Minufiya J. Agric. Res. Vol. 32 No.2: 391 - 404 (2007)

FORTIFICATION FROZEN YOGHURT WITH DIFFERENT LEVELS OF BEE POLLEN AS FUNCTION FOOD

Eman, T. A. Yousef; E. A. Y. Essawy and W. A. Gafour.

Food Technology Research Institute, Agriculture Research Center, Giza, Egypt.

(Received: Feb. 25, 2007)

ABSTRACT: ***Five batches of frozen yoghurt were made to study the effect of Bee pollen on the quality of frozen yoghurt and the viability of yoghurt starter. Mix base containing 6% Fat, 15% Sucrose, 14% milk solids not fat and 0.50% gelatin was prepared. The first served as control and the other four portions were fortified with Bee pollen at level of 0.25, 0.50, 0.75 and 1.0% for treatments T_1, T_2, T_3 and T_4 respectively. T_4 which contained the highest ratio of from Bee pollen had the highest acidity and was not significantly different from T_2 and T_3, while the mix control had the highest pH value, specific gravity and weight per gallon. Treatments made with more than 0.25% Bee pollen had high overrun and least specific gravity and weight per gallon, while T_3 was the best melting resistance. Neither the level of Bee pollen nor the storage period affect the fat, protein and carbohydrate content of frozen yoghurt. Addition of Bee pollen increased the level of ash, diacetyl and acetyl methyl carbinol, acetaldehyde and counts of lactic acid bacteria. Treatment (T_2) which made 0.50% by adding Bee pollen had the highest flavour, Body & texture and melting quality scores, while T_4 had the lowest scores.***

Key words*: frozen yoghurt, Bee pollen.*

INTRODUCTION

Frozen desserts manufacture has been increased markedly in Egypt, because of increasing their popularity. One of these frozen desserts is the frozen yoghurt which has the flavour of yoghurt and quality of ice cream.

Yoghurt is the most popular fermented milk in Egypt and all over the world. Consumption of yoghurt in Egypt has nearly doubled in the past three years. The nutritive value of yoghurt is based on the nutritive value of milk from which it is made. It has increased digestibility, and prophylaxis and healthy effects in certain conditions (Rasic and Kurman, 1978; Marshall, 1984).

The levels of trace elements and some amino acids are not sufficient in milk and dairy products for human daily requirements (Jayasekara *et al.,* 1992). Some investigators tried to enrich milk and dairy products with a mixture of these elements, using different salts (Seteils *et al.,* 1994; Degheidi and Abd Rabou, 1998). Unfortunately, some of these salts may cause health

problems to the consumer. Therefore, much attention has been focused on using natural additives for example Bee pollen.

Interestingly, bee pollen has received a fair amount of attention over the last few decades. Bee pollen is a food that has been universally praised for its impressive nutrient content and remarkable ability to provide energy (Orzaez–Villanueva *et al.,* 2001). Bee pollen is a rich source of B–vitamins including B_1, B_2, B_3, B_5 and B_{12} (Rita-Elkins, 2001). Also it contains vitamins A, C, E and folic acid plus over 100 different kinds of enzymes and factors (Serra Bonvehi and Escola Jarda, 1997).

Bee pollen contains various compounds which can speed healing, help the cells against free radical damage (Wright *et al.,* 1995), protect the bodies from devastating side effects of pollutant or radiation exposure, counteract against toxins (Florek and Leciejewska, 1995), inhibit the growth of malignat cells, lower cholesterol level (Barth *et al,* 1990), remedy against decling memory functions and anti-ageing (Iversen *et al.,* 1997). Consequently, bee pollen induces valuable effect on human health.

Therefore the objective of this study were increasing nutritive and healthy value of frozen yoghurt and to investigate the effect of adding bee pollen grains on frozen yoghurt properties.

MATERIALS AND METHODS

Ingredients

The following materials were used in preparing frozen yoghurt: buffaloe's milk (the herd of the Faculty of Agriculture, Cairo University, Egypt), non fat dry milk (Ecoval N.V., Paris, France), sucrose (Local market), vanilla (Aromisr, Egyptian Sugar and Distilleries Company, Food Flavours and Essences Factory, Cairo, Egypt), gelatin (CP kelco, Chicago, IL USA). Cream was obtained by separating fresh buffaloe's milk in the Dairy Science Department, Food Technology Research Inst. Agriculture Research centre, Giza, Egypt. Bee pollens were collected from honey bee colonies established in the Apiary of Agric. Experimental Station, Faculty of Agric, Cairo Univ., Giza. Bee Pollen. Bee pollen were sieved, air dried and stored in glass containers in refrigerator until used.

