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# "Assessing the efficacy of Therapeutic Potential of Turmeric and Dates in Type 2 Diabetes"

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**ABSTRACT :**

Diabetes is a lifelong metabolic disorder affecting millions of people globally with limitations to sustain blood glucose levels with current methods of eating well, physical health and medications. Alternative methods of treatment like turmeric plus date syrup have been studied for their ability to control diabetes. Turmeric is an anti-inflammatory and antioxidant spice and has been used in traditional medicine treatments for thousands of years treating all sorts of ailments from A-Z including diabetes. Curcumin influences insulin sensitivity improvements, decreases inflammation, decreases oxidative stress, and has changed all functions associated with the pathogenesis of diabetes and its progression.

Dates are a "whole" food, meaning they are natural sweeteners containing sugar, fiber and antioxidants. Dates are used in traditional medicine for various treatments, including, but not limited to, diabetes, for thousands of years. Dates have a low glycaemic index and the fibrous component delays the digestion and absorption of sugar causing limited influence on blood sugars. The turmeric plus dates syrup may also confer other beneficial influences on the control of diabetes, including a greater insulin sensitivity, lessened intern inflammation, leptin levels maintaining stable blood glucose levels, plus the antioxidant effects of the dates. The collective use of turmeric plus date syrup may also have the potential for the control of diabetes by using the product as a replacement for refined sugars and instead of traditional treatment methods.Curcumin (from turmeric) has multiple beneficial effects in diabetes therapy by: improving insulin sensitivity, reducing incidence of type 2 diabetes, reducing oxidative stress, lowering blood glucose levels, improving glycaemic control, activating AMPK, inhibiting inflammatory pathways, and promoting glucose uptake into muscle cells. Curcumin has extremely low bioavailability, however, and additional research is needed to determine specific and possibly individualized dosing.

Dates are a naturally sweet food with many properties. Dates also contain notable amounts of zinc, potassium, magnesium, fibre, vitamin B3 and vitamin B6 that are recommended for individuals with diabetes, expedite metabolism, and reduce postprandial glucose excursions.

## Introduction

Diabetes is a lifelong metabolic condition that effects millions of people worldwide; traditional treatment methods, such as eating well, physical activity and medications, have some limitations in controlling blood glucose levels. Also, alternative treatment methods, such as turmeric plus date syrup have been researched for their ability to control diabetes. Turmeric is an anti-inflammatory and antioxidant spice that has been used in traditional medicine for thousands of years, to treat many illnesses including diabetes. Curcumin increases insulin sensitivity, decreases inflammation, and decreases oxidative stress; thus, demonstrating effects associated with diabetes pathogenesis and its progression.[1] Dates are a natural sweetener that consists of sugar, fiber, and antioxidants. Dates have been used in traditional medicine for centuries to treat many conditions including diabetes. It has been shown that dates have a low glycaemic index and their fibrous matter delays sugar digestion and absorption causing limited influence on blood sugars.[2] Turmeric plus dates syrup could confer other beneficial influences on diabetes control including improved insulin sensitivity, decreased inflammation, stable blood glucose levels, and antioxidant effects. Their collective use could replace refined sugars and could also serve as an alternative to traditional treatment for diabetes control.[1][2]

There are possible benefits of turmeric, namely the compound curcumin, in diabetes treatment. Curcumin enhances insulin sensitivity, thus reducing the occurrence of type 2 (non-insulin dependent) diabetes. Curcumin is an antioxidant and alleviates oxidative stress, which contributes to insulin resistance.[2] In addition, curcumin lowers blood glucose levels and enhances glycaemic control. Curcumin also activates AMPK, which is believed to be important as it can improve glucose metabolism and insulin sensitivity. Curcumin inhibits inflammatory pathways (i.e., NF-κB) that might lead to insulin resistance and diabetes. Additionally, curcumin has been demonstrated to increase glucose uptake into muscle cells which would also increase insulin sensitivity. Curcumin also evidenced animal studies to be of benefit with diabetes and human studies which show potential benefits of enhancing glycaemic control and lessening inflammation in diabetic patients. The main issue is that curcumin has very limited bioavailability. The dose is mostly unknown. Additional studies are needed to establish specific and perhaps even individualized dosing.[9]

Curcuma aromatica, a species of turmeric, has been used in Southeast Asia for many years as a traditional medicine to treat respiratory diseases. Cough-causing diseases are among these ailments.[9] Turmeric contains many bioactive compounds including alkaloids, flavonoids, curcuminoids, tannins and terpenoids. Alkaloids are known to have medicinal effects, flavonoids provide antioxidant and anti-inflammatory effects, curcuminoids provide high antioxidant and anti-inflammatory effects and is a commonly known curcuminoid. Tannins provide an anti-infective and anti-inflammatory effect while terpenoids are reported to provide antimicrobial and antifungal properties.[2] Aside from its antitussive properties, curcuma aromatica may have anti-inflammatory properties that help relieve respiratory diseases. Its antimicrobial properties help possibly treat airborne infections that may cause cough-causing diseases. Its antioxidant properties help promote repair against oxidative stress and inhibit inflammatory processes. The Soxhlet apparatus is a popular mechanism to extract curcumin from turmeric. The method involves melting a solvent and cycled through the turmeric sample so as to allow for continuous extraction of curcumin. This process consists of sample preparation, solvent selection, extraction, and recirculation. Some parameters influencing extraction efficiency are solvent type, temperature, extraction time, and sample-to-solvent ratio.[2]

