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STUDY OF SUPPLEMENTED YOGHURT PRODUCTION WITH DIFFERENT VEGETABLES: QUALIFICATIONALLY AND SENSATIONALLY

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ABSTRACT: *Yoghurt is the most popular milk product owing to its particular physical, nutritional, probiotic and organoleptic properties. This study was conducted to prepare vegetables yoghurt fortified with 10 % of different vegetables (fresh cucumber and garlic, cucumber and dried mint leaf, fresh green pepper and dried mint leaf, fried eggplant and garlic, cucumber-garlic and mint leaf, and all mixed vegetables as cocktail), compared with plain yoghurt without any addition. Physicochemical, sensory evaluation and microbiological properties were analyzes to assay the quality of yoghurt products. The total solid, pH and the acidity of vegetable yoghurts supplemented products were increased significantly than plain yoghurt. Statistical analysis showed that yoghurts supplemented with 10% of fried eggplant and garlic, and then cucumber mixed with garlic were more acceptable than others vegetables comparing all quality properties. Sensory evaluation of the yoghurt products was improved due to supplementation of 10 % of both eggplant and cucumber supplementation. The flavor, texture and consistency, acidity, appearance and the total of the yoghurt products were very good acceptable by the panelists. The period storage of supplemented yoghurt did not affect the quality significantly, which was a good index for producing those healthy dairy products. The microbiological determination of the vegetable yoghurt products was also acceptable and lay within the Iraqi quality standard, due to the increased acidity content of those dairy products. The findings of this study may give an overall idea about manufacturing of vegetables yoghurt supplementing 10% concentration and appropriate technology of vegetable preparation side to side with plain yoghurt.*

KEYWORDS: Yoghurt Supplementation, Different Vegetable, Physicochemical Analysis, Sensory, Microbial Evaluation

INTRODUCTION

Yoghurt is produced by a fermentation process during which a weak protein gel develops due to a decreased pH of the milk by the conversion of lactose to lactic acid by the culture bacteria. Yoghurt is an important dairy product, and is accepted all over the world due to its high nutritive value and positive effects on human health are based on cultures containing viable bacteria (Streptococcus thermophiles and Lactobacillus delbrueckii susbsp. Bulgaricus) that are considered probiotics. Now, the product has gained an international recognition with yogurt and many other countries use yoghurt (Hayaloglu et al. 2007).

While most consumers are aware of the health benefits of low-fat diet, they are not prepared to sacrifice the taste, texture and aroma they enjoy in the dairy products in exchange for healthier products (Mcllveen & Armstrong, 1995). Thus, the goal of the food industry is to respond to

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consumer demand and to offer an increasing variety of low fat choices, in which the attributes that the consumer's desire is not impaired (Al-Humied, et al. 2010).

Yoghurt products have gained considerable economic importance worldwide due to their high nutritional content that can be increased by adding nutritional and pharmaceutical ingredients (Guggisberg, et al. 2009). In recent years, addition of different types of vegetables, dietary fibers, fruits, and different types of jams in fermented milk products have increased the numbers of researchers with increasing diversity in the field of functional foods (Cristina, 2013). Addition of mashed or chopped vegetables to yoghurt is an effective tool for reducing calories and fat (Nulifer 2003), nutritive values of their fibers, vitamins, and many minerals (Miguel, et al. 2003). Although some rheological characteristics were modified, the supplemented yoghurts were acceptable to consumers (Brennan and Carmen 2008). Yoghurt fortified with different vegetables had a different color, flavor, and texture compared with unfortified yoghurt (Peng, et al. 2009).

Therefore, the objectives of this study were to supplement yoghurt with selected vegetables to provide an additional health properties, especially concerning antioxidant properties and will result in the development of novel functional dairy products. So that, the addition of cucumber, fried eggplant, green and red sweet pepper preparations to determine the effect of selected vegetables on the PH, acidity, and sensory organoleptic acceptance of the obtained fermented milk products. Also, to present the effect of different period of storage of the products on the physiochemical properties and the microbial growth of resultant yoghurt.

MATERIALS AND METHOD

This study was carried out in the Dairy Products General Company, Abu-ghraib/ Baghdad/Iraq in 2-5/2014.

Materials:

Vegetables

Five different of popular vegetables: cucumber, Green pepper, eggplant, celery and mint leaves, and dried garlic were purchased from the local veg. market in Baghdad. Vegetables were washed very well and chopped with household electrical chopper, then drainage from water by squeezing with clean dried cloth, then weight.

