The effect of non-structural carbohydrate on *in vitro* first order disappearance kinetic of cellulose

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Introduction Ruminal cellulose digestion is a complex microbial process that involves adhesion of microbial cells to cellulose, cellulose hydrolysis, and fermentation of the resulting cellodextrins to volatile fatty acid, methane, and CO_2 (Weimer, 1996). Information about how cellulose digestion and fermentation are affected by different ruminal environmental conditions is necessary to understand ruminant performance (Mourino, 2001). The aim of the present study was to elucidate the impact of type of supplemental non-structural carbohydrates (NSC) (starch and/ or sucrose) on *in vitro* first order disappearance kinetic of commercial cellulose (Cell).

Materials and methods Experimental treatments consisted of non-supplemented Cell (150 mg) and Cell plus NSC (70 mg) as sucrose (Su) or starch (St) or a 1:1 mixture of Su and St (Su+ St). Treatments were incubated in a medium prepared as described by Arroquy *et al*. (2005). Forty five ml of medium were distributed into 100 ml bottles. Then, each bottle was inoculated with 5 ml of strained rumen fluid and finely bubbled with CO_2. The bottles (three bottles per each treatment per each time) were incubated for 24, 48, and 96 h at 39 ºC. For each time, three bottles containing just medium was run as blanks. Then, each bottle contents were filtered through a 22 µm filter, and the amount of the unfiltered Cell was determined. Data were analyzed as a complete randomized design using a 4 × 3 factorial arrangement. The first factor consisted of supplemental NSC type and the second factor consisted of incubation time. Data of the disappearance rate of Cell were analysed using general linear model procedure of SAS (2003). Non-linear first order model was used to estimate the digestion kinetic parameters of Cell. The model was: $D_{(t)}= D_{(i)}.\exp(-k.\ time)+ I$; Where, $D_{(t)}$ is potentially digestible fraction of Cell, $D_{(i)}$ is potentially digestible residues, k is fractional rate constant of digestion (h^{-1}) and, I is indigestible fraction.

Results Inclusion of NSC in the fermentation mixture resulted in a significantly larger depression in the extent of Cell disappearance with regard to the control (no NSC supplemented Cell), and this effect was more obvious for St supplementation (Fig. 1). However, the NSC effect on extent of Cell disappearance was most clearly evident at the time periods from 0 to 48 h of incubation. The fractional rate of Cell disappearance (Fig. 2) was greater ($P< 0.05$) in control treatment compared with those treatments containing NSC. However, the degree of depression in Cell fractional rate was dependent on the type of supplemental NSC used. When St or Su+ St was served as the source of supplemental NSC, the rate of Cell disappearance was significantly decreased. In contrast, the fractional rate of Cell disappearance for the Su treatment was not significantly influenced. Indigestible fraction of Cell was greater ($P< 0.05$) for treatments receiving Su or Su+ St as the source of supplemental NSC, when compared with the control.

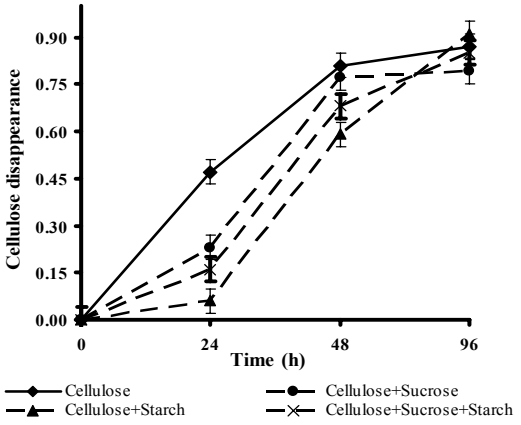

Figure 1 Effect of supplemental NSC on *in vitro* cellulose disappearance.

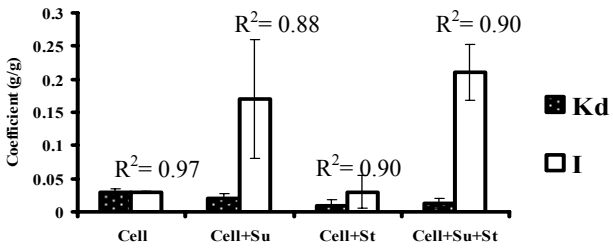

Figure 2 Effect of supplemental NSC on *in vitro* fractional rate of Cellulose digestion (K_d, h^{-1}) and indigestible fraction (I, g^{-1}). Cell= Cellulose, Cell+ Su= Cellulose+ Sucrose, Cell+ St= Cellulose+ Starch, Cell+ Su+ St= Cellulose+ Sucrose+ Starch

Conclusions *In vivo* work reported by Heldt *et al*. (1999) indicated that supplementation with starch had a more negative effect on forage fibre disappearance than did simple sugars. Under the *in vitro* condition that was employed in the present study, the types of supplemental NSC examined have different effect with regard to their effect on Cell disappearance, and starch had more negative effect than sucrose. However, it is a need to evaluate the effect of NSC on ruminal cellulose disappearance under *in vivo* condition.

References

Arroquy, J.I., Cochran, R.C., Nagaraja, T.G., Titgemeyer, E.C., Johnson. D.E. 2005. Animal Feed Science and Technology. 120, 93–106.
Heldt, J.S., Cochran, R.C., Stokka, G.L., Farmer, C.G., Mathis, C.P., Titgemeyer, E.C., Nagaraja, T.G. 1999. Animal Science. 77, 2793–2802.
Mourino, F., Akkarawongsa, R., Weimer, P.J. 2001. Dairy Science. 84, 848–859.
Weimer, P. J. 1996. Dairy Science. 79, 1496–1502.