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# Potential Impact of Dietary and Water Extract Date Pits Consumption on Health Profiles in Mice

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## ABSTRACT

**Background:** Date pit extract and dietary date pit supplement has been shown to improve body health functions.

**Methods:** Forty-five male albino mice were distributed over three groups; control, 5.0% dietary date pits supplement and 5.0% date pits water extract groups. Chemical composition of date pits was determined. Body weights (BW), rectal temperature, pulse rate and peripheral oxygen saturation ($SPO_2$), blood glucose values, hematological and biochemistry profiles were recorded.

**Result:** The results showed that date pits groups had higher final body weight (g) and rectal temperature if compared to control group. Pulse rate and $SPO_2$ values were not differed among date pits and control groups. Additionally, red and white blood cells, packed cell volume, total protein and HDL values were increased of date pit groups compared to control one. On the other hand, glucose and triglycerides values were decreased due to water extract date pit consumption compared to other groups. It could be concluded that five percent of dietary or water extract date pit consumption improved physiological, hematological and biochemistry profiles in mice.

**Key words:** Biochemistry, Date pit, Glucose, HDL, Hematology, Total cholesterol.

## INTRODUCTION

The date palm is a dioecious monocot belonging to the Arecaceae family and stands as one of humanity's oldest cultivated perennial plants, with its domestication dating back to around 4000 B.C. (Krueger *et al.,* 2023; Al-Karmadi and Okoh, 2024). Date palm cultivation is a cornerstone of Saudi Arabia's agriculture, holding significant religious, social and economic importance. In 2018, national statistics revealed over 31 million date palm trees cultivated across 207,369.8 hectares, yielding a total production of 1,541,769 tons, which represented approximately 17% of global date production (GASTAT, 2019; MEWA, 2020). Saudi Arabia boasts 400 date palm varieties grown across 72% of its permanent cultivated land (DSPS 2009; Al-Wusaibi *et al.,* 2012), positioning the Kingdom as a leading date palm cultivating and date-producing nation globally in 2019 (Shahbandeh, 2019). This thriving sector is supported by substantial long-term subsidies from the Saudi government to date palm growers.

Al-Ahsa Oasis in the Eastern Province of Saudi Arabia is a significant center for date palm cultivation and date production. The Al-Ahsa Oasis is the largest palm oasis in the world, boasting over 2.5 million date palm trees spread across approximately 8,000 hectares. This makes the region a major contributor to the overall date production in Saudi Arabia (Almutawa, 2022; Ismail *et al.,* 2022). In Al-Ahsa Oasis, valorizing date pits through water extraction and other methods presents an opportunity to create value-added products from agricultural waste, contributing to both economic and environmental sustainability (Nehdi *et al.,* 2018; Shi *et al.,* 2023). The water extraction of date pits is a process used to obtain valuable compounds from this date processing byproduct. Date pits, which constitute about 10-15% of the date fruit's weight, are a rich source of various beneficial substances (Kiesler *et al.,* 2024). Water extraction methods are favored for being environmentally friendly and low cost-effective.

Date pitting, a necessary step in processing date fruits, results in seed waste that constitutes roughly 18% of the fruit's total weight (Ibourki *et al.,* 2021). With global date production reaching 9.66 million tons in 2021, this process could potentially generate over 900,000 tons of date seeds (Statista, 2023). These date seeds, once viewed as waste, are now recognized as a rich source of fiber and phenolic compounds (Mrabet *et al.,* 2022; Shi *et al.,* 2023). Additionally, they hold potential for conversion into value-added products and the oil extracted from sate seeds can also be transformed into valuable commodities (Zhou *et al.,* 2023). Unfortunately, date pits are mostly discarded,

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used as animal feed (Al-Juhaimi *et al.*, 2018), or used for Arabic coffee (Ranasinghe *et al.,* 2022; Kiesler *et al.,* 2024). Therefore, given the large-scale date production in our region, the efficient extraction of date pits during processing is vital. Furthermore, the potential for valorizing these pits through the extraction of valuable compounds aligns with the growing emphasis on sustainability and economic diversification in Al-Ahsa.

