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كلية العلوم
قسم الأحياء

Biological and Therapeutic Effects of the *(Phoenix dactylifera)*

A graduation research project submitted to the Department of Biology in partial fulfillment of the requirements for the completion of the degree of Bachelor of Science in Biology

By Students name:	ID:
Ascia Mohammed Alzahrani	441020917
Roaa Meshal Almotairi	442012862
Jana Wasil Alddosari	442014017
Aziza Fayez Alshammari	443021567

This research project has been approved and accepted in part by fulfilling the requirement to obtain a Bachelor's degree in Biology.

Supervised by:

Dr. Badriah Alammari

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Title

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By

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Examination committee

	Name	Rank	Signature
First Examiner	**Dr.Moodi Alsubaie**	**Associate professor**	
Second Examiner	**Seham Moussa Hamed**	**Assistant professor**	
Advisor	**Dr.Badriah saleh Al-Ammari**	**Assistant professor**	

Imam Muhammad Ibn Saud Islamic University

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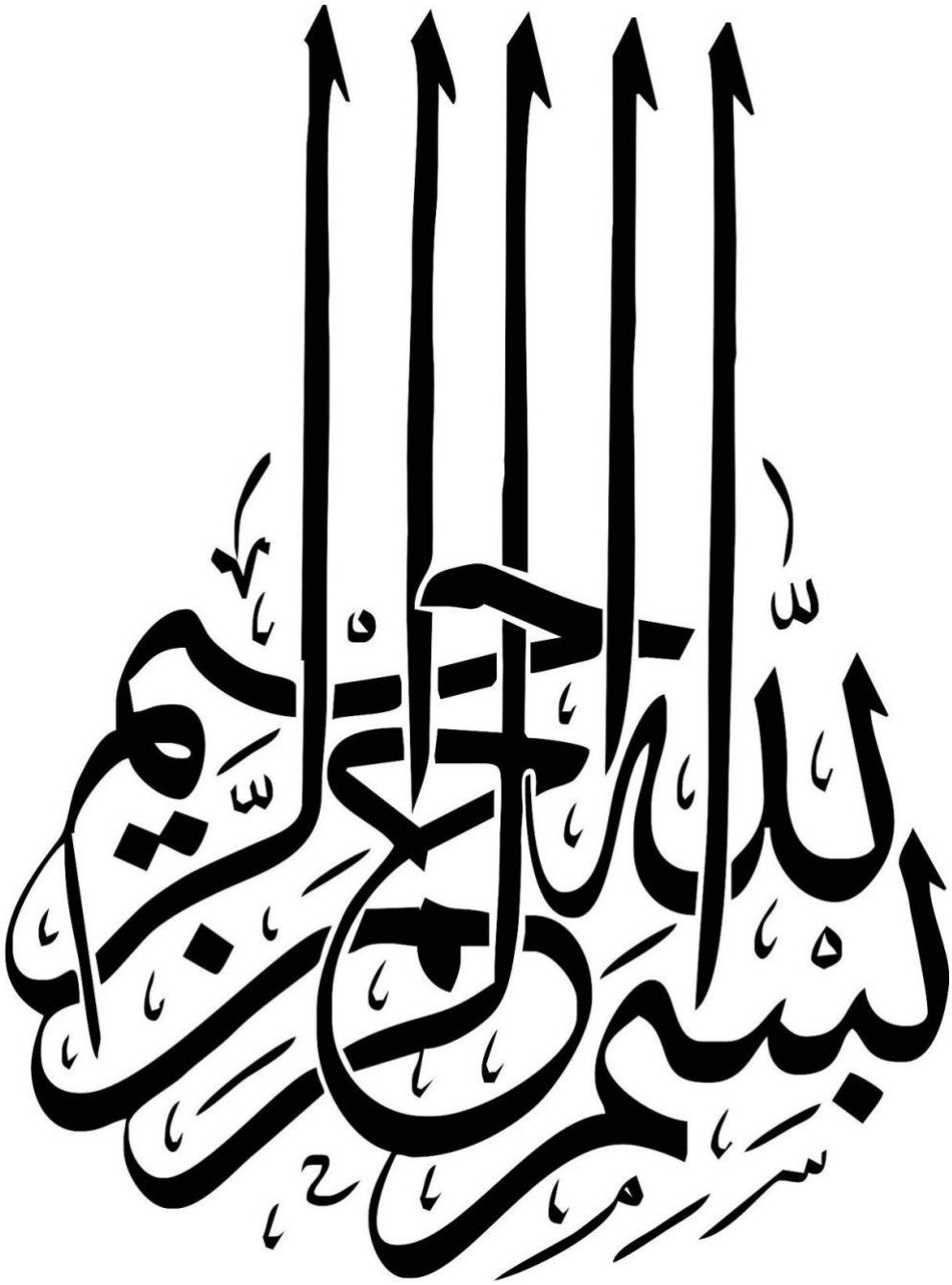
بسم الله الرحمن الرحيم

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﴿ وَءَاخِرُ دَعۡوَىٰهُمۡ أَنِ ٱلۡحَمۡدُ لِلَّهِ رَبِّ ٱلۡعَٰلَمِينَ﴾

الحمد لله الذي علّم بالقلم، علّم الإنسان مالم يعلم، والصلاة والسلام على خير من تعلّم وعلّم، سيدنا محمد وعلى آله وصحبه وسلم.

فالحمد لله حبًا وشكرًا وامتنانًا أن وفقنا لإتمام هذا البحث العلمي، وأمدنا بالصحة والعافية في تسهيل إعداده، ويسّر لنا إنهاء مسيرتنا العلمية في مرحلة البكالوريوس التي سوف تمهد لنا بإن الله العزيمة لإكمال مرحلة الدراسات العُليا.

وها قد قاربت محطتنا الدراسية على الانتهاء، حيث وجبّ الشكر وعظيم الثناء لسعادة الدكتورة الفاضلة والمشرفة على البحث: **" د/ بدرية صالح العماري"** التي كان لدعمها المستمر وإرشاداتها القيّمة الأثر الأكبر في إتمام هذا البحث؛ لقد بذلت من وقتها وجهدها لتوجيهنا، وكلماتها الداعمة وملاحظاتها الدقيقة شكلت أساس هذا الإنجاز، وكانت مثالًا يُحتذى به في الإخلاص والجدية.

كما نتقدم بجزيل الشكر والامتنان إلى أعضاء لجنة المناقشة الأفاضل التي سيكون لملاحظتهنّ أهمية كبرى في إثراء هذا البحث.

وإلى من كانوا نورًا لنا في مسيرتنا، ودعمًا في أوقات التحديات:

إلى أُسرنا التي غرست فينا حب العلم والعمل.

إلى أساتذتنا الذين لم يبخلوا علينا بعلمهم وتوجيهاتهم.

إلى زملائنا الذين شاركونا الجهد والطموح لتحقيق هذا الإنجاز.

نسأل الله أن يجعل هذا العمل خالصًا لوجهه الكريم، وأن ينتفع به كل من يطلع عليه، وأن يوفقنا جميعًا لخدمة العلم وأهله، راجين ان يكون هذا البحث لبنة في صرح العلم، وخيرًا ينتفع به في الدنيا والآخرة.

Abstract

The date palm (*Phoenix dactylifera*) is a highly valued tree with extensive nutritional, medicinal, and therapeutic applications. This review indicates that the tree's rich chemical composition, including antioxidants, phenolic compounds, and carotenoids, contributes to its potential in managing chronic diseases such as diabetes, cardiovascular issues, and cancer. It also highlights the developmental stages of the date fruit, showcasing changes in nutritional content that address various dietary needs, from early-stage fiber and minerals to late-stage sugars and energy.

