

## Phytochemical constituents and nutrient evaluation of date palm (*Phoenix dactylifera*, L.) pollen grains

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### Abstract:

The pollen of date palm -DPP (*Phoenix dactylifera* L. variety El- Ghanmi Ahmar.) has been analyzed for the main phytochemical composition, nutrient and mineral composition. The phytochemical screening of chemical constituents of the plant showed that the DPP grains contains phytosterols, flavonoids, alkaloids, protein, carbohydrates, glycosides, phenolic compounds, tannins, terpenoids, saponins, coumarins, lignin, oil and fats, with absent of quinones. The quantitative contents of alkaloids, tannin, phenolic compounds and sterols were (2416±0.034, 2279.6±35.769, 115±5 and 110.1±0.87) mg/100g in DPP grains. While the moisture content of palm pollen grains was 8.041 ± 0.1%, and 91.959 ± 0.1 % for the total solids. Values 0.113±0.003 % and 5.585 ± 0.144 % were estimated for crude fiber and ash contents respectively. Crude fat content of DPP grains was 7.678 ± 0.149%, 19.45%, for crude protein and 26.25±0.315 g/100g for carbohydrates, the energy value was 291.902 Kcal/100g. The predominant minerals were potassium 73.5 mg/g, followed by magnesium 19.6 mg/g, calcium 10.8 mg/g and iron 8.5 mg/g. Comparable amounts of sodium 4.34 mg/g and copper 3.658 mg/g with equal amounts of molybdenum, nitrogen and boron (3.169, 3.11 and 3.024) mg/g respectively were found in DPP grains. Palm pollen also contain useful amount of zinc 2.799 mg/g, manganese 2.702 mg/g, selenium 2.51 mg/g, cobalt 1.986 mg/g, nickel 1.698 mg/g and cadmium 0.12 mg/g. From all the results we can conclude that the date palm pollen was as rich source of antioxidant, energy, and important minerals, so its suitability as a regular component in human diet.

### Introduction:

Date palm pollen-DPP is a fine powder-like material produced by flowering plants and gathered by bees<sup>(1)</sup> and it's cause of human respiratory allergic disorders<sup>(2,3)</sup>. The early Egyptians and ancient Chinese used pollen as a rejuvenating medicinal agent. It has been called a "fountain of youth". Pollen preparations are distributed worldwide for dietary purposes and as diet supplement by increasing the total dietary intake<sup>(4,1)</sup>.

Little information are available on the chemical composition of pollen grains of date palm<sup>(5)</sup>. They contain concentrations of phytochemicals and nutrients and are rich in phytosterols, flavonoids, triterpenes, saponins and carotenoids<sup>(6)</sup>, saponins, tannins and crude gonadotrophic substance [Egyptian cultivars]<sup>(7,8-10)</sup>. Stanley and Linskens mentioned that palm pollen contains carbohydrates<sup>(11)</sup>, protein, lipids, nucleic acids, free amino acids, lipid-soluble vitamins and different kinds of enzymes and cofactors<sup>(11-13)</sup>. Bacha et, al conducted a study on the chemical analysis of pollen grains from 13 cultivars of date palm males grown in Deirab, Saudi Arabia, the chemical analysis revealed differences among cultivars. The average concentration of moisture, ash, lipids and protein in pollen were 3.6-4.8, 4.7-7.1, 0.8-1.8 and 15.8-18, respectively<sup>(14)</sup>.

The minerals content in DPP grains differed from one cultivar to another. The macronutrients, N was present in the highest concentrations, followed by Ca, P, Mg and Na, while the micronutrients, Fe was present in the highest concentrations, followed by Zn, Mn and Cu<sup>(11)</sup>.

The aim of this study is to investigate the phytochemical constituent, nutritional value and minerals in Iraqi DPP.

### Material and methods:

- Material: Plant material: Pollen grains of Iraqi date palm (*Phoenix dactylifera* L. variety El- Ghanmi Ahmar) were collected at the end of March to the end of April 2011. The pollens were separated from the kernels with a fine gauze sieve and left for 3 hours in an incubator at 35°C, and then kept in refrigerated (4°C) in closed container.

