Quality Assurance of Different Types of Yoghurt in Khartoum State Markets

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ABSTRACT

This study was carried out to insure the quality of different types of yoghurt in Khartoum State produce by Sudanese yoghurt producing companies (Capo, Daima, Kenana) and Traditional yoghurt. Chemical and microbial examinations were conducted for the products and during ten days storage period. Capo, Daima and Kenana yoghurts showed significant differences ($p \leq 0.05$) in protein content while there was no significant difference between Capo and traditional yoghurts. Ash and fat contents were of insignificant differences in all samples. The titratable acidity (as lactic acid) showed insignificant differences in all samples as well. pH values almost the same . The minerals content (mg /100g) for: calcium ranged from 680 to 663; phosphate (90 to77); sodium (80 to 73) potassium (123 to 103) ; iron (50 to 37) and magnesium (13 to1.9). The total amino acids (mg/100gm **)** were 2042.857, 1862.225, 2330.725 and 1883.1 for Capo, Daima, Kenana and traditional yoghurt, respectively. Total bacterial viable count (cfu/ml) of Kenana yoghurt recorded the highest level ($4.8x10^7$) while the traditional possessed the less ($7.3x10^6$). *Lactobacillus* was higher in Kenana ($9.8x10^6$) and less in the Traditional ($8.7x10^5$). *Streptococcus* was higher in Capo ($6.0x10^6$) and lower in the traditional ($3.2x10^4$). Coliforms were recorded in the traditional (not *E.coli*).The traditional yoghurt obtained 5.6×10^5/cf mg as yeasts while the other samples obtained no yeasts.

Key words: Yoghurt, quality assurance, shelf – life.

INTRODUCTION

Milk and milk products have wide consumption all over the world and the fermented milk products have their speciality because of their health value, while yoghurt is probably the most popular fermented milk in the world (Tamime and Deeth,1980).

Yoghurt is made in a variety of compositions (fat and dry matter contents), either plain or with added substance such as fruit, sugar and gelling agents.

Types of yoghurt vary according to their chemical composition, method of production, flavour nature, post-incubation and processing. However, based on the method of production and physical structure of the coagulum, there are two main types of yoghurt: set and stirred (Tamime and Deeth, 1980).

Manufacturers have responded to the growth in the yoghurt market by introducing many different types of yoghurt including low fat and no-fat, creamy, drinking, organic, baby, and frozen. Traditional yoghurt is thick and creamy (Medehow, 2007).

There are many dairy companies that produce and sell their yoghurt products in Khartoum State markets, and these products are subjected to various condition during the shelf- life, during distribution at the supermarket and retail sellers.

The quality evaluation is needed according to their processing condition and during handling in the market. The objective of the present study was to investigate the quality (chemical , microbial and the shelf- life) of the different types of yoghurt in Khartoum State markets.

MATERIALS AND METHODS

Sampling

Yoghurt samples used in this study were collected from supermarkets and retailer shops in Khartoum State, at their second production date .

These samples, were sold under the following trade marks:-

1- Capo :-produced by the Blue Nile for Dairy Products LTD.

2-Daima:- produced by the Bremair for food products.

3-Freeze Land:-produced by Kenana Freeze Land .

4- Traditional yoghurt: this product usually prepared by the retailers men by boiling milk, and cooling it to warm down and then add the yoghurt, one of the trade marks, as a starter and then incubate it at ambient temperature, at last they cool it at refrigeration temperature and sell it.

Chemical analysis

Protein content was determined by Kjeldahl method according to the AOAC (1990). On the other hand and according to Bradly *et al.* (1992), fat content was determined by Gerber method, total solids were determined by the forced – draft oven method. Ash and titrable acidity were determined according to Bradley *et al* (1992). The pH was measured by a glass –electrode pH meter (Knicks pH meter).

The dry ashing method that described by Chapman and Pratt (1961) was used for determination of sodium, potassium, magnesium and calcium in yoghurt samples using atomic absorption spectropho-tometer (3110-perkin Elmer). Phosphorous was determined by van date- molybdate yellow method according to AOAC (1970).

