

Utilizing the date palm (*Phoenix canariensis*) seeds in the preparation of some special foods of high nutritional value

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ABSTRACT

This research was carried out in order to evaluate the benefits of date seed powder (DSP) by adding it to bakery products to enhance the nutritional value of these products and maximize the economic value of these wastes. Thus, the contents of the (DSP) were determined from the chemical composition, mineral elements, amino acids, fatty acids, phenols and flavonoids, afterthought DSP were added to the toast bread and crackers with a ratio of 5, 10 and 15 % as substitute of the wheat flour and then the organoleptic properties of these products were evaluated. The findings of these investigations revealed that the (DSP) contains important minerals, essential amino acids, unsaturated fatty acids and antioxidants, and all of these compounds have an effective effect on the health of the body. In addition, the Sensorial evaluation of toast bread and crackers were shown to be acceptable by the judges, and thus the possibility of adding DSP to bakery products.

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1. Introduction

The date palm (*Phoenix dactylifera* L.) is one of Egypt's most economically important fruit trees.¹ For decades, the date palm's fruit has been a low-cost food source for millions of people all over the world, but date seeds can be easily harvested from date processing industries or emerging waste products.² The date pits account about 11-18% of the weight of the date fruit.³ Egypt produced 1.7 million tons of fresh dates in 2020, accounting for roughly 21% of global production.⁴

It represents around 1.3 billion tons of various food waste worldwide each year, enough to feed up to 2 million people without causing any further environmental damage, as resolute by the United Nations.⁵ Food waste has been described as “one of our time's greatest contradictions”, a waste of commodities used in food production.⁶ Recent study trends have focused on how food industry by-products can be used, as well as how waste can give economic benefit to industry, food security for farmers, and environmental protection.

The date pits regarded as an excellent and a rich source of waste product as food ingredients that used in food applications as it an important source of dietary fiber.⁷⁻⁸ DSP can be used to prepare functional foods in the human diet, agreeing to the reported study.⁹ Moreover, the use of DSP in the synthesis of some traditional medicines is of greater importance for human health.¹⁰ When the ratio of Na to K is less than one, it is favorable to patients with high blood pressure.¹¹

Ajwa date seed (ADS) contains nearly 19 % crude fibre, 7.8% crude protein, 9.8% crude fat, 62% carbohydrates and minerals such as phosphorus, potassium, zinc, boron, iron, magnesium, copper, calcium and phenolic and flavonoids compounds.¹² Ajwa date seed, which is high in antioxidants, is thought to have an essential role in the prevention and treatment of a variety of ailments. They are also listed in folk treatments for diabetes, liver disease, and gastrointestinal

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issues in traditional Egyptian medicine.¹³ According to the report studies,¹⁴ rats fed on DSP had lower plasma triglycerides, total cholesterol, and low-density lipoprotein.

The research aims to use additional natural sources of fruit date seeds that can be used in the manufacture of bakery products, and it is one of the techniques to overcome the shortage of wheat in addition to maximizing the value of date seeds waste.

2. Materials and Methods

2.1. Material

The subsequent commercially available materials (Date, Wheat flour (82% extraction), shortening, sugar, salt and Yeast) were procured from the market of Kafrelsheikh city, Egypt. Additionally, The chemicals that were used in the study were obtained from El- Gamhouria for Chemicals and Drugs Company, Egypt.

2.2. Methods.

2.2.1. Preparation of date seeds powder.

The date seeds were taken from the fruits and soaked in water to remove any remaining flesh before being air dried for 24 hours at room temperature until the pits were light brown. The date seeds were smashed in a pestle and mortar, then mixed in a high-powered laboratory blender, sieved to make a fine powder, and sieved again to make a fine powder (60 mesh).

2.2.2 Toast bread processing.

The formulas for making toast bread can be found in **Table 1** according to the reported method.¹⁵

2.2.3 Preparation of crackers

The crackers are prepared according to the reported method.¹⁶ The composition of the mixtures is explained in **Table 1**.

