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Total mixed ration in exercising horse: digestibility and nitrogen metabolism

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ABSTRACT: The aim of this study was to evaluate the apparent digestibility of a total mixed ration (TMR) versus a traditional mixed hay/cereals diet. Four adult trained Standardbred geldings – BW = 478±37 kg - were used. The two diets consisted of 20 kg of a commercial TMR - corn silage, alfalfa hay, wet brewers' grain, oat, apple pomace, molasses cane, soybean oil and mineral/vitamin supplement - (Diet 1) or 7 kg of meadow hay and 4.5 kg of cereal-mix - corn, oat, barley and protein/mineral/vitamin supplement - (Diet 2). The trial was conducted according to a Latin Square design (2x2). After an adaptation period of four weeks, total faeces and urine were collected for 6 days. Both feed and faeces samples were analysed for DM, OM, CP, EE, CF, NDF, ADF, cellulose, hemicellulose, ADL and GE. Data were analysed by ANOVA. The apparent digestibility and nitrogen balance of the two diets were compared. DM, OM, CP and GE apparent digestibility were significantly different between the diets, with higher values for unifeed diet than traditional diet. Energy requirement was satisfied by both diets (96.54 vs 95.55 MJ). Nitrogen balance showed negative values in both diets (- 61.67 vs - 9.05), but the hay/cereals supplemented diet showed the best protein utilisation.

Key words: Horse, Unifeed, Digestibility.

INTRODUCTION – Feeding management have to satisfy the physiological animal requirements by modern and specific diets. In particular in sport horses it is necessary to feed animals with complete rations, containing all nutrients, adequate energy to sustain effort and without predisposing to pathologies. In horses the amount and the quality of fibres influence digestibility (Bailoni *et al.*, 2001). In particular high level of fibrous fractions reduce organic matter digestibility coefficient (INRA, 1990; Wolter, 1994; Miraglia *et al.*, 2000). Quality and fiber percentage of hay are often influenced by climatic events, so it is not unusual to find high in fiber, dusty or molded hay (Corino *et al.*, 1995). Furthermore the management of sport horse lead up to a reduction of daily feeding time with a drastical decrease in fiber ingestion and a consequent unbalance in hay/concentrate ratio. This condition may induce digestive disorders like excessive gas production, colics, laminitis, and may effect fiber fermentation. Technological treatments of starch (Casini *et al.*, 2002; Casini *et al.*, 2003) showed a beneficial effect on fiber digestibility. The use of TMR is unusual in horses; however different kind of silage (meadow, corn, alfalfa) were studied related with horses for meat production (Agabriel *et al.*, 1982; Preziuso *et al.*, 1997) but no reports were found related to TMR and sport horse. TMR could be useful for providing a complete ration avoiding the negative effect of a low quality hay and cereals excess. Furthermore TMR could reduce the time of feeding management, improve feeding time and, for the lack of dust, could be useful in horses with respiratory disorder (Vandenput *et al.*, 1998). Since digestive equine capacity could be modified during physical activity, the aim of this study was to evaluate digestibility of TMR based on corn silage in comparison with a traditional hay/cereal diet in horses submitted to a moderate work.

MATERIAL AND METHODS – Four adult trained Standardbred geldings (average BW = 478±37 kg) were used. According to a 2x2 Latin Square design, animals were fed two different diets in two experimental periods, composed of an adaptation phase (4 weeks) and a sampling phase (6 days). During the experimental periods horses were stabled in individual stall with *ad libitum* water and each animal was weighed at the beginning and at the end of each period. Diets were formulated to be isocaloric and isonitrogenous, according to NRC (1989) require-

