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Quality and acceptability of a set-type yogurt made from camel milk

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ABSTRACT

Camel milk (CM) set yogurts were formulated with gelatin, alginate (ALG), and calcium (Ca). Titratable acidity, pH, sensory properties, and acceptability of CM yogurts were studied. Twelve treatments were prepared; 3 using gelatin at 0.5, 0.75, and 1% levels and 9 with combinations of ALG and Ca at different levels. Titratable acidity and pH of fresh yogurt were not affected by the addition of gelatin or the ALG and Ca combinations. Trained sensory panel results showed that CM yogurt containing 1% gelatin or 0.75% ALG + 0.075% Ca had the highest intensities for firmness and body. Consumer results indicated that the hedonic ratings of the sensory attributes and acceptability of CM yogurt containing 0.75% ALG + 0.075% Ca were similar to that of cow's milk yogurt. The CM yogurts containing ALG + Ca and flavored with 4 different fruit concentrates (15%) had similar hedonic ratings and acceptability. Addition of 0.75% ALG + 0.075% Ca could be used to produce acceptable plain or flavored CM yogurt.
Key words: camel milk, flavored yogurt, sensory quality, acceptability

INTRODUCTION

In the United Arab Emirates (**UAE**), the camel (*Camelus dromedarius*) is an important livestock species uniquely adapted to the hot and arid environment. Camels can survive under environmental conditions that are difficult for other domestic livestock species. The camel has the ability to produce more milk for a longer period of time in arid zones and dry lands (an environment of extreme temperature, drought, and lack of pasture) than in other domestic livestock species. Daily milk yield varies from 3.5 L (under desert conditions) to 40 L (under intensive management). Feed and availability of water can affect the chemical composition and taste of camel milk (**CM**). Camel milk contains 2.9 to 5.5% fat, 2.5 to 4.5% protein, 2.9 to 5.8% lactose, 0.35 to 0.90% ash, 86.3 to 88.5% water, and 8.9 to 14.3% SNF (Khan and Iqbal, 2001). Camel milk has similar protein content, lower lactose content (Elamin and Wilcox, 1992), and lower fat containing less saturated fatty acids and greater total cholesterol (Gorban and Izzeldin, 1999) compared with cow's milk. Camel milk has greater contents of vitamin C (Mehaia, 1994), ash, and sodium, potassium, phosphorus, zinc, iron and manganese (Gorban and Izzeldin, 1997) than cow's milk. Although there are many camel farms in UAE producing 39,350 t of milk (FAO, 2008), a limited amount of pasteurized CM is available at local markets. During the pre-oil period, CM was considered an important food for nomads, but because of socio-economic changes, CM is consumed mainly by the older generation and has lost its popularity among the younger generations. Camel milk has different sensory properties compared with cow's milk, and flavoring camel milk with chocolate improved its acceptance among elementary school children (Hashim, 2002). Camel milk has been used to treat tuberculosis and other lung ailments in Russia, and tuberculosis, dropsy, jaundice, and anemia in India. Traditionally, CM has been used to treat diabetes. Agrawal et al. (2005) also reported that CM improved long-term glycemic control and reduced insulin dose in patients with type-1 diabetes. In Sudan, garris, a traditionally fermented CM product, is used to cure leishmaniasis and the protozoal disease of the belly (Dirar, 1993).

Products made from CM include the traditionally fermented products garris and koumiss (Dirar, 1993), Domiati cheese (Mehaia, 1993a), fresh soft white cheese (Mehaia, 1993b), hard cheese (Mohamed et al., 1990), and ice-cream (Hammad, 1992). In contrast to CM, goat milk products, especially cheeses and yogurt, are very popular in the Mediterranean peninsula and in the Middle East (Tamime and Robinson, 1999). Caprine milk produces a very delicate yogurt with soft texture (Stelios and Emmanuel, 2004), whereas CM was shown to have greater resistance to bacterial growth leading to less active cultures, and thus causing quality problems in its fermented products. The proteolysis rate in fermented CM has been reported to be greater compared

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with cow's milk (Abu-Tarboush, 1996). Mohamed et al. (1990) reported that CM failed to reach a gel-like structure after an 18-h incubation with lactic acid cultures. The rheological and microscopic characteristics of the dromedary milk coagulum did not reveal curd formation and produced a fragile and heterogeneous structure. Attia et al. (2001) suggested the presence of antibacterial factors in dromedary skim milk because the starter culture showed a longer lag phase and an earlier decline phase resulting in a fragile coagulum. Jumah et al. (2001) reported that CM viscosity was not changed during gelation process of yogurt. El Agamy et al. (1992) reported that CM contains good amounts of lysozyme, lactoferrin, lactoperoxidase, immunoglobulin G, and secretory immunoglobulin A. These antimicrobial factors were present at significantly greater concentrations in CM and were more heat stable compared with those in cow and buffalo milks (El Agamy, 2000).

