

Study of Qualification and Sensation Properties by Using Date Extraction and Date Syrup in Yoghurt Processing

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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 date palm yoghurt supplemented with different level of date extraction and its syrup (10, 20, 30, and 40%). Physicochemical, sensory evaluation and microbiological properties were analyzed to assay the quality of yoghurts. The total solid, pH and the acidity of date yoghurts supplemented products were increased significantly than plain yoghurt by increasing the concentration of date extraction and date syrup. Statistical analysis showed that yoghurts supplemented with 20, 30 % of date extraction were more acceptable, then 40%. Statistical analysis showed that yoghurts supplemented with 10, than 30 and 40% of 20% of date syrup were more acceptable in their texture, appearance, and the total supplementation. Sensory evaluation of the yoghurts was improved due to supplementation of 20 and 30% of both date extraction and date syrup. The flavor, texture and consistency, acidity, appearance and the total of the yoghurts were very good acceptable. The microbiological quality of the date yoghurts was also acceptable and within the Iraqi standard quality, due to the increased the acidity content, or may be due to the antimicrobial effect of dates fruit. The findings of this study may give an overall idea about manufacturing of date palm yoghurt supplementing with different level of date extraction or with low level of concentration of its syrup and appropriate technology of date extraction and its syrup preparation.

Keywords: yoghurt supplementation, date palm fruit- date syrup, physicochemical analysis, sensory and microbial evaluation.

1. Introduction

Date palm fruit were found to contain carbohydrates 44-88%, fat 0,2-0,4%, proteins 2,3-5,6%, fibers 6,4-11,5, minerals and vitamins (Al-Shahib & Marshall 2003). Most of the carbohydrates in dates are in the form of fructose and glucose, which are easily absorbed by the human body (Al-Farsi et al. 2007). The aqueous extracts of dates have a potent antioxidant activity among 28 fruits commonly consumed in China (Guo et al. 2003). Several studies concluded that antioxidants have received increased attention by nutritionists and medical researchers for their vital effects in the prevention of several chronic diseases such as coronary heart disease CHD, cardiovascular disease CVD, cancer, aging, atherosclerosis, neurodegenerative disease, Parkinson and Alzheimer, and inflammation among other (Dillard & German 2000; Prior & Cao 2000). The most effective antioxidants in this respect appear to be an optimal mixture of phytochemicals such as dietary fiber, phenolic, and flavonoids (Al-Humaid et al. 2010; Faqir et al. 2012). Due to their metal-chelating and radical-scavenging properties, phenolic, were considered effective inhibitors of lipid peroxidation (Mansouri et al. 2005; vayalil 2002).

Yoghurt is produced by the conversion of lactose to lactic acid of the milk by the fermentation culture bacteria. As the PH reached 5.0, the casein micelles are partially broken down and become linked to each other under the form of aggregated chains forming part of a three-dimensional protein matrix in which the liquid phase of the milk is immobilized. This gel structure contributes due to the overall texture and sensory properties of yoghurt and gives rise to shear and time dependent viscosity (Oroian et al. 2011).

The most famous defects associated with yoghurt texture that affect consumer acceptance are apparent viscosity variations and the occurrence of syneresis (Cristina 2013).

The beneficial effects of fiber for human health are well known. Fiber enrichment into yoghurt represents beneficial effects in all sectors of the population, there are many studies of the effect of the addition of dietary fibers on the properties of yoghurt. Adding 1% of citrus fiber to yoghurt reduced yoghurt syneresis and improved texture, viscosity and the gel firmness (Brennan & Tudorica 2008). Fortification with date fiber did not cause significant changes in yoghurt acidity, although PH was increased, consumer test result also indicated that the appearance, color, and flavor rating were significant affected by date fiber fortification (Hashim et al. 2009). Brennan and Tudorica 2006, presented that the inclusion of the carbohydrate components reduced product syneresis and improved the texture and rheological properties of the low-fat based products so that their quality characteristics were similar to yoghurt made.

This study aimed was designed to manufacture date yoghurt fortified different levels of date extraction and its syrup with fermented milk and to compare their qualities on physic-chemical, microbial and sensory parameters.

