N4.20 - **COMPARATIVE DIGESTIBILITY AND PREDICTION OF INTAKE OF A LOW QUALITY GRASS HAY BY TWO BREEDS OF CATTLE USING INTERNAL AND EXTERNAL MARKERS.**

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1 – MESSAGES

- Fibre (NDF) digestibility of low quality meadow hay (73 g CP and 656 g NDF per kg DM) offered at maintenance level of energy intake was slight but significantly higher in Holstein than in a small Portuguese native breed of cattle ($P<0.05$).
- Prediction of OM digestibility of the hay when it was offered alone from AIA or Cr released in the rumen from controlled release capsules gave similar results.
- In both breeds, hay intake was accurately predicted from the Cr/AIA ratio.

2 – INTRODUCTION

It is quite often argued that ruminant native breeds developed higher ability to digest plant cell wall constituents (CWC) than breeds selected for milk production as the result of feeding behaviour and digestive processes adapted for survival in distinct environmental conditions. However, the available scientific information to support this hypothesis is inconclusive.

The present experiment is part of a larger research project designed to predict intake and digestibility of grazing ruminants using internal markers. It was planned to examine differences in digestive ability between the native Portuguese cattle breed Barrosão and Holstein breed when offered low quality meadow hay and to evaluate internal and external markers as predictors of intake.

3 – MATERIALS AND METHODS

Animals and diets

Four non-pregnant and non-lactating mature cows of each breed with 635 (Holstein) and 457 kg (Barrosão) as initial live weight (LW) were used. They were housed in a well ventilated barn with 17 h light per day and kept in individual rubber-floored stalls with access to individual mangers.

The animals were offered coarsely chopped hay either alone or supplemented with soya bean meal (15% of the diet, DM basis). Grass plants were largely dominant in the hay. Diets were offered in amounts estimated to cover maintenance requirements for energy of the cows in two equal portions at 08.00 and 20.00 h.

Experimental procedure

Representative samples of feed (and refusals, when present) and faeces were collected during six days after a two weeks adaptation period of the animals to the diets. Faecal samples were collected through the grab sample technique at 08.00 and 20.00 h. Acid insoluble ash (AIA) and Cr_2O_3 administered via controlled release capsules (CRC) in the rumen were used as internal and external markers, respectively, to estimate digestibility of the diets and to estimate intake of hay when offered alone.

Chemical analyses

Samples of feeds, faeces and refusals were prepared for chemical analyses according to current procedures. Ash, Kjeldhal-N, neutral detergent fibre (NDF), acid detergent fibre (ADF), acid detergent lignin (ADL), ether extract (EE) and AIA were determined according to standard procedures. Cr was determined by atomic absorption spectrometry.

Calculations and statistical analysis

Digestibility was calculated as (g per kg DM) = (1- Ci/Cf) x 1000 where Ci and Cf are the concentrations of the markers in diet or faeces, respectively. DM intake was calculated from digestibility and faecal output measured from Cr batch release rate per day in the rumen (978.4 mg) and Cr concentration in faeces.

Variance analysis was performed according to standard procedures and the Student's t-test was used to compare means.

4 – RESULTS AND DISCUSSION

The chemical composition of the two batches of hay is shown in Table 1. In a few cases, Barrosão cows did not eat the amount of hay offered in totality. However, from the NDF content of feed offered and refused, the calculated NDF content of the feed eaten did not differ between breeds ($P>0.05$). Thus, it can be concluded that selective intake did not occur.

Table 1
Chemical composition of the meadow hay (MH) and soya bean meal (SBM)[1].

Chemical composition (g kg^{-1}DM)	MH[3]	MH[4]	SEM	SBM
Organic matter	**931**[a]	**930**[a]	**0.98**	**931 ± 1.0**
Crude protein (N x 6.25)	**72**[a]	**74**[a]	**1.27**	**477 ± 2.4**
Ether extract	**10**[a]	**11**[a]	**0.49**	**16 ± 3.2**
Neutral detergent fibre[2]	**641**[a]	**671**[b]	**7.99**	**155 ± 11.7**
Acid detergent fibre	**409**[a]	**431**[b]	**4.77**	**94 ± 21.6**
Acid detergent lignin	**56**[a]	**58**[a]	**2.11**	**5 ± 2.1**
Acid insoluble ash	**23**[a]	**25**[a]	**0.72**	**1 ± 0.5**

SEM: standard error of mean.
Values in the same line with different letters are significantly different (P<0.05).
[1] Each value is the mean of 14 samples.
[2] NDF ash free; assayed without sodium sulphite.
[3] Meadow hay without supplementation.
[4] Meadow hay supplemented with soya bean meal.