Preparation of frozen yoghurt

Control frozen yoghurt mix was free from Bee pollen, with milk 6% fat, 14% milk solids-not-fat, 15% sucrose, and 0.5% gelatin was prepared according to Arbuckle, (1986). The prepared mix was heated to 90°C then cooled to 42°C and starter which was composed of 2.0% mixed normal starter (*Streptococcus salivarius sub sp. thermophilus* and *Lactobacillus delbruekii sub sp. bulgaricus*). The amount of normal starter was chosen according to Yousef (1996).

Mix was incubated at 42°C until it was coagulated. All other from frozen yoghurt treatments were prepared as described above except Bee pollen was added at ratio 0.25% (T1), 0.50% (T2), 0.75% (T3) and 1.0% (T4) respectively.

The resultant frozen yoghurt was then packaged in plastic cups and placed in deep freezer held at -18°C for hardening for 24 hrs. Frozen yoghurt was stored at -20°C for 8 weeks. Samples from each frozen yoghurt treatment were taken when fresh at zero days and every two weeks up to the eighth week for chemical, bacteriological and sensory evaluation. The whole experiment was done in triplicate.

Physical and chemical analysis

Each frozen yoghurt mix was tested (before freezing) for titratable acidity and pH (ling, 1963), specific gravity (Winton, 1958) and weight per gallon (Burke, 1947), overrun (Arbuckle, 1986), and melting resistance (Reid and Painter, 1933). Samples from each frozen yoghurt were analyzed at zero time and every two weeks for pH values, Fat, total protein, total solids (ling, 1963), ash content (AOAC 1975), carbohydrate content were calculated by difference [total solids- (protein + fat + ash) contents]

Acetaldehyde content was measured using Shimadzu (240 UV– Vis) spectrophotometer (Japan) as described by (Lee and Jago 1970) diacetyl and acetyl methyl carbinol were determined according to (Brandel, 1960).

Bacteriological analysis

Total bacterial counts were enumerated on standard plate count agar (Marth, 1978). Lactic acid bacterial was enumerated on Elliker's medium, (Elliker *et al.,* 1956). Psychrophilic bacterial count was measured using Nutrient agar medium (Oxoid) as reported in the Difco manual (1984). The plates were incubated at 4°C for 72 hrs.

Sensory evaluation

Organoleptic properties of each frozen yoghurt treatment were assessed by ten panelists from the staff members of Department of Dairy science, Food Technology Research Ins. Agriculture Research center, Giza according to Farag *et al.,* (1993).

Statistical analysis

Factorial design 2 factors 3 replicates and the completely randomized design were used to analyze all the data and Newman keuls test was followed to make the multiple comparisons, (Steel and Torrie, 1980) using COSTAT program. Significant differences were determined at $P \leq 0.05$.

RESULTS and DISCUSSION

Mix properties

Treatment (T_4) which contained the highest ratio from Bee pollen had the highest acidity (Table 1). Conversely, control which free from Bee pollen had the lowest acidity and was not significantly different from T_1 and T_2.

Gradually increase in acidity of treated mix containing Bee pollen may be due to the increasing addition ratio of Bee pollen.

It was found that there were insignificant differences in pH values between control mix (C), treatment (T_1) and treatment (T_2) (Table 1). On the other hand, while the pH values of treatments T_3 and T_4 decreased significantly ($P \leq 0.05$) lower than those of control (C), T_1 and T_2.

The specific gravity and weight per gallon of control (C) which was free from Bee pollen was significantly ($P \leq 0.05$) higher than the other treatments (Table 1). Weight per gallon of the mixes was closely related to the specific gravity of the corresponding mixes (Table 1). Treatments T_2, T_3 and T_4 were not significantly ($P > 0.05$) different in both specific gravity and weight per gallon. This means that addition of Bee pollen caused a significant decrease ($P \leq 0.05$) in the specific gravity and weight per gallon. This means that addition of Bee pollen caused a significant decrease ($p \leq 0.05$) in the specific gravity and weight per gallon.

