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A SURVEY STUDY ON CHEMICAL, MICROBIOLOGICAL AND SENSORY PROPERTIES OF INDUSTRIAL RAYEB MILK PRODUCED IN EGYPT

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ABSTRACT

A total of twenty-four industrial Raybe milk samples for six dairy products plants were collected from various supermarkets in Damietta and Al-Dakahlia governorates. Physicochemical, microbiological and sensorial properties of collected samples were studied at the beginning and the end of storage period (15 days). The results showed that the average values of acidity, pH and redox potential (E_h) of fresh samples ranged from 0.63 to 0.80%, 4.92-5.20 and 130.8 to 168.7 respectively. The collected fresh samples contained 10.10 - 12.56% total solids, 1.4 - 3.5% fat and 2.01 - 3.74% total protein. Increase in acidity and E_h values and decrease in pH were noticed in Raybe milk samples during storage period. Microbiological analysis revealed that probiotic bacteria were detected in all fresh Raybe milk samples and also after 15 days of storage except one sample which didn't contain *B. bifidum* at the end of storage stage. Counts of lactic acid bacteria and bifidobacteria gradually lowered during storage of collected samples. Coliform bacteria and moulds and yeasts were not detected over the storage period in various samples. Sensory evaluation scores were similar for different samples but samples of flavored Raybe milk gained the highest smell and taste scores.

Keywords: industrial Raybe- ABT- Bifido- Egypt.

INTRODUCTION

Probiotics bacteria are. living microorganisms when consumed in sufficient amounts provide health benefits beyond basic nutrition.They are important dietary ingredients in functional foods. many of probiotics are lactic acid bacteria, mainely lactobacilli, and bifidobacteria. Factors related to technological and sensory aspects of the probiotic food products are of utmost importance since only by satisfying the demands of consumers can the food industry succeed in promoting the consumption of functional products in the future (Mattila-Sandholm *et al*., 2002).

On the other hand, Raybe milk is one of the most important indigenous fermented milk products in Egypt, especially, in the north. It is usually made from buffalo milk as a by-product in butter making.Traditional manufacture method of Raybe milk depends on spontaneous fermentation of raw milk. This fermentation is the result of presence and activity of microorganisms and their enzymes in raw milk. Raw milk is kept at room temperature for about two days, fllow by cream layer separation to use in manufacture of butter and butter oil. Because of its very high acidity content, the residual milk coagulated by heating to give traditional Raybe milk. Recently, safe and standardized Raybe milk is produced on large scale in dairy products plants which use ABT culture in production. Traditional Raybe milk was investigated by many authors (Mistry, 2001; Redda, 2001 and Abd El Gawad *et al.,* 2010). On the contrary, no data are available about industrial Raybe milk. Therefore, the objective of this study was to investigate the chemical composition, the load of starter bacteria and sensory evaluation of Raybe milk samples produced in dairy products plants in Egypt.

MATERIALS AND METHODS

A total of 24 samples of different six different types of industrial Raybe milk (four samples for each type) were collected from scattered supermarkets in Damietta and Al-Dakahlia governorates. Samples were brought to the laboratory at 4-5 ° C by using of an icebox, and analyzed immediately after arrival for the chemical, microbiological and sensorial analysis.

Total solids, fat and TN contents of samples were determined according to (AOAC, 2000). Titratable acidity in terms of % lactic acid was measured by titrating 10 g of sample mixed with 10 ml of boiling water against 0.1 N NaOH using phenolphthalein indicator to an end point of faint pink color (Parmar 2003). pH of the sample was measured using a pH meter (Corning pH/ion analyzer 350, Corning, NY) after calibration with standard buffers (pH 4.0 and 7.0). Redox potential was measured with a platinum electrode [model P14805-SC-DPAS-K8S/325; Ingold (now Mettler Toledo), Urdorf, Switzerland] connected to a pH meter (model H 18418; Hanna Instruments, Padova, Italy).

Raybe milk samples were analyzed for *Streptococcus thermophiles* and *Lactobacillus acidophilus* counts according to the methods described by Tharmaraj and Shah (2003). Population of coliform, moulds and yeasts were accounted according to the methods described by the American Public Health Association (1992).The count of bifidobacteria was determined according to Dinakar and Mistry (1994).

