

Evaluation on the Benefits of Date Palm (*Phoenix dactylifera*) to the Brain

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Abstract

Date palm, *Phoenix dactylifera* has been known for a lot of beneficial properties such as antioxidant, antihyperlipidemic and hepatoprotective activity but there is a lack of research which explores the benefits of the date palm to the brain. Thus, its physical and psychological benefits to the brain are evaluated. For the physical benefits evaluation, cerebral ischemia is induced in the brain of rats through middle cerebral artery occlusion (MCAO) or bilateral common carotid arteries (BCCAO) restriction and later followed by reperfusion to expose them to reactive oxygen species activity. After that, they were treated with date fruit or date seed extract and then neuronal damage is observed. Meanwhile for the psychological benefits evaluation, rats is supplied with a date fruit extract diet before exposed to motor-coordination test, locomotor activity, hot plate test and haloperidol-induced catalepsy. It is found that neuronal damage in the form of shrinkage, atrophy and necrosis of neurons is greatly reduced and there is an increase in the levels of endogenous antioxidants in the brain of rats treated with date palm fruit extract. In contrast, rats supplied with date fruit extract diet shows no difference with the control group. In conclusion, constituents of *P. dactylifera* particularly its antioxidant properties and fatty acids benefit the brain physically through its neuroprotective effect which protects the brain from actions of reactive oxygen species but its benefit to the brain psychologically is still unclear and could not be proven.

Keywords: Antioxidant properties; Brain benefits; Dates; *Phoenix dactylifera*

Introduction

Phoenix dactylifera, or also known as date palm is a monocotyledon plant within the palm tree family and they can be found mostly in the North Africa and Middle East region [1]. They are among a few plants that could survive the harsh arid environment and thus is highly regarded for the nutritional value that the palm tree fruit provides. As stated by Baliga et al. [1], in these arid regions where foods are scarce, date palm serves as a good food source as they are rich in carbohydrates and they have even become a part of Arabian diet. Aside from a common food source, date palm fruits have been used traditionally to treat various types of ailments and it has been regarded that consumption of the fruit is good for health [2].

Phytochemical compositions of the date palm

Numerous studies have been conducted to study the benefits of the date palm, either from its fruit or seed, and it has been found that the date palm possesses several highly beneficial properties such as antiviral, antifungal, antioxidant, antihyperlipidemic activity and hepatoprotective activity [3]. These are attributed to the rich contents of antioxidant in date fruit such as the coumaric acid and ferulic acid. Moreover, it contains flavonoids, sterols, procyanidins, carotenoids, anthocyanins, sugar (glucose, sucrose and fructose) with low GI, dietary fibers, less protein and fats, vitamins such as riboflavin, biotin, thiamine, ascorbic and folic acid, and minerals for example calcium, iron, copper, cobalt magnesium, fluorine, manganese, phosphorus, potassium, sodium, boron, sulfur, zinc and selenium within the date palm itself [1,4,5].

In the date seed, it majorly consists of fatty acids including capric, lauric, myristic, myristoleic, palmitic, stearic, oleic, linoleic, linolenic, arachidic [6]. Constituents of the date fruit and date seed may contribute to synergistic effects in the aforementioned bioactivities. While these studies have been successful to investigate the benefits of the date palm generally, only a few of them explore the benefits of the date palm on the brain. In the next few paragraphs, the benefits of the date palm physically and psychologically to the brain will be explored.

Physical benefits of the date palm

Phoenix dactylifera, or the date palm provides a physical benefit that is crucial to the brain, called the neuroprotective or cerebroprotective effect. In general, this neuroprotective effect protects the brain from the destructive activity of the reactive oxygen species (ROS) that could come from the cell metabolism itself or from exogenous sources [7]. This neuroprotective effect is basically an extension from the previously known antioxidant effect of palm date as it operates based on similar concept. Date palm is an excellent antioxidant agent and this is due to the high concentrations of phenolic compounds, flavonoids and anthocyanins as well as the presence of selenoproteins [1]. This basic antioxidant effect is studied in the brain of the rats in order to evaluate its benefit to the brain.

From the previous studies, two different parts of the date palm can be used to exhibit this neuroprotective effect which is the fruit extract [8] and the seed extract [9]. Fruit extract was obtained by drying the fruits at room temperature. Stainless-steel blender was used to grind the fruits before extraction at room temperature with methanol-water (4:1, v/v) began. After filtration and 10 min centrifugation at 4000 g, extract of fruit was obtained by using rotary evaporator to concentrate the supernatant at 40°C for 3 hours under reduced pressure. For seed extract, the seeds were soaked in distilled water and washed before drying at room temperature. After grinding with heavy-duty grinder, distilled water was used to extract the powder (1:3 ratio, w/v) before 20 min centrifugation at 4000 g at 4°C was carried out [8,9].

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In order to expose the brain of rats to the ROS activity, cerebral ischemia is induced by restricting the blood flow to the brain through restriction of bilateral common carotid arteries (BCCAO) or through middle cerebral artery occlusion (MCAO). Ischemia is a term where there is an inadequate oxygen supply cause by the blockage of these arteries. After the treatment of either BCCAO or MCAO, it is followed by reperfusion. When the blood supply is restored by reperfusion, this will damage the cell as ROS will react with cellular macromolecules and this could lead to neuronal death [8].

