TECHNOLOGY AND MICROBIOLOGICAL STUDIES ON SOME PROBIOTIC DAIRY BEVERAGES FORTIFIED WITH PINEAPPLE PULP

M.N.F. Hamad[1]*, Samaa M. El_Say[2] and Reham R. Anees[1]

[1]Dairy Department, Faculty of Agriculture, Damietta University, Egypt.

[2]Food Science and technology Department, Faculty of Home Economic, Al-Azhar University, Egypt.

** Corresponding author:MohamedNour-EldinFaridHamad; (Hamad, M.N.F.), dr_mnour@du.edu.eg, +201004855145*

SUMMARY

The main target of this study is preparing functional dairy product mainly probiotic beverages or drinkable yogurt fortified with Pineapple as sweet beverage. The probiotic strain are *Lactobacillus acidophilus* LA-5 (A), *Bifidobacteriumbifidium and L. acidofilus.* Results indicated that blending of yogurt drink with pineapple increased the titratable acidity according to the acidic nature of pineapple itself. TS contents ofbeverages were increased as the proportion of pineapple increased; the increases were parallel to the level of pineapple. It could be noticed also that ash percent increased as the level of fruit increased in fresh samples.WSN and TVFA; it could be noticed that all values were considerably increased as a result of proteolysis and lipolysis.The growth of *St. thermophiles*in beverage samples fortified withdifferent ratios (w/w) of pineapple pulp during the storage period were estimated. It was clear that the counts were decreased as pineapple level increased and also as a storage period progressed.The counts of *Biffidobacteriumssp* were increased in pineapple samples rather than control. The counts of fresh samples were 33, 36, 44 and 46 (cfu×x10^5) in C, T1, T2 and T3, respectively. The counts decreased during storage to reach 24 and 18 (cfu×x10^5) for control and 25 and 20 (cfu×x10^5) for T1, while it became 35 and 25 (cfu×x10^5) for T2. The third sample (T3) gained 46, 37 and 29 (cfu×x10^5) when fresh and after one and two weeks.The scores for body & consistency were clear, varied either in treating samples or stored samples. Adding of pineapple lead to produce non homogenized body and little coagulated particles as an effect of acidic action of pineapple. Flavour scores indicated that the favorite sample was T3, where it possessed 47.71, 47.90 and 47.99 points when fresh and after one and two weeks, respectively. The total acceptability indicated that control samples had the highest degrees.

Keywords*: cow milk, probiotic, Bifidobacterium, L. acidofilus, beverage pineapple.*

INTRODUCTION

The primary role of diet is to provide sufficient nutrients to meet metabolic requirements while giving the consumer a feeling of satisfaction and well-being.Functional foods have experienced rapid market growth in the recent years and the global market of functional foods is increasing annually. This growth is fueled by technological innovations, development of new products, and the increasing number of health-conscious consumers interested in products that improve life quality.

In recent times, there has been also an increased interest to adapt healthy diets, which, help in preventing diseases, and as a consequence, linking between food and health is becoming more and more essential in consumers' daily lives, as they are trying to get foods that support some health benefits and lower the risk of consumers' health problems.

The term *functional food* was defined initially in Japan during the 1980s asFoods for Specialized Health Use(FOSHU).However, in accordance with the worldwide accepted definition, functional food is coined to describe foods or nutrients whose ingestion leads to important physiological changes in the body that are separate and distinct from those associated with their role as nutrients (FDA 2004). Functional foods providing additional health benefits that may reduce disease risk and/or promote optimal health. Functional foods include conventional foods, modified foods (fortified, enriched, or enhanced), medical foods, and foods for special dietary use (ADA, 2009).

The probiotics products are a branch of functional food. Probiotic is a relatively new word meaning ‘‘for life’’ and it is generally used to name the bacteria associated with the beneficial effects for the humans and animals. The term probiotic was technically defined by an Expert Committee as ‘‘live microorganisms which upon ingestion in certain numbers exert health benefits.In another side; there is no doubt that dairy products are the main vehicle for probiotic supplementation. The development of probiotics in the last two decades has signaled an important advance in the dairy sector industry. The majority of probioticproducts available in the marketplace contain species of *Lactobacillus* and *Bifidobacterium*, which are the main genera of Gram-positive bacteria currently characterized as probiotics (FAO/WHO, 2001).

