

Kertas Asli/Original Article

Determination of Mineral Content in The *Ficus Deltoidea* Leaves

(Penentuan Kandungan Mineral dalam Daun *Ficus Deltoidea*)

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ABSTRACT

Ficus deltoidea leaves were widely used as a tea beverages in Malaysia with no information of its mineral content. Hence the mineral content of two species of *Ficus deltoidea* leaves were investigated. The dried leaves of *F. deltoidea* var. *angustifolia* and *F. deltoidea* var. *deltoidea* were acid digested and mineral elements of Na, Mg, K, Ca, Mn, Cr, Fe and Zn were determined using ICP-MS. Magnesium, potassium, sodium, manganese, iron and zinc were found to be present in the leaves of *F. deltoidea* var. *angustifolia* and *F. deltoidea* var. *deltoidea*. Concentration of magnesium (1934 mg/L), manganese (58.37 mg/L), iron (6.89 mg/L) and zinc (1.77 mg/L) in *F. deltoidea* var. *deltoidea* species were significantly ($P < 0.05$) higher than in *F. deltoidea* var. *angustifolia* species with concentration of 317 mg/L, 29.62 mg/L, 4.55 mg/L and 1.26 mg/L for magnesium, manganese, iron and zinc respectively. Meanwhile, concentration of sodium in *F. deltoidea* var. *deltoidea* species (3.13 mg/L) was found to be significantly ($P < 0.05$) lower than the concentration in *F. deltoidea* var. *angustifolia* species (9.11 mg/L). The finding showed that the leaves of *F. deltoidea* var. *deltoidea* has higher nutritional value than the leaves of *F. deltoidea* var. *angustifolia*. Leaves of *Ficus deltoidea* especially the *F. deltoidea* var. *deltoidea* species contain high amount of magnesium, manganese and potassium. Therefore, tea made of this leaves can be served as a good source of minerals for human consumption.

Keywords: *Ficus deltoidea*, mineral element, tea

ABSTRAK

Daun *Ficus deltoidea* digunakan secara meluas sebagai minuman teh di Malaysia tanpa diketahui kandungan mineralnya. Disebabkan itu, kandungan mineral dalam daun dua spesies *Ficus deltoidea* dikaji. Daun *F. deltoidea* var. *angustifolia* dan *F. deltoidea* var. *deltoidea* dikeringkan dan dilakukan penghadaman asid. Unsur mineral Na, Mg, K, Ca, Mn, Cr, Fe dan Zn ditentukan menggunakan ICP-MS. Unsur magnesium, kalium, natrium, mangan, ferum dan zink didapati terdapat di dalam kedua-dua daun *F. deltoidea* var. *angustifolia* dan *F. deltoidea* var. *deltoidea*. Kepekatan magnesium (1934 mg/L), mangan (58.37 mg/L), ferum (6.89 mg/L) dan zink (1.77 mg/L) dalam *F. deltoidea* var. *deltoidea* adalah lebih tinggi secara signifikannya ($p < 0.05$) berbanding *F. deltoidea* var. *angustifolia* dengan kepekatan 317 mg/L, 29.62 mg/L, 4.55 mg/L dan 1.26 mg/L untuk magnesium, mangan, ferum dan zink masing-masing. Didapati kepekatan natrium dalam *F. deltoidea* var. *deltoidea* (3.13 mg/L) lebih rendah ($p < 0.05$) berbanding kepekatan natrium yang terkandung di dalam *F. deltoidea* var. *angustifolia* spesies (9.11 mg/L). Hasil kajian juga menunjukkan daun *F. deltoidea* var. *deltoidea* mengandungi nilai nutrisi yang lebih tinggi berbanding *F. deltoidea* var. *angustifolia*. Daun *Ficus deltoidea* terutamanya daripada spesies *F. deltoidea* var. *deltoidea* tinggi unsur magnesium, mangan dan natrium. Oleh yang demikian, teh yang dibuat daripada kedua-dua spesies daun ini boleh menjadi sumber mineral kepada manusia.

