## Effect of adaptation of rumen fluid to starch fermentation on in vitro methane production

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**Introduction** Production of methane in the rumen is determined by the ration the animals receive, and especially the amount of starch fermentation may negatively influence the methane synthesis. The effect of starch on methane production may be evaluated in *in vitro* tests. However, it is not known how the ration of the donor animals influences the fermentation of the substrate and subsequently the synthesis of methane, i.e. how the microbial population in the rumen adapts to the substrate and affects methane synthesis *in vitro*. The aim of the present study was to investigate the influence of adaptation of rumen fluid to different amounts and qualities of starch on the total fermentation and methane synthesis *in vitro*, using the gas production technique (Cone *et al.*, 1996).

**Materials and methods** Rumen fistulated lactating Holstein-Friesian donor cows were fed rations with a low (27%) or a high (53%) content of starch (DM basis) in the concentrate and the starch was either slow (S; native maize starch) or fast fermentable (F; gelatinized maize starch). Starch was exchanged with beet pulp and palm kernel. The total mixed ration (TMR) consisted of 60% grass silage and 40% concentrate (DM basis). Sixteen different cows were used in a randomized block design. The substrates incubated *in vitro* in rumen fluid of the different cows were beet pulp, grass silage, native maize starch, gelatinized maize starch, the concentrates S27, S53, F27 and F53 and the TMR's S27, S53, F27 and F53. The samples were incubated in duplicate in rumen fluid from the 16 cows, adapted for 2 weeks to TMR S27, S53, F27 and F53, using an automated gas production technique, with simultaneous determination of methane synthesis (Pellikaan *et al.*, 2011). This was repeated 4 times using different cows.

Results Table 1 shows that the total gas and methane production after 72 h incubation in rumen fluid depends on the substrate, with highest gas production for beet pulp (avg. 351 ml/g OM) and lowest for grass silage (avg. 265 ml/g OM). Gas production of native starch (S) was higher than of gelatinized starch (F), which was also the case for the concentrates and TMR consisting native starch, compared with gelatinized starch. The total methane synthesis after 72 h incubation varied between 55 ml/g OM for grass silage and 64 ml/g OM for beet pulp and the methane in the total gas ranged from 18.4% for beet pulp to 20.6% for grass silage. In all cases the total gas production and methane synthesis using rumen fluid from cows fed gelatinized starch (rumen fluid F27 and F53) was lower than when using rumen fluid from cows fed native starch (rumen fluid S27 and S53). Using rumen fluid from cows fed the low level of starch, both native and gelatinized starch, resulted in all cases in a higher methane synthesis than when using rumen fluid from cows fed the high level of starch. Increasing the starch content in the ration of the donor cows decreased the in vitro

**Table 1** Total gas and methane production (ml/g OM) and % methane in the total gas after 72 h incubation in rumen fluid (RF) from cows fed rations differing in starch content and quality.

		gas		CH <sub>4</sub>			
Substrate	RF	ml/g	s.d	ml/g	s.d	% CH4	s.d
		OM		OM			
Beet pulp	S27	369	16.8	71	4.4	19.2	1.2
Beet pulp	S53	356	15.4	66	5.5	18.4	1.4
Beet pulp	F27	350	23.9	65	3.3	18.7	1.1
Beet pulp	F53	326	8.9	56	3.0	17.1	0.7
Conc. S27	S27	331	19.2	68	5.7	20.7	1.4
Conc. S53	S53	331	23.6	64	7.9	19.4	1.5
Conc. F27	F27	310	12.4	60	3.2	19.4	0.9
Conc. F53	F53	257	36.0	48	6.5	18.9	4.1
Grass silage	S27	290	-	67	-	23.2	-
Grass silage	S53	272	7.3	58	4.1	21.4	1.1
Grass silage	F27	270	9.9	58	5.4	21.3	1.9
Grass silage	F53	226	-	38	-	16.7	-
Native starch	S27	336	35.5	67	6.3	20.0	2.8
Native starch	S53	355	15.5	63	5.9	17.6	1.5
Gelatinized st.	F27	351	11.7	61	4.3	18.4	2.0
Gelatinized st.	F53	311	9.8	50	6.0	16.1	1.5
TMR S27	S27	303	19.1	66	2.7	21.7	1.2
TMR S53	S53	322	13.5	62	6.5	19.3	2.0
TMR F27	F27	300	14.0	56	3.1	19.4	1.0
TMR F53	F53	272	1.1	46	1.2	16.8	0.4

methane synthesis of all tested substrates. Also the % methane in the total gas was in all cases higher when using rumen fluid from cows fed native starch than when fed gelatinized starch and higher for the low starch level than for the high starch level, showing that the microbial population adapts to the offered rations with respect to methane synthesis, also influencing the fermentation characteristics of substrates *in vitro*.

**Conclusions** It can be concluded that type and level of starch fed to donor cattle results in adaptation of the rumen microbial population and influences the methane synthesis *in vitro* of all tested substrates.

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## References

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