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Production of Yoghurts from Three Different Kinds of Milks Using *Lactobacillus bulgaricus* and *Saccharomyces cerevisiae* in Esfahan, Iran

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Abstract: A six kinds of yoghurts were produced from cow, goat and sheep milks using *Lactobacillus bulgaricus* and *Saccharomyces cerevisiae* (Baker's yeast) as starter cultures which were used separately and as a consortium. Goat and sheep milks fermented separately with each of the starter cultures had lower pH than those of cow's milk. The textures of yoghurts from goat and sheep's milks were thicker than the yoghurt from cow milk which was watery. The acidity of the six kinds of yoghurt was low when compared with commercial yoghurts produced with a mixed culture of *L. bulgaricus* and *Streptococcus thermophillus*. Yoghurts from goat and sheep's milks were preferred to yoghurt from cow although, goat milk's yoghurt had a characteristic goat like aroma and it will be more preferred if the goat like aroma is removed. Pasteurization of the fermented milk product had no effect on their acidity. Hence, yoghurt from goat and sheep's milk were found acceptable to the panelists.

Key words: Yoghurts, *Lactobacillus bulgaricus*, *Saccharomyces cerevisiae*, acidity, pasteurization

INTRODUCTION

Yoghurt is a fermented drink made from milk, skimmed milk or fortified milk usually from cows but sometimes from other animals such as goats or sheep. The name yoghurt is derived from the Turkish word Jugurt which means dense and thick (Adams and Moss, 1995; Kolars, 1984). The name shows how yoghurt was originally made. Other fermented milk products includes buttermilk, sour cream, kefir, cheese, etc. Fermented food products have been produced as food since the 3rd millennium BC (Kolars, 1984). The earliest yogurts were produced from goat's milk and sheep's milk until cow was domesticated in Turkey or Macedonia between 6100 and 5800 BC (Adams and Moss, 1995; Kolars, 1984). The yoghurts were believed to have been spontaneously fermented by wild bacteria living on the goat skin bags carried by the Bulgars, a nomadic people who migrated into Europe in the 2nd century AD and eventually settled on the Balkans by the end of the 7th century (Kolars, 1984).

Yoghurt was primarily a food of India, Central Asia, South Eastern Europe and central Europe until the 1990s when a Russian Biologist named Ilya Ilyich Mechnikov theorized that the long lifespan of the Bulgarians peasants were as a result of heavy consumption of yoghurt. The theory was based on the fact that lactobacillus, one of the starter organisms for yoghurt production is essential for good health. This, thus facilitated the spread of yoghurt as food stuff throughout Europe (Kolars, 1984). The fermentation of milk in the production of yoghurt is achieved by introducing the bacteria *Lactobacillus delbrueckii* (*L. bulgaricus*) and *Streptococcus salivarius* (*S. thermophillus*) into milkunder controlled conditions. The final product may be consumed as pasteurized fermented milk without any live bacteria or as non-pasteurized yoghurt with live active culture of the starter organisms (Kolars, 1984). Pasteurized yoghurt has a shelf life of months and does not require refrigeration. Yoghurt is rich in protein, several B vitamins and essential minerals. It contains much fat as the milk it is made from like yoghurt culture contains enzymes that help break down lactose inside the intestine; therefore, it is enjoyed by people with lactose intolerance. Yoghurt containing *Lactobacillus acidophilus* is used to cure yeast infections such as candidiasis caused by *Candida albicans* when taken daily or applied topically to the affected female area (Adolfson *et al*., 2004). The bacteriocidal action of the bacterium is due to the production of an acidic pH in which *Candida albicans* cannot thrive. This scientific investigation carried out in November 2006 was initiated to produce yoghurt from three types of milk, cow, sheep and goat's milk using two organisms namely; *Lactobacillus bulgaricus* and *Saccharomyces cerevisiae* (Baker's Yeast); to access the quality of the yoghurt produced from sheep and goat milks using yeast and *L. bulgaricus*; to determine the acceptability of the yoghurt produced with goat and sheep's milk as an alternative to cow's milk yoghurt. The

purpose was to assess the fermentative quality such taste, colour, texture, aroma, flavour and pH of *S. cerevisiae* on milk.

MATERIALS AND METHODS

Source of materials: Three different milk samples (cow, goat and sheep) were collected (1000 mL each) from the Esfahan farms that select with simple Randomize Method (sheep and goat section. *Saccharomyces cerevisiae* (Baker's yeast) powder and *Lactobacillus bulgaricus* (freeze-dried) pallets was obtained from a commercial yoghurt producing company in Esfahan, Iran.

