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VITAMINS AND MINERAL CONTENTS OF TEN SELECTED WEEDS AND LOCAL PLANTS OF KELANTAN, MALAYSIA

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ABSTRACT

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Two experiments were carried out to determine the amount of vitamins (B₂, B₃ and C) and minerals in ten weedy herbs and local plants of Kelantan to know the possibility of using as alternative human food source. Spectrophotometric analyses were done with the extracts of the test plants to estimate the vitamins and minerals in the laboratory of Universiti Malaysia Kelantan, Jeli campus. It was found that *Ipomea aquatica* contained the highest amount of riboflavin (2.144mg/100mg). Niacin content was found to be high in *Acalypha indica* (1.805mg/100mg) and *Diplazium esculentum* contained the highest amount of ascorbic acid (0.858mg/100mg). When the total vitamin contents for each weed and local plants was estimated it was found that *Sesbania grandiflora* contained the highest amount of vitamins compared to other plant samples. Among the selected plants for mineral estimation, *Kaempferia galangal* contained the highest amount of zinc (1.899 ppm) and ferum (17.43 ppm). The herb *Clinacanthus nutans* contained the highest amount of calcium (498.0 ppm) and magnesium (234.0 ppm). The highest amount of manganese (13.02 ppm) was found in *Melastoma malabathricum*. It is opined that *I. aquatica*, *A. indica* and *D. esculentum* have a good potential to be used as an alternative vitamin source and *K. galanga*, *C. nutans* and *M. malabathricum* are the good alternative source of minerals. Further studies to investigate the toxicity of the plant extracts and sensory evaluation should be carried out before suggesting for commercial production.

**Keywords: Alternative vitamin source, Alternative mineral source, Weeds, Local plants,
Spectrophotometry, AAS**

INTRODUCTION

The body needs vitamins to maintain the normal functions of cells and organs, although it is needed in trace amount [1]. There are many vitamin deficiency cases in Malaysia. The presence of the minerals in food is also necessary for their normal life processes. The deficiency in minerals can give a major impact on health such as anaemia and osteoporosis [2]. Since a number of rural people in Malaysia have been suffering from the minerals and vitamin deficiencies and most of the rural people cannot afford to buy high-priced vitamin fruits and vegetables, it is important to develop a low-cost technology for supplying those minerals and vitamins to the rural people.

Weeds and local plants have indispensable role to play in improving food security of country people including indigenous people (*orang asli*). Wild edible plants are more important in the livelihood strategies of forest dwellers or tribal populations. In many situations, wild foods are not dietary staples but they have very good potential as medicine. Moreover they provide nutritionally valuable supplements in the form of vegetables and beverages [3]. Weeds, which are highly deemed as a nuisance

plants are sometimes useful for human beings [4].

Many of the local plants and weeds may contain a good amount of vitamins and minerals, which may have the potential to act as an alternate vitamin and mineral source for rural people. No sufficient information on this issue is available in Malaysia. Therefore, the objective of this research was to estimate the vitamin and mineral contents of ten selected weeds and local plants of Kelantan, Malaysia.

MATERIALS AND METHODS

Seventeen weedy herbs and local plants of Kelantan as mentioned in Table 1 were collected and used to estimate their vitamin and mineral contents.

The preparation of extracts from the test plants and estimation the contents of vitamins B₂, B₃ and C in the samples were done as per technique of Hussain et al. [5] and Okwu and Josiah [6]. All the three vitamins were estimated by using a spectrophotometer (Genesys 20, Soft Rev.-2.10, Model 4000/4, Thermo Fisher Scientific).

To determine riboflavin, 5 g of the samples was extracted with 100 ml of 50% ethanol solution and it was shaken for 1 hour (Temp: 40°C, rpm: 200). This

was filtrated into a 100ml flask, while 10ml of the extract was put into 50ml volumetric flask. 10ml of the 5% potassium permanganate and 10 ml of the 30% H₂O₂ were added. The mixture was allowed to stand over a hot water bath (50°C) for about 30 min. Subsequently, 2ml of the 40% sodium sulphate was added. This was made up to 50 ml mark and the absorbance was measured at 510 nm in a visible UV/spectrophotometer [5]. To determine niacin, 5 g of the samples were treated with 50 ml of 1N sulphuric acid and was shaken for 30 min (Temp: 40°C, rpm: 200). Three drops of ammonia solution were added to the sample and was then filtrated. Afterwards, 10 ml of the filtrate was added into a 50 ml volumetric flask and 5 ml of 0.02N H₂SO₄ was added. The absorbance was measured in the UV/visible spectrophotometer at 470 nm [4]. For determination of Vitamin C one gram of each plant sample was weighed in a 25 ml conical flask. Then, 10 ml of the oxalic acid (0.05 M)-EDTA (0.02M) solution was added. The sample was placed at room temperature for 24 hour to provide the required reaction time. After 24 hour, the samples were filtrated through a filter paper. Then, 2.5 ml of

