

Effect of dates on blood glucose and lipid profile among patients with type 2 diabetes

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Abstract

Poor fruit and vegetable consumption is one of the 10 major risk factors for mortality. There is a misconception regarding the consumption of dates among patients with diabetes. This manuscript assessed the effects of date consumption on fasting and postprandial blood glucose, glycated hemoglobin, total cholesterol, triglycerides, low-density lipoproteins, high-density lipoproteins, and microbial markers. Four literature databases were searched for relevant articles. Of the 595 studies retrieved, 24 assessed the effects of dates on glycemic control and lipids. Overall, the evidence suggests that dates have a lowering effect on blood glucose. Dates reduce total cholesterol and triglyceride levels and increase high-density lipoprotein levels. Dates also promote the abundance of beneficial gut microbiota. Therefore, patients with diabetes and dyslipidemia can consume dates to reduce their blood glucose, cholesterol, and triglycerides.

Key Words: Dates; Lipid profile; Blood glucose; Diabetes mellitus; Microbial contamination

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Core Tip: Literature on date consumption among patients with diabetes is scarce and limited. This article highlights the benefits and possible hazards of date consumption in this patient population. Additionally, a discussion on microbial contamination in dates and the beneficial fungi that might produce antibiotics is provided. Finally, the article suggests future research to investigate the role of microbes in pharmacotherapy of certain diseases.

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INTRODUCTION

Diabetes mellitus is a highly prevalent disease with high mortality. Over 10% of people aged 20-79 are suffering from diabetes globally. This percentage is expected to increase to 12.2% by 2045[1,2]. Unfortunately, the actual prevalence of diabetes is likely higher because it is postulated that for every diagnosed patient there is 1 undiagnosed patient. Lifestyle modifications, including diet and exercise, are effective factors to treat diabetes[3,4].

Diabetes mellitus can be comorbid with dyslipidemia, and high triglycerides and small dense low-density lipoproteins (LDLs) with LDL are commonly observed abnormalities. Lipid-lowering drugs (*i.e.*, statins) are the primary therapy but have several undesirable side effects. Therefore, natural products with lipid and blood glucose-lowering properties are beneficial to these patients[5]. It has been shown that fruit and vegetable consumption can decrease weight, mitigate hyperglycemia, and reduce certain cancer risks[6,7]. Likewise, low intake of fruits and vegetables is among the highest risk factors of mortality globally.

Dates are a widely available and cheap food staple. *Phoenix dactylifera* L. or the date palm tree has been utilized as a source of food for more than 6 centuries[8]. Dates are typically dried and serve as an alternative to fresh fruit[9]. There are more than 2000 distinct types of dates, including Ajwa (the super date), Sukari, and Khalas. Dates have a high nutritional value and an abundance of flavonoids and phenolic compounds with anti-inflammatory and antioxidant effects. Dates are also rich in starch, proteins, unsaturated fats, minerals, nutrients, and salt[6,10]. In addition, dates are very rich in carotenoids, phenols, dietary fiber, and phytoestrogens with high antioxidant activity[11]. The European Food Safety Authority suggests 100 mg of dried fruit for gastrointestinal health. Similarly, consumption of up to 76.2 g of dates are purported in Arab tradition to be beneficial for postprandial glucose[12].

Dates also promote beneficial gut microbiota that play an important role in inflammation and oxygen free radical suppression. There is an increasing awareness of the association between gut microbiota and chronic diseases, including diabetes, dyslipidemia, and hypertension[13,14]. The effects of phytochemicals and bioactivity towards gut microbiota function and composition have been an active area of research in recent years.

Although dates are an excellent source of phytochemicals[10], the current evidence of the effects of date consumption on diabetes is controversial. It has been demonstrated that dates can be safely consumed by patients with diabetes due to the high fructose and fiber contents of dates[7]. However, Razaghi *et al*[15] conducted a clinical trial among patients with type 1 diabetes and recommended against its use due to the non-significant increments observed in the postprandial blood glucose. The current editorial elaborates on the effects of date consumption on diabetes mellitus, obesity, dyslipidemia, and hypertension. The contamination of dates with fungi, bacteria, and hepatitis A virus is also discussed.

