

Emerging Trends in Horticultural Crops: Role of Date Fruit in Promoting Urinary and Kidney Health

Mitanshu Singhal¹, Sofia Saifi¹, Aditi Rikhari^{2,*}

Abstract

Dates, or *Phoenix dactylifera* L., have been widely consumed in different cultures, both as a food source and for their health benefits. Whereas dates have been reported extensively to improve cardiovascular, gastrointestinal, and metabolic function, their role in urinary tract and renal health has received lesser attention in mainstream nutritional sciences. This review systematically evaluates and synthesizes the current literature on the potential effects of dates to promote urinary health with respect to their specific antimicrobial, anti-inflammatory, antioxidant, and diuretic effects. Dates are especially high in bioactive compounds, such as flavonoids, tannins and phenolic acids with potent antioxidative and antimicrobial properties. Such phytochemicals have shown inhibitory action against the common uropathogens like *Escherichia coli* indicating their role in prophylaxis and treatment of recurrent urinary tract infection (UTIs). Moreover, nephroprotective effects in preclinical models suggest the potential of date extracts to attenuate oxidative stress and inflammatory damage in renal tissues, notably in models of chemically induced nephrotoxicity. Dates have a high potassium-to-sodium ratio and a low oxalate content enabling them to play a healthy role in the metabolism to create a favorable internal environment for kidney stone prevention. Certain strains have also been linked with mild diuretic effects, which can help to promote urination and expel pathogens and metabolic waste from the urinary tract. An extensive review of the potential functions of *Phoenix dactylifera* in kidney health and urinary tract function offers a foundation for future investigations as well as dietary recommendations in clinical medical practice.

Keywords: Kidneys, *Phoenix dactylifera*, urinary health, Nephroprotection, Urinary Tract Infection

INTRODUCTION

Overall health is linked to the health of the urinary tract, and diseases like urolithiasis and nephrotoxicity can be extremely serious. Assessing natural remedies, such as dates offers encouraging opportunities for therapeutic and preventive strategies. One of the world's oldest fruits to be grown,

dates *Phoenix dactylifera* (Figure 1) have long been an integral part of traditional diets, especially in the Middle East, North Africa, and some regions of Asia. Often called a “superfruit,” dates are prized for their many nutritional and therapeutic benefits in addition to their sweet flavor and high energy content. Natural sugars, dietary fiber, essential vitamins and minerals like potassium and magnesium, and a variety of bioactive compounds like flavonoids and phenolic acids are all abundant in them (Alsarayrah et al., 2023) [3].

In recent years, scientific interest in the health benefits of dates has grown significantly. The role they play in managing metabolic conditions like diabetes, promoting heart health, as well as

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improving digestion have been thoroughly studied (Farsi et al., 2008) [1]. Their impact on urinary health is one area that is still largely unknown though. To efficiently eliminate waste and maintain the fluid balance of the body, the urinary system is necessary. Overall health and quality of life may be impacted when this system is weakened, whether by infections, inflammation, or kidney-related conditions (Platat et al., 2019) [13].

Dates may have characteristics that promote urinary tract health, according to new research. Their essential anti-inflammatory and antioxidant properties could be beneficial in reducing kidney oxidative stress as shown in Figure 2. Additionally, urinary tract infections (UTIs) may be prevented or managed with the help of their possible antimicrobial activity. In addition to supporting kidney function, its beneficial mineral content—particularly the high potassium-to-sodium ratio—may reduce the risk of kidney stones. Exploring natural dietary strategies that can help prevent or manage urinary health issues is necessary considering the increasing incidence of these conditions worldwide, particularly among women and older adults (Hasan and Mohieldein 2016) [9].

Nutritional Composition Relevant To Urinary Health

Dates are a source of:

- *Dietary fiber*: through the balance of the microbiome, dietary fiber may indirectly improve urinary health through the promotion of gut health.



Figure 1. Dates.

