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MANUFACTURE OF YOGHURT FROM COW'S MILK FORTIFIED WITH BUTTER MILK

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ABSTRACT: ***The effect of replacing skim milk powder that used to fortify cow's milk with spry dried butter milk on the quality of yoghurt was studied. Control yoghurt was made from 3.0% fat cow's milk fortified with 3% skim milk powder. Four treatments were made from that milk, but skim milk powder was replaced by butter milk at the rate of 25, 50, 75 and 100%.***

Replacement of skim milk powder with butter milk did not affect significantly total solids, total protein, ash contents, titratable acidity, viscosity and curd tension of the resultant yoghurt treatments. Whey syneresis decreased, while diacetyl and acetyl methyl carbinol (DA + AMC) increased by replacing skim milk powder with butter milk and this increase or decrease was proportional to the rate of replacement. Replacement of skim milk powder with butter milk up to 50% did not affect the scores of organoleptic properties, while increasing the replacement rate above that decreased those scores. Scores of organoleptic properties did not change significantly during the first 6 days of storage, then decreased slightly up to the end of storage period. Total solids, total protein, fat, ash contents did not change significantly during storage, while titratable acidity increased. Diacetyl and acetyl methyl carbinol increased as storage period proceeded and reach their maximum values at the sixth day then decreased up to the end of storage period. Whey syneresis decreased during the first 6 days of storage period, then increased up to the end of storage period. Total bacterial, lactobacilli and streptococci counts increased during the first 3 days of storage period, then decreased up to the end of storage period.

Key Words: ***Yoghurt, cow's milk, skim milk powder, butter milk.***

INTRODUCTION

Yoghurt is the most popular fermented milk produced in Egypt and world wide. The consumption of yoghurt has been increased markedly in Egypt. The value of yoghurt in human nutrition is based not only on the strict nutritive effect of milk from which it is made and increased digestibility due to changes of milk constituents occurring during lactic acid fermentation, but also on the beneficial effect of intestinal microflora, prophylactic and heeling effects (Rasic and Kurmann, 1978; Agerbaek *et al.,* 1995; Tvede, 1996; Buttriss, 1997 and Hussein and Kebary, 1999).

The most important problems facing the manufacture of yoghurt from cow's milk are the weak body and texture in addition to the yellow colour. Therefore, it has been suggested that, fortification with skim milk powder, using stabilizers and / or ropy culture are good methods to improve the body and texture of yoghurt made from cow's milk. Also, butter milk were used for at the level of 1.0% only (Abd El-Salam *et al.,* 1996; Harby and El-Sabie, 2001; Kebary *et al.,* 2004; Kebary *et al.,* 2009; El-Sonbaty *et al.,* 2008).

Using butter milk as dairy ingredients will achieve three objectives, the first is economical where we will use the by-products as food ingredients, the second is environmental where the pollution will be decreased and the third is nutritional where butter milk almost has similar composition of that of skim milk powder, in addition it is rich with some constituents such as phospholipids which is absolutely necessary for the normal lungs function and the synthesis of important neurotransmitters to facilitate brain and nervous tissue function (Williams, 1985). Butter milk has many health benefits such as anticholesterolemic (Eckhardt *et al.,* 2002 and Noh and Koo, 2003, 2004), suppression of gastrointestinal pathogens (Sprong *et al.,* 2002) shift in tumer type (Spitsberg, 2005), neonatal gut maturation (Oshida *et al.,* 2003) and antioxidant (Spitsberg, 2005). Also, butter milk has technological roles such as natural emulsifier, baking improver, wetting enhancer, drug delivery carrier (Correding and Dalgleish, 1997; Vanhoutte *et al.,* 2004; Wong and Kitts, 2003; Zhang *et al.,* 2006; Thompson *et al.,* 2006).

The objectives of this study were to evaluate the possibility of making a good quality yoghurt that made from cow's milk fortified with butter milk, study the chemical, microbiological, rheological and sensory quality of yoghurt made with butter milk and to monitor changes during storage of yoghurt.

MATERIALS AND METHODS

Starter cultures:

Active *Streptococcus thermophilus* EMCC 1043 and *Lactobacillus delbrueckii* subsp. *bulgaricus* EMCC 1102 were obtained from Cairo Mircen, Ain Shams University, Egypt. *Lactobacillus bulgaricus* and *Streptococcus thermophilus* were activated individually by three successive transfers in sterile 10% reconstituted skim milk powder.

Manufacture of yoghurt:

Fresh cow's milk was obtained from the herd of Tokh Tanbisha Farm, Faculty of Agriculture, Minufiya University, Shibin El-Kom, Egypt.

Preliminary experiment was carried out to choose the best amount of skim milk powder that should be added to cow's milk to make a good quality yoghurt. The results revealed that yoghurt made from cow's milk fortified with 3.0% skim milk powder was the most acceptable yoghurt. Five yoghurt treatments were made,

control yoghurt was made from 3.0% fat cow's milk fortified with 3.0% skim milk powder, the other four yoghurt treatments were made from 3.0% fat cow's milk, while 25, 50, 75 and 100% of the amount of skim milk powder that used to fortify the cow's milk in control yoghurt were replaced with dry buttermilk. Spry dried sweet butter milk was gratefully provided by Land O'Labes Inc. St. Paul, MN, USA with the following composition: protein 32.0%, moisture 3.2%, carbohydrates 49.0%, fat 5.5% and ash 8.5%. All milk treatments were heated to 85°C for 20 min, then cooled to 42°C and inoculated with 1.5% *Streptococcus thermophilus* and 1.5% *Lactobacillus delbrueckii* subsp. *bulgaricus*. The inoculated batches were packed in sterilized plastic cups and incubated at 42°C until complete coagulation. All batches were stored in the cooler at 6 ± 1°C for 12 days and were analysed when fresh (0 time) and at 3, 6, 9 and 12 days for chemical, rheological, microbiological and sensory evaluation. The whole experiment was performed in triplicate.

