

Manufacture and Evaluation of Fruit Yoghurt

**Mohamed O. Abdalla', Hala Ahmed Abdalla, and
Abdel Azim A.M. Nour.**

*Faculty of Agriculture, University of Khartoum
P.O.Box 32, Khartoum North.*

ABSTRACT

This investigation was carried out to study the effect of different fruits on the quality of Yoghurt.

Yoghurt was made from fresh cow's milk mixed with sugar (6%), Gum Arabic stabilizer (0.35%) and fruit juice of banana (90 gm/100 ml water), mango (50 gm/100 ml), guddiem (30 gm/100 ml), tabaldi (10 gm/100 ml) and karkade (3 gm/100 ml), separately, plus the control sample. The starter culture was added at the rate of 5% (v/v) (mixed culture of *Streptococcus thermophilus* and *Lactobacillus bulgaricus* at 1:1 ratio) and stored for 7 days at 4 °C.

Chemical composition of the manufactured Yoghurt (fat, protein, total solids, ash and acidity) was determined at 0, 3 and 7 days. Moreover, sensory evaluation (color, flavour, consistency, taste and overall acceptability) was carried out using untrained panelists at 0 and 3 days.

With regard to type of fruit, the highest content of protein ($4.13\% \pm 1.04$), total solids ($17.50\% \pm 1.17$) and ash ($0.72\% \pm 0.18$) ($P < 0.001$) were obtained from control samples (plain yoghurt), while the lowest contents of total solids ($15.00\% \pm 0.13$) and ash ($0.59\% \pm 0.13$) were obtained by karkade yoghurt and the lowest content of protein was in guddiem and tabaldi yoghurt ($3.94\% \pm 0.82$ and $3.94\% \pm 0.79$ respectively). The highest fat content ($1.69\% \pm 1.24$) was in tabaldi yoghurt and the lowest was in mango and guddiem yoghurt ($1.58\% \pm 1.19$ and $1.58\% \pm 1.17$ respectively), although the difference was not significant ($P > 0.05$). The acidity showed the highest value in mango and the lowest in karkade yoghurt ($P < 0.001$).

On the other hand, yoghurt made from control sample scored the highest in colour, flavour, consistency, taste and overall acceptability.

Karkade yoghurt scored the lowest in colour and consistency ($P < 0.001$), while tabaldi yoghurt scored the lowest in from mango scored the lowest in flavour ($P < 0.001$).

INTRODUCTION

Yoghurt has become a highly popular food product over the last 15 to 20 years.. Per capita sales increased from 0.12 kg in 1960 to 1.62 kg in 1984 and continues to increase (MC Gregor and White, 1987). The increased popularity of yoghurt is due largely to the addition of fruit flavourings and sweeteners. Just under 90% of consumers prefer fruit-flavoured (thus sweetened) yoghurt (MC Gregor and White, 1987).

Different types of fruits are used in the production of fruit yoghurt over the world. However, it is estimated that in the German Federal Republic, the share of domestic fruits (strawberries, cherries, raspberries and apricots) is 75-80%, and that of exotic fruits e.g. mangos, kiwi fruit, papaya and guava, is about 15% (Vobl and Makarowa, 1984).

Fruits of Karkade, Guddeim and Tabaldi are widely used in the Sudan because of their nutritional as well as their medicinal values. They are used as food and to a large extent, as drinks (Palmer and Pitman, 1972; Wickens, 1980; FAO, 1988; Abd-Elmuti, 1991; Gasim, 1994). This study is an attempt to use these fruit juices, beside mango and banana juices, in the manufacture of fruit yoghurt.

MATERIALS AND METHODS

Source of milk, fruits, sugar and stabilizers

Fresh cow's milk was obtained from a private farm in Omdurman. Sugar and fruits used in the manufacture of yoghurt were purchased from the local market, while the stabilizer (Gum Arabic) was kindly supplied by Department of Food Science and Technology, Faculty of Agriculture, University of Khartoum.

Source of starter culture

The starter culture (a mixed culture of *L. bulgaricus* and *S. thermophilus* in a 1:1 ratio) was supplied by Khartoum Dairy Products Company Ltd. (KDPC) as bulk culture.