The current review study demonstrates that date palm pollen exhibits significant antioxidant properties, making it beneficial for human health and a promising dietary supplement. Additionally, studies have shown that consuming dates enhances breast milk production in nursing mothers without affecting infant nutrition, positioning it as a natural galactagogue. For elderly individuals, the findings suggest that dates improve cardiovascular health, boost immunity, and enhance overall well-being by reducing LDL cholesterol and increasing hemoglobin levels.

Moreover, this review explores the therapeutic role of Ajwa dates in pediatric cancer patients, revealing reduced infection rates, fewer hospitalizations, and improved survival outcomes when combined with standard treatments. Overall, this review confirms the date palm's role as a functional food with versatile applications in traditional and modern medicine, contributing to improved global nutrition and health.

الخلاصة

تُعتبر شجرة النخيل *(Phoenix dactylifera)* من الأشجار ذات القيمة العالية لتطبيقاتها الغذائية والطبية والعلاجية. تشير هذه المراجعة البحثية إلى أن التركيب الكيميائي الغني للنخيل، بما في ذلك مضادات الأكسدة والمركبات الفينولية والكاروتينات، يسهم في قدرتها على إدارة الأمراض المزمنة مثل السكري وأمراض القلب والسرطان. كما أظهرت المراجعة أيضًا أن مراحل نضج التمر تؤثر على تركيبته الغذائية، مما يجعله مناسبًا لتلبية احتياجات غذائية متنوعة، بدءًا من الألياف والمعادن في المراحل المبكرة إلى السكريات والطاقة في المراحل المتأخرة.

وأظهرت المراجعة كذلك أن حبوب لقاح النخيل تتميز بخصائص مضادة للأكسدة، مما يجعلها مفيدة لصحة الإنسان وكمكمل غذائي واعد. كما أظهرت الدراسات أن استهلاك التمر يعزز إنتاج حليب الأم لدى المرضعات دون التأثير على تغذية الرضيع، مما يجعله محفزًا طبيعيًا لإدرار الحليب. وبالنسبة لكبار السن، تشير النتائج إلى أن التمر يحسن صحة القلب والأوعية الدموية، ويعزز المناعة، ويحسن الصحة العامة من خلال خفض مستويات الكوليسترول الضار وزيادة مستويات الهيموغلوبين.

علاوة على ذلك، تستعرض المراجعة الدور العلاجي لتمر عجوة في مرضى السرطان من الأطفال، حيث تُظهر النتائج انخفاض معدلات العدوى، وتقليل فترات الإقامة في المستشفى، وتحسين معدلات البقاء على قيد الحياة عند استخدامه مع العلاجات التقليدية. وبشكل عام، تؤكد هذه المراجعة البحثية أن شجرة النخيل تُعد غذاءً وظيفيًا ذا تطبيقات واسعة في الطب التقليدي والحديث، مما يسهم في تحسين التغذية والصحة العالمية.

List of Abbreviations

Abbreviations	Full Name
AIDS	Acquired Immunodeficiency Syndrome
DPP	Date Palm Pollen grain
DNA	Deoxyribonucleic acid
DPPH	2, 2diphenyl 2 picrylhydrazyl hydrate
ESR	Erythrocyte Sedimentation Rate
Hb	Hemoglobin
HDL	High-Density Lipoprotein
HIV-1	Human Immuno Deficiancy virus
KSA	King Saudi Arabia
MSSA	methicillin-sensitive *Staphylococcus aureus*
MRSA	methicillin-resistant *Staphylococcus aureus*
MI	Myocardial infarction
LM	Light Microscope
LDL	Low Density Lipoprotein
P. dectylifera	*Phoenix dactylifera*
SEM	Scanning Electron Microscope
TLC	Thin layer chromatography

CHAPTR 1

INTRODUCTION

Introduction

Phoenix dactylifera (date palm) is a perennial, tall evergreen plant widely spread across the globe, particularly in Saudi Arabia, which ranks as the third-largest producer of dates worldwide. Saudi Arabia produces 1.3 million tons of dates annually from over 28 million date palm trees (KSA General Authority for Statistics, 2015). The country is home to around 400 cultivars, including Khalas, Sukari, Hilwah Aljouf, and Ajwah, each with unique characteristics based on the region (Alaida et al., 2022).

Date palms thrive in arid and semi-arid regions with extreme temperatures ranging from 17.5°C to 50°C and low humidity levels. They tolerate high salinity and can grow in harsh environments, making them vital for agriculture in the Middle East and North Africa (Rambabu et al., 2020).

Which can each part of the tree, from leaves and stems to fruit and pollen, offer various benefits for human use (Vyawahare et al., 2008).

Chemically, dates are a rich source of carbohydrates (70–80%), dietary fiber, and essential minerals such as potassium, magnesium, and copper. They also contain bioactive compounds like carotenoids and phenolics, which exhibit antioxidant, anti-inflammatory, and antibacterial properties. Vitamins like B1, B2, and B3 enhance metabolism and nervous system functions, while trace minerals like selenium and zinc strengthen immunity (Al-Alawi et al., 2017).

Physiologically, date palms are highly resilient, with deep root systems that allow efficient water absorption in arid conditions. Their ability to withstand strong winds, salinity, and temperature fluctuations makes them an essential agricultural asset. Furthermore, date palm pollen grains (DPP) serve not only for reproduction but also as nutritional supplements and traditional medicine for various health benefits (Hassan et al., 2011).

Moreover, the different ripening stages of dates significantly affect their chemical composition and health benefits. Early-stage dates are high in fiber and minerals, supporting digestive health and immunity (Mansouri et al., 2005). Late-stage dates, rich in natural sugars like glucose and fructose, provide quick energy, making them suitable for athletes and active individuals (Biglari et al., 2008).

The World Health Organization highlights the importance of including dates in daily diets due to their role in reducing chronic diseases such as diabetes and heart disease (Al-Farsi & Lee, 2008). Dates also help regulate blood sugar levels and improve lipid profiles, making them a functional food for health promotion (Habib and Ibrahim, 2011).

Finally, as mentioned in the Quran in Surah Maryam, verse 25, dates have been recognized for their benefits during labor and breastfeeding, supporting the health of mothers and infants (Modepeng et al., 2021). This underscores their role as a natural food with diverse benefits for different populations.

Classification

P.dactylifera is a woody tree, diploid with 2n = 36 (Vyawahare et al., 2008), belonging to the Arecaceae family, which is a monocot, comprising over 2,500 species and 200 genera. It is a dioecious plant classified as a tall evergreen tree (Al-Alawi et al., 2017).

Botanical description	
Kingdom	Planta
Subkingdom	Tracheobionta
Superdivision	Spermatophyta
Division	Magnoliophyta
Class	Liliopsida
Subclass	Arecidae
Order	Arecales
Family	Arecaceae
Genus	*Phoenix*
Species	*P. dactylifera*

Figure 1: Date Palm trees (Barmalini, 2018).

Morphological characteristics

The date palm (*P.dactylifera*) is a medium-sized tree characterized by either solitary, clustered, or dioecious; the trunk can be 1 m in diameter and is covered by diamond-shaped papery patterns from old leaf scars, with pinnate leaves containing about 150 leaflets having narrow spines on the armed petiole, modified leaflets (Thulin M. et al., 2008).

