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RUMINANT NUTRITION/FEED IMPROVEMENTS

- 33 A comparison of the grassland based systems for mid season prime lamb production from two ewe genotypes
Keady T.W.J., Hanrahan J.P., Flanagan S.
- 34 Reduction in content of saturated fatty acids in milk fat by inclusion of whole rapeseed in the diet of dairy cows at pasture
Fearon A.M., Patterson D.C.
- 35 Effect of gamma irradiation on glucosinolate and erucic acid content of canola meal
Gharaghani H., Zaghari M., Shah Hoseini G., Moravej H.
- 36 Effect of spice supplementation on rumen ammonia concentration *in vitro*
Khan M, Chaudhry A
- 37 Effect of spice supplementation on *in vitro* forage degradability
Khan M, Chaudhry A
- 38 Effect of microbial inoculants on the nutritive value of corn silage for beef cattle
Teimouri Yansari A, Kamarlooie M
- 39 Effects of different additives on chemical composition of Whole Crop Canola Silage
Ghasemi S., Naserian A. A.
- 40 *In vitro* methods for fibre degradation show how feed enzymes can improve the nutritional value of coproducts from bioethanol production in rations for monogastric animals
Nuyens F., Somers I., Van Dyck S.M.O.
- 41 The effect of non fibre carbohydrate on *in vitro* first order dry matter disappearance model of various ruminant feeds
Danesh Mesgaran M, Rezaii F, Heravi Mousavi A, Nassiri M-Reza
- 42 Synthesis of ligninolytic enzymes from solid and aqueous growth of white-rot fungi on wheat straw
Pinto P., Bezerra R.M.F., Dias A.A., Guedes C.V.M., Ferreira L.M.M., Cone J.W., Rodrigues M.A.M.
- 43 Effect of particle size and micro-organism on lactic acid fermentation of sorghum
Niba A. T., Kouchika H., Kudi A. C., Beal J. D., Brooks P. H.
- 44 Upgrading the *in vitro* degradability of wheat straw by using soaking treatments
Shirif A-F, Chaudhry A S, Younger A

The effect of non fibre carbohydrate on *in vitro* first order dry matter disappearance model of various ruminant feeds

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Introduction Starch is digested rapidly in the rumen, but more slowly than sugar sources. The effective use of high-sugar products in supplementation programs requires knowledge of their effects on forage use and of how they compare with other common supplemental carbohydrate sources such as starch (Sniffen and Robinson, 1987). The objective of this study was to determine the effect of supplementing sucrose or starch on *in vitro* first order dry matter disappearance model of various ruminant feeds (lucerne, wheat bran and sugar beet pulp).

Materials and methods Experimental feed samples were lucerne, wheat bran, and sugar beet pulp. Samples were ground using a Willey-mill to pass 0.75 mm screen, and dried at 80 °C for 48 h. Non-supplemented or non fibre carbohydrate (starch and/or sucrose) supplemented samples were incubated in a medium prepared as described by Arroquy *et al.* (2005). The supplementation was carried out as 70 mg/g DM of feed sample as starch or sucrose or Starch+ sucrose as 1:1. Forty-five ml of medium (0.40 cell-free rumen fluid and 0.60 mineral mixtures) were distributed into 100 ml bottle containing 1 g of each feed sample. Then, each bottle was inoculated with 5 ml of cloth-cheese strained rumen fluid and finely bubbled with CO₂. Previous to the inoculation, the rumen fluid was incubated for 1 h in an incubation chamber at 39 °C. Rumen fluid was obtained from 4 Holstein steers fed maize silage, lucerne hay, wheat straw, barley grain and soybean meal (3.4, 2.4, 0.8, 1.6 and 0.8 kg/d DM, respectively). Bottles were incubated for 24, 48, and 96 h at 39 °C (4 bottles per each treatment and 2 bottles as blank per incubation). Then, bottle content was filtered through a 22 µm filter paper. Unfiltered dry matter was measured using air forced oven at 80 °C, 48 h. Data were analysed using GLM procedure of SAS and applied to a non-linear first order model to estimate the digestion kinetic parameters. The model was $D_{(t)} = D_{(i)} \cdot \exp(-k \cdot \text{time}) + I$; where $D_{(t)}$ is potentially digestible fraction of DM, $D_{(i)}$ is potentially digestible residues, k is fractional rate constant of digestion (h^{-1}) and I is indigestible fraction.

Results First order fractional rate constant of digestion (/h) and indigestible fraction of none or NFC supplemented of the feeds are shown in Table 1. Indigestible fraction of lucerne hay was significantly increased when it was supplemented by NFC ($p < 0.05$). The lowest constant rate of digestion was observed when a mixture of starch and sucrose (1:1) was added to wheat bran ($p < 0.05$). Constant rate of digestion of sugar beet pulp was also significantly influenced by supplemental NFC ($p < 0.05$). The indigestible fraction of all NFC supplemented sugar beet pulp was lower than non supplemented samples.

Table 1 Effect of non fibre carbohydrate sources on *in vitro* first order dry matter fractional rate constant of digestion (h^{-1}) and indigestible fraction of various ruminant feeds (mean \pm s.e.m.).

* Sucrose or starch was added as 70 mg/g DM; ** 35 mg/g DM of sucrose and 35 mg/g DM of starch was added.

^{a, b} Within each feed, difference between means with different letters is significant ($P < 0.05$).

Feeds	Fractional rate constant of digestion (/h) [‡]		Indigestible fraction [‡]		R ²
	mean	s.e.m.	mean	s.e.m.	
Luerne	0.109 ^a	0.019	0.529 ^a	0.012	0.977
Luerne+ sucrose *	0.079 ^a		0.570 ^b		0.978
Luerne+ starch *	0.092 ^a		0.571 ^b		0.962
Luerne+ sucrose+ starch **	0.079 ^a		0.570 ^b		0.978
Wheat bran	0.118 ^a	0.009	0.339 ^a	0.004	0.997
Wheat bran+ sucrose	0.150 ^b		0.349 ^b		0.999
Wheat bran+ starch	0.113 ^a		0.338 ^a		0.998
Wheat bran+ sucrose+ starch	0.092 ^c		0.345 ^{ab}		0.997
Sugar beet pulp	0.096 ^a	0.004	0.368 ^a	0.006	0.998
Sugar beet pulp+ sucrose	0.079 ^b		0.335 ^b		0.997
Sugar beet pulp+ starch	0.072 ^b		0.339 ^b		0.997
Sugar beet pulp+ sucrose+ starch	0.072 ^b		0.335 ^b		0.998

Conclusions Results of the present study showed that the first order fractional rate of digestion of a feed might be influenced by source of NFC. In addition, there was different response in fractional rate constant of digestion and indigestible fraction when different feeds were incubated with sucrose, starch or a 1:1 mixture of starch and sucrose. Therefore, there is a need to determine the associated effect of a feed and nature of NFC on fractional rate constant of digestion and indigestible fraction for individual feed or a composed diet.

References

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