Ethanol and methanol are the most used solvents for extracting curcumin. Temperature conducts solubility and extraction rat, while extraction time focuses primarily on yield capture. The sample-to-solvent ratio more relates to efficiency. Using the Soxhlet extraction method has highly efficient extraction since it is constantly cycled into one strain of vapor to one strain of liquid. The Soxhlet apparatus can be used to extract both curcumin in small quantities (i.e. Regulatory purposes) and extreme quantities (i.e. trade purposes).[20] However, it does limit the rank of effectiveness, mostly due to the amount of solvent needed and the time consumption parameters with indulgent quantities of solvent needed in a heavy-duty dilution. To summarize, the Soxhlet apparatus is a good choice for isolating curcumin from turmeric; however, the major factor it limits its effectiveness is the amount of solvent that is wasted through high consumption rates and time consumption rates.[21]

Dates are a natural sweetener that can be helpful for diabetics in moderation. Dates have a low Glycaemic Index (GI = 47-54) which means they probably won't cause a spike in your blood sugar levels. Dates also include fiber that has the ability to slow absorption of sugar, aiding in blood sugar control. A single Medjool date has about 1.6 grams of fiber, 6% of the daily recommended fiber intake, and dates are packed full of nutrients and also provide you with vitamins, minerals, and antioxidants, including potassium, magnesium, and copper. Date syrup is a natural sweetener made from dates and can be used to further eliminate refined sugars in your diet; however, like all other sugars, it should still be consumed in moderation, and no more than 1 tablespoon (20g)/ day. The glycaemic load is calculated by not only taking into each ingredient's glycaemic index (GI) but also account for your serving size which allows for it to be good alternative for diabetics [4]. Dates can also be integrated within a diabetic diet by combining them with protein or fiber-rich foods, including monitoring blood sugar levels over time, and regular reporting and taking into consideration whole dates, fresh and dried, which also provide fiber that path away to slow absorption sugar, but can also have adverse side effects and risks such as overuse, digestive issues and potential health benefits, other than diabetes. Date species differ such as Medjool Dates or Deglet Noor Dates also can affect blood sugar levels in a different substance. Medjool dates have about 16 grams of sugar per date, where Deglet Noor have approximately 12 grams of sugar. Dates also provided anti-inflammatory compounds because of their antioxidant content and could decrease the risk of chronic disease.[3]

Dates are a naturally sweet food with many attributes that make them a great option for sweetening food and drink. They are a natural source of sugars including glucose, fructose, and even sucrose, and they provide sweetness without added refined sugars. While dates typically vary in sweetness depending on variety and ripeness, they are sweet and can be used in many recipes. Dates are a source of fiber, potassium, and other nutrients that make them a nutritious sweetening option. They also have a low glycaemic index, which prevents sharp increases in blood sugar levels. It is a healthy food option that can be good for diabetic patients in moderation.[3]

Dates contain natural sugars including fructose, glucose, and sucrose that help combat fatigue and increase energy levels. Dates are a good source of zinc, potassium and magnesium (vitamins and minerals) which promote insulin production and help stabilize blood sugar levels. Dates are composed of fiber (dietary fiber), which aids proper bowel movements and can abstain constipation. Dates have a low to medium glycaemic index (GI) as a result of their high fibre content which slows the release of sugar into the bloodstream after eating. Dates are a good source of vitamin A, which may assist in the prevention of macular degeneration of sight (vision impairment) and may also lower the risk for blindness. Dates contain vitamin B3 and vitamin B6, which are suggested for patients with diabetes, enhance your metabolism. Dates are shown to decrease postprandial glucose excursions, lower blood glucose levels when consumed with insulin, and low blood glucose, total cholesterol and triglycerides. Any fruit consumed by a diabetic patient should be consumed in moderation, and you will want to consume 2-3 dates daily, while also monitoring your blood sugar levels.[4]

## History

### *Diabetes Mellitus*

Diabetes mellitus has been known since ancient times, with the first mention of the condition possibly being as far back as 1500 BCE in Ebers Papyrus. Ancient Indian physicians also identified a disease called "Madhumeha," referring to the sweet nature of the urine which attracted ants. The term "diabetes" was first used by Greek physician Aretaeus of Cappadocia in the 2nd century CE, referring to the Greek word "siphon," which referred to characteristic frequent urination.[5]

In 1675, the English physician, Thomas Willis, added the term "mellitus" to differentiate the disease based on its sweet taste. In the Middle Ages general knowledge of diabetes was rather limited, but the Persian physician Avicenna in the 11th century recorded details of it including being complicated with gangrene and sweet urine. Thomas Willis also observed that diabetes mellitus was different than diabetes insipidus, referring to tasteless urine, despite representing different underlying causes for each.[10] The 18th and 19th centuries saw important breakthroughs in diabetes research. In 1776, Matthew Dobson bravely commented that diabetic urine tasted sweet and contained "sugar". Research from Claude Bernard, a French physiologist, in the 19th century showed that the liver had a critical role in turning excess glucose into sugar as well. In 1869, Paul Langerhans discovered the Islets of Langerhans which are the cells that produce insulin. Langerhans also discovered that diabetes was induced in animals by simply removing the pancreas. After this, the link between the pancreas and diabetes was established.[11]