Table (1): Effect of different Bee pollen ratios on some properties of frozen yoghurt mixes.

Treatments	Acidity (%)	pH value	Specific gravity	Weight per gallon (kg)
C*	0.59^{c}	5.09^{a}	1.160^{a}	4.392^{a}
T_1	0.60^{bc}	5.06^{a}	1.137^{b}	4.304^{b}
T_2	0.62^{abc}	5.00^{a}	1.095^{c}	4.145^{c}
T_3	0.63^{ab}	4.98^{b}	1.093^{c}	4.138^{c}
T_4	0.65^{a}	4.92^{b}	1.091^{c}	4.130^{c}

C* = Control frozen yoghurt were free Bee pollen
T_1 = Frozen yoghurt made with 0.25% Bee pollen
T_2 = Frozen yoghurt made with 0.50% Bee pollen
T_3 = Frozen yoghurt made with 0.75% Bee pollen
T_4 = Frozen yoghurt made with 1.00% Bee pollen
a,b,c Means with different superscript letter in the same column are significantly different ($P \leq 0.05$)

Fresh frozen yoghurt

It could be noticed that control (C) frozen yoghurt was significantly lower than treatments T_2, T_3 and T_4 ($P \leq 0.05$), while it was not significantly different ($P > 0.05$) from treatment T1 in overrun (Table 2). This means that making frozen yoghurt by addition 0.25% Bee pollen did not affect significantly the overrun.

Treatment (T_1) which made with 0.25% Bee pollen had the highest specific gravity and weight per gallon and was not significantly different from control ($P > 0.05$). This might be due to the decrease of overrun.

The effect of different ratio of Bee pollen on the melting resistance of fresh frozen yoghurt is shown in Table (2). Treatment (T_2) which made with adding 0.50% had the lowest melted portion and significantly different from other treatments ($P \leq 0.05$) in the first 60 min. and next 30 min. During the next 30 minutes period it could be noticed that the melted portion slightly increased in all treatments and the mean values were 40.0, 41.20, 35.00, 39.30 and 40.20,

while the same treatment (T_2) had the highest melted portion in the last 30 minutes and significantly different from the other treatments (P≤ 0.05). This means that addition 0.50% of Bee pollen increased the melting resistance significantly (P≤ 0.05).

Table (2): Effect of different Bee pollen percent on some properties of fresh frozen yoghurt.

Treatment*	Overrun	Specific gravity	Weight per gallon	Melting resistance (loss % at 30°C)		
				First 60 min.	Next 30 min.	Last 30 min.
C*	11.00 [c]	1.170 [a]	4.429 [a]	35.40 [a]	40.00 [a]	24.00 [b]
T_1	11.6 [c]	1.190 [a]	4.505 [a]	35.30 [a]	41.20 [a]	23.20 [b]
T_2	34.1 [b]	1.112 [b]	4.210 [c]	30.50 [b]	35.00 [b]	34.30 [a]
T_3	39.7 [a]	1.146 [b]	4.339 [b]	34.20 [a]	39.30 [a]	26.20 [b]
T_4	35.00 [b]	1.150 [b]	4.354 [b]	34.50 [a]	40.20 [a]	25.00 [b]

*** see Table (1)**

a,b,c Means with different superscript letter in the same column are significantly different (P≤0.05)

Frozen yoghurt during the storage

The results showed significant (P≤ 0.05) differences among frozen yoghurt treatments (Tables 3 and 5). It was found that T_3 and T_4 had lower pH than control, T_1 and T_2. There were negative correlation between increasing ratio from Bee pollen and PH value. This may be due to Bee pollen stimulate the activity of bacteria starter. Treatments T3 and T4 were not significantly (P > 0.05) different from each other in pH value and also control (C), T_1 and T_2 were not significant different. On the other hand, pH values were slightly decreased during storage period in all treatments. These results are in agreement with those reported by Kebary (1996), who found that in frozen zabady samples, the pH values decreased during storage at -25± 2°C.

There were slight significant (P≤0.05) differences among frozen yoghurt treatments in total solids (Tables 3 and 5), which means that the addition of different ratios from Bee pollen have slight (P≤0.05) effect on the total solids of frozen yoghurt. But total solids of all frozen yoghurt treatments did not change significantly (P>0.05) during storage period (Tables 3 and 5). These results are in agreement with those found by Kebary (1996), who reported that total solids content of frozen yoghurt samples did not change significantly (P>0.05) during storage at -25± 2°C for 5 weeks.