It consists of small-sized and yellowish flowers borne solitary in a spiral attached directly to the spikelets, which develop into fruits (date fruits). additionally, male flowers with fused tepals in two whorls. The seeds have a longitudinal groove running its length (Thulin M. et al., 2008).

The dates are fruits; they are oval-cylindrical, having a single seed, and range from bright red to bright yellow in color when unripe, depending on cultivation (Vyawahare et al., 2008).

Figure 2: Shape development of the date palm (Nepenthes et al.,2009).

Figure 3: Germination of date palm (Frolov. S.,2019)

Figure 4: Leaves of the date palm (David.J,2005).

Figure 5: *Phoenix dactylifera* trunk section (Eliran.T,2019).

Aim of the work

The purpose of this review study is:

- Analyze the chemical composition of dates and their role in preventing chronic diseases.
- Evaluate the health benefits of dates in enhancing immunity and improving overall health.
- Study the anti-inflammatory, antioxidant, and anticancer properties of dates.
- Explore the use of dates in traditional and modern medicine.
- Study the applications of dates in food, pharmaceuticals, and cosmetics.
- Promote date consumption and encourage further research on therapeutic applications.

CHAPTER 2

LITERATURE REVIEWS

1. Cultivation and Composition of Date Palms

1.1. Cultivation:

One of the most significant trees grown worldwide is the date palm *(Phoenix dactylifera)*, which offers a wealth of nutrients and medicinal substances. Date fruits are a major source of energy due to their high carbohydrate content, which makes up between 70 and 80 percent of the fruit. Date palms thrive in well-drained soil and require abundant sunlight (Alotaibi et al., 2023).

Proper irrigation is essential, especially during flowering and fruiting periods (Hanieh et al., 2020).

Common methods include flood irrigation, sprinklers, and the highly efficient drip irrigation system (Al-Farsi et al., 2008).

1.2. Challenges in Date Palm Cultivation:

- Chemical Contamination: Includes residues from pesticides and heavy metals (Bjornebrg, 2013).
- Microbial Contamination: Vulnerability to bacterial (e.g., E. coli) and fungal infections (Dehghanisanij et al., 2023).
- Agricultural Limitations: Issues such as water shortages, soil salinity, and pests like the red palm weevil (Bjornebrg, 2013).

1.3 Composition:

1.3.1. Ripening Stages and Nutritional Impact of Dates:

Hababauk, Kimri, Khalal, Rutab, and Tamer are the five main phases of ripening that date fruits go through. The fruits' chemical and nutritional characteristics undergo substantial changes during these phases. Dates are good for promoting general health in their early stages since they are high in fiber, vitamins, and minerals including potassium and iron. The fruits get sweeter and simpler to digest as the ripening process

goes on because simple carbohydrates like fructose and glucose are present in higher concentrations (Baliga et al., 2011).

Phenolic acid levels drop from the Khalal to the Tamer stage during the ripening process by about 25%. Dates are a special functional food for disease prevention, nevertheless, because they still have antioxidant qualities. Furthermore, early fruit stages have a significant concentration of flavonoids including luteolin and quercetin (Kimri), which progressively diminish as the fruit ages (Mansouri et al., 2005).

The benefits of dates are varied due to these chemical changes that occur during ripening. Dates are perfect for athletes and anyone who need a quick energy boost because they are low in fiber and high in energy in their latter stages. In the meanwhile, dates help improve general health and strengthen immunity in the early phases (Al-Farsi and Lee, 2008).

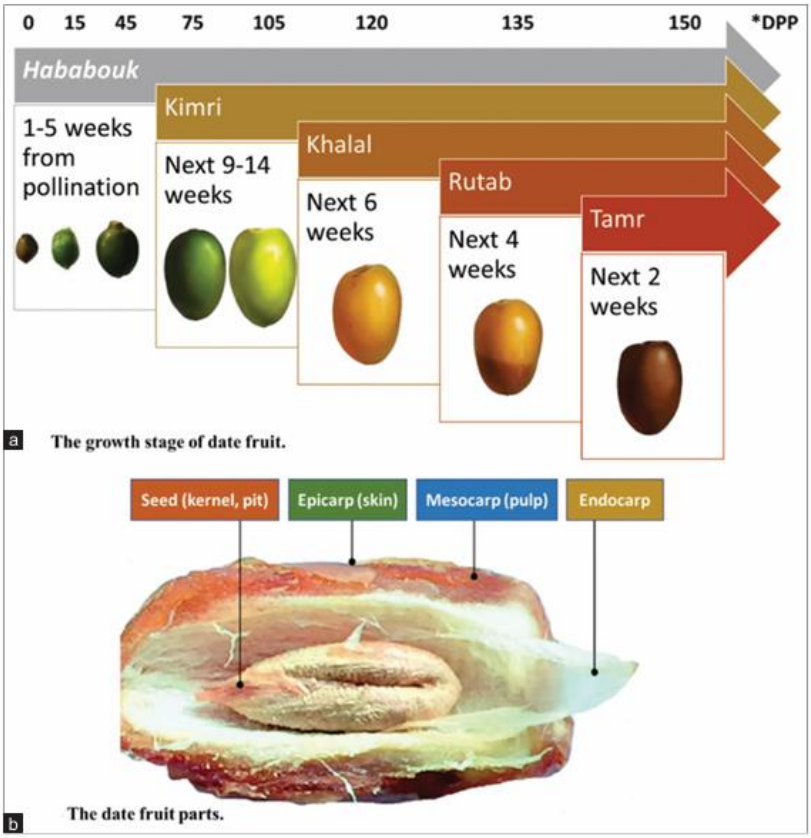

Figure 6: The growth stage of date fruit (Alsarayrah et al., 2023).

1.3.2. Nutritional Profile:

Dates are high in dietary fiber (84–94% insoluble), which lowers the risk of colorectal cancer and promotes digestive health. Additionally, they include a range of critical minerals that are necessary for many body processes, including copper, magnesium, calcium and potassium (Samaniego-Sandoval et al.,2021).

Rich in carbohydrates (65–88%), including glucose, fructose, and sucrose (Ismail et al., 2023).

Contains proteins (1.22–3.73%), fats (0.11–7.33%) and antioxidants (Mullan et al., 2011).

Carotenoids are one of the most important active plant molecules (phytochemicals) in dates. They shield cells from oxidative damage by acting as potent antioxidants. Additionally, carotenoids are a major source of vitamin A, which boosts immunity and supports eye health. Additionally, dates are a perfect functional food for preventing chronic diseases because of their anti-inflammatory and anti-cancer qualities due to their phenolic compounds and tannins (Baliga et al., 2011).

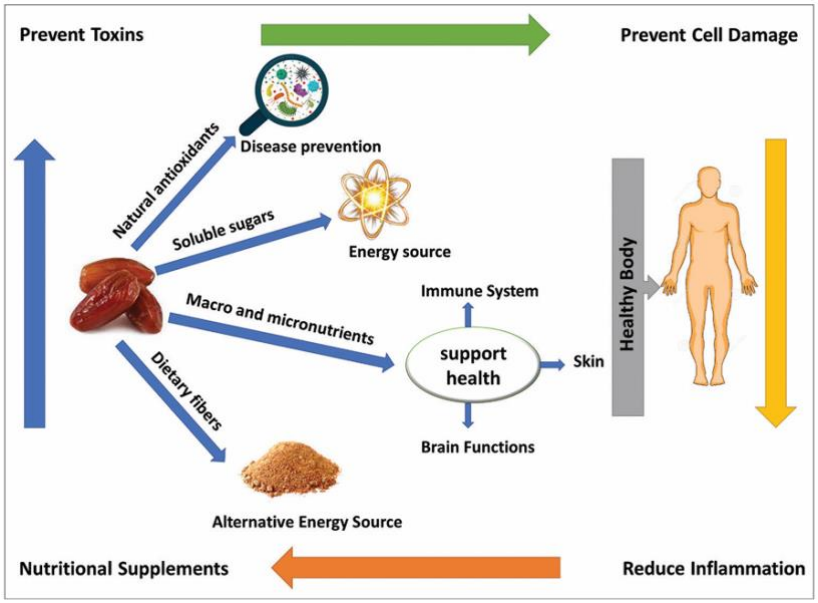

Figure 7: Role of dates in disease prevention via antioxidant, anti-microbial and anti-inflammatory activity (Alsarayrah et al., 2023).

