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UTILIZATION OF DATE SEEDS POWDER AS ANTIOXIDANT ACTIVITIES COMPONENTS IN PREPARATION OF SOME BAKING PRODUCTS

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ABSTRACT

The importance of antioxidants, phenols, is seen to increase the content of phenolics in plants, producing less hydrophilc derivatives by enzymatic modification of their structure with improved pharmacological characteristics, exploring novel effects and elucidating the quantitative structure–activity relationships of various phenol classes.

The current study was designed to add an economic value to date seeds powder (DSP) by using it, as phenolic and antioxidant activities components, at varied amounts (of 2, 5 or 10%) to manufacture some bakery products (muffins and shaboura). The corresponding products were characterized in terms of chemical composition, minerals content, phenols content, antioxidant activities and sensory properties.

Results showed a favorite significant effect of the date seeds flour on the chemical composition and minerals content of the tested products. It was found that fiber, protein, ash and moisture contents were gradient upwarded as a result of raising the substitution amount of date seeds powder. The carbohydrate was the predominant component in all the tested products. Indeed, muffin and shaboura manufactured by 10% DSP were the richest among of all samples. The total phenols content and antioxidant activity seemed to be higher in the products supplied by DSP and the enhancement in their amount applied the same pattern in case of chemical compositions. Sensory evaluation showed that among of all muffin and shaboura, the sample manufactured by 10% DSP were the least one in compare to the control sample with respect to the tested sensory attributes.

Keywords: Date seed flour, chemical composition and mineral contents, total phenols content and antioxidant activity, muffin, shaboura.

INTRODUCTION

The date (*Phoenix dactylifera* L.) has been an important crop in arid and semiarid regions of the world. It has always played an important part in the economic and social lives of the people of these regions. The fruit of the date palm is well known as a staple food (Besbes *et al*., 2004a). The world production of dates has increased considerably during the last 30 years. Indeed, the production has tripled from 2,289,511 tonnes in 1974 to 6,772,068 tonnes in 2004 (FAOSTAT, 2005). Dates of date palm tree (*Phoenix dactylifera* L.) are popular among the population of the Middle East countries. A date is composed of a seed surrounded by a fleshy pericarp which constitutes about 85–90% of date fruit weight (Elleuch *et al*., 2008). The seed constitutes between 10% and 15% of date fruit weight (Hussein *et al*., 1998). The date seeds considered a waste product of many date processing plants producing pitted dates (seed), date syrup and date confectionery. These date wastes are not consumed by humans and at present, are used mainly as animal feeds in the cattle, sheep, camel and

poultry (Rahman *et al*., 2007). With world production of dates reaching 6.9 million tonnes in 2004, from this approximately 863 thousand tonnes of date seeds are year globally produced (FAO., 2007). Thus, utilization of such wastes is very important to increase the income of this sector.

Chemical and nutritional constituents of date seeds were reported by numerous researchers. Al-Farsi *et al.*, (2007) reported that the date seeds contain 3.1–7.1% moisture, 2.3–6.4% protein, 5.0–13.2 fat, 0.9–1.8% ash and 22.5–80.2% dietary fiber.

The seeds of two date palm (*Phoenix dactylifera* L.) cultivars, Deglet Nour and Allig, from the Degach region—Tunisia, were analyzed for their main chemical composition. The following values (on dry-weight basis) were obtained for Deglet Nour and Allig cultivars, respectively: protein 5.56 and 5.17%, oil 10.19 and 12.67%, Ash 1.15 and 1.12% and total carbohydrate 83.1 and 81.0%. Gas–liquid chromatography revealed that the major unsaturated fatty acid was oleic acid (41.3–47.7%), while the main saturated fatty acid was lauric acid (17.8%) for the Deglet Nour cultivar and palmitic acid for the Allig cultivar (15.0%). Capric, myristic, myristoleic, palmitoleic, stearic, linoleic and linolenic acids were also found (Besbes *et al*., 2004b).

The good nutritional value of date seeds is also based on their high dietary fiber content, which makes them suitable for the preparation of fiber-based foods and dietary supplements (Al-Farsi and Lee, 2008).

Al-Farsi *et al*., (2007) evaluated the chemical composition of seeds of three native sun-dried date varieties from Oman (namely Mabseeli, Um-sellah, and Shahal). They found that carbohydrate was the predominant component in all varieties, followed by moisture, along with small amounts of protein, fat, and ash. Fat in seeds was ranged from 5.02 g/100 g in Mabseeli to 5.90 g/100 g in Um-sellah. Seeds were, also, found to be good sources of dietary fiber, whichvaried between 77.75 and 80.15 g/100 g fresh weight.

