

# THE CORN SILAGE DIGESTIBILITY BY HORSES

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## ABSTRACT

Four mares were used in experiments to determine *in vivo* dry matter (DM) digestibility of corn silage and to evaluate the new *in vitro* system, DAISY<sup>II</sup> incubator, to determine nutrient compound of corn silage. Horses were fed thrice daily at the amount 20 kg corn silage per day. All the diets, refusals and faecal samples were collected. Samples were analyzed for contents of DM, crude protein (CP), crude fiber (CF), organic matter (OM), crude fat, neutral detergent fiber (NDF) and acido detergent fiber (ADF). Further, faecal samples were taken from each horse to form inoculum. Forty nylon bags (0.25g corn silage) were placed in each vessel, and *in vitro* fermentation was carried out for 48 h to determine DM, CP, CF, OM, crude fat, NDF a ADF. Partial results from Exp. I indicated that nutrients composition of corn silage corresponding with previous determination of other authors. The estimation of DM and OM digestibility is comparable only with data for ruminants, which showed that horses have lower DM and OM digestibility of corn silage than ruminants. Probably this caused the fact that the ruminants have better digestion apparatus. *In vitro* method is still analyzed.

**Key words:** horses, digestibility, corn silage, *in vitro* system,

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## INTRODUCTION

Horses are classified anatomically as nonruminant herbivores or hindgut fermenters. Although horses can use hay and other roughage much more efficiently than do other nonruminants such as poultry or pigs, this ability is limited by the anatomy of the equine digestive tract and is less efficient than that of ruminants (Zeman, 2006). The stomach of the horse is small in relation to the size of the animal and makes up only 10% of the capacity of the digestive system. The small intestine of the horse is the major organ of digestion in the horse. There are many components to this digestive process.

The site of fermentation in horses is the cecum and large intestine, where large numbers of microorganisms digest hemicellulose and cellulose, utilize protein and nonprotein nitrogen, and synthesize certain vitamins. The by-products of this microbial fermentation provide the horse with source of energy and micro-nutrients. (Meyer and Coenen, 2002). The cecum and large colon are analogous to the rumen of the cow and sheep, and house billions of bacteria and protozoa which serve in a symbiotic relationship with the horse enabling the digestion of cellulose and other fibrous fractions of the feed (Pagan, 1998). The *in vivo* methods are optimal for determination and assessment digestibility of feedstuff for horses, but the ethics, high costs and labor intensiveness of determining the digestibility of feeds *in vivo* have led to the use of alternative, laboratory based techniques. (Stern et al., 1997). The use of *in vitro* fermentation procedures to study diet digestion and fermentative end products has become increasingly more popular in equine nutrition. The equine faeces is a suitable source of microbial inoculum for *in vitro* gas production studies and that *in vitro* batch culture technique evaluated has considerable potential as a routine predictor of the nutritive value of a wide range of equine feedstuffs (Lowman et al., 1999). Ringer et al. (2005a,b) reported that the combined use of equine faecal inoculum with a closed-system fermentation apparatus (Daisy<sup>II</sup> incubator) yielded valid *in vitro* estimates of dry matter (DM), neutral detergent fiber (NDF), and acid detergent fiber (ADF) digestibility. The Daisy<sup>II</sup> is an effective system for measuring *in vitro* DM digestibility and this system is more labor efficient than traditional methods and represents a significant advantage for analysis of forage, grain, and mixed samples (Holden, 1999). Brons and Plaizier (2005), King and Plaizier (2006) showed on their study that apparent *in vitro* DM digestibilities of grass/legume forages, grain crop silages, and TMR determined using the DAISY<sup>II</sup> incubator are comparable with those determined using the Tilley and Terry method.

The objectives of this study were to determine *in vivo* dry matter digestibility of corn silage by horses and demonstrate that equine faeces is a suitable source of microbial inoculum for *in vitro* digestibility.