each sample was transferred to a separate 25 ml volumetric brown flask, after which 2.5 ml of the oxalic acid (0.05 M) - EDTA (0.02) solution was added. Subsequently, meta phosphoric acid was added separately with acetic acid (0.5 ml), sulphuric acid (5% v/v) solution (1 ml) and ammonium molybdate solution (2 ml) in each volumetric brown flask and the volume was made up to 25 ml with distilled water. The absorbance was measured at 760nm on a UV/ visible spectrophotometer [4, 5].

For estimation of minerals the following procedure was followed. One gram of dried, ground plant materials was weighed and it was placed in a porcelain crucible. Then, it was placed in a muffle furnace at 500⁰C for 4 hours and was ground to ashes. The ash was cooled and dissolved in 5 ml of 20% HCl. The solution was filtered through an acid-washed filter paper into 50 ml volumetric flask. The filter paper was washed. The solution was diluted with deionised water and it was mixed well. The minerals content in the weeds and herbs were determined using flame Atomic Absorption Spectrometer (A Analyst 700, PerkinElmer, USA) by putting the sample digestion into the AAS. Before starting

the minerals estimation, the AAS was calibrated properly.

The analysis of variance was performed on data for knowing differences between

and within the subgroups using the one-way ANOVA. Mean separations were determined by Post-Hoc's Duncan's test at $P \leq 0.05\%$ using IBM SPSS Version 21.

Table 1: The weeds and local plants used for vitamin and mineral analyses

| English name, Malay local name, Scientific name and Family | Photos |
|---|--|
| <p>1. Indian neetle Kucing galak <i>Acalypha indica</i> Euphorbiaceae</p> |  |
| <p>2. Mexican mint Bangun- bangun <i>Plectranthus amboinicus</i> Lamiaceae</p> |  |
| <p>3. Hummingbird tree leaves Kacang turi <i>Sesbania grandiflora</i> Fabaceae</p> |  |

| | |
|---|--|
| <p>4. Water amaranth Daun ki tolod/ Keremak <i>Alternanthera sessilis</i> Amaranthaceae</p> |  A photograph of a water amaranth plant (Alternanthera sessilis) growing in a brown plastic nursery tray. The plant has numerous bright green, lanceolate leaves with prominent veins, growing densely together. |
| <p>5. King's salad Ulam raja <i>Cosmos caudatus</i> Asteraceae</p> |  A photograph of a King's salad plant (Cosmos caudatus) growing in a brown plastic nursery tray. The plant has finely divided, feathery green leaves and several upright, thin stems. |
| <p>6. Beach's morning glory Kangkung <i>Ipomoea aquatica</i> Convolvulaceae</p> |  A photograph of a Beach's morning glory plant (Ipomoea aquatica) growing in a brown plastic nursery tray. The plant has large, heart-shaped green leaves with prominent veins and several upright stems. |

| | |
|---|--|
| <p>7. Basil Daun kemangi <i>Ocimum basilicum</i> Lamiaceae</p> |  |
| <p>8. Cassava Pukok ubi kayu <i>Manihot esculenta</i> Euphorbiaceae</p> |  |
| <p>9. Fern Pukok paku <i>Diplazium esculentum</i> Athyriaceae</p> |  |

| | |
|--|--|
| <p>10. Indian bayleaf Daun serai kayu <i>Syzygium polyanthum</i> Myrtaceae</p> |  |
| <p>11. Indian pennywort Pegaga <i>Centella asiatica</i> Umbeliferae</p> |  |
| <p>12. Stone breaker Dukong anak <i>Phyllanthus niruri</i> Phyllanthaceae</p> |  |

| | |
|--|--|
| <p>13. Wild betel Kaduk <i>Piper sarmentosum</i> Piperaceae</p> |  |
| <p>14. Sabah snake grass Belalai gajah <i>Clinacanthus nutans</i> Acanthaceae</p> |  |
| <p>15. Butterfly pea Kacang telang <i>Clitoria ternatea</i> Fabaceae</p> |  |
| <p>16. Indian rhododendron Senduduk <i>Melastoma malabathricum</i> Melastomataceae</p> |  |

17. Aromatic zinger
Cekur
Kaempferia galanga
Zingiberaceae



(Some pictures are taken from internet. We gratefully acknowledge the authors)

RESULTS AND DISCUSSION

The plant sample with the highest amount of riboflavin was *Ipomoea aquatica* (2.144mg/100mg), followed by *Sesbania grandiflora* (1.718mg/100mg) and the third highest was in *Ocimum basilicum* (1.402mg/100mg). The ranking followed as *I. aquatic* > *S. grandiflora* > *O. basilicum* > *P. amboinicus* > *S. polyanthum* > *C. caudatus* > *D. esculentum* (Table 2). The ranking varied in case of Niacin and Ascorbic acid contents.