Table 1. Toast bread and crackers formula prepared with date Seeds powder

Ingredients (g)	Toast bread				crackers			
	Control	Blend 1	Blend 2	Blend 3	Control	Blend 1	Blend 2	Blend 3
wheat flour	100	95	90	85	100	95	90	85
Date seeds powder	0	5	10	15	0	5	10	15
Yeast	1.5	1.5	1.5	1.5	3.48	3.48	3.48	3.48
Salt	2	2	2	2	2	2	2	2
Butter	3	3	3	3	10	10	10	10
Sugar	5	5	5	5	1	1	1	1
Fresh egg	24	24	24	24	-	-	-	-
Baking powder	-	-	-	-	3	3	3	3

*Water (ml)

As required

2.2.4 Proximate determination

Determination of the chemical composition of DSP according to the reported method.¹⁷

Available carbohydrates = 100 – (protein + ash + ether extract + crude fibre) .

Energy value estimate according to report papers.¹⁸

2.2.5 Determination of total phenolic content

Total phenolic content of DSP was assayed as described before.¹⁹

2.2.6 Determination of total flavonoids content

Total flavonoids content of DSP was according to the reported method.²⁰

2.2.7 Determination of DPPH radical-scavenging activity

DPPH radical-scavenging activity was determination by using the method reported before.²¹

2.2.8. Determination of phenolic and flavonoids content

Phenolic acids and flavonoids samples was prepared according to the method reported before.²²⁻²³

2.2.9. Fatty acids analysis

Fatty acids composition in DSP was determined according to the reported method.²⁴

2.2.10. Determination of amino acids

Amino acids composition in date seeds powder was determined according to the reported method.¹⁷

2.2.11. Computed protein efficiency ratio (C-PER)

C-PER was calculated as according to the reported method.²⁵ using the equation:

$$C - PER = -0.468 + 0.454 (\text{Leucine}) - 0.105 (\text{Tyrrosine})$$

2.2.12. Computed Biological value.

Biological value (BV) was calculated as described by.²⁶

$$\text{Computed Biological value (BV)} = 49.9 + 10.53 C - PER$$

where: C-PER = computed protein efficiency ratio.

2.2.13. Sensory evaluation of crackers.

The prepared crackers was determination by using the method reported before.²⁷

2.2.14. Sensory evaluation of toast bread

Toast is cooled and then its sensory properties are appreciated by 20 members from the staff in food Tech. Res., Institute Agric. Res. Center. Egypt, for taste, crust color, odor, crumb texture, appearance and overall acceptability According to a study the reported method.²⁸

2.2.15. Statistical analysis

The analytical data was evaluated using the SPSS version 16.0 software. The means and standard deviations were calculated using descriptive statistics. Comparisons between samples were made using analysis of one-way variance (ANOVA) and multiple range tests. The statistical significance was determined using the $P \leq 0.05$ value.

3. Results and Discussions

3.1 Nutrient contents wheat flour and date seed powder

The nutritional content such as the chemical composition in wheat flour and DSP was determined and the results were recorded in **Table 2**. When compared to wheat flour, date seed powder included the largest percentage of fat, ash, and crude fibre. DSP contains fewer calories and protein than wheat flour. These results are in agreement with the reported data.²⁹

Table 2. chemical composition wheat flour and date Seeds powder (% on dry weight basis)

Components	Wheat flour	Date Seeds
Crude protein	11.75 ±0.23	7.90 ±0.75
Ether extract	1.05 ±0.07	7.50 ±0.25
Ash	0.60 ±0.55	4.98 ±0.13
Crude fiber	0.55 ±0.75	26.53 ±0.25
Available carbohydrates	86.05 ±0.21	53.09 ±0.42
Caloric value (kcal/100 g)	401 ±0.35	311 ±0.52

Available carbohydrates were calculated by difference.

Available carbohydrates = 100 – (protein + ash + ether extract + crude fiber)

3.2 Minerals content of wheat flour and date seed powder

The minerals present in wheat flour and DSP were identified in **Table 3**. The results showed that DSP contained the highest amounts of potassium, sodium and calcium, while iron, manganese, zinc and copper had the lowest amounts in date seed powder compared to wheat flour. Therefore, by adding date seeds powder to wheat flour, we get products that are rich in all the mineral elements and thus get all the mineral elements in the product. These results were confirmed with the reported work.³⁰

Table 3. Mineral composition of wheat flour and date Seeds powder

Mineral content	Wheat flour (mg/100g)	Date Seeds (mg/100g)
Calcium (Ca)	16.4	98.3
Phosphorus (P)	134.6	59.1
Potassium (K)	150.5	135.1
Magnesium (Mg)	103.8	65.2
Sodium (Na)	4.5	126.7
Iron (Fe)	1.39	1.51
Manganese (Mn)	1.31	0.86
Copper (Cu)	0.04	1.6
Zinc (Zn)	4.29	1.33