LITERATURE SEARCH

The PubMed, MEDLINE, Cochrane Library, and Google Scholar literature databases were searched for relevant articles assessing the effects of date consumption on blood glucose and lipid profile. The keywords used were "cholesterol", "low-density lipoproteins", "high-density lipoproteins", "triglycerides", "lipid profile", "date fruit", "*Phoenix dactylifera*", "blood glucose", "glycated hemoglobin", "HbA1c", "microbial contamination", "infections", "bacteria", "viruses", and "aflatoxin". In total, 595 articles were retrieved and 60 full-text articles were screened. Finally, 24 studies were identified that assessed the effect of dates on glycemic control and lipid profile. Nine cohorts from seven studies had involved humans (five studies assessed glycemic control, and four assessed lipid profile) (Figure 1 and Table 1). In addition, 20 studies assessed bacterial contamination. The remaining studies were used to collect and present background information in the introduction.

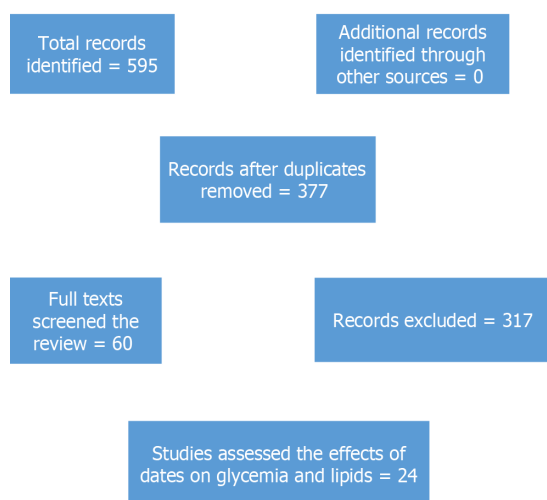
EFFECTS OF DATES ON BLOOD GLUCOSE

Animal and experimental studies

Dates contain more than 13 phenolic compounds and are strong inhibitors of alpha-glucosidase. Animal studies have shown the benefits of dates in treatment and prevention of diabetes[16-19]. A study conducted in 50 rats with streptozotocin-induced type 2 diabetes showed that *Phoenix dactylifera* extract increased insulin and decreased blood glucose [20]. Zaakouk *et al*[21] confirmed these findings in their study on male diabetic rats. It is possible that this occurred due to the positive effects of flavonoids on the islet β cells and decreased gastric emptying due to the phenols[22,23]. Similarly, two case-control studies in rats demonstrated that dates reduce blood glucose compared to placebo[24] and to acarbose [25]. The proposed mechanisms are delayed gastric emptying, decreased intestinal absorption of glucose, inhibition of α -amylase and α -glucosidase, and increased glucose entry to skeletal muscle[22,26]. An interesting theory is the presence of

Table 1 Studies conducted among adults and assessing the effects of date fruit on glycemic control and lipid profile

Ref.	Country	Type of study	Dates fruit consumption	Number of participants	Quality of study
Foshati <i>et al</i> [33], 2015	Iran	Cross-over trial	19 g of tea; 150 mL of tea once	15	Good
Alalwan <i>et al</i> [34], 2020	Bahrain	Randomized controlled trial	3 dates/d for 6 wk	100	Good
Algheshairy <i>et al</i> [35], 2018	Saudi Arabia	Randomized controlled trial	One date/d for 12 wk	75	Good
Forghani <i>et al</i> [37], 2003	Iran	Randomized controlled trial	20 mL/d for 10 wk	55	Good
Ali <i>et al</i> [36], 2018	Pakistan	Non-randomized controlled trial	A meal with 50% carbohydrates and 50% dates	16	Good
Butler <i>et al</i> [42], 2022	Bahrain	Randomized controlled trial	60 g dates/d for 4 wk	20	Good
Al-Abachi <i>et al</i> [43], 2022	Iraq	Non-randomized controlled trial	5-7 dates/d for 3 wk	20	Good

**Figure 1 Literature search to retrieve articles assessing the association of date fruit on blood glucose, lipid profile and microbial contamination.**

insulin-like substances in certain types of dates[27]. In contrast, date consumption showed no significant glycemic effects among hyperglycemic rats compared to normoglycemic rats[28].

Studies in humans

Date vinegar consumption for 7 wk has been shown to reduce glycated hemoglobin and fasting blood glucose in a study of 55 patients. The acetic acid in vinegar could delay gastric emptying, leading to decreased glucose absorption[29,30]. Additional studies have demonstrated that dates can be consumed as an alternative snack because no significant spikes in postprandial blood glucose were observed[31,32]. However, conclusions from these studies are limited due to small sample sizes. Mirghani[7] conducted a meta-analysis of five randomized trials with a high risk of bias[33-37] and showed a reduction in fasting blood glucose with no effects on postprandial blood glucose and glycated hemoglobin. The results were limited, however, by the short duration of the studies and high heterogeneity.