Preparation of fruit juices

After a number of trials during which the concentrations of the juices to be used in fruit yoghurt manufacture were evaluated by untrained panelists, it was concluded that the suitable weights of fruits in 100 ml water were 90, 50, 30, 10 and 3 gm for banana, mango, guddiem, tabaldi .powder and karkade powder respectively. It was also concluded that 6% sugar was much desirable than the other added percentages (2, 4, 8% sugar).

The fruits were either sliced as in banana and mango (finally converted to juice), ground into powder as in karkade and tabaldi or soaked in water as in guddiem, then weighed, blended with water in. warring blender and finally sieved to obtain the juice.

Preparation of fruit milks

Banana-milk mix was prepared by mixing the juice with milk in the ratio of 1:5 (juice :milk), the mixture was immediately warmed to 38 °C, then the sugar (6%) and stabilizer (0.35%) were added, pasteurized at 72 °C for 30 minutes and cooled to 45 °C (Wheeler and Gillies, 1973).

Other fruit-milk mixed (mango, guddiem, karkade and tabaldi) were prepared by the same procedure (1:5 juice :water) with the exception that the warmed juices were added after pasteurization and cooling of milk to avoid the problem of acidity.

Preparation of fruit yoghurt

Fruit-milk mixed at 45 °C were made into fruit yoghurt by adding 5% starter culture. The mixture was then stirred by a glass rod for 5 minutes, packaged into cups, covered, incubated for 3-4 hours in an incubator at 40-45 °C and finally stored at refrigerator at 4 °C for a period of 7 days for further study. Plain yoghurt (control) was prepared by the same procedure without the addition of fruit juices as control.

Chemical analysis of milk and fruit yoghurt

The fat content by Gerber method, total solids content by the forced-draft oven method, ash content and acidity were determined according to Bradley *et al.*, (1992), while protein content was determined by kjeldahl method according to A.O.A.C. (1990).

Sensory evaluation of fruit yoghurt

Yoghurt samples were subjected to sensory evaluation for colour, flavour, consistency, taste and overall acceptability using ten untrained panelists at 0 and 3 days of storage.

Statistical analyses

Statistical analyses were performed using the Statistical Analysis Systems (SAS). General Linear Models (GLM) were used to determine the effects of type of fruit on fat, protein, total solids, ash and titratable acidity as well as sensory characteristics (colour, flavour, consistency, taste and overall acceptability). Means were separated using Duncan Multiple Range Test with an α of 0.05 (SAS, 1988).

RESULTS

Results in Table (1) show the chemical composition (fat, protein, total solids, ash and acidity) of plain and fruit flavoured fresh cow's milk.

Effect of type of fruit on the chemical composition of yoghurt

Table (2) presents the chemical composition of yoghurt made from different types of fruits. The highest contents of protein ($P < 0.05$), total solids and ash ($P < 0.001$) were obtained from yoghurt made from control sample, while the lowest contents of total solids and ash were obtained by karkade yoghurt, and the lowest content of protein was obtained from guddiem yoghurt. The highest value for fat content was in tabaldi yoghurt and the lowest was in mango and guddiem yoghurt although the difference was not significant ($P > 0.05$). The acidity showed the highest value in mango yoghurt and the lowest in karkade yoghurt ($P < 0.001$).

Effect of type of fruit on the sensory characteristics of yoghurt

Table (3) showed that yoghurt made from control sample scored the highest in all parameters. Karkade yoghurt scored the lowest in colour and consistency ($P < 0.001$), while tabaldi yoghurt scored the lowest in taste and overall acceptability ($P < 0.001$). However, yoghurt made from mango scored the lowest in flavour ($P < 0.001$).

DISCUSSION

Results in Table (2) presents the chemical composition of fruit yoghurt. The highest acidity was in mango yoghurt and the lowest was in karkade yoghurt. This is due to the high concentration of mango fruit (50 gm/100 ml water) used compared to karkade and tabaldi fruits. The total solids content was highest in control yoghurt and lowest in karkade yoghurt. This can be explained by the lower

Table 1. Chemical composition of fruit-flavoured fresh cow's milk.

