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Ficus deltoidea: Review on Background and Recent Pharmacological Potential

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ABSTRACT

Ficus deltoidea is a native plant of Malaysia which is very potential plant for varied purposes. It has diversed morphology and was spread throughout Malaysia and adjacent countries. Its great potential had been valued by the old folks and now it is getting famous as more attention given in exploring herbs as an alternative for medicine. *Ficus deltoidea* is an ultimate source of antioxidant and natural products. It is commercialized as tea and is proposed as a possible supplement for type II diabetes patients. *Ficus deltoidea* studied for its numerous pharmacological properties such as antioxidant and antidiabetic properties, anti-inflammation and antinociceptive activity, wound healing activity, antiulcerogenic effect, antibacterial, anticancer and also it's potential as an uterotonic agent. This article review provide more thorough information about *F. deltoidea* plants in detail in term of plant, origin, morphology, ecology, variety, commercial usage and its pharmacological benefits.

Key words: *Ficus deltoidea*, growth, medicinal value, commercial value

INTRODUCTION

Ficus deltoidea got its name from the golden spot present on its leaves. It is also known as Mas cotek, telinga beruk and ser apatangin in peninsular Malaysia, sempit-sempit and agoluran in Sabah, Sarawak and Kalimantan Island and tabat barito in Indonesia (Desaku, 2005) and kangkalibang in Africa (Bunawan *et al*., 2014). *Ficus deltoidea* is a very potential plant for varied purposes. It famous for its health benefits and medicinal value, that can be used by both male and female (Sulaiman *et al*., 2008). *Ficus deltoidea* fruits are traditionally chewed to relieve toothache, cold and headache and the entire *Ficus deltoidea* plant is also traditionally used as an aphrodisiac tonic and as health tonic by women in Indonesia. Malays in the peninsular Malaysia have been using the powdered root and leaves of *F. deltoidea* to treat wounds, rheumatism, sores and other ailments for centuries. The decoction of boiled leaves of *F. deltoidea* is traditionally used as an antidiabetic treatment and an after-birth tonic to contract the uterus and vaginal muscles to treat disorders of the menstrual cycle and also to treat leucorrhoea (Burkill and Haniff, 1930).

The leaves of *F. deltoidea* have been report to exhibit blood glucose-lowering effects (Farsi *et al*., 2011), antinociceptive (Sulaiman *et al*., 2008), ulcer healing (Zahra *et al*., 2009), antioxidant (Abdullah *et al*., 2009), anti-inflammatory (Zakaria *et al*., 2012) and antimelanogenic (Oh *et al*., 2011) properties. Recent animal studies had shown that the leaves of *F. deltoidea* possess the antioxidant activity (Hakiman and Maziah, 2009), anti-hyperglycemic (Adam *et al*., 2011), antinociceptive (Sulaiman *et al*., 2008) and also able to promote wound healing (Abdulla *et al*., 2010). All of this ability believed to relate with *F. deltoidea* leaves nutritional value content. The aim of this review is to provide a details report on pharmaceutical value of *Ficus deltoidea* plant.

ORIGIN

Lansky and Paavilainen (2010) state that *Ficus deltoidea* is a native plant of peninsular Malaysia and were distributed elsewhere. Now, it also can be founded in Thailand and Indonesia. The genus *Ficus* consists of about 750 species worldwide including trees, epiphytes and shrubs in tropical and subtropical regions worldwide (Starr *et al*., 2003). The scientific classification of *F. deltoidea* is as follows (Mat *et al*., 2012; Awang *et al*., 2013):

Kingdom	:	Plantae
Division	:	Magnoliophyta
Class	:	Magnoliopsida
Order	:	Rosales
Family	:	Moraceae
Genus	:	*Ficus*
Species	:	*Deltoidea*
Binomial name	:	*Ficus deltoidea Jack*

ECOLOGY

Ficus deltoidea plant widely spread around Malaysia, form sandy and bushy area to mountain tops and in bogs (Starr *et al*., 2003). Most variety grows below 1200 m latitude, though some of it is not. *Ficus deltoidea* var. *intermedia* can be found in the higher mountain areas above the dipterocarp forest. *Ficus deltoidea* var. *angustifolia* grows near by the streams or riversides. In Borneo, the var. *motleyana* is found in the coastal, peat-swamp and sandy heath forests (Corner, 1969).

Ficus deltoidea var. *deltoidea* and var. *kunstleri* are primarily epiphytes, growing on other plants without deriving nutrients from the host plant. *Ficus deltoidea* var. *trengganuensis* is primarily terrestrial similar to var. *motleyana* which grows on the ground. The var. *motleyana* may grow up as a spindly tree reaching 6 m high while var. *angustifolia* is the undergrowth shrub (Corner, 1969).

MORPHOLOGY

Leaf morphology of *F. deltoidea* diversed in nature and make some confusion for direct determination just by look at their morphology. Kochummen and Rusea (2000) reported that the leaf shapes of *Ficus deltoidea* are of varied shape as deltoid, elliptic, obovate, spathulate or rhomboid. Other variations in the leaf morphology also involved dimension, shape, venation, presence and distribution of waxy glands and length of petiole. Leaf's lamina are oblong, elliptic, obtriangular, oblanceolate, spathulate, linear and suborbicular (Berg and Corner, 2005).