2. Compare between some species Saudi Arabian Date Palm cultivars from morphology and phytochemical component to pollen grains

In Saudi Arabia, various species of *P. dactylifera* exist, which can be differentiated by comparative morphology, size, and color to date fruit or phytochemical component to pollen grains (Abou-Zeid et al., 2019).

Usually, they are classified based on morphological characters of the female tree for cultivar identification, but the male tree is mostly identical to any female cultivar, so we are facing a problem when dependent on the male tree for cultivar identification, but farmers can identify some male cultivars from their experience (Simozarg et al., 2016).

It is possible to use pollen grains to contribute to taxonomic studies by useful characters because they affect the strong selective forces involved in various reproductive processes for many pollen traits, including pollination, dispersal, and germination (Erdtman, 1952).

To determine the antioxidant activity for developing additional pollen identification tools, Saudi Arabia acts to detect and analyze their phytochemical based on their total phenolics and flavonoids content, also on the content of individual phenolic compounds (Abou-Zeid et al., 2019).

2.1. The experiment and resulted:

Pollen grains of nine date palm cultivars were obtained that were examined using both light microscope (LM) and scanning electron microscope (SEM); these microscopes helped them to record each of pollen length, pollen width, colpus length, muri thickness, and lumen area (Abou-Zeid et al., 2019).

Then begin the preparation of extracts by taking up 3 g from the pollen sample, which was individually extracted with 100 mL of methanol kept on a rotary shaker for 24 h. Thereafter, it was filtered and centrifuged for collected upper fluid, and the solvent was evaporated to make the final volume one-fifth of the original volume, which was stored at 4 ºC (Tura and Robards, 2002).

Now, we can determine the total phenolic content by the Folin-Ciocalteu method (Wolfe et al., 2003) and use a T80 UV-Vis spectrophotometer—double beam—to measure the absorbance of samples after 2 h in the dark until the reaction is complete and express it as gallic acid. While using aluminum chloride, the colorimetric assay method was reported by Potter et al. (2010) to estimate the total flavonoid content in the pollen and calculated as rutin by the same spectrophotometer after 1 h at room temperature (Abou-Zeid et al., 2019).

This experiment detected the micromorphological characteristics of the pollen grains that enable taxonomical and distinguishing species (Nikolić and Milatović, 2016). The pollen morphology appeared to be relatively uniform, so the lengths of the pollen grains ranged from 16.3 to 18.17 μm, whereas the pollen width was 11.17 to 12.37 μm, which appear elliptic in equatorial view, with the aperture extending almost the full length of the grain axis from monosulcate pollen grains and having aperture membrane that is smooth, thin, and narrow with an inconspicuous margin show on (Table 1 and Figures 1 & 2) (Abou-Zeid et al., 2019).

Table.1 General pollen features of the examined *Phoenix dactylifera* cultivars (Abou-Zeid et al., 2019).

No.	Characters Cultivars	Mean (µm)					Tectum
		Pollen length	Pollen width	Colpus length	Muri thickness	Lumina size	
1	Mabroom	17.12	11.55	16.8	0.14	0.08	Micro reticulate
2	Sallag	17.28	11.88	17.0	0.16	0.09	
3	Khadary	17.20	11.92	16.5	0.15	0.20	
4	Dikhiny	16.3	11.17	16.0	0.11	0.25	
5	Maktumi	16.83	12.37	15.9	0.09	0.21	
6	Succary	18.0	12.25	17.5	0.11	0.30	
7	Safawy	18.17	12.27	18.0	0.09	0.11	
8	Khalas	17.82	12.29	17.1	0.10	0.02	
9	Safry	17.58	12.07	16.98	0.08	0.53	

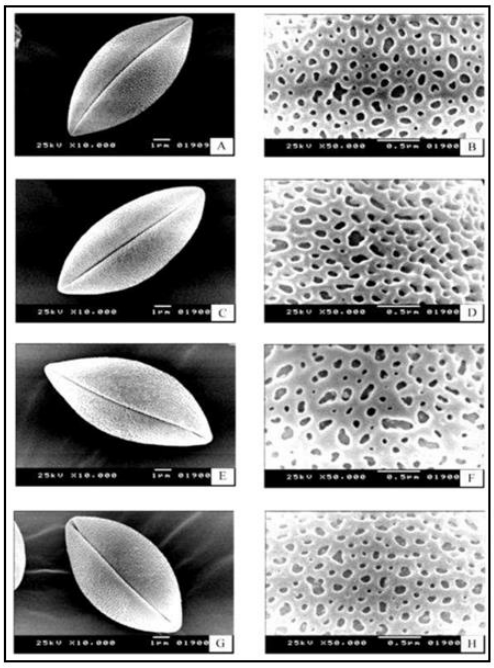

Figure 8: Pollen shape and exine pattern of date palm cultivars: A, B, cultivar "1"; C, D, cultivar "2"; E, F, cultivar "3"; G, H, cultivar "4" (Abou-Zeid et al., 2019).

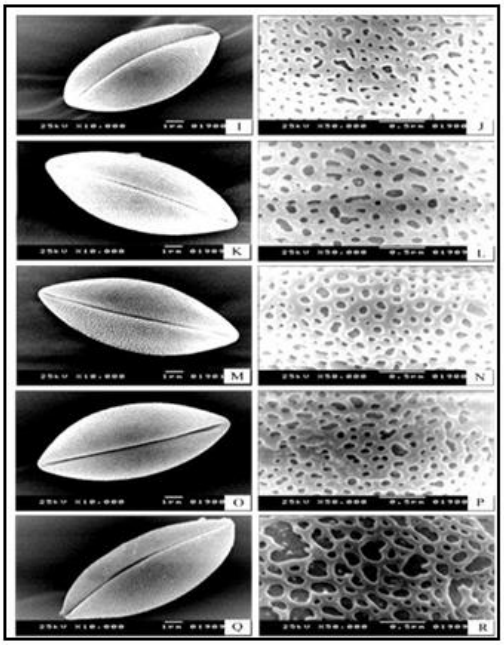

Figure 9: Pollen shape and exine pattern of date palm cultivars: I, J, cultivar "5"; K, L, cultivar "6"; M, N, cultivar "7"; O, P, cultivar "8"; Q, R, cultivar (Abou-Zeid et al., 2019).

2.2. Phytochemical analysis:

Chemical analysis of pollen grains has revealed the presence of a wide range of important compounds with pharmacological properties, biochemically and nutritionally substances (Almedida-Muadian et al.,2005 &Morais et al., 2011). Pollen extracts showed high quantities of phenolic composites—factory secondary metabolites—in cultivars Safawy and Safry and also a class of antioxidant agents that include flavonoids in Khadary and Safawy (Figure 3A) (Tulipani et al., 2008).

