PHYSICOCHEMICAL CHARACTERIZATION OF THE MIXED FRUIT JUICE (ORANGE, APRICOT)USING DATE FRUIT EXTRACT AS A SWEETENER

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Abstract
Date fruits from Phoenix dactylifera L., *are among the most important agricultural productsin Algeria. The biochemical composition of common Mech-Degla variety (dried date), is marked by its high sugar content of about 64% on the basis of fresh weightthe reason why they are suitable for the production of liquid extract to substitute sucrose in juice formulations. The aim of this study is to evaluate physicochemical and sensory properties of orange and apricot mixed fruit juice produced using date fruit extract as sweetener. In this study sucrose (white sugar) was totally or partially replaced by date fruit extract (50 and 100 %). The determination of mineral content indicate that elaborated formulations were enriched by many important elements such as potassium,sodium and calcium compared to hose made with sucrose. The organoleptic tests showed thatjuice produced with date fruit extract (50 % sucrose substitution), had higher global acceptability (6.90) compared to the juice made with exclusively date fruit extract (100% sucrose substitution) and to samples prepared with sucrose, scoring 6.11 and 5.13 respectively with significant difference($p<0.05$). Date fruits extract is a natural sweetener which could be used as an alternative to sucrose largely used in many food formulations.*

Keywords: date fruits, valorization, date extract, sucrose substitution, mixed juice, physicochemical composition, sensory analysis

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1. INTRODUCTION

Dates, the fruits of the date palm (*Phoenix dactylifera* L.), are a major staple food in the desert regions of North Africa and the Middle East, and the date crop plays a central role in the economy and social life of these regions. Algeria is the 4th largest producer of dates with a rich genetic heritage reaching 940 cultivars (Hannachi et al., 1998) and an annual production of about 1058559 tons (FAO, 2017). 48.2 %, approximately, of the annual production is made up of good varieties: Deglet-Nour(MADR, 2010). The remaining production includes common dates, which are less appreciated by consumers and not valued, especially dry varieties. Nancib et al., (1997), reported that 60 000 tons of dates are lost every year in Algeria.

It is a real economical loss, because they are rich in noble components especially sugars. In addition, dates are rich in dietary fiber, phenolic compounds, minerals, vitamins and antioxidant compounds (Booij et al., 1992; Al-Shahib and Al-Marshal, 2003; Barreveled, 1993; Al-Farsi et al., 2005; Vayalil et al.,2012;Noui et al., 2014).Date fruits have also been used in several forms such as syrups, spread, liquid sugarand flour as a sweetener in food(Khalil et al., 2002; Sidhu et al., 2003; Tammam et al., 2014 ; Amerinasab et al., 2015 ; Messaoudi and Fahloul, 2018).

The unrefined sugar of date provides non-empty calories unlike sucrose, which is drained of its nutrients (minerals, vitamins and polyphenols).

The objective of this work is to substitute the sucrose usedactually in common mixed juice formulation (apricot/orange) by Mech-degla water extract for reducing the harmful effect of sugar, and improving the nutrient properties. In addition, this study evaluates the sensory characteristics and consumer acceptability of such substitution.

2. MATERIALS AND METHODS

2.1. Raw materials

Dry dates are selected for this study, namely Mech-Degla. They come from the palm groves of the South-East of Algeria (Biskra). They are harvested at full maturity and stored at 4°C.Apricot and orange concentrated pulp,which came from the food cannery of Menaa-Batna, is a dark orange pasta raw material used in the industry of juices.

2.2. Production of dates fruit extract

Dates are first cleaned and sorted out to remove soiled and molded fruits. Sorted dates are pitted and crushed, then mixed with distilled water at a ratio flesh/water: 1/3. The mixture was heated at 72°C for 30 min with periodic stirring, and then filtered through a sieve of 50 µm; the obtained extract was stored at 4°C.

2.3. Mixed juice Formulation

Juice has been made by using date fruit extract instead of sucrose, the composition was illustrated in Fig 1.No Additives were used. Obtained juices were homogenized, then pasteurized at 90°C for 15 seconds (pH< 4.5) in their packages to avoid recontamination and to ensure minimum conservability of one month.

2.4. Analysis Method

The moisture content is determined by drying the sample of flesh dates in a stove at 105°C until constant weight (Zapata et al., 2011).The pH was measured by a pH meter, at 20°C (AFNOR, 1984). The soluble solids content is determined by measuring the Brix at 20°C by using a Digital refractometer, Reichert type, AR200(AFNOR,1984).Ash was determined by combustion of the sample in a muffle furnace at 550°C for 5 h. Minerals (K, Na and Ca)were determined by flame spectrometry, using a Jenway flame spectrophotometer, after hydrochloric digestion and appropriate dilution(AFNOR, 1984).