3.3. Total phenol compound, flavonoids and antioxidant activity in date Seeds powder

The characteristics of the analysis of phytochemicals in date seed powder were determined and the results were tabulated in **Table 4**. The results noted that date seeds are rich in total phenol content, total flavonoids and antioxidant activity (DPPH). The most effective antioxidant and antibacterial substances discovered in nature are phenolic compounds. Furthermore, it has been demonstrated that all fruit, vegetable, and seed extracts prevent lipid oxidation and microbiological deterioration.³¹ Date pit powder also possessed the highest levels of radical scavenging capacity, chelating activity, lowering power, and lipid peroxidation suppression.³²

Table 4. Total phenol compound, flavonoids and antioxidant activity in date Seeds powder

Sample	Samples (mg/100g)		
	Total phenolics as gallic acid	Flavonoids as catechin	DPPH (%)
Date Seeds	1295	545	62.24

3.4 Phenolic content of date seeds powder

Table 5 shows the phenolic compounds content of date seeds. The results indicate that the date seeds powder is rich in phenolic compounds such as Cinnamic, protocatechoic acid, p-Coumaric, resorcinol, pyrogallol, vanillic acid in addition to other phenolic compounds. These results are in agreement with the reported work.²⁹ Date seeds are rich in p-coumaric, gallic, resorcinol, pyrogallol, ferulic, and chlorogenic acids. Different phenolic chemicals may be responsible for natural antioxidant action. An aromatic benzene ring is connected to one or more hydroxyl groups in these molecules. Furthermore, dietary natural antioxidants were present to protect against a variety of ailments.³³

Table 5. Phenolic content of date seeds powder

phenolic acids	Quantification (mg/100 g dw)	phenolic acids	Quantification (mg/100 g dw)
Pyrogallol	9.09	Epicatechin	4.50
Resorcinol	10.90	Chlorogenic acid	5.90
Cinnamic	40.50	P-OH-Benzoic	5.01
Ellagic acid	1.90	P-hydroxybenzoic acid	7.56
Catechol	2.01	Sinapinic acid	7.87
Protocatechoic acid	19.05	Epicatechin	6.58
p-Coumaric	15.04	Ferulic acid	8.83
Caffeine	6.02	Gallic acid	13.41
Vanillic acid	9.16		

3.5 Flavonoid compounds of date seeds powder

Table 6 Shows the flavonoid compounds content of date seeds. The results indicate that the date seeds powder is rich in flavonoid compounds such as apigenin, kaempferol, hesperidin, luteolin, quercetin in addition to other flavonoid compounds. These results are in agreement with the reported work.²⁹ Apigenin, kaempferol, hesperidin, luteolin, and quercetin are abundant in date seeds. By limiting the diffusion of oxidative chain reactions, natural antioxidant substances might postpone the oxidation of lipid profiles.³⁴ Date seed powder contains a variety of polyphenols that may help protect the body from free radicals.

Table 6. Flavonoid compounds from date seeds powder

Flavonoids compounds	Quantification (mg/100 g Dw)	Flavonoids compounds	Quantification (mg/100 g Dw)
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Hesperdin	20.30	Apigenin	25.67
Narengin	8.95	Kaempferol	20.80
Rutin	8.42	Quercetin	10.06
Hesperitin	4.45	Luteolin	10.50

3.6 The fatty acids in date seed powder

Table 7 shows the fatty acid composition of date seed powder. The results showed that lauric acid, myristic acid and palmitic acid are the main saturated fatty acids while oleic acid and linoleic acid (omega 6) were the major unsaturated fatty acids in date seeds powder. These findings is in the same side of those obtained before.³⁵ The main fatty acids in various date seed oil were oleic acid (42.3 %) and lauric acid (21.8 %, followed by myristic (10.9 %) and palmitic acid (9.6 %).