Milk

Vegetables and Skimmed Milk Mixed Ingredient

Yoghurt manufacture

The total solid content of milk was standardized to about 14% by adding 30 g/L skimmed milk powder, and then the mixture was blended with laboratory blender until all ingredients were dissolved in the milk. The chopped vegetables were added according to the composition of the samples were first: 10% of cucumber +1g dried garlic (Cg), second: 10% of green pepper +1g dried mint (Gm), third 10% of fried eggplant +1g dried garlic (FEg), fourth: 10% of cucumber +1g of dried mint+ 1g of dried garlic (Cgm), fifth: 5% each of chopped fresh leaves of mint and celery (Cem), and sixth: 2.5% mixed of all the above vegetables (cocktail Co). After that

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all vegetables placed in an electrical oven at 80°C/10 minutes, cooled to 44°C, then transferred to plastic cups. The above Skimmed milk (30% low fat) also, was heated at 85°C for 15 min, cooled rapidly to 45°C to kill pathogens and then mixed with starter culture was a 1:1 mixture of Str. Thermophiles and L. bulgaricus. Inoculated milk was incubated at 42± 0.5°C then mixing with c different chopped veg. for about 2-3 hours, until PH decreased to 4.7. Following the incubation, all samples were placed immediately in a cooler and stored at 4 ± 1°C for 1, 7, 14, and 21 days before testing. Control yoghurt without any addition also prepared. Preliminary studies indicated that yoghurt containing a high level of vegetables had a different flavor, so we added crushed garlic (or mashed) and a grinding dried mint to mask the flavor that might arise from the high level of addition of vegetables. In addition of that, the best percent of vegetable addition was 10%. Three replicates of set yoghurt were produced.

Analytical methods

PH and Titratable Acidity

The PH of the samples was determined according to (Ling, E. R. 2008) using a Testo 230 PH meter by immersing the sensor of digital pH-meter in yoghurt. The measurements were done in duplicate.

Titratable acidity, expressed as percentage of lactic acid, was determined by mixing 10 ml of yoghurt with 20 ml of distilled water and titrating with 0.1 N NaOH using phenolphthalein as an indicator to an end-point of faint pink color. The measurements were done in duplicate.

Fat, T.S. determined as given in the (A.O.A.C. 2000).

Sensory Evaluation:

Yoghurt manufactured were subjected to organoleptic evaluation by 20 panelists of Stuff member of Dairy Products general Company, Abu-ghraib/ Baghdad/Iraq was carried out according to scheme of (Salem et al 2013, 26), or according to Iraqi yoghurt Standard (2001). Samples were organoleptic ally scored for flavor (45 point), consistency with spoon (35 point), acidity (10 point), and appearance (10 points) when fresh and after storage for 7, 14, and21 days at 5±1 °C.

Microbial tests:

Prepared yoghurt supplement samples were examined for total viable count, total coliform count, total yeast and mold count. For total viable count of bacteria, colony count method was used according to Laboratory Methods in Dairy Products Company (Iraqi Quality Standards). The total number of viable bacteria per gram of yoghurt was obtained by multiplying the number of colony forming units (CFU) on the plate with respective dilution factor and then was counted by MPN method.) converted into logarithmic form. Total coliform ($MPNg^{-1}$

Yeast and mold were determined according to the Standard Methods for Examination of Dairy Products By Iraqi Quality Standard.

For microbial analysis, all yoghurt samples were homogenized and serial dilution were prepared. Yoghurt samples were analyzed at weekly intervals for two weeks. All relative data were transferred using a based-10 logarithm.

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Statistical analysis

The results of researchers were estimated by using Completely Random Design and GIM Procedure of SAS Statistic Analysis Program (SAS 2012). LSD test were used for mean comparison. Analysis are the averages of production which had five replications and made as parallel. Only results of dietary fibrous yoghurts were evaluated in this study.

RESULTS AND DISCUSSION

Fat% in Yoghurt products:

Table 1 shows the fat% values of vegetables yoghurt products. Effect of different addition of vegetables does not affect the percent of the fat contents significantly, due to the low content of fat in the vegetables. Thus was a good reason for consuming such products for health.

Total solid percentage (T.S %):

Table 1 shows the T.S% values of vegetables yoghurt products. Effect of different addition of vegetables affect the percent of the T.S% contents significantly, the highest content was 19% in yoghurt enriched with eggplant, then cucumber with garlic and mint which was 18%. The lowest content of T.S% was in yoghurt enriched with celery and mint that was 13. It was shown also, there were no significant interaction between storage time and T.S values, but there were significant effects of different additions of the vegetables on the T.S%.