Chemical analysis:

Titratable acidity, total solids, total protein, fat and ash contents were determined according to Ling (1963). Diacetyl and acetyl methyl carbinol (DA + AMC) were determined according to the method of Brandel (1960).

Microbiological analysis:

The total bacterial count was determined using standard plate count agar (Marth, 1978). Lactobacilli was enumerated using MRS medium (DeMan *et al.,* 1960), while yeast lactose agar medium was used to enumerate streptococci (Skinner and Quesnel, 1978). Yeasts and moulds were enumerated on Potato Dextrose Agar (acidified) medium (Difco, 1953).

Rheological analysis:

Syneresis was determined according to the methods of Dannenberg and Kessler (1988) with slight modification. Hundred gram yoghurt in plastic cup was cut into four sections and transferred into a funnel fitted with 120 mesh metal screen. The whey was drained into graduated cylinder. The amount of whey drained off was measured after 120 min. at room temperature (20 ± 1°C).

Curd tension was determined by a penetrometer supplied by "Koehler" Instrument Company Inc. New York, USA. The test was performed as mentioned by El-Shabrawy *et al.* (2002) as follows: the penetrometer cone was adjusted to touch the surface of yoghurt sample. Then, the cone was released to skin into the sample for 5 sec. The penetration depth was recorded in units of 0.1 mm penetrometer reading which is related inversely to the firmness of sample.

Viscosity:

The viscosity of yoghurt was measured using coaxial cylinder viscometer (Bohlin V88, Sweden) attached to a work station loaded with

software V88 viscometry programme. The system was filled with yoghurt sample at room temperature [standard room temperature as before (20 ± 1°C)] and measurement of viscosity was carried out in the up mode at shear rate 1142 $^{1}/_{5}$.

Sensory evaluation:

Yoghurt was judged by ten panelists from the Staff of Department of Dairy Science and Technology and Department of Food Science and Technology, Faculty of Agriculture, Minufiya University using the score sheet described by Kebary and Hussein (1999).

Statistical analysis:

Data were analyzed using Completely randomized block design and 2 × 3 factorial design, Newman-Keuls' Test was used to make the multiple comparisons (Steel and Torrie, 1980) using Costal Program. Significant differences were determined at $p \leq 0.05$.

RESULTS AND DISCUSSION

Replacement of skim milk powder that was used to fortify cows with dried butter milk did not affect significantly ($p > 0.05$) the total solids, total protein and ash contents of the resultant yoghurt (Tables 1, 2, 5). These results might be due to the similarity of chemical composition of both skim milk powder and dried butter milk. Similar results were obtained by (Abd El-Baky *et al.,* 1981; El-Neshawy and El-Shafie, 1988 and Hofi *et al.,* 1995).

On the other hand, total solids, total protein and ash contents of all yoghurt samples did not change significantly ($p > 0.05$) throughout storage period (Tables 1, 2, 5). Similar results were reported by El-Sonbaty *et al.* (2008), Hamed *et al.* (2008) and Kebary *et al.* (2008).

The obtained results indicated that, substitution of skim milk powder with dried butter milk increased ($p \leq 0.05$) the fat content of the resultant yoghurt treatments (Tables 1, 5). These results might be due to the higher fat content of dried butter milk than that of skim milk powder. Fat content of all yoghurt treatments did not change significantly ($p > 0.05$) as storage period progressed (Tables 1, 5). These results are in accordance with those reported by El-Shibiny *et al.* (1979), Badawi *et al.* (2004) Badran (2004), Badawi *et al.* (2008), El-Sonbaty *et al.* (2008) and Kebary *et al.* (2008).