2.5. Sensory evaluation

Sensory evaluation was carried out by 13 panelists (group of trained and untrained panel - students of department of food technology, University of Batna 1). Samples are coded and presented to degustation panel. Juices were evaluated for their appearance, color, taste and odor, using a hedonic scale of 9 degrees. The scale interval fluctuates from "notpleasant" to "very pleasant" (Le Magnen,1998).Overall acceptability was determined.

2.6. Statistical Analysis

Results were expressed as mean ± standard deviation and analyzed by SPSS (version 20). Duncan's test (p<0.05) was used to determine the significant differences between mean values. All analyses were conducted in triplicate.

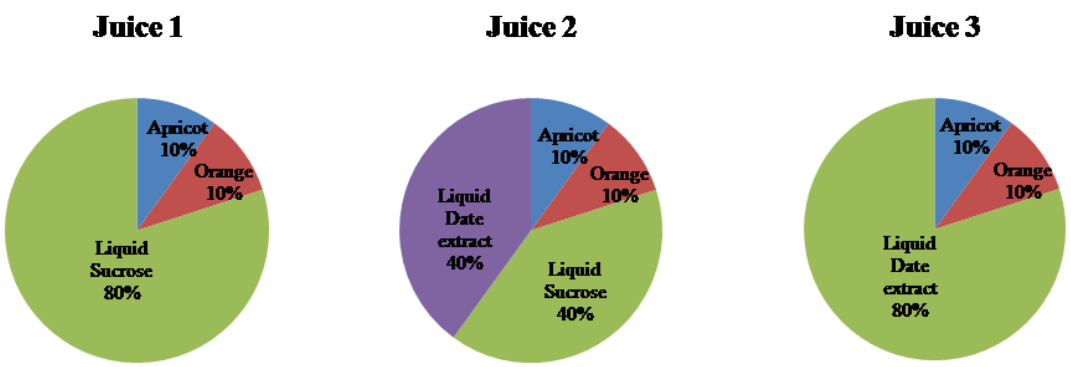

Fig 1. Ratios of orange, apricot, sucrose solution and date extract in different juice formulations(Juice 1 : 0% sucrose substitution; Juice2 : 50% sucrose substitution; Juice3:100 % sucrose substitution, percentages are reported to weight)

3. RESULTS AND DISCUSSION

3.1. Physicochemical characterization of flesh dates

The results of the physicochemical date's composition are shown in table 1.

Table 1. Physicochemical characterization of date Mech-Degla variety

Parameters	Values
Moisture (%) [1]	13.63 ± 0.17
Dry matter (%)[1]	86.36 ± 0.17
Total sugars (%)[1]	63.80 ± 0.35
Ash(%)[2]	02.42 ± 0.12

[1]: fresh weight.[2]: dry weight.

The moisture content of date varieties: Mech-Degla is 13.36 %. These values are similar to those cited by Al-Hooti et al. (2002), with contents about 11.53 and 11.55 % respectively for the two Saudi varieties: Birhi and Safri. These dates could be classified as dry dates where the moisture content is less than 20 % (Booij et al., 1992). The studied dates were characterized by the predominance of sugars. The rate of total sugars is 63.80 % for Mech-Degla. This value is in agreement with the results reported by Noui et al.(2014) for the same variety, with a value equal to 63.10 % (dry weight).The date fruit is a good source of energy.The level of the date pulp ash is 2.42 % (dry weight).This value is in agreement with the results reported by Noui et al.,(2015) for Degla-Beida(dry variety), with a value equal to 2.47 % (dry weight).

It is well to note that the difference in the biochemical composition recorded between varieties of dates depends on several factors such as: variety, soil type, fertilization, irrigation conditions and climatic conditions (Booij et al., 1992, Al-Farsi et al., 2007).

3.2. Brix of raw materials used for juice preparation

Brix of raw materials used for the elaboration of juice is summarized in the table 2.

Table 2. Brix of concentrate apricot, orange juice, date fruit extract and sucrose solution

Parameters	Brix (%)
Concentrateapricot	31.86 ± 0.40
Date extract	16.65 ± 0.03
Sucrose solution	14.50 ± 0.10
Orange Juice	10.30 ± 0.17

Date extract Brix is slightly higher than sucrose solution.