In 1921, scientists Frederick Banting and Charles Best conducted their successful research experiment on the isolation of insulin from the pancreas. They succeeded in finding an "insulin," which led to a viable treatment for diabetes. The first time that insulin was injected into a human being occurred in 1922 and transformed diabetes treatment from a fatal disease to a manageable chronic disease. Banting and John Macleod received the Nobel Prize in Physiology or Medicine in 1923.[11] Long-acting insulin formulations were developed in the 1930s and 1940s and have continued to help improve the control of blood glucose levels in diabetic patients.[16] In the latter half of the 20th and early 21st centuries, there have been great advances in the management of diabetes. Thanks to recombinant DNA technology, the development of human insulin was developed in the 1980s (insulin derived from protein extracted from animal pancreas). This greatly reduced the allergic reactions associated with animal insulin.[10]

Advancements in glucose monitoring have made it possible for patients to monitor their own blood glucose level at home with portable glucometers in addition to the many forms, systems and methods of insulin delivery including insulin pens, pumps, and continuous glucose monitors. Moreover, there are now artificial pancreas devices to automously provide patients with insulin based on their readings. There is certainly much to be said for islet cell transplanting it would be an amazing way to manage diabetes providing long term disease state management without the use of injecting insulin.[4]

***Turmeric***

Curcumin is a polyphenolic compound derived from turmeric that has been used for thousands of years. Curcumin has been used in Ayurvedic and traditional Chinese medicine for a variety of ailments including inflammation, wounds, and digestive issues. Curcumin was first extracted in 1815 by Vogel and Pelletier, followed by structural elucidation a few years into the 20th century. Curcumin's pharmacologic properties include anti-inflammatory effects, antioxidant effects, and potential cancer prevention and treatment. Regularly, curcumin's neuroprotective effects are now being gleaned alongside its potential role in cancer prevention and treatment. The potential benefit of curcumin comes with important questions for modern medicine.[9]

***Dates as a natural sweetener***

The history of date palm cultivation dates back thousands of years, back to ancient civilizations in Mesopotamia, Egypt, and the Indus Valley. Cultivated from the region of Iraq today, dates were an essential food source and were likely a staple at the time and they were also sufficiently common to have become a part of the broader diet of civilization. Dates were valued as a food source, for their medicinal properties, and as a form of currency in ancient Mesopotamia. Dates were cultivated, gathered, and later spread to ancient Egypt, as a food source, in medicines, and in religious rituals. Archaeological evidence shows that dates were cultivated in the Indus Valley Civilization (c. 3300–1300 BC). Dates however did not remain in only their native regions. Trade routes connected them to ancient civilizations, and they were transported to places in ancient trade routes which helped with date palm cultivation.[3]

As well as linking trade, date palms linked cultural transmission across the civilizations, both in the trade of harvested date palms to rituals or ceremonies using date palms. Today, dates are grown throughout the world, with leading production coming from Egypt, Saudi Arabia, and Iran. Today in the cultivation of dates, with scientific and modern breeding, new varieties of date palm have been produced. Different varieties have developed around other yield and performance traits (the range of consumption), incorporating consumer preferences for date fruit, better fruiting, increased tolerance of disease and other pests, improved nutritional quality.[7] Dates have a historical reputation for being used as a natural sweetener for diabetes for thousands of years for their low to medium glycaemic content with high fibre. Studies indicate the presence of antioxidants, and that dates lower inflammation and oxidative stress with respect to diabetes, and they may also help control the glycaemic profiles of people living with diabetes. An important element of a full diabetes treatment plan, dates are a culturally pertinent food in the Middle East and North Africa where they are often consumed during Ramadan and other holidays.[8]

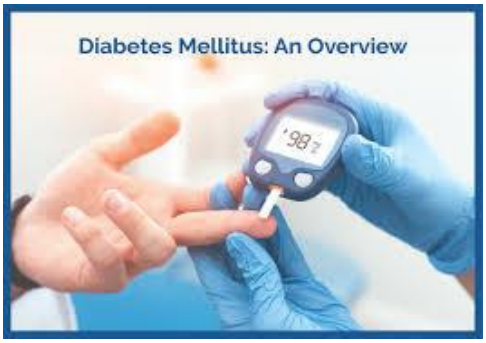
***Evaluation of combining activity of Curcumin and dates sweetness for Diabetes Mellitus***

Curcumin, a spice found in South Asian cuisine, has been used in Ayurveda and Traditional Chinese Medicine for over 4,000 years for its anti-inflammatory, antioxidant, and antiseptic properties, and has been used for balancing blood sugar and reducing chronic inflammation. This is relevant in type 2 diabetes. Meanwhile, dates have been cultivated for over 6,000 years in the Middle East and North Africa and have been found and enjoyed as a source of energy booster, a digestive aid, and tonic when fasting. Dieticians have traditionally steered diabetics away from dates because they are naturally very high in sugar, but some of the more recent research has shown that certain varieties have low to moderately low glycaemic indices and likely do not cause much blood sugar to spike when consumed in moderation.[2]