Development of probiotic dairy products is an expensive and multistage process that takes into account many factors, such as sensory acceptance, physical and microbial stability, price, and chemical and other intrinsic functional properties to be successful in the marketplace.

Yogurt is acidified, custard like semisolid dairy product produced by fermenting pasteurized milk with starter culture containing lactic acid producing bacteria.The increase of yogurt consumption worldwide is largely attributed to altering plain yogurt for unique flavors, desirable textures, and maintaining excellent nutritional profiles and healthy food values.

The drinkable yogurt marketplace is a competitive and growing category in the dairy industry.It is defined as a dairy-based yogurt that is drinkable and in a liquid form that may or may not include fruit or fruit flavoring. Then it defined fermented dairy beverage or drinkableYogurt.Dairy beverages are delicious products which consumed by all ages; they have high nutrition value as they mainly supplemented with healthy food additive such as fruits. Dairy beverages can be supplemented with apple, apricot, mango, strawberry, sweet lemon, etc.

This paper dealt with preparing functional dairy beverages inoculated with probiotic microbial strains and fortified with pineapple pulp at three ratios. Their chemical, microbiological and sensory properties were studied through two weeks of storages at refrigerator.

MATERIALS AND METHODS

Milk: Fresh raw cow milk was obtained from the local market in Damiatta Governorate.Milk samples were collected in winter season; the amount of each sample was about 12 Kg. Pineapple pulpwas obtained from Alnada factory in Damietta El-Jadida city, Damietta Governorate, Egypt.There chemical analyses were as follow:Total dissolved solids (Brix) 61.4; Total acidity 2.6 % and pH 3.25.Sugar:Sugar “El-Fayrouz”, produced by El-Fayrouz Food Packaging & Distribution Company, Damietta was used.Starter:“ABT-5 culture” probiotic yogurt culture which consists of *Lactobacillus acidophilus* LA-5 (A), *Bifidobacteriumbifidium*and *Streptococcus thermophilus* CHCC 742/2130 (T) (Chr. Hansen’s Lab A/S Copenhagen, Denmark) was used,starter cultures were in freeze-dried direct-to-vat set form and stored at –18°C until used.

MRS agar medium (Tharmaraj and Shah, 2003) was composed of: Dextrose 20.0 g, Yeast extract 4.0 g, Bacteriological peptone 10.0 g, Ammonium citrate 2 g, Beef extract 8 g, Magnesium sulphate 0.29 g, Sodium citrate 5 g, Manganese sulphate 0.05 g, Agar 15 g, Di potassium phosphate 2 g, Tween 1 ml and Distillation water 1000 ml (pH 6±0.2 at 25^{o}C). Sterilized in autoclave at 121^{o}C for 15 minutes. The medium was used for counting *Lactobacillusacidophilus* counts.M17 agar medium (Tharmaraj and Shah, 2003):The counting of *Streptococcus thermophillus* was determined using M17-lactose agar medium which has the following composition: Tryptone 5 g, Soya peptone 5 g, Meat digest 5 g, Magnesium sulphate 0.25 g, Di-sodium-glycerophosphate 19 g, Agar 15 g and Distillation water 1000 ml (pH 6.9 ± 0.2 at 25^{o}C).

Bifidobacterim medium (Dinakar and Mistry, 1994): This media was composed of: Neomycin sulfate 2 g, Nalidixic acid 0.3 g, Paromomycin sulfate 4 g, Lithium chloride (NPNL, Sigma Chemical Co.) 60 g.It was prepared in 1 Liter of distilled water, sterilized in autoclave at 121^{o}C for 15 minutes and stored at 4°C until use.

Chemicals:All chemical reagents used in the present study were analytical fine grade and were obtained from El-Gomhoria Chemical Company, Mansoura, Egypt.

