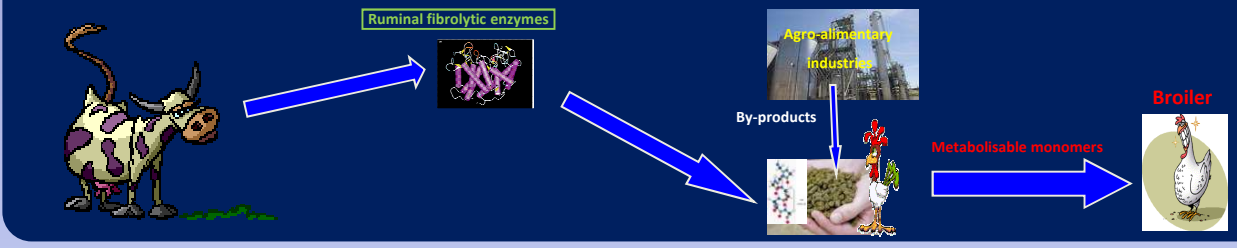
Potential of ruminal cellulosome to valorise biofuel by-products

Hissette M. *, Destain J., Théwis A., Thonart P. and Beckers Y.

Animal Science and Bio-industry Units, Gembloux Agro-Bio Tech /University of Liège, Belgium
*mhissette@ulg.ac.be

INTRODUCTION : The valorisation of by-products from biofuel industry will promote the application of the 2010 (2003/30/EC) and 2020 European Directives, stipulating the inclusion of biofuels in transport sector. Addition of exogenous enzymes to valorize these by-products in monogastric animals opens very wide and interesting opportunities toward Sustainable Development.

The aim of the study : Utilization of fibrolytic ruminal enzymes to valorize by-products in the digestive tract of the poultry.



RUMINAL FIBROLYTIC BACTERIA

Fiber adherent bacteria (cellulosome) = 80-90 % of ruminal cellulolytic activities

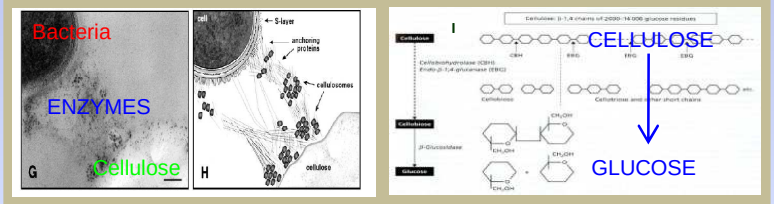


Figure 1 : Cellulosome structure (G-H ; *Bayer et al., 2004*), specific activities of cellulolytic enzymes and hydrolysis mecanism of cellulolytic bacteria (I ; *Mouriño et al., 2001*)

RUMINAL CRUDE EXTRACT FROM RUMINAL SOLID CONTENT

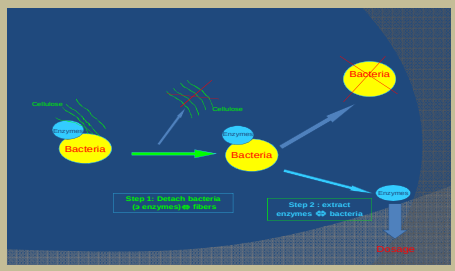


Figure 2 : General methodology to produce crude extract from ruminal solid content

CELLULOLYTIC POTENTIAL OF RUMINAL CRUDE EXTRACT ON BY-PRODUCTS

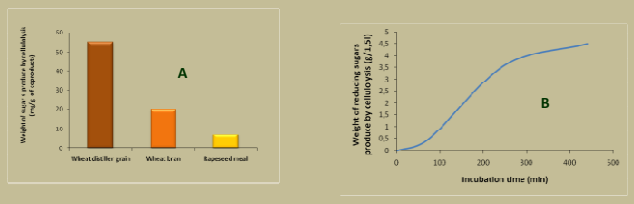


Figure 3 : Hydrolysis of cellulose content (9-10% in the coproducts) in different types of agro-alimentary by-products (A). Kinetic of by-products cellulolysis in a 1,5 liter reactor (scale up =100x ; B). Stabilisation of hydrolysis after 7,5 hours and 45 % of sugars produce from cellulose.

ISOLEMENT OF CELLULOLYTIC RUMINAL BACTERIA

Different media were tested in order to isolate cellulolytic bacteria from ruminal microorganism consortium.

Figure 4 : Hydrolysis halo from cellulolytic ruminal bacteria cultivated anaerobicaly on specific medium.

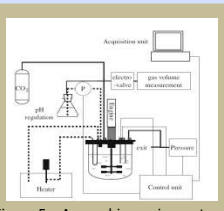


Figure 5 : Anaerobic *ex vivo* system

FIBROLYTIC ENZYME PRODUCTION FROM *EX VIVO* SYSTEM

Starter, inoculum and medium were cultivated in a 10 liters anaerobic continuous batch reactor to produce large scale up of fibrolytic ruminal enzymes.

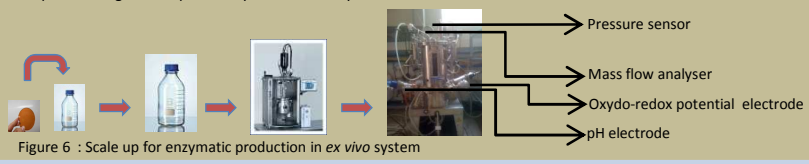


Figure 6 : Scale up for enzymatic production in *ex vivo* system

Conclusion : The ruminal crude extract hydrolyse *in vitro* by-products of the biofuel industry by producing quantities of sugars varying from 30 mg to 50 mg per g of by-products (grains of wheat, wheat bran and rapeseed expellers). In these conditions, Ruminal cellulosome can hydrolyse half-part of cellulose content in by-products.

Bibliography: Bayer et al., THE CELLULOSOMES Multienzyme Machines for Degradation of Plant Cell Wall Polysaccharides. Annual review of microbiology. Vol 58. 521-554. 2004. *Mouriño et al. Initial pH as a determinant of cellulose digestion rate by mixed ruminal microorganism in vitro. J. diary Sci. 84:848-859, 2001.*. Christophe et al., Growth monitoring of Fibrobacter *succinogenes* by pressure measurement. Bioprocess Biosyst Eng (2009) 32:123-128.

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