Table 1 - 2

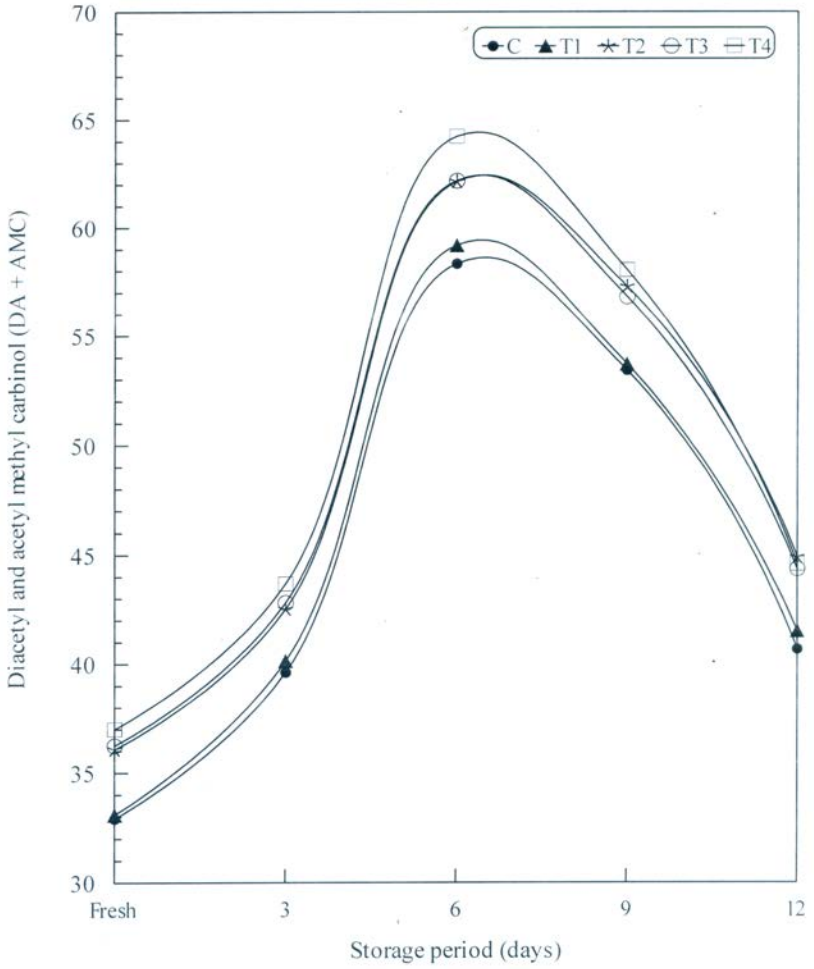

Fig. (1). Effect of replacing skim milk powder with dried butter milk on DA + AMC content (µg / 100 gm) of yoghurt.

Titratable acidity of yoghurt treatments as well as yoghurt treatments at any given storage period were not differ significantly ($p > 0.05$) Similar results were obtained by Zedan *et al.* (2001) and Kebary *et al.* (2009) who replaced skim milk powder with modified whey protein concentrates. Titratable acidity of all yoghurt treatments increased gradually ($p \leq 0.05$) as the storage period progressed which might be due to the metabolic activity of the starter culture (Tables 2, 5). These results are in agreement with those reported by Farooq and Haque (1992), Khader (1994), Salama and Hassan (1994), Abd El-Salam *et*

_al._ (1996), Kebary _et al._ (1996), Badawi and El-Sonbaty (1997), Kebary and Hussein (1999), Badawi _et al._ (2008), El-Sonbaty _et al._ (2008) and Kebary _et al._ (2008).

Replacement of skim milk powder with dried butter milk caused a significant ($p \leq 0.05$) increase in diacetyl and acetyl methyl carbinol content (DA + AMC) and this increase was proportional to the amount added of butter milk up to 50% replacement (Table 5 and Fig. 1). These results might be due to the presence of some constituents in butter milk those stimulate the production of DA + AMC for some extend and the concentration above that level did not have significant effect on DA + AMC formation. It was found that yoghurt treatment made with replacement of 50% skim milk powder with dried butter milk was not significantly different from treatments those made with 75 and 100% replacement, while they contained higher DA + AMC than those made with adding skim milk powder (Table 5 and Fig. 1). The diacetyl and acetyl methyl carbinol content of all yoghurt treatments increased gradually ($p < 0.05$) and reached their maximum values at 6^{th} day of storage, then decreased up to the end of storage period (12 days) (Table 5 and Fig. 1). Similar trends were obtained by Salama (2001), Zedan _et al._ (2001), Talwalkar and Kailasapathy (2004), Badawi _et al._ (2008) and El-Sonbaty _et al._ (2008). The decrease of diacetyl and acetyl methyl carbinol during storage may be attributed to the reduction of these compounds to acetone (Cogan, 1974).

Replacement of skim milk powder with dried butter milk in yoghurt manufacture significant caused ($p \leq 0.05$) reduction of syneresis compared to control yoghurt (Table 5 and Fig. 2). The decrease of whey syneresis from yoghurt treatments was proportional to the rate of replacement. There were negative correlation between whey syneresis and the rate of skim milk powder replacement with dried butter milk (Table 5 and Fig. 2). Similar results were obtained by Farooq and Haque (1992) who used sugar esters, Khader (1994) who used butter milk to increase the total solids of fat free yoghurt, Zedan _et al._ (2001) and Kebary _et al._ (2009) who replaced skim milk powder with modified whey protein concentrates.

These results might be due to some constituents of dried butter milk which prevent casein micelles from excessive fusion and form a fine meshed gel net work which is less susceptible to whey separation (Danneberg and Kessler, 1988).

Syneresis from all yoghurt batches decreased ($p \leq 0.05$) as storage period progressed and reached their minimum values at 6^{th} day of storage then increased up to the end of storage period (Table 5 and Fig. 2). This increase of wheying off might be due to acid development which causes the contraction of curd and hence the expulsion of whey. These results are in agreement with those reported by Farooq and Haque (1992), Abd El-Salam _et al._ (1990), Khader (1994) and Kebary and Hussein (1999), Badawi _et al._ (2008), El-Sonbaty _et al._ (2008) and Kebary _et al._ (2008).