Amino acid content was determined as follows:- To prepare hydrolysate samples 200 mg of sample were taken in the hydrolysis tube.- Five ml 6 NHCL were added and the tube was tightly closed and incubated at 110ºC for 24hrs. The solution was then filtered and 200ml of the filtrate were taken and evaporated at 40ºC for about one hour. 1ml of diluted buffer was added to the dried sample. Amino acid profiles were measured for the prepared samples by using Sykam amino acid analyzer SY33.

Microbial analysis

Ten grams of each sample were weighed aseptically and added to a conical flask containing 90ml of sterile diluent (0.1% peptone solution) and mixed well to give (10^{-1}), by using sterile pipette, 1ml was transferred to a test tube containing 9ml of sterile diluents and mixed well to give (10^{-2}). Subsequent serial dilutions up to 10^{-6} were made .

For total viable count of bacteria the pour plate count method was used according to Harrigan (1998). Spreading plate count method on MRS agar medium for counting lactic acid bacteria (lactobacilli) and on M17 agar medium for counting lactic acid bacteria (Streptococci) was used. Then colonies were counted according to Harrigan (1998).

Again spreading plate count method on potato dextrose agar (PDA) was used for counting moulds and yeasts according to Harrigan (1998).

The most probable number table was used, for counting coliform bacteria using MacConkey broth medium and EC medium was used for *E. coli* (Harrigan, 1998).

Statistical analysis

Data obtained was subjected to analysis using Statistical Package For Social Sciences (SPSS). Means±SD were tested using one way analysis of variance (and then means separated using Duncan's Multiple Range Test [DMRT] according to Mead and Gurnow(1983).

RESULTS AND DISCUSSION

The discussion of the different parameters should follow the same pattern as in the table (1) i.e. with acidity first and ash control last.

Proximate analysis of yoghurt types

Table (1) shows the proximate analysis of tested yoghurt samples.

The fat content

Fat contents were 2.5%, 3% and 2% for Capo, Daima and Kenana samples, respectively and were significantly different ($p \leq 0.05$). These results are comparable to that reported by Sudanese Standards (SSMO, 2007) for yoghurt produced from partial skimmed milk (0.5-3%) and the traditional yoghurt sample obtained 4%for fat content where Sudanese Standards (SSMO, 2007) reported that the fat content should be at least 3% for yoghurt produced from whole milk, and Shalaby (1991) reported a fat content of 5.54% for Sudanese traditional yoghurt.

The crude protein content

Protein content for Capo, Daima , Kenana and traditional yoghurt was 4.10% ,4.80% , 4.50% and 4.00 %, respectively and Shalaby (1991) reported a protein of 4.48% for modified yoghurt and 4.64% for traditional yoghurt while Atta Almannan (1995) reported 3.99% for protein content of yoghurt.

Table (1): Proximate analysis and acidity of yoghurt types.

Yoghurt type	Titratable acidity (%)	Total solids (%)	Fat content (%)	Crude protein (%)	Ash content (%)
Capo	0. 89±0. 055[a]	14.30±0.10[b]	2.5±0.00[c]	4.10± 0.10[c]	0.60±0.10[a]
Daima	0.90± 0.050[a]	15.27±0.15[a]	3.00±0.00[b]	4.80± 0.10[a]	0.61± 0.11[a]
Kenana	0.90±0.076[a]	13.30±0.10[d]	2.00±0.00[d]	4.50±0.10[b]	0.60± 0.00[a]
Traditional	0.90± 0.050[a]	13.90±0.10[c]	4.00±0.00[a]	4.00±0.00[c]	0.50± 0.10[a]

Mean values ±SD having different superscript letter(s) in each column differ significantly ($p \leq 0.05$).

The statistical analysis showed that there were significant differences between the tested sample results for protein content and no significant difference between Capo and traditional yoghurt.

Ash content

Ash content was 0.60%, 0.61%, 0.60% and 0.50% for Capo, Daima, Kenana and traditional yoghurt respectively while Atta Almannan (1995) reported that the ash content was 0.7% for yoghurt and the statistical analysis showed no significant difference between the results of the tested samples.