Two popular variants are *Ficus deltoidea* var. *angustifolia* (known as male plant) and *Ficus deltoidea* var. *deltoidea* (female plant). They are of different variant but often discriminate as a same variant by the traditional farmers. Arifin (2005) define *Ficus deltoidea* var. *angustifolia* as having small leaves with parallel vein while *Ficus deltoidea* var. *deltoidea* as having big leaves with ramified vein. The difference between male and female plant is that the male plant is having black dots on its leaves while red dots can only be seen on female leaves (Hakiman and Maziah, 2009). Mohammad *et al.* (2012) reported that there is leaf heterophyll in *F. deltoidea* variety that was measured based on leaf shape and leaf apex.

All members of the genus *Ficus* share the distinctive inflorescence (syconium), where pollination occurs through mutualism interaction with fig wasps of the subfamily Agaonidae (Cook and Rasplus, 2003). Syconium or fruit of Mas cotek range 7 mm in diameter, up to 0.2 cm thick and can be yellow, orange or red when ripening (Berg and Corner, 2005), placed along the twigs on short stalks. Syconia usually come in pairs or solitary, axillary, oblong, globose or ellipsoid, 0.3-2×0.2-1.2 cm and strongly umbonate at apex. It has 3-4 tepals red in color, glabrous, also ovate to lanceolate in shape (Kochummen and Rusea, 2000). The fruits are tiny, convoluted, with numerous seeds and flowers inside the fruits. It is term as fig. Fig has thin and delicate skin, allowing the wasps to burrow, mate and leaving the eggs there for hatching (Lansky and Paavilainen, 2010).

VARIETY

There were 15 recognizes varieties of *Ficus deltoidea*, eight of it from originate from Sabah and Sarawak (Kochummen and Rusea, 2000). Bunawan *et al*. (2014) added the one more variety make it into 16 which are var. *arenaria Corner*, var. *borneensis Corner*, with *subhirsuta Corner*, var. *lutescens* (Desf) *Corner*, with *forma longipedunculata Corner* and *forma subsesssilis* (Miq.) *Corner*, var. *peltata Corner* var. *recurvata Kochummen* and var. *oligoneura* (Miq.) *Corner*.

Those seven varieties of *Ficus deltoidea* originated form peninsular Malaysia are var. *deltoidea*, var. *angustifolia*, var. *trengganuensis*, var. *bilobata*, var. *intermedia*, var. *kunstleri* and var. *motleyana* (Turner, 1995). Nur Fatihah *et al*. (2014) further classified these seven varieties morphologically and it nested into two clades, clade subspecies *deltoidea* (var. *deltoidea*, var. *bilobata*, var. *angustifolia*, var. *kunstleri* and var. *trengganuensis*) and clade subspecies *motleyana* (var. *intermedia* and var. *motleyana*). Some morphological differences among the varieties of *F. deltoidea* are given in Fig. 1 and 2.

Fig. 1(a-g): Photograph showing the morphological differences among the varieties of *F. deltoidea*
(a) *Ficus deltoidea* var. *angustifolia*, (b) *Ficus deltoidea* var. *bilobata*, (c) *Ficus deltoidea* var. *trengganuensis*, (d) *Ficus deltoidea* var. *deltoidea*, (e) *Ficus deltoidea* var. *kunstleri*, (f) *Ficus deltoidea* var. *intermedia* and (g) *Ficus deltoidea* var. *motleyana*

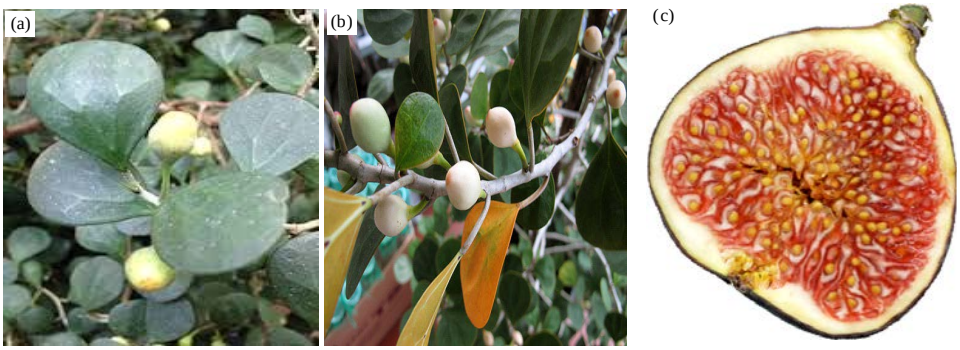

Fig. 2(a-c): Photograph showing syconium characteristics of different *F. deltoidea* varieties
(a) Syconium of *Ficus deltoidea* var. *deltoidea*, (b) Syconium of *Ficus deltoidea* var. *intermedia* and (c) Cross section of syconium of *Ficus* species

POLLINATION

Ficus deltoidea flowers are completely obscured within the fig with hundreds of petite florets lining the inside of a central cavity. Fig trees in general are depend solely on tiny wasps, only a couple of millimeters long for their propagation and survival (Simon, 2004). Each species of fig tree is usually pollinated by one fig wasp species that is only associated with that fig species, although increasing number of concessions have been reported (Lopez-Vaamonde *et al*., 2002). Formerly, no specific wasps has been claimed to be specific to *Ficus deltoidea* plant, which is actually crucial for better understandings of this plants and its reproduction in natural habitat.

Figs are produced throughout the year and are cross pollinated by the female wasp. When the syconium receptive to wasp allowing it to penetrate through ostiole, tiny bract-lined opening at the apex of the fig. Female wasps will lay eggs in the ovule of the florets, also pollinate the stigma. Larvae will feed on endosperm of fruits ovary, once maturing will also chewing up of fruits to find their ways out. Once the female fig wasps have left the fig, it will ripens and exhibit other ripening characteristics to attract the animals. Male wasp only involves in mating and chewing of figs to allow female escape and they will die soon after that (Lansky and Paavilainen, 2010).

