

Replacing sugar by date syrup in orange drink and produce a new orange drink

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ABSTRACT

Date Syrup is a natural sweetener that it is a suitable replacement for sugar in formulation of food products for reducing the harmful effect of sugar, and improving the nutrient properties. In this Research orange drink Sugar replaced by Date Syrup in amount of 25%, 50%, 75% and 100%, and then physical, chemical properties, rheological behavior and sensory evaluation of samples were investigated. Statistical analysis by SPSS software and Duncan test at 95% confidence level done. It was concluded that with increasing amount of Date Syrup in formulation of orange drink characteristics such as Ash, pH, Turbidity, were increased but Brix was decreased Rheological properties of samples showed all of treatment introduce behavior of Shear-thickening liquid and flow index more than 1. Sensory evaluation of drink showed significant difference between treatments samples and with increasing Date Syrup in formulation of orange drink acceptability of samples increased and among the samples, the highest score belonged to the sample including 100% Date Syrup.

Keywords: Date Syrup, Orange Drink, Sugar

INTRODUCTION

Due to the increasing rate of cardiovascular and cancer diseases and the complications and problems in using some of the foods containing sugar in the formulation, the intention to new foods which are modified by replacing their ingredients have been increased. Since sugar can cause diabetes (Vartanian et al, 2007) and plays a role in the improvement of heart disease, arteriosclerosis, mental illness, depression, aging and hypertension (Foulkes, 1997) and interferes with absorption of calcium and magnesium and protein (Vasanti, 2010). Also sugar is considered as the factor increasing obesity and decreasing enzyme function (Gibson, 2008). Thus, using natural sweeteners instead of sugar in food formulations can be a good method. Date Syrup that produces from date is one of the suitable replacements that can be used for this purpose. Dates (*Phoenix dactylifera* L.) are significant product in hot desert regions of world and are marketed as high-value fruit. Iran which produces 18 percent of global date production is a major date producing country (Nasehi, 2010). Dates are served as a source of calories with about 78% carbohydrates 2-3% proteins and 1% fat. Date consumption is an important source of supplying vitamin and mineral in a balanced nutrition regime (Al-Shahib and Marshall, 2003). Date has anti-tumor activity, antioxidant and anti-mutagenic properties (Abbes et al, 2013). Some studies have been carried out to use low quality dates to develop new products. The low quality date is a rich source of carbohydrates composed mainly of sugars and

dietary fibers or used a date of good quality to product some products such a bakery, drink, jam and the confection (Gad et al, 2010). Research showed that when dates are eaten alone or mixed meals with plain yoghurt have low glycemic indexes (Abbes, 2013). Larger parts of the carbohydrates in dates are in the form of fructose and glucose (Ishurd and Kennedy, 2005). Polysaccharide isolated from dates has an antitumor activity (Mohamed and Ahmed, 1981). High fructose syrup and liquid sugar can be produced from date syrup (Ishurd and Kennedy, 2005). Date syrup is a product obtained from matured which about 67-72% solid concentration consist to 95% reducing sugar (Mohamed and Ahmed, 1981; Rofehgari-Nejad, 2010). Date syrup is a high energy food rich in carbohydrate, a good source of minerals; but it is also contains a very complex mixture of other saccharides, amino and organic acids, polyphenols and carotenoids (Abbes et al, 2013). The ingredients of date syrup depend on the type of date, but generally date syrup contains fructose, glucose, moisture and small amount of sucrose, protein, pectin, and calcium (Mohamed and Ahmed, 1981). Date syrup being used in the preparation of some traditional and industrial foods (Khosravanipour Mostafazadeh, 2011; Rofehgari-Nejad, 2010). The Date syrup is directly consumed or used as an ingredient in some food formulation such as ice cream products, drink, confectionery, bakery products, bakery products, sesame paste/date syrup blends, jam and butter (Barreveld, 1993; Raeisi ardali, 2013 and 2014). The purpose of this study is the use of date syrup as a suitable flavor to improve the

Fatemeh Raiesi Ardali et al

sensory characteristic and nutritional properties of drink and production a new drink.

MATERIALS AND METHODS

The aim of this study was replace the date syrup with sugar in the formulation of orange drink. For this purpose the date syrup was provided from Sybasan Company of Borujen.

Orange Drink Production: In order to prepare control sample drink, orange concentration (%4 W/V), sugar (%8.5 W/V) and citric acid (%0.1 W/v) were mixed and the water was rinsed for appropriate volume. Preparation of other samples was performed by the constant amounts of concentration, sugar and citric acid but 25, 50, 75 and 100 percentage of the water content were substituted by date liquid syrup. The samples were pasteurized in water bath (Mettler Model WNB-10, made in Germany) at 85° C for 20 seconds and the samples after being packed in 200 cc bottles, were kept in the refrigerator.