By the radical scavenging activity of pollen extracts against stable 2, 2-diphenyl-2-picrylhydrazyl hydrate (DPPH), screening and evaluation of the antioxidant activity were determined by the method of Singh et al. (2002). This natural activity that contributes to their electron transfer/hydrogen donating ability might be related to phenolic and flavonoids (Abou-Zeid et al., 2019).

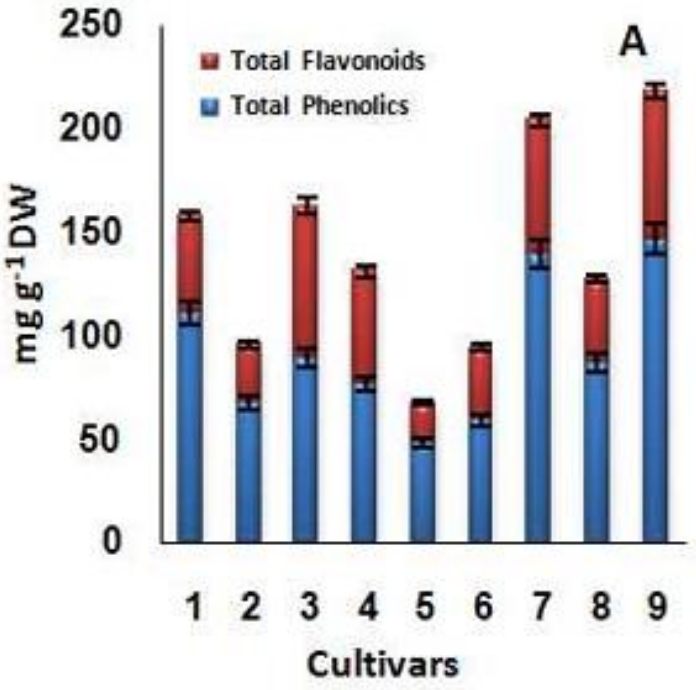

Figure 10: Total phenolics and flavonoids content (A) (Abou-Zeid et al., 2019).

Table.2 HPLC analyses of phenolics constituents of the methanolic extracts of the nine pollen cultivars 1-9, names of cultivars are in Table 1 (Abou-Zeid et al., 2019).

Peak Name	Amount ((µg mL^{-1})								
	1	2	3	4	5	6	7	8	9
Gallic acid	8.21	2.60	1.80	2.93	4.08	2.36	1.85	1.48	1.46
Chlorogenic acid	60.17	41.32	33.28	63.01	25.18	1.55	130.05	42.89	128.90
Caffeic acid	68.83	72.20	29.43	72.69	26.13	34.38	127.74	52.72	187.25
3, 4-Dicaffeoyl quinic acid	-	-	16.72	-	6.16	27.06	25.17	-	-
2, 5-Dihydroxy benzoic acid	-	-	-	-	-	-	-	-	-
3, 5-Dicaffeoyl quinic acid	-	-	-	-	-	9.30	-	-	-
4, 5-Dicaffeoyl quinic acid	7.15	10.21	3.83	5.32	3.16	8.19	19.01	-	12.15
Catechin	-	-	-	-	22.27	-	-	50.84	-
Rutin	-	-	2.29	2.72	1.69	5.52	2.50	4.40	5.52
Phloridzin	-	1.51	2.43	1.80	-	2.07	3.57	1.02	5.39
Tannic acid	-	-	-	-	5.50	-	-	7.48	-
Geraniol	2.37	-	2.74	-	-	-	4.24	-	6.85
Quercetin	6.25	6.20	-	6.22	6.21	6.48	6.49	6.23	-
Cinnamic acid	-	-	-	-	-	-	-	-	-

Generally, in this table the phytochemical analyses of pollen grains showed considerable antioxidant activity and a great diversity of phenolics and flavonoids. Whereas gallic acid, chlorogenic acid, and caffeic acid were commonly found in all

pollen extracts. While other phenolic and flavonoid compounds contain different amounts in pollen extracts. Serra Bonvehí et al. (2001) stated that rutin could be an indicator of the quality of bee pollen and found in all pollen samples except cultivar Mabroom, which might reflect long periods of storage or excessive heating during the drying process. The emphasized the significant role that pollen grains exhibited considerable phenolic and flavonoid content play in the antioxidant capacity of pollen and good antioxidant activities (Abou-Zeid et al., 2019).

3. Normal uses, phytochemistry and pharmacology to *P.dactelifera*

Date palm occupies first order in many Middle Easterners, because they believe eating date fruit, especially in the morning on an empty stomach, can reverse the actions of any toxic material that person was exposed to and is used for the treatment of a range of diseases, including memory disturbances, fever, inflammation, paralysis, loss of consciousness, and nervous disorders. Also used as a detersive and astringent in intestinal troubles, treatment for sore throat, colds, bronchial asthma, to relieve fever, cystitis, gonorrhea, edema, liver and abdominal counteracttroubles, and to alcohol intoxication (Vyawahare et al.,2008).

3.1. Phytochemistry:

The whole plant contains carbohydrates, alkaloids, steroids, flavonoids, vitamins and tannins. The phenolic of the plant detected the presence of mainly cinnamic acids, flavonoid glycosides, and Four free phenolic acids (protocatechuic acid, vanillic acid, syringic acid, and ferulic acid) and nine bound phenolic acids (gallic acid, protocatechuic acid, p-hydroxybenzoic acid, vanillic acid,caffeic acid, syringic acid, p-coumaric acid, ferulic acid, and o-coumaric acid) (Vyawahare et al.,2008).

Thin-layer chromatography (TLC) analysis showed the presence of steroids, namely cholesterol; it also showed that the major carotenoid pigment in dates is lutein, followed by α-carotene, and detected gas-liquid chromatography of the date seed oil, the presence of oleic, lauric, palmitic, capric, myristic, myristoleic, palmitoleic, stearic, linoleic, and linolenic acids. There also dates have at least six vitamins. (Vyawahare et al.,2008).

3.2. Activity:

3.2.1.Antiulcer Activity:

Application pretreatment with date fruit ethanolic and aqueous extracts improves in rats the ulcer, biochemical levels of some enzymes such as gastrin and histamine,

and histological indices such as necrosis, hemorrhage, congestion, and edema in parts of the stomach; it also appears to have a dose-dependent anticancer activity. (Vyawahare et al.,2008).

3.2.2.Anti-diarrheal Activity:

Used in rats to reduce both castor oil-induced intestinal transit and frequency of diarrhea. (Vyawahare et al.,2008).

3.2.3.Effect on Gastrointestinal Transit:

When taking dialyzed date flesh extract, lead a dose-dependent decrease in gastrointestinal transit time (Vyawahare et al.,2008).

3.2.4.Hepatoprotective Activity:

To induce liver damage in rats can be reversed by aqueous extracts from date flesh or pits when daily oral consumption of an aqueous extract of the flesh of dates was preventive to thioacetamide poisoning (Vyawahare et al.,2008).

3.2.5.Antimutagenic Activity:

Date fruit extract takes indication of potent antimutagenic activity, which is evidence that date fruit extract is able to produce a dose-dependent inhibition of benzopyrene-induced mutagenicity on *Salmonella* tester and with metabolic activation (Vyawahare et al.,2008).

3.2.6.Antioxidant Activity:

In an in vitro study, they have been shown to significantly inhibit lipid peroxidation and protein oxidation and also exhibited a potent superoxide and hydroxyl radical scavenging activity, phytochemicals from fruits to possess significant antioxidant capacities that may be associated with lower incidence and lower mortality rates of degenerative diseases in humans (Vyawahare et al.,2008).