The sensory properties of Raybe milk samples were determined by a panel of judges who were familiar with the product using the hedonic scale where 1-10 represents dislike extremely to like extremely (Tunde-Akintunde and Souley, 2009).

The obtained results were statistically analyzed using a software package (SAS, 1991) based on analysis of variance. When F-test was significant, least significant difference (LSD) was calculated according to Duncan (1955) for the comparison between Mean. The data presented, in the tables, are the mean (± standard deviation) of 4experiments.

RESULTS AND DISCUSSION

Data of acidity, pH and E_h of the collected samples of Raybe milk are presented in Table 1. It was obvious to see that significant differences in the above mentioned tests were noticed between various samples. The acidity values of fresh Raybe milk samples ranged from 0.63 to 0.80%, whereas pH values ranged between 4.92-5.20 ,Realox poteional (E_h)levels,on the other hand if collected semples varied from 130.8 to 168.7. These differences might be attributed to several reasons such as chemical composition of milk used in production, starter activity, manufacturing conditions or handling. Anyway, industrial Raybe milk samples had higher pH value than that of traditional Raybe milk reported by El-Abasy *et al.,* (2012), which was 4.53. This is due to the different processing conditions. In manufacturing of Raybe milk in dairy products plants, fermentation time and temperature are controlled and selective starter is utilized unlike spontaneous fermentation for two days at ambient temperature with natural microorganisms which, occurred in traditional Raybe milk.

Notwithstanding storage at 4ºC, increase in acidity and E_h values and decrease in pH were noticed in Raybe milk samples during storage period which due to the activity of the starter culture.

Table 1. Acidity, pH and redox potential (E_h) values of collected samples of fresh Raybe milk and after 15 days of storage period Raybe milk

Properties	Treatments	Storage period (day)		Mean ± SD
		Fresh	15	
Acidity %	A	0.80	1.10	0.95^{a}
	B	0.63	0.91	0.77^{c}
	C	0.72	1.05	0.88^{ab}
	D	0.75	1.09	0.92^{a}
	E	0.78	1.07	0.92^{a}
	F	0.66	0.97	0.81^{bc}
	Mean ± SD	0.72^{B}	1.03^{A}	
pH values	A	4.92	4.65	4.78^{ab}
	B	5.20	4.90	5.05^{a}
	C	5.09	4.80	4.69^{b}
	D	5.07	4.70	4.88^{ab}
	E	5.00	4.73	4.89^{ab}
	F	4.96	4.83	4.89^{ab}
	Mean ± SD	4.96^{A}	4.77^{B}	
E_h mV	A	168.7	188.5	178.6^{a}
	B	130.8	154.2	142.5^{f}
	C	149.1	181.4	165.3^{d}
	D	153.9	187.6	170.7^{c}
	E	164.2	184.1	174.1^{b}
	F	135.3	166.7	151.0^{e}
	Mean ± SD	150.33^{B}	177.09^{A}	

^{abcde} Letters indicate significant differences between Labneh treatments
^{ABCD} Letters indicate significant differences between storage times

The total solids (TS), fat and total protein contents of Raybe milk samples are shown in Table 2. It is clear that TS, fat and total protein contents of four kinds of Raybe milk produced in Egypt (samples A, B, C and E) were close to each other. The other two samples possessed the lowest concentrations of these contents. Levels of TS, fat and total protein of collected fresh Raybe milk samples ranged between 10.10 to 12.56, 1.4 to 3.5 and 2.01 to 3.74%, respectively.

The literature is lacking in reference data about chemical composition of industrial Raybe milk, Therefore, it will be necessary to make some comparison between industrial and traditional Raybe milk. The former was rich in TS and fat values as compared with those of the latter. These results could be explained on the basis of using skim milk or butter milk in making traditional Raybe milk contrary to industrial Raybe milk where whole milk is used in production. These findings were in agreement with those of Hamad *et al.,* (2013), who reported that the fat and total solids contents of fresh Robe milk were 0.95 and 8.67% respectively.

No significant differences were found in TS, fat and total protein contents of various samples through storage period. Total solids values of fresh sample A and after 15 days of storage were 12.36 and 12.50% respectively. Respective values of total protein were 3.54 and 3.57% respectively.