Table 2 shows the organic matter (OM) and NDF digestibility of the diets and the OM digestibility of the hay as assessed by the internal marker AIA. All the digestibility coefficients were slight but significantly higher in Holstein than in Barrosão cows (P<0.05). No interactions between breed and diets occurred.

Table 2.
Organic matter (OM) and neutral detergent fibre (NDF) digestibility (g kg^{-1} OM) of total diets and hay (MH) with and without soya bean meal (SM) supplementation using AIA as marker.

	Barrosão		Holstein				Effects	
	MH	MH+SM	MH	MH+SM	SEM	F	Diet (D)	Breed (B)
OM								
Diet	**599**	**647**	**626**	**662**	**8.1**	***	***	*
MH[1]	**599**	**606**	**626**	**623**	**8.6**	NS	NS	*
NDF								
Diet	**538**	**577**	**572**	**596**	**9.8**	*	**	*

SEM: standard error of mean.
[1] Values calculated by difference, assuming OM digestibility of soya bean meal as 880 g kg^{-1} OM (INRA, 1988).
NS : non significant; *P<0.05; **P<0.01; ***P<0.001.

OM digestibility of the hay was unaffected by supplementation (P>0.05; Table 2). Considering the level of crude protein of the hay and using the AFRC (1993) recommendations to calculate its fermentable energy value (FME) and the required amount of effective rumen degradable protein (ERDP), it can be concluded that nitrogen requirements for growth of the microbial population were not met from hay when it was offered alone, even if all nitrogen would have been fully degraded in the rumen and used for microbial growth (Table 3). Clearly this was not the case when 15% of the hay was replaced by soya bean meal. Given the short duration of the experiment and the good body condition of the animals, it seems very likely that nitrogen recycled through saliva and/or diffused across the rumen wall fill the calculated gap between microbial requirements and ERDP.

Table 3.
Estimated energy and protein values of the diets (per kg DM)

	MH		**MH+SM**	
	Holstein	Barrosão	Holstein	Barrosão
MOD	**626**	**599**	**662**	**647**
ME (MJ)[1]	**9.15**	**8.77**	**9.67**	**9.46**
FME (MJ)[2]	**8.78**	**8.41**	**9.27**	**9.06**
$ERDP_{required}$ (g)[3]	**79.0**	**75.7**	**83.4**	**81.5**
CP intake	**72.0**	**70.3**	**134.5**	**132.8**

[1] Value obtained by the equation proposed by Barber et al. (1984): ME (MJ/kg DM)=0.157*D, where D is the digestible OM/kg DM (AFRC, 1993).
[2] Estimated by the equation proposed by AFRC (1993): [FME] (MJ/kg DM)=[ME]-[ME fat].
[3] Assuming that ERDP is not limiting: ERDP=MCP=9 g/MJ of FME (at maintenance level of feeding)

Prediction of OM digestibility of the hay when it was offered alone from AIA or Cr2O3 gave similar results (Table 4).

Table 4.
Organic matter digestibility of hay using AIA or Cr_2O_3 as markers (g kg^{-1} OM).

Barrosão		**Holstein-Friesian**				**Effects**	
AIA	Cr_2O_3	AIA	Cr_2O_3	SEM	F	Breed	Marker
599	**597**	**626**	**629**	**12.4**	**NS**	*****	**NS**

SEM: standard error of mean. NS: non significant

Prediction of hay intake when it was offered as the sole component of the diet using the ratio Cr/AIA showed to be in close agreement with the observed values in both breeds (Table 5).

Table 5.
Comparison between observed and estimated intake of hay dry matter (DM) using Cr/AIA as estimator**.**

	Barrosão	**Holstein-Friesian**
Hay intake, kg DM		
Observed	**5.64**	**7.76**
Estimated	**5.66**	**7.72**
SEM	**0.183**	**0.755**
F	**NS**	**NS**

SEM : standard error of mean; NS : Non significant

5 – CONCLUSIONS

◆ The current belief that native cattle, even of temperate regions as is the case, exhibit higher ability to digest fibrous feeds than genetically improved breeds as an adaptation mechanism to the environmental conditions was not demonstrated. In fact the opposite was observed.

◆ Further studies designed to examine specific features of the feeding behaviour and/or the digestive process of this small cattle breed are needed. In particular, the rate of passage of feed particles should be investigated.

◆ The markers ratio Cr/AIA proved to be a good estimator of the hay intake under stall fed conditions.