Producing fermented CM products may be difficult because of the problem of milk coagulation. Yogurt texture is a very important characteristic that affects its quality (appearance, mouthfeel, and overall acceptability). In an attempt to increase firmness and prevent syneresis, stabilizers and hydrocolloids have been added to yogurt (Keogh and O'Kennedy, 1998). Other researchers (Fiszman et al., 1999; Koksoy and Kilic, 2004; Kumar and Mishra, 2004; Ares et al., 2007; Supavititpatana et al., 2008) have reported that addition of gelatin increased viscosity and firmness, prevented syneresis, and improved the sensory attributes of yogurt. Herrero and Requena (2006) reported that the addition of whey protein concentrate enhanced the textural properties of yogurt made from goat milk. Yogurt fortified with calcium was produced without affecting its microbiological, sensory, and rheological characteristics (Fligner et al., 1988; Pirkul et al., 1997; Singh and Muthukumarappan, 2008). The objectives of the study were to investigate the factors affecting CM fermentation and to determine the effects of addition of gelatin, alginate, and calcium on yogurt quality.

MATERIALS AND METHODS

Fresh pasteurized CM, milk SNF (**MSNF**), commercial stabilizer (Grindstred ES255 Emulsifier and Stabilizer system, Danisco Ingredients, Brabrand, Denmark), commercial yogurt culture (Yo-Fast-88, Chr. Hansen, Hørsholm, Denmark), and fruit concentrates (strawberry, cherry, and peach + apricot + mandarin) were provided by a local dairy company. Date paste and date syrup were obtained from a local date factory. Gelatin was purchased from a local supermarket; carboxymethyl cellulose (**CMC**) was obtained from Sigma Chemical Company (St. Louis, MO), and sodium alginate (**ALG**) was obtained from BDH Chemicals Ltd. (Poole, UK).

Yogurt Making

Yogurt samples were made from cow milk (control) and CM in the Food Preparation Laboratory of the Food Sciences Department, UAE University, following the procedure used at a local dairy company (Al Ain Dairy, Al Ain, UAE). Yogurt was made by dissolving MSNF (2.5%) and stabilizer (0.6%); other ingredients were added according to milk composition. The mixture was heated in a water bath at 85°C for 30 min, cooled to approximately 42°C, inoculated with commercial yogurt culture, transferred to plastic cups, incubated at 43°C for 4 h, and stored at 4°C overnight before testing. For fruit-flavored yogurts, dry ingredients (MSNF, commercial stabilizer, ALG, and Ca) were added and blended with the milk. The yogurt mixture was pasteurized at 85°C for 30 min, cooled to 42°C, and divided into 4 equal lots. The fruit concentrates were added to the yogurt mix and blended. The commercial yogurt culture was added and blended into the mixture and packaged into plastic cups. The samples were incubated at 43°C for 4 h and stored at 4°C overnight before testing.

Experimental Design

Preliminary trials were conducted to determine the effects of the main ingredients. Three levels each of MSNF (2.5, 3.75, and 5%), of commercial stabilizer (0.6, 0.9, and 1.2%) and of commercial yogurt culture [the level recommended by the dairy company (**x**), 1.5x, and 2x] were used to prepare yogurt samples. Then, trials with different levels of colloids and stabilizers (gelatin, CMC, and ALG) and calcium chloride (Ca) were conducted to prepare CM yogurt. The study was designed based on the results of the preliminary trials, where 3 levels of gelatin and ALG (0.5, 0.75, and 1.0%) and 3 levels of Ca (0.05, 0.075 and 0.1%) were used to prepare yogurt samples.

Based on the sensory results of the trained panel, the best yogurt formulations (i.e., with the highest intensities) were selected for the consumer acceptance study. The most acceptable CM yogurt formula was flavored with 15% fruit concentrate [strawberry, cherry, peach + apricot + mandarin, or a mixture of date paste + date syrup (2:1)] and tested for its acceptability.

pH

The pH of the samples was determined using a digital pH meter (Thermo Orion pH meter, model 420, Thermo