Preparation of dairy beverage treatments:Four treatments of dairy beverages were made from cow milk and Pineapple pulp as follows:C: cow's milk (control) + 5%sugar, T1: cow's milk + 8% Pineapple pulp+5%sugar, T2: cow's milk + 10% Pineapple pulp5%sugar and T3: cow's milk + 12% Pineapple pulp5%sugar.After heating milk samples to 85°C for 15 min, milk of various treatments were immediately cooled to 45°C; then control milk (C) was sweated with 5% sugar, inoculated with 0.1 g/L of mix cultures ABT-5, incubated at 45°C for fully coagulation and stored at 5-7°C overnight.In other treatments, 5% sugar was mixed with cow's milk then the 8,10 and 12% (w/w) of Pineapple pulp were added to serve three treatments (T1, T2, and T3) and individually blended at 2000 rpm for 3–4 min. Samples were inoculated with "cultures ABT-5" (0.1 g/L of milk mix), incubated at 45°C for fully coagulation and stored at 5-7°C overnight. Samples were preserved at 5-7°C for two weeks. Dairy beverage samples were analyzed when fresh and after 7 and 14 days of refrigerated storage.

Gross composition and pH values of milk samples: Gross composition of all milk samples included total solids, fat, protein and ash contents were determined as mentioned by AOAC (2012). Lactose content was determined by subtracting the percentage of other components (moisture, fat, protein, ash) from 100.

Chemical analysis of beverages:

Total Solids (TS) of Dairy beverages were determined according to AOAC (2012). TS content was obtained by the difference between the known weight of milk sample and the determined weight of the total solid after evaporating the liquid component of the milk sample in oven at 105ºC for four hours.Fat content was determined using the Gerber's method according to Ling (1963).Titratable Acidity (TA) in terms of % lactic acid was measured by titrating 10g of sample mixed with 10 ml of boiling water against 0.1N NaOH using phenolphthalein indicators to an end point of faint pink colour(Ling, 1963).The pH value of samples were measured using a laboratory digital pH–meter equipped with glass electrode (model H 18418; Hanna Instruments, Padova, Italy). (Corning pH/ ionanalyzer 350, Corning, NY) after calibration with standard buffers (pH 4.0 and 7.0). Total Nitrogen (TN) and Water Soluble Nitrogen (WSN) contents of dairy beverages were determined by the macro-kjeldahl method according to ling (1963). Total Volatile Fatty Acids (TVFA) were determined according to Kosikowski (1978).Ash content of dairy beverage samples was measured by incineration of the sample placed in the muffle furnace at 550°C for 6 h (AOAC, 2012).

Microbial analysis:

Cultivation methods: Dairy beverage samples were analyzed for *Streptococcus thermophiles* and *Lactobacillus acidophilus* counts according to the methods described by Tharmaraj and Shah (2004).The counting of *Streptococcus thermophiles* was determined using M17-lactose agar medium. The medium was sterilized in autoclave at 121^{o}C for 15 minutes. 5.3 ml of membrane-filtered sterile solutions of 10% lactose were added per 100 ml of the sterilized mentioned medium just before pouring the agar medium. Inculcated plates in duplicates were incubated aerobically at 37^{o}C for 24 h. The colony morphology was 0.1-0.5 mm, round yellowish. Enumeration of *Lactobacillus acidophilus* was done by using MRS-sorbitol agar medium. The medium was sterilized in autoclave at 121^{o}C for 15 minutes. Ten ml of membrane-filtered sterile solutions of 10% D-sorbitol were added to 90 ml of the sterilized mentioned medium just before pouring the agar medium. Inculcated plates were incubated anaerobically at 37^{o}C for 48 h. The colony morphology were rough, dull, small (0.1-0.5 mm) brownish. The counting of *Bifidobacterium bifidium* was determined according to Dinakar and Mistry (1994). A mixture of antibiotics, including 2 g of neomycin sulfate, 4 g of paronomycin sulfate, 0.3 g of nalidixic acid, and 60 g of lithium chloride (NPNL, Sigma Chemical Co.), was prepared in 1L of distilled water, filter-sterilized, and stored at 4°C until use. The mixture of antibiotics (5 ml) was added to 100 ml of MRS agar medium. Cysteine-HCl was added at the rate of 0.05% to decrease the redox potential of the medium. Plates were incubated at 37°C for 48 to 72 h under anaerobic condition. The colony morphology was 1 mm, white, shiny and smooth.

