Nutritive value of pea residue (Pisum sativum L.)

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Nutritive value of pea residue (pisum sativum L.)

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SUMMARY - It was our aim to study the nutritive value of pea residue (fresh) and its variation with the process of conservation. One experiment was made (3 x 3 Latin Square Design) with a group of adult male Serra de Estrela sheep, fed the pea residue fresh and preserved (as hay or silage) at a level of intake of 40 DM/kg0.75. The chemical characterization, "in vitro" and "in vivo" digestibilities and the nitrogen and minerals apparent availabilities were performed. The Crude Protein content varied between 12.2 and 16.9% DM, presenting hay the lowest level. Although these values are acceptable for maintenance requirements of adult sheep, one of the animals presented negative values of nitrogen retention and of nitrogen digestibility. The "in vitro" digestibility of DM varied between 53.3 and 56.6%. The "in vivo" apparent digestibilities showed the best values for fresh product (F), being those of the silage (S) and hay (H) very near: DM - 71% (F), 54% (S) and 56% (H); NDF - 69% (F), 55% (S) and 56% (H); ADF - 69% (F), 59% (S) and 53% (H); Energy - 60% (F), 54% (S) and 56% (H). Also for minerals apparent availabilities the best values were observed for the fresh product. Nevertheless, plasmatic levels indicative of critical situation of mineral deficiency were observed. It seems that pea residue can be successfully used in ruminant feeding, preferentially fresh, but as it is available for short periods it must be preserved. If the silage process is chosen, then an additive must be used.

RESUME - "Valeur nutritive des résidus du pois frais (pisum sativum L.)". Afin d'étudier la valeur nutritive des résidus du pois frais ou après conservation, une expérience est réalisée (3 x 3 en carré latin) avec un groupe de moutons mâles adultes de race Serra de Estrela nourris avec des résidus de pois frais ou conservés (foin ou ensilage) à un niveau d'ingestion de 40 g/kg0.75. La composition chimique, les digestibilités "in vitro" et "in vivo" et la disponibilité de l'azote et des minéraux sont mesurées. Le taux de matières azotées totales varie de 12,2 à 16,9%, le foin ayant le taux le plus bas. Bien que cette teneur soit suffisante pour l'entretien, un des moutons présente un bilan azoté négatif. La digestibilité "in vitro" de la matière sèche varie de 53,3 à 56,6%. La digestibilité apparante "in vivo" est supérieure pour le produit frais, l'ensilage et le foin étant très voisins avec pour le DM 71%, 54% et 56% respectivement pour le vert, l'ensilage et le foin; pour le DADF 69%, 59% et 53%et pour l'energie 60%, 54% et 56%. La disponibilité des matières minérales est la plus élevée avec le produit frais. Toutefois, des taux plasmatiques indiquent une situation critique de déficience minérale. Il semble que les résidus de pois puissent être utilisés de façon efficace dans l'alimentation des ruminants de préférence à l'état frais mais, compte tenu de sa faible disponibilité dans le temps, ce sous-produit doit être conservé, l'ensilage nécessite la distribution d'une complémentation.

Introduction

It was our aim to study the nutritive value of the pea residue (fresh) and its change with the conservation process as hay and silage, for the possible utilization in ruminant feeding.

Methodology

On arival, the product was separated in three fractions: one was frozen at -40° C, another was air dried for hay and the last one was ensiled without additives.

Experiments were made following a Latin Square Design (3 x 3). A group of adult male Serra da Estrela breed sheep, with an average live weight of 50 kg was allocated in individual metabolism crates. Pre-experimental periods of three weeks were made, followed by balance trials of seven days, in which a daily control of feed intake, faecal and urinary excretions was made.

The feed was given at an intake of 40 g DM/kg0.75 day, twice daily.

Feeds and faeces samples were analysed by the Weend and Van Soest methods. The "in vitro" DM and organic matter (OM) digestibilities were determined in feeds. The fresh and ensiled products were also analysed

for DM by the toluene extraction, for volatile fatty acids (VFA), lactic acid, and ammoniacal nitrogen (N-NH3).

The "in vivo" true digestibilities of DM and N were estimated as reported by Van Soest (1982) and the N retention by deduction of the daily urinary and faecal N excretion from the daily N intake.

The data were studied by variance analysis (Fisher, reported by Davies, 1976).

Results and discussion

In Table 1, the organic constituents as well as the "in vitro" digestibility of the pea residue are shown. Significative variations ($P<0.05$) were observed for dry matter, ether extract, water soluble sugars and acid detergent fiber, relatively to the mode of preservation.

Regarding crude protein (CP = N x 6.25) we can say that the hay presented the lowest level (12.2% DM) which however was higher than that considered as the minimal requirement for the normal function of rumen microorganisms. The fresh product and the silage presented levels of that nutrient above those reported by Serrano (1988).

The gross energy content was high in the three feeds, being in agreement with the high fractions of fibrous compounds (NDF) which varied between 15.2 and 17.9% DM and with the high values of organic matter (OM) observed. The calculated metabolizable energy (ME) presented lower values than those reported by MAFF (1975) for this by-product.

