Potential of ruminal cellulosome to valorise biofuel by-products

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INTRODUCTION: The valorisation of by-products from biofuel industry will promote the application of the 2010 (2003/38/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 mechanism of cellulolytic bacteria (I; Mouriño et al., 2001)

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

CELLULOYTIC POTENTIAL OF RUMINAL CRUDE EXTRACT ON BY-PRODUCTS

Figure 3: Hydrolysis of cellulose content (9-10% in the coproduits) 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 CELLULOYTIC 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 anaerobically on specific medium.

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 5: Anaerobic ex vivo system

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:

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