Reactive oxygen and nitrogen species, ROS/RNS are essential to energy supply, detoxification, chemical signaling and immune function. They are continuously produced in the human body and they are controlled by endogenous enzymes (superoxide dismutase, glutathione peroxidase, catalase). When there is an over-production of these species, an exposure to external oxidant substances or a failure in the defense mechanisms,

The antioxidant hypothesis says that ‘as antioxidants can prevent oxidative damages, increased intakes from the diet will also reduce the risks of chronic diseases’ (Stanner *et al*., 2004). The importance of antioxidant plant phenols is also seen in the efforts of researchers: (a) to increase the content of phenolics in plants (Wilhelm *et al*., 2000) (b) to produce less hydrophilc derivatives by enzymic modification of their structure with improved pharmacological characteristics (Kontogianni *et al*., 2003) (c) to explore novel effects (d) to elucidate the quantitative structure–activity relationships of various phenol classes (Nenadis *et al*., 2003; Kontogiorgis *et al.*, 2005). Phenolic components have been shown, also, to possess benefits, such as antioxidant, anti-carcinogenic, antimicrobial, anti-mutagenic and anti-inflammatory activities, as well as reduction of cardiovascular diseases. Thus, it is considered important to increase the antioxidant intake in the human diet and one way of achieving this is by enriching food with phenolics.

As some synthetic antioxidants may exhibit toxicity, require high manufacturing costs and have lower efficiency than natural antioxidants, there is a need to identify natural and possibly to devise more economical ways to obtain effective antioxidants with potential to be incorporated into foods. At present, the natural antioxidants commercially produced include tocopherols, ascorbic acid and plant extracts (Al-Farsi and Lee, 2008).

Seeds contained significant higher contents of total phenolics (3102–4430 mg of gallic acid equivalents/100 g fresh weight) and antioxidant activity (580–929 µmol of Trolox equivalents/g fresh weight). In general, such study suggested that date by-products (seeds) could be served as a good source of natural antioxidants and could potentially be considered as a functional food or functional food ingredient (Al-Farsi *et al*., 2007) . It has been found that date seed oil (DSO) has better oxidative stability than most vegetables and also has a high antioxidant capacity owing to its richness in phenol and tocopherol compounds (Besbes *et al*., 2004 b and c).

Dammak *et al.,* (2007) showed that DSO has a protective effect against hydrogen peroxide (H_2O_2)-induced oxidative stress (OS) in human skin organ culture and suggested that the use of DSO as a dietary supplement may have beneficial effects in protecting against skin disorders in humans (Ben *et al*., 2009).

Briones *et al*., (2011) reported that little research has been undertaken on date seeds and this has focused particularly on their chemical composition for nutritional purposes. Hence, studies on product development from date seeds are limited. Some applications such as oil extraction from the seeds and the use of the seeds as a dietary-fiber provider in bakery formulations have been reported (Rahman *et al*., 2007). Others suggest some potential uses of the date seeds and their constituents in cosmetics, pharmaceuticals and to a lesser degree for food products (Devshony *et al*., 1992).

Since a large quantity of date seeds in being produced as a waste material and the seeds contain a significant amount of bioactive phenolics and dietary fiber. Therefore, the present work is aimed to determine the optimum amounts of date seeds to be accepted by the consumer to involve in specified bakery products.

MATERIALS AND METHODS

Date palm (*Phoenix dactylifera* L.) fruits were obtained from the a private farmer at Riyadh region, KSA. The seeds under investigation were directly isolated from date fruit collected at the ‘‘Tamr stage’’ (full ripeness) and kept in a refrigerator (10˚C) for a week. The seeds were soaked in water, washed to get rid of any adhering date flesh, and then air-dried at ambient room temperature. Then, they were further dried at about 50˚C for about 3 days. Date pits were separately milled in a heavy-duty grinder to pass 1.5 mm screens and then preserved at -20˚C until utilized (Al-Farsi and Lee, 2008 and Besbes *et al*., 2004a).The ingredient amounts, of the control and tested samples, of muffins and shaboura were listed in Tables (1 and 2), respectively.