2. Material and methods

The experiment was conducted in May, 2014 in the laboratory of the Dairy Products Company/ Ministry of Industry and Minerals/ Abu-Ghraib/Baghdad /Iraq.

Skim milk powder (low fat, origin USA) was reconstituted in distilled water and left overnight at 4°C to allow full hydration. Good quality of Iraqi date palm flesh (Shorcy), and date syrup (72°Brix) was obtained from local market which brought from Iraqi date factory, Baghdad city. All dates were stored in a refrigerator at approximately 5°C before analysis and making yoghurt with date extraction and its syrup. Starter: freeze dried culture of *Lactobacillus delbrueckii subsp. Bulgaricus* and *Streptococcus salivarius subsp. Thermophiles* (1:1) were obtained from Chr. Hansens Laboratories, Denmark.

2.1 Preparation of date Extraction

Briefly, 500g of dates (Shorcy) cleaned and the seeds were removed, then soaked with 1500 ml of warm distilled water for half hour, then were good blended with the electrically laboratory blender, Then filtered through very fine sieve (0.5mm), and the extract stored in a refrigerated temperature at 4°C. The date extraction diluted with distilled water until its reached 14°Brix, then were used (10, 20,30,40% DE) concentration in each of 200ml plastic cups for making yoghurt as following step.

2.2 Preparation of date Syrup dilutions

Date syrup was diluted with distilled water until the total solid been 13-14%, then were taken 10, 20, 30, and 40% from the diluted syrup and placed in the plastic cups for making yoghurt as following step.

2.3 Yoghurt Making

The total solid content of milk was standardized to about 14% by adding 30g / L skimmed milk powder, and then the mixture was blended with laboratory blender until all ingredients were dissolved in the milk. The date extractions (DE) were added according to the different concentrations of the samples (10, 20, 30, 40% DE). The same things were made for the samples of the date syrup (DS). The mixture was heated to a hot water bath at 85°C for 30 min. cooled to approximately 42°C, then good mixed with the milk which was inoculated with commercial yoghurt culture at the rate of 3%, then it poured in to plastic cups, covered with sealing, incubated at 43°C for 4h until coagulation occur and samples reached to pH 4.3. Yoghurt then refrigerated at 4°C for overnight, 7, 14, and 21 days for subsequent analysis. Plain yoghurt without date palm extraction (Control, C) was prepared. The measurements were done in tetra plicate for each yoghurt sample. Preliminary studies indicated that yoghurt containing a high level of date palm extraction and its syrup had a un-acceptable flavor and color that might arise from the high level of addition of date extraction and date syrup, so, we agreed to use the concentration of both date palm extraction and sits syrup below than 50%.

2.4 Physicochemical analysis

2.5 Total Solid

Total solid of the samples was determined using digital T.S meter. The measurements were done in triplicate.

2.6 PH and Titratable Acidity

The pH of the samples was measured using a Testo 230 pH meter by immersing the sensor of digital pH-meter in yoghurt (Ling 2008). The measurements were done in duplicate.

Titrate 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).

2.7 Sensory Evaluation

Twenty six panelists consisting of worker and staff of the Dairy Products Company/ Ministry of Industry and Minerals/ Abu-Ghraib/Baghdad Governate. Yoghurt samples were presented in white plastic cups under fluorescent light. All samples were marked with 3-digital code, and the order of presentation of samples was randomized for each panelist. The panelists rated flavor (45 degree), Texture (35 degree), color (10 degree), and overall appearance (10 degree).

2.8 Statistical Analysis

The Statistical Analysis System- SAS (2012) was used to effect of different factors in study parameters. Least significant difference –LSD was used for means comparison.

3. Results and Discussion

3.1 Physicochemical determination

Plain yoghurt (control without any fruit addition) was compared with yoghurts incorporating different concentrations (10, 20, 30, and 40%) of both date extraction and syrup for averages smell and taste, body consistency, color, and flavor by a team of the dairy company. Results were presented in tables 1-7.

Table 1 shows fat%, T.S%, PH%, and acidity% values of fresh yoghurt (1day, overnight) fortified with DE or DS. Also, the same determinations were taken after (7,14, and 21 days of storage at 4°C).

