

Effect of live yeast (*Saccharomyces cerevisiae*) administration on apparent digestibility of horses

Alessandro Agazzi, Guido Invernizzi, Mariella Ferroni,
Andrea Fanelli, Giovanni Savoini

Dipartimento di Scienze e Tecnologie Veterinarie per la Sicurezza Alimentare.
Università di Milano, Italy

Corresponding author: Alessandro Agazzi. Dipartimento di Scienze e Tecnologie Veterinarie per la Sicurezza Alimentare. Facoltà di Medicina Veterinaria, Università di Milano. Via Celoria 10, 20133 Milano, Italy - Tel. +39 02 50317879 - Fax: +39 02 50317898 - Email: alessandro.agazzi@unimi.it

ABSTRACT - Six mares were divided into two groups of three subjects each in a crossover design on the basis of body weight and age: **Control (C)** fed a basal diet, **Treatment (T)** fed a basal diet and 2 g/head/d of live yeast (*S. cerevisiae* 4.6x10¹⁰ CFU/day). **The experimental design was divided into two periods** named period 1 and period 2 respectively of 35d each, and consisting of 3 different phases. During each period all animals were subject to an adaptation phase of 14d (phase1); during phase 2 (18d) and phase 3 live yeast was administered (T) or not (C). Phase 3 consisted in a three days individual fecal collection period all the groups, in order to determine dry matter, organic matter, crude protein, crude fat, NDF and ADF apparent digestion rates using acid insoluble ash (AIA) as internal marker (Bergero *et al.*, 2005). Results obtained evidenced as the administration of *S. cerevisiae* to mature horses resulted in increased digestibility of dry matter, organic matter, NDF, and ADF.

Key words: Horse, Live yeast, Digestibility, Fiber fractions.

Introduction - Nowadays the ability of microbial direct fed to modify the equine gastrointestinal tract environment and its population is still debated and has not been extensively examined. The addition of live yeasts is referred to increase the digestion of fibre fractions (Jouany *et al.* 2008). In particular positive effects of *S. cerevisiae* on cellulose digestion and ADF apparent digestibility in horses have previously been reported (Medina *et al.* 2002) independently of diet. In this study on the microbial profile and fermentation patterns in the large intestine of horses, the authors found that the interaction effect between *S. cerevisiae* and the diet was greater inside the caecum than inside the colon probably due to the greater counts of yeast cells. This suggests that the effects of *S. cerevisiae* are possible only if viable yeast cells are present in intestinal ecosystems (Nagaraja *et al.*, 1997). **Moreover the effect of live yeasts** on the caecal pH of horses combined with an increase in the lactic acid-utilizing to lactic acid-producing bacteria ratio, which increased the molar percentage of acetate in the caecum and the colon, suggested an enhancement of the fibrolytic activity in the hindgut of horses according with previous findings by Moore *et al.* (1994).

Material and methods - Six mares were divided into two groups of three subjects each in a crossover design on the basis of age (15.30 ± 3.91 years), and body weight at the beginning of the trial (529.34 ± 29.85 kg). The crossover design consisted of two different periods named respectively period 1 and period 2 of 35d each. The two experimental periods were composed by three different phases each named respectively phase 1 (14d), phase 2 (18d), and phase 3 (3d). **No prophylactic gastrointestinal treatments** were performed during the trial. Phase1 consisted of an adaptation period to the individual basal diet for both Control (C) and Treated (T) horses. Basal diet consisted of mix hay and concentrate on the basis of the 2.5% of live weight as suggested by NRC (2007) with a 70:30 DM forage/concentrate ratio (CP