Table (1): Ingredient amounts of muffins manufactured by different ratios of date seeds powder

Muffin ingredients	Muffin samples (g)			
	Control (DSP free)	2% DSP	5% DSP	10% DSP
Wheat flour (70 % extraction rate)	100	98	95	90
Date seeds powder	0	2	5	10
Sugar	70	70	70	70
Egg	124	124	124	124
Fat	50	49	48	46
Skimmed milk powder	20	20	20	20
Water	20	20	20	20
Baking powder	5	5	5	5
Vanilla	2.5	2.5	2.5	2.5

DSP refers to date seeds powder

Table (2): Ingredient amounts of shabora manufactured by different ratios of date seeds powder

Shabora ingredients	Shabora samples (g)			
	Control (DSP free)	2% DSP	5% DSP	10% DSP
Wheat flour (80 % extraction rate)	1000	٩٨٠	٩٥٠	٩٠٠
Date seeds powder	٠	٢٠	٥٠	١٠٠
Instant active dry yeast	١٥	١٥	١٥	١٥
Table salt	١٠	١٠	١٠	١٠
Sugar	١٥	١٥	١٥	١٥
Fat	٥٠	٤٩	٤٨	٤٦
Water	٥٩٠	٥٩٠	٥٩٠	٥٩٠

DSP refers to date seeds powder

Muffin control samples were prepared according to Baixauli *et al*., (2008). But shaboura control samples were prepared according to a traditional method applied at KSA as follows: The sugar and fat amounts were mixed in a blender for 5 min. In another container, the flour, salt and instant active dry yeast were mixed and then added to the blended mixture. The water amount was added to the whole mixture and mixed well and formatted in the final form. The dough was left to fermented and then baked in the oven.

Specified amounts (2, 5 or 10%) of the dried date seed samples were subjected to partially substituted the same amounts of the corresponding utilized flour (70 and 80 % extraction rate) to prepare muffins and shaboura , respectively, and subjected to the same procedure, previously mentioned.

All the final products were subjected to the chemical composition (moisture, protein, fat, ash, fiber and Carbohydrates, calculated by differences) as recommended by AOAC (1990). Minerals content (iron, zinc, calcium, manganese , magnesium, sodium and potassium were determined using a Pye Unicum SP1900 Atomic Absorption Spectroscopy instrument (Perkin Elmer model 4100ZL) as described by AOAC (1990).

Samples of muffin and shaboura were subjected to extraction process to extract and determine total phenols content and antioxidant activities as described by Ragaee *et al.*, (2006). Total phenols content was based on the Folin-Ciocalteu method using gallic acid as a standard. The total phenols content was calculated as g gallic acid equivalent/100g. The free radical scavenging capacity of sample extracts was determined using the stable 2,2-diphenyl-1-picrylhydrazyl radical (DPPH). The kinetics of the antioxidant reaction in the presence of extracts were also determined over a 30 min period and compared with butylated hydroxytoluene (BHT) as an antioxidant reference.

The sensory evaluation of the tested samples attributes were determined by well trained panelists (15 judges) at Umm Al-Qura University for general appearance, taste, color, odor, tenderness, porous distribution and palatability as suggested by Dhingra and Jood, (2001).

Data analysis was performed using SAS (1987) software. Analysis of variance was used to test for differences between the groups. Least Significant Differences (LSD) test was used to determine significant differences ranking among the mean values at $P< 0.05$.

RESULTS AND DISCUSSION

Chemical compositions of muffin and shaboura:

Data presented in Tables (3 and 4) illustrated the impact of the 2, 5 and 10% date seeds powder partially substituted on the chemical composition of muffin and shaboura, respectively. It could be noticed that moisture, protein, ash and fiber content were upwarded as a result of raising the substituted amount of date seeds powder in both of muffin and shaboura.

Table (3): Chemical composition of muffins manufactured by different ratios of date seeds powder (as g/100 g dry weight basis)

Muffin samples	Moisture	Protein	Fat	Ash	Fiber	Carbohydrates
Control (DSP free)	22.65	12.82	18.22	1.02	1.66	66.28
Control + 2% DSP	23.11	12.89	18.00	1.88	2.12	65.11
Control + 5% DSP	23.88	12.93	17.72	2.32	2.82	64.21
Control + 10% DSP	24.22	13.22	17.55	2.54	3.44	63.25
LSD	1.06	0.12	0.42	0.64	0.46	1.12

DSP refers to date seeds powder LSD refers to least significant difference

Table (4): Chemical composition of shabora manufactured by different ratios of date seeds powder (as g/100 g dry weight basis)