Kata kunci: *Ficus deltoidea*, unsur mineral, teh

INTRODUCTION

Tea is one of the most popular beverages in the world. Health benefits of tea have been documented since the early Chinese and Japanese texts and these are being seriously considered by a number of researchers in the scientific community. The regular consumption of tea may contribute to the daily dietary requirements of several minerals (Fernandez et al. 2002). Minerals are inorganic elements that occur in nature. They originate from the earth's crust and in animal or plant constitute only a small proportion of the body tissue. Many mineral elements are essential

constituents of enzymes, regulate a variety of physiologic processes (maintenance of osmotic pressure, oxygen transport, muscle contraction and central nervous system integrity) and are required for the growth and maintenance of tissues and bones.

Each mineral element has its biological role in human body. Macrominerals such as sodium (Na), potassium (K), calcium (Ca) and magnesium (Mg) are important in nerve stimulation and muscle contraction. Sodium and potassium contribute more in regulating osmotic pressure, water and acid-base balance. Besides that, potassium is also important in synthesis of protein and glycogen formation.

Calcium and magnesium are the main components of bone and teeth and also important in enzyme activation. Calcium is also needed in blood clotting. Iron (Fe) is the most abundant and important trace element inside human body. It is important in hemoglobin and myoglobin formation. Manganese (Mn) is cofactor of large number of enzymes. It is important for normal brain function, reproduction and bone structure. Chromium (Cr) which is in trivalent form increases glucose tolerance and plays role in lipid metabolism. Therefore, it is useful in prevention and treatment of diabetes but chromium in hexavalent form is toxic. Last but not least, Zinc (Zn) is constituent of many enzyme systems and important in vitamin A utilization (Szefer & Nriagu 2007). Besides that, Zinc is crucial for normal development and function of cells mediating innate immunity, neutrophils, and NK cells. The ability of zinc to function as an antioxidant and stabilize membranes suggests that it has a role in the prevention of free radical-induced injury during inflammatory processes (Prasad 2008).

Ficus deltoidea, a native shrub from the family of Moraceae, is widely distributed in several countries of the Southeast Asia including Malaysia (Mahmood et al. 2010). There are many variants of *Ficus deltoidea* but only two variants are widely used which are *Ficus deltoidea var. angustifolia* (known as male plant) and *Ficus deltoidea var. deltoidea* (female plant). They can be discriminated from each other by their morphology. *Ficus deltoidea var. angustifolia* leaf is small with parallel veining while *Ficus deltoidea var. deltoidea* leaf is big with ramified veining (Noraida 2005). Black dots can be seen on male leaf while red dots can be seen on female leaf (Mansor & Mahmood 2009). Animal studies showed that the leaves of *Ficus deltoidea* possess the activity of antioxidant (Mansor & Maziah 2009), anti-hyperglycemic (Zainah et al. 2011), anti-inflammatory (Zunoliza et al. 2009), antinociceptive (Sulaiman et al. 2008) and promoting wound healing (Mahmood et al. 2010). These activities are believed to be contributed by the nutritional properties of *Ficus deltoidea*.

Therefore, the main objective of this study is to determine the minerals content of the leaves of *Ficus deltoidea var. angustifolia* and *Ficus deltoidea var. deltoidea* and their contributions to average daily dietary intake of mineral elements.

MATERIALS AND METHODS

CHEMICALS AND REAGENTS

Deionized water, concentrated nitric acid (HNO₃ 65%), concentrated hydrochloric acid (HCl 37%), hydrogen peroxide (H₂O₂ 30%) & standard solution of multi-mineral elements contained Na, Mg, Ca, K, Cr, Mn, Fe and Zn.

PLANT MATERIAL

Ficus deltoidea var. angustifolia and *Ficus deltoidea var. deltoidea* leaves were purchased from Juaseh Tengah, Negeri Sembilan, Malaysia. Botanical identification was performed in the Herbarium, Universiti Kebangsaan Malaysia where a voucher number UKMB 29780 and UKMB 29781 were deposited for *F. deltoidea var. angustifolia* and *F. deltoidea var. deltoidea*, respectively. The leaves were air-dried for 6-7 days prior determination of the minerals content.