PH and the different addition of the vegetables:

Table 1 shows the PH values of vegetables yoghurt products. Effect of different vegetables to the yoghurt and the PH was found significant ($p>0.05$). There were no significant interaction between storage time and the PH values.

Acidity and the different addition of the vegetables:

Table 1 shows the acidity values of vegetables yoghurt products. Effect of different vegetables to the yoghurt and the acidity was found significant ($p>0.05$). There were no significant interaction between storage time and the acidity values. Thus, a good index of the addition of vegetables for the improvement of the nutritional properties of yoghurt and fermented dairy products (Zare, et al. 2011). Soluble fibers have repeatedly been shown to reduce blood cholesterol both in hypercholesterolemia and normal cholesterolemia individuals (Bengmark, and Finocchiaro 2010)

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Table 1: The average (2trial) treatments of %Fat, %T.S, PH, and %Acidity of the enriched yoghurt with different chopped vegetables which stored at 4°C after1, 7, 14, 21 day from processing.

T	Fat %	% T.S. after				PH after				Acidity % after			
		1d	7d	14d	21d	1d	7d	14d	21d	1d	7d	14d	21d
10% Cg	4.0	14	14	13	13	5.2	5.0	4.9	4.8	84	87	83	89
10% Gm	4.0	15	14	14	14	5.3	5.1	4.9	4.9	87	88	89	89
10% FEg	4.0	19	18	17	17	5.3	5.1	4.9	4.8	85	86	88	89
10% Cgm	4.0	18	17	17	16	4.6	4.5	4.4	4.2	72	74	77	81
10% Cem	3.9	13	13	12	12	4.3	4.7	4.5	4.3	103	103	106	108
10% Co	4.0	17	18	18	18	3.4	3.3	3.1	3.1	104	104	104	105
Control	3.9	12	12	12	12	4.3	4.2	4.2	4.1	104	104	104	107
LSD value	0.77 NS	2.81 *	3.26 *	2.82 *	2.65 *	0.71 *	0.52 *	0.59 *	0.38 *	12.5 *	12.6 *	12.5 *	11.9 *

Sensory Evaluation after 1 day of storage

Sensory evaluation is widely used for food quality control and product development. Table 2 present sensory evaluation scores of different vegetables supplemented yoghurt products.

Flavor plays an important role in food choice of consumers. Different addition of the vegetables affect the flavor significantly, table 2 shows the higher score of the acceptable flavor was 42 for the eggplant and garlic addition, then 40 points for Cg and Co addition which were comparable to the control. Whereas, the lowest score of the flavor was 32 for the Gm. addition which is far away compared with control.

Texture: texture is one of the most essential components of yoghurt quality. Elaboration of yoghurt is depending on various factors, which have been extensively studied with the goal to improve the quality of the yoghurt. Most applications of dietary fiber to yoghurt are related to using water soluble dietary fiber because of water binding properties. Dietary fibers in yoghurt have been used for increasing the viscosity of the product as a stabilizer, preventing syneresis and improving textural properties as creaminess. Also, the addition of dietary fiber to yoghurt is an effective tool for reducing calories and fat (Nulufer, et al. 2004).

Table 2 shows significant differences between the different addition of the vegetables and the texture scores. The highest score was 33 which was comparable to the control was the fried eggplant and garlic (FEg) addition, that means the dietary fiber of the eggplant was effective on the texture of the product FEg, then 32 point for the Cg, Gm, and Co, then 30 points for Cgm addition. While the lowest score was 29 which was celery and mint leaves addition. Textural defects of celery and mint leaves yoghurt include weak body, wheying-off, the floating of the celery leaf on the top of container. So that it was rejected by all the panelists.

Acidity: The acidity values for the entire yoghurt samples were similar compared with control. The acidity scores ranged from 7 to 9 points compared with control which was 9 points also, that means no significant differences in acidity, this indicate that lactose content was responsible for the coagulum formation. Singh and Muthukkumarappan (2008) indicated that there was no statistical difference in the acidity of control and calcium-enriched fruit yoghurt. Also, Hashim and Khalil (2008) reported that the addition of gelatin, ALG, and Ca did not affect the PH and the titratable acidity of the yoghurt.

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Appearance: Appearance values for the entire yoghurt samples were similar compared with control. The appearance scores ranged from 5 to 10 points compared with control which was 10 points. Fried eggplant FEg had the highest appearance score (10 points) and the celery and mint Cem addition had the lowest (5 points). The others different addition of vegetables was proportional.