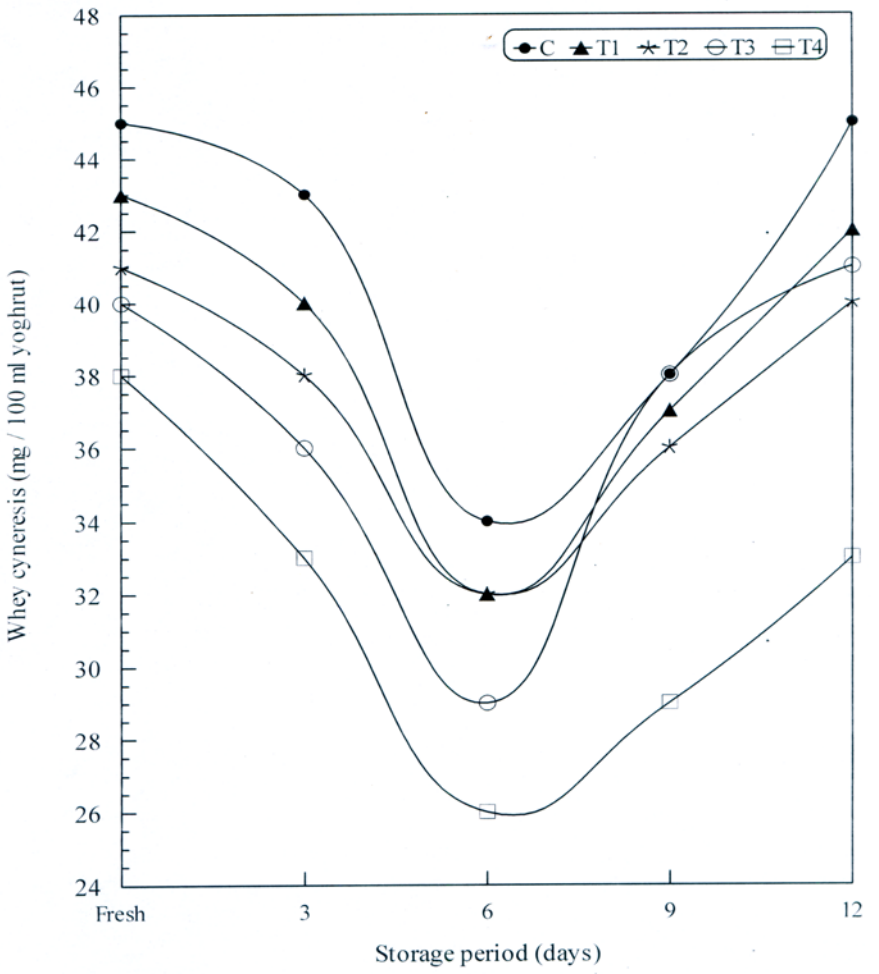

Fig. (2). Effect of replacing skim milk powder with dried butter milk on whey syneresis (mg / 100 ml) of yoghurt.

Curd tension of yoghurt treatments are presented in Table (2). There were no significant (p > 0.05) differences among yoghurt treatments, as affected by replacing skim milk powder with dried butter milk (Tables 2, 5). These results might be due to both skim milk powder and dried butter milk have comparable chemical composition.

Apparent viscosity of yoghurt treatments as affected by replacing skim milk powder with butter milk is presented in Table (2). These results revealed that

replacing skim milk powder with dried butter milk did not affect significantly ($p > 0.05$) the viscosity of the resultant yoghurt treatments (Tables 2, 5). These results might be due to the similar composition of both skim milk powder and dried butter milk (Gönc, 1977 and Müller, 1981).

Total bacterial, lactobacilli and Streptococci counts followed almost similar trends (Table 3). Total bacterial, lactobacilli and streptococci counts increased gradually during the first 3 days of storage and reached their maximum counts, then decreased gradually up to the end of storage period (12 days) in all treatments (Table 3). These reduction in counts might be attributed to the development of acidity and cold storage. These results are in agreement with those reported by Hussein and Kebary (1999), Hussein *et al.* (2004), Badawi *et al.* (2004), Kebary *et al.* (2004), Badawi *et al.* (2008) and El-Sonbaty *et al.* (2008).

Replacement of skim milk powder with dried butter milk did not affect the total bacterial, lactobacilli and streptococci counts of yoghurt treatments (Table 3).

Data in Table (3) show that, all yoghurt treatment samples were free from yeasts and moulds during the first three days of storage. After that, they increased slightly up to the end of storage period in all yoghurt treatments. These results are in agreement with those reported by El-Sonbaty *et al.* (2008) and Badawi *et al.* (2008). Mehriz *et al.* (1993). These authors found that moulds and yeasts in yoghurt were only detected at the end of storage period. Also, appearance of yeasts and moulds after 6^{th} days of storage might be due to the post contamination. On the other hand, the yeast and moulds counts in the yoghurt samples were comparable and did not affect by replacing of skim milk powder with dried butter milk.

Scores of organoleptic properties (flavour, body and texture, appearance and acidity) during storage of yoghurt treatment are presented in Table (4). Replacement of skim milk powder that used to fortify cow's milk with dried butter milk up to 50% replacement rate did not affect significantly the scores of flavour, body and texture, appearance, acidity and the total scores. On the other hand, increasing the rate of replacement to 75 and 100% of skim milk powder decreased the scores of flavour, body & texture and total scores. Yoghurt treatment that made with replacing 50% of skim milk powder with dried butter milk was not significantly different ($p > 0.05$) from control yoghurt treatment. On the other hand, replacement of skim milk powder with dried butter milk did not have significant ($p > 0.05$) effect on the scores of appearance and acidity of all yoghurt treatments (Tables 4, 5). Scores of organoleptic properties of all yoghurt treatments did not significantly ($p > 0.05$) change up to 6^{th} day of storage then decreased as storage period progressed (Tables 4, 5). These results are in agreement with those reported by Badran (2004), Kebary *et al.* (2004), Badawi *et al.* (2008), El-Sonbaty *et al.* (2008) and Kebary *et al.* (2008).