Table 7. Fatty acids content of date seeds powder

Fatty acids	Symbol	(mg/100g oil)
Myristic acid	C14:0	10.59
Palmitic acid	C16:0	8.37
Palmitoleic acid	C16:1	0.16
Myristoleic	C14:1	0.64
Lauric	C12:0	21.85
Stearic	C18:0	2.73
Oleic acid	C18:1	46.31
Linoleic acid (Omega6)	C18:2	7.94
Linolenic acid (Omega3)	C18:3	0.03
Arachidic acid	C20:0	0.32
Eicosenoic acid	C20:1	0.30
Total saturated fatty acid	SAF	43.86
Total Unsaturated fatty acid	USFA	55.11
	Unknown	1.03

3.7 Amino acids composition of date seeds powder and wheat flour

The data in **Table 8** shows the content of date seed powder of essential amino acids and nonessential amino acids compared to wheat flour. It has been observed that date seed powder contains the highest percentage of essential amino acids such as lysine, valine, cysteine and threonine compared to wheat flour. Where we find that one of the most important defects of wheat flour is the lack of the amino acid lysine, and therefore the addition of date seed powder treats this problem. These results are consistent with the reported work.³⁶ stated that date seeds proteins are a good source for most essential amino acids such as lysine, isoleucine, leucine, methionine, threonine, valine and phenylalanine.

Table 8. Amino acids composition of date seeds powder and wheat flour (g. amino acid /100g protein)

Amino acids (g/100g protein)	wheat flour	D Date seeds p	FAO/WHO/UNU ³⁷
Essential amino acids (EAA)			
Isoleucine	4.01	2.70	1.30
Lysine	2.46	4.05	1.60
Valine	4.45	6.35	1.30
Methionine	1.17	2.80	1.70
Cysteine	1.53	3.30	
Phenylalanine	5.33	3.60	1.90
Tyrosine	1.97	0.70	
Threonine	2.00	5.20	0.90
Leucine	4.50	5.70	1.90
Histadine	3.71	1.90	1.60
Total EAA	31.13	36.30	12.20
Non-essential amino acids (Non-EAA)			
Arginine	2.20	10.07	
Alanine	3.77	4.04	
Aspartic acid	5.41	10.80	
Glutamic acid	43.12	25.80	
Glycine	3.81	5.20	
Serine	6.36	5.70	
Total NEAA	64.67	61.61	
C – PER*	1.37	2.05	
Biological value (B V) **	64.33	68.49	

C-PER = computed protein efficiency ratio. **BV= Biological value*

3.8 Sensory evaluation of crackers:

The results presented in **Fig. 1**. Indicate that the organoleptic characteristics of crackers made from mixture 1 are acceptable compared to the control, and that the higher the concentration of date seed powder added to wheat flour, the lower the acceptability. And that the mixture 2 was less acceptable and the mixture 3 was not acceptable. Thus, the possibility of adding date seed powder to baked products to raise the nutritional value of the products in addition to maximizing the economic value of date seeds. These findings are consistent with the reported work.³⁸ who stated that date-processing industry by-products might be regarded as a good source of food ingredients with unique technological capabilities that could also be employed in food as a significant source of dietary fibre.³⁹ found that bread containing 10% date seed had higher dietary fibre content and sensory qualities equivalent to wheat bran control, but worse colour, flavour, odour, and overall acceptability sensory scores than wheat bran control.

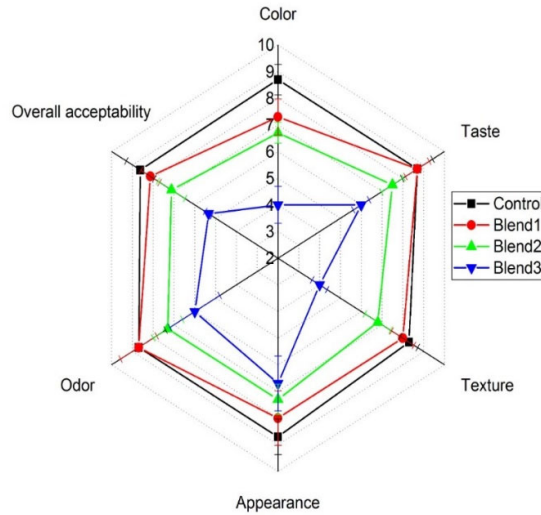


Fig.1. Comparison of sensory evaluation of cracker containing 0%, 5% , 10% and 15% date seed powder.