The overall total: The total of the sensory evaluation were found to be low for chopped celery and mint leaves (Cem) yoghurt supplement. But total sensory evaluation of cucumber and garlic, and fried eggplant and garlic yoghurt supplement were high and acceptable rating. The green pepper Gm, Cucumber Cgm, and the cocktail Co yoghurt supplement were found to be a medium rating. Based on sensory scores, FEg, Cg, and Co products were the best.

Table 2: The average (2trial) treatments of sensory evaluation for enriched yoghurt with different vegetables which stored at 5°C after 1 day from processing.

Treatments	Flavor 45	Texture & consistency35	Acidity 10	Appearance10	Total 100
10% Cg	40	32	9	9	90
10% Gm	32	32	8	9	81
10% FEg	42	33	9	10	94
10% Cgm	35	30	9	8	82
10% Cem	39	29	9	5	82
10% Co	40	32	7	8	87
Control	44	35	9	10	96
LSD value	4.51 *	3.69 *	2.82 NS	2.48 *	5.24 *
* ($P<0.05$).					

Sensory Evaluation after 7 days of storage

Table 3 present sensory evaluation scores of different vegetables supplemented yoghurt products after 7 days of storage.

Different addition of the vegetables affect the flavor significantly, table 3 shows the higher score of the flavor was 41 for the eggplant and garlic addition, then 40 points for Cem addition which were comparable to the control which had 42 points. Whereas, the lowest score of the flavor was 30 point for the Co addition which is far away compared with control. The Cg, Gm, and the Cgm yoghurt products were had the middle acceptance. That means, storage period affect the flavor significantly.

Table 3 shows significant differences between the different addition of the vegetables and the texture and consistency scores. The highest point was 32 which was equal to the control which was in Co addition, that means the dietary fiber of the different vegetables were effective on the texture of the product, then 31 points for the Cg, and FEg, then 29, and 26 points for Gm, and Cgm addition respectively which were the lowest points. Textural defects of celery and mint leaves yoghurt include weak body, wheying-off (syneresis), the floating of the celery leaf on the top of container. So that it was rejected by all the panelists.

Acidity: The acidity values for the entire yoghurt samples were similar compared with control. The acidity scores ranged from 6 to 9 points compared with control which was 8 points also,

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that is means no significant differences in acidity, this indicate that lactose content was responsible for the coagulum formation

Appearance: The appearance scores ranged from 5 to 8 points compared with control which was 8 points also. Cucumber Cg, Fried eggplant FEg, and cocktail Co had the highest appearance score (8 points) and the celery and mint Cem addition had the lowest (5 points). The others different additions of vegetables were proportional.

The overall total: The total of the sensory evaluation were found to be low for chopped celery and mint leaves (Cem) yoghurt supplement. But total sensory evaluation of fried eggplant and garlic, and cucumber and garlic yoghurt supplement were high and acceptable rating. The green pepper Gm, Cucumber Cgm, and the cocktail Co yoghurt supplement were found to be a medium rating. Based on sensory scores, FEg, Cg, and Cgm products were the acceptable products.

Table 3: The average (2trial) treatments of sensory evaluation for enriched yoghurt with different vegetables which stored at 5°C after 7 day from processing.

Treatments	Flavor 45	Texture & consistency35	Acidity 10	Appearance10	Total 100
10% Cg	39	31	9	8	86
10% Gm	39	29	7	7	83
10% FEg	41	31	9	8	89
10% Cgm	39	26	7	7	80
10% Cem	40	28	7	5	60
10% Co	30	32	6	8	75
Control	42	31	8	8	89
LSD value	4.57 *	3.62 *	3.29 NS	2.42 *	8.71 *
* ($P<0.05$).					

Sensory Evaluation after 14 days of storage

Table 4 present sensory evaluation scores of different vegetables supplemented yoghurt products after 14 days of storage.

Different addition of the vegetables affect the flavor significantly, as shown in table 4. The higher score of the acceptable flavor after 14 days of storage were 40 for the eggplant and garlic addition, then 39 points for Cg addition which were comparable to the control which had 40 points, which these scores decrease a little bit than the fresh yoghurt. Whereas, the lowest score of the flavor was 30 point for the Gm addition which is far away compared with control. The Cgm, Co, and the Cem were had the middle proportional yoghurt products acceptance. That means, storage period affect the flavor significantly.

