MINIREVIEW

Ecology and biotechnological potential of the thermophilic fermentative Coprothermobacter spp.

M.C. Gagliano¹, C.M. Braguglia¹, M. Petruccioli² and S. Rossetti¹,*

¹Water Research Institute, IRSA-CNR, Via Salaria km 29.300, 00015 Monterotondo (RM), Italy and ²Department for Innovation in Biological, Agri-Food and Forestry systems (DIBAF), University of Tuscia, Via San Camillo de Lellis s.n.c., 01100 Viterbo, Italy

*Corresponding author: Water Research Institute, CNR, Via Salaria km 29,300, 00015 Monterotondo (RM), Italy. Tel: +39-06-90672697; E-mail: rossetti@irsa.cnr.it

One sentence summary: The microbial ecology of Coprothermobacter spp. is attracting great attention due to their proteolytic properties, syntrophic association with methanogens and the possible exploitation in several biotechnological processes.

Editor: Gerard Muyzer

ABSTRACT

Thermophilic bacteria have been isolated from several terrestrial, marine and industrial environments. Anaerobic digesters treating organic wastes are often an important source of these microorganisms, which catalyze a wide array of metabolic processes. Moreover, organic wastes are primarily composed of proteins, whose degradation is often incomplete. Coprothermobacter spp. are proteolytic anaerobic thermophilic microbes identified in several studies focused on the analysis of the microbial community structure in anaerobic thermophilic reactors. They are currently classified in the phylum Firmicutes; nevertheless, several authors showed that the Coprothermobacter group is most closely related to the phyla Dictyoglomi and Thermotoga. Since only a few proteolytic anaerobic thermophiles have been characterized so far, this microorganism has attracted the attention of researchers for its potential applications with high-temperature environments. In addition to proteolysis, Coprothermobacter spp. showed several metabolic abilities and may have a biotechnological application either as source of thermostable enzymes or as inoculum in anaerobic processes. Moreover, they can improve protein degradation by establishing a syntrophy with hydrogenotrophic archaea. To gain a better understanding of the phylogenesis, metabolic capabilities and adaptations of these microorganisms, it is of importance to better define the role in thermophilic environments and to disclose properties not yet investigated.

Keywords: Coprothermobacter; syntrophy; proteolytic thermophiles; protein fermentation

WHY COPROTHERMOBACTER?

Thermophilic bacteria have recently attracted great attention because of their potential application in improving different biochemical processes like anaerobic digestion of various substrates, wastewater treatment or hydrogen production. In particular, they possess enzymes with enhanced thermostability and hence may have a potential industrial application (Ollivier, Patel and Garcia 2000). There is, indeed, a considerable demand for a new generation of stable enzymes that are able to withstand severe conditions in industrial processes by replacing or supplementing traditional chemical processes (Elleuche et al. 2014).

Although proteolytic activity seems to be a common characteristic among mesophilic bacteria, only few proteolytic thermophiles have been characterized so far (Kersters et al. 1994; Cai, Gu and Wang 2011), and the majority of the enzymes currently used in the industry are obtained from fungi or mesophilic bacteria (Elleuche et al. 2014).

Coprothermobacter spp. are gram negative anaerobic thermophilic bacteria detected mostly at high temperatures (from