It could be concluded that, replacement of skim milk powder that used to fortify cow's milk in yoghurt manufactured with dried butter milk did not affect significantly, total solids, total protein, fat, ash contents and titratable acidity, while decreased whey syneresis. Also, replacement up to 50% did not affect the organoleptic properties of the resultant yoghurt, therefore it could be replace up to 50% of skim milk powder with dried butter milk without detrimental effect on yoghurt quality.

REFERENCES

Abd El-Salam, M. H., H. M. El-Etriby and N. M. Shahein (1996). Influence of some stabilizers on some chemical and physical properties of yoghurt. Egyptian J. Dairy Sic., 24: 25 – 36.

Abd El-Salam, M. H., S. El-Shibiny, M. B. Mahfouz, H. F. El-Dein, H. El-Atriby and V. Antila (1990). "Preparation of whey protein concentrate from salted whey and its use in yoghurt" XXIII International Diary Congress. Montreal, Vol. 11. Brussels, Belgium No. 1501, 15 pp.

Abdel Baki, A. A., M. M. Ashour, M. M. Omar and A. A. El-Neshwey (1981). Quality of Zabadi made from milk fortified with protein concentrate. Research-Bulletin, Fac. of Agric., Ain-Shams Univ., 1501: 15.

Agerbaek, M., L.V. Gerdes and B. Richelsen (1995). Hypocholesterolaemic effect of a new fermented milk product in healthy middle-aged men. Europe. J. Clinical Nutr., 49: 346 – 352.

Badawi, R. M. and A. H. El-Sonbaty (1997). Viability of *Staphylococcus aureus* and *Escherichia coli* in zabady made with bifidobacteria. Egypt. J. Dairy Sci., 25 (2): 217 – 233.

Badawi, R. M., A. I. Hamed, K. M. K. Kebary and Hweda, A. El-Sayed (2008). Effect of the ingredients on flavoured low fat probiotic stirred yoghurt quality made from cow's milk. 2- Effect of replacing milk fat with fat replacers. Egyptian J. Dairy Sci. Submitted.

Badawi, R. M., K. M. K. Kebary and S. A. Hussein (2004). Impact of substituting non-fat dry milk with pictin on cow's milk yoghurt quality. Proc. 9th Egyptian Conf. for Dairy Sci. and Tech., pp. 133 – 151.

Badran, I. I. (2004). Effect of replacing non-fat dry milk with gelatin in making yoghurt from cow's milk. Mansoura J. Agric. Res., 29 (5): 2673 – 2689.

Brandel, E. (1960). Determination of DA and A.M.C of the starter culture. Milchwissenchaftlich Berichte, Wolf, Passing, 10 (4): 289 – 303.

Buttriss, J. (1997). Nutritional properties of fermented milk products. Int. J. Diary Technol., 50 (1): 21 – 27.

Cogan, T. (1974). Aroma and flavour production by starters. Dairy Res. Rev. Ser., 6: 5.

Corredig, M. and D. G. Dalgleish (1997). Isolates from industrial buttermilk: Emulsifying properties of materials derived from the milk fat globule membrane. J. Agric. and Food Chem., 45: 4595 – 4600.

Dannenberg, F. and H.G. Kessler (1988). Effect of denaturation of β-lactoglobulin on texture properties of set-style nonfat yoghurt. I-Syneresis. Milchwissenschaft, 43 (10): 632 – 635.

DeMan, J. C., M. Rogosa and M. E. Sharpe (1960). A medium for the cultivation of lactobacilli. J. Applied Bacteriol., 23 (1): 130 – 135.

Difco Manual (1953). Dehydrated Culture Media and Reagents 9th ed. Difco laboratories, Detriot, Michigan.

Eckhardt, E. R. M., D. Q. H. Wang, J. M. Donovan and M. C. Carey (2002). Dietary sphingomyclin suppresses intestinal cholesterol monomers. Gastroenterology, 122: 948 – 956.

El-Neshawy, A. A. and N. M. El-Shafie (1988). Quality of Zabadi made from cows milk fortified with whey and soy protein. Nahrugn., 32 (10): 939 – 943.

El-Shabrawy, S. A., R. A. Awad and S. A. Saad (2002). Manufacture and properties of flavoured processed cheese spread with different fruit flavour. J. Annal. Agric. Sci., Ain. Shams Univ., Cairo, 10: 641.

El-Shibiny, S., H. F. El-Dein and A. A. Hofi (1979). Effect of storage on the chemical composition of zabady. Egyptian J. Dairy Sci., 7: 1 – 7.

El-Sonbaty, A. H., Seham, I. Farag, R. M. Badawi, S. A. Hussein and A. M. Shahine (2008). Preparation of goat's and camel's milk yoghurts fortified with skim milk powder and whey protein concentrate. Proc. 3rd International Conference on Food Sci. and Nutrition, pp. 220 – 235.

Farooq, K. and Z. U. Haque (1992). Effect of sugar esters on the textural properties of non-fat low calorie yoghurt. J. Dairy Sci., 75: 2676 – 2680.

Gönc, C. S. (1977). Composition of some dairy by-products. Ege Universitesi Ziveaat Fakultesi Dergisi, 14 (2): 175 – 180. [C.F. D. S. A. 41:12, 8007].

Hamed, A. I., A. N. Zedan, A. H. El-Sonbaty, A. F. Farag and Hoda, A. El-Sayed (2008). Effect of added flavours on the quality of stirred yoghurt. 3rd International Conference, "Nutritional Statues, and Food Sciences in Arab Countries", NRC, Cairo, 3 – 5 Nov., 2008.

