Influence of Feeding Roughage and Concentrate (Soy Bean Meal) Simultaneously or Consecutively on Levels of Plasma Free Amino Acids and Plasma Urea in the Equine

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Summary

Associated diet (roughage and concentrate given simultaneously – D1) and dissociated diet (concentrate given 2 hours later than the roughage – D2) are compared as regards the levels of PFAA and plasma urea on 9 mature male ponies. Blood samples were taken 3 hours, 6 hours and 9 hours after the feeding of concentrate. The dissociated diet shown stables levels of plasma urea, the associated diet, rise in time – D2 gave higher values of total PFAA at 6 and 9 hours after feeding, while there was no difference between the diets concerning the total of nonessentials AA.

Einfluß der Fütterung von Rauh- und Kraftfutter (Sojaextraktionsschrot), gleichzeitig oder konsekutiv auf den Plasmaaminosäuren- und Harnstoffgehalt bei Equiden

Der Effekt gemeinsamer Verabreichung von Rauh- und Kraftfutter (D1) oder zeitlich getrennter Fütterung (Kraftfutter 2 Stunden nach Rauhfutterangebot; D2) auf den Plasmaaminosäuren- und Harnstoffgehalt wurde bei 9 erwachsenen Ponys verglichen. Blutproben wurden 3, 6 und 9 Stunden nach der Kraftfuttergabe gezogen. Bei getrennter Fütterung (D2) blieb der Harnstoffspiegel auf einem gleichmäßigen Niveau, während sich nach gemeinsamer Verfütterung (D1) ein Anstieg ergab. Der Gehalt an essentiellen Aminosäuren im Plasma lag 6 und 9 Stunden postprandial bei getrennter Fütterung (D2) höher. Die Konzentration der nichtessentiellen Aminosäuren unterlag dagegen keinem fütterungsbedingten Einfluß.

Introduction

As it is the case with other domestic species, nitrogen plays an important role in nutrition of the equine. However, in horses utilization of nitrogen is not well understood. Especially the associated or dissociated intake of nutrients may influence the availability of amino acids in the small intestine by gastric retention. We have carried out an experiment to gain more insight into this phenomenon.

Material and Methods

Nine mature ungelding ponies were used, each weighing between 150 and 200 kg.
INRA recommendations for maintenance were observed to compose the diets:
2.750 kg of molassed straw (roughage) complemented by 654 g of maize, and 438 g of soybean meal (concentrate).
For the associated diet D1 the roughage and the concentrate were given simultaneously. And for dissociated diet D2 the concentrate was given 2 hours later than the roughage. The chemical composition of the rations is shown in table 1.

Table 1

Automatic watering troughs provided animals a constant supply of good quality water.
The experiment was carried out in two experimental periods (D1 in the first, D2 in the second) each consisting of a 2 week adaptation period and 1 week during which samples were taken. During the experimental periods the ponies were kept in boxes.
Samples of jugular blood were taken from each animal at the end of each experimental period:
At T0 (just before feeding), at T1 (3 hours after feeding), at T2 (6 hours after feeding), at T3 (9 hours after feeding).
During the second period two extra samples were taken from each animal: 5 hours and 8 hours after feeding (i. e. 3 hours and 6 hours after the nitrogen supplement was fed).
Repeated measures did not appear to have any influence on the results (*Johnson,* 1972; *Ott* et *al.,* 1979). One measurement per experimental period was found to be enough significant. *Reitnour* and *Salsbury,* 1975, carried out their experiments that way, as did *Russel* et *al.,* 1986.
Plasma urea was analyzed by using the colorimetric-enzymatic technique of hydrolysis with urease/Berthelot's reaction from Boehringer Mannheim GmbH Diagnostica (test-combination urea).
Plasma Free Amino Acids (PFAA) were analyzed by means of gas chromatography, using a Beckman 6300 Amino Acid Autoanalyzer.
Each of the 24 amino acids (AA) were measured, as well as total PFAA, total essential AA, and total nonessential AA.
A three-factor analysis of variance was carried out.

Results and Discussion

Plasma urea concentrations after feeding are shown in figure 1. Using the D1 diet, there was a rise in plasma urea in the hours after feeding. With D2, plasma urea was more stable.
Total PFAA are shown in figure 2. At T0 (before feeding) and T1 (3 hours after feeding) there is no significant difference between the two diets. At T2 and T3 (6 hours and 9 hours after feeding) D2 gives significantly higher values than D1.

Table 1: Chemical composition of rations (% Dry Water)

Nutrients	Ash	Crude Fibre	Crude Protein
Molassed Straw	6.82	38.54	4.74
Soybean Meal	6.88	7.36	45.80
Maize	1.11	3.10	10.46

Total of nonessentials AA are shown in figure 3. There is no significant difference between the two diets.
Total of essentials AA are shown in figure 4. As with total PFAA, there was no difference between the diets at T0 and T1, whilst concentrations were significantly higher at T2 and T3.

