

OPTIMIZATION OF FERMENTATION CONDITION FOR THE PREPARATION OF FRUIT YOGHURT

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Abstract

In this research, yoghurt was prepared from goat and cow milks. Available cow milks in the market such as Ngwe Sin Palei and Sein Lei KanThar Brands were purchased from Hledan Market, Kamayut Township and native cow milk was collected from YwarThit Village, Htantabin Township, Yangon Region. Native goat milks were also collected from Ywar Thit Village, Htantabin Township and Insein Township. In the preparation of fruit yoghurt, 5%, 10% and 15% of fruits were used. Three kinds of fruits such as strawberry, avocado and banana were used in yoghurt. The physico-chemical characteristics, yield percent and shelf-life of prepared fruit yoghurt were also investigated. Starter culture, pH, fermentation temperature, time and fruit percent were important to control the parameters for preparation of fruit yoghurt. It was observed that at 43°C of fermentation temperature, 15g of starter culture, 5hr of fermentation time and 10% fruit were the most suitable conditions for the preparation of fruit yoghurt based on its pH, taste and texture.

Keywords: fruit yoghurt, starter culture, pH, fermentation temperature and time, fruit percent

Introduction

Milk is a unique substance in that it is both consumed as fluid milk with minimal processing and it is the raw material used to manufacture a wide variety of products. Milk also has a unique nutritional property that makes it an especially important food, particularly for the young. Milk and milk products have formed an important part of the diet of man (Potter, 1986).

The milk from cows and goats will vary in composition and many other factors. These include the breed, individuality of the animal, age, stage of lactation, season of the year, the feed, time of milking, period of time between milking, the physiological condition of the cow whether it is calm or excited, whether it is receiving drugs and so on (Eckles, 1982).

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Processing milk into a dairy product makes it more stable for storage over extended period of time. In the tropics where ambient temperature are high and refrigeration is not readily available, milk may be concentrated by boiling or made into butter or ghee or other products which keep better at room temperatures. When there is an abundant local supply, storage and marketing may have a low priority, leading to wastage (Edgar, 1995).

Yoghurt is a dairy production that has more profits than milk. Digestive system in some people has an allergy to lactose (sugar of milk), but lactose is transformed to lactic acid in yoghurt and does not create allergy. Fermented milk products are traditional, particularly in countries with warm climates, primarily because raw milk rapidly sour as a result of the production of lactic acid by microorganisms, which inevitably gain access to the milk. This souring, or fermentation, constitutes an important means of preventing spoilage by *proteolytic* and other bacteria which cannot tolerate acid conditions and inhibits the growth of certain common pathogens (Meyer, 1960).

Lactic acid bacteria are used also to produce fermented milks other than yoghurt, most with a national original significance. One of the oldest fermented milk is known as yoghurt. Yoghurt consists of pasteurized, homogenized whole milk that is inoculated with *Streptococcus thermophilus* and *Lactobacillus bulgaricus* and incubated for a short time (2-3 hours) at 43-45°C (Hall, 1976).

The objectives of this research work were to convert milk, which is perishable, into yoghurt with a longer shelf-life whilst preserving most of its nutrients and to explore the possibility for the commercial production of yoghurt from cow and goat milks.

Materials and Methods

Sampling and Analysis of Raw Milks

Available cow milks in the market such as Ngwe Sin Palei and Sein Lei KanThar Brands were purchased from Hledan Market, Kamayut Township and native cow milk was collected from YwarThit Village, Htantabin Township, Yangon Region. Native goat milks were also collected

from YwarThit Village, Htantabin Township and Insein Township, Yangon Region.

Milk Analyzer (MILKOTESTER) was used in the determination of physico-chemical characteristics of milk samples. Milk Analyzer (MILKOTESTER) is designed for percentage analysis of Fat, Solids-Not-Fat (SNF), Protein, Lactose, Water Content, Temperature(°C), Freezing point, Total Solids, Density and pH. These components can all be measured at the same time.

Pasteurization and Homogenization of Milk

1liter of Cow Milk (Sein Lei KanThar Brand) was poured into a stainless steel pot. The milk was heated up to 85°C and it was held there for at least 15 min. The heated milk was homogenized by using magnetic stirrer for about 10 min.

Similarly, cow milk (Ngwe Sin Palei Brand and YwarThit Village) and goat milk (Insein and YwarThit Village), were prepared in the same manner.

Preparation of Fruit Yoghurt

1 liter of pasteurized milk was added to a sterilized stainless steel pot, stirred and heated at 95°C using a magnetic stirrer, and held for 2 minutes. It was then cooled until it reached the required incubation temperature of 43 - 46°C that is the critical temperature for yoghurt culture growth. 15g of starter culture was added to the milk and held at 45°C, for 4 - 5 hr to reach a pH range of 4.3 to 4.6. Then, 70 g of sugar, 1.5 g of sodium carboxymethyl - cellulose, 50 mg of sodium sorbate and 5% strawberries by weight of yoghurt were added respectively and blended by using a blender. The mixture is again pasteurized at 75°C for 3 minutes and poured carefully into a previously sterilized bottle and capped tightly, labeled and stored in a cool dry place.