#### -Methods:

##### A-Preliminary phytochemical screening:

Chemical test were carried out on the powdered of Iraqi palm pollen and their extracts by using standard procedures to preliminary phytochemical screening as follows:

##### I-Preparation of extracts:

Ten grams of Iraqi palm pollen powdered were macerated in 50ml of each of the following solvents [chloroform, ethanol, ethyl acetate and hot distilled water-DW] at room temperature, the extracts filtrate after 24hr. While petroleum ether extract prepared by soxhlet for 10hr at (45-60)C°, The half of the solvent was evaporated under reduced pressure at (35-45) C° by rotary evaporator.

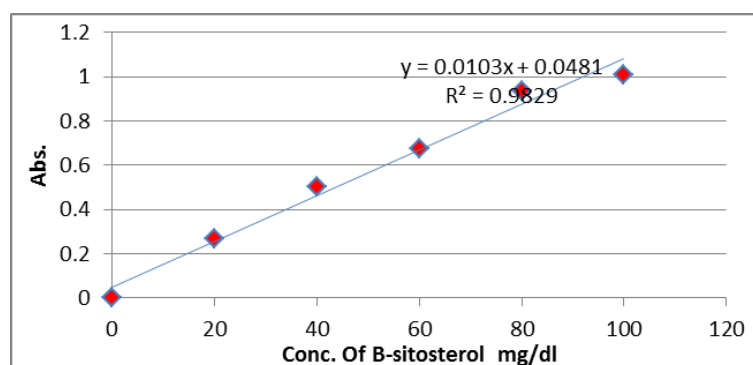
##### II-Phytochemical tests procedure:

The various extracts of DPP were subjected to preliminary phytochemical tests by standard methods<sup>(15-20)</sup>.

##### B- Quantitative estimation of some secondary metabolites by colorimetric methods:

I- Estimation of sterols: Estimation of sterols in DPP was carried out by using colorimetric method by Liberman – Burchard reagent. In this reaction the acetic anhydride in the Liberman –Burchard reagent is reacted with the sterol in the sample, which gives a green colour. The total content of sterols was

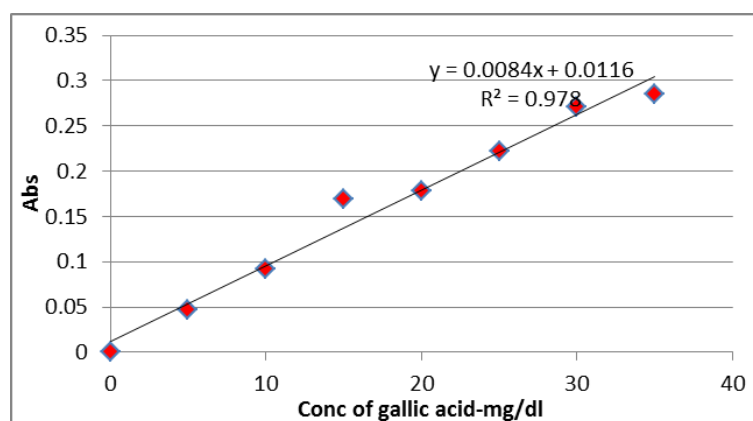
calculated from standard graph of  $\beta$ -sitosterol<sup>(21)</sup> Fig.(1).



**Fig.(1):Standard curve of  $\beta$ -sitosterol.**

II- Estimation of alkaloids: it was determined by using Harborne method<sup>(19)</sup>.

III- Estimation of phenolic compounds<sup>(22)</sup>: Total phenolic compounds were determined by the Folin-ciocateu method as modified by Swin and Hillis. The total content of phenolic compounds was calculated from standard graph of gallic acid, Fig(2).



**Fig.(3-2):Standard curve of gallic acid**

IV- Estimation of tannin: it was determined according to Boham an Kocipai, The total content of tannins was calculated from standard concentration of tannic acid<sup>(23)</sup>.

#### C- Proximate nutritive values of DPP:

The moisture, total solids content, crude fiber, ash, crude fat were determined according to the standard methods<sup>(21,22)</sup>. Crude protein was estimated by Kjeldahl method<sup>(22)</sup>. Carbohydrates were determined according to anthron method. All determinations were carried out in triplicate and reported as mean (% DM)  $\pm$  standard deviation.