ments for moderate work (ED: 93.28 MJ; CP: 890 g). The horses were exercised daily 5 km at submaximal level on a high-speed treadmill. To cover nutritional requirements the horses received 20 kg of a commercial TMR (Unifeed, Betting Shop, Montecatini T., Italy) composed of 45% corn silage, 20% alfalfa hay, 15% wet brewers' grain, 10% oat, 5% apple pomace, 2.5% molasses cane, 1.2% soybean oil and 1.3% mineral/vitamin supplement (Diet 1) or 7 kg of meadow hay plus 4.5 kg of cereal-mix composed by corn, oat, barley, and protein/mineral/vitamin supplement (Diet 2). Chemical composition of feeds is showed in Table 1. The diets were offered twice daily (8 a.m. and 4 p.m.). During sampling periods faeces and urines were collected with a horse diaper (Equison Marketing, Australia) and sampled twice a day. Feed and faeces were analysed for dry matter (DM), ash, crude protein (CP), ether extract (EE), crude fiber (CF) and fibrous fractions (NDF, ADF, ADL) according to Martillotti *et al.* (1987). Gross energy (GE) was determined by adiabatic calorimeter (Martillotti *et al.*, 1987). Total collection of faeces and urine were carried out. Data were subjected to ANOVA with a level of significance of $P < 0.05$ using the SAS Institute software package JMP (SAS, 2002).

Table 1. Chemical composition of feeds on DM basis.

		TMR	Hay	Cereal-Mix
DM	%	57.64	92.13	91.28
OM	"	51.91	83.71	87.24
CP	"	10.82	5.99	13.80
EE	"	2.62	1.03	1.95
CF	"	18.05	36.42	4.87
NDF	"	42.92	73.36	23.33
ADF	"	24.74	46.64	8.33
Cellulose	"	20.31	37.58	6.69
ADL	"	3.75	6.22	0.84
GE	MJ/kg	18.20	17.29	17.07

RESULTS AND CONCLUSIONS - TMR diet showed a lower palatability in comparison with traditional diet with a consequent lower dry matter intake (7.62 *vs* 9.44 kg). However because of the significant higher GE digestibility ($P < 0.05$), requirements of digestible energy (DE) were widely satisfied with both diets (96.54 *vs* 95.55 MJ/d of DE respectively for Diet 1 and 2). Protein showed similar results. The coefficients of digestibility are presented in Table 2. Values were in normal range and similar to those reported by Gatta *et al.*, 2000 and Casini *et al.*, 2002. For the lower DM intake in Diet 1 (TMR), CP ingestion was lower than required (825g) but digestible protein was similar in both diets (597 *vs* 593 g) due to the significant higher protein digestibility of Diet 1 (72.38 *vs* 66.14 g) with a lower faecal losses. The TMR was favourable for DM and OM digestibility too.

Table 2. Apparent digestibility of diets (% , means \pm SE).

	Diet 1	Diet 2
DM	65.08 \pm 1.39 ^A	58.85 \pm 0.46 ^B
OM	71.26 \pm 1.73 ^A	63.65 \pm 1.07 ^B
CP	72.38 \pm 1.32 ^a	66.14 \pm 1.43 ^b
CF	45.52 \pm 4.14	45.38 \pm 0.97
NDF	54.17 \pm 3.33	48.33 \pm 2.27
ADF	34.87 \pm 6.10	34.08 \pm 1.61
GE	67.81 \pm 1.88 ^a	58.75 \pm 1.22 ^b

^{A, B}: $P < 0.01$; ^{a, b}: $P < 0.05$.

Nitrogen balance (Table 3) showed negative values for both diets (- 9.05 *vs* - 61.67 g/d of retained N), nevertheless the traditional supplemented hay/cereals diet had a significant best nitrogen retention ($P < 0.01$). This results could be explained by the different quality of proteins used in diets. The presence of sunflower and soybean meal (high biological value) in Diet 2 improved protein quality and a better nitrogen utilisation was found; on the contrary the highest amount of urinary nitrogen in Diet 1 indicated the use in TMR of low biological value protein.

Table 3. Nitrogen balance (g/d, means±SE).

	Diet 1	Diet 2
Intake N	135.42±9.68	143.40±4.28
Absorbed N	98.13±5.98	90.61±6.78
Retained N	- 61.67±5.98 A	- 9.05±7.26B

^{A, B}: $P < 0.01$.

In conclusion TMR, for its best digestibility, could be an useful alternative to a traditional hay/concentrate diet in particular in riding horses for providing a complete ration avoiding the negative effect of a low quality hay and cereals excess. However we suggest to formulate accurately TMR composition using high quality protein like soybean meal to improve nitrogen utilisation. Furthermore it is necessary to improve palatability to increase DM ingestion.

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