A summary of the results of the statistical analyses is shown in table 2.

Except for leucine and lysine, there are differences between the animals for every other AA.

Although there are differences in time for all AA except glycine, the interaction time x animal is not significant (except for histidine, phenylalanine and ornithine), which indicates that the concentrations of AA follow the same pattern in time for the 9 ponies.

Diet has no significant effect on total nonessential AA, but has an effect on every AA and the sum of AA.
The interaction diet x animal is not significant for either total PFAA, total essential AA, or total nonessential AA. For some AA, however, it is significant. This confirms the first result, namely that certain animals have an aptitude for certain AA, but that the animals react in the same way to the diet with regard to total PFAA, total essential AA, and total nonessential AA.
The interaction diet x time is significant for all AA except serine. This shows that the concentration of the AA in time depends on diet.
The differences between the two diets concerning the values for urea and for each AA were calculated to establish correlations. As there are only 4 observations, it is difficult to obtain significant levels. Nonetheless, there is a signifi-

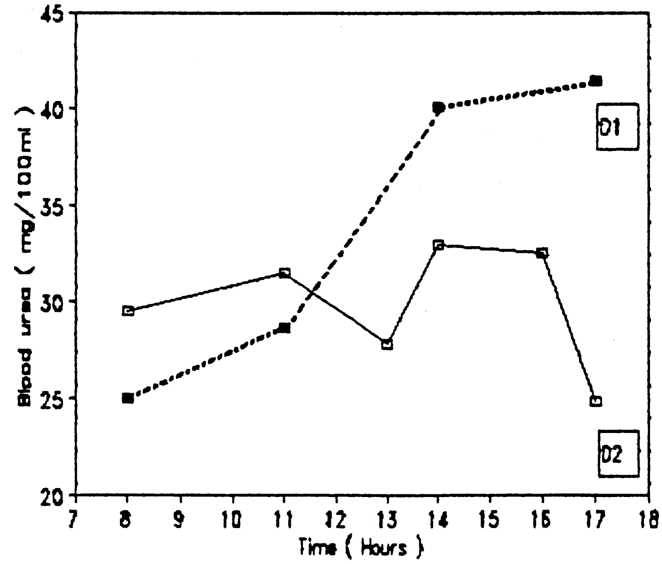

Figure 1: Concentrations of plasma urea in the hours after morning feeding (average of 9 ponies).

Table 2: Three ways analysis of variance of PFAA (animal, time, diet)

Amino acids	A	T	T×A	D	D×A	D×T
Essential	*	*	NS	*	NS	*
Arginine	*	*	NS	*	NS	*
Histidine	*	*	*	*	*	*
Isoleucine	*	*	NS	*	NS	*
Leucine	NS	*	NS	*	NS	*
Lysine	NS	*	NS	*	NS	*
Methionine	*	*	NS	*	*	*
Phenylalanine	*	*	*	*	NS	*
Threonine	*	*	NS	*	*	*
Tryptophane	*	*	NS	*	*	*
Valine	*	*	NS	*	*	*
Nonessential	*	*	NS	NS	NS	NS
Alanine	*	*	NS	*	NS	*
Asparagine	*	*	NS	*	*	*
Cystine	*	*	NS	*	*	*
Glutamic acid	*	*	NS	*	*	*
Glutamine	*	*	NS	*	*	*
Glycine	*	NS	NS	*	*	*
Proline	*	*	NS	*	NS	*
Serine	*	*	NS	*	*	NS
Tyrosine	*	*	NS	*	*	*
Aspartic acid	*	*	NS	*	*	*
Citruline	*	*	NS	*	*	*
Ornithine	*	*	*	*	*	*
Taurine	*	*	NS	*	*	*
3-Met-Histid.	*	*	NS	*	NS	*
Total	*	*	NS	*	NS	*

A = animal; T = time; D = diet; * = significant at 5 % level

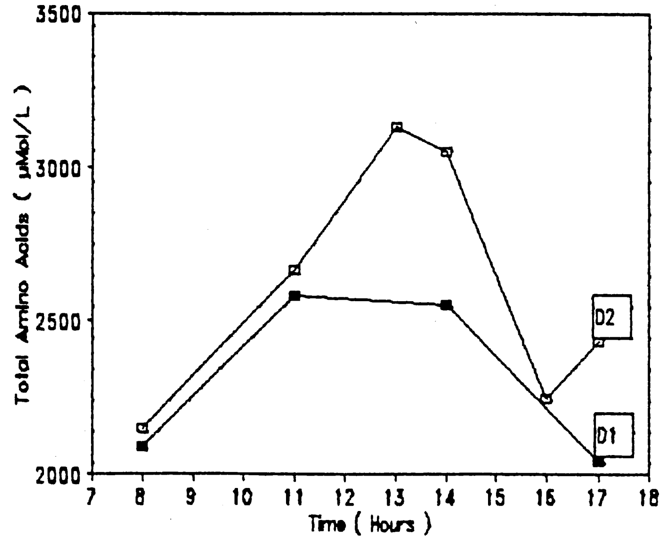

Figure 2: Concentrations of total PFAA in the hours after morning feeding (average of 9 ponies).