Harby, S. and W. El-Sabie (2001). Studies on skim milk yoghurt using some stabilizers. Proc. 8th Egyptian Conf. Dairy Sci. and Techn., pp. 537.

Hofi, M. A., M. A. Khorshid, S. A. Khalid and A. A. Ismail (1995). The use of ultrafiltrated whey protein concentrate in the manufacture of Zabady. Egyptian J. of Food Sci., 20 (2): 189 – 200.

Hussein, S. A. and K. M. K. Kebary (1999). Improving viability of bifidobacteria by microentrapment and their effect on some pathogenic bacteria in stirred yoghurt. J. Dairy Sci. and Technol., 28 (2) 113 – 131.

Hussein, S. A., R. M. Badawi and I. I. Badran (2004). Quality of fat free yoghurt made with fat repalcers. Minufiya J. Agric. Res., 29 (6): 1295 – 1315.

Kebary, K. M. K. and S. Hussein (1999). Manufacture of low fat Zabady using different fat substitutes. Acta Alimentaria 28 (1): 1 – 14.

Kebary, K. M. K., A. M. Moussa, A. I. Hamed and E. T. Yousef (1996). Quality of zabady made with *Bifidobacterium bifidum* DI. The proceeding of 36th Science week, Supreme Council of Science, Alepo University, Syria, Book 3, Part 1: 79-91.

Kebary, K. M. K., A. H. El-Sonbaty, A. N. Zedan and Hweda, A. El-Sayed (2008). Impact of bifidobacteria on flavoured low fat stirred yoghurt quality. Sciences in Arab Countries (NRC, Cairo, 3 – 5 Nov., 2008.

Kebary, K. M. K., S. A. Hussein and R. M. Badawi (2004). Impact of fortification of cow's milk with a modified starch on yoghurt quality. Egypt. J. Dairy Sci., 32 (1): 111 – 124.

Kebary, K. M. K., A. M. Mousa, I. I. Badran, S. A. Hussein and A. M. Gaber (2009). Functional properties of enzymatic modified whey protein. Egyptian. J. Dairy Sci. (Submitted).

Khader, S. A. (1994). Studies on the special dairy products. M.Sc. Thesis, Fac. of Agric., Minufiya Univ., Egypt.

Ling, E. R. (1963). A Text Book of dairy Chemistry, Vol. 2 Practical 3rd ed. Chapman & Hall, Ltd., London.

Marth, E. H. (1978). Standard methods for the examination of dairy products, 14th ed. Am. Buble. Health Assoc. Washigton, DC.

Mehriz, A. M., M. N. A. Hassan, A. A. Hefny and A. H. Aziz (1993). Manufacture and some properties of ABT cultured and sweet acidophilus milks. Egyptian J. Dairy Sci., 21: 259 – 272.

Müller, Ute (1981). Untersuchungen uber qualitatskriterien der buttermilch. Inaugural-Dissertation zur Erlangung des Doktor grades be idem Fachbereich Ernahrungs Wissenschaften der Justus-Liebig. Universitat GieBen. Bundes Republik Deutschland.

Noh, S. K. and S. I. Koo (2003). Egg sphingomyclin lowers the lymphatic absorption of cholesterol and alpha-tocopherol in rats. J. Nutr., 133: 3571 – 3576.

Noh, S. K. and S. I. Koo (2004). Milk sphingomyclin is more effective than egg sphingomyclin in inhibiting intestinal absorption of cholesterol and fat in rats. J. Nutr., 134: 2611 – 2616.

Oshida, K., T. Shimizu, M. Takase, Y. Tamura, T. Shimizu and Y. Yamashiro (2003). Effects of dietary sphingomyclin on central nervous system myclination in developing rats. Pediatric Res., 53: 589 – 593.

Rasic, J. L. and J. A. Kurmann (1978). Yoghurt. Scientific grounds, technology, manufacture and preparations. Technical Diary Publishing House, Copenhagen, pp. 99 – 137.

Salama, F. M. M. (2001). Preparation of high protein therapeutic acidophilus yoghurt. Egyptian. J. Dairy. Sci., 29: 277 – 484.

Salama, F. M. M. and F. A. M. Hassan (1994). Manufacture of new yoghurt like products. Egyptian J. Dairy Sci., 22: 31 – 38.

Skinner, F. A. and L. B. Quesnel (1978). Streptococci. Academic Press, New Work, p. 390.

Spitsberg, V. L. (2005). Bovine milk fat globule membrane as a potential nutraceutical. J. Dairy Sci., 88: 2289 – 2294.

Sprong, R. C., M. F. E. hulstcin and R. Van der Meer (2002). Bovine milk fat components inhibit food-borne pathogens. Intern. Dairy J., 12: 209 – 215.

Steel, R. G. D. and J. H. Torrie (1980). Principles and Procedures of Statistics. A biometrical approach. 2nd Ed. McGraw-Hill Book Co., New York.

Talwalkar, A. and K. Kailasapathy (2004). Oxidative stress adaptation of probiotic bacteria. Milchwissnsechaft, 59 (3/4): 140 – 143.

Thompson, A. K., J. P. Hindmarsh, D. Haisman, T. Rades and H. Singh (2006). Comparison of the structure and properties of liposomes prepared from milk fat globule membrane and soy phospholipids. J. Agric. and Food Chem., 54: 3704 – 3711.

Tvede, M. (1996). Potential of probiotic a strains in stabilizing intestinal microflora to prevent gastrointestinal infection. Newsletter Int. Dairy Federation, 145, 30.

