

Comparison of Associative Growth and Proteolytic Activity of Yogurt Starters in Whole Milk from Camels and Cows

H. M. ABU-TARBOUSH

Department of Food Sciences, College of Agriculture,
King Saud University, Riyadh, Saudi Arabia 11451

ABSTRACT

Growth and proteolytic activities were studied using yogurt starter cultures incubated in pasteurized whole milk from camels and cows at 42°C as single and mixed cultures. In general, the growth of four strains of *Streptococcus thermophilus* and three strains of *Lactobacillus delbrueckii* ssp. *bulgaricus* was higher in cow milk than in camel milk. However, proteolysis was higher in camel milk than in cow milk. *Lactobacillus delbrueckii* ssp. *bulgaricus* LB12 in combination with streptococci had lowered pH more than did the other lactobacilli. Mixed cultures released the same amount of free amino groups as the corresponding single cultures, except for *L. delbrueckii* ssp. *bulgaricus* LB12.

(Key words: camel milk, growth, proteolysis, yogurt starter cultures)

Abbreviation key: FAG = free amino groups.

INTRODUCTION

Cultured milk is produced by the growth in milk of lactic acid bacteria in sufficient quantity to produce curdling or thickening, giving the milk a typical sour flavor. Yogurt is a coagulated milk product obtained by lactic acid fermentation of milk through the action of *Lactobacillus delbrueckii* ssp. *bulgaricus* and *Streptococcus thermophilus*.

Energy and nitrogen are required by these microorganisms to maintain their life cycle. Lactose in milk is the only available carbohydrate for providing energy to lactic acid bacteria that possess the enzyme lactate dehydrogenase for the synthesis of lactic acid. Nitrogen is a growth-limiting factor for yogurt starter because milk has an inadequate supply of protein breakdown products to support good growth (29). Lactic acid bacteria are usually weakly proteolytic; however, they do cause a significant degree of proteolysis in yogurt (8). Lactobacilli are more proteolytic than streptococci and have the ability to hydrolyze

casein (28). Proteinase activity of *S. thermophilus* is limited, but peptidase activity can hydrolyze the intermediate products of casein proteolysis from *L. delbrueckii* ssp. *bulgaricus*, which is an important aspect of the synergistic relationship between the two organisms in yogurt (27).

Other growth factors contributing to the symbiotic relationship between *L. delbrueckii* ssp. *bulgaricus* and *S. thermophilus* have been studied by many investigators (5, 11, 12, 13, 25, 27, 30). *Lactobacillus delbrueckii* ssp. *bulgaricus* stimulates *S. thermophilus* by releasing valine, histidine, methionine, glutamic acid, and leucine (25); *S. thermophilus* produces other compounds, such as peptides, purine, pyrimidine, CO₂ (27), formic acid (5, 11, 13, 30), oxaloacetic acid, and fumaric acids (13) that stimulate the growth of *L. delbrueckii* ssp. *bulgaricus*. During growth in milk, *L. delbrueckii* ssp. *bulgaricus* apparently exhibits a preference for utilizing β -casein over other proteins as a nitrogen source, indicating that the type of protein is also an important factor influencing the growth of this culture (9).

Camel milk is extremely popular and widely consumed by people in Saudi Arabia both as fresh raw milk and as soured milk. The protein fractions of camel milk produced locally in Saudi Arabia have been studied by Abu-Lehia (1), Mehaia and Al-Kanhal (19), and Mehaia et al. (21). The mean casein content of camel milk (1.90 to 2.04%) is lower than that of cow milk (2.58 to 2.68%); the casein fraction constituted about 61 to 71% of the crude protein content. The casein content of camel milk was analyzed by Larsson-Raznikiewicz and Mohamed (14), who found that each of the four main caseins in cow milk appeared to have its counterpart in camel milk. However, casein fractions showed obvious differences, resulting in varying elution patterns in ion-exchange chromatography and electrophoresis of the two milks. Mehaia (17, 18) reported that cheese could be made from camel milk if yogurt or lactic cultures were used. Moreover, cheeses made from camel milk without use of starter cultures had high moisture and very high pH, which could permit growth of pathogens and cause serious health problems.

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