#### D- Determination of mineral components of DPP:

Dry ashing method was used for the mineral contents of Iraqi DPP using the atomic absorption spectrophotometer according to the following steps<sup>(24)</sup>.

#### Result and discussions:

##### -Preliminary phytochemical screening:

The concentrations of phytochemical compounds in the different solvent extracts were significantly different from each other. The result indicate that the chloroform extract contains moderate amounts of phytosterols, terpenoids, lignin, oil and fat, table(1),

with less amounts of alkaloids, carbohydrates and coumarins, while the ethanolic extract were found to be rich of phytosterols, flavonoids with trace amounts of alkaloids, amino acids, protein, carbohydrates, phenolic compounds and tannins, lignin, oils and fats with absent of glycosides, terpenoids, saponins, coumarins and quinones.

The ethyl acetate extract was very poor in the phytochemical compounds, its contains only trace amount of phytosterols, flavonoids, alkaloids, terpenoids, oil and fats with absent of amino acids, protein, carbohydrates, glycosides, phenolic compounds, tannins, saponins, coumarins, lignin and quinones. The hot water extract contained all compounds under investigation except lignin and quinones. The petroleum extract contained phytosterols, alkaloids, carbohydrates, terpenoids, coumarins, oil and fats with absent of flavonoids, amino acids, proteins, glycosides, phenolic compounds, tannins, saponins, lignin and quinones.

Table(1):Phytochemical screening for various extracts of palm pollen

Phytochemical tests		Chloroform	Ethanol	Ethyl acetate	Hot DW	Pet. ether
Phytosterol	Salkowski	Trace	++	-	+	+
	Liebermann-Burchard	++	++	Trace	Trace	++
Flavonoids	Shinoda	-	+	Trace	-	-
	Zinc-HCl	-	++	-	+	-
	Alkaline reag.	-	++	-	+	-
	Ferric chloride	-	+	-	Trace	-
	Lead acetate	-	+	Trace	-	-
Alkaloids	Dragendorff	Trace	-	Trace	+	Trace
	Mayer	-	Trace	-	-	Trace
	Wagner	+	-	+	Trace	+
	Hager	-	-	-	+	-
	Tannic acid	-	Trace	-	+	Trace
Protein and Amino acids	Ninhydrin	-	+	-	++	-
	Xanthoproteic	-	-	-	-	-
	Biuret	-	Trace	-	+	-
Carbohydrate	Molish	+	+	-	++	++
	Bendict	Trace	Trace	-	++	-
	Salwinoff	Trace	Trace	-	++	-
	Anthron	+	+	-	++	++
Glycosides	Killer-Llni	-	-	-	-	-
	Alkaline reag.	-	-	-	+	-
phenolic compounds and tannins	Ferric chloride	-	-	-	Trace	-
	Gelatin	-	Trace	-	Trace	-
	Lead acetate	-	Trace	-	Trace	-
	Dichromate	-	-	-	-	-
Terpenoids	Trim-Hill	-	-	-	-	-
	Liebermann-Burchard	++	-	Trace	+	+
Saponins	Foam test	-	-	-	-	-
	HgCl <sub>2</sub>	-	-	-	Trace	-
Coumarins	Mercuric chloride	Trace	-	-	-	+
Lignin	Galic acid	+++	Trace	-	+	-
	Furfulaldehyde	-	-	-	Trace	-
Quinones	Potassium hydroxide	-	-	-	-	-
Oil and fats	Spot test	++	+	Trace	+	++