WET ACID DIGESTION

Acid digestion of the leaves was conducted employing the method modified from environmental protection agency 200.3 method (EPA 1991). A total of 5 g of dried leaves of each species were ground by blender and placed in 100 ml beaker. Then, the leaves were digested with 30 ml concentrated nitric acid, 10 ml hydrogen peroxide and 2 ml hydrochloric acid and heated on magnetic stirrer hot plate. Volume of the sample solution was reduced to 10 ml. Sample was cooled, filtered with filter paper and transferred into 100 ml volumetric flask. Sample solution was diluted with deionized water to achieve dilution of 10. This sample solution was analysed by ICP – MS.

DETERMINATION OF MINERAL ELEMENTS WITH ICP – MS

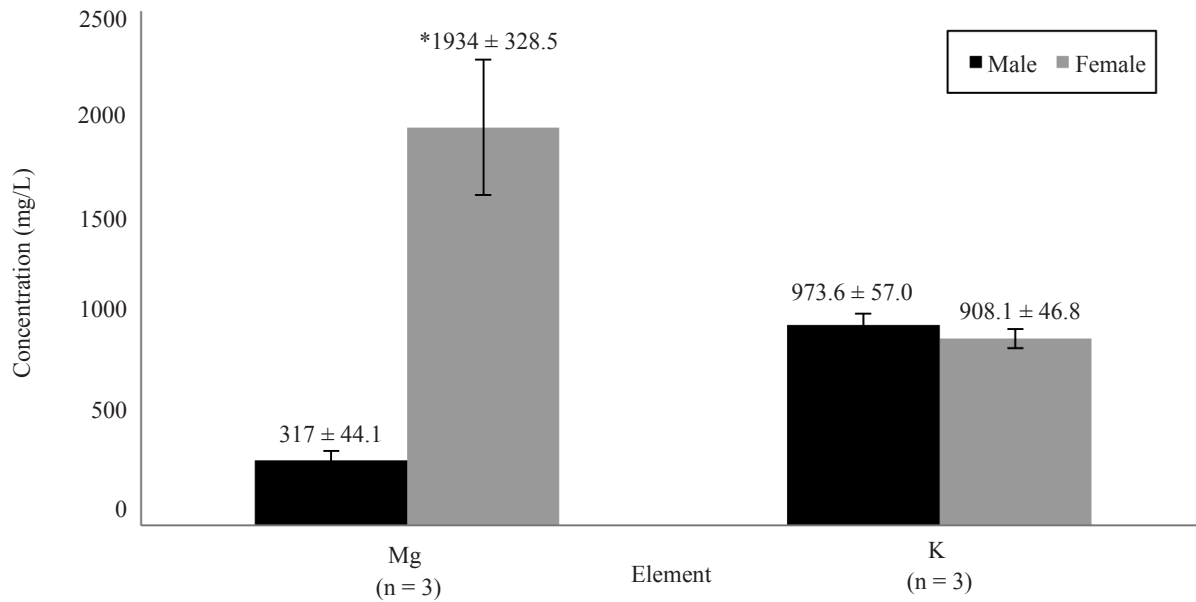
The instrument was calibrated with standard solution of multielements consist of Na, Mg, K, Ca, Mn, Cr, Fe and Zn with the following concentration: 1, 10, 25, 50, 100, 200 and 300 µg/L. Blank was prepared by doing wet acid digestion without sample. Blank was analyzed together with sample. Blank was used to ensure getting the precise concentration of elements in sample because reagent used for wet acid digestion may contain elements.

STATISTICAL ANALYSIS

Student t test and Mann Whitney were used to compare mean of concentration of each element in *F. deltoidea var. angustifolia* and *F. deltoidea var. deltoidea* leaves.

