

Growth, Viability, and Proteolytic Activity of Bifidobacteria in Whole Camel Milk

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ABSTRACT

Four species of bifidobacteria were evaluated for growth, viability, and proteolytic activity in whole camel milk, and comparison was made with whole cow milk. Growth of all species in either whole milk was characterized by the appearance of two logarithmic phases following anaerobic incubation at 37°C for 36 h. The growth rate of *Bifidobacterium longum* 15707 was higher in camel milk than in bovine milk and was higher for *Bifidobacterium angulatum* 27535 in bovine milk than in camel milk. *Bifidobacterium bifidum* 2715 and *Bifidobacterium breve* 2258 showed the same trend as *B. angulatum* 27535 after 16 h of postinoculation. Viable counts of all species except *B. bifidum* 2715 increased in the fermented whole milks during the first 3 d of storage at 4°C. However, such counts did not change in unfermented milk, except for *B. longum* 15707, which showed an increase in viable counts after 12 d of storage. Viability of all species in both fermented and unfermented milks was unaffected during refrigerated storage for 15 d. All species except *B. longum* 15707 showed higher proteolytic activity in fermented camel milk than in bovine milk. However, proteolytic activity of all species except *B. breve* 2258 started at d 9 in unfermented camel milk only and increased sharply until the end of the storage period.

(**Key words:** camel milk, viability, proteolysis, bifidobacteria)

Abbreviation key: FAG = free amino groups.

INTRODUCTION

Bifidobacteria, which are Gram-positive rods that produce lactic acid, were first discovered in 1900 in the feces of infants by Henry Tissier (4). The potential health and nutritional benefits of bifidobacteria have been reported by many researchers (12, 14, 15, 16, 17, 24, 25).

Bifidobacteria are nutritionally fastidious organisms that require specific growth factors. Bovine milk is considered to be an artificial medium because of its deficiency of growth factors (25, 31). Modler et al. (22) and Ventling and Mistry (32) suggested the use of MRS broth and ultrafiltered milk to improve growth conditions for the different strains of bifidobacteria, particularly for the manufacture of products that contain bifidobacteria. However, such approaches are too costly, and cells harvested from MRS medium may contribute an off-flavor to finished products (yogurt and ice cream) unless the cells are extensively washed. Moreover, regulations may prohibit the use of nondairy-based media in dairy products. An alternative approach is the use of camel milk powder.

The population of camels in Saudi Arabia is estimated to be 0.60 million (5). Camel milk is extremely popular and is widely consumed in Saudi Arabia both as fresh raw milk and as soured milk. Camel milk has more free amino acids and peptides than does bovine milk (20, 30). Moreover, Taha and Kielwein (30) stated that the nonprotein-bound amino acids in camel milk are easily digested by microorganisms, and, therefore, camel milk has a higher metabolic activity when used in a starter culture preparation. The importance of free amino acids and peptides for the growth of bifidobacteria has been studied by Cheng and Nagasawa (6). Those researchers presumed that free amino acids could be utilized during the early stage of incubation and that peptides became available during the prolonged incubation of *Bifidobacterium* cultures.

The objective of this study was to investigate growth rates, proteolytic activity, and survivability of four different species of bifidobacteria in whole camel milk. Comparison with whole bovine milk was also evaluated in this study.

MATERIALS AND METHODS

Source and Maintenance of Cultures

Lyophilized *Bifidobacterium breve* NCFB 2258 and *Bifidobacterium bifidum* NCFB 2715 were obtained

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