In addition, modern research studies with turmeric and dates in relation to diabetes show some promise. For example, curcumin improves insulin resistance, lowers blood glucose, lowers HbA1c, has antioxidant effects to protect the pancreatic β-cells, and reduces oxidative stress and inflammation. Dates provide natural energy, fiber, and beneficial phytochemicals, which creates a functional food combination of turmeric and dates for diabetics that is more appetizing to use and include into daily life. In consideration of dates and curcumin for having significant benefits for diabetes, it is still useful to note that there is limited direct clinical research on the therapeutic effects of curcumin and dates in combination in the treatment of diabetes. In fact, most current research study material studies curcumin or date separately from the other.[20]

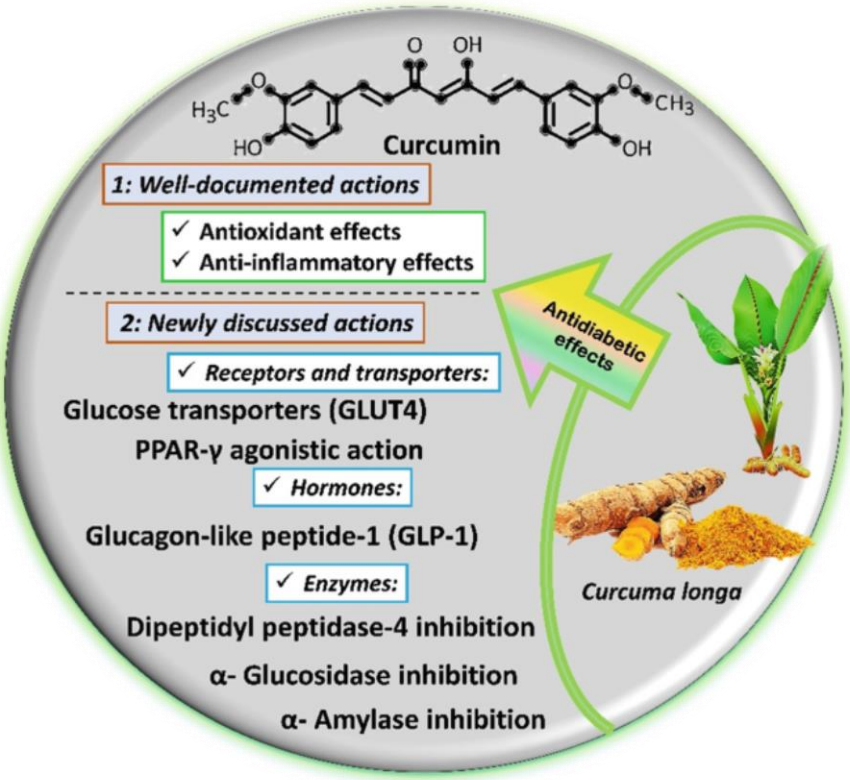
***Overview to Diabetes Mellitus***

Diabetes mellitus is a chronic disease that impairs the body's ability to use food for energy, and specifically blood sugar (glucose). The body endures the digestion of almost all food into glucose which will enter then enter the bloodstream. Insulin is a hormone released from the pancreas that helps glucose enter the cells where it can be used for energy. Diabetes is a disease that can occur because the body is not making enough insulin or using insulin well, causing blood glucose to become high.[15]




The three types of diabetes are the following: Type 1 diabetes, which destroys the insulin-producing cells in the pancreas, requiring those with this form of diabetes to have insulin injections; Type 2 diabetes which is most common among adults but is occurring at increasing rates in children and adolescents due to increasing obesity and is typically treated with lifestyle modifications, oral medications, or insulin; Gestational Diabetes which can occur during pregnancy and usually resolves after delivery, although those with gestational diabetes have a higher risk of developing type 2 diabetes later in life.[12][13] There are several causes of diabetes-- genetics, obesity, physical inactivity, and diets that are high in sugar, salt, and other fats.[15] Diabetes can also be a risk factor for cardiovascular disease, nerve damage, kidney damage, and vision loss. Higher levels of sugar in the blood can cause numbness, tingling, pain, kidney failure, and vision loss. Utilizing medications like metformin, sulfonylureas, and insulin are tools to manage diabetes, along with lifestyle changes including following a healthy diet, participating in regular exercise, and managing weight.[14] Keeping a record of blood sugar levels will help identify changes so treatment plans can be adjusted accordingly. Overall, managing diabetes is a combination of genetics, which we can't modify, and healthy changes and regular monitoring for optimal health outcome.[17]

***Action of turmeric(curcumin) on Diabetes Mellites.***




Curcumin is a bioactive substance found in turmeric that represents an exciting development in diabetes mellitus therapy. Curcumin does this by not only decreasing oxidative stress by inhibiting the production of reactive oxygen species (ROS) and improving antioxidant capacity but also through anti-inflammatory properties which assist in reducing pro-inflammatory cytokines, TNF-α, IL-1β, and IL-6, that influence insulin resistance and the disease progression. Curcumin also increases insulin sensitivity by promoting adiponectin release, reducing leptin and resisting, and improving glucose homeostasis.[21]

Benefits to diabetic (or pre-diabetic) patients as documented in a systematic review: reduced blood sugars, improved lipid profile, a decreased BMI, and a potential anti-depressant effect. Some notable studies include a pilot study completed in 2012 demonstrated that curcumin reduced oxidative stress in patients with proteinuria chronic kidney disease both diabetics and non-diabetics, a 2016 study showed that nano-curcumin supplements improved fasting blood glucose, HbA1c, BMI levels in patients with type 2 diabetes, and a 2019 study showed that curcuminoid supplementation with piperine caused increased HDL-c and reduced serum Lp(a), and non-HDL-c in type 2 diabetes patients.[20]