PROPAGATION

Mas cotek in natural habitat commonly associated with *Rhodomyrtus tomentosa* (kemunting) which might be caused by the same dispenser such as bird that eat the fruit and dispense the seeds at the same area. *Ficus deltoidea* have low germination rate of its seeds. This makes the vegetative propagation a better choice in its commercialization (Jamilah *et al*., 2005). Generally, all *Ficus* species propagate from seed, also cutting or trees can begin life as epiphytes on other trees (Ronsted *et al*., 2008).

It is suggested that the application of the rooting hormone during the propagation of *Ficus* stem cutting as it might enhance root production (Balakrishna and BhattacHarjee, 1991). Hassanein (2013) demonstrated that Indole Acetic Acid (IAA) was more effective than treatment by either Indole Butyric Acid (IBA) or Naphthyl Acetic Acid (NAA) on rooting of *Ficus hawaii* as woody tree and *Chrysanthemum morifolium*. Chitosan also significantly shown to improve rooting rate of *Ficus triangularis*, *Ficus microcarpa* and *Ficus benjamina* compared to Naphthalic Acetic Acid (NAA) (Gamlath *et al*., 2010).

COMMERCIAL USAGE

Tea: Mohammad *et al.* (2012) states that the leaves of *F. deltoidea* var *deltoidea* have high amount of magnesium, manganese and potassium in addition to other minerals such as potassium, sodium, iron and zinc. They suggest that the tea made of this leaves can be served as a good source of mineral for human consumption. Therefore, tea beverages of *F. deltoidea* leaves may act as a suitable source of elements intake for human body. Regular consumption of this type of tea will contribute to adequate amount of manganese and magnesium which have functional role in physiological process in human body. The recommended consumption is 2-3 cups of this tea (each cup 50 mL) as it contained very high magnesium and manganese value compared to our recommended daily dietary intake. This is parallel to the consumption of *Ficus racemosa* bark as nutra tea due to its mineral content (Ahmed *et al*., 2010).

Smilkstein *et al*. (1988) reported that excessive consumption of Mas cotek tea, daily more than one litre may lead to hypermagnesemia and manganese toxicity. The symptoms of hypermagnesemia are hypotension, nausea, vomiting, central nervous depression, respiratory depression also severe cardiac arrest. Manganese toxicity may lead to neurogenerative disorder characterized by both central nervous system abnormalities and neuropsychiatric disturbances (Santamaria, 2008). This is opposed to studies by Farsi *et al*. (2013) that demonstrated that mammalian toxicity of *F. deltoidea* extract is low and that its use in traditional medicine presents no genotoxic risks to human.

Woon *et al*. (2014) reported that water extract for *F. deltoidea* var. *angustifolia* and var. *deltoidea* had higher cytotoxicity to 3T3-L1 preadipocytes than methanol extract of this plant. This shown by maximum non-toxic level of var. *deltoidea* in methanol extract was 300.0±28.3 μg mL^{-1} and in aqueous extract was 225.0±21.2 μg mL^{-1}. In var. *angustifolia*, maximum non-toxic dose was report as 60.0±2.0 μg mL^{-1} in methanol extract while in aqueous extract was 8.0±1.0 μg mL^{-1}. Higher cytotoxicity in aqueous extract may be caused by the presence of high amounts of phenolic compounds, such as flavonoids. Thus, consuming this tea will need a proper control and right dose not to exceed the maximum non-toxic dose for human consumption to obtain optimum benefit.

Food: Draman *et al*. (2012) proposed *F. deltoidea* as a possible supplement for type II diabetes patient. Although the study did not give significant result, there were still some advantages of this plant over other herbs medicinal plants. This plant consumption in human with diabetes were able to reducing diabetes complications such as reducing edema and lethargic, increase HDL level and decrease LDL blood level. This study also observed improved sexual life of the patients. Fortunately, the patients did not show any negative impacts form the plant consumption. Author did suggest that *F. deltoidea* is better plant instead of cinnamon in term of its medicinal value as a supplement for diabetic patient. Now-a-days, customers could consume them in capsule form (Misbah *et al*., 2013).

In China, figs commercialized as wine when mix with either grape, rice, or powder of dried ganoderma lucidum as it believed to promoted health due to their nutritional content, while at the same time endowed tasty unique flavored (Lansky and Paavilainen, 2010).

Serio-Silva *et al*. (2002) reported that *Ficus* species among the most important food for Mexican howler monkeys which contributed to 64.2% of their meals. This study was supported by Felton *et al*. (2008) when he recorded *Ateles chamek* monkey spent up to 50% their meals on *Ficus* species although on season of high overall food availability. *Ficus* species obviously is an important source of food to human and animal.

PHARMACOLOGICAL PROPERTIES

Antioxidant and antidiabetic properties: Studies revealed that antioxidants play a key role in reducing diabetic complications (Rahimi *et al*., 2005; Tchinda *et al*., 2008). Antioxidant is a part of our complex defense system that will protect our body from oxidative damage of free radicals form internal or external sources. Previous study by Zino *et al*. (1997) shows the ability of antioxidant to improve immune system functions and in delaying some effects of aging. Aris *et al*. (2009) demonstrates *F. deltoidea* fruit extract var. *angustifolia* as a good source of antioxidant. The fruits of *F. deltoidea* extract by using 3 different solvent; hexane, chloroform and methanol able to reduce the amount of peroxide better than vitamin E. The highest antioxidant activity could be found in hexane extract.

