

Alternative Medicines from Edible Bitter Plants of Besut, Malaysia

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ABSTRACT

In Besut, some elderly is believing the bitter taste vegetables may provide medicinal benefits. However, discontinuity of their knowledge to the young generation leads to deterioration. To this time, there still no documentation is done on the consumption of edible bitter plants in Besut. This research conducted to reveal their knowledge in consuming edible, bitter and native plants for medicinal purposes. From the field visit and conversation, a list of accessions had been made, followed by the frequencies on how it had been used. A dendrogram, to show the linkage between the purposes of the studied plants as alternative medicine and supplement had been done by using IBM SPSS Statistics 20 software and bar chart plotted by using Microsoft Excel. There were 15 native families comprised of 17 plants species had been consumed for treating 31 types of health problems. The highest percentage of diseases treated represented by digestion problems, 64.7 %. The species of *Morinda citrifolia* (mengkudu besar) found achieved the highest uses among the studied plants. The value of Pearson correlation, $r = 0.633$, showed a positive correlation between the purposes of treating diabetes and digestion problems at a significant level, $p = 0.01$. Based on the dendrogram, there was the nearest linkage at the distance of 3/25 in a cluster of 3; *Crateva religiosa* (dala), *Oroxylum indicum* (beka) and *Tylopilus felleus* (kulat gelam) which were used for treating hypertension, diabetes and supplement for a person with poor food appetite. The bitter taste from plants was stimulated positive perception of people to eat them as alternative medicine. Besides the leafy vegetables, mushroom also had been consumed as healing food.

Keywords: Edible plants, bitter, alternative medicine, Besut

ABSTRAK

Di Besut, terdapat golongan berumur yang mempercayai bahawa sayuran-sayuran yang rasanya pahit boleh memberi kebaikan nilai perubatan. Walau bagaimanapun, pengetahuan mereka yang tidak diturunkan kepada generasi muda menyebabkan ia luput. Memandangkan masih belum terdapat suatu dokumentasi mengenai penggunaan tumbuhan makanan yang pahit dibuat di Besut, kajian ini dijalankan untuk membongkar pengetahuan mereka dalam mengamalkan tumbuhan makanan yang pahit dan asli untuk tujuan perubatan. Hasil daripada tinjauan lapangan, satu senarai dapatan berkenaan tumbuhan makanan pahit dibuat, diikuti dengan analisis untuk kekerapan ia digunakan. Kemudian, dendrogram yang menunjukkan perkaitan antara kegunaan tumbuhan yang dikaji tersebut sebagai ubatan alternatif dan makanan tambahan dibuat dengan menggunakan perisian komputer IBM SPSS Statistics 20 dan carta bar diplot dengan menggunakan Microsoft Excel. Terdapat sebanyak 15 keluarga asli tumbuhan terdiri daripada 17 spesies tumbuhan yang digunakan untuk merawat 31 jenis masalah kesihatan. Peratus tertinggi masalah kesihatan yang dirawat ialah masalah penghadaman iaitu 64.7 %. Spesies *Morinda citrifolia* (mengkudu besar) didapati mempunyai penggunaan tertinggi daripada semua tumbuhan yang dikaji. Nilai korelasi Pearson, $r = 0.633$, menunjukkan korelasi positif di antara tujuan rawatan diabetes dengan masalah penghadaman pada aras signifikan, $p = 0.01$. Berdasarkan dendrogram, terdapat perkaitan yang paling hampir, pada jarak 3/25 di dalam 1 kelompok bagi 3 tumbuhan iaitu *Crateva religiosa* (dala), *Oroxylum indicum* (beka) dan *Tylopilus felleus* (kulat gelam) yang mana digunakan untuk merawat hipertensi, diabetes dan makanan tambahan bagi seseorang yang kurang selera makan. Rasa pahit daripada tumbuhan tersebut telah mencetus persepsi positif pengguna untuk makan sebagai perubatan alternatif. Di samping tumbuhan berdaun, cendawan juga digunakan sebagai makanan penyembuh penyakit.