The phytochemical screening of chemical constituents of the plant in different solvents studied showed that the DPP grains contain phytosterols, flavonoids, alkaloids, amino acids, protein, carbohydrates, glycosides, phenolic compounds, tannins, terpenoids, saponins, coumarins, lignin, oil and fats with absent of quinones. These results are in agreement with the finding of Mahran<sup>(25)</sup> which found that Egyptian DPP contains sterols, triterpenes, saponins, proteins, carbohydrates and/or glycosides. Abed<sup>(26)</sup> found that Iraqi DPP cultivars (Ghannamy Ahmar, Ghannamy Akder and Khikri adi) contain carbohydrates, protein and phenolic compounds. And Abbas<sup>(27)</sup> which identified sterol and flavonoids in Egyptian DPP. Also Mohamed *et al*<sup>(28)</sup> demonstrated that the flavonoids are present only in pollen grains in high amount and shoot tip in moderate amount as

compared with other parts of the plants (leaves and fruits tissues), while alkaloids present with moderate amount in DPP in which gave (+ve) result with Dragen'dorf test, and also detect tannins, no information about the present of coumarins, lignin and quinones in the date palm pollen in the literature but<sup>(29,30)</sup> identified higher contents of lignin in the date palm without any information about coumarins and quinones.

#### -Quantitative estimation of some phytochemical compounds in DPP:

The quantitative contents of alkaloids, tannin, phenolic compounds and sterols of Iraqi DPP are shown in Fig.(3), which indicate the highest concentration of alkaloids in DPP grains was 2416±0.034 mg/100g and for tannin 2279.6±35.769 mg/100g, while the phenolic compounds was 115±5

mg/100g and phytosterols recorded the least concentration of  $110.1 \pm 0.87$  mg/100g.

This concentration is higher than sterol concentration recorded for Zaghoul and Sewi cultivars of Egyptian DPP (16.6 and 12.7) g /100g<sup>(10)</sup>, and in support with the study conducted by Abed<sup>(26)</sup> who reported the presence of phenolic compounds in three DPP

cultivars, 22.09% for Ghannamy Ahmar, 20% for Ghannamy Akder and 19.25% for Khikri adi with no significant differences in the concentration between the three cultivars under investigation. These variations in the phytochemical concentrations may be due to cultivars and the difference in soil composition and difference in the method of analysis.

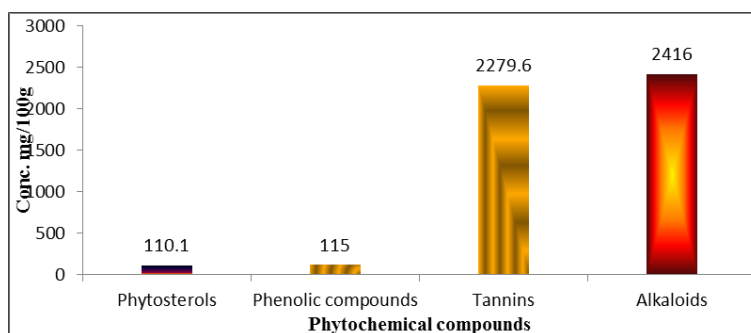


Fig.(3): Quantitative phytochemical composition of DPP grains.

#### - Proximate nutritive values of DPP:

In this study, palm pollen grains were analyzed for their constituents of moisture, total solids, fiber, ash, crude fat, total protein and carbohydrates. The obtained data are given in table (2). Which indicate that moisture content of palm pollen grains was  $8.041 \pm 0.1\%$ , this value was less than 28.80%<sup>(5)</sup> and higher than (3.6-4.8)% obtained by Bacha *et al.*<sup>(31)</sup>, while the total solids was  $91.959 \pm 0.1\%$  and this value is higher than 71.2%<sup>(5)</sup>.