RESULTS

Magnesium, potassium, sodium, manganese, iron and zinc were found to be present in the leaves of *F. deltoidea var. angustifolia* and *F. deltoidea var. deltoidea*. Concentration of magnesium in *F. deltoidea var. deltoidea* species (1934 mg/L) was significantly (P = 0.043) higher than concentration of magnesium in *F. deltoidea var. angustifolia* species (317 mg/L) (Figure 1). There was no significant different between *F. deltoidea var. angustifolia* and *F. deltoidea var. deltoidea* species for the concentration of potassium with 973.6 mg/L and 908.1 mg/L, respectively.

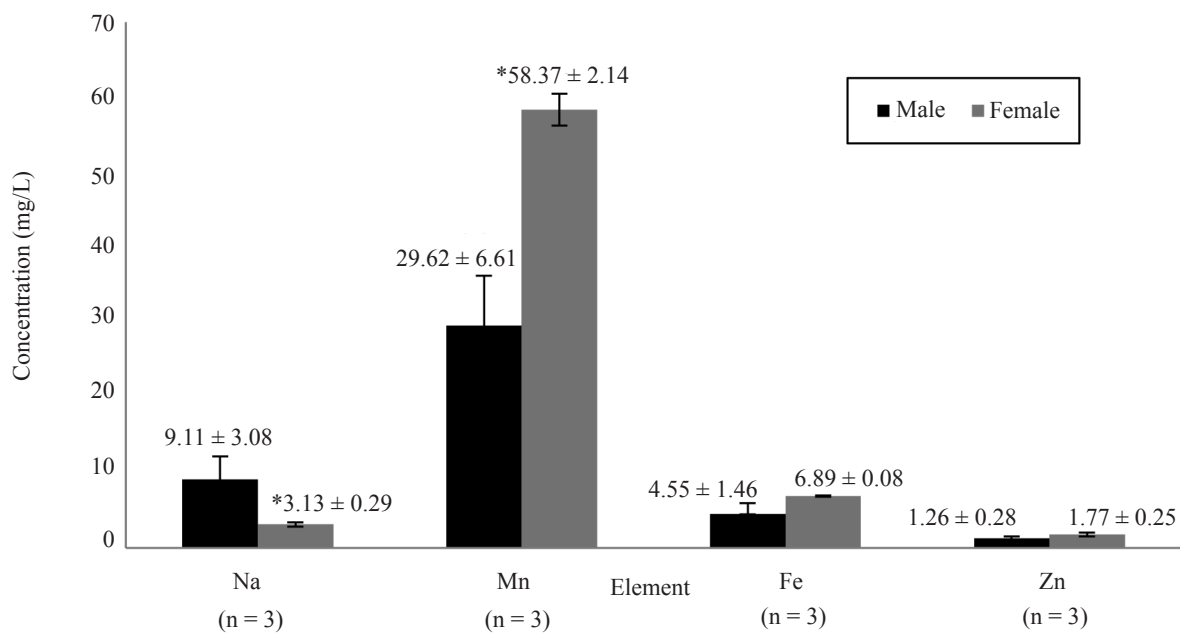


* Significant ($P < 0.05$) different when comparing with *F. deltoidea* var. *angustifolia*.

FIGURE 1. Concentration of magnesium (Mg) and potassium (K) in the leaves of *F. deltoidea* var. *angustifolia* and *F. deltoidea* var. *deltoidea* species

Concentration of sodium in *F. deltoidea* var. *deltoidea* species (3.13 mg/L) was significantly ($P = 0.029$) lower than the concentration of sodium in *F. deltoidea* var. *angustifolia* species (9.11 mg/L) (Fig. 2). Meanwhile, concentration of manganese, iron and zinc were significantly higher ($P = 0.002$; $P = 0.049$; $P = 0.033$) in *F. deltoidea* var. *deltoidea* species as compared to *F. deltoidea* var. *angustifolia* species. Concentration of manganese, iron and zinc in *F.*

deltoidea var. *deltoidea* species were 58.37 mg/L, 6.89 mg/L and 1.77 mg/L respectively while concentration of manganese, iron and zinc in *F. deltoidea* var. *angustifolia* species were 29.62 mg/L, 4.55 mg/L and 1.26 mg/L respectively. Concentration of calcium and chromium in the leaves were too low therefore cannot be detected by ICP – MS.



