Utilisation of coffee grounds for total mixed ration silage

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Introduction In the beverage industry, wastes from coffee grounds are of particular importance given their rapid increase in recent years. Although a small part is converted into raw compost material, wastes generated from tea grounds are generally incinerated. There is increasing demand for efficient use of by-products due to economic and environmental concerns. Approximately 200,000 t of coffee grounds are produced annually in Japan. These grounds usually have high protein, fat, fibre, and nitrogen-free extract and possibly could be a source of nutrients for ruminant (Xu *et al.,* 2004). The objectives of this study were to evaluate the fermentation characteristics of silages prepared from coffee grounds mixed with various feeds and their nutritive values with sheep.

Materials and methods Three silages were prepared using commercial formula feed, timothy hay, lucerne hay, dried beet pulp and vitamin and mineral supplement and coffee grounds at 0%, 10% and 20% on dry matter (DM) basis. Wet coffee grounds were obtained from a local beverage factory. The silages were ensiled with an inoculant Chikuso-1 (*Lactobacillus plantarum,* Snow Brand Seed Co. Ltd.; 5 mg/kg fresh weight) in polyethylene bag silos (350 kg/bag). These silos were stored outdoors at -0.7 to 34.8°C for 225 days. Six 2-year-old Suffolk sheep (73.0 ± 3.2 kg) were used in a two 3×3 Latin square. A 7-d preliminary adjustment period was followed by 7-d period during which all faeces and urine were collected.

Results Three silages were well preserved, with low pH value and ammonia-nitrogen content, and high lactic acid content. The propionic acid and butyric acid were not detected. The DM, organic matter (OM) and crude protein (CP) contents of all silages were similar, but the ether extract (EE), acid detergent fibre (ADF) and neutral detergent fibre (NDF) contents were significantly (P<0.05) higher with the increase in the proportion of coffee grounds (Table 1). Increasing concentrations of coffee grounds in the silages decreased the digestibility of DM, CP, ADF, NDF and energy, and increased that of EE. Total digestible nutrients (TDN) and voluntary feed intake for the silage with 20% coffee grounds was significantly (P<0.05) lower than those with 0% and 10% coffee grounds (Table 2). With increases in coffee ground concentrations in silages, nitrogen intake was not different, but amount of nitrogen retained decreased as the faecal and urinary nitrogen losses increased.

Table 1 Chemical composition of total mixed ration silage (% of DM)

	The mixing ratio of coffee grounds		
	0	10	20
DM	42.6±0.75	43.1±0.78	43.1±0.71
OM	93.1±0.25	92.9±0.40	93.4±0.35
CP	14.5±0.21	14.7±0.15	14.8±0.25
EE	2.4±0.10^{a}	4.1±0.12^{b}	5.6±0.17^{c}
ADF	24.1±0.41^{a}	25.6±0.55^{b}	27.1±0.21^{c}
NDF	37.4±0.55^{a}	39.2±0.45^{b}	41.0±0.19^{c}

Mean ± SD. (n = 3)

$^{a, b, c}$ Values with different superscript letters differ (P<0.05).

Table 2 Digestibility and nutrient content of total mixed ration silage (% of DM)

	The mixing ratio of coffee grounds		
	0	10	20
DM	71.9±0.88^{a}	70.5±1.03^{b}	67.2±1.36^{c}
CP	72.7±0.42^{a}	66.8±0.85^{b}	61.6±0.61^{c}
EE	71.2±1.24^{c}	80.0±1.21^{b}	83.5±1.26^{a}
ADF	57.5±1.58^{a}	54.5±1.51^{b}	46.3±2.03^{c}
NDF	59.9±2.25^{a}	57.0±1.79^{b}	54.4±1.07^{c}
TDN	71.2±0.82^{a}	71.5±0.79^{a}	70.4±0.74^{b}

Mean ± SD. (n = 6)

$^{a, b, c}$ Values with different superscript letters differ (P<0.05).

Conclusions These results suggest that all three silages with various concentrations of coffee grounds were well preserved, and the proportion of the coffee grounds in silages should not exceed 20% (DM basis) based on the voluntary feed intake and TDN content.

References

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