gases (H_2, CO_2 and, in some cases CH_4). A large part of the hydrogen produced is re-utilized *in situ* by hydrogenotrophic microorganisms (methanogenic archaea, sulphate-reducing and acetogenic bacteria). Reductive acetogenesis, i.e. acetate synthesis from CO_2 reduction, was demonstrated to be an active process of H_2 disposal in the colon of non-methane excreting subjects, harboring low numbers of methanogens [1,2]. The taxonomy and phylogeny of the H_2/CO_2-utilizing acetogenic strains isolated from non-methane producing human faeces, showed the important diversity of this microbial population [3]. These acetogenic bacteria belong to different genera including *Clostridium*, *Ruminococcus* and *Streptococcus*.

The aim of the present work was to investigate the characteristics of H_2/CO_2 metabolism in four of these acetogenic species (two *Clostridium* spp., a strain of *Streptococcus* and *Ruminococcus hydrogenotrophicus* sp. nov.[4]). The four strains were able to use H_2/CO_2 as sole energy source to produce acetate. Incorporation of $^{13}CO_2$ into acetate by these species further demonstrated the utilization of the reductive pathway of acetogenesis. Chemiosmotic mechanisms of ATP generation seemed to be involved during acetate synthesis. It is likely that those of *Clostridium* F5a15 were sodium-dependent in contrast to the other strains. The minimal threshold of H_2 uptake in these acetogens was higher than that of the predominant colonic methanogen, *Methanobrevibacter smithii*. Autotrophic metabolism in acetogenic strains was modulated by yeast extract, tryptone or rumen fluid. Vitamins were required for H_2/CO_2 metabolism in most strains except *Clostridium* M5a3. The presence of glucose also modulated H_2/CO_2 utilization by these acetogens but the conditions in which they were able to co-utilize both glucose and H_2/CO_2 varied according to the species.

1. Lajoie SF, Bank S, Miller TL, Wolin, MJ (1988) *Appl Environ Microbiol* 54, 2723-2727
2. Bernalier A, Lelait M, Rochet V, Grivet JP, Gibson GR, Durand, M (1996) *FEMS Microbiol Ecol* 19, 193-202
3. Bernalier A, Rochet V, Leclerc M, Dore J, Pochart P (1996) *Curr Microbiol* 33, 94-99
4. Bernalier A, Willems A, Leclerc M, Rochet V, Collins MD (1996) *Arch Microbiol* 166, 176-183

Study of the adaptation of the rumen ecosystem to the anti-methanogenic effect of monensin measured in vivo.

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Monensin is known as a potent anti-methanogenic agent in the rumen. According to the literature, its effect persists throughout treatment [1], or decreases quickly and disappears approximately two weeks after the start of the treatment [2,3].

Four adult sheep fitted with a special rumen cannula allowing rumen gas sampling [4] just before (T0), 2h after (T2) and 5h after feeding (T5) were used. Animals were fed a mixed diet of grass hay (950 g) and barley (400 g) given twice daily. During period 1 (15 days) sheep

Effect of monensin on methane production in sheep

	CO_2/CH_4 in rumen gases		
	T_0 h	T_2 h	T_5 h
Before monensin treatment	1.22[a]	2.31[b]	2.18[a]
During monensin treatment	1.26[a]	2.84[a]	2.34[a]
After monensin removal	1.31[a]	2.39[b]	2.25[a]
RSD	0.20	0.30	0.27
Monensin effect	0.34	0.00	0.28

RSD : Residual Standard Deviation. Means with different superscripts are significantly different ($P \geq 0.05$)

were fed the control diet. The antibiotic was added to the diet (25mg kg^{-1}) during period 2 for 86 days, and it was withdrawn during period 3 (50 days). Rumen gases were analysed by gc [4]. Analysis of variance with two controlled effects (day and animal) was applied. The ratio CO_2/CH_4 in rumen gas significantly increased immediately after monensin was given and remained higher throughout period 2. It significantly decreased as soon as monensin was withdrawn during period 3 and almost immediately fell to the mean value of period 1. However, these effects were observed only during the 2h following feed intake and were not evident between T5 and the next meal (T0). In conclusion, methanogenic bacteria did not adapt to monensin during the 86-day treatment and recovered immediately after removal of the antibiotic.

1. Mbanzamihigo L, Van Nevel CJ, Demeyer, DI (1995) *Reprod Nutr Dév* 35, 353-365
2. Johnson DE, Aboomar JS, Saa CF, Carmean BR (1994) *Proc XIII[th] Symp on Energy Metabolism of Farm Animals*, (JF Aguilera ed), pp 339-342, EAAP Pub 76, CSIC, Spain
3. Kirchgessner M, Windisch W, Müller HL (1995) *Proc VIII[th] Int Symp on Ruminant Physiology*, (WV Engelhardt, S Leonhardmarek, G Breves, D Giesecke, F Enke, eds), Verlag, Stuttgart, Germany
4. Jouany JP, Senaud J (1979) *Ann Biol Anim Biochim Biophys* 19, 1007-1010

Effect of minerals on methane production and protozoa numbers in continuous culture of rumen microorganisms. L-P Broudiscou, Y Papon[1], AF Broudiscou[2] (*[1]INRA, Station de Recherches sur la Nutrition des Herbivores, Centre de Clermont-Theix, 63122 Saint Genès-Champanelle, France; [2]LMRE, Université d'Aix-Marseille III, 52 avenue Escadron Normandie-Niemen, 13013 Marseille, France)*

In ruminants, the minerals supplied by the diet or salivary secretion act on rumen microorganisms directly by providing them with enzymatic cofactors and essential elements for biosynthesis, by modifying rumen pH and osmolality, and indirectly by affecting the host digestive physiology, e.g. rumen content dilution rate and absorption rate of metabolites. In the present study, six dual outflow continuous fermentors [1] were used to quantify the direct response of mixed rumen microbes to a change in the input of minerals, and to