Shabora samples	Moisture	Protein	Fat	Ash	Fiber	Carbohydrates
Control (DSP free)	3.3	12.46	6.23	1.42	1.88	74.71
Control (DSP free)	3.72	12.55	5.79	1.64	2.42	73.88
Control + 2% DSP	4.5	12.82	5.46	1.92	3.26	72.04
Control + 5% DSP	4.82	13.0	5.12	2.11	4.79	70.16
LSD	0.62٠	0.16٠	٠,١٤0	0.22٠	1.22	1.12

DSP refers to date seeds powder LSD refers to least significant difference

On contrary, both of fat and carbohydrates were downwarded as a result of raising the substitution ratio of date seeds powder in both of the tested products. Such results are due to the higher amount of protein, ash and fiber content in date seeds powder. Concurrent with that found by Alasalvar *et al*., (2005) and Al-Farsi *et al*., (2007) who reported that the carbohydrate content was the predominant component in date by-products (seeds), followed by moisture, along with small amounts of protein and ash. The same tables showed also that the utilization of 10% DSP led to produce a more nutritious significant product than the control one. The results of 2 and 5% DSP utilization in the tested samples showed values in between the highest (10% DSP samples) and the lowest (control samples).

Minerals content of muffin and shaboura manufactured by different ratios of DSP:

Minerals content of DSP, control, DSP, muffin and shaboura samples are shown in Tables (5 and 6). The sodium content in the control sample of both products was the highest mineral. It was due to the utilization of salt (sodium chloride) in the ingredients formula (Table 2). The manganese content in the control sample of both products was the lowest Potassium, calcium, magnesium, iron and zinc contents were less than sodium in a gradient downward order. On the other hand, the gradient downward order of the mineral content of the DSP sample was calcium > potassium > sodium > magnesium > iron > zinc > manganese. The great variation of minerals content of control sample and DSP reflected a varied amount of the corresponding minerals in the 2, 5 and 10% DSP substitution tested samples.

Table (5): Mineral contents of muffins manufactured by different ratios of date seeds powder (mg/100 g dry weight basis)

Muffin samples	Iron	Zinc	Calcium	Manganese	Magnesium	Sodium	Potassium
Date seeds powder	5.24	1.53	142.0	0.767،	104.62	105.2	141.3
Control (DSP free)	2.29	1.42	86.7	0.297	34.82	342.3	232.6
Control (DSP free)	3.06	1.49	106.5	0.351	35.73	366.4	272.3
Control + 2% DSP	3.12	1.83	115.0	0.382	38.44	386.5	292.4
Control + 5% DSP	3.64	2.02	125.1	0.411	42.11	412.6	321.4

Table (6): Minerals content of shabora manufactured by different ratios of date seeds powder (mg/100 g dry weight basis)

Shabora samples	Iron	Zinc	Calcium	Manganese	Magnesium	Sodium	Potassium
Date seeds powder	5.24	1.53	142.0	0.767،	104.62	105.16	141.3
Control (DSP free)	1.42	1.12	214.8	0.321	31.84	519.42	389.7
Control (DSP free)	2.55	1.46	233.0	0.272،	33.19	523.34	391.6
Control + 2% DSP	3.11	1.49	242.2	0.447	35.45	566.12	394.1
Control + 5% DSP	3.34	1.57	263.8	0.472	42.40	643.44	488.6

In general, as the substitution amount increased the minerals content was gradient increased. It was a result of the higher amounts of all minerals, except sodium and potassium in DSP than in the control sample. So, utilization of DSP resulted in more nutritious muffin and shaboura products than the control ones.

Phenols compounds and antioxidant activities of muffin and shaboura manufactured by different ratios of DSP:

An important field of research today is the control of 'redox' status with the properties of food and food components. Natural antioxidants present in the diet increase the resistance toward oxidative damages and they may have a substantial impact on human health. Plant phenols have not been completely studied because of the complexity of their chemical nature and the extended occurrence in plant materials. Attempts are also made to identify and evaluate antioxidants in agricultural by-products and other raw materials rich in antioxidant phenols that have nutritional importance and/or the potential for applications in the promotion of health and prevention against damages caused by radicals (Dimitrios 2006). Therefore, the utilization of DSF as antioxidant and phenols compounds sources were evaluated in the current study in muffin and shaboura products and the results are found in Tables (7and 8).