These result in its possible use in diseases such as scurvy, ataxia, and night blindness caused by the deficiencies of vitamins C, E, and A, respectively (Vyawahare et al.,2008).

Confirmed the potent free radical scavenging activity of the plant from limit oxidative injuries induced by hydrogen peroxide in human skin organ culture by use of date seed oil (Vyawahare et al.,2008).

3.2.7.Effect on Reproductive System:

Taking oral doses of date palm fruit suspensions improved the sperm count, motility, morphology, and DNA quality with a concomitant increase in the weights of the testis and epididymis (Vyawahare et al.,2008).

This study suggests solutions to infertility problems in males (Vyawahare et al.,2008).

3.2.8.Anti-inflammatory Activity:

P.dactylifera fruits repressed the swelling in the foot significantly, and methanolic extract of date seeds showed significant reduction in adjuvant arthritis in rats by mechanistically reducing ESR and plasma fibrinogen and normalizing the plasma level of antioxidants (Vyawahare et al.,2008).

Take of the extracts also produced significant increases in body weight gain and food efficiency ratio (Vyawahare et al.,2008).

3.2.9.Antiviral Activity:

Date palm pits extracts are a source of crude acetone and have a dose-dependent ability to inhibit the infectivity of Pseudomonas phage. These indicates suggest that the pit extract *P.dactylifera* fruit is capable of playing an important role in controlling the replication of Human Immunodeficiency Virus (HIV-1) by a novel technique of

interaction with the binding of the phage to the host bacterium and injection of its genome (Vyawahare et al.,2008).

That given novel drug from *P.dactylifera* can prove to be effective for the treatment of AIDS without causing any side effects (Vyawahare et al.,2008).

3.2.10. Effect on Cisplatin-induced Genotoxicity:

A significant recovery at the histopathological level from the testis histology of animals administered with pollen grains prior to cisplatin treatment (Vyawahare et al.,2008).

This plays a preventive role in the pollen grains against the chemotherapeutic-induced infertility in males (Vyawahare et al.,2008).

3.2.11. Antihyperlipidemic Activity:

In a study, *P.dactylifera* fruit pulp observed significantly reduced the elevated levels of plasma lipids, including cholesterol, triglycerides, and low-density lipoprotein (LDL), while total cholesterol levels increased the high-density lipoprotein (HDL) levels in the treated animals. It is also possible to use it in the treatment of obesity, wherein it reduced the total body, liver, and kidney weights of the hamsters; the obesity represents the most prevalent nutritional problem worldwide (Vyawahare et al.,2008).

The effects of *P.dactylifera* pollen grains on liver function, lipid fractions of plasma, liver, and brain, as well as fatty acid composition of liver lipids were investigated (Vyawahare et al.,2008).

Also, as *P.dactylifera* contributes to nephroprotective activity (Vyawahare et al.,2008).

4. Health and Therapeutic Benefits of Dates in Preventing Chronic Diseases

Dates are a complete food with many health advantages, not merely a source of energy. Antioxidants found in abundance in dates, such as flavonoids and phenolic acids, have potent anti-free radical properties. These substances minimize the risk of conditions including diabetes and cancer, support heart health, and lessen inflammation (Mansouri et al., 2005).

Date extracts, whether alcoholic or aqueous, have been shown to offer important preventive qualities against a range of illnesses. For instance, research indicates that date extracts have antibacterial properties, lessen oxidative stress in cells, and shield the liver from harm brought on by chemical pollutants. Because of this, dates are a natural way to protect and improve health (Biglari et al., 2008).

Dates are a great snack for those with metabolic problems because studies have shown that eating them improves lipid profiles and glucose management. Natural sugars included in dates, like fructose and glucose, aid to balance blood sugar levels since they breakdown slowly (Habib and brahim, 2011).

Furthermore, dates have antifungal and antibacterial qualities that strengthen their function as a functional meal to ward off infections and long-term illnesses.

Active plant chemicals including flavonoids and alkaloids, which increase immunity and decrease inflammation, are responsible for these advantages (Tang et al., 2013).

Figure 11: Types of dates: A: Ajwa; B: Sukhary; C: Sabaka; D: Munifi. Dates fruits in the management of diseases (Rahmani.A.H. et al.,2014).

5. Date Palm *(Phoenix dactylifera)* as a Cardioprotective Agent

5.1. Cardioprotective Potential:

- Cardiovascular diseases, particularly myocardial infarction (MI), are a leading cause of death due to the permanent damage they cause to heart tissues (Dawn et al., 2005).
- Stem cells and progenitor cells like CD34+ and CD133+ have shown potential in repairing cardiac tissues through regeneration (Adamo and Garcia-Cardena, 2012).
- Date fruits may aid in mobilizing these progenitor cells, facilitating tissue repair following MI (Adamo and Garcia-Cardena, 2012).

5.2. Nutritional and Bioactive Components:

- Dates are rich in phenolic and flavonoid compounds, which contribute to their potent antioxidant activity (Al-Farsi et al., 2005a).
- These compounds help neutralize free radicals, reduce oxidative stress, and provide anti-inflammatory, anti-apoptotic, and hypolipidemic effects (Chaira et al. 2009).

5.3. Research Findings:

5.3.1. Experimental Studies:

- Pretreatment with date extracts for 28 days significantly improved heart health in rats after MI induction (Bhandari et al., 2008).
- Biomarkers like troponin-T and creatinine kinase nearly returned to normal levels, and tissue damage was reduced (Bhandari et al., 2008).

5.3.2. Histopathological Analysis:

- Date extracts preserved the structure of cardiac muscle, reduced necrosis, and decreased inflammation (Bhandari et al., 2008).

- Higher doses (400 mg/kg) were more effective than lower doses (200 mg/kg) (Bhandari et al., 2008).

5.3.3.Progenitor Cell Mobilization:

Date extracts increased CD34+ and CD133+ cell reserves in bone marrow, promoting their mobilization to damaged heart tissue after MI (Kumar et al., 2009).

Extracts from date fruits, particularly varieties such as Khalase and Reziz, exhibited strong cardioprotective effects by boosting antioxidant defenses and supporting tissue repair (Kumar et al., 2009).

These findings highlight the potential of dates as a natural dietary supplement for individuals at risk of cardiovascular diseases (Kumar et al., 2009).

6. The Health Benefits of Eating Date Fruit for Increase Breast Milk Production

6.1. Date of Production of Fruit and Breast Milk:

Date fruit is a natural galactagogue that is mostly taken to increase the production of breast milk, according to research. Its effects on nursing moms and their babies during the first three months after giving birth were investigated in a controlled study. The study had 48 nursing mother-infant pairs who were split into two groups. While the control group abstained from dates, the intervention group ate ten date fruits per day (Modepeng et al., 2021).

Over the course of the four-week research, the intervention group's breast milk production increased by 11% in the first two weeks and by 23% at the end of the fourth week. The control group's milk production changed very little in comparison. According to measurements, the amount of breast milk increased statistically significantly ($p<0.05$), indicating that dates' nutritional components and potential oxytocin-like actions may stimulate milk secretion (Modepeng et al., 2021).

How eating dates increased milk production but had no discernible effect on the nutritional health of infants. Both groups' weight-for-age percentiles stayed constant. This result suggests that within a brief trial time, the amount of breast milk produced may rise without having an immediate impact on the infant's growth. Dates offer a wholesome and natural way for nursing moms to boost their milk supply. By essential nutrients from date fruit can supplying energy and assisting with hormone balance, these nutrients probably help nursing moms produce more milk (Modepeng et al., 2021).

