

In vitro fermentation patterns of different carbohydrates: ranking of grass meal (cellulose), sugar beet pulp (pectin), oats (starch) and Jerusalem artichoke (fructans)

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Introduction

In recent studies, it has been proposed that fructans might be responsible for pasture-induced laminitis horses (Pollit and van Eps 2002). The aim of the study was to investigate the fermentation patterns of slowly and highly fermentable carbohydrates with special emphasis on fructans using different in-vitro systems with equine faeces. It is hypothesized that fructans will be fermented more intensively and quicker which might result in disturbances in the equine intestinal microbial system. Dry matter degradation, production of gas, short chain fatty acids (SCFA) and lactate are used as markers of in vitro fermentability.

Material and methods

Six horses were fed 6 kg hay and additionally fermentable carbohydrates in a randomised order: grass meal (GM, cellulose), oats (starch), sugar beet pulp (SBP, pectins) or Jerusalem artichoke (JA, 50 % fructans, inulin-type). All diets were formulated to provide 1.5 g carbohydrates/kg BW/day from the different sources over a feeding period of ten days. At day one and ten, horses' faeces were collected and the respective feedstuff was incubated in the faecal inoculum. Dry matter degradation was measured for each feedstuff, SCFA, lactate, and pH were analysed in the faecal inoculum before and after incubation, and gas accumulation (method by Theodorou et al. 1994) was measured every 2 hours for 12 hours post-inoculation. All results are presented as means \pm standard deviation (SD).

Results

Fructans showed the highest dry matter degradation (JA 90 %, O 69 %, SBP 54 %, and GM 32 %, $P < 0.05$) and revealed the highest production of SCFA (Figure 1) and lactate (Figure

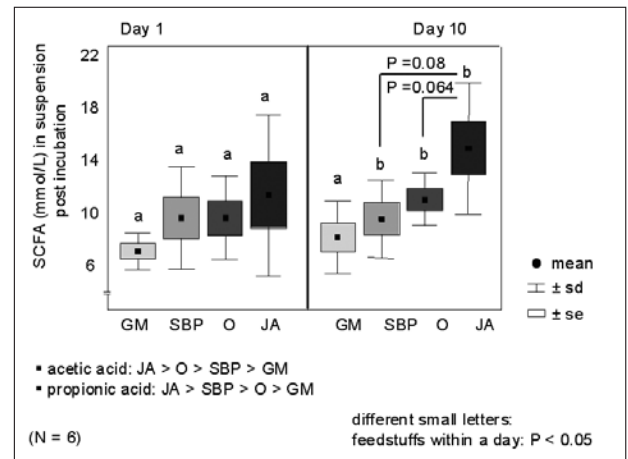


Fig 1 SCFA production (mmol/L) after incubation of GM, SBP, O and JA.

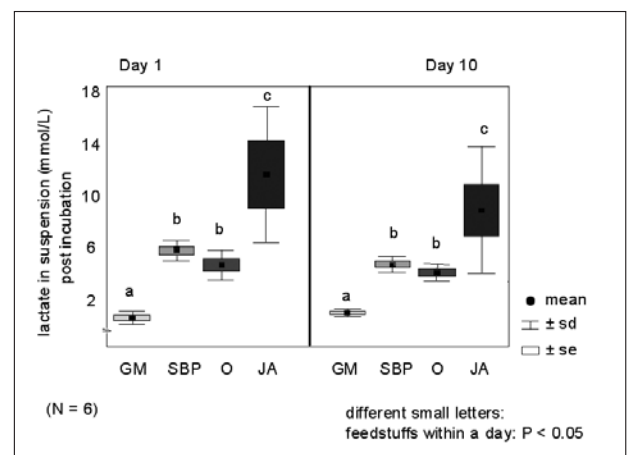


Fig 2 Lactate production (mmol/L) after incubation of GM, SBP, O and JA.