Control frozen yoghurt had the lowest ash content and was not significantly (P>0.05) different from treatments T_1, T_2 and T_3, while treatment T_4 which made with 1% Bee pollen had the highest ash content but was not significantly (P>0.05) different from with T_1, T_2 and T_3. This means that increasing Bee pollen ratio affect significantly of ash content of frozen yoghurt, this may be due to that Bee pollen is a rich source of minerals

Sahar, (2003). On the other hand, ash content of frozen yoghurt samples did not change significantly throughout storage period (Tables 3 and 5). The obtained results were in agreement with those reported by Hussein and Badawi (1999), who found that ash content of ice milk did not change significantly (P>0.05) during ten weeks of frozen storage.

Frozen yoghurt treatments were not significantly (P>0.05) different from each other in Fat, protein and carbohydrate content (Tables 3 and 5). This means that the addition of Bee pollen did not affect significantly (P>0.05) the fat, protein and carbohydrate content of frozen yoghurt. On the other hand fat, protein and carbohydrate content of frozen yoghurt samples did not change significantly throughout the storage period (Tables 3 and 5). The obtained results are in agreement with those reported by Hussein and Badawi (1999), who found that fat and protein content of ice milk did not change significantly (P> 0.05) during ten weeks of frozen storage.

Table (3): Chemical composition of frozen yoghurt during storage of control and samples with different Bee pollen ratios.

Treatments	Storage period (weeks)				
	0	2	4	6	8
	pH values				
C	5.08	5.07	5.08	5.06	5.02
T_1	4.98	4.96	4.92	4.90	4.85
T_2	4.92	4.90	4.89	4.89	4.87
T_3	4.85	4.87	4.83	4.81	4.79
T_4	4.84	4.85	4.80	4.78	4.77
	Total solids %				
C	33.56	33.63	34.05	34.18	34.25
T_1	33.72	33.79	34.18	34.41	34.51
T_2	33.92	34.02	34.35	34.68	34.79
T_3	34.19	34.25	34.72	34.92	35.02
T_4	34.48	34.61	34.98	35.18	35.27
	Ash				
C	0.98	1.01	1.02	1.07	1.08
T_1	1.02	1.05	1.05	1.09	1.11
T_2	1.08	1.10	1.08	1.11	1.13
T_3	1.10	1.13	1.11	1.15	1.16
T_4	1.13	1.20	1.13	1.16	1.18
	Fat %				
C	5.01	4.98	5.03	5.07	5.12
T_1	5.01	5.00	5.02	5.04	5.06
T_2	5.00	5.01	5.05	5.07	5.12
T_3	4.99	5.11	5.04	5.08	5.14
T_4	4.97	4.98	5.07	5.03	5.09
	Total protein %				
C	6.48	6.51	6.58	6.62	6.61
T_1	6.56	6.59	6.66	6.60	6.69
T_2	6.89	6.69	6.70	6.80	6.81
T_3	6.80	6.83	6.85	6.94	6.95
T_4	7.01	7.03	7.03	7.14	7.16
	Carbohydrates %				
C	21.09	21.13	21.42	21.43	21.44
T_1	21.13	21.15	21.45	21.58	21.65
T_2	21.18	21.22	21.52	21.70	21.73
T_3	21.30	21.28	21.72	21.75	21.77
T_4	21.37	21.40	21.80	21.85	21.84

*** see Table (1)**

The obtained results indicated that T_4 which was made with adding 1% Bee pollen contained the highest acetaldehyde content (Tables 4 and 5) and was not significantly different from T_2 and T_4, while the lowest content was found in control frozen yoghurt which was significantly (P≤ 0.05) different from other treatments. Acetaldehyde content increased gradually as Bee pollen addition increased. This due to Bee pollen stimulate the formation of acetaldehyde as a result of the high nutritive value Bee pollen grains particularly vitamins, minerals and amino acids Sahar, (2003) and Jayasekara *et al.,* (1992). On the other hand, acetaldehyde content slightly decreased as storage period progressed.