The "in vitro" digestibility varied between 53.3 and 56.6% for dry matter and between 49.6 and 52.3% for organic matter in the different feeds.

Regarding the fermentative parameters of the fresh and ensiled pea residue, it can be said that while the fresh product remained well preserved, with no fermentations and with values near those reported by Serrano (1988), the silage showed high values of pH, and volatile fatty acids followed by an extremely low level of lactic acid, even below the one observed for the fresh product.

Table 1 - Organic constituents, "in vitro" digestibility and fermentative parameters of pea residue.

The high pH found may be due to the high levels of N-NH3 and of butyric acid observed which may be due to a butyric acid fermentation, indicative of deterioration of the product. All these observations are very far from those indicated by Demarquilly (1986) as corresponding to a good silage (pH 4; N-NH3 5.7% Total N; Soluble N ± 50% Total N; acetic acid 20-25 g/kg DM; propionic and butyric acids - traces).

Table 1. Organic Consituents, "in vitro". Digestibility and Fermentative Parameters of Pea Residue.

	Fresh	Silage	Hay	SD	S
DM (%)	22.2 a	17.8 b	80.2c	1.59	*
I OM	90.1	87.7	90.8	–	–
I CP	16.9	15.9	12.2	4.22	NS
I Esther Ext.	2.3 ab	3.1 b	1.4a	0.58	*
% Starch	3.4	3.4	2.9	0.97	NS
D					
M Sol. Sugars	1.2 a	0.61a	5.3b	0.59	*
I ADF	37.2 a	48.3 b	47.3b	2.03	*
I NDF	46.7	55.4	58.5	4.77	NS
I ADL	7.2	10.5	7.3	1.34	NS
Energy (MJ/kg DM)					
GE	15.2	17.9	17.4	1.46	NS
ME**	6.9	6.5	7.1	0.48	NS
"in vitro" Digest. (%)					
DM	55.3	53.3	56.6	3.57	NS
OM	51.1	49.6	52.3	3.17	NS
Ferment. Parameters					
pH	5.7	5.5	–	–	–
Soluble N (% TN)*	30.3	42.3	–	–	–
NH_3 - N (% TN)	6.4	24.7	–	–	–
Lactic Acid (g/kg DM)	4.5	1.4	–	–	–
Vol. Fatty Acids (g/kg DM)					
Acetic	11.6	55.4	–	–	–
Propionic	0.84	6.02	–	–	–
Butüric	0.23	39.8	–	–	–

* % TN - % Total Nitrogen
** - ME = 0.15 DOMD % (MAFF, 1975).
Numbers in rown with different letters are significantly different at P < 0.05 (*) SD - Standard Deviation; S - Significance; NS - No significative.

In Table 2 the mean values of "in vivo" digestibilities of organic constitutents and of nitrogen retention are presented.

Table 2 - Mean values of "in vivo" digestibilities and of nitrogen retention

At first we would like to note that palatability problems were not observed, the by-product being well accepted by the animals.

The "in vivo" digestibilities of dry matter (apparent) and of NDF and the nitrogen retention varied significantly ($P < 0.05$) among feeds.

However, although significative differences had not been observed for the other nutrients studied, it can be said that the fresh product presented in all cases the best values.

Table 2. Mean Values of "in vivo". Digestibilites and of Nitrogen Retention.

	Fresh	Silage	Hay	SD	S
DM					
Apparent	71.2	54.1	56.4	2.78	*
True	87.5	80.3	76.8	2.51	NS
NDF	68.7b	55.0a	55.6a	2.17	*
%					
ADF	68.5	58.7	52.7	4.05	NS
Energy	60.1	55.4	55.5	2.84	NS
N					
Apparent	73.4	53.9	45.9	15.11	NS
True	92.6	87.9	86.7	2.42	NS
N. Retention (% Intake)	31.3c	8.8a	15.5b	0.97	*

Numbers in rown with different letters are significantly different at P < 0.05 (*) SD - Standard Deviation; S - Significance; NS - No significative.

The values observed in silage are near those reported by Serrano (1988) and by Ribeiro et al. (1983). Differences from this last work are at the level of energy digestibility due to the utilization, by the authors, of a maize supplementation as an energetic source. Although it was not a good silage (no lactic fermentation and high butyric fermentation) the values of "in vivo" digestibility were not too low, being very near those of the hay. However, if the silage was well preserved, this value could be improved to one closer to that of the fresh product.

Conclusions

From the obtained results and as final conclusions, we would like to note that:

– Pea residue can be successfully used in ruminant feeding.

– Regarding its nutritive value it can be considered a well balanced by-product.

– This by-product must, preferably, be used fresh, however, as it is available for short periods (May-June) in great quantities (5000 tons/year), from the economical view it must be preserved.

– If the silage process is chosen, then an additive must be used because an increase in pH values occurred followed by a butyric instead of a lactic acid type fermentation.

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