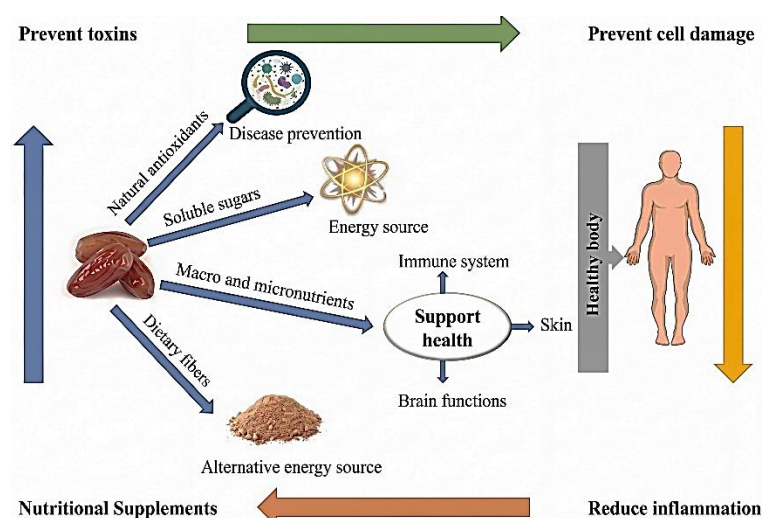


Figure 2. Role of dates in disease prevention via antioxidant, anti-microbial and anti-inflammatory activity.

- *Magnesium and potassium*: necessary for kidney filtration and fluid-electrolyte balance.
- *Phenolic compounds* (such as flavonoids and tannins): renowned for their antimicrobial and anti-inflammatory properties.
- *Sugars and low oxalate content*: When consumed in moderate amounts, sugars, and low oxalate content are beneficial for individuals who are at risk of kidney stones as shown in Figure 3 and Table 1.

Nephroprotective Effects of Dates

In Figure 4, Dates (*Phoenix dactylifera*) possess significant nephroprotective properties because of their rich phytochemical composition, which includes polyphenols, flavonoids, and carotenoids which




Type of date	Total sugar content %	Glucose	Fructose %	Sucrose %	Moisture %	Ash %	Author
	74.3	51.3	48.5	3.2	---	---	(Assirey, 2015)
	---	---	---	---	23	3	(Batoool et al., 2020)
	75.2	---	---	---	22.9	3	(Adwas et al., 2019)
	---	54.5	52	---	22.8	3	(Khalid et al., 2016)
	24.3	---	---	---	9.7	6.7	(Perveen and Bokahri, 2020)
	---	234 g/kg ¹	201 g/kg ¹	245 g/kg ¹	---	---	(El-Mergawi et al., 2019)
	78.5	52.3	48.2	3.2	21	3.2	(Assirey, 2015)
	78.3	51.8	47.5	3	12.57	2.30	(Siddeeq et al., 2019)
	80.7	---	---	---	16	2.2	(Perveen and Bokahri, 2020)

Figure 3. The moisture, ash, and sugar content of date fruit (Alsarayrah et al., 2023).

Table 1. The mineral content of date fruit, Protein, fat, and fiber content (Alsarayrah et al., 2023)

Type of date	Calcium (mg/100g)	Magnesium (mg/100g)	Potassium (mg/100g)	Phosphorus (mg/100g)	Author	Protein (%)	Fat (%)	Fiber (%)	Author
Ajwa	187	150	476	27	Assirey, 2015	2.77	0.26	2.43	Arshad et al., 2019
Ajwa	189	148	480	---	Batoool et al., 2022	2.9	0.49	2.03	Batoool et al., 2020
Ajwa	---	---	---	---	---	1.6	2.47	---	Rahmani et al., 2014
Ruthana	920.53 mg/kg	851.17	7396.7	726.9	Perveen and Bokahri, 2020	---	---	---	Siddeeq et al., 2019
Sukkari	742 mg/kg	731	6789	651	Perveen and Bokahri, 2020	3	0.65	3.15	Siddeeq et al., 2019
Sukkari	186.5	148	620	26.5	Siddeeq et al., 2019	2.75	0.42	4.95	Alghamdi et al., 2018
Sukkari	---	64.4	433.6	69.4	Habib and Ibrahim, 2011	5	0.32		

contribute to their anti-inflammatory and antioxidant effects. The fruits of dates and extracts of seeds have been successfully demonstrated in experiments to reduce renal damage caused by nephrotoxic substances. In rats with gentamicin-induced nephrotoxicity, Al-Qarawi et al. showed that oral administration of water-soluble extracts of date flesh and pits significantly decreased serum levels of creatinine and urea concentrations, suggesting a protective effect on renal tubular structures (Al-Qarawi et al., 2008) [2].