The deficiencies of vitamins cause adverse effects on the metabolism of the human body and they are essential for human body even in a trace amount. The values of vitamins in Table 2 indicated that *I. aquatic* and *S. grandiflora* had high quantity of B₂ vitamin (1.72 to 2.14 mg/100 mg) and it can be used these plants as a source of these riboflavin. Riboflavin, niacin and ascorbic acid are

the water soluble vitamins. Vitamin C is synthesized in the liver in some mammals, while humans and some other species are unable to synthesize vitamin C [7]. Hussain et al [5] stated that sufficient amount of vitamin C in the diet is important for the body as its deficiency causes scurvy disease. In the scurvy disease, defective collagen is formed, which lead to a disease of connective tissue. The ascorbates (derivative of ascorbic acid) have also anti-oxidant ability to prevent the formation of carcinogenic substances. It is important to mention that carcinogenic compounds, such as nitroso compounds, are formed from oxidation of nitrate which is oxidized to nitrite and the nitrites react with certain amino compounds to form detrimental nitroso compounds. The ascorbates can prevent the oxidation of nitrate [8]. Niacin is a constituent in two pyrimidine nucleotide coenzymes, NAD

and NADP, and it is stated that niacin is active in preventing pellagra disease in humans [7].

Plants, especially *Sesbania grandiflora*, *Alternanthera sessilis* and *Acalypha indica* are a good source of niacin. When total vitamin contents are estimated it is obvious that the plants *S. grandiflora*, *I. aquatic* and *A. indica* are more vitamin contributory to human diets.

In the earliest years, dandelion and wild asparagus have been common food to some people. Some edible wild plants from Ohio and Kentucky were assayed for vitamin content and the result showed

that some of the edible wild plants contained more vitamin value than fresh fruits and vegetables. The ascorbic acid values of 16 edible plants were determined and when compared with oranges, on a weight basis, ten of the wild plants had higher values of vitamin C [9].

The mineral contents that were determined from the plant samples are - Zn, Ca, Fe, Mg and Mn (Table 3). The higher is the concentration (ppm), the higher are the amount of minerals contents.

Table 2: Contents of vitamins of the ten weeds and local plant samples (mg/100mg)

| Plant name | Riboflavin (B ₂) | Niacin (B ₃) | Ascorbic acid (C) | Total vitamins |
|-------------------------------|------------------------------|--------------------------|--------------------|----------------|
| <i>Ipomea aquatica</i> | 2.144 ^a | 0.418 ^e | 0.156 ^d | 2.718 |
| <i>Ocimum basilicum</i> | 1.402 ^b | 0.717 ^d | 0.164 ^c | 2.283 |
| <i>Manihot esculenta</i> | 1.171 ^e | 0.244 ^f | 0.116 ^e | 1.531 |
| <i>Diplazium esculentum</i> | 0.320 ^f | 0.570 ^d | 0.086 ^g | 0.976 |
| <i>Syzygium polyanthum</i> | 1.242 ^c | 0.580 ^d | 0.400 ^a | 2.222 |
| <i>Sesbania grandiflora</i> | 1.718 ^b | 1.586 ^b | 0.130 ^e | 3.434 |
| <i>Alternanthera sessilis</i> | 0.951 ^e | 1.081 ^c | 0.134 ^e | 2.166 |
| <i>Acalypha indica</i> | 0.977 ^e | 1.805 ^a | 0.090 ^f | 2.872 |
| <i>Plenranthus amboinicus</i> | 1.380 ^b | 0.527 ^d | 0.170 ^b | 2.077 |
| <i>Cosmos caudatus</i> | 1.226 ^d | 0.602 ^d | 0.065 ^h | 1.893 |

The figures in column bearing dissimilar small letters indicate significant difference