Date pits extract can yield a variety of valuable compounds from including polyphenols and other antioxidants, dietary fiber, minerals and vitamins and Other bioactive compounds (Barathikannan *et al.,* 2025; Manai *et al.,* 2024). The extracts of date pits have potential applications in various industries including food industry, pharmaceutical and cosmetic industry and environmental applications (Ghafoor *et al.,* 2022; Al-Khalili *et al.,*2023). The question arose, does the date pits able to promote health status. Despite these existing uses, date pits are undervalued and they could be put to innovative applications with grinding or water extraction. Therefore, the aims of the current study were to investigate the potential impact of date pits 5.0% water extract or dietary supplements upon *ad libitum* consumption on blood glucose values, physiological parameters and hematological and lipid profiles in mice.

## MATERIALS AND METHODS

The experimental procedures of the current study were approved by KFU ethical committee [KFU-REC-2025-MAY-EA3281]. Experiments were conducted in the experimental animal laboratories within the Agriculture and Food Sciences College at King Faisal University.

### Materials and sample preparation

Ekhlas date fruits were purchased from the Seasonal Date Fruit Market, Al-Ahsaa, Saudi Arabia during November 2024. The seed were separated manually from date flesh. The seeds were dried in an oven at 50°C and ground using a mill (Pulverisette 19, Germany).

### Chemical composition of date pits

Proximate analysis was carries out for determination of chemical composition of date pits. Moisture content was determined by drying 5.0 g of date pit powder in an oven at 105°C for three hours. The ash content was determined after complete combustion (550°C) 2.0 g date pit powder in a muffle furnace for five hours. Protein content was determined using the Kjeldahl method. Fat content was determined by extracting the lipid components from the dried sample using petroleum ether in a Soxhlet extractor. Fiber content was determined after digestion with dilute acid and alkali. Carbohydrate content calculated by subtracting the percentages of moisture, ash, crude protein and crude fat from 100% (AOAC 1995; Van Soest *et al.*, 1991; Osman *et al.*, 2019). Total phenols was determined with the Folin-Ciocalteu assay procedure (Kalpoutzakis *et al.,* 2023).

### Mice and experimental groups

Forty-five albino male mice (23.58±0.99) were kept in cages (40.0 × 24.0 × 18.0 cm) for control, date pits 5.0% water powder extract supplement and date pits 5.0% dietary powder supplement groups (Fig 1) (15 males per group). The date pits powder is indicated in Fig 2A. Date pits 5.0% dietary pelleted supplement (Fig 2B) and date pits 5.0% water extract (Fig 2C) were offered *ad libitum* during the study (Fig 2).

The basal diet composed of 18.0 protein, 2.9 fat, 3.2 fiber, 1.0 minerals and vitamins mixture. The groups of current study were control group offered *ad libitum* basal diet and water, dietary date pits group given *ad libitum* date pits 5.0% dietary pelleted supplement and water extract date pits group offered *ad libitum* basal diet and date pits