Similarly, the same procedure was also carried out with strawberries 10% and 15%.

The same procedure was repeated by using bananas and avocados. The effect of fruit percent on the pH and taste of fruit yoghurt were determined and its result shown in Table (4).

Results and Discussion

Physico-chemical characteristics of milk samples such as Cow milk Ngwe Sin Palei brand, Sein Lei KanThar brand and native cow milk from YwarThit Village, Htantabin Township were determined by Milk Analyzer (MILKOTESTER). Similarly, goat milk from YwarThit Village, Htantabin Township and Insein Township were also analyzed. The comparison between cow milk and goat milk samples is shown in Table (1). The protein and fat content of cow milk (Sein Lei KanThar Brand) were the highest and so it was the best for making yoghurt.

Table (2) shows the effect of starter culture on the fermentation time in the preparation of yoghurt. It was observed that starter culture (15g), fermentation time (5hours) and fermentation temperature (43°C) were the most suitable condition. At 43°C, pH of prepared yoghurt reached the range of 4.3 to 4.6 during fermentation time of 5hr and the data are shown in Table (3).

In the preparation of fruit yoghurt, 5%, 10% and 15% of fruits by weight of yoghurt were used and the experimental data are shown in Table (4). It was evident that 10% fruit by weight of yoghurt was the most suitable condition in the preparation of fruit yoghurt according to pH, taste and type of prepared fruit yoghurt. Physico-chemical characteristics of fruit yoghurt are shown in Table (5) and it was found that fat content and protein content of avocado yoghurt were greater than other fruit yoghurt samples. Table (6) shows the comparison of physico-chemical characteristics of prepared yoghurt and commercial yoghurt. It was found that fat content and protein of prepared yoghurt were greater than the commercial yoghurt.

During storage, the acidity of prepared fruit yoghurt decreased. The determination of the acidity of prepared yoghurt was conducted seven times at three days interval and the data are shown in Table (7).

Table 1: Comparison of Physico-chemical Characteristics of Cow and Goat Milk Samples

Sr. No.	Characteristics	Cow Milk Samples			Goat Milk Samples		*Literature value
		Ngwe Sin Palei	Sein Lei KanThar	Ywar Thit Village	Ywar Thit Village	Insein	
1	Milk yields (viss/head/day)	5-6	6-7	2-2.5	0.5-1	0.7-1	-
	Chemical characteristics						
2	Fat content (%) (w/w)	3.6	4.3	3.8	3.8	4.1	3.80
3	Protein content (%) (w/w)	3.2	3.6	3.3	3.2	3.4	3.35
4	Solid not fat (%) (w/w)	8.8	12.2	8.5	8.6	8.9	8.80
5	Water content (%) (w/w)	87.6	83.5	87.7	87.6	87	87.25
6	Total solids content (%) (w/w)	12.4	16.5	12.3	12.4	13.0	12.60
7	Ash content (%) (w/w)	0.63	0.65	0.60	0.68	0.65	0.70
	Physical characteristics						
8	Specific gravity	1.018	1.04	1.009	1.02	1.007	1.03
9	Refractive index	1.35	1.33	1.32	1.34	1.31	-
10	pH	6.60	6.62	6.64	6.62	6.61	6.65

The experiments were conducted at the Laboratory of Department of Industrial Chemistry, West Yangon University.

*Winton, L.A., 2000.

Table 2: Effect of Starter Culture on the Fermentation Time

Volume of milk = 1 liter

Sr. No.	Temperature(°C)	Starter Culture(g)	Fermentation Time(hours)	
			Experiment	**Literature value
1	40	10	8	4-5
		15	7	
		20	6	
2	*43	10	7	4-5
		*15	*5	
		20	4	
3	45	10	6	4-5
		15	4	
		20	3	

* The most suitable condition

**Winton, L.A., 2000

The experiments were conducted at the Laboratory of Department of Industrial Chemistry, West Yangon University.

Table 3: Changes in pH of Yoghurt During Fermentation

Volume of milk = 1 liter , Starter culture = 15g,

Fermentation temperature = 43°C

Sr. No.	Source		pH at Different Fermentation Times (hour)						
			0	1	2	3	4	*5	6
1	Cow milk	Ngwe Sin Palei	6.6	6.1	5.7	5.2	4.8	4.3	3.8
		Sein Lei KanThar	6.7	6.3	5.6	5.4	4.9	4.4	4.0
		YwarThit Village	6.5	6.1	5.6	5.3	4.7	4.2	3.6
2	Goat milk	YwarThit Village	6.6	6.2	5.8	5.5	4.9	4.5	4.0
		Insein	6.5	6.0	5.6	5.3	4.9	4.6	3.9

*Optimum fermentation time = 5hr

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Table 4: Effect of Fruit Percent on the pH and Taste of Yoghurt
Milk Sample = Sein Lei KanThar