Phenolic compounds and its derivatives are strongly correlated with its antioxidant activities (Maisuthisakul *et al*., 2007). This statement was parallel with the study carried by Hakiman and Maziah (2009). They found out that plant extract with high antioxidant activities also have high antioxidant compounds. Cocoa also has high antioxidant activities with the presence of high total phenolic and flavonoid content (Lee *et al*., 2003). On the other hands, Misbah *et al*. (2013) reported that there was no correlation between antioxidant activities and the amounts of flavonoids in the extracts or fractions of *F. deltoidea* fruits although there was a positive correlation between plants phenolic and its antioxidant activities. This deviation of result might be caused by different parts of plants that had been used in each study.

Hakiman and Maziah (2009) states that antioxidant compounds that can be found in *F. deltoidea* leaves extract were polyphenol, phenolic acid and flavonoid, also said as non-enzymatic antioxidant. On the other hands, enzymatic antioxidants that can be found in *F. deltoidea* leaves extract were ascorbate oxidase, peroxidase, catalase and ascorbate peroxidase. However, the enzymes activities are not stable and did not provide consistent result in test done. A study conducted by Maizatul *et al*. (2011) proposed that 85% of the total antioxidant activity of the aqueous *F. deltoidea* distillation was attributable to the flavan-3-ol monomers, proanthocyanidins and C-linked flavone glycosides.

Recently, more research done to provide scientific explanation to the traditional practices of consuming *F. deltoidea* as an antidiabetic medicine. Adam *et al*. (2011) suggest that the aqueous extract of *F. deltoidea* leaves might contain water-soluble insulin-secreting constituents which give better effects than glibenclamide. Misbah *et al*. (2013) reported that *F. deltoidea* fruits have the potential in reducing blood glucose level. Her study shows the presence of phenolic and flavonoid of *F. deltoidea* fruits were positively correlated between the phenolic compounds of plants and their effective antidiabetic properties. She also suggests the glucose-lowering property of *F. deltoidea* is achieved through inactivation of α-glucosidase but not via α-amylase inhibition.

Another study conducted by Adam *et al*. (2011) to evaluate the ethanolic effect of *F. deltoidea* on glucose levels in normal rats showed that all doses introduced to the rats were able to reduce fasting blood glucose, especially after 6 h of administration. Adam *et al*. (2012) also evaluated extracts of *F. deltoidea* for hyperglycemia effects at different prandial states. The study found that hot aqueous extracts of *F. deltoidea* stimulate insulin secretion and show a high magnitude of stimulation and the extract induced the usage of intracellular Ca^2 to initiate release of insulin. It was also observed that ethanolic and methanolic extract of *F. deltoidea* increased basal and insulin-mediated glucose uptake into adipocytes cells (liver cell line), with ethanolic extract having the highest insulin mimetic activity. Kalman *et al*. (2013) reported that *F. deltoidea* has significant effect on reducing glucose and lipid levels in human adults with prediabetes.

In addition, Misbah *et al*. (2013) proposed that antidiabetic properties of *F. deltoidea* extract was caused by the low molecular mass protein at peaks 3360 and 4400 Da may be involved in the significant activity of antidiabetic properties of *F. deltoidea* fruit extracts var. *angustifolia* and *kunstleri*. He proposed this as she found out that there was no correlation between α-glucosidase inhibitory activities and both phenolic and flavonoid content.

Anti-inflammation and antinociceptive activity: Anti-inflammation is defined as a natural response of human body as a part of immune system to remove harmful stimuli such as damaged cells, irritants or stimulants. The signs of acute inflammation are swelling, pain, heat, redness and loss of function. Zunoliza *et al*. (2009) reported that the leaves extract of *F. deltoidea* have significant anti-inflammatory properties after being evaluate by using three *in vitro* assays: lipoxygenase, hyaluronidase and TPA-induced edema. This proved the potential of *F. deltoidea* leaves as a functional reagent in relieving pain and reducing inflammatory effect. This study was parallel to study by Zakaria *et al*. (2012), that the leaf of *F. deltoidea* significantly possesses anti-inflammatory activity against acute and chronic inflammatory responses and against pain-associated inflammatory response due to dose response effect on animal trials. *F. deltoidea* also is an important agent in

prevent or reducing nociception, the sensation of pain. Sulaiman *et al*. (2008) observed that *F. deltoidea* leaves significantly affected on reducing nociception as it produced significant dose-dependent antinociceptive effect in all the models used.

Wound healing activity: Abdulla *et al*. (2010) shows that the extract of *F. deltoidea* significantly enhanced wound healing activity in rats by enhancing wound enclosure and fibroblast proliferation, which contributed to angiogenesis. Bonte *et al*. (1994) suggest that this wound enclosure activities may be caused by the regulation of collagen 1, also an increase in tensile strength of the wounds (Suguna *et al*., 1996). Suarez *et al.* (1996) reported that the presence of flavonoid in *F. deltoidea* extract might contribute to this wound healing process as flavonoid was report to be able to promote wound healing and protect tissues form the oxidative damage.