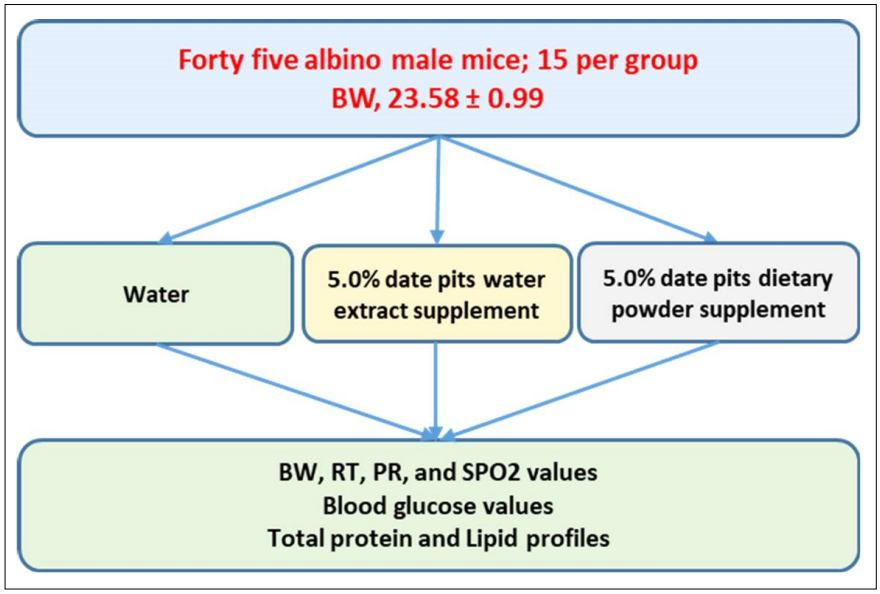


**Fig 1:** Experimental design and groups of the study.

5.0% water extract. The mice consumed daily ~4.0 ml of water or date pits 4.0% water extract, respectively. The temperature (°C) and relative humidity (%) values during the study were controlled to 24.0±1.2°C and 38.0±3.0%, respectively. The experiment lasted four weeks.

**Monitoring body weight, rectal temperature, heart rate, peripheral oxygen saturation and blood glucose values**

Body weights (g) of control, dietary date pits and water extract date pits groups were recorded using digital balance (Sartorius balance, Azulmart-KSA). Rectal temperature, heart rate, peripheral oxygen saturation and blood glucose values were recorded weekly. Rectal temperatures were monitored using clinical thermometer (Citizen). Peripheral oxygen saturation and pulse rates were monitored using pulse oximeter apparatus (CMS60D-VET). The blood glucose values were recorded using blood glucose meter (Contour, KSA) (Mohammed *et al.,* 2024, 2025a,b).

**Statistical analysis**

Body weight, rectal temperature, $SPO_2$ and pulse rate and hematological and biochemistry profiles of control, dietary date pits and water extract date pits groups were statistically analyzed using one way ANOVA (SAS 2008) according to the following model:

$$Yij = \mu + Ti + eij$$

Where,

μ = Mean.

Ti = Effects of 5.0% dietary date pits, 5.0% water extract date pits.

Eij = Standard error.

Duncan's multiple range test (Duncan, 1955) was used to compare between means of control, dietary date pits and water extract date pits groups.

## RESULTS AND DISCUSSION

**Chemical composition of date pits**

Chemical composition of date pits is shown in Fig 3. The study indicated that date pit contains 3.82% moisture, 96.18% dry matter, 5.93 protein, 60.47% fiber, 9.01% fat, 19.86% carbohydrate and 0.91% ash. In addition, date pit contains 3.23% total phenols.

**Body weight, rectal temperature, $SPO_2$ and pulse rate**

The changes of body weight (g) rectal temperature (°C), pulse rate (beats/min.) and $SPO_2$ (%) among control, dietary date pits and water extract date pits groups are presented in Table 1. Final body weights (g) and rectal temperature were significantly ($P<0.04$) increased in dietary and water extract date pits groups if compared to control group. Pulse rate and $SPO_2$ values were not differed among date pits and control groups.

**Hematological and biochemistry profiles**

The changes of blood cells and biochemistry profiles are presented in Table 2. The results showed that date pits groups had higher red and white blood cells, packed cell volume, total protein and high-density lipoprotein (HDL) values compared to control group. On the other hand, glucose and triglycerides values were decreased due to water extract date pit consumption. Furthermore, lower ratio of total cholesterol (TC) to high-density lipoprotein (TC/HDL) was recorded in date pit groups (1.17 and 1.16) compared to control group (1.29).

The results of the current experiment is showed in Table 1-2 indicating the effects of dietary date pits and water extract date pits supplement (5.0%) on body weight gain, physiological parameters, blood and biochemistry profiles. Date seed powder has a shelf life of approximately 11 months when stored at room temperature (Nandhini and Sathiya, 2022).