cant correlation between the difference in 3-met-histidine (R = –0.956). The correlations between the difference in total PFAA (R = –0.809), between the difference in total essential AA (R = –0.738), and between the difference in nonessential AA (R = –0.873) are not significant.

D1 (diet 1) favours the synthesis of urea: nitrogen which is not digested before the cecum is transformed into ammonia, and subsequently transformed into urea. When roughage and nitrogen supplement are fed simultaneously, as is the case with D1, the transformation appears to be quicker. This seems to be confirmed by the absorption of essential AA, which is better in D2.
Total PFAA are also better absorbed with D2, whereas there is no difference between D1 and D2 as far as the absorption of nonessential AA is concerned.
We are presently repeating our experiment, and we are waiting for these results to draw some final conclusions.

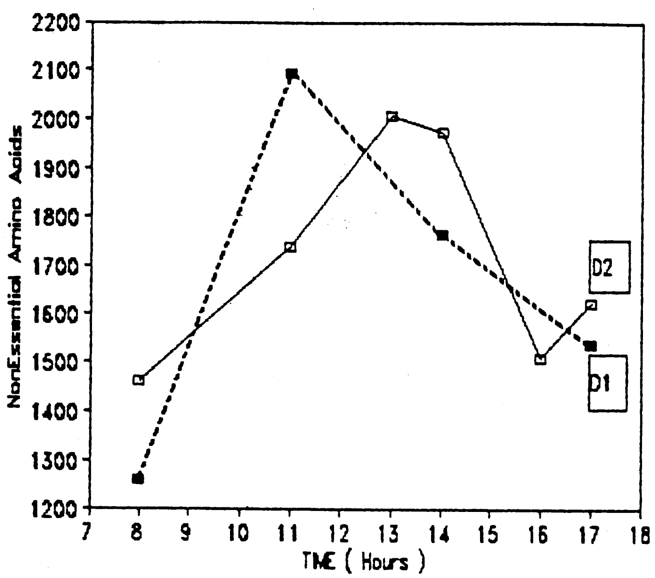

Figure 3: Concentrations of total nonessential AA in the hours after morning feeding (average of 9 ponies).

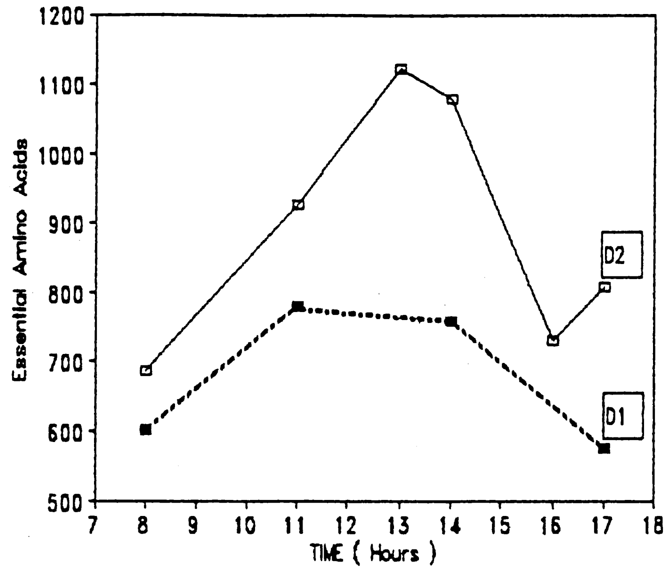

Figure 4: Concentrations of total essential AA in the hours after morning feeding (average of 9 ponies).

However, these preliminary results might indicate that feeding the nitrogen supplement after the roughage keeps plasma urea concentrations lower, it also raises total PFAA the equine's most important source of nitrogen.

Conclusion

This conclusion seems all the more interesting, as it concerns mainly the essential AA.
When nitrogen supplements are fed after the roughage, they spend more time in the stomach. Which improves their digestion in the small intestine.
It therefore seems recommendable to feed nitrogen supplements in small quantities after or independently of roughage. This allows gastric retention to be profited by, thus ensuring pre-digestion of protein, and regularizing the movement in the small intestine, which favours the utilization of the proteinic fraction.

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