Sensory evaluation: Samples of dairy beverage were organoleptic scored by 25 members of the staff of the Dairy Department, Faculty of Agriculture; Damietta University. The score points were 50 for flavor, 35 for body & fluidity and 15 points for colour & appearance, which give a total score of 100 points.

RESULTS AND DISCUSSION

Quality evaluation of stirred yogurt as dairy beverages fortified with pineapple pulp to prepare probiotic dairy beverages was present in this section. The cow milk was used as main source to prepare the beverages. Three ratios of pineapple were used 8, 10 and 12% vs. control. Starter culture contained *Lactobacillus acidophilus* LA-5 (A), *Bifidobacteriumbifidium*,and *Streptococcus thermophiles* were also used to prepared probiotic dairy beverages.

Physicochemical properties of pineapple pulp:

The physicochemical properties of raw pineapple pulp which used in this section was listed in Table (1).The physical properties and appearance were normal and acceptable. Their dissolved total solids (brix), acidity and pH were also present in the same Table. It was clear that its TS was 54.76 % while the brix number was 61.40%; it means that that the pineapple sample was concentrated. Its acidity content (2.6%) and the pH value (3.25), which reflected its acidic behavior.

Tables (2) reflected the pH values, acidity (%),TS (%), Fat (%), Ash (%), TN (%) WSN (%) and TVFA content of the beverages fortified with pulp pineapple. It could be observed that pH value of control was 4.48 in fresh sample decreased, to 4.17 and 3.75 and 3.60 when the samples fortified with 8, 10 and 12% pineapple, respectively. During two weeks of storage; the values were normally decreased as a result of fermentation. At the first week their values become 4.23, 4.05, 3.63 and 3.34 for control, T1, T2 and T3, respectively. While after two weeks their values reached 4.19, 3.74, 3.41 and 3.03 in the same order. For acidity data; the acidity were increased in two directions. The first as a result of adding pineapple pulp because it is an acidic ingredients; and the other as effect of storage as a result of starter action. Acidity values for control sample were 0.795, 0.972 and 1.116 % at fresh and after one & two weeks, respectively. The corresponding values for T1 were 0.879; 1.026 and 1.161 against 0.918; 1.065 and 1.194 for T2 and 0.972; 1.137 and 1.206 % for T3. These results were in confirming with that obtained by Sawant*et al*., (2015) who used 3, 6 and 9% pineapple pulp. They reported that blending of yogurt drink with pineapple increased titratable acidity according to the acidic nature of pineapple. Similar results have been reported also by Khan *et al*. (2008),Chougrani*et al*. (2009) and Amadou*et al*. (2016).

Table (1): Some physicochemical behavior of natural pineapple pulp used in preparation of flavoured probiotic dairy beverages

Item	Result
Appearance	Turbid yellow orange
Physical state	Viscous liquid
Organoleptic properties	Conform to standard
pH	3.25
Total dissolved solids (brix^0)	61.40
Total acidity %	2.6

Chemicalcomposition of Beverages:

Total solids ofprobiotic dairy beverages samples fortified withdifferent ratios were increased as the proportion of pineapple increased. The increases were parallel to the level of pineapple. Control sample gained 15.77; 16.47 and 17.24% at fresh and after 1& 2 weeks storage respectively. The corresponding values for T1 were 19.71; 20.31 and 22.6% vs. 20.64; 21.32 and 22.06% for T2 and 21.61; 22.99 and 23.68 for T3, respectively. The obtained data were in agreement with Sawant*et al*. (2015), mentioned that TS values were found significantly different as pineapple added. The yogurt drink blended with 9% pineapple pulp contained the highest TS while it decreased with fruit added as TS content of pineapple itself are higher than milk. The results of Amadou*et al*.(2016) and Gangwar*et al*. (2016) confirming the obtained results.