Sr. No.	Source	Characteristics	Fruits (%) (w/w)			*Literature value
			5	**10	15	
1	Strawberry	pH	4.9	4.2	3.7	4.1-4.3
		Yoghurt type	liquid	liquid	semi-solid	liquid
		Taste	slightly sweet	slightly sour	sour	sour
2	Avocado	pH	5.1	4.3	4.0	4.1-4.3
		Yoghurt type	liquid	liquid	semi-solid	liquid
		Taste	slightly sweet	slightly sour	sour	sour
3	Banana	pH	4.8	4.4	3.9	4.1-4.3
		Yoghurt type	liquid	liquid	semi-solid	liquid
		Taste	slightly sweet	slightly sour	sour	sour

*Winton, L.A., 2000

**The most suitable condition

The experiments were conducted at the Laboratory of Department of Industrial Chemistry, West Yangon University.

Table 5: Physico-chemical Characteristics of Prepared Fruit Yoghurt
Milk Sample = Sein Lei KanThar

Sr. No.	Characteristics	Fruit Yoghurt			*Literature value
		Strawberry	Avocado	Banana	
	Chemical characteristics				
1	**Fat content (%) (w/w)	6.2	7.3	6.5	≥ 3
2	**Protein content (%) (w/w)	3.24	4.15	3.48	3-8
3	Total solids content (%) (w/w)	15.36	16.34	16.20	11.20
4	Solid not fat (%) (w/w)	9.16	9.04	9.70	≥ 8.2
5	Ash content (%) (w/w)	0.82	0.98	0.90	0.92
6	Lactic acid content (%) (w/w)	1.2	1.7	1.8	1.1-1.8
	Physical characteristics				
7	Water content (%) (w/w)	80.52	75.38	77.23	88.80
8	pH	4.2	4.3	4.4	4.1-4.3
9	Yoghurt type	liquid	liquid	liquid	liquid
10	Taste	sour	slightly sour	slightly sour	sour

*Winton, L.A., 2000

**Fat and protein content were determined at SGS (Myanmar) Company limited.

The experiments were conducted at the Laboratory of Department of Industrial Chemistry, West Yangon University.

Table 6: Comparison of Physico-chemical Characteristics of Prepared Yoghurt and Commercial Yoghurt

Sr. No.	Characteristics	Prepared Fruit Yoghurt (Sein Lei KanThar)	Commercial Yoghurt (Hlegalay Yoghurt)
	Chemical characteristics		
1	*Fat content (%) (w/w)	4.2	3.2
2	*Protein content (%) (w/w)	6.8	6.3
3	Total solids content (%) (w/w)	18.2	16.4
4	Solid not fat (%) (w/w)	13.95	13.2
5	Ash content (%) (w/w)	0.90	0.87
6	Lactic acid content (%) (w/w)	1.5	1.4
	Physical characteristics		
7	Water content (%) (w/w)	81.8	83.6
8	pH	4.3	4.2
9	Yoghurt type	liquid	liquid
10	Taste	slightly sour	slightly sour
11	Shelf-life (week)	2	2

*Fat and protein content were determined at SGS (Myanmar) Company limited.

The experiments were conducted at the Laboratory of Department of Industrial Chemistry, West Yangon University.

Table 7: Effect of Storage Time on the Acidity of Prepared Yoghurt
 Milk Sample = Sein Lei KanThar
 Storage temperature = Refrigeration Temperature (0-4°C)

Sr. No.	Yoghurt	Storage Time (days)	Acidity (%) (v/w)	*Literature value
1	Strawberry Yoghurt	0	4.30	3.9
		3	4.24	
		6	4.21	
		9	4.18	
		12	4.12	
		15	3.70	
2	Avocado Yoghurt	0	4.60	3.9
		3	4.53	
		6	4.48	
		9	4.40	
		12	4.25	
		15	3.95	
3	Banana Yoghurt	0	4.50	3.9
		3	4.45	
		6	4.40	
		9	4.32	
		12	4.15	
		15	3.85	

*Winton, L.A., 2000

The experiments were conducted at the Laboratory of Department of Industrial Chemistry, West Yangon University.

Conclusion

Standard fermented milk products are made from raw milk (Cow or Goat) that has good quality such as yield, fat, protein, total solids and pH. This means fresh, pure and clean milk from healthy animals and the milk should be free from odors and taints that could affect the quality of products. In this research work, milk products – yoghurt was prepared from cow milk as well as from goat milk. In the preparation of fruit yoghurt, the effect of starter culture on fermentation time, the effect of fermentation time on pH and the

effect of fruit percent on the pH and taste of the products were investigated. In the preparation of fruit yoghurt, different ratios of fruit (5%, 10%, 15%) were used. It was observed that at 43°C of fermentation temperature, 15g of starter culture, 5hr of fermentation time and 10% fruit were the optimum conditions for the preparation of fruit yoghurt based on its pH, taste and texture. Prepared fruit yoghurt was compared with commercial fruit yoghurt (Hlegalay Yoghurt). It was found that the quality of prepared fruit yoghurt were higher than that of commercial yoghurt samples.

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