Aspen wood or aspen bark as substitution for grass silage in dairy cow diets

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Introduction

The 2018 forage shortage spurred interest for alternative forage sources and their possibilities to supply energy and structure to ruminant diets. Aspen wood and bark from the Swedish matchstick industry is among those sources. Aspen has in previous research been among the most digestible wood materials (Mellenberger et al., 1971) and it has recently been consumed by dairy cows (4.5 kg DM /cow/d) when partially substituting grass silage (Prestløkken & Harstad, 2019). During 2020, a trial was performed at the Swedish University of Agricultural Sciences with three lactating cows where aspen wood or aspen bark partially replaced grass silage. The main purpose was to study changes in rumen microbiota composition and function, whereas data on production, intake and digestibility from the experiment are presented here.

Materials and Methods

The experiment was performed as a 3×3 Latin square with three ruminally cannulated lactating Swedish Red cows (804 ± 72 kg of BW; 156 ± 15 DIM; 34.5 ± 1.1 kg milk/d at experimental onset), three diets and three 21-d periods, where measurements were carried out the last eight days. A 21-d preparation period when cows were introduced to the novel feeds preceeded the experiment. The cows were kept in a separate section of a loose house barn with a common water bowl, a common concentrate feeding station and two forage feeding troughs per animal (BioControl, Rakkestad, Norway). Cows were manually moved to an adjacent AMS for milking at 06:00 and 18:00 h. The Control diet (Table 1) contained grass silage, a basal concentrate and a protein supplement (Komplett Xtra 205 and Konkret Mega 28, respectively, both from Lantmännen, Stockholm). For the diets Wood and Bark, silage was partially replaced by aspen wood and aspen bark, respectively. Silage, wood and bark were supplied in individual forage troughs. Concentrates were supplied in a concentrate station and in the AMS, except for 4.3 kg DM basal concentrate that was mixed with the wood/bark allowance at feeding (1:1 on a DM basis). The same proportion was assumed for orts from the mixture. Aspen material was from Swedish Match, Vetlanda and consisted of bark from rotor debarking and wood chips from the log cores. The aspen products were stored frozen until milling on a hammermill to pass a 8-mm screen shortly before feeding. Weighing of orts and provision of new feeds were performed daily at 09:00 h. All feeds were accessible until daily allowance (silage and concentrates only) was reached.

Sampling, analyses and calculations followed routine procedures described by Eriksson & Rustas (2014). Cows were test milked on Day 17-18; on Day 17-21 feeds were sampled, feces were spot sampled for digestibility assessment with acid insoluble ash and ruminal liquid was sampled during the interval 05:00 – 19:00 . Total rumen evacuations were performed at 13:00 h on Day 14 and 21. Data were analysed by Proc Mixed of SAS 9.4 with diet and period as fixed variables and cow as random variable. Results are presented as least square means with standard error of difference and probability for diet effect. Because of few observations, most of the response variables differed only numerically between treatments

(P>0.05) and the results should be regarded as descriptive for this experiment rather than as generally applicable research findings.

Results and Discussion

Table 1 Daily feed allowance and composition of feeds

	Grass silage	Aspen wood	Aspen bark	Basal concentrate	Protein supplement
Control diet, kg dry matter (DM) allowed	12.29			6.08	3.05
Wood diet, kg DM allowed	6.76	4.58		6.08	3.05
Bark diet, kg DM allowed	6.76		4.13	6.08	3.05
Composition of feeds					
Dry matter, g/kg	307 ± 2.6	571 ± 9.8	516 ± 3.9	869 ± 3.4	873 ± 7.1
Ash	104 ± 1.5	6.3 ± 1.9	26.2 ± 3.2	70 ± 2.3	88 ± 3.6
Crude protein (CP), g/kg DM	164 ± 0.1	9.3 ± 4.4	20 ± 2.3	205 ± 1.6	265 ± 1.6
Neutral detergent fiber (NDF), g/kg DM	605 ± 48	880 ± 17	716 ± 9.8	199 ± 12	233 ± 19
In vitro OM digestibility 96 h, %	81.2 ± 0.2	16.5 ± 5.1	20.8 ± 2.8	-	-