7. The Health Benefits of Eating Date Fruit for Elderly Patients

7.1. Elderly Cardiovascular Health and Date:

Additional studies on date intake looked at how it affected older adults' cardiovascular health. 60 senior citizens 60 years of age and above participated in a study that examined how dates affected overall health indicators and LDL cholesterol levels. In addition to consuming 20–35 grams of dates every day for six months, participants also had routine physical examinations and laboratory testing, which included hemoglobin levels and lipid profiles (Verma, 2016).

The results showed that LDL cholesterol, a key cause of cardiovascular illnesses, had significantly decreased ($p<0.001$). Hemoglobin levels also significantly improved, treating anemia and boosting vitality. Because dates include fiber, participants reported better digestion, better bowel movements, and less joint discomfort, which is probably related to the minerals like magnesium and selenium they contain (Verma, 2016).

Additionally, dates improved mental alertness, decreased weariness, and increased general vitality, all of which had a good effect on the neurological system. The fruit's high potassium content, which promotes brain function, is thought to be responsible for these effects. Dates' inherent carbohydrates, such as fructose and glucose, gave users a rapid energy boost and helped fight off sluggishness in the aged (Verma, 2016).

7.2. Characteristics of Date Fruit in Terms of Nutrition:

Dates' rich composition is responsible for their health advantages. Essential nutrients like vitamins A, B-complex, and K, minerals like iron, calcium, magnesium, and potassium, and phytochemicals like flavonoids and polyphenols are all rich in dates. These substances support the fruit's anti-inflammatory, anti-oxidant, and metabolic advantages (Verma, 2016).

The same elements improve cardiovascular health, aid in digestion, fortify bones, and foster brain reactivity in older adults (Modepeng et al., 2021).

7.3. Benefits of Interconnected Health:

The results of the study highlight how date fruit can be used to support health in a variety of age groups. Seniors, on the other hand, gain from lower cholesterol, better blood health, and more vitality (Verma, 2016).. Dates are a functional food that promotes both short-term and long-term health goals because of these overlapping benefits (Modepeng et al., 2021).

This comprehensive viewpoint highlights the need for more investigation into the wider uses of date fruit in enhancing the health of various groups.

8. Effectiveness of Ajwa for cancer patients' children category

Between 2008 and 2017 in King Abdulaziz University Hospital manner study to nonrandomized controlled trial determined the effects of *P.dactylifera* palm date (Ajwa) on the number of infections and hospitalizations associated with fever, neutropenia, and mortality of pediatric cancer patients admitted (Al- Jaouni et al., 2018).

In this experiment of 200 screened patients, 56 were included and 144 were excluded. Of the 56, 26 agreed to take Ajwa, and 30 served as controls. Both groups were assessed based on infection rates, frequency of hospital admissions for fever and neutropenia, and mortality rate (Al- Jaouni et al., 2018).

In this study, the type of date from the *P.dactylifera* known as Ajwa is a soft, dark brown date that grows mainly in the region of Saudi Arabia, especially Madinah, and is known for its antimicrobial, anticancer, anti-inflammatory, and antioxidant properties. In extension, it has the potential to increase levels of various blood components such as red blood cells, hemoglobin, reticulocytes, and platelet counts, it has dates, has a strong potential for scavenging of free radicals and, as such, limits cancer progression and development (Al- Jaouni et al., 2018).

Immunocompromised pediatric patients with cancer are susceptible to many microbial infections that can have a detrimental effect on their lives and the outcome of their treatment, so they are based on in another study on dates, demonstrated anti-lymphoma activity (Al- Jaouni et al., 2018).

8.1. Procedure the experiment:

In the Ajwa group, patients were given one piece of Ajwa that they got from the local market in Jeddah, KSA, with breakfast and were organic in nature. They took up with breakfast test doses daily in the Ajwa group and observed they did not show any allergic reactions. During the standard treatment, including chemotherapy, the continuous Ajwa intake was increased to 3 pieces daily, with daily breakfast until the treatment period ended (Al- Jaouni et al., 2018).

8.2. Results:

The study group was half male and half female, from different origins, Asia and Africa, with a mean age of 9.1 ± 4.1 years, with 68% of the patients having hematological cancer, and most of the patients were at advanced stages (Table 3) (Al-Jaouni et al., 2018).

Recorded effect of Ajwa intake for decreasing the infection rate for most of the organisms shown in Table 4 (Al- Jaouni et al., 2018).

Showing in Table 5, the infection rates and frequency of hospital admissions related to fever and neutropenia and how effective Ajwa intake is on it (Al- Jaouni et al., 2018).

Table 3. Demographics and Clinicopathological Characteristics of the Study Patients (Al- Jaouni et al., 2018).

Variables	Ajwa Intake		P Value
	Yeas, n (%)	No, n (%)	
Gender:			
Male	14 (54)	17 (57)	.786
Female	12 (46)	13 (43)	
Ethnicity:			
Sothern Asian	2 (40)	3 (60)	.502
Southeastern Asian	8 (44)	10 (56)	
Western Asian	11 (48)	12 (52)	
African	2 (20)	8 (80)	
Type of cancer:			
Hematological	17 (45)	21 (55)	.418
Non-hematological	6 (33)	12 (67)	
Relapse of cancer:			
Yeas	5 (56)	4 (44)	.335
No	18 (38)	29 (62)	
Stage of cancer:			
Early stage	8 (53)	7 (47)	.259
Advanced stage	15 (37)	26 (63)	
Radiotherapy status:			
Yeas	5 (50)	5 (50)	.527
No	18 (39)	28 (61)	

All patients were on chemotherapy, whereas radiotherapy was applied based on the chemotherapy protocol. Mean age ± SD = 9.1 ± 4.1 years (Al- Jaouni et al., 2018).

Table 4. Infection Rates Before and After Ajwa Intake Among 12 Randomly Screened Pediatric Oncology Patients (Al- Jaouni et al., 2018).

	Before Ajwa Intake		After Ajwa Intake	
	Mean ± SD	Range	Mean ± SD	Range
Klebsiella pneumonia	0.6 ± 0.9	0-3	0.2 ± 0.4	0-1
K pneumoniae (ESBL)	0.8 ± 2.3	0-8	0.1 ± 0.3	0-1
K oxytoca	-	-	-	-
Escherichia coli	0.7 ± 1.0	0-3	0.4 ± 0.5	0-1
Escherichia coli (ESBL)	0.4 ± 0.9	0-3	0.3 ± 0.5	0-1
Proteus mirabilis	0.3 ± 0.9	0-3	0.1 ± 0.3	0-1
Spice organisms	0.2 ± 0.4	0-1	0.2 ± 0.4	0-1
Pseudomonas aeruginosa	1.5 ± 4.6	0-16	0	0
Pseudomonas species	0.1 ± 0.3	0-1	0	0
Acinetobacter baumannii	0.4 ± 0.8	0-2	0.3 ± 0.7	0-2
Stenotrophomonas maltophilia	-	-	-	-
Coagulase ve- Staphylococcus	1.8 ± 4.8	0-17	0.3 ± 0.5	0-1
Staphylococcus aureus (MSSA)	0.2 ± 0.6	0-3	0	0
Staphylococcus aureus (MRSA)	0.1 ± 0.3	0-1	0.1 ± 0.3	0-1
Enterococcus faecalis	0.3 ± 0.5	0-1	0	0
Enterococcus faecium	0.4 ± 1.4	0-5	0	0
Streptococcus viridans group	0.1 ± 0.3	0-1	0.1 ± 0.3	0-1
Streptococcus agalactiae	-	-	-	-
Streptococcus pneumoniae	-	-	-	-
Candida albicans	0.3 ± 1.2	0-4	0	0
Candida species	0.2 ± 0.4	0-1	0.1 ± 0.3	0-1
Aspergillus species	0.1 ± 0.3	0-1	0.1 ± 0.3	0-1
Varicella zoster	-		-	

Table 5. Effect of Ajwa Intake on Infection Rates and Frequency of Hospital Admissions Related to Fever and Neutropenia (Al- Jaouni et al., 2018).