The ash contents of various pineapple dairy beverages increased as the level of fruit increased in fresh samples. Their values were 1.17; 1.25 1.39 and 1. 45 % for control; T1; T2 and T3, respectively. This result is logic for adding fruit source which considered a good source of minerals. The values were generally increased during storage as result of increasing the TS. The present data were in harmony with that obtained by Amadou*et al*. (2016) and Ganwar*et al*. (2016) mentioned that control yogurt had high content of ash

compared with those blended with pineapple. They explained this by the low ash content (0.20%) of their pineapple puree samples.

The values of fat contents of pineapple dairy beverages were 3.6; 3.5 and 3.4 % for control sample at fresh and after one & two weeks of storage. No clear differences were noticed between T1 and T2 where they possessed the same values. While the corresponding values for T3 were 3.8; 3.7 and 3.6 %. Pineapple is a fruit poor in fat content. Sawant*et al*. (2015) mentioned that the addition of pineapple pulp resulted in no significant differences between control and pineapple yogurt drink samples for fat percent as pineapples pulp contains lower fat. Amadou*et al*. (2016) confirming the data of Sawant*et al*. (2015).

Table (2): Chemical composition of probiotic dairy beverages samples fortified with different ratios (w/w) of pineapple pulp during storage period.

Treatment	Days	Chemical composition							
		Acidity	pH	TS (%)	Fat (%)	Ash (%)	TN (%)	WSN (%)	TVFA content*
C	Fresh	0.795	4.48	15.77	3.6	1.17	0.496	0.186	7.41
	7	0.972	4.23	16.47	3.5	1.21	0.491	0.210	10.25
	15	1.116	4.19	17.24	3.4	1.24	0.490	0.233	12.48
T1	Fresh	0.879	4.17	19.71	3.7	1.25	0.516	0.233	9.17
	7	1.026	4.05	20.31	3.6	1.26	0.513	0.256	12.41
	15	1.161	3.74	21.11	3.5	1.29	0.492	0.280	15.31
T2	Fresh	0.918	3.75	20.64	3.7	1.39	0.520	0.256	12.02
	7	1.065	3.63	21.32	3.6	1.32	0.533	0.285	15.77
	15	1.194	3.41	22.06	3.5	1.34	0.500	0.308	18.31
T3	Fresh	0.972	3.60	21.61	3.8	1.45	0.568	0.280	15.17
	7	1.137	3.34	22.99	3.7	1.39	0.583	0.303	18.15
	15	1.206	3.03	23.68	3.6	1.42	0.599	0.356	21.68

C: Control, T1: 8% pineapple, T2: 10% pineapple, T3: 12% pineapple
** ml. 0.I Na OH/ 10 g sample.*

No clear differences in the TN contents were observed as a result of fortification of the pulp. Control sample gained 0.496% at fresh while T1 possessed 0.516 and T2 gained 0.520; however T3 contained 0.568%. values of total protein, albumin and globulin, creatinine, urea AST, ALT, total antioxidant, triglyceride and cholesterol. These results are in agreement with those obtained by Deraz and Ismail (2001) and Mahrous et al. (2011) who found that no significant differences were noticed in blood plasma parameters among all groups fed untreated or fungal treated crop residues and the values were within the normal range. On the other hands, the present results disagree with those obtained by Bassuny et al. (2003b) who found that blood components were significantly affected ($P<0.05$) and higher values of total protein, albumin, urea, GOT and GPT were recorded with urea + fungi treatment followed by urea treatment compared to untreated group. as results of protein content of pineapple itself. The values of TN were normally deceased through the storage. These finding were in agreement withSawant*et al*. (2015).The WSN were noticeably increased as the level of pineapple pulp ratio increased. Their values were 0.186; 0.233; 0.256 and 0.280% for Control; T1; T2 and T3,respectively.During storage, all values were considerably increased as result of proteolysis as starter action. The pineapple pulp contains nutrients which enhance the action of starter and probiotic bacteria.

It clear that their values of volatile fatty acids were considerably increased as pineapple ratio increased as well as storage period increased. Control samples had 0.741; 10.25 and 12.48 ml 0.I Na OH/ 10 g sample. These increased as result of proteolysis during storage. The addition of pineapple increased the rate of proteolysis and this increase was parallel to the added- ratio. Fresh T1-sample had 9.17 reached to 12.41 and 15.31. After one and two weeks of storage For T2 sample; the values were 12.02,15.77 and 18.31 at fresh, after one week and after two weeks. The corresponding values for T3 were15.17, 18.15 and 21.68 in the same order.