Unfortunately, in the studies mentioned above, the chemical composition of both fruit and seed extract was not examined [8,9]. This makes it difficult to relate the phytochemical composition of date extracts with their effects on the neuroprotective action in the brain as phytochemical composition varies with different date cultivar, location and stage of fruit picking [1]. Sun-dried dates also lose some of their antioxidant and carotenoid constituents compared to fresh dates [10]. However, a review done by Al-Farsi and Lee [3] based over almost 80 references summarized that date fruit serves as a good antioxidants, mainly high in carotenoid and phenolic contents which could reach up to 661 mg/100 g of phenolics and 146 µg/100 g of β-carotenoids [4]. Meanwhile, date seed contains essential fatty acids [6]. Both phytochemical compositions may contribute to the abovementioned effects.

In the studies conducted previously, when the rats are treated with either date fruit or date seed extract, it is found that neuronal damage in the form of shrinkage, atrophy and necrosis of neurons is greatly reduced. How the date palm extract works is that they decreased the peroxidation of lipid in brain and restored altered antioxidant enzymes caused by ROS [9]. A study done by Kalantaripour et al. [9] shows that MCAO induced 89.37% neuronal death in rats while group treated with the date seed extract (80 mg/kg) manage to decrease the neuronal damage by 30.33%.

Another important discovery made by Pujari et al. [8] is that rats treated with date fruit extract has increased levels of endogenous antioxidants in brain and this contributes to the neuroprotective effect of the date palm as it helps to counter the oxidative stress. These antioxidants, namely glutathione (GSH) and glutathione reductase (GR) remove lipid peroxides and hydrogen peroxide (H₂O₂) and thus help to protect the brain from oxidative damage. In order to combat ROS triggered by brain ischemia, antioxidants levels such as GSH and GR among others in the brain will decrease to remove the formation of lipid peroxides and H₂O₂. Rats treated with high concentration of date fruit extracts (100 and 300 mg/kg) however shows an increase in the levels of GSH and GR compared to the rats treated with none or lower extract doses [8]. In addition, observation with rotary microtome under 40X magnification reveals that rats administered with 100 and 300 mg/kg date fruit extract experience lesser neuronal loss, in terms of the neuron shrinkage and atrophy. Another study has proven the benefits of date palm to the brain as date fruit extract has prevented the formation of abnormal myelinated fiber to a high extent in rats [11].

Although both date fruit and date seed extract can be used to exhibit this neuroprotective effect, it is unclear which one is better since these studies are conducted using different parameters and they operate based on different results. Another important thing to note here is that although all the studies mentioned above came out with different results based on different sets of methods, all of them demonstrate the neuroprotective effect of *P. dactylifera*. The importance of these studies is that it indicates that *P. dactylifera* could serve as a potential therapeutic agent for treating brain ischemia and other neurodegenerative diseases.

Unfortunately the physical benefits of the date palm can only be seen through neuroprotective effect at the present as the research on the brain is limited.

Psychological benefits of the date palm

Previously, there are no studies conducted to explore the psychological benefits of date palm. The psychological benefit of the date palm has just been studied recently, pioneered by Vyawahare et al. [12]. Their main focus is to investigate whether is there any psychological effects of the date palm fruit towards the brain and its potential use for the treatment of the central nervous system disorder. Several tests with mice have been conducted to monitor the psychological effect such as motor-coordination test, locomotors activity, hot plate test and haloperidol-induced catalepsy among others [12]. Differences in psychological behaviour in the control group mice with mice group given with the date fruit extract are observed.

Unfortunately, most of the tests show no differences between the control group mice and mice given with the date fruit extract. All of the mice exert same behaviour and even if there is a difference in one or two tests, the differences are not very clear which makes the result to be insignificant. As they are the first group to study on the psychological effects of the date palm, there are no other sources that we can refer to in order to support any of the observations. Furthermore, as the mechanism behind the psychological action of *P. dactylifera* is not known currently, this makes it difficult to come out with a strong positive conclusion that supports the hypothesis. In addition, in experiments where animal psychology is involved, there are various other factors to be taken into consideration. More studies need to be done with regards to this field especially studies that cover the mechanism underlying psychological effects imposed by *P. dactylifera*.

Conclusion

The date palm, *P. dactylifera* including its fruit and seed are rich with antioxidant properties and other nutrients. It exhibits various useful properties to the humankind in the form of antioxidant, antifungal, antihyperlipidemic activity and hepatoprotective activity. It is also proven that the date palm benefits the brain through neuroprotective property, protecting the brain from the actions of ROS by utilizing its antioxidant property. This protects the brain cells physically. For the psychological benefits of *P. dactylifera* to the brain, it is currently unknown and could not be proven at the moment as there is a lack of research on that area. Yet, area for the research is required to be explored intensively and perhaps, it will reveal intriguing findings.

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