	Ajwa Group, Mean ± SD	Non-Ajwa Group, Mean ± SD	P Value
Infectionsa	1.1 ± 1.8	5.1 ± 3.7	$< .001$
Hospital admissions F/Nb	5 ± 5.5	17.1 ± 20.7	.009

Recorded a better survival rate of patients on Ajwa as a supplement to their ongoing conventional therapy, as compared with controls (Table 6) (Al- Jaouni et al., 2018).

From the non-Ajwa group, 13 died among the 30 participants. This is in contrast to the Ajwa group, where all survived (Al- Jaouni et al., 2018).

Table 6. Demographics and Clinicopathological Characteristics According to Survival Rates Among the Sample Patients (Al- Jaouni et al., 2018).

Variables	Survival Status		P Value
	Yeas, n (%)	No, n (%)	
Gender:			
Male	22 (51)	6 (46)	.752
Female	21 (49)	7 (54	
Ethnicity:			
Sothern Asian	4 (80)	1 (20)	.558
Southeastern Asian	15 (83)	3 (17)	
Western Asian	18 (78)	5 (22)	
African	6 (60)	4 (40)	
Type of cancer:			
Hematological	31 (82)	7 (18)	.217
Non-hematological	12 (67)	6 (33)	
Relapse of cancer:			
Yeas	8 (89)	1 (11)	.348
No	35 (74)	12 (26)	
Stage of cancer:			
Early stage	14 (93)	1 (7)	.076
Advanced stage	29 (70)	12 (29)	
Radiotherapy status:			
Yeas	6 (60)	4 (40)	.165
No	37 (80)	9 (20)	

9. Significance and Applications of Dates Fruit

9.1 Significance:

- Economic Importance: Dates play a vital role in the economies of many nations, particularly in the Middle East and North Africa (Chao et al., 2007).
- Nutritional Value: Packed with natural sugars, dietary fiber, vitamins, and essential minerals (Fayadh et al., 1990).
- Health Benefits: Dates support digestion, improve cardiovascular health, and provide a natural source of energy (Manda et al., 2022).

This is some of the significance of date fruit, and it found more significance in other fields.

9.2 Applications:

9.2.1 Industrial and Culinary:

- Dates are widely used in desserts, syrups, and candies (Attia et al., 2021).
- Byproducts, including seeds and pulp, are utilized for bioenergy production or as nutritional supplements (Mirmohamadsadeghi et al., 2021).
- The milk in which clean and fresh dates is a very nourishing and restorative drink for the children as well as adults, especially during convalescence from fevers and smallpox (Vyawahare et al.,2008).

9.2.2 Therapeutic:

- The date fruit is useful in dysentery; they are also useful in asthma. The smoke produced from the burning of the date seeds is a useful fumigatory for piles (Vyawahare et al.,2008).
- The water in which fresh dates are drunk is given to relieve alcohol intoxication (Vyawahare et al.,2008).
- Dates are consumptives as they promote expectoration and soothe the chest (Vyawahare et al.,2008).

9.2.3 Cosmetic:

Applied to protect against signs of aging by the virtue of its antioxidant and soothing properties, these are one of the ingredients Epionce Renewal Eye Cream and Epionce Renewal Facial Cream and ingredient of D'Orientine™ S formulation (Vyawahare et al.,2008).

CONCLUSION AND RECOMMENDA

Conclusion

The study highlights the exceptional nutritional and medicinal benefits of date palms (*Phoenix dactylifera*), including their bioactive compounds and antioxidants that support health and prevent chronic diseases. Date palm pollen grains (DPP) were found to contain high levels of phenolics and flavonoids, demonstrating significant antioxidant capacity.

Dates also serve as a functional food, offering benefits such as regulating blood sugar levels, enhancing immunity, and improving lipid profiles. They play a role in reducing inflammation, supporting liver and kidney health, and preventing microbial and viral infections. The ripening stages of dates cater to diverse health needs, from providing natural sugars for energy to offering high fiber and essential minerals.

Specific varieties, such as Khalas and Reziz, exhibited strong cardioprotective effects by enhancing antioxidant defenses and promoting tissue repair, making them valuable for individuals at risk of cardiovascular diseases. For older adults, regular consumption of dates improves hemoglobin levels, lowers LDL cholesterol, and enhances vitality and digestion.

In nursing mothers, consuming dates significantly increases breast milk production in the postpartum phase without affecting the nutritional status of newborns, serving as a natural and safe way to support breastfeeding.

Furthermore, Ajwa dates, when combined with conventional therapies for pediatric cancer patients, enhanced treatment outcomes by reducing side effects and infections, showcasing the therapeutic potential of date-based supplements.

These findings emphasize the role of date palms as a vital resource for global nutrition and health, cementing their importance as a staple food in arid regions and a valuable component in traditional and modern medicine.

Recommendation

Based on the findings of this study on the biological and therapeutic effects of the date palm (*P.dactylifera*), the following recommendations can be made:

1. Promotion of Date Palm Consumption:

Encourage the incorporation of dates into daily diets, whether to puplic or patients due to their rich nutritional and medicinal properties, such as their antioxidant, anti-inflammatory, and antimicrobial activities.

2. Further Research on Therapeutic Applications:

Conduct more clinical and pharmacological studies to explore the potential of date palm extracts as natural remedies for managing chronic diseases such as diabetes, cardiovascular disorders, and cancer.

3. Utilization in Functional Foods and Pharmaceuticals:

Develop and market functional food products and nutraceuticals based on the bioactive compounds in dates, particularly phenolics, carotenoids, and flavonoids.

4. Support for Traditional Medicine:

Encourage the integration of date-based treatments into traditional medicine systems while ensuring scientific validation and safety assessments.

5. Sustainable Cultivation Practices:

Advancing sustainable farming practices and improving post-harvest processing to increase yield while minimizing environmental impacts and ensuring its availability for future generations.

6. Public Awareness Campaigns:

Increase awareness of the health benefits of date palms among communities through educational programs, emphasizing their role in preventing and managing diseases.

7. Exploration of Underutilized Date Varieties:

Encourage the study and utilization of lesser-known date varieties, which may have unique bioactive properties and nutritional benefits.

8. Incorporation into National Health Programs:

Advocate for the inclusion of date-based products in national health and nutrition programs, especially in regions where dates are a staple food.

9. Investigation of Environmental Factors:

Study the impact of environmental conditions on the bioactive components of dates during different ripening stages to optimize their therapeutic potential.

10. Nanoparticles:

More study about the green synthesis approach is cost-effective, eco-friendly, and produces the most stable metal-based nanoparticles without the use of toxic chemicals. For increased knowledge about biosynthesis of FeNPs from *P. dactylifera.*

These recommendations aim to enhance the utilization of the date palm as a vital resource for improving health, advancing research, and supporting sustainable development.

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