Microbiological Examination:

Table (3) reflected the growth of *St. thermophiles*, *L.acidophilus* and*Bifidbacteriumspp*in probiotic dairy beverages samples fortified withdifferent ratios (w/w) of pineapple pulp during storage period. It was clear that the counts of *St. thermophiles*were decreased as pineapple level increased and also as storage period progressed. Control sample had 33, 23, and 19 cfu×x10^6. The corresponding counts for T1 were 28, 17 and 8 cfu×x10^6.While their counts for T2 were17, 8 and 4 cfu×x10^6, respectively. Samples labeled T3 contained 9, 5 and 2 cfu×x10^6.It could be explained this phenomenon as mentioned by Amadou*et at*. (2016) who used pineapple in preparing flavored yogurt.They reported that control yogurt significantly presented the high value of total plate counts; while treated pineapple samples had the lowest counts. They explained the reduction of bacterial growth to the antibacterial effect of bromelain in pineapple. However; Sawant*et al*. (2016) recorded an opposite trend. They observed highest number of totalviable count in experimental sample contained 9% pineapple rather than control sampleand Hossain *et al*. (2015).

The growth of *L. acidophilus* in probiotic dairy beverages samples fortified withdifferent ratios (w/w) of pineapple pulp during storage period. It was clear that the counts were decreased as pineapple level increased and also as storage period progressed. Control sample had 27, 23, and 14 cfu×x10^5. The corresponding counts for T1 were 22, 14 and 12 cfu×x10^5.While their counts for T2 were17, 13 and 11 cfu×x10^5, respectively. Samples labeled T3 contained 14, 11 and 10 cfu×x10^5.It could be explained this phenomenon as mentioned by Amadou*et at*. (2016) who reported that control yogurt significantly presented the high value of total plate counts; while treated pineapple samples had the lowest counts.

The counts of*Bifidbacteriumspp* in probiotic beverages fortified with pineapple. It could be observed that the counts were increased in pineapple samples rather than control. The counts of fresh samples were 33, 36, 44 and 46 (cfu×x10^5) in C, T1,T2 and T3, respectively. The counts decreased during storage to reach 24 and 18 (cfu×x10^5) for control and 25 and 20 (cfu×x10^5) for T1 while it became 35 and 25 (cfu×x10^5) for T2. The third sample (T3) gained 46, 37 and 29(cfu×x10^5) when fresh and after one and two weeks.

Table (3): Microbiological examinationof probiotic dairy beverages samples fortified withdifferent ratios (w/w) of pineapple pulp during storage period.

Treatment	Days	The counts (cfu×x10^6) of *St. thermophilus*	The counts (cfu×x10^5) of *L.acidophilus*	The counts (cfu×x10^5) of *Bifidbacteriumspp*
C	Fresh	33	27	33
	7	23	23	24
	15	10	14	18
T1	Fresh	28	22	36
	7	17	14	25
	15	8	12	20
T2	Fresh	17	17	44
	7	8	13	35
	15	4	11	25
T3	Fresh	9	14	46
	7	5	11	37
	15	2	10	29

C: Control, T1: 8% pineapple, T2: 10% pineapple, T3: 12% pineapple

Sensory evaluation of beverages:

Table (4) showed the organoleptic properties of the probiotic beverages fortified with pineapple pulp. The panel test showed that the colour & appearance degrees were high in treated samples rather than control. Their scores were also increased during storage.The scores for body & consistency were clear varied either in treated samples or stored samples. Adding of pineapple lead to produce non homogenized body and little coagulated particles as effect of acidic action of pineapple.

Flavour scores indicated that the favorite sample was T3, where it possessed 47.71, 47.90 and 47.99 points when fresh and after one and two weeks, respectively. The total acceptability indicated that control samples had the highest degrees.Gangwar*et al*. (2016) prepared plain yoghurt and fruit yoghurts from whole milk of buffalo by adding different levels of fruit juice (5%, 10% and 15%) of pineapple. Yoghurts fortified

with 5% and 10% pineapple juice were good in smell and taste; yoghurts with 5% pineapple juice good in body and consistency; Yoghurts with 5% and 10% pineapple juice, were good in colour and texture;however10% pineapple juice yoghurt being the best among all yoghurts.