The total soluble solids content

Total soluble solids were 14.3%, 15.3%, 13.3%and 13.9 % for Capo, Daima, Kenana and traditional yoghurt, respectively and the results were comparable to that reported by Shalaby (1992) who found 16.11% for modified yoghurt and 15.82% for traditional yoghurt while Atta Almannan (1995) reported that the total soluble solids content for yoghurt was 15.98%.

Titratable acidity

Titratable acidity expressed as lactic acid for Capo, Daima, Kenana and traditional yoghurt was 0.893%, 0.900%, 0.90%, and 0.90%, respectively. However, Atta Almannan (1995) reported that the titratable acidity was 0.99% for yoghurt and the statistical analysis showed that there was no significant difference between the titratable acidity of the tested samples in the present study.

Minerals content

Table (2) shows the minerals content (mg/100g) of the different types of yoghurt . For calcium, Capo, Daima Kenana and traditional yoghurt gave 680, 663,677 and 677, respectively and the statistical analysis showed that there were no significant differences between the tested samples. National Public Health Institute of Bahrain (2009) specified that the calcium content of yoghurt is 143mg/100g, this means that the tested samples showed high calcium content

Phosphate content for Capo, Daima, Kenana and traditional yoghurt was 83, 83, 90 and 77, respectively and the statistical analysis showed no significant difference between them, while the National Public Health Institute of Bahrain (2009) reported that the phosphate content is120 mg/100g.

Table (2): Minerals content of yoghurt types (mg/100g).

Yoghurt type	Ca	P	Na	K	Fe	Mg
Capo	680.0±0.10^{a}	83.0 ± 0.06^{a}	79.0± 0.01^{b}	103.0± 0.06^{b}	37.0 ± 0.06^{a}	13.1 ± 0.10^{a}
Daima	663.0±.015^{a}	83.0± 0.06^{a}	80.0± 0.02^{a}	107.0± 0.06^{b}	43.0±0.12^{a}	1.90± 0.10^{a}
Kenana	677.0± 0.15^{a}	90.0 ± 0.10^{a}	73.0± 0.02^{c}	123.0± 0.06^{a}	50.0± 0.01^{a}	1.90± 0.00^{b}
Traditional	677.0 ± 0.06^{a}	77.0± 0.12^{a}	80.0± 0.03^{a}	123.0± 0.06^{a}	37.0±0.06^{a}	1.90± 0.00^{b}

Mean values ±SD having different superscript letter(s) in each column differ significantly ($p \leq 0.05$).

Sodium content was 79, 80, 73 and 80 for Capo, Daima Kenana and Traditional yoghurt, respectively, which is comparable to that reported by National Public Health Institute of Bahrain (55mg/100g) in 2009 and the statistical analysis showed no significant difference between Daima and Traditional yoghurt for sodium content..

The National Public Health Institute of Bahrain (2009) reported that the potassium content for yoghurt showed 200 mg/100g and this was higher than 103,107,123 and 123 mg/100g for Capo, Daima, Kenana and Traditional yoghurt, respectively. According to the statistical analysis for potassium content there was no significant difference between Capo and Daima and this result was significantly different from that obtained by Kenana

and Traditional yoghurt where kenana and Traditional yoghurt values were similar to the standard reported by the National Public Health Institute of Bahrain (2009).

Magnesium content was 13.1, 1.9, 1.9 and 1.9 mg/100g for Capo, Daima, Kenana and Traditional yoghurt, respectively, and the statistical analysis showed that there was highly significant difference between Capo sample and other samples, where Capo sample was nearly to 14 mg/100g which was reported by the National Public Health Institute of Bahrain (2009).

Amino acids content

Table (3) shows the amino acids (mg/100g) for the yoghurt samples . The tryptophan is an essential amino acid, but it was not determined as it is not stable to acid hydrolysis.The results showed that Kenana sample had the higher values of aspartic acid, glutamic acid, glycine, valine, isoleucine, leucine, phenylalanine, hestidine and lysine (206.738,408.613, 49.788, 152.052, 189.888, 310.663,156.65, 119.863 and 244.625 mg/100g), respectively .