Different addition of the vegetables affect the texture and consistency significantly, as shown in table 4. The higher score of the acceptable texture after 14 days of storage were 32 for Co addition, then 31 points for both Cg and FEG addition which were the same score to the control which had 31 points. Whereas, the lowest score of the texture was 26 point for the Cgm addition which is far away compared with control. That means, storage period affect the flavor significantly some vegetables like green pepper and especially leafy vegetables which float on

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the surface product and look like strange view and not acceptable by the panelists. Also, textural defects of celery and mint leaves yoghurt include weak body, wheying-off. So that it was rejected by all the panelists. Seckin and Baladura, 2012 founded also, that type of dietary fiber caused statistically significant changes in color, texture values and sensory evaluation scores.

Acidity: The acidity values for the entire yoghurt samples were similar compared with control. The acidity scores ranged from 6 to 9 points compared with control which was 8 points also, that is means no significant differences in acidity, this indicate that lactose content was responsible for the coagulum formation

Appearance: The appearance scores ranged from 5 to 8 points compared with control which was 8 points also. Cem addition had the lowest 5 points. The others different addition of vegetables was proportional.

The overall total: The total of the sensory evaluation were found to be low for chopped celery and mint leaves (Cem) and cocktail yoghurt supplement, due to the whey separation and chopped leaves floating happen, so that effect on rating score. But total sensory evaluation of fried eggplant and garlic, and cucumber and garlic yoghurt supplement were high and acceptable rating. The green pepper Gm, Cucumber Cgm yoghurt supplement was found to be a medium rating. Based on sensory scores, FEg and Cg, products were the acceptable products after the 14 days of storage.

Table (4): The average (2trial) treatments of sensory evaluation for enriched yoghurt with different vegetables which stored at 5°C after 14 day from processing.

Treatments	Flavor 45	Texture & consistency35	Acidity 10	Appearance10	Total 100
10% Cg	39	31	9	8	86
10% Gm	39	29	7	7	83
10% FEg	41	31	9	8	89
10% Cgm	39	26	7	7	80
10% Cem	40	28	7	5	60
10% Co	30	32	6	8	75
Control	42	31	8	8	89
LSD value	4.57 *	3.62 *	3.29 NS	2.42 *	8.71 *
* (P<0.05).					

Comparison of microbial characteristics of different vegetables yoghurt supplement: Microbiological characteristics are indicators of safety, quality and shelf life of prepared yoghurt. Total Viable Count (TVC), total coliform and yeast and mold count of the vegetable yoghurt products were determined at weekly intervals for two weeks. All relative survival data were transformed using a based-10 logarithm.

The result showed that**,** the average viable counts of coliform bacteria, during 2 weeks after storage periods in **Table** 5 . The viable counts of coliform bacteria in all yoghurt samples were zero that indicates that no contamination happens of the yoghurt product. There was a little contamination of both Yeast and Mold in the samples of low concentrations of vegetables

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yoghurt products, may be due to the low acidity of the vegetables used, but the contamination lies within the limit of the Iraqi Quality standard of the dairy product (IS). This finding agree with (Oya, et al. 2013).

Table (5): The microbial contamination of the different vegetables yoghurt product

Treatments	Coliform (CFU/g)	Mold No. (CFU/g)	Yeast No. (CFU/g)
10% Cg	Nil a	1×10^3 a	2×10^2 b
10% Gm	Nil a	1×10^2 b	3×10^2 b
10% FEg	Nil a	Nil c	1×10^2 b
10% Cgm	Nil a	Nil c	2×10^3 a
10% Cem	Nil a	1×10^2 b	Nil d
10% Co	Nil a	Nil c	3×10^1 c
Control	Nil a	1×10^2 b	1×10^2
LSD value	0.00 NS	50.71 *	46.13 *

*** (P≤0.05)**

CONCLUSION AND RECOMMENDATION

The research was conducted to develop supplemented vegetable yoghurt with acceptable chemical, sensation, and microbial quality. Six different vegetables (cucumber, green pepper, fried eggplant, celery and mint leaves, and dried garlic) with 10% of these vegetable +1g of dried garlic were used in this experiment. It is obvious from the study that 10% of fried eggplant with garlic, 10% of cucumber with garlic and mint, and the 10% of mixed vegetables improves the sensory evaluation and chemical characteristics of vegetable yoghurt at the refrigeration temperature within two weeks period time only, this study were been done without any addition of texture improver, so we must work more on this side of addition with different stabilizers, and it was safe and healthily products for consumers who ware about healthier products due to a valuable source of nutrients and are also low in calories. They are rich in dietary fiber, minerals as well as many bioactive compounds such as antioxidants, e.g. carotenoids, ascorbic acid, tocopherols, phenolic substances (Prior and Cao 2000). In addition of that, it was economically to produce healthier dairy products better than depending only on the importing products.

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