Table (4): Sensory evaluation (degree) of probiotic dairy beverages samples fortified withdifferent ratios (w/w) of pineapple pulp during storage period

Treatment	Storage period (days)	Colour& Appearance (15)	Body& consistency (35)	Flavour (50)	Total (100)
C	Fresh	13.71	31.92	43.51	89.13
	7	13.6o	30.14	43.42	87.14
	14	13.5o	29.85	43.25	86.51
T1	Fresh	14.00	30.57	39.57	83.64
	7	14.43	30.28	39.5	83.00
	14	14.50	29.34	38.7	80.90
T2	Fresh	14.07	29. 11	32.42	61.49
	7	14.61	28.27	41.5	60.3
	14	14.74	27.96	45.8	59.1
T3	Fresh	14.45	21.57	47.71	70.13
	7	14.59	21.2	47.90	67
	14	14.62	20.1	47.99	65

C: Control, T1: 8% pineapple, T2: 10% pineapple, T3: 12% pineapple

REFERENCES

ADA (American Diabetes Association) (2009). Diabetes Care 2009 Jan; 32 (Supplement 1): S13-S61. https://doi.org/10.2337/dc09-S013

AmadouN. M., M. Peter Y., N. Caroline W. and I. Helene (2016). Physicochemical, Microbiological and Sensory Properties of Pineapple (*Ananascomosus*(L.) Merr.) Flavoured Yoghurt. *International Journal of Agriculture Innovations and Research*, 4(6):1154-1158.

AOAC (2012). Association of Official Analytical Chemists. Official Methods of Analysis. 19th Ed, Washington, DC, USA.

Chougrani F., Cheriguene A. and Bensoltane A. (2009). Sensorial and Physico-Chemical Characteristics of Yoghurt Manufactured with Ewe's and Skim Milk". *World Journal of Dairy and Food Sciences*, 4(2): 136-140.

Dinakar P. and Mistry V.V. (1994). Growth and viability of *Bifidobacteriumbifidum* in Cheddar cheese. *Journal of Dairy Science*, (77):2854-2864

FAO/WHO (2001). Probiotics in food Health and nutritional properties and guidelines for evaluation. Report of a Joint FAO/WHO Expert Consultation on Evaluation of Health and Nutritional Properties of Probiotics in food including Powder Milk with live Lactic acid Bacteria. Cordoba, Argentina, 1-4 October 2001. https://www.who.int/foodsafety/fs_management/en/probiotic_guidelines.pdf

Food and Drug Administration (FDA)(2004).Guidance for Industry: Juice HACCP Hazards and Controls Guidance First Edition. March 3.

GangwarR., Hafsa A.H.,Prashant K. and Naveen K.S. (2016). Development and Quality Evaluation of Yoghurt Fortified with Pineapple, Apple and Sweet Lemon Juice (Fruit Yoghurt). *International Journal of Engineering Research and Technology* (IJERT), 5(3): 621-629.

Hossain Md. F., Shaheen A., Mustafa A. (2015). Nutritional Value and Medicinal Benefits of Pineapple. *Nutritional Value and Medicinal Benefits of Pineapple*,4(1): 84-88.

Khan K., Rehman S.U., Khan M.A., Anwar F. and Bhadar S. (2008). Physical and chemical quality appraisal of commercial yoghurt brands sold at Lahore ARPN.*Journal of Agricultural and Biological Science*, 3(3): 14-21.

Kosikowski F.V. (1978). Cheese and Fermented Milk Foods. 2nd Ed. Cornell Univ. Ithaca, New York.

Ling E. R. (1963). A Text - Book of Dairy Chemistry. Vol. 2, Practical, 3rd Ed, Champan and Hall, London, England.