It was shown that the fat% of the yoghurt fortified with DE or DS had similar fat% as control yoghurt. Similar results were reported for different storage period of time (Kose and Elvan 2011).

It was shown that the T.S% of the fresh yoghurt fortified with DE and DS increased significantly by increasing the concentrations of addition as clearly shown in table 1. Also, there were a significant correlation increases between T.S% and increasing the concentration of the addition for both DE and DS. In contrast, there were no significant correlation increases between T.S% and storage time. The result agrees with the previous work of (Gad, et al. 2010).

It was shown that the PH of the yoghurt fortified with DE or DS had similar PH as control yoghurt, in addition there were no significant correlation between PH and storage time. Similar results were reported for quality characteristics and consumer acceptance of yoghurt fortified with date fiber (Hashim et al. 2009; Al-Humaid et al. 2010).

It was shown that the acidity% of the fresh yoghurt fortified with DE And DS increased significantly by increasing the concentrations of addition as clearly shown in table 1, but there were a negatively significant correlation between increasing the acidity and the concentrations compared with the control.

Table (1): The average (2trial) treatments of %Fat, %T.S, PH, and %Acidity of the enriched yoghurt with different concentrations of date palm extraction and concentrated date syrup which stored at 4°C after 1, 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% DE | 3.9 | 14 | 14 | 14 | 14 | 4.3 | 4.4 | 4.4 | 4.5 | 102 | 98 | 99 | 97 |
| 20% DE | 3.9 | 15 | 15 | 15 | 15 | 4.3 | 4.4 | 4.4 | 4.5 | 103 | 103 | 102 | 101 |
| 30% DE | 3.9 | 15 | 15 | 15 | 15 | 4.5 | 4.4 | 4.4 | 4.3 | 98 | 103 | 103 | 103 |
| 40% DE | 3.9 | 17 | 16 | 16 | 16 | 4.7 | 4.7 | 4.5 | 4.4 | 95 | 96 | 97 | 98 |
| 10% DS | 3.9 | 15 | 15 | 15 | 15 | 4.6 | 4.6 | 4.5 | 4.4 | 99 | 96 | 100 | 101 |
| 20% DS | 3.9 | 16 | 16 | 16 | 16 | 4.9 | 4.7 | 4.5 | 4.3 | 97 | 95 | 101 | 103 |
| 30% DS | 3.9 | 17 | 17 | 17 | 17 | 5.2 | 4.3 | 4.3 | 4.3 | 94 | 93 | 104 | 107 |
| 40% DS | 3.9 | 18 | 17 | 17 | 17 | 4.9 | 4.7 | 4.6 | 4.4 | 97 | 96 | 98 | 100 |
| Control | 3.9 | 13 | 13 | 13 | 13 | 4.3 | 4.3 | 4.3 | 4.3 | 104 | 103 | 103 | 109 |
| LSD value | 0.0 | 2.75 | 2.74 | 2.86 | 2.80 | 0.78 | 0.60 | 0.69 | 0.52 | 7.2 | 7.4 | 8.9 | 7.4 |
| | NS | * | * | * | * | * | NS | NS | NS | * | * | NS | * |

LSD = Least Significant Difference, NS= significant differences

3.2 Sensory evaluation after 1 day of storage of the yoghurt products

Flavor properties of fresh yoghurt (1 day of storage) fortified with DE and DS are presented in Table 2. It was shown that, yoghurt fortified with 20, and 30% of DE had acceptable flavor as control yoghurt, while yoghurt fortified with more than 20% of DS effect the flavor negatively, compared to the control.

Texture properties of fresh yoghurt had the heights degree 33 and 34 score respectively by addition of 30, and 40% of DE as control yoghurt which was 33 score. Similar result reported by (Peng, et al. 2009, Brennan et al. 2008) who stated that the texture improved by increasing the total solids content of milk. Also, there were no significant differences between the yoghurt fortified with DS and the control, so I could conclude that the excellent effect of adding DE or DS on texture properties, may be related to the dietary fiber in the date extraction absorbing more moisture because of its higher water-holding capacity as it presented as (Hashim et al. 2009), or the sucrose, fructose et al. in the DE or in DS increase the total solids of the mix and strengthens the gel network. Oroian, et al. (2011) reported that the rheological properties of the yoghurt were modified by the addition of dietary fiber from fruits improve textural properties, increasing gel firmness, and reduce yoghurt syneresis. These changes may be related to the disrupting effect of fiber in the gel, when this fiber dose is added, is counteracted by the high water-holding capacity of the fiber.