## MATERIALS AND METHODS

The experiment was performed at VÚŽV Uhřetěves, Czech Republic

### *Experiment 1 – in vivo*

Four adult Czech Warmblooded mares with mean age of 11 yr (range 7 to 17 yr) and a mean initial body weight (BW) of 556 kg (range 500 to 585 kg) were used. Before the beginning of the experiment, all horses were dewormed, vaccinated, and their hooves were trimmed. The mares were kept

in individual stables 3.5 m x 4.0 m and were taken out daily for a 45-min exercise period between meals. During the diet-adaptation period (18 d), stables were bedded with sawdust. Horses had ad libitum access to fresh water and salt blocks. After the initial 18-d acclimation period, total faecal collections were conducted for 72 h. The corn silage was fed on an individual basis thrice daily (0700, 1300 and 1900) at the amount 20 kg per day (7 kg, 5 kg and 8 kg). Faeces were collected immediately after excretion and store daily for total weight determination and then a 10% representative sample for individual animals. All the diets, refusals and faecal samples were preserved in sealed polyethylene bags stored in freezers until chemical analyses.

### **Chemical analysis**

Freeze-dried samples were analyzed for contents of DM, crude protein (CP), crude fiber (CF), crude fat, NDF, ADF. DM was determined after drying at 105 °C (Regulation No. 497/2004, 2004). Crude fat was extracted for 6 h with petroleum ether, whereas the Kjeldahl method was used to determine nitrogen (N) (AOAC, 1990). Crude protein was calculated as  $N \times 6.25$ . NDF, ADF were determined according to the methods of Van Soest et al. (1991) using an ANKOM 220 Fibre Analyzer (ANKOM Technology Corporation, NY, USA, 1998a,b).

### ***Experiment II – in vitro***

In vitro fermentation was carried out for 48 h using the Daisy II incubator. The complete unit consisted of 4 incubation vessels with a capacity of 2 litres each. Each vessel contained 1.6 L of buffer solution, 0.4 L of faecal inoculum, and 10 nylon bags. Grab samples were obtained throughout the acclimation period. These samples were ground to pass a 2-mm screen (RESCH Mill, Verder Praha s.r.o.). Ten nylon filter bags (Ankom F57, Ankom Technology, Fairport, NY, USA, 1998a,b) per incubation vessel were rinsed in acetone and allowed to air dry. Bags were then placed into a 100°C oven for 24 h, after which their weight was recorded. A 0.25-g diet were weighed into 10 bags each, then heat-sealed. The microbial inoculum was prepared by collecting fresh faeces via a rectal grab sample using palpation sleeves. Faecal samples were placed into an air-tight freezer bag to maintain an anaerobic environment and transported to the laboratory in a cooler containing warm (39°C) water. Once in the laboratory, faeces from

each horse were prepared separately. A 40-g sample of faeces was placed in a blender with 360 mL of warm, distilled water. Samples were blended for 2 min while being gassed with CO<sub>2</sub>, then strained through a double layer of cheesecloth directly into the prewarmed incubation jars (Hayes et al., 2003).

Each fermentation jar contained 400 mL of faecal inoculum and 1.600 mL of buffer solution. Buffers consisted of 2 solutions that were combined in the incubation jars immediately before the faecal inoculum. Buffer solution A (KH<sub>2</sub>PO<sub>4</sub>, 13.3 g/L; MgSO<sub>4</sub> x 7 H<sub>2</sub>O, 0.665 g/L; NaCl, 0.655 g/L; CaCl<sub>2</sub> x 2 H<sub>2</sub>O, 0.133 g/L; and urea, 0.665 g/L) was added at 1.330 mL to 266 mL of buffer solution B (Na<sub>2</sub>CO<sub>3</sub>, 15.0 g/L a Na<sub>2</sub>S x 7H<sub>2</sub>O, 1.0 g/L) to obtain a final pH of 6.8. The faecal inoculum was then added to each fermentation jar, after which the jars were purged with CO<sub>2</sub> for 30 s and then sealed. The sealed jars were placed into the prewarmed Daisy II incubator. The incubator maintained a constant temperature of 40°C throughout the incubation, and the jars were continuously agitated. The jars were

removed after 48 h, and the filter bags were immediately rinsed for 30 min with cold water to stop microbial activity.