Sawant P., Dilip K., Vaibhav P., Yeshwant I. and Dhruvaraj S. (2015).Physico-chemical, Sensory and Microbial Quality of Yoghurt Drink Fortified with Pineapple Pulp. *International journal of food and fermentation technology*.5(1):69-63. DOI: 10.5958/2277-9396.2015.00008.2

Tharmaraj N. and Shah N. P. (2003). Selective Enumeration of *Lactobacillus delbrueckii*ssp. *bulgaricus, Streptococcus thermophilus, Lactobacillus acidophilus*, Bifidobacteria, *Lactobacillus casei, Lactobacillus rhamnosus*, and Propionibacteria. *Journal of Dairy Science*. (86):2288-2296.

Tharmaraj N. and Shah N. P. (2004). Survival of *Lactobacillus acidophilus*, *Lactobacillus paracasei* subsp. *paracasei*, *Lactobacillus rhamnosus*, *Bifidobacteriumanimalis* and Propionibacterium in cheese-based dips and the suitability of dips as effective carriers of probiotic bacteria. *International Dairy Journal*, 14(12):1055-1066.

دراسات تكنولوجية وميكروبيولوجية علي بعض مشروبات الألبان المدعمة بالبكتيريا الداعمة للحيوية

محمد نور الدين فريد حماد*، سماء محمود السيد محمود، ريهام راغب أنيس***

**** قسم الألبان، كلية الزراعة، جامعة دمياط، مصر.***

***** قسم علوم وتكنولوجيا الأغذية، كلية الاقتصاد المنزلي، جامعة الأزهر، مصر.***

الهدف الرئيسي من هذه الدراسة هو إعداد منتجات ألبان وظيفية وبشكل رئيسي المشروبات بروبيوتيك أو اللبن الزباديالمدعم بلب الأناناس. سلالة البروبيوتيك هي (A) *Lactobacillus acidophilus* LA-5، *Bifidobacteriumbifidium* و *L. acidofilus*.

أوضحت النتائج أن مزج مشروب اللبن الزبادي مع الأناناس قد زاد من نسب الحموضة المقدرة بطريقة المعايرة ويرجع ذلك إلي الطبيعة الحمضية للأناناس نفسه, زادت محتويات الـTS من المشروبات مع زيادة نسبة الأناناس؛ كانت الزيادات موازية لمستوى نسب إضافة لب الأناناس, يمكن ملاحظة أن نسبة الرماد زادت مع زيادة مستوى اللب في العينات الطازجة. WSN و TVFA ؛ لوحظ أن جميع القيم قد ازدادت بشكل كبير نتيجة لتحلل البروتين وتحلل الدهون.

تم تقدير نمو *St. thermophiles* في عينات المشروبات المدعمة بنسب مختلفة (وزن / وزن) من لب الأناناس خلال فترة التخزين, اتضح أن النسب انخفضت مع زيادة مستوى الأناناس وكذلك مع تقدم فترة التخزين. لوحظ زيادة عدد *Biffidobacteriumssp* في عينات الأناناس عن العينة الكونترول الخالية من اللب,وكانت الأعداد العينات الطازجة 33 و 36 و 44 و 46 ($cfu \times x10^5$) في C و T1 و T2 و T3 ، على التوالي. وانخفضت النسب أثناء التخزين لتصل إلى 24 و 18 ($cfu \times x10^5$) للخالية من اللب و 25 و 20 ($cfu \times x10^5$) لـ T1 ، بينما أصبحت 35 و 25 ($cfu \times x10^5$) لـ T2. اكتسبت العينة الثالثة (T3) 46 و 37 و 29 ($cfu \times x10^5$) عندما كانت طازجة وبعد أسبوع واحد وأسبوعين.

كانت درجات القوام والتركيب واضحة ومتنوعة سواء في العينات الطازجة و العينات المخزنة,وإتضح أن إضافة لب الأناناس أدي إلى إنتاج قوام غير متجانس وجزيئات متخثرة قليلاً كنتيجة للعمل الحمضي للأناناس,وأشارت درجات النكهة إلى أن العينة المفضلة كانت T3، حيث حصلت علي 47.71 و 47.90 و 47.99 نقطة عندما كانت طازجة وبعد أسبوع وأسبوعين على التوالي. وتشير درجة القبول الكلية إلى أن عينات التحكم كانت أعلى الدرجات.