

## Effect of Starter Culture, Fermentation Temperature and Fermentation Time on the Preparation of Yoghurt

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### Abstract

The aim of this research work is to prepare yoghurt from goat milk and cow milk. Milk samples were collected from different sources such as cow milk (Ngwe Sin Palei and Sein Lei Kan Thar Brands) and native cow milk from Ywar Thit Village, Htantabin Township, Yangon Region. Similarly, native goat milk samples were collected from from Ywar Thit Village, Htantabin Township and Insein Township. Fluid yoghurt and cream yoghurt were prepared from different milk samples. The physico-chemical characteristics, yield percent and shelf-life of prepared yoghurt were also investigated. In this research work, starter culture, pH, fermentation temperature and fermentation time were important control parameters for preparation of yoghurt. It was observed that starter culture (15g), fermentation time (5hours) and fermentation temperature (43°C) were the most suitable conditions for the preparation of yoghurt.

**Keywords:** fluid yoghurt, cream yoghurt, starter culture, pH, fermentation temperature, fermentation time

### Introduction

Milk is a unique substance which 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. 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 physiologic condition of the cow whether it is calm or excited, whether it is receiving drugs and so on (Lampert, 1970).

Yoghurt is a dairy production that has more profits than milk. Digestive system in some of 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 sours 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 the certain common pathogen (Eckles et al, 1982).

Lactic acid bacteria are also used 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 (Meyer, 1960).

The objectives of this research work are 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.

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## Materials and Methods

### Sampling of Raw milk

Samples of cow milk and goat milk were collected from different farms. Samples of cow milk from native cow at U Mya Aye's Farm, Ywar Thit Village, Htantabin Township, Yangon Region and samples of cow milk (Ngwe Sin Palei and Sein Lei Kan Thar Brands) from Hledan Market, Kamayut Township, were used. Similarly, samples of goat milk from native goat at U Mya Aye's Farm, Ywar Thit Village, Htantabin Township, Yangon Region and U Hla Maung's Farm, Ward No.9, Insein Township, Yangon Region were used.

### Pasteurization and Homogenization of Milk

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

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

### Preparation of Fluid Yoghurt

Pasteurized milk (1 liter) was added to a sterilized stainless steel pot, stirred and heated at 70-75°C using a heated magnetic stirrer for 2 minutes. It was then cooled until it reached the required incubation temperature of 40-46 °C, critical temperature for yoghurt culture growth. 10 g of starter culture was added to the milk and held at 43°C, for 4 - 5 hours to reach a pH range of 4.3 to 4.6. Then, 70 g of sugar, 1.5 g of sodium carboxymethylcellulose, 50 mg of sodium sorbate were added and again pasteurized at 75°C for 3 minutes and poured carefully into a previously sterilized container and capped tightly, labeled and stored in a cool dry place.

The same procedure was carried out by using 15 g and 20 g of starter cultures. The effect of starter culture on fermentation time and changes in pH of prepared fluid yoghurt were determined and its result was shown in Table 1 and Table 2.

### Preparation of Cream Yoghurt

1 liter of pasteurized milk and 50 g of cream milk powder were added to a sterilized stainless steel pot, stirred and heated at 95°C using a magnetic stirrer for 2 minutes. It was then cooled until it reached the required incubation temperature of 40 - 46°C that is the critical temperature for yoghurt culture growth. 15 g of starter culture was added to the milk and held at 43°C, for (4 - 5 hours) to reach a pH range of 4.3 to 4.6. After that, 70 g of sugar, 1.5 g of sodium carboxymethylcellulose, 50 mg of sodium sorbate were added and stirred thoroughly. Then the mixture was 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.

The same procedure was repeated by using cream milk powder 60 g, 70 g, 80 g and 90 g. The effect of amount of cream milk powder on the fat content of cream yoghurt were determined and its result was shown in Table 4.