Control frozen yoghurt contained the lowest in Diacetyl and acetyl methyl carbinol and was significantly different from other treatments (Table 4 and 5). Treatments T_1, T_2, T_3 and T_4 were not significantly different. This might be due to that Bee pollen encourage the starter activity as a result of the high nutritive value particularly vitamins, minerals and amino acids. It could be noticed that diacetyl and acetyl methyl carbinol decreased slightly at the end of storage period (P > 0.05) (Table 4 and 5). This decrease might be due to the reduction of these compounds (Cogan, 1974).

Table (4): Effect of different percent of Bee pollen on acetaldehyde, diacetyle and acetyl methyl carbinol contents of frozen yoghurt during storage period.

Treatments	Storage period (weeks)				
	0	2	4	6	8
	Acetaldehyde (m mol/100g)				
C	20.12	20.05	19.98	19.93	19.90
T_1	21.52	21.49	21.45	21.42	21.45
T_2	22.74	22.75	22.62	22.48	22.45
T_3	22.81	22.79	22.73	22.56	22.43
T_4	23.52	23.49	23.39	23.37	23.29
	Diacetyl and acetyl methyl carbinol (µg/100g)				
C	7.15	7.25	7.36	7.12	7.02
T_1	8.10	8.20	8.28	8.09	8.01
T_2	8.25	8.34	8.32	8.17	8.09
T_3	8.34	8.45	8.39	8.29	8.17
T_4	8.32	8.51	8.72	8.46	8.29

*** see Table (1)**

Table (5

Bacteriological properties

Counts of total bacteria decreased gradually in all treatments up to the end of storage period (Table 6). This may be attributed to the effect of frozen storage on bacterial growth (Banwart, 1980) or due to increase in acidity. These results are in agreement with those obtained by Kebary (1996); Big and Prased (1997), who found that total bacterial counts decreased during preparation and storage of frozen yoghurt. On the other hand, control (C) which was free from Bee pollen grains had the lowest total bacterial count, while treatment T_4 (1% Bee pollen grains) contained the highest total bacterial counts. Total bacterial count increased gradually as Bee pollen grains ratios increased which means that Bee pollen grains enhanced the growth of bacteria and acts as cryogenic agent as a result of its high nutritive value particularly vitamins, minerals and amino acids.

Table (6): Behaviour of bacteria during storage of frozen yoghurt made with different Bee pollen percent.

Treatments	Storage period (weeks)				
	0	2	4	6	8
	Total bacterial count (cfu/ml x 10^5)				
C	200	120	38	25	18
T_1	280	184	42	30	22
T_2	330	245	220	65	28
T_3	322	300	250	80	50
T_4	375	320	280	90	40
	Lactic acid bacterial count (cfu/ml x 10^5)				
C	155	61	32	8	2
T_1	215	75	45	15	3
T_2	269	250	200	58	20
T_3	300	290	141	62	30
T_4	340	300	250	70	35
	Psychrophilic bacterial count (cfu/ml x 10)				
C	55	45	21	20	15
T_1	50	39	10	2	6
T_2	20	15	6	5	4
T_3	25	12	4	3	4
T_4	20	9	4	2	5

*** see Table (1**

Lactic acid bacterial counts followed similar trends of total bacterial count. Lactic acid bacterial counts decreased gradually in all treatments up to end of storage period (Table 6). These results are in agreement with those obtained by Inoue *et al.,* (1998), who stored frozen yoghurt for 6 months at -35°C and found that the counts of viable lactic acid bacteria decreased during storage. On the other hand, the highest lactic bacterial counts were found in treatment T_4, which made with adding 1% Bee pollen grains. Control frozen

yoghurt had the lowest lactic acid bacterial counts this may be due to the high nutritive value of pollen grains particularly vitamins, minerals and amino acids which enhanced the growth of bacteria.

Results indicated that the count of Psychrophilic bacteria (Table 6) decreased gradually as storage period advanced in all treatments. Psychrophilic bacteria count decreased as Bee pollen grains ratio increased. Control which was free from Bee pollen grains had the highest Psychrophilic bacteria count, while treatment T_4 which made with adding 1.0% Bee pollen grains had the lowest Psychrophilic bacteria count, this may be due to the effect of Bee pollen grains, the count of Psychrophilic bacteria still lower than the other investigators. This means that the product was made under good hygienic condition.

Organoleptic properties:

Scores of organoleptic properties of frozen yoghurt are presented in Tables (7 and 5). The results indicated that treatment (T_2) which made with 0.50% Bee pollen had the highest flavour, Body and texture and melting quality scores, while treatment (T_4) which made with 1% Bee pollen had the lowest scores. This means that adding Bee pollen in ratio more than 50% retarded the organoleptic properties of frozen yoghurt.