10.87%, EE 1.61%, NDF 53.80%, ADF 37.70% on DM). In phase 2 and 3 Control (C) animals were fed the individual basal diet plus 50 g/head/d of micronized oat and Treated (T) group was fed the basal diet plus 2 g/head/day of the test material (*S. cerevisiae* 4.6 x 10¹⁰ CFU/day). The test material was previously mixed with 50 g of micronized oat (supplied into two equal amount per day of 25 g, each during the concentrate feeding), and contained in single bags for every experimental day. During the phases 2 and 3 animals were fed individually four times per day respectively at 0830AM, and 0500PM for hay and 1230AM, and 0900PM for concentrate. Phase 3 consisted of a three day confinement period in single boxes where the refusals were daily weighted to determine feed intake, and two daily hay samples for each horse were taken, pooled in a 1:1 ratio sample (200 g), and stored at -20°C pending analysis for dry matter (DM), organic matter (OM), crude protein (CP), crude fat (EE), neutral detergent fiber (NDF), acid detergent fiber (ADF), and acid insoluble ash (AIA) content. Concentrate samples were obtained at the beginning of each period and analyzed as for hay. For each phase 3, a 3 day total fecal production was collected from each horse diaper (Equisan Marketing Pty. Ltd., South Melbourne, Victoria, Australia) at 0600AM, 1200AM, 0600PM, and 1200PM, and an individual 500 g fresh matter of fecal sample was obtained from daily homogenized total collection of each horse, frozen, and stored for subsequent analytical determinations as for hay samples. AIA content was used as internal marker to determine the apparent digestibility of the experimental diets as reported by van Kuelen (1977). Statistical analysis included in the model the effects of the group, day of sampling, period, and group per day interaction applying a multivariate ANOVA for repeated measurements of SAS (SAS/STAT, 2006).

Results and conclusions - The effects of the administration of 2 g/head/day of live yeasts on nutrient digestibility of horses lead to significant differences between treatments on apparent digestibility of nutrients. Dry matter and organic matter digestibility were improved in horses fed live yeast by 7.25% and 7.37% respectively ($P < 0.05$) (Table1), while crude protein and crude fat were not influenced by the treatment at any time and overall the trial period. Statistical evaluation evidenced a positive effect of the dietary treatment on the apparent digestibility of the fibrous fractions such as NDF and ADF: both parameters had improved digestibility in horses fed 2 g/head/day of live yeast respectively by 18.47% ($P < 0.05$) and 30.46% ($P < 0.05$).

Often the findings on nutrient equine digestibility lead to contradictory results, probably due to the influence of internal markers used for estimation (Bergero et al., 2005). Previous studies indicated that live yeasts can improve the microbial balance in the hindgut of horses, stimulating the population of cellulolytic bacteria and their activity, and increasing the digestibility of dietary nutrients (Medina et al., 2002). However, the diet composition-related ability of live yeasts to modify microbial digestion and fiber degradation in horses has not been extensively studied (Jouany et al. 2008). In the present study dry matter and organic matter digestibility in both experimental groups were in accordance with results evidenced by Miraglia et al. (1999) respect to the use of acid insoluble ash (AIA). These values for C and T animals were later confirmed by the study of Jouany et al. (2008), but higher digestion of DM in T horses was evidenced during the present trial respect to these authors. As regard OM digestibility T animals results are in accordance with what reported for the inclusion of *S. cerevisiae* in high fiber diets fed to horses by the same authors. Looking at crude protein digestibility the values obtained for C and T animals are slightly higher than the ranges suggested, but these kind of differences could be attributed to the effects of the composition of the diet on digestibility as evidenced by many authors (Jouany et al., 2008). Digestibility of crude fat in horse is characterized by a large variability independently from the internal markers applied as reported by Miraglia et al. (1999). In the present work both C and T animals values relative to fat digestibility are in the ranges suggested by these authors. The fibrous fractions, that were significantly improved in T animals than C for both NDF and ADF digestibility, were within the ranges reported by Miraglia et al. (1999) and Jouany et al. (2008) although the administration of *S. cerevisiae* evidenced higher values for NDF digestibility than data published in the study performed by Jouany et al. (2008). Generally positive effects of *S. cerevisiae* on cellulose di-

Table 1. Effects of the administration of 2 g/head/day of live yeast (*S. cerevisiae* 4.6x10¹⁰ CFU/day) on nutrient apparent digestibility of horses.