Curcumin has been demonstrated to help β-cell function in individuals with prediabetes and reduce risk of type 2 diabetes. Several meta-analyses show that supplementation with curcumin results in relatively small but statistically significant decreases in fasting blood glucose levels, HbA1c, and insulin resistance. The typical dose of curcumin extract is 500-2,000 mg/day, usually with piperine to improve absorption. However, curcumin has limited natural bioavailability and should be viewed as a supplemental therapy not a substitute for traditional diabetes treatment. Individual differences in effect may be due to severity of disease, dose amount, formulation and each person's unique metabolism.[3]

Curcumin, however, may still be ineffective in some applications due to its low bioavailability. For this reason, researchers are looking at other methods of delivering curcumin, such as nanoparticles, or looking at it with other compounds such as piperine. Much more research is warranted to more completely understand curcumin and its possible therapeutic applications related to diabetes management.[3]

**Chemical Structure**

- Molecular formula: C21H20O6
- Molecular weight: 368.38 g/mol
- Chemical name: (1E,6E)-1,7-bis(4-hydroxy-3-methoxyphenyl)-1,6-heptadiene-3,5-dione

**Physical Properties**

- Appearance: Yellow-orange crystalline powder
- Melting point: 183°C
- Solubility: Poorly soluble in water, soluble in organic solvents like ethanol, acetone, and DMSO

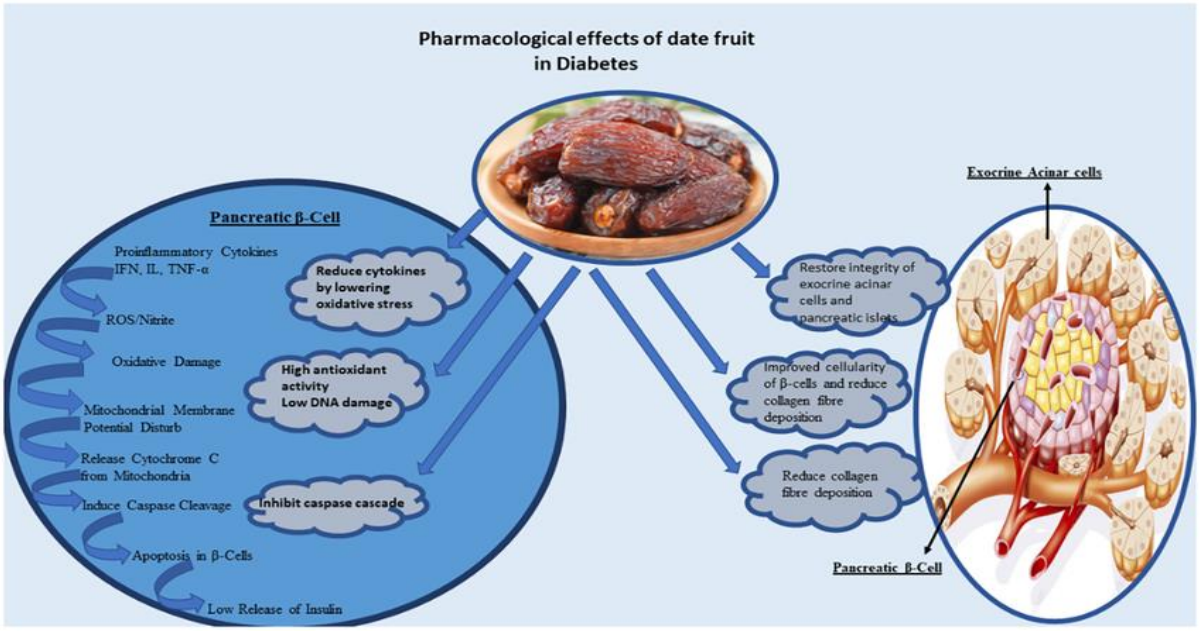
**Chemical Properties**

- pH-dependent stability: Curcumin is unstable at alkaline pH and stable at acidic pH
- Light sensitivity: Curcumin is sensitive to light, which can lead to degradation
- Metal chelation: Curcumin can chelate metal ions, which may influence its biological activity

**Biological Information:**

- Common name: Turmeric
- Botanical name: *Curcuma longa* L.
- Family: *Zingiberaceae*
- Part used: Dried rhizomes
- Primary bioactive compound: Curcumin (also known as diferuloylmethane)
- Habitat: Native to South Asia, particularly India and Southeast Asia. Now cultivated in tropical and subtropical regions worldwide.
- Description: A perennial herb with a short stem and large, oblong leaves. The rhizome is bright yellow-orange and aromatic.