3.9. Sensory evaluation of toast bread

Fig. 2 shows the sensory properties of toast bread made from wheat flour and DSP. The results indicate that the sensory properties of toast bread made from wheat flour and DSP were acceptable compared to the control made from wheat flour only. Therefore, it is possible to add DSP to bakery products to raise the nutritional value of these products. Similar results were obtained previously.⁴⁰ who investigated the nutritional value of date bran muffins. They concluded that increasing the amount of date syrup and date seeds in date muffins resulted in an increase in protein, fibre, softness, and color development while decreasing the calorific value.

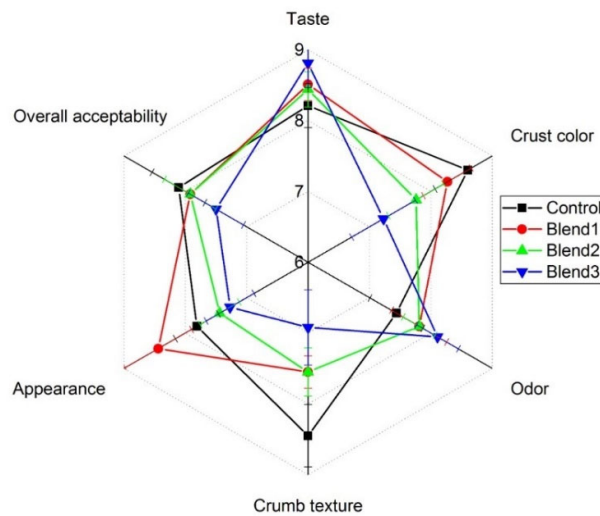


Fig. 2. Comparison of sensory evaluation of Toast bread containing 0%, 5% , 10% and 15% date seed powder.

4. Discussion

Ajwa date seed (8ml/kg/day) administration resulted in significantly less weight increase than the disease control group, according to the current study. This could be because the seeds' antioxidants vitamin C, zinc, copper, polyphenols, and flavonoids impeded the oxidative stress associated with obesity.⁴¹

Some studies have shown that bakery goods containing 15% of date powder got the highest overall acceptability score.⁴² They also came to the conclusion that DSP improves the nutritional value of bread and has a hypoglycemic effect, reducing the risk of developing diabetes. Arabic bread incorporating DSP has greater amounts of flavonoids and antioxidant potential.⁴³

The antioxidant chemicals polyphenols (gallic acid, ferulic acid, coumaric acid, chlorogenic acid, caffeic acid, catechin, and quercetin) and vitamin C present in DSP are like to those found in citrus peel extract.¹² The activity of the hepatic enzyme 3-hydroxy-3-methylglutaryl-CoA (HMG CoA) reductase, which is required for cholesterol production, was lowered by these antioxidant chemicals.⁴⁴ Ajwa date seed polyphenols and vitamin C may be responsible for a decrease in hepatic cholesterol storage, leading in enhanced hepatic uptake of cholesterol from extrahepatic sources, particularly the vascular system. It has the effect of reducing blood lipid levels.⁴⁵ Quercetin inhibits the transcription of numerous enzymes involved in fatty acid production.⁴⁶ Saponins are also found in Ajwa date seeds, which inhibit the lipase enzyme and limit lipid absorption in the intestines. Hasan and Mohieldein.⁴⁷

A single seed's total mineral content is comparable to barley's mineral content. Sodium, calcium, potassium, manganese, magnesium, iron, zinc, copper, phosphorus, lead, and cadmium are all minerals found in DSP. This shows that a single seed can provide a good supply of nutrients and can also be used to replace barley in diet.⁴⁸ Date seed, on the other hand, has a significant amount of protein. Albumin, globulin, prolamin, and glutelin are soluble proteins found in date seed, accounting for 5-6 % of total protein content.⁹

5. Conclusion

Bread wheat is an Egyptian cuisine that is found in both rich and poor Egyptian households. There is a significant gap between wheat production and consumption in Egypt, with total wheat grain yield satisfying just about 55% of overall needs.. Date seed powder is high in dietary fiber, total carbs, minerals, amino acids, unsaturated fatty acids, antioxidants, phenolic compounds, and important flavonoids, as well as antioxidants, phenolic compounds, and key flavonoids. Date seed powder, for example, can be utilized in various amounts to make functional baked goods, increasing the nutritional content of these baked goods while also maximizing the nutritious worth of waste products from the date business.

Finally, some bakery products such as toast and crackers, can be prepared using ingredients such as date seed powder and wheat flour to obtain A suitable bakery that has functional food properties.

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Competing Interests

Authors have declared that no competing interests exist.

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