Item	Group	Phase of sampling			Mean	SEM
		1	2	3		
DM, %	T	64.58	63.32	65.52	64.47 ^a	1.63
	C	60.78	59.16	60.38	60.11 ^b	
OM, %	T	68.53	64.44	65.36	66.11 ^a	1.79
	C	60.63	62.00	62.09	61.57 ^b	
CP, %	T	80.46	77.87	78.85	79.06	1.68
	C	78.45	76.84	75.55	76.95	
EE, %	T	52.24	37.66	45.70	45.20	5.00
	C	43.00	39.96	36.82	39.92	
NDF, %	T	40.62	42.09	44.87	42.53 ^a	2.61
	C	36.00	34.47	37.25	35.90 ^b	
ADF, %	T	34.75	35.48	39.24	36.49 ^a	3.14
	C	28.17	26.82	28.93	27.97 ^b	

^{a,b} $P < 0.05$.

the efficacy of the supplement can be derived from the yeast strain and the concentration of viable cells itself in the added preparation.

The authors wish to thank Dott. Bonvicini from Prosol, and the farm "Centro Ippico La Fornace".

REFERENCES - **Bergero**, D., **Meineri**, G., **Miraglia**, N., **Peiretti**, P.G. 2005. Apparent digestibility of hays in horses determined by total collection of faeces and using internal markers methods. *J. of Food, Agricultural & Environment*, 3(1):198-201. **Hall**, R. R., S. G. Jackson, J. P. Baker, and S. R. Lowry. 1990. Influence of yeast culture supplementation on ration digestion by horses. *J. Equine Vet. Sci.* 10:130-134. **Jouany**, J. P., **Gobert**, J., **Medina**, B., **Bertin**, G., **Julliand**, V. 2008. Effect of live yeast culture supplementation on apparent digestibility and rate of passage in horses fed a high-fiber or high-starch diet. *J. of Anim. Sci.* 86, 2:339-347. **Medina**, B., **Girard**, I. D., **Jacotot**, E., **Julliand**, V. 2002. Effect of a preparation of *Saccharomyces cerevisiae* on microbial profiles and fermentation patterns in the large intestine of horses fed a high fiber or a high starch diet. *J. Anim. Sci.* 80:2600-2609. **Miraglia**, N., **Bergero**, D., **Polidori**, M., **Gagliardi**, D., **Tarantola**, M. 1999. Stima della digeribilità della razione in un caso di enterite cronica nel cavallo. *Atti del Convegno: Nuove acquisizioni in materia di alimentazione, allevamento e allenamento del cavallo sportivo. IX Settimana della Cultura Scientifica e Tecnologica. Campobasso, 26 marzo. 15-19.* **Moore**, B. E., **Newman**, K. E., **Spring**, P., **Chandler**, V. E. 1994. Effect of yeast culture (Yea Sacc1026) on microbial populations and digestion in the cecum and colon of the equine. *J. Anim. Sci.* 72 (Suppl 1):252 (Abstr.). **Nagaraja**, T. G., **Newbold**, C. J., **Van Nevel**, C. J., **Demeyer**, D. I. 1997. Manipulation of ruminal fermentation. In: P. N. Hobson and C. S. Stewart (ed.), *The Rumen Microbial Ecosystem*. (2nd ed.), pp. 523-632. Chapman and Hall, London. **National Research Council**. 2007. *Nutrient Requirements of Horses*. 6th Rev. Ed. National Academy Press, Washington, D.C., USA. **SAS**, 2006. *User's Guide: Statistics, Version 9.1*. SAS Institute, Cary NC. **Van Keulen**, J., **Young**, B.A. 1977. Evaluation of acid-insoluble ash as a natural marker in ruminant digestibility studies. *J. Anim. Sci.* 44: 282-287.

gestion and on ADF apparent digestibility in horses have previously been reported by **Medina et al.** (2002) independently of the diet, whereas other studies showed no effect of yeasts (**Hall et al.**, 1990). In the present study, increased digestibility of nutrient can be attribute to many factors as reported in previous published papers. In particular results observed can be explained by the improvement of microbial balance in the hind-gut of horses, stimulating the population of cellulytic bacteria and their activity (**Medina et al.**, 2002) thus leading to a favorable large intestinal environment capable of more efficient fermentation (**More et al.**, 2007). Moreover, as outlined by **Jouany et al.** (2008),