Table 2. Total solids, fat and total protein contents of collected samples of fresh Raybe milk and after 15 days of storage Raybe milk

Properties	Treatments	Storage period (day)		Mean ± SD
		Fresh	15	
TS %	A	12.36	12.50	12.43^{a}
	B	12.37	12.34	12.35^{a}
	C	12.48	12.54	12.51^{a}
	D	10.10	10.17	10.13^{c}
	E	12.56	12.48	12.02^{ab}
	F	11.47	11.38	11.42^{b}
	Mean ± SD	11.72^{A}	11.90^{A}	
Fat %	A	3.4	3.6	3.50^{a}
	B	3.5	3.5	3.50^{a}
	C	3.2	3.1	3.15^{b}
	D	2.8	2.8	2.80^{c}
	E	3.4	3.5	3.45^{a}
	F	1.4	1.5	1.45^{d}
	Mean ± SD	2.95^{A}	3.00^{A}	
Total Protein %	A	3.54	3.57	3.55^{ab}
	B	3.43	3.50	3.46^{b}
	C	3.74	3.70	3.72^{a}
	D	2.01	2.11	2.06^{d}
	E	3.54	3.49	3.51^{ab}
	F	2.61	2.64	2.62^{c}
	Mean ± SD	3.14^{A}	3.17^{A}	
Ash %	A	0.77	0.78	0.77^{a}
	B	0.80	0.79	0.79^{a}
	C	0.74	0.72	0.73^{b}
	D	0.65	0.68	0.77^{c}
	E	0.76	0.78	0.77^{a}
	F	0.68	0.66	0.67^{c}
	Mean ± SD	0.73^{A}	0.73^{A}	

^{abcde} Letters indicate significant differences between Labneh treatments
^{ABCD} Letters indicate significant differences between storage times

For their healthy importance, the main objective of the present study was to detect the probiotic bacteria (*Bifidobacterium bifidum* and *Lactobacillus acidophilus*) in industrial Raybe milk sold in Egypt. Data cleared in Table 3 summarized the mean log counts ($cfug^{-1}$) of some microbial groups tested in collected samples. Fortunately, probiotic bacteria were detected in all fresh Raybe milk samples and also after 15 days of storage except sample E which didn't contain *B. bifidum* at the end of storage stage. Significant differences ($P<0.05$) in the counts of *Str. thermophillus*, *L. acidophilus* and *B. bifidum* were observed between various samples. Numbers of the mentioned bacteria were high in samples D and A ,compared with the othes. Generally, the counts of *Str. thermophillus*, were larger than *L. acidophilus* and *B. bifidum* in different samples. Numbers of *Str. thermophillus*, *L. acidophilus* and *B. bifidum* of fresh samples ranged between 11 to 33, 6 to 19 and 4 to 16 $\times 10^{-2}$ $cfug^{-1}$ respectively.Counts of lactic acid bacteria and bifidobacteria gradually lowered during storage of collected samples. Loss of viability of bifidobacteria during storage was more pronounced than was that of *Str. thermophillus* and *L. acidophilus*. Viability losing of probiotic bacteria in fermented milk was reported to be due to acid injury to the organisms (Shah, 2000). The viability of bifidobacteria in fermented dairy products is a cause for concern. However, reducing of bifidobacteria numbers during storage period, but the recommended level of 10^6 $cfu.g^{-1}$ of bifidobacteria as a probiotic was exceeded for all collected Raybe milk samples (except sample E) and remained above10^6 cfu g^{-1} until the end of storage period. One of the possibilities of high stability of bifidobacteria at refrigerated storage in these samples could be the absence of *Lb. delbrueckii* ssp. *bulgaricus* which is known to produce post acidification. Post acidification could have further inhibitory effect on the *Streptococcus thermophilus* counts. Similar results and recommendations were obtained by FAO/WHO (2001) and Akin *et al*. (2007).