## Results and Discussion

### Physico-chemical Characteristics of Fluid Yoghurt

Table 1 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 fluid yoghurt reached the range of 4.3 to 4.6 during fermentation time of 5hr and the data are shown in Table 2. The comparison of physico-chemical characteristics of fluid yoghurt made

from cow milk and goat milk samples are shown in Table 3. From the comparison results shown in Table 3, it is evident that chemical characteristics such as fat content, protein content, etc. of fluid yoghurt (Sein Lei Kan Thar Brand) are the highest and the water content is the lowest. Thus fluid yoghurt prepared from cow milk (Sein Lei Kan Thar brand) is the best.

### Physico-chemical Characteristics of Cream Yoghurt

pH of prepared cream yoghurt was reached in the range of 4.3 to 4.6 during fermentation time (5 hours) and the data on the effect of fermentation time of cream yoghurt on pH at 43°C are shown in Table 4. The fat content of cream yoghurt depends upon the amount of full cream milk powder added to the milk and the data are shown in Table 5. It was observed that 70 g of full cream milk powder added to milk was the most suitable condition to get a fat content 10% (w/w) which is the literature value of cream yoghurt.

The comparison of physico-chemical characteristics of cream yoghurt made from cow milk and goat milk samples are shown in Table 6. It is observed that chemical characteristics such as fat content, protein content, etc. of prepared cream yoghurt (Sein Lei Kan Thar Brand) are the highest and the water content is the lowest. From the results shown in Table 6, taste and type of cream yoghurt prepared from cow milk (Sein Lei Kan Thar Brand) are the best. Table 7 shows the comparison of physico-chemical characteristics of prepared yoghurt and commercial yoghurt. It is found that fat content and protein of prepared yoghurt are greater than the commercial yoghurt.

**Table 1**      **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 2** Changes in pH of Fluid Yoghurt During Fermentation

Volume of milk = 1 liter

Starter culture = 15g

Fermentation temperature = 43°C

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

\*Optimum fermentation time = 5 hr

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

**Table 3** Comparison of Physico-chemical Characteristics of Fluid Yoghurt made from Cow and Goat Milk

Sr. No.	Characteristics	Fluid Yoghurt (Cow Milk)			Fluid Yoghurt (Goat Milk)		*Literature value
		Ngwe Sin Palei	**Sein Lei Kan Thar	Ywar Thit Village	Ywar Thit Village	Insein	
1	Fat content (%) (w/w)	3.9	4.2	3.4	3.7	5.2	≥3
2	Protein content (%) (w/w)	4.2	6.8	3.7	3.9	6.5	3-8
3	Total solids content (%) (w/w)	12.65	18.15	11.52	12.25	16.25	11.20
4	Solid not fat (%) (w/w)	8.75	13.95	8.12	8.55	11.05	≥8.2
5	Ash content (%) (w/w)	1.3	1.5	1.2	1.2	1.4	1.1-1.8
6	Water content (%) (w/w)	87.35	81.85	88.48	87.75	83.75	88.80
7	pH	4.0	4.3	3.9	4.0	4.4	4.1-4.3
8	Yoghurt type	liquid	liquid	liquid	liquid	liquid	liquid
9	Taste	sour	slightly sour	sour	sour	slightly sour	sour
10	Yield percent (%) (w/v)	85	87	82	80	82	-
11	Shelf-life (week)	4	4	4	4	4	-

\*Winton, L.A., 2000

\*\*The most suitable product

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 4 Changes in pH of Cream Yoghurt During Fermentation**

Volume of milk = 1 liter

Starter culture = 15g

Fermentation temperature = 43°C

Sr. No.	Source		pH at Different Fermentation Times						
			0hr	1hr	2hr	3hr	4hr	*5hr	6hr
1	Cow milk	Ngwe Sin Palei	6.9	6.3	5.8	5.2	4.7	4.2	3.8
		Sein Lei Kan Thar	6.8	6.4	5.7	5.1	4.8	4.6	3.9
		Ywar Thit village	6.9	6.4	5.9	5.3	4.6	4.1	3.7
2	Goat milk	Ywar Thit village	6.7	6.2	5.6	5.2	4.8	4.0	3.6
		Insein	6.9	6.3	5.7	5.3	4.9	4.2	3.7