## RESULTS AND DISCUSSION

The nutrient composition of the test corn silage is presented in Table 1. Zeman et al. (1995) reported the same values for CP (8.79%), CF (25.76%) and fat (4.24%) for corn silage with 33% of DM content. But there is missing data about ADF and NDF. The average daily intake of corn silage was 15.6 kg for each horse. This result is in line with authors Meyer and Coenen (2002) whose recommended for riding horses 2 – 4 kg of corn silage on 100 kg BW. The same amount confirm Sitárová et. al (2009). The digestibility of DM and OM are presented in Figure 1 and Figure 2. These values are not possible to compare with others studies because there are no values of in vivo corn silage DM digestibility for horses. During these experiments none of the mares showed any digestive problems.

The results from Experiment II are not available because the analysis still run.

*Table 1. Nutrient composition of com silage used in experiments I, II*

<i>Item</i>	<i>100,0</i>	<i>34,7</i>
	<i>% of DM</i>	<i>% of DM</i>
<i>Organic matter</i>	<i>4,2</i>	<i>1,5</i>
<i>Crude protein</i>	<i>8,8</i>	<i>3,0</i>
<i>Crude fiber</i>	<i>15,3</i>	<i>5,3</i>
<i>Fat</i>	<i>3,0</i>	<i>1,1</i>
<i>Neutral detergent fiber</i>	<i>37,5</i>	<i>13,0</i>
<i>Acido detergent fiber</i>	<i>20,8</i>	<i>7,2</i>

*Figure 1. The values of corn silage dry matter digestibility*

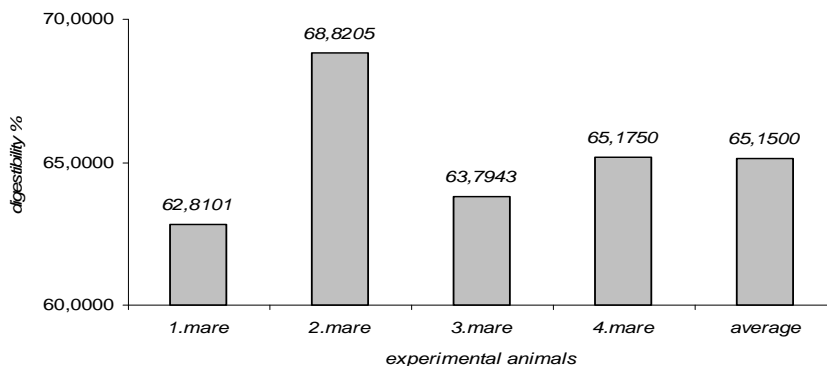
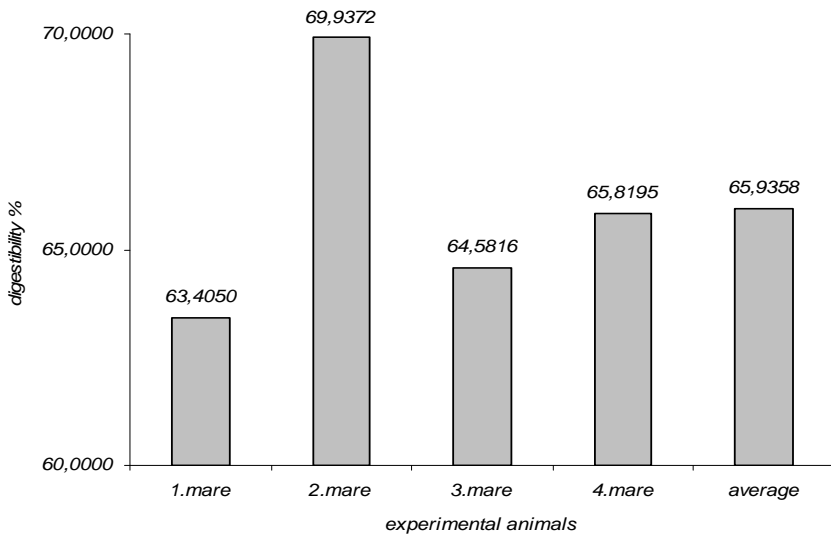


Figure2. The values of corn silage organic matter digestibility



## CONCLUSION

The results of this study showed that corn silage is suitable feed for horses with dry matter digestibility 65.2%. But it is necessary to finishing the analyses and compare data with in vitro digestibility with Daisy<sup>II</sup> incubator.

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