Type	of	fruit	milk
------	----	-------	------

Composition Plain Guddiem Karkade Tabaldi Mango Banana

Fat (%)	3.2	2.8	3.0	3.5	2.7	3.5
Protein (%)	4.5	3.4	4.0	3.8	4.3	3.5
Sugar (%)	6.0	6.0	6.0	6.0	6.0	6.0
Total solids (%)	19.39	17.58	16.77	16.86	16.83	17.57
Lactose (%)	4.97	4.69	3.27	2.98	3.17	4.05
Ash (%)	0.72	0.69	0.50	0.58	0.36	0.52
Acidity (% lactic acid)	0.12	0.32	0.18	0.30	0.35	0.32

Table 2. Effect of type of fruit on the chemical composition of Yoghurt.

Item	Plain	Type fruit	Guddiem	Karkade	Tabaldi	Mango	Banana
Sugar (%)	0.0	6.0					
			6.0	6.0	6.0	6.0	
Fruit (gni/							
100 ml)	0.0	30.0					
			3.0	10.0	50.0	90.0	
Fat (%)	1.65'	1.58'					
			1.61'	1.69 ^a	1.58 ²	1.67 ^a	
	±1.23	±1.19	±1.19	±1.24	±1.17	±1.22	
Protein	4.13 ²	3.94 ^b					
			3.98''	3.94 ^b	4.03''	3.95 ^b	
(%)	±1.04	±0.82	±0.88	±0.79	±0.92	±0.71	
Total	17.50 ²	15.99 ^k					
			15.00 ^d	15.65'	15.66'	16.20 ^b	
solida (%)	±1.17	±1.05	±0.97	±1.04	±1.22	±0.69	
Ash (%)	0.72'	0.67 ^b					
			0.59 ^d	0.65 ^{b`}	0.6'' ¹	0.60 ^d	
	±0.18	±0.16	±0.13	±0.12	±0.19	±0.16	
Acidity (%)	1.02 ^b	1.11'					
			1.01 ^b	1.09'	1.12 ²	1.10 ²	
lactic acid)	±0.19	±0.20	±0.10	±0.12	±0.15	±0.11	

Means within the same row bearing the same superscripts are not significantly different (P> 0.05).

Table 3. Effect of type of fruit on the sensory characteristics of Yoghurt.

Type	of fruit					
Item	Plain	Guddiem Karkade Tabaldi Mango Banana				
Colour	8.58 ^a	3.97 ^b	3.85 ^c	3.97 ^{bc}	4.38 ^a	4.30 ^a
	±0.81	±0.90	±1.25	±1.13	±0.98	±0.87
Flavour	2.73 ^a	1.82 ^b	1.87 ^b	1.67 ^b	1.65 ^b	1.92 ^b
	±1.13	±0.77	±0.77	±0.80	±0.71	±0.89
Consistency	3.63 ^a	3.17 ^b	3.05 ^b	3.63 ^a	3.30 ^b	3.62 ^a
	±0.55	±0.72	±0.93	±0.66	±0.70	±0.58
Taste	4.57 ²	4.00 ^d	4.17 ^{bc}	3.80 ^d	4.17 ^{abc}	4.37 ^a
	±0.70	±0.80	±0.94	±1.33	±0.80	±0.82
Overall	4.53 ^a	4.17 ^b	3.97 ^c	3.87 ^c	4.30 ^a	4.52 ^a
	±0.70	±0.74	±0.94	±1.23	±0.81	±0.70

Means within the same row bearing the same superscripts are not significantly different ($P > 0.05$).

Color, taste and overall acceptability:

1. Unacceptable. 2. Moderately unacceptable 3. Slightly acceptable 4. Moderately acceptable 5. Acceptable.

Flavor : 1. Bland 2. Slightly intense 3. Moderately inter 4. Externally intense .

Consistency : 1. Tough 2. Moderately tough 3. Slightly soft. 4. Soft.

concentration of karkade powder in the juice that resulted in lower total solids content. This is in agreement with the results of Duitschaever and Arnott (1972) who concluded that high-solids fruit preparations would raise the total solids of fruit yoghurt. Also in agreement with the results of Kroger and Weaver (1973) who stated that, in fruit yoghurt, the total solids content is strongly dependent on the fruit addition.