**Chemical composition of date pits**

Chemical composition of date pits is shown in Fig 3. The study indicated that date pit contained 96.18% dry matter, 3.82% moisture, 5.93 protein, 60.47% fiber, 9.01% fat, 19.86% carbohydrate, 0.91% ash and 3.23% total phenols. The exact composition can vary depending on the date cultivar, growing conditions and processing methods. Moisture, protein, oil and carbohydrate contents of date-pits varied from 3.1-12.5, 2.3-6.9, 5.0-12.5 and 70.9-86.9 g/100 g date-pits, respectively (Hossain *et al.,* 2014). Date

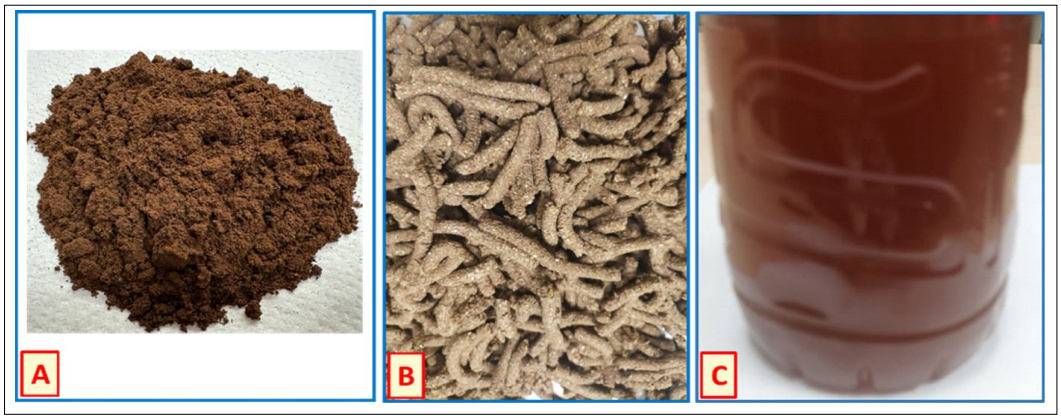


**Fig 2:** Date pits powder (A), basal diet supplemented with 5.0% date pits powder (B), 5.0% date pits water extract (C).

seeds are contained approximately 5.0-13.0% fat, which influenced by the varieties, growing conditions and extraction technique used (Hossain *et al.,* 2014). The difference between fatty acid concentrations in date seeds is linked to the date varieties, roasting processes and pollination (Rahman *et al.,* 2007). In additions, the total phenols of date seeds were found to influence by the varieties (Shams Ardekani *et al.,* 2010).

**Body weight, rectal temperature, $SPO_2$ and pulse rate**

The changes of body weight (g) rectal temperature (°C), pulse rate (beats/min.) and $SPO_2$ (%) among control, dietary

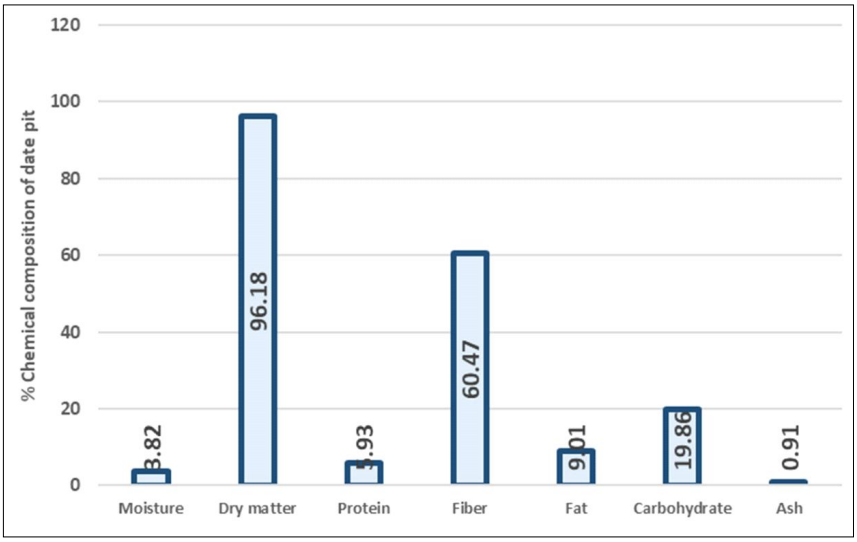


**Fig 3:** Chemical composition of date pits.

**Table 1:** Changes in rectal temperature (°C), pulse rate and peripheral oxygen saturation (%) of mice receiving dietary date pits and water extract date pits.