***Usage of dates for diabetic patients and its action:***




Dates are a great source of natural sugars, fiber, antioxidants, and minerals. When consumed in moderation, dates may even provide health benefits for diabetes patients. In general, the sweet fruit ranges from low to moderate on the glycaemic index (GI), and is specifically high in fiber, which aids the process of carbohydrate absorption in the intestine. Fiber can help regulate blood glucose spikes. Dates include polyphenols, potentially benefitting the diabetic population by reducing inflammation and maximizing insulin sensitivity. Dates still offer a nice natural form of energy in moderation. However, overconsumption will send blood glucose through the roof! Diabetes patients should consume dates in moderation, limiting 1-3 dates as a serving and ideally pairing them up with a protein or healthy fat. As with any dietary change, be sure to monitor blood glucose levels to see how you respond to consuming dates. The sugar content in dates does vary significantly between cultivars. As such, limit consumption to whole, fresh dates and not sugar-coated or processed dates. Pair dates with nuts for balanced and slower digestion, consume dates after meals, and if need be, choose lower GI cultivars such as Ajwa or Medjool when consuming in moderation.[4]

Effect of dates in controlling blood sugar level- Dates have a low to moderate Glycaemic Index (GI) of 35-55, so they are acceptable to eat for improving blood sugar control over time. Dates are high in soluble bulking fibres that would help slow the digestion of food and absorption of glucose. The soluble bulking fibres improve insulin sensitivity and reduce the spikes seen after the absorption of glucose from meals. Dates are also high in antioxidants and polyphenols that reduce inflammation in the body, protect the inherent beta cells in the pancreas, spending up the metabolism of glucose. Dates are also helpful for insulin function stimulating insulin secretion, improving insulin receptor sensitivity, and reducing oxidative stress associated with diabetes. Important for managing type II diabetes, dates improve satisfaction and weight control helping to reduce cravings for processed forms of sugar, overeating by helping pack in the sense of fullness. Diabetics should consider limiting the number of dates per serving to 1-3 and whole dates. When consumed they should be eaten with nuts or other high-fiber food sources such as yogurt. And people should monitor their blood glucose response to date consumption.[5]

| **Aspect** | **Date Syrup** |
|---|---|
| Glycaemic Index | Moderate (better than sugar) |
| Sugar Content | High (natural sugars) |
| Nutritional Value | Contains minerals & antioxidants |
| Diabetic Use | Possible in moderation |

**Chemical composition of Dates**

Chemical Composition

The chemical composition of dates can vary depending on the variety, ripeness, and growing conditions. However, dates are generally composed of:

- Fiber: 6-8%
- Protein: 2-3%
- Fat: 0.2-0.5%
- Minerals: 2-3%

Carbohydrates

- Sugars: Dates contain natural sugars like fructose, glucose, and sucrose.
- Fiber: Dates are high in dietary fiber, including soluble and insoluble fiber.

Phenolic Compounds

- Flavonoids: Dates contain flavonoids like quercetin and luteolin.
- Phenolic acids: Dates contain phenolic acids like ferulic acid and caffeic acid.

Other Compounds

- Potassium: Dates are a rich source of potassium, an essential mineral.
- Antioxidants: Dates contain various antioxidants, including polyphenols and flavonoids.

**Physical Structure of Dates**

Dates are a type of fruit that grows on date palm trees (Phoenix dactylifera). The physical structure of dates includes:

Outer Layer (Skin): The outer layer of the date is a thin, edible skin that is often brown or yellowish in colour.

Flesh - The flesh of the date is the edible, sweet, and soft part that surrounds the seed. The texture of the date flesh can vary from soft and chewy to firm and crunchy, depending on the variety and ripeness.

Seed (Pit or stone): Dates have a single seed, also known as a pit or stone, that is inedible and runs through the centre of the fruit.

Size and Shape - Dates come in various sizes and shapes, depending on the specific variety. Dates are typically 2-7 cm (0.8-2.8 in) long and 1-2 cm (0.4-0.8 in) wide.

Colour: The colour of dates can vary from yellow to brown to black, depending on the variety and ripeness[8].

**Biological Information:**

The biological source of dates is the **date palm tree**, scientifically known as ***Phoenix dactylifera***.

- **Plant type**: Perennial, flowering plant
- **Family**: Aceraceae (palm family)
- **Fruit**: The **date** is the edible sweet fruit produced by the female date palm.
- **Native region**: Likely the Middle East and North Africa, but now cultivated widely in warm climates worldwide.
- **Growth habit**: Date palms grow tall (up to 75 ft or 23 m), with long feather-like fronds.

**Date fruit characteristics:**

- Dates grow in large clusters.
- They are rich in sugars like glucose and fructose.
- As they ripen, they go from green → yellow/red → brown, becoming softer and sweeter.
- Often eaten fresh, dried, or used in various culinary dishes.[7]

**Combining action of curcumin and dates in diabetes mellites**

Curcumin reduces oxidative stress and inflammation, which are elevated in diabetes. It enhances insulin receptor function and reduces insulin resistance. Curcumin helps in lowering blood glucose and HbA1c levels. Reduces apoptosis (cell death) of insulin-producing cells. While dates contain Fiber, which slows glucose absorption. Provide antioxidants (flavonoids, carotenoids, phenolic acids) that help combat oxidative stress. Have a low to moderate glycaemic index depending on variety and ripeness.

Together their Potential synergistic benefits are:

1. **Glycaemic control**: Curcumin helps reduce fasting blood sugar and HbA1c.Fiber in dates slows carbohydrate absorption.
2. **Antioxidant activity**: Both are rich in antioxidants, potentially reducing diabetes-related complications like neuropathy, nephropathy, and retinopathy.
3. **Anti-inflammatory effects**: Helps lower chronic inflammation seen in type 2 diabetes.
4. **Lipid profile improvement**: Curcumin may lower LDL and triglycerides. Dates (in moderation) contribute healthy nutrients and may not raise cholesterol.[7][8][9]

A few studies on animal models (e.g., diabetic rats) showed that:

- The combination helped normalize blood glucose levels.
- There was restoration of pancreatic tissue integrity.
- Improved antioxidant enzyme levels.