Vanhoutte, B., R. Rombaut, K. Dewettinek and P. Van der Meeren (2004). Phospholipids. In L. M. L. Nollet (Ed.), Food Analysis (pp. 349 – 382). New York, USA: Marcel Dekker.

Williams, S. R. (1985). Nutrition and diet therapy. Times Mirror Mosluy. Coolege Publishing, St. Louis, Toronto and Stantaclara.

Wong, P. Y. Y. and D. D. Kitts (2003). A comparison of the buttermilk solids functional properties to nonfat dried milk, soy protein isolate, dried egg white and egg yolk powders. J. Dairy Sci., 86: 746 – 754.

Zedan, M. A., A. N. Zedan, K. M. K. Kebary and S. F. Mahmoud (2001). Effects of fortification of cow's milk with acetylated whey protein concentrates on the quality of set yoghurt. Egypt. J. Dairy Sci., 29: 285 – 297.

Zhang, L., L. I. Hellgren and X. B. Xu (2006). Enzymatic production of ceramide from sphingomyclin. J. Biotech., 123: 93 – 105.

تصنيع اليوجورت من اللبن البقرى المُدعّم باللبن الخض المُجفف

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قسم علوم وتكنولوجيا الألبان – كلية الزراعة – شبين الكوم – جامعة المنوفية

الملخص العربي

يهدف هذا البحث لدراسة تأثير استبدال اللبن الفرز المجفف لتدعيم اللبن البقرى بواسطة اللبن الخض المُجفف على جودة اليوجورت الناتج لهذا فقد صنّعت ٥ معاملات حيث صنّعت العينة الكنترول من لبن بقرى يحتوى على ٣% دهن ومُدعم بإضافة ٣% لبن فرز مجفف أما المعاملات الأربع الأخرى فقد صنّعت من نفس اللبن البقرى ولكن تم استبدال ٢٥ ، ٥٠ ، ٧٥ ، ١٠٠% من اللبن الفرز المُجفف بواسطة اللبن الخض المُجفف على الترتيب . ولقد أوضحت النتائج المتحصل عليها بعد تحليلها إحصائياً ما يلى :

- **لم يؤثر استبدال اللبن الفرز المجفف بواسطة اللبن الخض المجفف على نسب كلٍ من الجوامد الصلبة الكلية والبروتين الكلى والرماد والحموضة وكذلك لم يُؤثر على قوة الخثرة ولزوجة اليوجورت الناتج.**
- **أدى استبدال اللبن الفرز المُجفف بواسطة اللبن الخض إلى انخفاض نسبة انفصال الشرش، بينما أدى الاستبدال إلى زيادة نسبة الداى أسيتايل والأسيتايل ميثيل كربينول ولقد زاد هذا التأثير بزيادة نسبة الاستبدال .**
- **ازدادت درجات التحكيم بزيادة نسبة الاستبدال حتى ٥٠% ثم انخفضت درجات التحكيم بزيادة نسبة الاستبدال أعلى من ذلك . ولم تتغير درجات تحكيم عينات اليوجورت خلا الأيام الستة الأولى من التخزين ثم انخفضت درجات التحكيم بعد ذلك.**
- **لم تتأثر نسب كلٍ من الجوامد الصلبة الكلية والبروتين الكلى والدهن والرماد أثناء التخزين بينما ازدادت نسبة الحموضة .**
- **انخفضت نسبة انفصال الشرش بتقدم فترة التخزين ووصلت لأقل مستوى لها عند اليوم السادس ثم بدأت فى الزيادة حتى نهاية فترة التخزين .**
- **ازدادت نسبة الداى أسيتايل والأسيتايل ميثيل كربينول بتقدم فترة التخزين ووصلت لأعلى مستوى لها عند اليوم السادس ثم بدأت تنخفض حتى نهاية فترة التخزين .**
- **ازداد العدد الكلى للبكتريا وعدد بكتريا Lactobacilli و Streptococci حتى اليوم الثالث ثم بدأت تتناقص أعداد هذه البكتريا حتى نهاية فترة التخزين .**

Manufacture of yoghurt from cow's milk fortified with butter milk

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Whey cyneresis (mg / 100 ml yoghurt)

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Table (1): Effect of replacing skim milk powder with butter milk on total solids, fat and total protein contents during storage of yoghurt.

Yoghurt treatments	Total solids content (%)					Fat content (%)					Total protein content (%)				
	Storage period (days)					Storage period (days)					Storage period (days)				
	Fresh	3	6	9	12	Fresh	3	6	9	12	Fresh	3	6	9	12
C	15.11	15.16	15.18	15.23	15.26	3.82	3.86	3.85	3.83	3.82	3.1	2.9	3.0	2.9	3.1
T_1	15.06	15.13	15.10	15.18	15.24	3.81	3.85	3.90	3.89	3.85	3.1	3.1	3.1	3.1	3.1
T_2	15.05	15.16	15.15	15.21	15.27	3.79	3.81	3.85	3.85	3.83	3.1	3.1	3.2	3.1	3.1
T_3	15.12	15.18	15.16	15.23	15.28	3.81	3.82	3.83	3.81	3.86	3.2	3.1	3.2	3.2	3.3
T_4	15.08	15.13	15.11	15.18	15.29	3.82	3.84	3.82	3.82	3.81	3.2	3.2	3.2	3.3	3.3

C: Control yoghurt treatment made from cow's milk that fortified with 3.0% skim milk powder.
T_1, T_2, T_3 and T_4: Yoghurt treatments made by replacing 25, 50, 75 and 100% of skim milk powder with dried butter milk, respectively.