Table (7): Total phenols content and antioxidant activities of muffins manufactured by different ratios of date seeds powder

Shabora samples	Total phenol*	Antioxidant activities**
Control (DSP free)	52.11	46.22
Control (DSP free)	73.55	82.09
Control + 2% DSP	83.09	83.44
Control + 5% DSP	88.23	86.30

*** Determined as g gallic acid equivalent/100g on dry basis**
**** Determined as g BHT equivalent/100g on dry basis**

Table (8): Total phenols content and antioxidant activities of shabora manufactured by different ratios of date seeds powder

Shabora samples	Total phenol*	Antioxidant activities**
Control (DSP free)	42.96	32.66
Control (DSP free)	69.88	68.80
Control + 2% DSP	75.11	83.50
Control + 5% DSP	83.50	91.50

*** Determined as g gallic acid equivalent/100g on dry basis**
**** Determined as g BHT equivalent/100g on dry basis**

The aforementioned Tables show that the phenols content in the control samples of muffin and shaboura products were 52.11 and 42.96 g gallic acid equivalent/100g on dry basis. Such amount was gradually highered in muffins as a result of utilization of 2, 5 and 10% DSF to be 73.55, 83.09 and 88.23 g gallic acid equivalent/100g on dry basis, respectively, while in shaboura it reached 69.88, 75.11 and 83.50 g gallic acid equivalent/100g on dry basis, respectively.

Throwing the light on the antioxidant activity, data presented in Tables (7 and 8) showed a resemble pattern of total phenols content. Wherein, the amount of the control samples of muffin and shaboura products was 46.22 and 32.66 g BHT equivalent/100g on dry basis, respectively. It was reached, in muffin, to 82.09, 83.44 and 86.30 BHT equivalent/100g on dry basis, due to the utilization of 2, 5 and 10% DSF, respectively. While in shaboura, it

reached 68.80, 83.50 and 91.50 BHT equivalent/100g on dry basis, as a result of the utilization of 2, 5 and 10% DSF, respectively.

In spite of Al-Farsi *et al*., (2007) reported that no sufficient data is available in the literature regarding total phenolic contents of date by-products, many other researchers (Al-Farsi *et al*., 2005; Mansouri *et al*., 2005 and Wu *et al*., 2004) confirmed that, dates and their by-products (particularly seeds) may be considered as rich sources of total phenolics. Al-Farsi *et al*., (2007) reported that seeds had the highest antioxidant activity in all varieties ranging from 580 to 929 µmol of torolex equivalent/g fresh weight. Mansouri *et al*., (2005) explained that the highest $ORAC_{FL}$ values in seeds are due to their highest phenolic contents, which were 661 and 572 mg of gallic acid equivalent / 100 g fresh weight in date varieties. It was explained that various factors such as variety, growing condition, maturity, season, geographic origin, fertilizer, soil type, storage conditions, and amount of sunlight received, among others, might be responsible for the observed differences in the phenols content and antioxidant activities.

Sensory evaluation could be considered the main factor for consumers in order to select the most suitable amount of date seeds flour for making the most appreciat muffin and shaboura, which may be used to overcome such healthy problems. Therefore, sensory properties of the two prepared products were evaluated and compared with those of control one (the most consumed in KSA) to estimate the consumer reaction to these new products.

Data presented in Tables (9 and 10) show that all the attributed samples were significantly differed than the control sample, whither in case muffin or shaboura products. It was, also, found that as the DSP amount increased the degree of sensory estimated of each attribute decreased, and vice versa. For instant, the general appearance attribute degree of muffin control was 10.00, significantly lowerd to be 9.65, 8.42, 8.00, as result of using 2, 5 and 10% DSP, respectively. The same pattern are detected in the other tested attributes (taste, color, odor, tenderness, porous distribution and palatability. The same Tables (9 and 10) show a typical model of data in case of all the tested attributes of both muffin and shaboura.

Consequently, the dietary fiber and phenolic concentrates obtained from DSP could be used as natural additives for manufactured well known food products (muffin and shaboura) to enhance their functional properties.

Thus, the objectives of the current study are in line with current needs to upgrade date by-products, to evaluate better traditional products and to develop compositional databases to improve accuracy of nutritious and antioxidants consumption data, taking into consideration the limited existing compositional data available and the different cultural preferences among populations. Detailed information on nutritional composition and health-promoting components of dates and their by-products will enhance our knowledge and appreciation for the use of dates, syrups, and their products in a variety of food and specialty products, including their use as functional foods and ingredients in nutraceuticals, pharmaceuticals, and medicine (Al-Farsi and Lee, 2008).