Similarly, El Arem et al. found that giving rats supplemented date fruit extract after they were exposed to dichloroacetic acid, a nephrotoxic environmental contaminant, enhanced the kidney function markers and increased the activity of the antioxidant enzymes like catalase and superoxide dismutase, while also decreasing lipid peroxidation (El Arem et al., 2014) [8].

The scavenging of reactive oxygen species and the inhibition of inflammatory pathways that contribute to renal injury are most likely the physiological processes underlying these effects. Moreover, inflammatory cytokines like TNF- α and IL-6, which are frequently elevated during renal insult, have been demonstrated to be influenced by date seed oil (Vayalil PK, 2012) [17]. Even though most scientific evidence currently available today is derived from animal models, these results demonstrate *Phoenix dactylifera*'s possible function as a nephroprotective agent and call for more clinical research.

Anti-Urolithiatic Properties of Dates

Kidney or urinary stones commonly known as urolithiasis, is a prevalent condition which is characterized by the accumulation of solid mineral deposits in the urinary tract. These stones are made up of substances like calcium oxalate, struvite, uric acid, or cystine. Presence of these stones can lead to several problems like severe discomfort, including flank pain, blood in the urine, and in more serious cases, urinary obstruction and infections (Kallidonis et al., 2011) [10]. Some medical approaches like medications and surgical procedures are effective in managing the condition, but there are high chances of recurrence and some unwanted side effects and that's where doctors started putting their interest in natural, plant-based therapies that are safer and more sustainable (Ashok et al., 2010) [6].

Among these, *Phoenix dactylifera* (date palm), has attracted considerable attraction. While dates are commonly consumed for its nutritional value, they are also traditionally recognized for their healing properties in medicine systems. They have several health promoting compounds, such as flavonoids, tannins, phenolics, and dietary fibers which are observed to have therapeutic action against stone formation (Reddy & Vardhaman, 2013) [15].

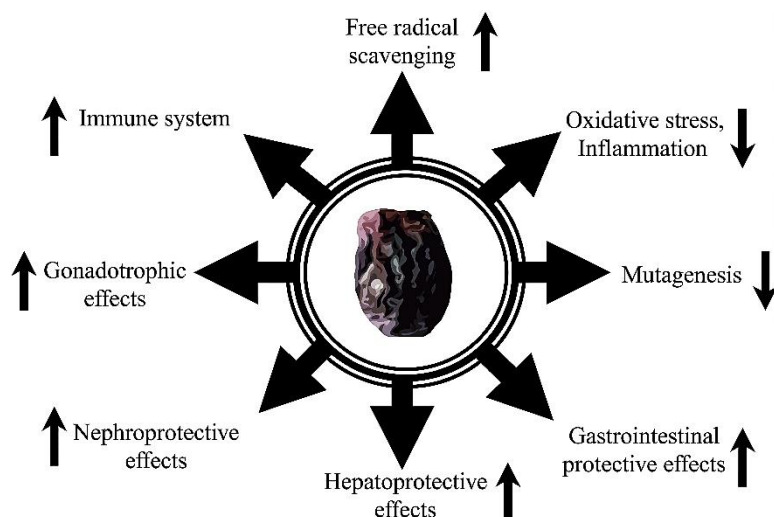


Figure 4. Benefits of dates.

How dates may help prevent stone formation:-

There are several synergistic mechanisms due to which dates fruit may prevent urinary stones, these mechanisms as shown in Figure 5 are:

Prevention of crystal formation: some laboratory studies have indicated that date fruit extract can interfere with the formation, growth, and clustering of calcium oxalate crystals commonly found in stones (Mohamed et al., 2024) [12].