Reactivation of starter cultures: About 5 g of *Saccharomyces cerevisiae* powder were dissolved in 500 mL of warm distilled water to which 50 g of sucrose were added. A sterile glass rod was used to mix the dissolved yeast powder to form a yeast slurry and then incubated for 12 h at 35°C. The freeze-dried sample of *Lactobacillus bulgaricus* was stirred in a container of about 50 mL of milk and then covered with aluminium foil. It was also incubated for 12 h before addition to 250 mL of milk (Kolars, 1984).

Fermentation of milk: Total 500 mL of each milk sample was poured into two 250 mL conical flask and covered with sterile aluminum foil. The different milk samples were pasteurized at 85°C for 2 min (Adams and Moss, 1995). The milk samples were cooled slowly to approximately 43°C and the reconstituted starter cultures were added to each sample of the milk and incubated for 24 h at approximately 43°C. After the fermentation, the milk samples were pasteurized and kept in the refrigerator.

Chemical analysis: The pH of the different milk samples was analyzed before pasteurization of the raw milk samples after fermentation and after pasteurization of the fermented milk samples.

Sensory evaluations: The sensory assessment was performed on fermented milk prepared from the different milk samples. The fermented milks were tasted without adding sugar. The sensory panelist consisted of three students, two Academic staffs and one non-academic staff of which all are familiar with yoghurts. The panelists rated the fermented milk samples for colour, texture, aroma, taste and overall liking using a scale of 1 (dislike extremely) to 9 (like extremely).

RESULTS AND DISCUSSION

The pH of the raw milk samples was observed to be 6.3 for cow's milk, 6.9 for goat's milk and 6.8 for sheep's milk. The pH of the fermented milk samples after fermentation and after pasteurization of the fermented milk samples is shown in Table 1. The samples were evaluated on the basis of colour, texture, aroma and taste. The result obtained from the evaluation of the samples is shown in Table 2 while Table 3 shows the result of the sensory evaluation based on overall liking. Fermentation of milk by

Table 1: pH of milk samples after fermentation and pasteurization

Sample code	After fermentation	After pateurization of fermented milk
CL	6.10	6.10
CY	6.10	6.10
GL	6.20	6.10
GY	6.00	6.00
SL	6.70	6.40
SY	6.10	6.10

CL = Cow milk + Lactobacilli, CY = Cow milk + Yeast, GL = Goat Milk + Lactobacilli, GY = Goat milk + Yeast, SL = Sheep milk + Lactobacilli, SY = Sheep milk + Yeast

Table 2: Sensory evaluation for fermented milk samples codes

Parameters	CL	CY	GL	GY	SL	SY
Colour	Milky	Light milky	Milky	Light milky	Creamy	Pale yellow
Texture	Watery	Watery	Thick	Watery	Thick	Slightly thick
Aroma	Yoghurt	Decaying coconut	Goat-like Yoghurt	Goat-like	Yoghurt	Yoghurt
Taste	Sour/Yoghurt	Coconut	Sour	Milk	Bitter to sour	Coconut

CL = Cow milk + Lactobacilli, CY = Cow milk + Yeast, GL = Goat Milk + Lactobacilli, GY = Goat milk + Yeast, SL = Sheep milk + Lactobacilli, SY = Sheep milk + Yeast

Table 3: Overall liking

Sample code	Ist person	2nd person	3rd person	4th person	5th person	6th person
CL	Dislike moderately	Dislike moderately	Dislike very much	Dislike moderately	Dislike moderately	Like moderately
CY	Neither likes nor dislike	Neighter likes nor dislike	Dislike extremely	Like slightly	Dislike moderately	Like moderately
GL	Like very much	Like slightly	Neither likes nor dislike	Like moderately	Like moderately	Like extremely
GY	Like slightly	Like moderately	Dislike slightly	Like slightly	Dislike slightly	Like very much
SL	Like moderately	Dislike moderately	Dislike slightly	Like slightly	Like slightly	Like slightly
SY	Like extremely	Like extremely	Like slightly	Like moderately	Like slightly	Like moderately

