International Journal of Dairy Technology SDT SOCIETY OF DAIRY TECHNOLOGY

doi: 10.1111/1471-0307.12384

ORIGINAL RESEARCH

Effect of copper on probiotic properties of *Lactobacillus helveticus* CD6

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Copper imparts better organoleptic properties to cheese, while cheese acts as a vehicle for probiotic cultures. These studies revealed that copper stress changed key probiotic properties like acid and bile salt tolerance of a model organism Lactobacillus helveticus *CD6. After growing the culture in copper stress, the acid tolerance at pH 2 was lost along with a decrease in bile salt tolerance by 15%, while other desiring properties like auto-aggregation, cell surface hydrophobicity and antibacterial activity were improved. This study suggests that copper tolerant culture with retained probiotic properties could be used to deliver through cheese to the consumers.*

Keywords Cheese, *Lactobacillus helveticus*, Probiotic.

INTRODUCTION

Functional foods are defined as the foods having health benefits in addition to their essential nutritional value (Galland 2013). Due to safety and efficacy issues of modern drugs, the concept of functional foods is gaining more importance (Roberfroid 2007), and hence, researchers are interested in focusing the disease deterrence and treatment using functional or natural foods (Sharma and Tan 2013; Oliveira *et al.* 2016). The global functional food market revenue for the year 2013 was around $168 billion, while with an annual average growth rate of about 8.5%, it may exceed $305.4 billion by 2020 (PR Newswire 2015).

Currently, the most important and popular functional foods are the probiotic foods (Nagpal *et al.* 2012). Probiotics are live micro-organisms which when administered in adequate amounts confer a health benefit on the host (FAO/WHO 2002). The widely exploited probiotic micro-organisms in probiotic foods are the members of genus *Bifidobacterium* and *Lactobacillus* (Corbo *et al.* 2001; Demers *et al.* 2016). Yoghurt, kefir and cultured drinks like dairy products are the best examples of probiotics containing foods. The communication media also suggested that owing to the benefits conferred, the best way of emancipation of the probiotics into the intestine is through cheese, and an issue of a range of marketing and research studies (Deccan Herald 2012). As a carrier of probiotics, cheese being less acidic over yoghurt and bearing better buffering action in the highly acidic milieu of gastrointestinal tract facilitates probiotic endurance all the way through gastric transit (Karimi *et al.* 2012).

While manufacturing, some cheese are prepared essentially in copper vessels where copper ions impart a typical taste, odour and colour to cheese. According to a comparison, COMTE cheese (Juva Massif, France) prepared in copper and inox vessels reported by the Comite InterProfessionnel du Gruyere de Comte (1996), and the copper ion concentrations were found about 12.7 and 3 mg/kg, respectively. Further, it was observed that COMTE cheese made in the inox vessel was of poor quality as compared to cheese prepared in copper vessel possibly due to the presence of copper. Although copper is an active ingredient of cheese, it has potential to affect the viability of lactic acid bacteria used in cheese making. A recommended viable count for a probiotic strain per gram or millilitre is ranging between 10^5 and 10^7 cfu in various probiotic products to provide health benefits (Shah *et al.* 1995). As the presence of an adequate amount of probiotic cultures is a prerequisite, the viability of probiotic bacteria in cheese bearing copper as an active ingredient is in question. Unlike understanding the mechanism of

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