The physical, chemical treatments characteristics: Parameters evaluated were pH, performed on a digital pH meter. Density, was measured using a pycnometer, turbidity, were evaluated by turbidimeter. Total soluble solids were measured as° Brix with refractometer. Dry matter was determined by the AOAC method 934.01 (AOCS, 1990). Ash was determined by igniting a weighed sample in a muffle furnace at 550° c to constant weight, and extract was measured by the method of AOAC.

The rheological behavior: Evaluation of rheological properties of date syrup and drink samples treatments was done by Brookfield rheometer model LV-DV III equipped by ULA. Obtained data analyzed by rheocal 3.2 Software, to determine its rheological. The temperature of the test (5°C±0.1) was kept circulating refrigerating water bath TC502. Rheological behavior of all samples was fitted with the power law and the Herschel Bulkley models.

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Color measurements: A tristimulus reflectance colorimeter (HunterLab, model D25, Hunter Associates Laboratory, Inc Reston,VA) was used for determination of colour of samples. Tripartite measurements of L*, a*, and b* were recorded for each sample. The L* parameter (lightness index scale) ranges from 0 (black) to 100(white). The a* parameter indicates the degree of red (+a*) or green (-a*) color and the b* parameter measures the degree of yellow (+b*) or blue (-b*) color.

Sensory analysis: Samples of orange drink were assayed for sensory preference test in a hedonic scale of 9 points, where 1 (one) was for disliked very much and 9(nine) for like very much according to stone and sidle The evaluators were asked to drink water after eating any of the previous samples to omit the effect of their previous evaluations on new evaluations. The samples were presented to each assessor separately so that their evaluations do not affect each other's opinions (Moskowitz, 1983).

Statistical analysis: Statistical analyses were conducted using SPSS VERSION 18.0. One-way analysis of variance (ANOVA) was conducted and Duncan test (p<0.05) was used to determine the differences between treatment means.

RESULTS

Characteristics of date syrup: The date syrup physical and chemical characteristics were studied. Results are shown in Table2. The major part of date syrup sugar is reducing sugar and the amount of sucrose of date syrup is low (**Table-1**). The major sugars of date syrup are fructose and glucose. These sugars have more advantages in comparison with sucrose on health, natural and high in sweetness (Ghafari et al, 2013).

Table.1.Properties of date liquid syrup

72.1	Dry matter (%)
1.69	Ash (%)
1.36	Specific gravity
4.20	pH
70.27	Total sugar
67.97	Reducing sugar
2.18	Sucrose
72.1	Dry matter (%)
1.69	Ash (%)

Rheological analysis of date syrup indicates the shear thinning behavior and the flow index is less than one. Rheological properties of date syrup were investigated at

various temperature, concentration and shear rate by Gabsi, 2013. A shear thinning behavior was observed for all concentration (n<1). Flow curved were well described

Fatemeh Raiesi Ardali et al

by the power law model and the power law model was suitable for describing the flow behavior of date syrup since coefficients of determination were high (Gabsi et al, 2013).

Physical and chemical characteristics of orange drink treatments: Physical and chemical properties of orange drinks are shown in table 3 indicate the brix decreasing as bleached date syrup percentage was increasing in the drink. Increasing the bleached date syrup in the formulation causes turbidity and density increase. Since the date syrup PH is higher than orange juice, the final PH of the drink treatments increased.

The effect of date syrup s on the color of samples: Two factors determinate the color of orange juice, on one side the desired color of natural pigments, principally carotenoids, that can fade upon processing, on the other side browning that may occur through the formation of pigmented substances caused by enzymatic and/or non-enzymatic reactions. In addition Study on colorants of date syrup showed that Melanoidin is the major part of colorant of date juice originating from Millard reactions between amino acids and reducing sugars. Another study indicated that alkaline degradation products of hexoses and iron- polyphenol complexes are the other colorants (Rouse et al, 1997). Thus using date syrup in formulation of orange drink can change the color of samples. The * L *, a *, b factors were studied to understand the effect of date syrup in formulation on the final product color. The factors indicate brightness (white - black), redness - green color and yellow- blue respectively. The larger a * amount means more reddish color and the larger amount of b * causes more yellowish color. The negative a * and b * tends to be more of blue and green color. The results are shown in Table 4 indicate more brightness and yellowish color and less redness in samples.