Antiulcerogenic effect: In developed countries, peptic ulcer was report as the most common gastrointestinal disorder that was caused by the disruptions of gastric mucosal defense and repair system (Grossman, 1981). As a popular herbs used by the old folks, *F. deltoidea* plant pharmacological properties to cure ulcer was investigated. Zahra *et al*. (2009) in his study in anti-ulcerogonic activity of aqueous extract of *F. deltoidea* whole plant towards gastric walls of rats shows the ability of *F. deltoidea* to cure ulcer by decreasing the ulcer area, inhibit submucosal edema and leucocytes infiltration of submucosal layer. *Ficus deltoidea* extract was significantly reduce effect of ulcer induced by ethanol at 500 mg kg^{-1} dose, as the same effect observed in omeprazole, a type of common drug to reduce the amount of acid produce in the stomach. The potential of *F. deltoidea* as antiulcerogenic agent was constant with studies by Gregory *et al*. (2009) where *Ficus arnottiana* Miq. also posses anti-ulcer properties.

Antibacterial activity: *Ficus deltoidea* plants said contains flavonoid, which normally related to antioxidant activity of the plant. Besides, flavonoid also gives the yellow pigmentation. This yellow pigmentation acts as a natural protection of this plant in helping the plant to protect itself from microorganism and insects. Any herbs that contain flavonoid could also have the ability to act as anti-allergy, anti-inflammatory, antimicrobial and anti-cancer agent (Xiao *et al*., 2011). Dzolin *et al*. (2015) reported the positive correlation was observed between flavonoid constituents present and radical scavenging activities of the aqueous extracts of four types of *F. deltoidea*.

Suryati *et al*. (2011) reported that lupeol ($C_{30}H_{50}O$), an antibacterial compound found in *Ficus deltoidea* leaves inhibit growth of *E. coli*, *B. subtilis* and *S. aureus* at 150, 220 and 130 μg mL^{-1} at minimum inhibition concentration. Lee *et al*. (2003) also shows the potential of *Ficus deltoidea* leaves extract to inhibit up to 30% of all bacterial isolates ranged from 31.26-125 mg L^{-1}. It proved that methanol extract of *F. deltoidea* significantly inhibited the growth of *S. aureus* at lowest Minimum Inhibitory Concentration (MIC) value (3.125 mg mL^{-1}), while the other extract act as good antibacterial and antifungal against fungus, gram-positive and gram-negative bacteria strains tested on this study.

Anticancer effect: Shafaei *et al*. (2014) in his study shows that standardized leaf extract of *F. deltoidea* have the anticancer potential. In his study, the leaf extract have the ability as antiangiogenic towards animal cells. Antiangiogenic is the potential to inhibit the formation of new blood vessels. This potential plays a critical role in pathogenesis of various disease related to blood. The highlight is that the extract was non-toxic towards HUVECs, while showing potent cytotoxicity towards hormone-resistant breast cancer (MDA-MB-231) and colon cancer cells (HCT 116). He suggest that this antiangiogenic activity caused by the presence of high concentration of antioxidant such as phenolic and flavonoid in addition to ursolic acid which famous for its pharmacological properties. This selective antiangiogenic property makes extract of *F. deltoidea* leaves as a potential sources of new anticancer agent.

This statement was supported by Akhir *et al.* (2011) on human ovarian carcinoma cell line states when this plant extract could cause apoptosis at 1000 μg mL^{-1}, with faster apoptosis effect in ethanolic extract than aqueous extract. Both extract effects differently towards cancer cell growth, DNA fragmentation and cell morphology. Aqueous extract of *F. deltoidea* tend to promote cell detachment while the ethanolic extract prompted to stop cells form cell proliferation through DNA fragmentation as DNA fragmentation was found in cells treated with ethanolic extract at around 200 Kbp. This apoptosis effect make it possible for suppressing the growth of uncontrolled cell especially in human.

Uterotonic agent: Study by Amiera *et al*. (2014) revealed potential of *F. deltoidea* var. *deltoidea* and var. *angustifolia* as natural uterotonic agent to induce labor also to be used for post-partum hemorrhage as this study demonstrated the contractile effects of this leaves extract on uterine contraction of rats. This study showed that these two varieties and oxytocin induced dose-related intensification in force of contraction of rats. Salleh and Ahmad (2013) suggested that uterotonic effects of *F. deltoidea* aqueous extracts act via muscarinic, oxytocin and PGF2α receptors and is dependent on the extracellular Ca^{2}. Author also proposed that degree of uterus contraction highest via oxytocin receptor, followed by PGF2α and muscarinic receptor with least degree of contraction. The uterotonic effects also observed in other *Ficus* species such as *Ficus exasperata Vahl* (Bafor *et al*., 2010) and *Ficus asperifolia* (Watcho *et al*., 2011).

Anti-adipogenic agent: Recently, Woon *et al*. (2014) report the anti-adipogenic effects of *F. deltoidea* extract. Treatment of methanol and aqueous extract of *F. deltoidea* var. *deltoidea* and var. *angustifolia* on 3T3-L1 preadipocytes shows the potency of *F. deltoidea* extract as potential anti-obesity effects. Methanol extract of both extract and water extract of var. *angustifolia* were significantly proved to inhibit the maturation of preadipocytes at maximum non-toxic dose and half maximum non-toxic dose. More significant result was demonstrated in methanol extract of var. *deltoidea* than var. *angustifolia*. This study was a support to Ong *et al*. (2011) that previously relate anti-adipogenic activity of *F. deltoidea* with the flavonoid and quercetin that present in significant amount in this plant. The potential anti-adipogenic compounds should be further examined for better understanding of the compound and its potential as a slimming aid.