Statistical analysis show that treatment (T_2) gained the highest total scores and was not significantly different from control and T_1.

On the other hand, there was negative correlation between storage period and total scores of all frozen yoghurt treatments which decreased insignificantly ($P > 0.05$) as storage period progressed (Kebary, 1996).

Conclusion, addition of Bee pollen increased the level of ash, diacetyl and acetyl methyl carbinol, acetaldehyde and counts of lactic acid bacteria. Treatment (T_2) which made 0.50% by adding Bee pollen had the highest flavour, body & texture and melting quality scores.

Table (7

REFERENCES

A.O.A.C. (1975). Offical Method of Analysis of the Association of analytical chemists. 12th ed. Published by the Association of Official Agriculture chemists, Washington, D.C.

Arbuckle, W. S. (1986). Ice Cream 4th ed., The AVI publishing Co. Inc. West port, Connecticut, U.S.A.

Banwart, G. J. (1980). Basic Food Microbiology. AVI publishing Co., Inc. Westport, Connecticut.

Barth, C. A., K. E. Scholz-Ahrens, M. De vrese and A. Hotze (1990). Difference of plasma amino acids following casein or soy protein intake: significance for differences of serum lipid concentrations. J. Nutr. Sci., Vitaminol. 36: pp.111-117.

Big, M. I. and V. Prasad (1997). Biological, microbiological and sensory an aracteristics of frozen yoghurt fortified with whey solids. Indian J. Dairy Sci. 49 (9): 585-592.

Brandel, E. (1960). Determination of Diacetyl and acetyl methyl carbinol of the starter culture. Milchwissensh. Of thiche Berichte, Wolf passing 10 (4): 289-303.

Burke, A. D. (1947). Practical Ice Cream Making. The Olsen publishing Co. Milwaukee, Wis. USA.

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

Degheidi, M. A. and N. S. Abd Rabou (1998). Effect of zinc salts on the ripening process of Ras cheese. Egyptian conf. Dairy Sci. and Tech: proc 7th pp. 403-416.

Difco manual (1984). Dehydrated culture media and reagents for microbiological and clinical laboralory procedures, pub-Difco lab. Detroits, Michigan, U.S.A.

Elliker, P. K., A. Anderson and C. Hannesson (1956). An agar culture medium for lactic streptococci and Lactobacilli. J. Dairy Sci. 39, 116.

Farag, S. I., A. E. Khader, A. M. Mousa and A. M. El-Batawy (1993). A study on ice cream. I. On the use of high fructose syrup as a sweetener. Egyptain J. Dairy Sci., 21 (1): 97-107.

Florek, E. and A. Leciejewska (1995). Attempted application of apiarian preparation in prophylaxis of trichloroe thylene poisoning. Herba polonica, 41: (2): 70-76.

Hussein, S. A. and R. M. Badawi (1999). Effect of fat substitutes on physico, chemical and organoleptic properties of low fat ice milk. Minufiya J. Agric. Res., 24 (3) : 923-935.

Inoue, K., K. Shiota and T. Ito (1998). Preparation and properties of ice cream type frozen yoghurt. Inter. J. Dairy Techn. 51 (2) : 44-50.

Iversen, T., K. M. Fiirgaard, P. Schriver, O. Rasmussen and F. Andreasen (1997). The effect of Naolisu on memory Functions and blood chemistry in elderly people. J. Ethnopharmacology 56 (2): 109-116.

Jayasekara, S., Samara M. Jeewa and AN. Jayakody (1992). Trac elements in foods of animal origin in Serilanka. ASEAN, Food J., 7 (2) 105-107. Cited from food sci. tech. Abst. (1990).

Kebary, K. M. K. (1996). Viability of *Bifidobacterium bifidum* and its effect on quality of frozen zabady. Food research Inter. 29 (5/6): 431-437.

Kivance, M., M. Yamac and B. Kunduhoglu (1996). The microbiological analysis of ice cream marketed in eskisehir. Eskisehir'de Halkin Tuketimine Sunulan Dondurmalarn Mikrobiyolojik Analizi Gida 19 (5): 317-322. C.F. Dairy SCI. Abs. Vol. 57, No.1.