| Parameters | Control | Dietary date pits | Water extract date pits | SEM | P value |
|---|---|---|---|---|---|
| Initial body weight, g | 23.18 | 24.04 | 23.60 | 0.99 | 0.96 |
| Final body weight, g | 33.20$^{b}$ | 35.30$^{a}$ | 34.80$^{a}$ | 1.10 | 0.04 |
| Rectal temperature, °C | 35.60$^{b}$ | 35.80$^{a}$ | 35.85$^{a}$ | 0.05 | 0.05 |
| Pulse rate/min. | 163.3 | 165.4 | 167.2 | 5.40 | 0.86 |
| Peripheral oxygen saturation, % | 87.10 | 88.90 | 89.30 | 2.90 | 0.15 |

$^{a,b}$ Values between groups in the same row with different superscripts significantly differ at P<0.05.
SEM standard error of means.

**Table 2:** Changes in blood cells and biochemistry profiles of mice receiving dietary date pits and water extract date pits.

| Parameters | Control | Dietary date pits | Water extract date pits | SEM | P value |
|---|---|---|---|---|---|
| RBCs, $10^6$/µl | 7.35$^{b}$ | 8.24$^{a}$ | 8.13$^{a}$ | 0.40 | <0.0001 |
| Packed cell volume, % | 40.00$^{b}$ | 44.50$^{a}$ | 44.66$^{a}$ | 1.20 | 0.04 |
| WBCs, $10^3$/µl | 5.45$^{b}$ | 6.60$^{a}$ | 6.30$^{a}$ | 0.30 | <0.0001 |
| Total protein, g/dl | 6.46$^{b}$ | 6.57$^{b}$ | 7.22$^{a}$ | 0.30 | <0.0001 |
| Glucose, mg/dl | 132.4$^{a}$ | 117.50$^{b}$ | 129.4$^{a}$ | 3.50 | 0.03 |
| TC, mg/dl | 102.25 | 103.0 | 106.75 | 1.93 | 0.60 |
| HDL, mg/dl | 79.00$^{b}$ | 93.25$^{a}$ | 87.75$^{a}$ | 2.95 | 0.03 |
| TG, mg/dl | 96.75$^{a}$ | 74.66$^{b}$ | 96.33$^{a}$ | 2.80 | <0.0001 |
| TC/HDL | 1.29$^{a}$ | 1.17$^{b}$ | 1.16$^{b}$ | 0.06 | <0.0001 |

$^{a,b}$ Values between groups in the same row with different superscripts significantly differ at P<0.05.
SEM standard error of means; TC Total cholesterol; HDL, high-density lipoprotein; TG, triglycerides.

date pits and water extract date pits groups are presented in Table 1. Final body weights (g) and rectal temperature were significantly ($P<0.04$) increased in dietary and water extract date pits groups if compared to control group. Pulse rate and $SPO_2$ values were not differed among date pits and control groups.

The recommended daily fiber intake for adult is 25 grams to promote regular bowel movements and reduce the risk of heart diseases (EFSA, 2010). Date seed fiber is a beneficial and easily incorporated source of dietary fiber that can be added to bread doughs.