Acidity properties of fresh yoghurt (1 day after storage) significantly decreased by increasing the concentration of DE or DS addition compared with control as shown in the Table 2, also creates increased buffering that requires additional acid development by the starter cultures to achieve a similar PH target (Lee and Lucey, 2010, Gad et al. 2010).

Appearance properties of fresh yoghurt (1 day after storage) was no significant differences by increasing the concentration of DE or DS addition compared with control as shown in the Table 2.

Thus, fortifying yoghurt with 20, and 30% of both DE and DS produced acceptable yoghurt with beneficial effects.

Table (2):The average (2trial) treatments of sensory evaluation for enriched yoghurt with different concentrations of date palm extraction and concentrated date syrup which stored at 5°C after 1 day from processing.

| Treatments | Flavor 45 | Texture & consistency35 | Acidity 10 | Appearance10 | Total 100 |
|-------------|-----------|-------------------------|------------|--------------|-----------|
| 10% DE | 41 | 31 | 9 | 9 | 89 |
| 20% DE | 42 | 33 | 9 | 8 | 91 |
| 30% DE | 42 | 33 | 8 | 8 | 91 |
| 40% DE | 40 | 34 | 8 | 8 | 89 |
| 10% DS | 41 | 31 | 9 | 8 | 88 |
| 20% DS | 41 | 31 | 8 | 8 | 89 |
| 30% DS | 39 | 31 | 8 | 8 | 84 |
| 40% DS | 37 | 31 | 6 | 7 | 80 |
| Control | 43 | 33 | 9 | 9 | 94 |
| LSD value | 3.26 * | 4.69 NS | 2.53 * | 2.49 NS | 6.75 * |
| * (P<0.05). | | | | | |

3.3 Sensory evaluation after 7 days of storage of the yoghurt products

Sensory evaluation of fortified yoghurt with different concentrations of DE and DS after the 7th day's period of storage in refrigerator was presented in Table 3. Flavor, texture, and the total scores were the higher in both 20 and 30% concentration of DE and DS than, 10 and 40% which was significantly decrease compared with control yoghurt. While there were no significant decrease ($P \geq 0.05$) in the acidity and appearance compared with control.

Storage time did not affect the total score of 20 and 30% of fortified yoghurt with DE and 10 and 20% of DS, which was comparable to the control yoghurt. While storage time affect the total score of 40% addition for both DE and DS of fortified yoghurt significantly negative differences. In addition, there were no syneresis happened of all samples, which was encourages and very acceptable for different sectors of population. But it was found that the 40% addition Of DS to the yoghurt effect the flavor significantly high which was dominant date syrup taste and strong odor. Thus, effects were not acceptable from all the panelists.

Table (3): The average (2trial) treatments of sensory evaluation for enriched yoghurt with different concentrations of date palm extraction and concentrated date syrup which stored at 5°C after 7 day from processing.

| Treatments | Flavor 45 | Texture & consistency35 | Acidity 10 | Appearance10 | Total 100 |
|-------------|-----------|-------------------------|------------|--------------|-----------|
| 10% DE | 36 | 33 | 9 | 9 | 88 |
| 20% DE | 40 | 32 | 9 | 9 | 90 |
| 30% DE | 41 | 34 | 9 | 8 | 91 |
| 40% DE | 37 | 34 | 8 | 7 | 85 |
| 10% DS | 44 | 33 | 9 | 9 | 95 |
| 20% DS | 41 | 32 | 9 | 9 | 91 |
| 30% DS | 34 | 31 | 8 | 8 | 81 |
| 40% DS | 28 | 30 | 7 | 7 | 73 |
| Control | 43 | 33 | 9 | 9 | 94 |
| LSD value | 6.84 * | 3.16 * | 3.09NS | 2.66 NS | 8.11 * |
| * (P<0.05). | | | | | |

3.4 Sensory evaluation after 14 days of storage of the yoghurt products

Sensory evaluation of fortified yoghurt with different concentrations of DE and DS after the 14th days period of storage refrigerator were presented in Table 4.