Table (9): Sensory evaluation of muffins manufactured by different ratios of date seeds powder

Muffin samples	General appearance	Taste	Color	Odor	Tenderness	Porous distribution	Overall acceptability
Control (DSP free)	10.00	9.54	9.82	10.00	10.00	9.64	10.00
Control (DSP free)	9.65	8.66	9.00	9.88	9.55	9.00	9.44
Control + 2% DSP	8.42	7.23	8.52	9.32	8.53	8.12	8.00
Control + 5% DSP	8.00	6.12	8.00	8.00	7.00	7.55	6.12
LSD	0.26	0.64	0.28	0.12	0.36	0.22	0.64

LSD refers to least significant difference

Table (10): Sensory evaluation of shabora manufactured by different ratios of date seeds powder

Shabora samples	General appearance	Taste	Color	Odor	Tenderness	Thickness	Overall acceptability
Control (DSP free)	9.72	9.68	9.44	9.42	9.55	10.00	9.68
Control (DSP free)	9.00	9.00	9.00	9.22	9.32	9.88	9.58
Control + 2% DSP	8.66	8.00	8.00	8.44	8.oo	9.72	8.42
Control + 5% DSP	8.00	7.00	7.43	8.00	7.42	9.54	8.12
LSD	0.22	0.18	0.12	0.42	0.21	o.02	0.12

LSD refers to least significant difference

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إستخدام مسحوق أنوية التمر كمواد لها نشاط مضاد للأكسدة فى تصنيع بعض منتجات المخابز

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تبدو أهمية المواد المضادة للأكسدة إلى كونها تتواجد بنسبة كبيرة فى المواد النباتية ، وكذلك قدرتها على تكوين مشتقات منخفضة فى محتواها من الدهون نتيجة التغيرات التى تتم بواسطة الإنزيمات وتودى إلى تحسين الخواصا العلاجية للمواد المضادة للأكسدة ، وكذلك قدرة تلك المواد على إظهار التأثيرات غير التقليدية وتفسير كفاءة نشاط الأنواع المختلفة للفينولات.

وقد تم تصميم الدراسة الحالية من أجل رفع القيمة الإقتصادية لمسحوق أنوية التمر من خلال إستخدامه كمصدر للمواد الفينولية والمواد التى لها نشاط مضاد للأكسدة بنسب مختلفة (٢، ٥، ١٠%) فى تصنيع بعض منتجات المخابز (المافينز والشابورة). وقد تم تقدير التركيب الكيماوى، محتوى العناصر، محتوى الفينولات، نشاط المواد المضادة للأكسدة والتقييم الحسى فى تلك المنتجات.

وقد أظهرت نتائج الدراسة وجود تأثيرات معنوية مرغوبة لمسحوق أنوية التمر على التركيب الكيماوى ومحتوى العناصر المعدنية لتلك المنتجات المستخدمة فى الدراسة. ووجد أن هناك زيادة متدرجة فى محتوى تلك المنتجات من الألياف الخام، البروتين، الرماد، الرطوبة نتيجة زيادة نسبة مسحوق أنوية التمر المستخدمة فى الإستبدال. كما لوحظ أن الكربوهيدرات هى المكون الرئيس فى تلك المنتجات المستخدمة فى الدراسة. وحقيقة، فإن منتجات المافينز والشابورة المصنعة بإستخدام نسبة ١٠% من مسحوق أنوية التمر كانت الأغنى من بين كل المنتجات فى محتواها من العناصر السابق ذكرها . كذلك، فإن كمية الفينولات والمواد المضادة للأكسدة كانت أكبر فى المنتجات التى أضيف لها مسحوق أنوية التمر وأن نسبة التحسن فى تلك المكونات قد سلك نفس نمط التحسن فى التركيب الكيماوى. كما وجد أنه من بين كل منتجات المافينز والشابورة فإن العينات المصنعة بإستخدام نسبة ١٠% من مسحوق أنوية التمر كانت هى الأكثر دنوا من نتائج عينات المقارنة (الكونترول) من حيث درجة التقييم الحسى للصفات المختبرة.

الكلمات الدالة: مسحوق أنوية التمر، التركيب الكيماوى، محتوى العناصر المعدنية، محتوى الفينولات الكلية، المواد المضادة للأكسدة، المافينز، الشابورة.

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