CONCLUSION

Ficus deltoidea is a valuable medicinal plant. It had been used by the old folks for multiple purposes in our daily life. As it getting more concerned, there was scientific study to prove its functions in pharmacological purpose especially. Previous study related the presence of its bioactive compound such as phenolic and flavonoid to its pharmacological properties. Its ability in aid for further fertility for both sexes should be explored due to its possibility to be used by both sexes. Not only research in pharmacological side, its agronomy and propagation needs more study to provide a good foundation for further understanding of this valuable plant also in preparation for its commercialization. It is also a good step for introducing this plant for better promotion and appreciation for its medicinal value.

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REFERENCES

Abdulla, M.A., K.A.A. Ahmed, F.M. Abu-Luhoom and M. Muhanid, 2010. Role of *Ficus deltoidea* extract in the enhancement of wound healing in experimental rats. Biomed. Res., 21: 241-245.

Abdullah, Z., K. Hussain, Z. Ismail and R.M. Ali, 2009. Anti-inflammatory activity of standardised extracts of leaves of three varieties of *Ficus deltoidea*. Int. J. Pharmaceut. Clin. Res., 1: 100-105.

Adam, Z., A. Ismail, S. Khamis, M.H.M. Mokhtar and M. Hamid, 2011. Antihyperglycemic activity of *F. deltoidea* ethanolic extract in normal rats. Sains Malaysiana, 40: 489-495.

Adam, Z., S. Khamis, A. Ismail and M. Hamid, 2012. *Ficus deltoidea*: A potential alternative medicine for diabetes mellitus. Evidence-Based Complement. Altern. Med. 10.1155/2012/632763

Ahmed, F., M.R. Asha, A. Urooj and K.K. Bhat, 2010. *Ficus racemosa* bark: Nutrient composition, physicochemical properties and its utilization as nutra tea. Int. J. Nutr. Metab., 2: 33-39.

Akhir, N.A.M., L.S. Chua, F.A.A. Majid and M.R. Sarmidi, 2011. Cytotoxicity of aqueous and ethanolic extracts of *Ficus deltoidea* on human ovarian carcinoma cell line. Br. J. Med. Med. Res., 1: 397-409.

Amiera, Z.U.R., M. Nihayah, I.F. Wahida and N.F. Rajab, 2014. Phytochemical characteristic and uterotonic effect of aqueous extract of *Ficus deltoidea* leaves in rats uterus. Pak. J. Biol. Sci., 17: 1046-1051.

Arifin, N., 2005. Penyembuhan Semula Jadi Dengan Herba [Natural Healing with Herbs]. PTS Publications & Distributors Sdn. Bhd., Malaysia, ISBN-13: 9789833372294, pp: 1-3, (In Malay).

Aris, S.R.S., S. Mustafa, N. Ahmat, F.M. Jaafar and R. Ahmad, 2009. Phenolic content and antioxidant activity of fruits of *Ficus deltoidea* var *angustifolia* sp. Malaysian J. Anal. Sci., 13: 146-150.

Awang, N.A., S.M.Z. Hasan and M.S.B. Shafie, 2013. Morphological study of *Ficus deltoidea* jack in Malaysia. J. Agric. Sci. Technol. B, 3: 144-150.

Bafor, E.E., E.K.I. Omogbai and R.I. Ozolua, 2010. *In vitro* determination of the uterine stimulatory effect of the aqueous leaf extract of *Ficus exasperata*. J. Ethnopharmacol., 127: 502-507.

Balakrishna, M. and S.K. BhattacHarjee, 1991. Studies on propagation of ornamental trees, through stem cuttings. Indian J. Horticult., 48: 87-94.

Berg, C.C. and E.J.H. Corner, 2005. Moraceae (*Ficus*). Flora Malesiana, Series I (seed plants). Flora Malesiana, 17: 17-29.

Bonte, F., M. Dumas, C. Chaudagne and A. Meybeck, 1994. Influence of asiatic acid, madecassic acid and asiaticoside on human collagen I synthesis. Planta Medica, 60: 133-135.

Bunawan, H., N.M. Amin, S.N. Bunawan, S.N. Baharum and N.M. Noor, 2014. *Ficus deltoidea* jack: A review on its phytochemical and pharmacological importance. Evidence-Based Compl. Altern. Med. 10.1155/2014/902734

Burkill, I.H. and M. Haniff, 1930. Malay village medicine. Garden's Bull., 6: 167-332.

Cook, J.M.C. and J.Y. Rasplus, 2003. Mutualists with attitude: Coevolving fig wasps and figs. Trends Ecol. Evol., 18: 241-248.

Corner, E.J.H., 1969. The complex of *Ficus deltoidea*; A recent invasion of the Sunda Shelf. Philosoph. Trans. R. Soc. London, 256: 281-317.

Desaku, 2005. *Mas cotek/Ficus deltoidea* mistletoe fig (Moraceae). http://www.bio-asli.com/Herba/e_Herba/e_mascotek.asp.

Draman, S., M.A.M. Aris, Razman, S.F.U. Akter and H. Azlina *et al*., 2012. Mas cotek (*Ficus deltoidea*): A possible supplement for type II diabetes: (A pilot study). Pertanika J. Trop. Agric. Sci., 35: 93-102.

Dzolin, S., R. Ahmad, M.M. Zain and M.I. Ismail, 2015. Flavonoid distribution in four varieties of *Ficus deltoidea* (Jack). J. Med. Plant Herbal Theraphy Res., 3: 1-9.

Farsi, E., A. Shafaei, S.Y. Hor, M.B.K. Ahamed, M.F. Yam, M.Z. Asmawi and Z. Ismail, 2013. Genotoxicity and acute and subchronic toxicity studies of a standardized methanolic extract of *Ficus deltoidea* leaves. Clinics, 68: 865-875.