Coliform bacteria were not detected over the storage period in various samples. Also, no moulds and yeasts growth was observed in different fresh and stored Raybe milk samples. These outcomes confirm the hygienic conditions of the manufacture. Counterproductive were reported in traditional Rayeb milk. Abd El Gawad *et al*. (2010) showed that counts of coliform, moulds and yeasts and Staphylococci groups were high in all traditional Rayeb milk samples from different governorates in Egypt, and ranged from 1.02×10^{-2} to $9.89\times10^{-2}cfug^{-1}$. All these populations rose from around 10^2cfug^{-1} to 10^4cfug^{-1}. These results can be

explained by the fact that the methods of production of the various traditional foods are usually primitive and the major risk enhancing factors are the use of contaminated raw materials, lack of pasteurization and inadequate fermentation and storage conditions (Savadogo *et al.*, 2004).

Sensory evaluation of collected Raybe milk samples:

Table 4 shows sensory evaluation scores of fresh Raybe milk samples and after 15 days of storage. Generally, all the samples gave a good total impression, were medium sour and did not have any marked off-flavour during the storage period. None of the collected samples were judged to be weak. Fresh treatments ranked the highest scores of color, appearance, smell, taste, mouth feel, body and texture. They were described as good flavour, rich taste, normal body and texture and good appearance. Unfortunately, with storage progressive the sensory evaluation degrees of various samples lowered. This may be attributed to the developed acidity and/or whey separation, which may impair the pleasant acid flavour of Raybe **milk (El-Sayed *et al.*, 2013).**

All samples characterized by white color and good appearance therefore no significant differences were found in color and appearance between various samples. Color scores of fresh samples ranged between 9.00 and 9.40 whereas appearance scores varied from 9.10 to 9.50. As a result of addition flavourings agents to sample F, the scores of smell, taste and mouth feel were higher than those of other samples. Grades of smell and taste of fresh samples ranged between 9.25 to 9.75 and 9.30 to 9.75 respectively. Sample E had the highest texture and body score because of its relatively thick body.

Table 3. Starter bacteria counts of collected samples of fresh Raybe milk and after 15 days of storage Raybe milk

Properties	Treatments	Storage period (day)		Mean ± SD
		Fresh	15	
Streptococcus thermophillus (cfu×x10^5/g)	A	33	28	30.50^{b}
	B	14	11	12.50^{d}
	C	13	11	12.00^{d}
	D	49	41	45.00^{a}
	E	28	23	25.50^{c}
	F	11	8	9.50^{e}
	Mean ± SD	24.67^{A}	20.33^{B}	
Lactobacillus acidophilus (cfu×x10^5/g)	A	19	9	14.00^{b}
	B	10	4	7.00^{c}
	C	8	4	6.00^{cd}
	D	24	10	17.00^{a}
	E	19	8	13.50^{b}
	F	6	3	4.50^{d}
	Mean ± SD	14.33^{A}	6.33^{B}	
Bifidobacterium bifidum (cfu×x10^5/g)	A	16	6	11.00^{a}
	B	8	2	5.00^{b}
	C	7	2	4.50^{bc}
	D	15	6	10.50^{a}
	E	4	0	2.00^{d}
	F	4	1	2.50^{cd}
	Mean ± SD	9.00^{A}	2.83^{B}	
Coliform (cfu×x10^2/g)	A	NO*	NO	-
	B	NO	NO	-
	C	NO	NO	-
	D	NO	NO	-
	E	NO	NO	-
	F	NO	NO	-
	Mean ± SD	-	-	-
Moulds and Yeasts (cfu×x10^2/g)	A	NO	NO	-
	B	NO	NO	-
	C	NO	NO	-
	D	NO	NO	-
	E	NO	NO	-
	F	NO	NO	-
	Mean ± SD	-	-	-

^{abcde} **Letters indicate significant differences between Labneh treatments**

^{ABCD} **Letters indicate significant differences between storage times**

***NO: not detected**

Table 4. Sensory evaluation of collected samples of fresh Raybe milk and after 15 days of storage

