental group consumed less energy and less protein, the latter had a higher biological value due to a better availability of the essential amino acids: lysine, methionine, threonine, tryptophan;
- the experimental group gained more (about 80 g), the difference being significant.

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