**Preparation method of syrup –**

Majorly formulated in 3 processes:

1) Extraction of curcumin by Soxhlet.
2) Preparation of Dates syrup.
3) Combining the formulation.

**Extraction of curcumin by Soxhlet method-**

Materials Required: Turmeric powder (Curcuma longa), Soxhlet apparatus Round bottom flask, Heating mantle or water bath, Condenser, Filter paper or thimble, Organic solvent (commonly used: ethanol, methanol, or acetone), Weighing balance Beaker, funnel, and glassware.

- •Sample Preparation: Dry turmeric rhizomes, grind them into a powder and weight 20-30g.
- Set Up Soxhlet Apparatus: Add turmeric powder in a filter paper or cellulose thimble and place it in the Soxhlet extractor chamber. Place organic solvent in a flask, connect the extractor and worm golf, and connect the condenser.
- Start extraction: Place the flask on a heating mantle or in a water bath, boil and vaporize the solvent.
- Condensed solvent drops onto turmeric powder, pump back into the flask, thus curcumin is extracted.
- Solvent Recovery: After extraction cool the apparatus; then remove solvent and evaporate the solvent, and a crude curcumin extract remains.[2]

**Preparation of dates syrup –**

Ingredients:500g to 1kg dates (Medjool, Deglet Noor, or any soft, sweet variety), Water (as needed), A dash of lemon juice or salt for preservation (Optional)

Equipment: Large bowl, Saucepan or pot, Fine mesh strainer, Wooden stirrer, clean bottle or jar for storage.

Steps to prepare dates syrup:

- Clean Dates: Remove pits and clean under running water.
- Soak Dates: Soak dates in warm water for one to two hours, or simmer for about 10-15 minutes.
- Simmer Dates: Cook dates until they first start to boil, then reduce heat to simmer for 30-45 minutes.
- Mash and Strain: Smash dates in a pot, then strain into a bowl to collect date juice.
- Reduce to syrup: Lower the heat until date mixture begins bubbling. Simmer the mixture gently for a few minutes while reducing until you have a syrupy consistency. You can optionally add a bit of salt or lemon juice to help balance the natural sweetness.
- Cool and store: Pour syrup into sterilized glass jar or bottle and keep in the refrigerator for up to 1-2 months.[3]

## Combining the formulation-

Final formulation is prepared by combining the extracted curcumin and the prepared dates syrup using the specified formula in the sufficient quantity for the effective results.

Formulation of syrup is consisted as follows.

**Formula of Syrup-**

| Sr. No | Content | Quantity | Activity |
|---|---|---|---|
| 1 | Curcumin Extract | 15 ml | API |
| 2. | Dates Syrup | 20 ml | Sweetener |
| 3. | Ethanol | 10 ml | Preservative |
| 4. | Raspberry syrup | 7 ml | Flavouring Agent |
| 5. | Rose oil | 2 drops | Odour Masking Agent |
| 6. | Glycerine | Q. S | Viscosity Enhancer |
| 7. | Amaranth Red / Sunset Yellow | | Colouring Agent |

**Dosage** - The 1 teaspoon of syrup provides a moderate number of natural sugars, along with fiber, potassium, and other essential nutrients.

***Evaluation of Syrup-***

Evaluating a turmeric and date syrup formulation requires a set of standard quality control parameters to ensure it is safe, effective, and consistent. The evaluation process involves assessing several physical, chemical, and microbiological properties of the syrup.

1**. Organoleptic Evaluation (Sensory Testing)**

This ensures the syrup has the desired appearance, texture, flavour, and aroma.

- Colour: As per the colouring agent added.
- Consistency: Smooth, viscous texture
- Taste: sweet and moderately astringent
- Smell: Rose oil aroma

**2. pH Level**- Used alcohol for pH modification ranging from 4.5 to 6.5, ideal for herbal syrup stability

**3. Viscosity**-The viscosity indicates the thickness of the syrup. This is an important factor for both texture and mouthfeel.

- Ideal Viscosity: The syrup should have medium viscosity—not too runny but not too thick. Ranging from 500 to 3500 cp

**5. Microbial Testing**-To ensure the syrup is safe for consumption, microbial contamination is tested.

Test Method: Samples of the syrup is plated on selective agar media and incubated for microbial growth. The results are measured in colony-forming units (CFU).

**6. Shelf-Life Testing -** This involves testing the syrup over a period of time to ensure its stability and quality are maintained.

- Stability Tests: Evaluate the syrup for changes in color, taste, texture, and microbial contamination over time. This can be done by storing the syrup at different temperatures (room temperature, refrigerated, and high temperatures) and monitoring the changes.
- Storage Conditions: The syrup should be stored in airtight, sterile containers and evaluated regularly for any changes in quality. Typically, a syrup should have a shelf life of 3-6 months if stored properly.

**Safety Measures and Precautions**

1. Allergy Check- Ensure you or the intended consumer aren't allergic to turmeric, dates, or any added ingredients like honey or ginger.