Table 3: Mineral contents (ppm) of selected weeds and local plants of Kelantan

| Plant | Zinc (Zn) | Calcium (Ca) | Ferum (Fe) | Magnesium (Mg) | Manganese (Mn) |
|--------------------------------|--------------------|---------------------|---------------------|--------------------|---------------------|
| <i>Cosmos caudatus</i> | 0.511 ^h | 201.1 ^g | 4.573 ^g | 178.1 ^c | 0.648 ^h |
| <i>Diplazium esculentum</i> | 0.843 ^e | 11.67 ^j | 5.205 ^f | 159.2 ^c | 0.740 ^{gh} |
| <i>Kaempferia galanga</i> | 1.899 ^a | 415.40 ^b | 17.430 ^a | 192.0 ^b | 1.729 ^e |
| <i>Clinanthus nutans</i> | 1.508 ^d | 498.00 ^a | 4.333 ^h | 234.0 ^a | 2.005 ^d |
| <i>Phyllanthus niruri</i> | 0.552 ^g | 245.40 ^d | 5.640 ^e | 134.0 ^g | 3.343 ^c |
| <i>Piper sarmentosum</i> | 0.694 ^f | 90.89 ^h | 3.103 ^j | 136.5 ^f | 0.869 ^g |
| <i>Centella asiatica</i> | 1.753 ^b | 227.80 ^f | 10.270 ^b | 158.6 ^c | 7.001 ^b |
| <i>Clitoria ternatea</i> | 1.655 ^c | 261.00 ^c | 6.912 ^d | 161.5 ^d | 0.818 ^g |
| <i>Ipomea aquatica</i> | 0.195 ^j | 43.41 ⁱ | 8.986 ^c | 134.7 ^g | 1.274 ^f |
| <i>Melastoma malabathricum</i> | 0.319 ⁱ | 239.80 ^e | 3.537 ⁱ | 125.1 ^h | 13.020 ^a |

The figures in column bearing dissimilar small letters indicate significant difference

Clinanthus nutans plant contained the highest amount of calcium (498.0 ppm) and magnesium (234.0 ppm) while zinc (1.508 ppm), ferum (4.333 ppm) and manganese (2.005 ppm) contained in least amount. This result is acknowledged by the UTURN Company, Malaysia, who is the first producer of *Clinacanthus nutans* extract that this plant contains crude fiber and high calcium. The plant is also high in other nutrients. Therefore, *C. nutans* is a good minerals supplier and helps to maintain a harmonious body system. Based on the research done by Direkbusarakom *et al.* [10], the extract of *Clinacanthus nutans* also has been tested against yellow head virus (YHV) in shrimps and the result indicated an effective control of YHV infection in shrimps.

From the table 2 it is clear that *Cosmos caudatus* contained high amount of calcium (201.1 ppm) and magnesium (178.1 ppm). Ajaykumar *et al.* [11] observed that *Cosmos caudatus* plant contained high amount of calcium, phosphorus, iron, magnesium and potassium. All the minerals are good in order to clean the blood and also to strengthen the muscles and bones. Nurul *et al.* [12] showed that this plant

contained high antioxidant due to the presence of flavanoids [13] and had antimicrobial properties [12]. Shui *et al.* [14] also observed that *Cosmos caudatus* plant contained extremely high antioxidant capacity of about 2400 mg l-ascorbic acid equivalent antioxidant capacity (AEAC) per 100 grams of fresh sample.

Diplazium esculentum contained the high amount of zinc (0843 ppm) and magnesium (159.2 ppm) followed by calcium (11.67 ppm) and ferum (5.205 ppm). Irawan *et al.* [15] stated that *D. esculentum* plant contained high amount of ferum (44.6 ppm) and folic acid (6.3 ppm) while in this study *D. esculentum* plant contained only 5.205 ppm of ferum. Hochmuth [16] stated that plant tissue analyses for ferum are problematic to interpret unless the leaves have been rinsed in dilute acid or detergent. This problem arises because ferum is ubiquitous in dust and can be a contaminant on the surface on plant leaves.

According to Tanzima *et al.* [17], *Kaempferia galangal* contained high amount of ferum (192 ppm), manganese (68 ppm) and zinc (12 ppm). The result of this study are also more or less similar

which showed high amount of zinc (1.899 ppm), ferum (17.430 ppm), calcium (415.40 ppm) and magnesium (192.00 ppm) and the less amount of manganese (1.729 ppm). Based on Hodges [18], the concentration (ppm) of manganese is mostly affected by soil pH, organic matter and soil moisture.

It is concluded that *K. galangal* can be used as zinc and ferum supplement food, while *C. nutans* as calcium and magnesium supplement food. On the other hand, *M. malabathricum* can play a role to supply manganese. However, before suggesting for human consumption, toxicity test and sensory test should be conducted to know the consumers' acceptance.

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