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Rheological behaviors of orange drink treatments: Generally Viscosity of fruit juices changes with suspended solid and content of soluble. Pectin and sugar concentration are the main factors in changes of viscosity in orange juice (Rao et al, 1984). Rheological properties of most of the fruit juices can be described by a power law relationship. In order to describe the flow behavior of samples the two-parameter power-law model which has been extensively used in theoretical analysis and in practical engineering calculations was employed as,

$$\sigma = K \dot{\gamma}^n \quad (1)$$

In Eq. (1) σ is the shear stress, $\dot{\gamma}$ is the shear rate, K is the consistency index (Pa.sn) and n is flow behavior index. When fruit juice are concentrated, an additional resistance to flow may appear, which is represented by the yield stress σ^0 , In the Hershel-Bulkley model (Saravacos and Kostaropoulos, 1995).

$$\sigma = K \dot{\gamma}^n + \sigma^0 \quad (2)$$

The rheological parameters K and n are influenced by temperature and water content .Comparing the consistency index of the treatments indicates all the samples are more consistent with Herschel-Bulckley model. Also according to the table 5 all the samples have shear thickening behavior and the flow index is more than 1.

Sensory evaluation of drinks: To evaluate the consumer acceptance of the drinks containing date syrup the sensory characteristics of the drink treatments were tested. The results showed significant difference between treatments is the sensory properties of samples. Among these treatments, the acceptance increased with increasing date syrup and the highest score belonged to the sample containing 100% date syrup.

Table: 2. Measurement of the rheological behavior of date syrup according to power law model

	R2	n	K
0.99	0.99	23.93	date liquid syrup

Table: 3 Physical and chemical properties of orange drink

	Sample included %100 date liquid syrup	Sample included %75 date liquid syrup	Sample included %50 date liquid syrup	Sample included %25 date liquid syrup	Control sample
Brix	10.41±0.01 ^d	10.21±0.01 ^e	11.06±0.1 ^c	11.53 ± 0.05 ^b	12.13±0.05 ^a
Ash (%)	0.561±0.01 ^d	0.571±0.004 ^e	0.554±0.001 ^c	0.551 ±0.001 ^b	0.4903±0.008 ^a
Turbidity(NTU)	649.33±0.86 ^c	666±0.2 ^d	663±6.3 ^b	607.33±12 ^a	600±10 ^a
Specific gravity	1.043±0.001 ^{bc}	1.044±0.05 ^c	1.043±0.001 ^b	1.04±0.002 ^a	1.041±0.001 ^a
pH	3.86±0.05 ^{bc}	4.06±0.15 ^c	3.6±0.05 ^b	3.5±0.1 ^{ab}	3.43±0.05 ^a

Mean values ± SD of triplicate determinations.

Table.4.Characteristics of the sample colors

	L	a	b
date liquid syrup	6.15	0.9-	0.6
Control sample	a 2.22	a 3.33-	a 2.25
Sample included %25 date syrup	b 22.32	b 3.36-	b 2.29
Sample included %50 date syrup	c 23.34	3.73 c-	c 3.55
Sample included %75 date syrup	d 23.42	d 4.02-	d 4.77
Sample included %100 date syrup	e 23.43	e 4.05-	e 4.89

Table 5: Evaluation of the rheological behavior of Orange Drink using the power law and Herschel Bulckley Models

		Power law Models			Herschel Bulckley Models		
	Y ₀	K	N	R2	K	N	R2
Control sample	0.28	0.59	1.27	99.6	1.63	1.08	94.7
Sample (25 % date syrup)	0.27	0.7	1.25	100	1.78	1.07	94.6
Sample (50% date syrup)	0.27	0.76	1.23	99.5	1.90	1.06	94.2
Sample (75% date syrup)	0.47	0.15	1.51	99.7	1.35	1.11	94
Sample (100 % date Syrup)	0.5	0.27	1.14	99.2	1.64	1.08	95.3

Table: 6 Sensory evaluation of orange drink samples

Drink sample	Score
Control sample	2.30± 1.50 d
The sample including %25 date syrup	1.47b ±3.15
The sample including %50 date syrup	3.32c±1.43
The sample including %75 date syrup	2.82cd±1.23
The sample including %100 date syrup	3.42a±1.40

***Different letters indicated the significant difference (p<0/05).**

CONCLUSIONS

Adding date syrup in the formulation of drink samples caused changes in physical and chemical properties. Dry matter decreased and ash content increased with date syrup increase. Since the date syrup has a nutritional component, using it in the formulation of orange drink made that an enriched drink. Rheological properties of samples show all the samples are more consistent with Herschel-Bulckley model than power law model. Also according to all the samples have shear thickening behavior and the flow index is more than 1. According to the suitable sensory characteristics of date syrup, with adding it in formulation, acceptability of samples increased.

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Fatemeh Raiesi Ardali et al

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