Farsi, E., A. Shafaei, S.Y. Hor, M.K. Ahamed and M.F. Yam *et al*., 2011. Correlation between enzymes inhibitory effects and antioxidant activities of standardized fractions of methanolic extract obtained from *Ficus deltoidea* leaves. Afr. J. Biotechnol., 10: 15184-15194.

Felton, A.M., A. Felton, J.T. Wood and D.B. Lindenmayer, 2008. Diet and feeding ecology of *Ateles chamek* in a Bolivian Semihumid forest: The importance of Ficus as a staple food resource. Int. J. Primatol., 29: 379-403.

Gamlath, M., K. Abeywickrama and S. Wickramarachchi, 2010. Root growth promotion of *Ficus species* during air-layering. Cey. J. Sci. (Bio. Sci.), 39: 45-51.

Gregory, M., K.P. Vithalrao, G. Franklin and V. Kalaichelavan, 2009. Anti-Ulcer (Ulcer-Preventive) activity of *Ficus arnottiana* Miq. (Moraceae) leaf methanolic extract. Am. J. Pharmacol. Toxicol., 4: 89-93.

Grossman, M.I., 1981. Peptic Ulcer: A Guide for the Practicing Physician. Year Book Medical Publishers, Chicago, USA., ISBN: 0815140096, pp: 1-35.

Hakiman, M. and M. Maziah, 2009. Non enzymatic and enzymatic antioxidant activities in aqueous extract of different *Ficus deltoidea* accessions. J. Med. Plant Res., 3: 120-131.

Hassanein, A.M.A., 2013. Factors influencing plant propagation efficiency via stem cuttings. J. Hortic. Sci. Ornamental Plants, 5: 171-176.

Jamilah, M.S., N. Ismalia and N. Elyani, 2005. Ecological notes on *Ficus deltoidea* jack. on heath vegetation of BRIS soil of Terengganu. Proceedings of the 8th Symposium of Applied Biology, June 22-23, 2005, Marriot Putrajaya Hotel, Putrajaya, Malaysia.

Kalman, D.S.,H.I. Schwartz, S. Feldman,and D.R. Krieger, 2013. Efficacy and safety of *Elaeis guineensis* and *Ficus deltoidea* leaf extracts in adults with pre-diabetes. Nutr. J., Vol. 12.

Kochummen, K.M. and G. Rusea, 2000. Moraceae. Tree Flora Sabah Sarawak, 3: 181-334.

Lansky, E.P. and H.M. Paavilainen, 2010. Figs: The Genus Ficus. CRC Press, Boca Raton, FL., ISBN-13: 9781420089677, pp: 1-4.

Lee, K.W., Y.J. Kim, H.J. Lee and C.Y. Lee, 2003. Cocoa has more phenolic phytochemicals and a higher antioxidant capacity than teas and red wine. J. Agric. Food Chem., 51: 7292-7295.

Lopez-Vaamonde, C., D.J. Dixon, J.M. Cook and J.Y. Rasplus, 2002. Revision of the Australian species of *Pleistodontes* (Hymenoptera: Agaonidae) fig-pollinating wasps and their host-plant associations. Zool. J. Linnean Soc., 136: 637-683.

Maisuthisakul, P., M. Suttajit and R. Pongsawatmanit, 2007. Assessment of phenolic content and free radical-scavenging capacity of some thai indigenous plants. Food Chem., 100: 1409-1418.

Maizatul, H.O., W. Mullen and A. Crozier, 2011. Identification of proanthocyanidin dimers and trimers, flavone C-Glycosides and antioxidants in *Ficus deltoidea*, a Malaysian herbal tea. J. Agric. Food Chem., 59: 1363-1369.

Mat, N., N.A. Rosni, N.Z. Ab Rashid, N. Haron and Z.M. Nor, *et al*., 2012. Leaf morphological variations and heterophylly in *Ficus deltoidea* Jack (Moraceae). Sains Malaysiana, 41: 527-538.

Misbah, H., A.A. Aziz and N. Aminudin, 2013. Antidiabetic and antioxidant properties of *Ficus deltoidea* fruit extracts and fractions. BMC Compl. Altern. Med. Vol., 13. 10.1186/1472-6882-13-118

Mohammad, N., Y.K. Wei and N.F.A. Bakar, 2012. Determination of mineral content in the *Ficus deltoidea* leaves. J. Sains Kesihatan Malaysia, 10: 25-29.

Nur Fatihah, H.N., M. Nashriyah, A.R. Nor Zaimah, M. Khairil and A.M. Ali, 2014. Leaf morphology and anatomy of 7 varieties of *Ficus deltoidea* (Moraceae). Turk. J. Bot., 38: 677-685.

Oh, M.J., M. Abdul Hamid, S. Ngadiran, Y.K. Seo, M.R. Sarmidi and C.S. Park, 2011. *Ficus deltoidea* (Mas cotek) extract exerted anti-melanogenic activity by preventing tyrosinase activity *in vitro* and by suppressing tyrosinase gene expression in B16F1 melanoma cells. Arch. Dermatol. Res., 303: 161-170.

Ong, S.L., A.P.K. Ling, R. Poospooragi and S. Moosa, 2011. Production of flavonoid compounds in cell cultures of *Ficus deltoidea* as influenced by medium composition. Int. J. Med. Arom. Plants, 1: 62-74.