Daima sample has the lower value in aspartic acid, thereonine, serine, glutamic acid, glycine, tyrosine, and lysine (171.563, 102.425, 80.675, 241.4 23.313,93.475 and 147.538 mg/100 mg) ,respectively. Capo sample gave higher values in thereonine (116.05), serine (89.825), and alanine (127.563).

Results gave lower values in alanine ,valine ,isoleucine , leucine , phenylalanine and histidine for Traditional yoghurt (113.838, 121.563, 153.563 260.138, 131.463and89.7 mg/100 mg), respectively.

Table(3): Amino acids of yoghurt types(mg/100g).

Name	Capo	Daima	Kenana	Traditional yoghurt
Aspartic acid	184.263	171.563	206.738	175.288
Threonine	116.05	102.425	114. 384	111.175
Serine	89.825	80.675	82.625	89.613
Glutamic acid	283.025	241.4	408.613	259.438
Glycine	25.013	23.313	49.788	31.238
Alanine	127.563	118.675	126.138	113.838

Valine	146.7	134.35	152.025	121.563
Methionine	65.688	63.475	62.588	65.888
Isoleucine	182.4	166.863	189.888	153.563
Leucine	300.1	276.225	310.663	260.138
Tyrosine	101.413	93.475	105.6	111.788
Phenylalanine	148.175	135.075	156.65	131.463
Histidine	116.238	107.125	119.863	89.7
Lysine	156.438	147.538	244.625	168.425
Ammonia	23.77	223.725	257.625	181.463

Microbial analysis

Table (4) shows the microbial count (cfu/g) of the tested yoghurt samples

The total bacterial viable count

The total viable count of bacteria (cfu/g) was 4.2×10^7, 8.0×10^6, 4.8×10^7, and 7.3×10^6 cfu/ml for Capo, Daima, Kenana and Traditional yoghurt, respectively. According to these results Kenana sample reported higher bacterial viable count while traditional yoghurt possessed the less bacterial viable count .

The count of lactic acid bacteria

lactobacillus and *Streptococcus* were different in ratio in all samples, in Capo sample the *Streptococcus* was higher than the *lactobacillus*, where in Daima, Kenana and Traditional yoghurt the *lactobacillus* was higher than the *Streptococcus* .

For the *Streptococcus* the higher count was obtained by Capo samples and the less count was obtained by traditional yoghurt sample. However, for the *lactobacillus* the higher count was in Kenana sample and the less count was in the traditional yoghurt sample.

Table(4) Microbial analysis of yoghurt samples

Sample	Total bacterial viable count (cfu/ml)	*Lactobacillus* count (cfu/ml)	*Streptococcus* count(cfu/ml)	Coliforms MPN/ (cfu/ml)		Yeasts and moulds (cfu/ml)
				Total	*E. coli*	
Capo	4.2×10^7	2.4×10^6	6.0×10^6	0	0	-ve
Daima	8.0×10^6	1.6×10^6	9.6×10^5	0	0	-ve
Kenana	4.8×10^7	9.8×10^6	7.2×10^5	0	0	-ve

Traditional	7.3×10^6	8.7×10^5	3.2×10^4	43	0	5.6×10^5

Total count of coliforms

Total count of coliforms was nill in all tested samples except the traditional yoghurt sample which recorded 43 cells and this may be due to contamination during preparation and handling of the yoghurt . However the Sudanese standards (SSMO, 2007) for yoghurt stated that the coliforms count should not exeed 100 cuf/ml**.**

The count of *E. coli*

The count of *E. coli* was nill in all tested samples and this result was typical for the Sudanese Standards (SSMO, 2007) for yoghurt which specify that the *E .coli* should be zero in yoghurt .

Yeasts and moulds count

Yeasts and moulds were negative in Capo, Daima and Kenana where Traditional yoghurt obtained 5.6×10^5/ml yeasts, and the Sudanese Standards reported that maximum count of yeasts and moulds should be 1000 cfu/ml. According to the above microbial results we can say that the tested samples were similar to the Sudanese Standards (SSMO, 2007) except the Traditional samples which differs from the Sudanese Standards (SSMO, 2007), in the yeasts count and this may be due to the fact that the Traditional yoghurt was prepared under unsterilized conditions .