Properties	Treatments	Storage period (day)		Mean ± SD
		Fresh	15	
Color	A	9.15	9.00	9.07^{bc}
	B	9.25	9.05	9.15^{ab}
	C	9.30	9.20	9.25^{ab}
	D	9.40	9.20	9.30^{a}
	E	9.20	9.05	9.12^{ab}
	F	9.00	8.75	8.90^{c}
	Mean ± SD	9.22^{A}	9.04^{B}	
Appearance	A	9.20	9.10	9.15^{bc}
	B	9.35	9.20	9.27^{ab}
	C	9.30	9.20	9.25^{abc}
	D	9.50	9.35	9.42^{a}
	E	9.20	9.15	9.17^{bc}
	F	9.10	9.00	9.05^{c}
	Mean ± SD	9.27^{A}	9.17^{A}	
Smell	A	9.50	9.20	9.35^{b}
	B	9.30	9.05	9.17^{bc}
	C	9.40	9.05	9.22^{bc}
	D	9.25	9.00	9.12^{c}
	E	9.25	8.95	9.10^{c}
	F	9.75	9.45	9.60^{a}
	Mean ± SD	9.41^{A}	9.12^{B}	
Taste	A	9.50	9.25	9.37^{a}
	B	9.35	9.10	9.22^{bc}
	C	9.45	9.10	9.27^{bc}
	D	9.30	9.00	9.15^{c}
	E	9.30	9.00	9.15^{c}
	F	9.75	9.50	9.62^{a}
	Mean ± SD	9.44^{A}	9.16^{B}	
Mouth feel	A	9.15	9.10	9.12^{ab}
	B	9.10	9.00	9.05^{ab}
	C	9.10	9.00	9.05^{ab}
	D	9.05	8.90	8.97^{b}
	E	9.05	8.90	8.97^{b}
	F	9.25	9.20	9.22^{a}
	Mean ± SD	9.12^{A}	9.02^{A}	
Texture & Body	A	9.10	9.05	9.07^{ab}
	B	9.00	8.90	8.95^{b}
	C	9.10	8.90	9.00^{b}
	D	9.00	8.85	8.92^{b}
	E	9.25	9.20	9.22^{a}
	F	9.10	9.00	9.05^{ab}
	Mean ± SD	9.09^{A}	8.98^{A}	

^{abcde} **Letters indicate significant differences between Labneh treatments**
^{ABCD} **Letters indicate significant differences between storage times**

CONCLUSIONS

It can be concluded that various industrial Raybe milk samples manufactured in Egypt contained the appropriate levels of total solids, fat and total protein. Also, different samples contained the recommended level of 10^6 cfu.g^{-1} of bifidobacteria as a probiotic, and made it a highly suitable ingredient for human health. It is recommended that Raybe milk is preferably consumed as fresh.

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دراسة مسحية على الخواص الكيماوية و الميكروبية و الحسية للبن الرايب المنتج بمصانع منتجات الألبان بمصر

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تم تجميع ٢٤ عينة من اللبن الرايب المنتج بستة مصانع لمنتجات الألبان في مصر و تم تجميعها من متاجر البقالة بمحافظتي دمياط و الدقهلية. و تم دراسة الخواص الكيماوية و الميكروبية و الحسية للعينات المجمعة في بداية وقت الإنتاج و في نهاية فترة الصلاحية. و تشير النتائج إلي أن متوسط قيم الحموضة و الرقم الهيدروجيني و redox potential (E_h)للعينات الطازجة تراوح بين ٠,٦٣- ٠,٨٠% و ٥,٢٠-٤,٩٢ و ١٣٠,٨- ١٦٨,٧ على الترتيب. في حين تراوحت قيم المواد الصلبة لنفس العينات ما بين ١٠,١,٠- ١٢,٥٦% و الدهن ١,٤- ٣,٥% و البروتين ٢,٠١- ٣,٧٤%. و قد لوحظ زيادة في قيم الحموضة و E_h و انخفاض في قيم الرقم الهيدروجيني بتقدم فترة الحفظ. و تشير نتائج التحليل الميكروبي إلي اكتشاف البكتريا الحيوية في كل عينات اللبن الرايب الطازجة و بعد فترة ١٥ يوم من الحفظ فيما عدا عينة واحدة لم تحتوي على بكتريا *B. bifidum* في نهاية فترة الحفظ. و قد انخفضت أعداد بكتريا حمض اللاكتيك و بكتريا البفيدو في عينات اللبن الرايب المجمعة مع تقدم فترة الحفظ. هذا و لم تكتشف بكتريا القولون أو الفطريات و الخمائر في العينات الطازجة أو في نهاية فترة الحفظ. و قد تشابهت نتاج التقيم الحسي للعينات المجمعة إلا إنها كانت مرتفعة لأحدى العينات المضاف إليها مواد نكهة.