Table (2): Effect of replacing skim milk powder with butter milk on ash content, titratable acidity (%), viscosity and curd tension during storage of yoghurt.

Yoghurt treatments*	Ash content (%)					Titratable acidity (%)					Curd tension of fresh yoghurt (mm/100 g)	Viscosity of fresh yoghurt
	Storage period (days)					Storage period (days)						
	Fresh	3	6	9	12	Fresh	3	6	9	12		
C	0.99	1.01	1.02	1.04	1.06	0.93	0.98	1.05	1.13	1.19	30.6	165
T_1	0.97	0.98	1.00	0.98	1.01	0.95	0.98	1.07	1.15	1.19	31.2	1622
T_2	0.98	1.00	1.03	1.00	1.01	0.93	0.97	1.10	1.18	1.21	31.8	163
T_3	0.97	0.98	1.02	1.01	1.02	0.92	0.98	1.08	1.16	1.19	31.2	159
T_4	0.98	0.99	1.01	0.99	1.01	0.93	1.00	1.07	1.16	1.20	30.9	160

*** See Table (1).**

Table (3): Effect of replacing skim milk powder with butter milk on total bacterial, lactobacilli, streptococci and mould and yeast counts during storage of yoghurt.

Yoghurt treatments*	Total bacterial counts (cfu♦ × 10^5 / ml)					Lactobacilli count (cfu × 10^7 / ml)					Streptococci count (cfu × 10^6 / ml)					Mould and yeast (cfu × 10^2 / ml)				
	Storage period (days)					Storage period (days)					Storage period (days)					Storage period (days)				
	Fresh	3	6	9	12	Fresh	3	6	9	12	Fresh	3	6	9	12	Fresh	3	6	9	12
C	96	104	83	72	56	54	87	63	58	51	123	156	133	98	72	ND	ND	8	18	32
T_1	88	101	89	68	54	59	91	58	54	50	118	158	135	91	68	ND	ND	6	19	28
T_2	93	107	86	68	51	56	88	60	57	48	121	161	128	96	71	ND	ND	9	22	31
T_3	90	105	81	70	56	53	87	63	61	52	126	156	131	95	73	ND	ND	6	18	24
T_4	88	103	83	72	54	57	85	59	56	52	123	160	136	93	75	ND	ND	8	21	33

*** See Table (1).**
ND : Not detected.
♦ cfu = Colony forming unit.

Table (4): Effect of replacing skim milk powder with dried butter milk on the organoleptic properties of yoghurt.

Yoghurt treatments♦	Flavour (45)					Body and texture (35)					Appearance (10)					Acidity (10)					Total scores (100)				
	Storage period (days)																								
	Fresh	3	6	9	12	Fresh	3	6	9	12	Fresh	3	6	9	12	Fresh	3	6	9	12	Fresh	3	6	9	12
C*	42	41	41	40	38	32	32	30	30	30	8	8	8	8	7	9	8	8	7	6	91	89	86	85	81
T_1	42	42	41	40	37	32	32	30	30	30	8	8	8	8	8	9	8	8	7	6	91	90	87	85	81
T_2	42	42	41	40	37	32	32	30	30	30	9	8	8	8	8	9	8	8	7	6	92	90	87	85	82
T_3	40	40	38	37	35	31	30	30	29	28	8	8	8	7	7	8	8	8	7	6	87	86	84	80	76
T_4	40	38	37	37	35	31	30	29	28	27	8	8	7	7	7	8	8	8	7	6	87	84	81	79	75

*** Each value in the table was the mean of three replicates.**
♦ See Table (1).

Table (5): Statistical analysis of yoghurt quality that fortified with skim milk powder and dried butter milk.

Yoghurt properties	Effect of treatments						Effect of storage period (days)					
	Multiple comparisons●						Multiple comparisons●					
	Mean squares	C♦	T_1	T_2	T_3	T_4	Mean squares	Fresh	3	6	9	12
Total solids (%)	0.010	A	A	A	A	A	0.0006	A	A	A	A	A
Protein (%)	0.209	A	A	A	A	A	0.1318	A	A	A	A	A
Fat (%)	0.3026	C	BC	AB	A	A	0.0612	A	A	A	A	A
Ash (%)	0.003	A	A	A	A	A	0.005	A	A	A	A	A
Titratable acidity (%)	0.001	A	A	A	A	A	0.18771*	C	C	B	A	A
DA + AMC	52.1128*	C	B	A	A	A	1660.5475*	E	D	A	B	C
Syneresis	183.42*	A	B	C	D	E	204.42*	A	C	E	D	B
Viscosity	36.816	A	A	A	A	A						
Flavour	33.4799*	A	A	A	B	B	52.6799*	A	A	B	B	C
Body and texture	5.5199*	A	A	A	A	A	13.9199*	A	A	AB	B	B
Appearance	1.4999	A	A	A	A	A	1.4999	A	A	A	A	A
Acid	1.0799	A	A	A	A	A	4.0799	A	A	A	B	C
Total scores	102.48*	A	A	A	B	B	186.7799*	A	A	A	B	C
Curd tension	1.2840	A	A	A	A	A						

♦ See Table (1).

● For each effect the different letters in the same row means the multiple comparisons are different from each other, letter A is the highest mean followed by B, C, ... etc.

* Significant at 0.05 level ($p \leq 0.05$).