Yoghurt shelf-life

During delivery and handling of yoghurt and before consumption the acidity and the pH of yoghurt may slightly change because of the continuation of fermentation process depending on the type of starter used.

During storage period of ten days the tested samples showed increase in acidity while the pH value was decreasing with increasing storage time (Table 5) . The pH values decreased as follows: 4.70 to 4.40 , 4.65 to 4.42 , 4.60 to 4.30 and 4.65 to 4.40 in Capo, Daima , Kenana and traditional yoghurt, respectively . The titratable acidity inereased as follows: 0.80 to 1.20, 0.90 to 0.97 ,0.90 to1.30,0.90 to 0.95 in Capo, Daima, Kenana and traditional yoghurt, respectively.

Table (5) pH and acidity of yoghurt samples during shelf-life (ten days)

Sample / Time	Capo		Dima		Kenana		Traditional	
	pH	Acidity	pH	Acidity	pH	Acidity	pH	Acidity
2 days	4.7	0.8	4.65	0.9	4.6	0.9	4.65	0.9
4 days	4.65	0.85	4.63	0.92	4.55	0.94	4.55	0.92
6 days	4.6	0.89	4.61	0.94	4.53	0.95	4.51	0.95
8 days	4.52	0.99	4.55	0.93	4.43	0.99	4.45	0.94
10 days	4.4	1.2	4.42	0.97	4.3	1.3	4.4	0.95

From the above results it can be seen that the Kenana yoghurt obtained the higher acidity, and less pH value. This is compatible with the microbial count in which Kenana samples obtained the higher total viable count of bacteria and higher total count of *lactobacillus.*

CONCLUSION

According to the above mentioned results it can be concluded that most of the tested samples conform with the International Standards of yoghurt ,while the traditional yoghurt samples showed slight difference in the microbial number and this may be due to the use of unsterilized equipments .

In general, the tested samples were rich in amino acids (especially Kenana yoghurt), minerals, proteins and they are of good microbial characteristics.

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تأكيد الجودة لأنواع مختلفة من الزبادي في أسواق ولاية الخرطوم

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الملخص

أجريت هذه الدراسة لتأكيد جودة أنواع الزبادي (كابو، دايمة ، كنانة وعينة أخرى تقليدية) في أسواق الخرطوم وأجريت لها الاختبارات الكيميائية والميكروبية للعينات مباشرة وأثناء التخزين لمدة عشرة أيام. أعطى البروتين لعينات كابو، دايمة ، كنانة فروقات معنوية ولم توجد فروقات معنوية بين عينة كابو والعينة التقليدية. أما الرماد و الدهن فلم تسجل فروقات معنوية في كل العينات. الحموضة في كل العينات لم تسجل أي فروقات معنوية و الأس الهيدروجيني تقريبا ثابت. .كمية المعادن (ملجم / 100 جرام) كانت للكالسيوم 680 الي 663 و الفسفور 90 إلي 77 و الصوديوم 80 إلي 73 و البوتاسيوم 123 إلي 103و الحديد 50 إلي 37 بينما الماغنيسيوم 13 إلي 1.9.المجموع الكلي للأحماض الأمينية (ملجم /100جرام) كان 2042.875 ، 1862.225 ، 2330.725 و 1883.1 لعينات كابو ، دايمة ، كنانة والعينة التقليدية علي التوالي.العدد الكلي الحي للبكتريا (خلية/مل) كان الأعلى في عينه كنانة ($10x4.8^{7}$) والأدنى فى العينة التقليدية ($10x7.3^{6}$). والعدد الكلى لبكتريا حمض اللاكتيك العضوية(*Lactobacillus*) كان الأعلى فى عينة كنانة($10x9.8^{6}$) والأدنى في العينة التقليدية ($10x8.7^{5}$) والعدد الكلى لبكتريا حمض اللاكتيك الكروية *Streptococcus* كان عاليا في عينة كابو ($10x6.0^{6}$) وأقل ما يكون في العينة التقليدية ($10x3.2^{4}$)، أما باكتيريا القولون فلم توجد إلا في العينة التقليدية (ليست البرازية) .عدد الفطريات للعينة التقليدية كان 5.6×10^{6} كخمائر . بينما بقية العينات كانت خالية منها .