Antioxidant and Anti-Inflammatory Activities of Dates

Oxidative stress and inflammations are strongly linked with the development of a disease of numerous renal and urinary tract disorders, which includes diseases like urolithiasis, infections, and chronic kidney disease *(Wiley Online Library, n.d.). *These processes foster an environment that is conducive to the development of illness, additionally causing tissue damage and impaired function. The possible contribution of natural products that are high in antioxidants and anti-inflammatory substances in reducing these effects has drawn attention, and the date palm, is a particularly fascinating option in this respect* (Taleb et al., 2016) [16].

A Wealthy Source of Bioactive Substances

Several beneficial compounds, such as flavonoids (like quercetin and luteolin), phenolic acids, tannins, and carotenoids, are naturally found in date fruits. Such compounds are well-known for their effective scavenging of free radicals and their capacity to alter inflammatory signaling pathways as shown in Figure 6. Antioxidants found in dates, their effectiveness has been verified by several evaluations, including DPPH, FRAP, and ABTS, which indicate that they can neutralize reactive oxygen species (ROS) (Zhang et al., 2013) [18].

Effects of Antioxidants on Urinary Health

Oxidative stress may lead to DNA damage in renal cells, lipid peroxidation, and protein oxidation in the setting of urinary health (Haimoud et al., 2016) [5]. In addition to causing tissue damage, this promotes crystals to adhere to the renal epithelium, this is a crucial stage in the development of stones.

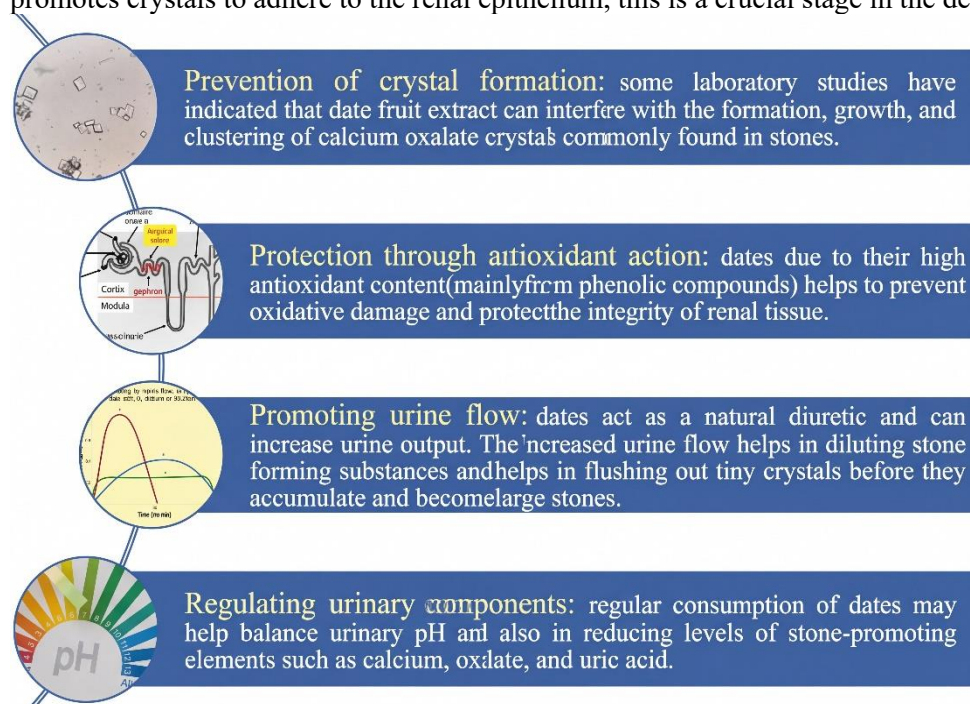


Figure 5. Synergistic mechanisms.

In Figure 7, antioxidants in dates help retain kidney cellular integrity and stave off diseases like nephritis and nephrolithiasis by reducing oxidative damage (El Abed et al., 2018) [7].