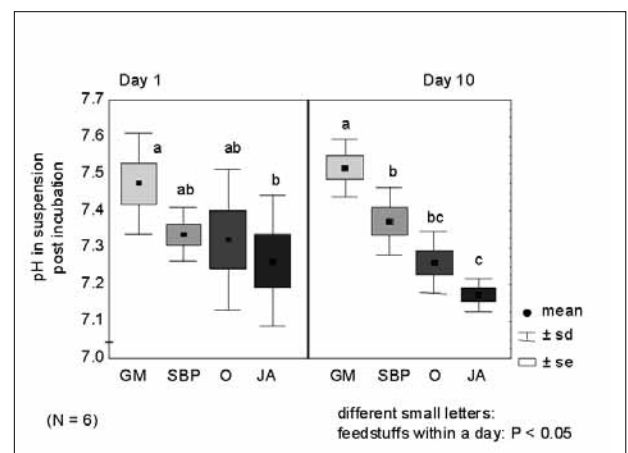


Fig 3 Changes in pH after incubation of GM, SBP, O and JA.

2). The increases in fermentation products were accompanied by a drop in pH (Figure 3), whereby SCFA had the most distinct effect on acidification (Figure 4). According to the fermentation products, the highest gas production was found for JA (Figure 5). However, SBP revealed more gas than the incubation of O and the smallest gas production rate was observed for GM. There were no clear differences between the first and tenth day of the feeding trial and the respective faecal inoculum.

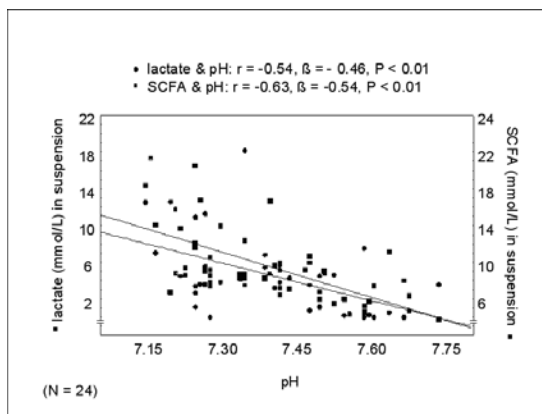


Fig 4 Relationship between SCFA (mmol/L), lactate (mmol/L) and pH after incubation of GM, SBP, O and JA.

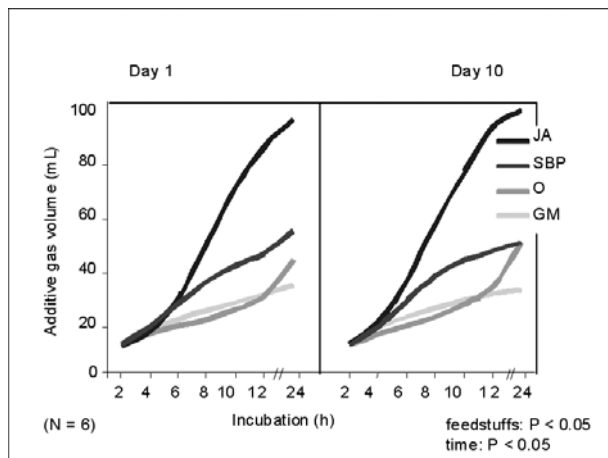


Fig 5 Gas production (additive gas volume, mmol/L) after incubation of GM, SBP, O and JA.

Discussion

Incubation of JA in vivo showed intensive fermentation processes which are described by gas production, an indirect marker of microbial activity. However, the low gas production rate of O in comparison to SBP was unexpected and needs further clarification. As a result of the high fermentation processes, JA led to dramatic changes in SCFA and lactate production. In contrast to gas production rate, the increases of SCFA and lactate after O incubation give evidence for an intensive microbial fermentation.

The production of organic acids resulted in a strong acidification (SCFA > lactate) of the suspension, which might have a negative impact on the integrity of the mucosa in vivo. These results confirmed the most dynamic fermentation processes by fructans. The particular ranking in comparison to other feedstuffs highlight the role of fructans in the aetiology of laminitis in horses.

References

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- Theodorou M. K., Williams B. A., Dhanoa M. S. and Mc Allen A. B. (1998): France J. A simple gas production method using a pressure transducer to determine the fermentation kinetics of ruminant feeds. Animal Feed Science Technology 1998; 48:185-197.

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