$0.113 \pm 0.003\%$  and  $5.585 \pm 0.144\%$  values were estimated for crude fiber and ash contents respectively. These values are lower than the value of fiber 1.37% and higher than the value of ash 4.57% obtained by Hassan<sup>(5)</sup>. Crude fat content of DPP grains was  $7.678 \pm 0.149\%$ , this value was higher than values (0.8-3.7)%<sup>(31)</sup> and lower than the value 20.74%<sup>(5)</sup>. Crude protein content value was 19.45%, this value was comparable to those reported by Bacha, *et al.*<sup>(31)</sup> who found that the crude protein ranged from 15.8% to 18.0%, and lower than the value 31.11%<sup>(5)</sup>. Also Campos *et al.*<sup>(32)</sup> reported that protein content of pollen ranges between (10-40)g/100g dry weight so that DPP considered good source of protein for children, adults, pregnant and lactating women which required [34-56, 13-19, 17 and 17] g of protein daily respectively<sup>(33)</sup>. The values obtained for carbohydrate content was  $26.25 \pm 0.315$  g/100g of dry weight. This value was higher than 13.41%<sup>(5)</sup> and values obtained for Iraqi DPP cultivars (Ghannamy Ahmar, Ghannamy Akder and Khikri adi) 20.6%, 12.3% and 8.1% respectively<sup>(26)</sup>. The recommended dietary allowance values of carbohydrates for children, adults, pregnant and lactating women were [130, 130, 175 and 210] g<sup>(33)</sup>, respectively so that DPP may contribute some carbohydrate requirement when 100 g of the grains were consumed by a normal human subject. Variations in the chemical composition of palm pollen reflect differences in species, environmental conditions during maturation and age

and vigor of the plants<sup>(5)</sup>. The energy value was 291.902 Kcal/100g. This value defined the pollen grains of palm as rich source of energy.

Table(2): Proximate nutritive values of DPP

Parameter	Mean $\pm$ S. D. (% or g/100g dry weight)
Moisture* %	$8.041 \pm 0.1$
Total solids* %	$91.959 \pm 0.1$
Crude fiber** %	$0.113 \pm 0.003$
Ash* %	$5.585 \pm 0.144$
Crude fat** %	$7.678 \pm 0.149$
Crude protein%	19.45
Crude carbohydrates*	$26.25 \pm 0.315$
Nutritive value (Kcal/100g)	291.902

- Values are means of two or three replicates :

\*duplicate

\*\*triplicate

#### - mineral components of DPP:

The mineral components of DPP grains was shown in table(3). The obtained results revealed that palm pollen grains constitute a rich source of mineral elements. The predominant minerals were potassium 73.5 mg/g, followed by magnesium 19.6 mg/g, calcium 10.8 mg/g and iron 8.5 mg/g. Comparable amounts of sodium 4.34 mg/g and copper 3.658 mg/g with equal amounts of molybdenum, nitrogen and boron (3.169, 3.11 and 3.024) mg/g respectively were found in DPP grains. Palm pollen also contain useful amount of zinc 2.799 mg/g, manganese 2.702 mg/g, selenium 2.51 mg/g, cobalt 1.986 mg/g, nickel 1.698 mg/g and cadmium 0.12 mg/g.

**Table (3): Mineral component of DPP grains**

Minerals	Concentration mg/g of dry DPP
Boron-B	3.024
Cadmium -Cd	0.12
Calcium-Ca	10.8
Cobalt-Co	1.986
Copper-Cu	3.658
Iron-Fe	8.5
Magnesium-Mg	19.6
Manganese-Mn	2.702
Molybdenum-Mo	3.169
Nickel-Ni	1.698
Nitrogen	3.11
Potassium-K	73.5
Selenium-Se	2.51
Sodium-Na	4.34
Zinc-Zn	2.799

According to Stanley and Linsken<sup>(11)</sup> pointed that date palm pollen (*Phoenix dactylifera*) is particularly high mineral content. This may be related to the high mineral content of the soil horizons in dry areas where this species grows. But, the capacity of the parent plant to accumulate salts in the pollen is also related to the species. Hassan<sup>(5)</sup> found that Egyptian DPP contain higher amount of copper 3.196 mg/g and equal amount of boron 3.094mg/g, cobalt 3.054, selenium 3.05mg/g, nickel 3.024mg/g and molybdenum 3.022mg/g, with lower amount of manganese 2.84mg/g, zinc 2.81mg/g and iron

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2.41mg/g, while Bishr<sup>(34)</sup> found that the higher amount of mineral found in Sewy cultivars for nitrogen, and lower amount magnesium, with absent of zinc and sodium. While Swaed<sup>(35)</sup> found that nitrogen concentration in smasmii cultivars found in higher than sodium, potassium and phosphor. The same results were shown by Abed and Altememy<sup>(36)</sup> which found that nitrogen found at higher concentration in Iraqi Khikri adi cultivars rather than potassium and phosphors.