* Significant ($P < 0.05$) different when comparing with *F. deltoidea* var. *angustifolia*.

FIGURE 2. Concentration of sodium (Na) manganese (Mn), iron (Fe) and zinc (Zn) in leaves of *F. deltoidea* var. *angustifolia* and *F. deltoidea* var. *deltoidea* species

Tea beverages act as suitable sources of mineral element intake for humans. The contribution of mineral elements in the leaves of *F. deltoidea* to average daily dietary intake for humans is shown in Table 1. Magnesium and manganese in *F. deltoidea* showed remarkable high contribution to average daily dietary intake. About one litre tea of *F. deltoidea var. deltoidea* leaves contain 552.6% of average 350 mg daily dietary intake of magnesium while *F.*

deltoidea var. angustifolia leaves contribute 90.57%. For manganese, one litre tea of *F. deltoidea var. deltoidea* leaves contains 1459.3% of average 4 mg daily dietary intake which is very high as well as tea beverage of *F. deltoidea var. angustifolia* leaves. *F. deltoidea var. angustifolia* contributes 740.5% of average 4 mg daily dietary intake. For other elements, one litre tea contributes < 50% of average daily dietary intake.

TABLE 1. Concentration of minerals in the leaves of *F. deltoidea* and contributions to average daily dietary intake of minerals for human

Element	* Average daily dietary intake / mg day ⁻¹ (range) (Powell et al. 1998)	Elemental concentrations of leaves/ mg L ⁻¹ (mean ± SD)		% of average daily dietary intake	
		<i>F. deltoidea var.</i> <i>angustifolia</i>	<i>F. deltoidea var.</i> <i>deltoidea</i>	<i>F. deltoidea var.</i> <i>angustifolia</i>	<i>F. deltoidea var.</i> <i>deltoidea</i>
Mg	350 (300 – 400)	317 ± 44.1	1934 ± 328.5	90.57	552.6
K	3800 (1900 – 5600)	973.6 ± 57.0	908.1 ± 46.8	25.62	23.90
Na	2200 (1100 – 3300)	9.11 ± 3.08	3.13 ± 0.29	0.41	0.14
Mn	4 (2 – 5)	29.62 ± 6.61	58.37 ± 2.14	740.5	1459.3
Fe	15 (10 – 18)	4.55 ± 1.46	6.89 ± 0.08	30.33	45.93
Zn	15	1.26 ± 0.28	1.77 ± 0.25	8.4	11.8

DISCUSSION

Leaves of *Ficus deltoidea* provides high contribution of average daily dietary intake of magnesium and manganese. Therefore, regular consumption of tea made of *F. deltoidea* leaves contribute adequate amount of magnesium and manganese which have the functional role in physiological process in human body. Magnesium is important in activation of many enzymes, nerve stimulation, muscle contraction and component of bones and teeth (Szefer & Nriagu 2007). Manganese is an essential element that is incorporated into a number of metalloenzymes (Mn– metalloenzymes), of which the three primary ones in humans are liver pyruvate carboxylase, arginase and manganese dependent mitochondrial superoxide dismutase (MnSOD) which acts as antioxidant that prevents cell damage from free radical (Powell et al. 1998). Besides that, manganese is necessary for a variety of metabolic functions including those involved in skeletal system development, energy metabolism, nervous system function, immunological function and reproductive hormone function (Santamaria 2008). However, daily consumption of about one litre or more of this tea will cause excessive consumption of magnesium and manganese into body which may cause hypermagnesemia and manganese toxicity. Clinical findings of hypermagnesemia are hypotension, nausea, vomiting, central nervous depression, respiratory depression and the most severe cardiac arrest (Smilkstein et al. 1988). Chronic intake of high levels of manganese or manganese toxicity has been associated with a neurodegenerative disorder characterized by both central nervous system abnormalities and neuropsychiatric disturbances (Santamaria 2008). Therefore, daily

consumption of 2 - 3 cups of this tea (each cup 50 mL) is more than enough to take in the adequate and safe amount of magnesium and manganese.