Rahimi, R., S. Nikfar, B. Larijani and M. Abdollahi, 2005. A review on the role of antioxidants in the management of diabetes and its complications. Biomed. Pharmacother., 59: 365-373.

Ronsted, N., G.D. Weiblen, W.L. Clement, N.J.C. Zerega and V. Savolainen, 2008. Reconstructing the phylogeny of figs (*Ficus*, Moraceae) to reveal the history of the fig pollination mutualism. Symbiosis, 45: 45-55.

Salleh, N. and V.N. Ahmad, 2013. *In-vitro* effect of *Ficus deltoidea* on the contraction of isolated rat's uteri is mediated via multiple receptors binding and is dependent on extracellular calcium. BMC Compl. Altern. Med., Vol. 13. 10.1186/1472-6882-13-359

Santamaria, A.B., 2008. Manganese exposure, essentiality and toxicity. Indian J. Med. Res., 128: 484-500.

Serio-Silva, J.C., V. Rico-Gray, L.T. Hernandez-Salazar and R. Espinosa-Gomez, 2002. The role of *Ficus* (Moraceae) in the diet and nutrition of a troop of Mexican howler monkeys, *Alouatta palliata mexicana*, released on an island in southern Veracruz, Mexico. J. Trop. Ecol., 18: 913-928.

Shafaei, A., N.S. Muslim, Z.D. Nassar, A.F.A. Aisha, A.M.S.A. Majid and Z. Ismail, 2014. Antiangiogenic effect of *Ficus deltoidea* Jack standardised leaf extracts. Trop. J. Pharm. Res., 13: 761-768.

Simon, V.N., 2004. The ultimate challenge how fig trees are pollinated. Veld and Flora, South Africa, USA., March 2004, pp: 13-15.

Smilkstein, M.J., S.C. Smolinske, K.W. Kulig and B.H. Rumack, 1988. Severe hypermagnesemia due to multiple-dose cathartic therapy. West J. Med., 148: 208-211.

Starr, F., K. Starr and L. Loope, 2003. Mistletoe fig, Moraceae. Ficus Deltoidea, 2: 1-5.

Suarez, J., M.D. Herrera and E. Marhuenda, 1996. Hesperidin and neohesperidin dihydrochalcone on different experimental models of induced gastric ulcer. Phytother. Res., 10: 616-618.

Suguna, L., P. Sivakumar and G. Chandrakasan, 1996. Effects of *Centella asiatica* extract on dermal wound healing in rats. Indian J. Exp. Biol., 34: 1208-1211.

Sulaiman, M.R., M.K. Hussain, Z.A. Zakaria, M.N. Somchit, S. Moin, A.S. Mohamad and D.A. Israf, 2008. Evaluation of the antinociceptive activity of *Ficus deltoidea* aqueous extract. Fitoterapia, 79: 557-561.

Suryati, S., H. Nurdin, D. Dachriyanus and M.N.H. Lajis, 2011. Structure elucidation of antibacterial compound from *Ficus deltoidea* jack leaves. Indonesian J. Chem., 11: 67-70.

Tchinda, A.T., M.H. Tchuendem, S.N. Khan, I. Omar, F. Ngandeu, E.A.N. Pepin and I.M. Choudhary, 2008. Antioxidant activity of the crude extract of the fruits of *Pycnanthus angolensis* and α-glucosidase inhibitory activity of its constituents. Pharmacologyonline, 1: 422-431.

Turner, I.M., 1995. A catalogue of the vascular plants of Malaya. Gardens Bull. Singapore, 47: 1-5.

Watcho, P., E. Ngadjui, P.A. Nkeng-Efouet, T.B. Nguelefack and A. Kamanyi, 2011. Evaluation of *in vitro* uterotonic activities of fruit extracts of *Ficus asperifolia* in rats. Evid. Based Compl. Alternat. Med.

Woon, S.M., Y.W. Seng, A.P.K. Ling, S.M. Chye and R.Y. Koh, 2014. Anti-adipogenic effects of extracts of *Ficus deltoidea* var. *deltoidea* and var. *angustifolia* on 3T3-L1 adipocytes. J. Zhejiang Univ. Sci. B, 15: 295-302.

Xiao, Z.P., Z.Y. Peng, M.J. Peng, W.B. Yan, Y.Z. Ouyang and H.L. Zhu, 2011. Flavonoids health benefits and their molecular mechanism. Mini-Rev. Med. Chem., 11: 169-177.

Zahra, M.A.S.F., A.A. Mahmood, M.A. Hapipah, M.N. Suzita and I. Salmah, 2009. Anti-ulcerogenic activity of aqueous extract of *Ficus deltoidea* against ethanol-induced gastric mucosal injury in rats. Res. J. Med. Sci., 3: 42-46.

Zakaria, Z.A., M.K. Hussain, A.S. Mohamad, F.C. Abdullah and M.R. Sulaiman, 2012. Anti-inflammatory activity of aqueous extract of *Ficus deltoidea*. Biol. Res. Nurs., 14: 90-97.

Zino, S., M. Skeaff, S. Williams and J. Mann, 1997. Randomised controlled trial of effect of fruit and vegetable consumption on plasma concentrations of lipids and antioxidants. Br. Med. J., 314: 1787-1791.

Zunoliza, A., S. Khalid, I. Zhari, M.A. Rasadah, P. Mazura, J. Fadzureena and S. Rohana, 2009. Evaluation of extracts of leaf of three *Ficus deltoidea* varieties for antioxidant activities and secondary metabolites. Pharmacog. Res., 4: 216-223.