CL = Cow milk + Lactobacilli, CY = Cow milk + Yeast, GL = Goat Milk + Lactobacilli, GY = Goat milk + Yeast, SL = Sheep milk + Lactobacilli, SY = Sheep milk + Yeast

lactic acid bacteria produces lactic acid due to fermentation of lactose present in milk by the bacteria (Adams and Moss, 1995). From Table 1, the differences in the rate of decrease in pH due to production of lactic acid during fermentation of the three milk samples using Lactobacillus and yeasts were found to be highest in goat milk samples (GL and GY) followed by sheep milk sample (SL and SY) while there is no difference in cow's milk samples (CL and CY). There is no difference in the pH of CL, CY, GL and SL, respectively. The increased acidity of the fermented goat and sheep milks samples using yeast must be responsible for their thicker texture and more acceptability to the panelists due to adequate curdling of the milk proteins (Clarence *et al*., 1993). It was observed from the result that heavy lumps of curds that homogenized on mixing were formed in goat and sheep milks fermented with Lactobacillus (Table 2) while those fermented with yeast did not homogenize completely although, the resulting mixture of SY was slightly thicker while CL and CY remained watery and grainy after homogenization. This may be due to low content of protein in the cow milk with the resultant scanty protein globules possibly due to seasonal variations that affect milk qualities. It is noteworthy that the milk samples were collected in the month of November a period of low fodder production and no rain fall. The sour nature of GL, bitter to sour taste of SL and sour/yoghurt taste of CL (Table 2) were due to lactic acid production by Lactobacilli with GL>SL = CL (Table 1).

The result also revealed (Table 1) that the acidity of the laboratory fermented milk samples were higher (6.0-6.7) when compared with commercially produced yoghurts whose acidity falls in the range 4.3-4.5. This confirms the report of (Adams and Moss, 1995) who reported that although, *Lactobacillus bulgaricus* on its own acidifies milk but the rate of growth and acidification is faster when it is grown together with *Streptococcus thermophillus*. The report further explained that Lactobacillus is slightly proteolytic and liberates small amount of the amino acid valine which stimulate streptococcal growth. In turn, the streptococcus produces formate, pyruvate and carbon dioxide all of which stimulate the growth of Lactobacillus. The relationship between the two starter organisms is a form of microbial cooperation known as symbiosis (Prescott *et al*., 2002). The greatee increase in acidity of commercially produced yoghurt may also be as a result of prolonged storage before pasteurization. The constant values in the pH of CY, GY and SY (Table 1) indicated that yeast did not produce acid during the fermentation. Thus, the resultant products in Table 2 (CY, GY and SY) had no sour taste. However, the cause of this effect is a subject for further research. From the sensory evaluation studies it was established that samples SL and SY had a thick texture and yoghurt like aroma (Table 2). Therefore, it was most preferred although with a bitter to sour and coconut taste. respectively. Samples GL and GY had a characteristic goat like aroma which may be due to the characteristic smell of goats and had a thick and watery texture, respectively. The products were moderately liked by the panelists but a dislike was voted in favour of the goat like aroma (Table 3). Samples CL and CY were moderately disliked by our sensory panelists may be due to their watery texture and coarseness. There was no significant difference between the colour and texture of samples CY and GY.

CONCLUSION

The results obtained demonstrated that it is possible to locally produce yoghurt using goat and sheep milks as well as to produce yoghurt using only *Lactobacillus bulgaricus* although with a high pH. It was observed that fermentation of milk with yeast can produce pleasant taste and aroma such as yoghurt like and coconut like taste and aroma. The overall liking of the products by the sensory panelists indicated that the production of yoghurt with goat and sheep milk will be locally accepted and preferred, although the new product has to compete actively with cow milk's yoghurt which is already in vogue and has taken root as part of the food culture of many people. It is worthy of note that *Streptococcus thermophillus* is very important in the production of yoghurt in order to acquire the acceptable flavour of yoghurt regardless of the type of milk used. The result showed that pasteurization of fermented milk had no effect on acidity already of the milk and that Lactobacillus produced acid while yeast did not.

RECOMMENDATIONS

Good quality yoghurt can be prepared with goat and sheep milks if proper fermentation procedures are followed. Goat milk's yoghurt will be readily accepted if the goat-like aroma is removed. Sheep milk with yeast produces very tasty and nice yoghurt. These yoghurts should be produced locally while soliciting for its commercial production. However, the production of yoghurt with goat milk should be accompanied with the removal of its goat like aroma in order for it to be well accepted locally probably by using *Streptococcus thermophillus* as part of the starter cultures. The general public should try to adapt to these new products in order to ensure a continuous production of yoghurt even when there is scarcity in the production of cow milk for the production of cow milk yoghurt which has formed part of

the food culture of the people. Therefore, the government (Nigeria) should encourage large scale rearing of goats and sheep and also participate fully in it in order to ensure the production of goat and sheep milks for yoghurt production.

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