2. Moderation- Don't overconsume; 1–2 tablespoons per day is usually enough. Overuse may cause stomach upset or interact with medications.

3. Medical Conditions & Interactions-Turmeric may thin the blood, so avoid before surgery or if you're on blood thinners.

4. Children & Pregnant Women- Safe in small amounts, but it's best to consult a healthcare provider before giving it regularly to children or during pregnancy.[18]

**Future Prospects**

The future prospects of a dates and turmeric syrup look promising, especially given current trends in wellness, natural remedies, and functional foods.

**Health & Wellness Trends**

1. Rising Demand for Natural Remedies-Consumers are moving away from synthetic supplements toward natural, plant-based products like turmeric and dates, known for anti-inflammatory and energy-boosting properties.

2. Functional Food Market Growth-Syrups with health benefits (e.g., immunity boosting, anti-inflammatory, antioxidant-rich) fit into the functional foods category, which is expected to grow globally.

3. Ayurvedic & Herbal Boom-The popularity of Ayurveda and traditional medicine is bringing attention to ingredients like turmeric and dates, which are considered "superfoods" in many cultures.

**Business & Commercial Potential**

1. Product Development Opportunities

- Infused variants: Add ginger, cinnamon, or honey.
- Dietary-specific options: Sugar-free or diabetic-friendly versions.
- Packaging innovations: On-the-go sachets or kid-friendly doses.

2. Export Potential-Health-conscious markets in Europe, North America, and Asia are actively seeking holistic wellness products rooted in tradition.

3. Collaboration with Nutraceuticals & Wellness Brands-Can be positioned as a supplement or functional tonic, opening doors to pharmacies, health food stores, and online wellness platforms.[18]

**Limitations of syrup-**

Here are some of a dates and turmeric syrup to keep in mind:

**1. Short Shelf Life-**Herbal based versions may spoil quickly. Needs refrigeration and proper hygiene to avoid contamination.

**2. Potential Allergic Reactions-** Rare, but turmeric can cause reactions in sensitive individuals.

**3. Limited Scientific Backing-** While turmeric and dates have known health benefits, the synergistic effect of this specific syrup hasn't been extensively studied or proven in clinical trials.

**4. Medical Interactions-**Turmeric can interact with medications, especially: Blood thinners (e.g., warfarin) and antacids.

**5. Not a Replacement for Medical Treatment-**Should be seen as a supplement, not a cure. Overreliance without proper medical advice could delay necessary treatments.[19]

## Conclusion

Diabetes is a chronic metabolic condition that impacts millions of people globally, and that conventional treatment, such as good nutrition, exercise, and medications, has variable efficacy controlling blood glucose.[5] Alternative methods of treatment, i.e., turmeric plus date syrup products, have been researched for its advantages in controlling diabetes. Turmeric is an anti-inflammatory and antioxidant spice has been utilized in traditional medicine for thousands of years for various diseases, including diabetes. Turmeric increases insulin sensitivity reduces inflammation and oxidative stress, all effects associated with the pathogenesis and progression of diabetes.[2] Dates are an innate sweetener that composed of sugars, fiber and antioxidants, and has been ingrained in the traditional medicine for centuries; Once again, including diabetes. Dates are a low glycaemic index food, and its fibrous matter delays sugar digestion and absorption enabling minimal effect on blood sugars.[7]

The turmeric plus dates syrup may hold additional beneficial effects on controlling diabetes, like improved insulin sensitivity, reduced inflammation, stable blood glucose levels, and antioxidant effects. Their combined used could replace refined sugars, as well as provide an alternative treatment for

diabetes management. Curcumin has potential uses in the treatment of diabetes, including increasing insulin sensitivity, reducing the incidence of type 2 (non-insulin dependent) diabetes, reduction of oxidative stress, lowering blood glucose levels, improving glycaemic control, activating AMPK, decreasing inflammation through inhibition of inflammatory pathways, enhancing glucose uptake into muscle cells, and improving glycaemic control and inflammation in patients with diabetes.[7][8][9]

However, because curcumin has very low bioavailability, more research will be needed to determine the dose of curcumin that is specific and individualized. Dates are a naturally sweetened food with several properties that make them a great choice for sweetening foods and drinks. They are high in natural sugars, are a good source of fiber, are rich in antioxidants and in minerals, and can provide health benefits for diabetes patients who consume them according to moderation. Dates have a GI of 35 - 55 (low to moderate), which is appropriate for improving blood glucose control overtime.[4][9]

The manufacturing procedure of turmeric and date syrup includes three methods: the Soxhlet method of curcumin extraction, the preparation of the date syrup, and the combination of the formulation.[2] When evaluating a dates and turmeric syrup formulation you will need to evaluate a number of its physical, chemical, and microbiological properties. Those properties include an organoleptic evaluation, assessment of pH, viscosity, microbes and shelf life. Safety measures and precautions include allergy checks, moderation, medical conditions and interactions, and safety for children and pregnant women.[20] The future outlook for dates and turmeric syrup will continue to grow, particularly when we look at today's trends in wellness, natural remedies, and functional foods. There are limitations, including a short shelf-life, allergy factors, limited scientific evidence, medical interactions, and an understanding that this product is a supplement to, not a replacement for, medical treatment.[21] Voice their expectations and consult a healthcare provider before using these products for children or pregnant women.[21]

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