In addition, studies have demonstrated that when date fruit extract is applied to animal models, endogenous antioxidant enzymes like glutathione peroxidase (GPx), catalase (CAT), and superoxide dismutase (SOD) increase while oxidative stress markers like malondialdehyde (MDA) are reduced. Overall renal protection is helped by this dual impact, which lowers oxidative load and develops antioxidant defense (Rahmani et al., 2014) [11].

Anti-inflammatory Potential

In Figure 8, inflammation is a crucial factor in several urinary tract disorders. Cytokines like TNF- α , prostaglandins and IL-6 increased frequently in response to kidney damage, UTI, and also the urinary stone development. By reducing or preventing the secretion of these pro-inflammatory mediators.

Dates extracts may reduce the nuclear factor activation-kappa B (NF- κ B) and other signaling pathways that increases inflammation, based on research conducted on animals and in-vitro (Kehili et al., 2016a) [14].

Anti-Microbial Properties of Dates

Urinary tract infections are a major health concerns which affect millions of people worldwide, and E. coli is the most common pathogen involved in it. Some other prominent culprits are Proteus mirabilis, Staphylococcus saprophyticus, and Klebsiella pneumoniae. With time the potential of anti-microbes has increased which makes the traditional antibiotics less effective and increases the interest in natural alternatives, such as date palm, which tends the ability to improve urinary health (Al-Shwyeh, 2019) [4].

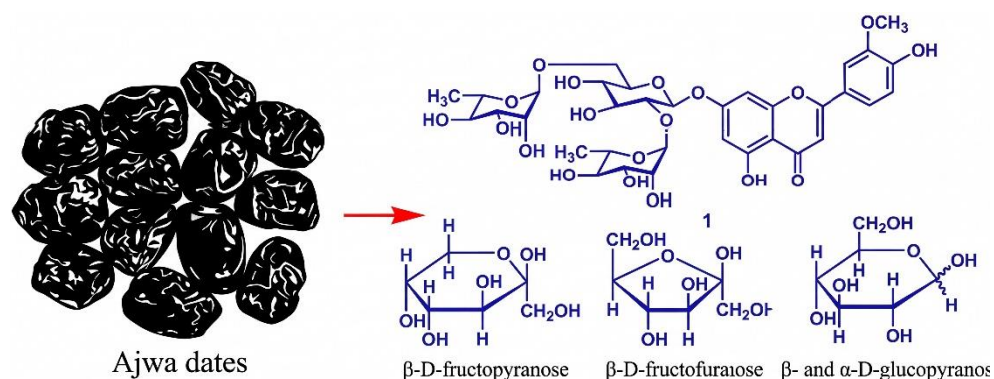


Figure 6. Antioxidants present in dates (Zhang et al., 2013).

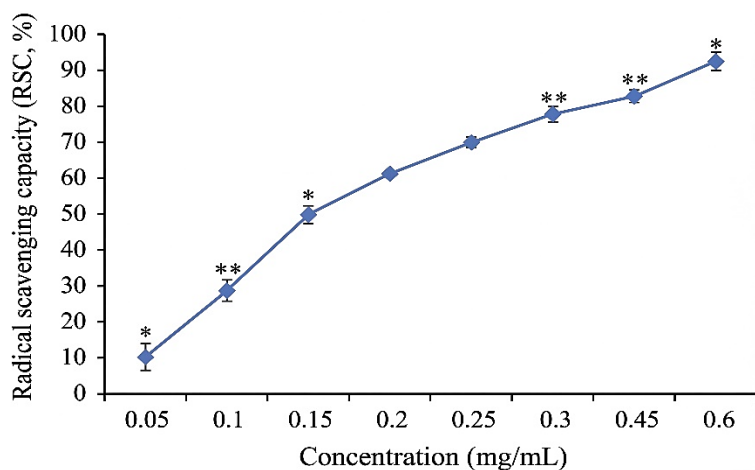


Figure 7. Antioxidant property of dates (*El Abed et al., 2018*).