Date pits are increasingly recognized for their rich and diverse chemical composition, making them a valuable source of various compounds with potential industrial and nutritional applications (Alkatheri *et al.,* 2024). Based on the available research, there is no direct evidence specifically examining the effects of date pits water extract and dietary date pits supplement (5.0%) on rectal temperature, pulse rate and peripheral oxygen saturation ($SPO_2$). Date pits are exceptionally rich in dietary fibers primarily insoluble dietary fiber (cellulose, hemicellulose, lignin), which contributes to digestive health and can be used as a bulking agent in addition to a smaller amount of soluble dietary fiber. Date pits contain a notable amount of oil, typically ranging from 5% to 13% of their dry weight. Date pit oil is characterized by a high content of fatty acids, with oleic acid (a monounsaturated fatty acid) often being the most abundant (*e.g.*, 30-50%). Other significant fatty acids include lauric acid, myristic acid, palmitic acid and linoleic acid. This oil is stable and has potential applications in food and pharmaceuticals due to its beneficial fatty acid profile and the presence of other bioactive compounds. Date pits contain a decent amount of protein, typically ranging from 2% to 7% of their dry weight. They are a source of various amino acids, including essential ones. Some studies have identified glutamic acid, leucine and phenylalanine as major amino acid. While most of the readily digestible sugars are in the date flesh, date pits still contain carbohydrates, primarily in the form of complex carbohydrates that contribute to their fiber content. Some simple sugars like glucose and fructose may also be present in small amounts. In addition, Date pits are a good source of various essential minerals.

**Blood cells and biochemistry profiles**

The results showed that date pits groups had higher red and white blood cells, packed cell volume, total protein and high-density lipoprotein (HDL) values compared to control group. On the other hand, glucose and triglycerides values were decreased due to water extract date pit consumption. Furthermore, lower ratio of total cholesterol (TC) to high-density lipoprotein (TC/HDL) was recorded in date pit groups (1.17 and 1.16) compared to control group (1.29).

Date pits extract is widely recognized as a valuable resource with various potential applications. The date pits extract contain bioactive compounds, seed oil and activated carbon production (Ghafoor *et al.,* 2022; Manai *et al.,* 2024). Additionally, the ground date pits can be incorporated into animal feed as a source of fiber and other nutrients (Bouaziz *et al.,* 2020; Kiesler *et al.,* 2024). Health benefits of dietary date pit and date pit water extract could be attributed to antioxidant activity, source of dietary fiber, potential anti-diabetic effects, anti-inflammatory properties, support for cardiovascular health, potential gut health benefits, rich in minerals. Date seed oils contained a high relatively percentage of oleic. The date seed oils are an important regarding their fatty acid composition and remarkable high amount of tocopherol contents (Al-Juhaimi *et al.,* 2018). Date pit contains similar fatty acid compositions as olive oil or other edible oils (Golshan Tafti *et al.,* 2017). The date seed oil oxidative stability is high and comparable to olive oil (Besbes *et al.,* 2004). Date seed oil has similar characteristics to edible vegetable oil and considered safe for human consumption (Niazmand, 2022).

Date pits are particularly rich in polyphenols, including phenolic acids and flavonoids (Osaili *et al.,* 2024). These compounds are known for their strong antioxidant properties, which can help protect the body from oxidative stress and have various health-promoting effects. The common phenolic acids identified include gallic acid, chlorogenic acid, ferulic acid, p-coumaric acid, caffeic acid, vanillic acid, syringic acid, ellagic acid. Flavonoids like hesperidin and quercetin have also been detected in date pits. The high concentration of these bioactive compounds makes date pits valuable for nutraceuticals and food additives. Phytosterols compounds, minor components, have cholesterol-lowering properties.

In summary, date pits are far from mere waste. Their diverse chemical composition, particularly their high fiber, beneficial oil and rich profile of phenolic compounds, positions them as a promising resource for various valorization efforts, aligning well with sustainability and economic diversification goals, especially in regions like Al-Ahsa with large-scale date production.

## CONCLUSION

Dietary and water extraction date pits upon consumption (5.0%) were contributing to better health. While the concentration and bioavailability of compounds might differ from dietary supplement or water extraction, it remains a promising avenue for utilizing this abundant resource for health benefits. More research, particularly human studies, is needed to fully understand the extent and mechanisms of these effects.

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### Disclaimers

The views and conclusions expressed in this article are solely those of the authors and do not necessarily represent the official stance of their affiliated institution.

### Informed consent

Ethical Approval of Scientific Research Deanship Committee of King Faisal University.

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### Conflict of interest

The authors have no conflicts of interest to declare.

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