3.3. Physicochemical characteristics of elaborated mixed juice

Table 3 shows the results of the physicochemical composition of mixed juices. The moisture content of juices is between85.75 and 86.92 %, with a significant difference (p<0.05). These values are almost similar to those cited by Ciqual (2019), with values of 87 % of juice made with multifruit.

Table 3. Biochemical characterization of elaborated mixed juice formulations (native and sweetened with date extract)

Parameters	Juice 1 (0% SS)	Juice 2 (50%SS)	Juice 3(100% SS)
Moisture	85.75 ± 0.08a	86.92 ± 0.04b	86.35 ±0.11c
Dry matter (%) [1]	14.23 ± 0.08a	13.63 ±0.11b	13.07 ± 0.04c
pH	3.42 ± 0.02a	3.71 ± 0.01b	3.99 ± 0.02c
Brix (%) [1]	14.23 ± 0.05a	13.64 ± 0.05b	13.06 ± 0.05c
Ash (%) [2]	0.64 ± 0.06a	0.79 ± 0.01b	0.93 ± 0.07c
K[2](mg per 100g)	60.69 ± 2.20a	115.44 ± 1.87b	176.48 ± 2.59c
Na[2](mg per 100g)	69.76 ± 5.10a	85.89 ± 0.7b	110.78 ± 1.40c
Ca[2](mg per 100g)	108.76 ± 3.51a	112.13 ± 1.04a	112.60 ± 5.58a

[1]: fresh weight.
[2]: dry weight (mg per 100g).
Means in line with different letters are significantly different (p<0.05)/ SS: sucrose substitution.

Table 4. Scores of sensory evaluation properties of mixed juice formulations (native and sweetened with date extract)

Parameters	Juice 1(0%SS)	Juice 2(50%SS)	Juice 3(100%SS)
Appearance	5.84±1.81a	6.85±1.67b	5.61±1.32c
Color	5.30±2.13a	6.69±1.43b	6.30±1.43c
Taste	4.23±1.83a	7.23±1.48b	6.38±1.80c
Odor	5.15±1.46a	6.84 ±1.57b	6.15±1.81ab
Global acceptability	5.13±1.86a	6.90±1.51b	6.10±1.59c

Means in line with different letters are significantly different ($p<0.05$)/ SS: sucrose substitution.

The pH of dates is between of 3.42 and 3.99, with a significant difference ($p<0.05$). Increasing values of pH could be attributed to the mineral elements brought by the date extract and which have a basic character such as potassium and sodium. These pH values maygive juice a good pathogenic bacteria growth inhibiting potential (Onyekwelu, 2017).
Brix of samples varied significantly, the values ranged between 13.06 and 14.23 %.This limit is higher than the results quoted by Raiesi Ardali et al. (2015), which gave values of 10.41-12.13% for orange juice made with date syrup.
Ash content of juice 1 is 0.64 %. This value is less than that of juice 2 and juice 3, which is respectively 0.79 % and 0.93 % of dry weight, with a significant difference. These levels are comparable to those quoted by El-Sherief et al.(2012), giving a percentage of 0.66 and 1.07 % for the juice of nectarine prepared with different ratios of dates syrups. Addition of date extract significantly increased pH from 3.42 to 3.99, potassium from 60.69 to 176.48 mg/100g and sodium from 69.76 to 110.78 mg/100g. However, sucrose contains mineral traces of potassium, calcium and magnesium with mean values about 2.2, 0.6 and 0.2 mg/100 g, respectively (Vierling, 2003), not affecting the product at all. These results show that date extract is a good source of minerals.

3.4. Sensory analysis

The results of sensory analysis of prepared juices are summarized in Table 4. Sensory evaluation revealed that juice 2 (50% sucrose substitution) was the most appreciate in term of appearance, color, odor and taste, while juice 1 (0% sucrose substitution) was least accepted. In general, these results indicate that, the partial use of data extractinstead of sugar have better sensory attributes.

4. CONCLUSIONS

Mixed fruit juices were produced from apricot and orange using date fruit extract as a sweetener. Samples with date fruit extracts had higher levels in minerals (K, Na and Ca).Mixed juice made with date fruit extract (50%) was well appreciated compared to the two other samples. The date extract is a promising product that offers many advantages over sucrose (refined white sugar), it could be used as a sweetener in many foods. In the future, it will be interesting to determine the flavoring and rheological characteristics of mixed juice.

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