Flavor had the heights score in 30% fortified yoghurt with DE and 20% DS, which were no significant differences statistically compared with control, while the 40% fortified yoghurt with DS had the lowest score 33 which was negatively significant differences.

Storage time did not affect the texture and consistency significantly, especially with 30 and 40% of DE and DS addition due to the inclusion of the carbohydrate components reduced product syneresis and improved the texture and rheological properties of the low-fat based products so that their quality characteristics were similar to yoghurt made full-fat-milk (Brennan and Carmen 2008).

Table (4): The average (2trial) treatments of sensory evaluation for enriched yoghurt with different concentrations of date palm extraction and concentrated date syrup which stored at 5°C after 14 day from processing.

| Treatments | Flavor 45 | Texture & consistency35 | Acidity 10 | Appearance10 | Total 100 |
|-------------|-----------|-------------------------|------------|--------------|-----------|
| 10% DE | 38 | 30 | 8 | 8 | 83 |
| 20% DE | 35 | 31 | 7 | 8 | 82 |
| 30% DE | 42 | 32 | 8 | 7 | 89 |
| 40% DE | 40 | 34 | 8 | 8 | 89 |
| 10% DS | 41 | 30 | 8 | 8 | 87 |
| 20% DS | 42 | 31 | 8 | 8 | 89 |
| 30% DS | 39 | 30 | 7 | 7 | 83 |
| 40% DS | 33 | 31 | 5 | 5 | 79 |
| Control | 43 | 33 | 9 | 9 | 94 |
| LSD value | 4.15 * | 3.00 * | 2.77 * | 2.81 * | 7.60 * |
| * (P<0.05). | | | | | |

3.5 Sensory evaluation after 21 days of storage of the yoghurt products

Sensory evaluation of fortified yoghurt with different concentrations of DE and DS after the 21th days after storage on 4°C were presented in Table 5. Flavor was the heights score in 10, 20, and 30% fortified yoghurt with DE and in 10, and 20% DS, which were no significant differences compared with control, while the 40% fortified yoghurt with DS had the lowest score 37 which was negatively significant differences compared with control.

Storage time did not affect the texture and consistency significantly, especially with 30 and 40% of both DE and DS addition and for all concentration there were no significant differences, that is mean the texture was good.

Storage time did not affect the texture and consistency significantly, especially with 30 and 40% of DE and DS addition.

Acidity property of fresh yoghurt (21 day after storage) effected significantly by increasing the concentration of 40% of DE and DS addition compared with control as shown in the Table 5.

Appearance property of fortified yoghurt (21 day after storage) did not affected significantly by increasing the concentration of DE or DS addition compared with control as shown in the Table 5.

Storage time did not affect the total score of 30 and 40% of fortified yoghurt with DE and 20% of DS, which was comparable to the control yoghurt. While storage time affect the total score of 40% of fortified yoghurt significantly negative differences. In addition, there were no syneresis of all samples happened, which was encourages and very acceptable for different sectors of population. It was found that the 40% addition of DS to the yoghurt affect the flavor highly and was not acceptable from all the panelists, Oya et al. (2013) reported that no whey separation was observed in guar-added yogurts containing different concentration of molasses types. Faqir et al. (2012) reported that inclusion of both Date extraction and its syrup in the yoghurt products will increase the values of the sensory evaluation significantly positively with all concentrations. The flavor, aroma, and the texture were an excellent scores and very acceptable by all the specialized panelist of the dairy plant. In

addition of that there was no syneresis (whey-off) in all samples on all storage periods, just a little bit of wheying -off happend with Date syrup addition 40% after 14 day of storage time due to bad flavor. In addition of that, there were syneris happen and thus not accepted by all the panelists, due to their ragged structure, dominant date taste and strong odor. This finding was comparable to that's finding by (lee and Lucey 2010). So, this study concludes that date palm extract have an excellent supplement for good functional and potential products, probably prevent oxidative deterioration of food due to their high content of an antioxidants, and their fiber content which was used to produce novel natural antioxidant as well as flavoring agent and can be used in various food products.