\*Optimum fermentation time = 5 hr

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

**Table 5 Effect of Amount of Full Cream Milk Powder on the Fat Content of the Cream Yoghurt**

Milk Sample = Sein Lei Kan Thar

Sr. No.	Source of Yoghurt		Fat Content of Cream Yoghurt (%) (w/w)	*Literature Value
	Milk (g)	Full Cream Milk Powder (g)		
1	1000	50	7.5	10
2	1000	60	8.7	
3	1000	**70	9.9	
4	1000	80	11.0	
5	1000	90	12.5	

\*Winton, L.A., 2000

\*\*The most suitable condition

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

**Table 6 Comparison of Physico-chemical Characteristics of Cream Yoghurt made from Cow and Goat Milk**

Sr · No.	Characteristics	Cream Yoghurt (Cow Milk)			Cream Yoghurt (Goat Milk)		*Literature value
		Ngwe Sin Palei	**Sein Lei Kan Thar	Ywar Thit Village	Ywar Thit Village	Insein	
1	Fat content (%)(w/w)	7.5	9.9	6.3	7.3	8.0	10
2	Protein content (%)(w/w)	4.7	6.8	4.2	4.9	5.6	4.5
3	Total solids content (%)(w/w)	23.4	26.5	21.6	21.0	22.3	25.5
4	Solid not fat (%)(w/w)	15.9	16.6	15.3	13.7	14.3	15.5
5	Ash content (%)(w/w)	1.22	1.16	1.28	1.09	1.21	1.0-1.2
6	Water content (%)(w/w)	76.6	73.5	78.4	79	77.7	74.5
7	pH	4.2	4.6	4.1	4.2	4.5	4.6
8	Yoghurt type	semi- solid	semi- solid	semi- solid	semi- solid	semi- solid	semi-solid
9	Taste	Sour	slightly sour	Sour	Sour	slightly sour	slightly sour
10	Yield percent (%)(w/v)	91	94	89	87	90	-
11	Shelf-life (week)	4	4	4	4	4	-

\*Winton, L.A., 2000

\*\*The most suitable product

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 Comparison of Physico-chemical Characteristics of Prepared Yoghurt and Commercial Yoghurt**

Sr. No.	Characteristics	Fluid Yoghurt		Cream Yoghurt	
		Sein Lei Kan Thar Yoghurt	Hlegalay Yoghurt (Commercial)	Sein Lei Kan Thar Yoghurt	Hlegalay Yoghurt (Commercial)
1	*Fat content (%) (w/w)	4.2	3.2	9.9	8.4
2	*Protein content (%) (w/w)	6.8	6.3	6.8	6.2
3	Total solids content (%) (w/w)	18.2	16.4	26.5	21.6
4	Solid not fat (%) (w/w)	13.95	13.2	16.6	13.2
5	Ash content (%) (w/w)	0.90	0.87	0.98	0.89
6	Lactic acid content (%) (w/w)	1.5	1.4	1.2	1.3
7	Water content (%) (w/w)	81.8	83.6	73.4	78.4
8	pH	4.3	4.2	4.6	4.6
9	Yoghurt type	liquid	liquid	semi-solid	semi-solid
10	Taste	slightly sour	slightly sour	slightly sour	slightly sour
11	Shelf-life (week)	4	3	4	3

\*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.

### 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 yoghurt (fluid yoghurt and cream yoghurt), the effect of starter culture on fermentation time and the effect of fermentation time on pH of the products were investigated. It is observed that starter culture (15 g), fermentation time (5hours) and fermentation temperature (43°C) are the most suitable conditions for the preparation of yoghurt. It is found that the quality and yield percent of yoghurt (fluid yoghurt and cream yoghurt) from cow milk (Sein Lei Kan Thar Brand) are higher than that of yoghurt (fluid yoghurt and cream yoghurt) from other milk samples.

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