Lee, G. J. and G. R. Jago (1970). the estimation of diacetyl in the presence of other carbonyl compounds. J. Dairy Res. 37-129.

Ling, E. R. (1963). A text Book of Dairy chemistry. Vol. 2,3 ed. Chapman and Hall, Ltd., London.

Marshall, V. M. E. (1984). Flavour development in fermented milks. In Advances in the Microbiology and Biochemistry of Cheese and Fermented milk, eds.F. VL. Davis and B. A.Law.E1 Sevier Applied Sci. pubishers, London.

Marth, E. H. (1978). Standard Methods for the Examination of Dairy Products. 14th ed., Am. Publ. Health Assoc., Washington D.C.

Orzaez-Villanueva, M.T., A. Diaz-Marquina, R. Bravo-Serranq and G. Blazquez-Bdellan (2001). Mineral content of commercial pollen. Intr. J. Food Sci. Nut., 52 (3): 234-249.

Rasic, J. L. and Kurman, J. A. (1978). Biology of the bifidobacteria. Bact Rev., 37, 136.

Reid, W. H. E. and W. E. painter (1933). The freezing properties, stability and physical quality of chocolate ice cream. Missouri, Agric. Exp. Sta. Bull., 185.

Rita-Elkins, M. A. (2001). Healing from the hive-bee pollen, royal Jelly, propolis and honey. This file was downloaded from www. Beehive treasures.com

Sahar, A. A. (2003). Biochemical studies on elderly people nutrition. P.H.D. thesis, Cairo University Egypt.

Serra-Bonvehi, S. J. and E. R. Escola-jord (1997). Nutrient composition and microbiological quality of honeybee- collected pollen in Spain. J. Agric. Food chem.., 45: 725-732.

Seteils. A., J. M. Gerome, J. C. Pirlet and F. Wats (1994). Nutrient enriched milk drink. International patent application (1994) WHO 94-05159-A2.

Steel, R. G. D. and J. H. Torrie (1980). Principles and Procedures of statistics. A. Biometrical Approach. 2nd ed. Mc Graw-Hill Book Co., New York.

Winton, A. L. (1958). Analysis of foods. 3rd printing p. 6 John Wiley and Sons Inc. New York.

Wright, A. J. A., Susan Southon, Angela, L. Bailey and P. M Finglas (1995). Nutrient intake and Biochemical status of non-institutionalized elderly subjects in Norwich: comparison with younger adults and adolescents from the same general community. British J. Nutr. 74: 453-475.

Yousef, E.T. (1996). Studies on some fermented dairy products. M. Sc thesis, Fac. Agric., Minufiya Univ., Egypt.

تدعيم الزبادي المجمد بحبوب لقاح نحل العسل كغذاء وظيفي

إيمان توفيق عبد العزيز يوسف – إيهاب عبد الباقي يوسف عيسوي –

وليد عبد المتعال محمد سليمان جافور

معهد بحوث تكنولوجيا الأغذية – مركز البحوث الزراعية – قسم بحوث الألبان

الملخص العربي

تم تصنيع يوجورت مجمد وتدعيمه بحبوب لقاح نحل العسل لما لها من قيمة غذائية عالية وفوائد صحية متعددة وبيان أثر إضافتها على الخواص المختلفة للمخلوط وكذلك على المنتج في حالته الطازجة وأيضا أثناء التخزين لمدة ثمانية اسابيع ، ولذلك فإنه في هذا البحث فقد تم تصنيع اليوجورت المجمد والذي احتوى مخلوطة على ٦% دهن، ١٤% جوامد لبنية لا دهنية، ١٥% سكروز، ٠,٥% جيلاتين ككنترول وتم إضافة حبوب اللقاح بالنسب ٠.٢٥% ، ٠.٥٠% ،٠.٧٥% ، ١% للمعاملات ١، ٢، ٣، ٤ على التوالي وقد أظهرت النتائج المتحصل عليها بعد تحليلها إحصائيا ما يلي:-