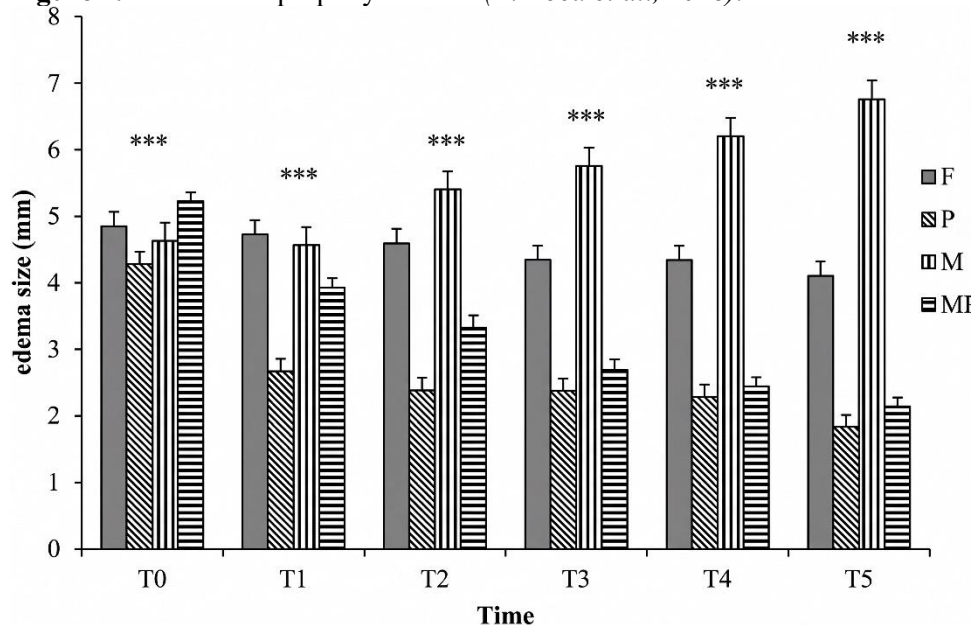


Figure 8. Anti-inflammatory property of dates (*Kehili et al., 2016b*).

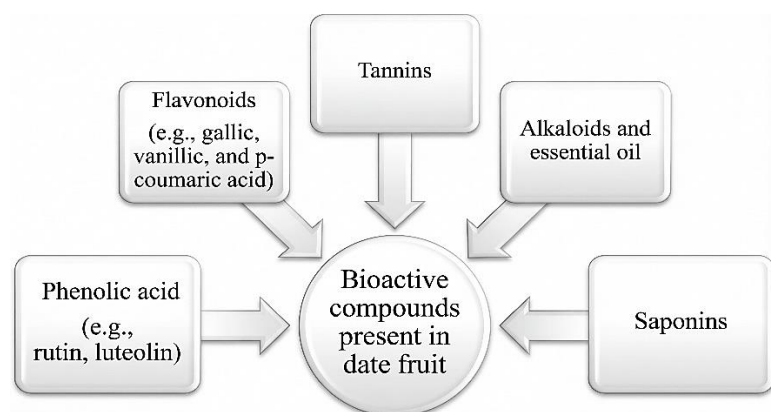


Figure 9. Bioactive compounds present in date fruit.

The microbial property in date fruits comes from several bioactive compounds as shown in Figure 9, Some of them are: -

CONCLUSION

Due to the increased interest in natural solution for improving urinary tract health, *Phoenix dactylifera* (dates) has drawn attention as a multifunctional medicinal agent. This comprehensive overview points out the many pharmacological features associated with dates, mainly their antioxidant, antimicrobial, anti-urolithiatic and nephroprotective property. All these health benefits are due to the rich phytochemical profile of the fruit which include flavonoids, tannins, vital minerals and phenolic acids.

Many studies done on animals have proven the ability of date extract in preventing kidney stone formation, counteract oxidative stress, ameliorate nephrotoxicity, and suppress urophathogenic. These studies help in identifying potential of dates as a complementary approach in the treatment and prevention of diseases related to urinary tract.

Even after several studies, it is necessary to further investigate and design a well-developed human

clinical trial to identify sufficient doses, delivery methods, and sustainable safety. Date extracts are potentially a natural and safe to use product when incorporated into diets or treatment plans can improve urinary health and avoid further kidney related problems.

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