Table (5): The average (2trial) treatments of sensory evaluation for enriched yoghurt with different concentrations of date palm extraction (DE) and concentrated date syrup (DS) which stored at 5°C after 21 day from processing.

| Treatments | Flavor 45 | Texture & consistency35 | Acidity 10 | Appearance10 | Total 100 |
|-------------|-----------|-------------------------|------------|--------------|-----------|
| 10% DE | 41 | 31 | 9 | 9 | 89 |
| 20% DE | 42 | 33 | 9 | 8 | 91 |
| 30% DE | 42 | 33 | 8 | 8 | 91 |
| 40% DE | 40 | 34 | 8 | 8 | 89 |
| 10% DS | 41 | 31 | 9 | 8 | 88 |
| 20% DS | 41 | 31 | 8 | 8 | 89 |
| 30% DS | 39 | 31 | 8 | 8 | 84 |
| 40% DS | 37 | 31 | 6 | 7 | 80 |
| Control | 43 | 33 | 9 | 9 | 94 |
| LSD value | 3.26 * | 4.69 NS | 2.53 * | 2.49 NS | 6.75 * |
| * (P<0.05). | | | | | |

LSD= Least significant difference

3.6 Microbiological determination

Table 6, show the viable counts of coliform bacteria, during 14-day storage periods. The viable counts of coliform bacteria in all yoghurt samples were zero that indicates that DE and DS inhibited the growth of the yoghurt bacteria negatively because of high carbohydrate level in DE or in DS by high osmotic pressure and high amount of sugar in DE, or DS yoghurt. There was a little contamination of both Yeast and Mold in the samples of low concentrations of DE or DS yoghurt only, but within the limit of the Iraqi standard of the dairy product (1).

Table (6): The microbial contamination of the DE, DS yoghurt product

| Treatments | Coliform (CFU/g) | Mold No. (CFU/g) | Yeast No. (CFU/g) |
|------------|------------------|-----------------------|-----------------------|
| 10% DE | Nil a | 1 x 10 ³ a | 8 x 10 ² b |
| 20% DE | Nil a | 1 x 10 ² b | 8 x 10 ² b |
| 30% DE | Nil a | Nil c | 4 x 10 ² b |
| 40% DE | Nil a | Nil c | 4 x 10 ³ a |
| 10% DS | Nil a | 1 x 10 ² b | 3 x 10 ¹ c |
| 20% DS | Nil a | 1 x 10 ² b | 1 x 10 ² b |
| 30% DS | Nil a | Nil c | Nil d |
| 40% DS | Nil a | Nil c | Nil d |
| Control | Nil a | 1 x 10 ² b | Nil d |
| LSD value | 0.00 NS | 49.71 * | 62.93 * |

* (P<0.05).

4. Conclusion and Recommendations

Our results indicate that inclusion of both Date extraction and its syrup in the yoghurt products increased the values of the sensory evaluation significantly positively with all concentrations. These results suggests that dietary fiber in date palm could be used successfully as carbohydrate-based fat replacers in low-fat yoghurt formulations to stimulate high-fat products. Interaction between dietary fiber and milk protein were seen promote changes in product structure, these could be directly related to improvement in sensory evaluation. Thus, the increased scores of the flavor, aroma, and the texture were an excellent scores and very acceptable by all the specialized panelist of the dairy plant. This observation would explain the improved yield of yoghurt, decreased syneresis (whey-off) and overall improved acceptability in terms of sensory attributes. So, this study extends the potential utilization of date palm extraction and its syrup have good antioxidants as well as flavoring agents that can be used in various food and dairy products with potential beneficial health effects. Due to its low cost and abundance in Iraq, so dates remain a species with incredible potential and innumerable possibilities for further investigation. In addition of that, Iraq is a producing country of the dates that are consumed directly or after processing.

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