EFFECTS OF DATES ON LIPID PROFILE

Animal studies

Ajwa date extract or the super date has been found to reduce total cholesterol, LDLs, and triglycerides among hypercholesterolemic rats[38]. Malik *et al*[39] reported their observations of the beneficial effects of dates on total cholesterol and LDL in rabbits, and Hasan and Mohieldein[40] reported their observations of the beneficial effects of date seed on cholesterol and triglycerides. A recent study corroborated these findings in rats[41].

Studies on humans

Alalwan *et al*[34] conducted a study with 100 patients with type 2 diabetes who consumed three dates/day for 6 wk. They observed a reduction in total cholesterol with no effect on LDL, high-density lipoproteins (HDLs), and triglycerides. Butler *et al*[42] also showed no effects on the lipid profile after consuming 60 g of dates for 12 wk. When Ali *et al*[36] studied the effects of adding 20 mL of date vinegar to the diets of patients with type 2 diabetes for 10 wk, they observed a reduction in total cholesterol and LDL and an increase in HDL. Finally, when Al-Abachi *et al*[43] tested the effects of the Zahdi variant of dates, they found a reduction in total cholesterol and triglycerides.

DATE CONTAMINATION WITH VIRUSES, FUNGI, AND BACTERIA

Hepatitis A virus contaminating dates fruit

A study published from the Netherlands demonstrated that 2/185 date samples were positive for hepatitis A virus. However, the test used was not able to answer whether the strains isolated were infectious[44].

Aflatoxin levels and dates

Aflatoxin exposure is dangerous and can lead to fulminant hepatic failure and gastrointestinal hemorrhage, while chronic low-level exposure increases the incidence of hepatoma[45]. Contamination of aflatoxin above the recommended United States' maximum regulatory levels of 20 ng/g was observed in Bangladesh[46]. Indeed, many date varieties consumed in Bangladesh show a high bacterial load, excluding the Nagal and Boroi varieties, according to the Woolworths Quality Assurance Standard, 2009[47].

Fungi including various types of *Aspergillus* produce aflatoxin, and the contamination rate varies from 4%-11% in Egypt and Yemen[48,49] to 60% in Pakistan. Fungi contamination is dependent on temperature, humidity, and storage [50]. Ahmed *et al*[51] reported that *Aspergillus parasiticus* penetrates dates and produces aflatoxin at all ripening stages except for the Tamr stage. In contrast, Shenasi *et al*[52] observed aflatoxin in 10 out of 16 samples assessed. However, no *Aspergillus* nor aflatoxin were found after 14 d of storage. *Aspergillus flavus*, *Aspergillus niger*, and *Penicillium chrysogenum* were isolated from dates in Saudi Arabia, and the majority were able to produce aflatoxin[53]. Interestingly, microbial spillage in Rutab dates from Saudi Arabia was not found when dates were stored in open containers for up to 60 d. Fruits stored in different containers showed contamination from different microbes depending on the temperature[54].

Dates grown in the Middle East showed an abundance of *Penicillium*, *Aspergillus*, *Cladosporium*, and *Alternaria* contamination[55]. *Penicillium* species may induce black rot. However, the role of the above endophytes remains to be determined. Interestingly, *Penicillium aethiopicum* can produce griseofulvin, tetracycline, and tryptoqualanine[56-59]. The abundance of non-pathogenic endophytes is promising for producing antimicrobial and anti-inflammatory factors and antioxidants that play important roles in disease prevention and treatment, including in diabetes. Experimental studies showed that date extract enhances the abundance of beneficial microbiota and decreases cancer cells in a media mimicking the distal human colon[60].

CONCLUSION

Evidence from animals and humans suggest that date consumption can decrease blood glucose, total cholesterol, and triglycerides and increase HDL. The proposed mechanisms to explain these observations are delayed gastric emptying, decreased intestinal absorption of glucose, inhibition of α -amylase and α -glucosidase, and increased glucose entry to skeletal muscle. Dates also promote the abundance of beneficial gut microbiota that plays an important role in inflammation and oxygen free radicals suppression. Therefore, dates can be consumed by patients with diabetes and dyslipidemia to reduce their blood glucose, cholesterol, and triglycerides. The abundance of non-pathogenic endophytes is promising for producing antimicrobial, anti-inflammatory, and antioxidants that play important roles in disease prevention and treatment. Research focusing on the role of date consumption in diabetes prevention and its effects on gut microbiota diversity is suggested.

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FOOTNOTES

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