Yoghurt made from tabaldi fruit was the highest in fat content, although the difference was not significant. This is not in agreement with the findings of Duitscharver and Arnott (1972) who stated that, plain yoghurt was generally higher in fat because it was not being diluted by the addition of fruit or flavourings. They also stated that, plain yoghurt was higher in protein content due to the absence of dilution effect. However, our results which showed that plain yoghurt was the highest in protein and ash content, is in agreement with the findings of Duitschaever and Arnott (1972).

Table (3) showed that yoghurt manufactured from plain milk scored the highest in colour, flavour, taste, consistency and overall acceptability. This is in agreement with the findings of Lee *et al.*, (1990) who reported that, milk-based yoghurt was preferred by the sensory panelists with respect to flavour. However, fruit yoghurt certainly has a 40-45% share of the world market (Firth, 1990). In Sudan, the consumer has not yet become accustomed to it, in addition flavoured and fruit yoghurts are significantly higher than plain yoghurt in calories mainly because of the extra sugar added (Kosikowski, 1982).

In conclusion, although addition of fruits should have altered the chemical composition and hence nutritive value of fruit yoghurt, the control samples were highest in protein, total solids and ash contents, a result might have been attributed to the dilution effect of the juices. Although control yoghurt scored the highest in overall acceptability, fruit yoghurt was also acceptable by panelists.

REFERENCES

Abd-Elmuti, O.M. (1991). Biochemical and nutritional evaluation of famine foods of the Sudan. Ph. D. Thesis,- University of Khartoum, Sudan.

AOAC (1990). Official Methods of Analysis, 15th ed., Association of Official Analytical Chemists, Washington, D.C., U.S.A.

Bradley, R.L. Jr.; Arnold, E. Jr.; Barbarno, D.M.; Semerad, R.G.; Smith, D.E. and Vines, B.K. (1992). Chemical and physical methods. In: “Standard Methods for the Examination of Dairy Products” Marshall, R.T. (ed.), 16th edition, port City press, Baltimore, Washington.

Duitscharver, C.L. and Arnott, D.R. (1972). Quality evaluation of Yoghurt produced commercially in Ontario. J. Milk Food Technol., 35 (3) : 173-175.

FAO (1988). Fruit bearing forest trees. Technical Notes, FAO, Rome.

Firth, W. (1990). An overview of the European flavours and fragrances market. British Food J., 92 (1) : 6-10.

Gasim, S.M. (1994). Genetic variability and interrelationships of some agronomic characters in Roselle (*Hibiscus sabdariffa* var. *sabdariffa*). M.Sc. Thesis, University of Khartoum, Sudan.

Kosikowski, F.V. (1982). Cheese and Fermented Foods. Kosikowski and Associates, 2nd edition, New York.

Kroger, M. and Weaver, J.C. (1973). Confusion about yoghurt-compositional and otherwise. J. Milk Food Technol., 36 (7) : 388-391.

Lee, S.Y.; Morr, V.C. and Seo, A. (1990). Comparison of milk-based and soymilk-based yoghurt. J. Food Sci., 55 (2) : 532-536.

MC Gregor, J.U. and White, C.H. (1987). Effect of sweeteners on major volatile compounds and flavour of yoghurt. J Dairy Sci., 70 (9) : 1828-1834.

Palmer, E. and Pitman, N. (1972). The trees of Southern Africa, Cape Town, Balkema. Cited by Abd-Elmuti, O.M. (1991).

SAS (1988). SAS/STAT ‘User’s Guide, version 6.03 edition, Cary, NC : SAS Institute Inc., 1028 pp.

Vobl, K. and Makarowa, A. (1984). Fruit-containing milk products in the German Federal Republic. Deutsche Molke, 105 (3) : 72-74. Cited in DSA (1984), 46 (10) : Abstr. No. 6602.

Wheeler, R.J. and Gillies, A.J. (1973). Banana milk- A milk fruit food. Aust. J. Dairy Technol., 28 (3) : 96-99.

Wickens, G.E. (1980). The use of baobab (*Adansonia digitata*) in Africa. Royal Bot. Gardens, Kew Richmond. Cited by AbdElmuti, O.M. (1991).

Authors :

Mohamed Omer Abdalla

Hala Ahmed Abdalla