The elements Fe, K, Mg, Na, Ca, Co, Mn, Zn, Ni and Cu have been classified as essential elements, while Cd, Pb and Li are non-essential elements for the human body<sup>(37)</sup>. The medicinal importance of DPP may be due to its content of Zn which is useful to manufacture of testosterone, as antioxidant and essential for normal functioning of the male reproductive system<sup>(38-39)</sup>, in contribution of Mn<sup>(40)</sup> which also are essential for normal functioning of central nervous system and are a good anti-oxidant<sup>(37)</sup>. DPP may be protect the body from Iron deficiency because it contain high amount of iron, in present of Mo which helps the body to regulate iron stores<sup>(41)</sup> and Cu [ without copper, iron cannot be properly converted to its usable<sup>(42)</sup>], while the Mg contain in the pollen grains may be decreased risk of stroke<sup>(43)</sup>. The presence of Ca+2, Mg+2, Na+, K+, Co+3, Cr+3, Cu+3, Fe+2, Mn+2, Ni+3 and Zn+2 reflects their function as essential nutrient elements, often as co-factor activators in metal-ligand enzyme complexes<sup>(37)</sup>.

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## التركيب الكيميائي والتغذوي لحبيبات لقاح طلع نخيل التمر *Phoenix dactylifera*, L.

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<sup>2</sup>قسم الكيمياء، كلية التربية للبنات، جامعة تكريت، تكريت، العراق

### الملخص

تم دراسة التركيب الكيميائي والتغذوي لحبوب لقاح نخيل التمر *Phoenix dactylifera*, L. (صنف الغنمي الاحمر) اضافة الى مكوناته من العناصر المعدنية. وقد اظهرت النتائج ان النبات يحتوي على الستيروولات، الفلافونات، القلويدات، البروتينات، الكربوهيدرات، الكلايكوسيدات، مركبات فينولية، ثانينات، تريينات، صابونيات، كيومارين، لكنين، زيوت ودهون مع غياب الكوينونات. اظهرت نتائج التقدير الكمي احتواء حبيبات طلع نخيل التمر على  $2416 \pm 0.034$ ،  $2279.6 \pm 35.769$ ،  $115 \pm 5$  و  $110.1 \pm 0.87$  ملغم/100غم من القلويدات، الثانينات، المركبات الفينولية والستيروولات على الترتب، كما ويحتوي على  $8.041 \pm 0.1$  % رطوبة و  $91.959 \pm 0.1$  % مواد صلبة كلية. اما نسبة الالياف فقد بلغت  $0.113 \pm 0.003$  % و  $5.585 \pm 0.144$  % من الرماد، هذا بالاضافة الى احتواء حبيبات الطلع على  $7.678 \pm 0.149$  % من الدهن الخام،  $19.45$  % بروتين خام و  $26.25 \pm 0.315$  غم/100غم من الكربوهيدرات، كما ويعطي قيمة طاقوية تقدر بـ 291.902 كيلو سعرة/100غم. كما ويحتوي طلع نخيل التمر على 73.5 ملغم/غم من البوتاسيوم، 19.6 ملغم/غم من المغنسيوم، 10.8 ملغم/غم من الكالسيوم و 8.5% ملغم/غم من الحديد، اضافة الى 4.34 ملغم/غم من الصوديوم، 3.658 ملغم/غم من النحاس، مع كميات متقاربة من المولبديوم، النايتروجين والبورون (3.169، 3.11 و 3.024) ملغم/غم على الترتب، اضافة الى كميات مفيدة من الزنك 2.799 ملغم/غم، المنغنيز 2.702 ملغم/غم، السليسيوم 2.51 ملغم/غم، الكوبلت 1.986 ملغم/غم، النيكل 1.698 ملغم/غم، والكادميوم 0.12 ملغم/غم. من النتائج اعلاه يمكن ان نستنتج ان حبيبات طلع نخيل التمر ممكن ان تعتبر مصدر غني بمضادات الاكسدة، الطاقة والعناصر المعدنية المهمة، لذا يمكن اعتماده في تعديل مكونات الغذاء للانسان.