With respect to potassium, tea made of the leaves of *F. deltoidea* provides an important amount of this mineral element although its percentage of contribution to average daily dietary intake is low because of the high potassium requirements of the human diet (Fernandez et al. 2002). Therefore, this tea is also a rich source of potassium besides magnesium and manganese. Potassium is important in regulation of osmotic pressure, water and acid-base balance, nerve stimulation, muscle contraction, synthesis of protein and glycogen formation (Szefer & Nriagu 2007). This tea also contributes moderate amount of iron. Iron is important in hemoglobin and myoglobin formation (Szefer & Nriagu 2007). However, this tea is a poor source of sodium and zinc.

The findings that the tea made of *F. deltoidea var. deltoidea* leaves has higher nutritional value than the tea made of *F. deltoidea var. angustifolia* leaves has some industrial implication, as currently the commercially available products using the mixture of both species. There is a need to analyze the nutrients content of the commercial samples and also the content in hot infusion.

CONCLUSION

Leaves of *Ficus deltoidea* especially the *F. deltoidea var. deltoidea* species contain high amount of magnesium, manganese and potassium. Therefore, tea made of this leaves can be served as a good source of daily minerals for human.

REFERENCES

- EPA. 1991. Method 200.3: *Sample Preparation Procedure for Spectrochemical Determination of Total Recoverable Elements in Biological Tissues*. Ohio: Environmental Protection Agency.
- Fernandez, P.L., Pablos, F., Marti'n*, M.J. & Gonzalez, A.G. 2002. Multi-element analysis of tea beverages by ICP-AES. *Food Chemistry* 76: 483-489.
- Mahmood, A.A., Khaled A-A.A., Faisal, M.A-L. & Mazin, M. 2010. Role of *Ficusdeltoidea* extract in the enhancement of wound healing in experimental rats. *Biomedical Research* 21(3): 241-245.
- Mansor, H. & Mahmood, M. 2009. Non enzymatic and enzymatic antioxidant activities in aqueous extract of different *Ficusdeltoidea* accessions. *Journal of Medicinal Plants Research* 3(3): 120-131.
- Noraida, A. 2005. *Penyembuhan Semulajadi dengan Herba*. PTS Publications & Distributors Sdn. Bhd.
- Powell, J.J., Burden, T.J. & Thompson, R.P.H. 1998. In vitro mineral availability from digested tea a rich dietary source of manganese. *Analyst* 123: 1721-1724.
- Prasad, A.S. 2008. Zinc in human health: effect of zinc on immune cells. *Molecular Medicine* 14(5-6): 353-357.
- Santamaria, A.B. 2008. Manganese exposure, essentiality & toxicity. *Indian Journal Medical Research* 128: 484-500.
- Smilkstein, M.J., Smolinske, S.C., Kulig, K.W. & Rumack, B.H. 1988. Severe hypermagnesemia due to multiple – dose cathartic therapy. *West Journal Medical* 148: 208-211.
- Sulaiman, M.R., Hussain, M.K., Zakaria, Z.A., Somchit, M.N., Moin, S., Mohamad, A.S. & Israf, D.A. 2008. Evaluation of the antinociceptive activity of *Ficusdeltoidea* aqueous extract. *Fitoterapia*: 557-561.
- Szefer, P. & Nriagu, J.O. 2007. Mineral components in foods. Taylor & Francis group.
- Zainah, A., Amin I., Shafii, K., Muhammad, H., Mohd. M. & Muhajir, H. 2011. Anti-hyperglycemic activity of *Ficusdeltoidea* ethanolic extract in normal rats. *Sains Malaysiana* 40(5): 489-495.
- Zunoliza A., Khalid H., Zhari I. & Rasadah M.A. 2009. Anti-inflammatory activity of standardised extracts of leaves of three varieties of *Ficusdeltoidea*. *International Journal of Pharmaceutical and Clinical Research* 1(3): 100-105.

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