Table 2 Intake, production, digestibility and rumen parameters in dairy cows offered aspen wood or aspen bark as a partial replacement for grass silage in a Latin square (n = 3)

	Control	Wood	Bark	SED	P
Silage dry matter intake (DMI), kg/d	12.18	6.88	6.88	-	-
Wood/Bark DMI, kg/d	-	3.57	3.60	0.045	0.55
Concentrate DMI, kg/d	9.10	8.16	8.56	0.36	0.22
Total DMI, kg/d	21.29	18.61	19.04	0.81	0.14
Total organic matter intake, kg/d	19.33	17.25	17.58	0.77	0.19
Total NDF intake, kg/d	9.30	9.02	8.53	0.27	0.19
Total CP intake, kg/d	4.05	3.04	3.14	0.11	0.02
Milk yield, kg/d	29.42	24.92	26.23	1.84	0.24
Energy corrected milk yield, kg/d	29.61	25.63	26.55	1.98	0.31
Rumen fresh weight, kg	84.60	84.70	77.80	4.30	0.37
Rumen DM, kg	12.17	13.92	12.43	0.45	0.10
Rumen OM, kg	11.11	12.65	11.29	0.56	0.18
Rumen NDF, kg	7.11	8.08	7.13	0.26	0.10
Rumen average pH (0500 -1900 hrs)	6.24	6.31	6.28	0.06	0.61
Rumen DM concentration, %	14.44	16.55	16.15	0.37	0.05
DM digestibility	0.67	0.65	0.63	0.02	0.37
OM digestibility	0.68	0.66	0.64	0.02	0.37
NDF digestibility	0.64	0.60	0.56	0.03	0.24
CP digestibility	0.70	0.71	0.69	0.009	0.35
Fecal DM concentration, %	15.1	15.5	17.0	0.26	0.03

SED= Standard error of difference

The whole silage and concentrate allowances were consumed when wood or bark was not mixed in (Table 2). For the Wood and Bark diets, 2.0 and 1.1 DM, respectively, of the aspen/concentrate mix was not eaten. This resulted in equal DM intake of wood and bark, because they were supplied on an as fed basis with moderately different DM concentration. Dietary crude protein concentration was 163 – 165 g/kg DM with Wood/Bark diets, compared to 190 g/kg DM with the control. The daily ME intake with the control diet (249 MJ) corresponded to feeding standards for the pre-experimental yield of approx. 35 kg ECM (Spörndly, 2003). The silage and concentrate intake for Wood and Bark diets was sufficient for 23 and 24 kg ECM, respectively, not including possible energy contribution from consumed wood/bark. The actual ECM yields recorded, although compromised by large variation and possible mobilization/deposition effects, then corresponds to an oversupply of ME for the control diet and to a contribution of about 3.3 MJ ME/kg DM from the wood/bark eaten. Applying the ME equation for straw (Spörndly, 2003) to the 96 h *in vitro* digestibilities (Table 1) resulted in 2.3 and 2.8 MJ ME/kg DM for wood and bark, respectively. However, the *in vitro* digestibility for these wood/bark samples was relatively low compared to literature reports (Mellenberger et al., 1971; Baker et al., 1975).

Rumen average pH was similar among diets, although the control diet had a larger diurnal range (5.9 – 6.5) compared to wood and bark diets (6.1 – 6.5). Rumen pools of DM and NDF tended to be largest with the wood diet, as well as DM concentration of rumen contents. Acid insoluble ash (AIA) based digestibility measures only differed numerically but consistently declined in the order control-wood-bark. Together with rumen pools and the larger fecal DM concentration with bark, this suggests less retention time for the bark than for the wood.

Conclusions

Aspen wood and aspen bark were both accepted by lactating cows achieving intakes of 3.6 kg DM/cow/d in the experiment. Data from rumen evacuations and digestibility measurements suggests lower *in vivo* digestibility for bark than wood because of shorter rumen retention time of bark in the experiment.

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