- أعطى مخلوط المعاملة الرابعة أعلى حموضة ولم يختلف معنويا عن المعاملة الثالثة والثانية وكان أقلها حموضة الكنترول وكان قيمة الـ pH على العكس من ذلك، بينما أعطى مخلوط الكنترول أعلى وزن نوعي والوزن بالجالون بينما كان أقلهم في المعاملات الثانية والثالثة والرابعة والتي لم تختلف معنويا عن بعضهم البعض.
- أدت زيادة حبوب اللقاح عن ٠.٢٥% إلى ارتفاع نسبة الريع، بينما أدت إلى انخفاض الوزن النوعي والوزن بالجالون لليوجورت المجمد الطازج، وكانت أفضل معاملة مقاومة للانصهار هي تلك المدعمة بـ ٠.٥٠% حبوب لقاح.
- كانت المعاملة الرابعة والثالثة والثانية أعلاهم في الجوامد الكلية والرماد ولكن لم تتأثر هذه المعاملات بفترات التخزين.
- لم يكن هناك اختلافات معنوية بسبب زيادة حبوب اللقاح في الدهن والبروتين والكربوهيدرات وكذلك لم تتأثر بطول فترة التخزين.
- كانت المعاملة الرابعة أعلى المعاملات في محتواها من الأسيتالدهيد وانخفضت قليلا بطول فترة التخزين.
- احتوى الكنترول على أقل نسبة من الداي أسيتايل و الأسيتايل ميثايل كربينول.
- كانت المعاملة الثانية والمدعمة بـ ٠.٥٠% حبوب لقاح أفضل خواص حسية.
- ازدادت الأعداد البكتيرية الكلية وبكتيريا حمض اللاكتيك تدريجيا بزيادة إضافة حبوب اللقاح ولكن كان أفضل المعاملات هي المعاملة الثانية والتي دعمت بـ ٠.٥٠% حبوب لقاح.

Fortification frozen yoghurt with different levels of bee pollen ……..

Eman, T. A. Yousef; E. A. Y. Essawy and W. A. Gafour.

Table (5): Statistical analysis of frozen yoghurt properties made with different Bee pollen during storage period.

Frozen yoghurt properties	Effect of treatments							Effect of storage periods (week)				
	Mean squares	Multiple comparison					Mean squares	Multiple comparison				
		C	T_1	T_2	T_3	T_4		Zero	2	4	6	8
pH values	0.150*	A	A	A	B	B	0.014	A	A	A	A	A
Total solids (%)	8.079*	B	BC	AB	AB	A	2.014	A	A	A	A	A
Ash content (%)	0.070*	B	AB	AB	AB	A	0.028	A	A	A	A	A
Fat content (%)	0.639	A	A	A	A	A	3.934	A	A	A	A	A
Protein content (%)	1.352	A	A	A	A	A	0.064	A	A	A	A	A
Carbohydrate content (%)	0.870	A	A	A	A	A	0.841	A	A	A	A	A
Acetaldehyde content m mol/100g	26.629*	C	B	AB	AB	A	0.155	A	A	A	A	A
Diacetyl and acetyl methyl carbinol (Mg/100g)	3.907*	B	A	A	A	A	0.203	A	A	A	A	A
Total organoleptic scores	179.58*	AB	AB	A	B	C	43.080	A	A	A	A	A

*** See Table (1). Significant at 0.05 level.**

The different letters in the means multiple comparisons are different from each. Letter A is the highest mean followed by B,C…etc.

Table (7): The organoleptic properties of frozen yoghurt made with different percent Bee pollen during storage period.

Treatments *	Flavour (50)					Body and texture (35)					Melting quality (10)					Appearance (10)					Total scores (100)				
	Storage period (weeks)					Storage period (weeks)					Storage period (weeks)					Storage period (weeks)					Storage period (weeks)				
	0	2	4	6	8	0	2	4	6	8	0	2	4	6	8	0	2	4	6	8	0	2	4	6	8
C	46	45	45	44	44	28	28	27	27	27	8	8	8	8	8	10	10	10	10	9	92	91	90	89	88
T_1	46	45	45	44	44	29	28	27	26	25	8	8	8	8	8	9	9	9	9	9	93	91	90	88	87
T_2	47	46	46	45	45	29	28	28	27	26	9	9	9	9	9	9	9	9	9	9	93	91	91	89	88
T_3	45	45	44	43	42	27	26	26	26	25	8	8	8	8	8	8	8	9	9	9	88	87	87	86	84
T_4	43	42	42	42	41	26	25	25	25	25	8	8	9	8	8	7	7	7	7	7	84	82	82	82	81

*** See Table (1)**

each value in the table is the mean of three replicates.