Kata Kunci: Antioxidant, antiemoebic, delima, nanopartikel perak, kesan Cytotoxicity

INTRODUCTION

Food taste is being considered as one of the important factors for consuming edible plants which it may influence the food selecting for the certain purposes among human, animals and even insects (Huffman, 2001; Redwick, 1999). Elderly in Besut are familiar to eat bitter vegetables for their health purposes. However, to current, there is no any record made about the consumption of edible bitter plants by residents in Besut district. In fact, the documentation is important to reveal their knowledge in consuming bitter plants as alternative medicine for

treating the certain disease before it had been deteriorated as young generation is not interested in the topic of traditional medicine.

Most elder people are believe that bitter substance in edible plants is special and contain therapeutic values. This is based on their experiences and knowledge received from the previous generation. Even in some plants, the phytochemical contents were never been confirmed, however through the ethno-botanical surveys in Malaysia, India, Iran, Bangladesh, Brazil and Ethiopia, researchers found people have their positive perceptions and had been practiced consuming edible and bitter plants as alternative medicine sources to treat common illnesses since ancient time (Ong *et al.*, 2012; Deb *et al.*, 2013; Najafi, 2013; Das *et al.*, 2012; Baliano *et al.*, 2015; Kewessa *et al.*, 2015).

The most helpful resources in revealing the occurrence of the economic plants were the explanation by Isaac Henry Burkill (1870 to 1965) in the Dictionary of the Economic Products of the Malay Peninsula (Burkill, 1935). The related information to most medicinal purposes of edible plants in Malaysia was provided by Ong (2004; 2006; 2008a; 2008b; 2011). The descriptions were included the wild, ornamental, spices and vegetables that contain nutritional values and phytochemical constituents. Earlier, some useful records of the edible and medicinal plants had been made and later being important sources for researchers in the botanical field (Ridley, 1890; Burkill, 1966; Whitmore, 1973). The ethno-botanical research was included the characterizations of plants into the category of food, medicine, construction and ornamental. There were great benefits of edible plants recorded in the context of alternative medicines (Ismail, 2000).

We believe our effort in this ethno-botanical survey will gain well cooperation from Besut people. While our communication with informers will reveal new knowledge and the consumption of the bitter plants as alternative medicine will be documented properly. Thus, the objective of this research is to provide a list of edible bitter plants that never been reported before, which the plants were used by Besut people for the medicinal and supplemental values. Based on the results, we can find the frequency in uses for each accession, also the correlation and linkage among the plants that had been used for certain purposes.

MATERIAL AND METHODS

Field trip

Besut district is in the coordinate of 5° 35' N longitude and 102° 35' E latitude (Oxford Fajar, 2007) in Terengganu state, Malaysia (Figure 1). The district formed by sixteen provinces and five electoral boundaries. The total resident number recorded in the year 1970 was about 79,197, increased to 118,058 in the year 1991 and had been estimated to be increased to 226,437 in the year 2020. The area has an equatorial climate with the mean temperature ranges from 24 °C to 34 °C at noon. The trends of the increasing resident number showed the nature growth pattern, resulted by the committed development including the developing of the university and East Coast Economic Region (ECER) plan (MDB, 2015).

Regular field trips were conducted in the area of Besut district. Village localities were selected by the early survey done for the knowledgeable Malay people aged 50 years old and above. They are mostly medicine men, midwives, alternative medicine practitioners and the owner of some rarely found plants. The selected criteria were made by assuming their ability to disclose their knowledge and experiences on edible plants consumptions, especially the bitter taste which had been used in healing certain health problems and gained more positive perception as alternative medicine and supplement.

Interview session and personal communication

As previous research done by Sukup *et al.* (2000), people with age above 45 years old have a better experience in consuming alternative medicine plants, while those who below 40 years old were lack of interest and knowledge about medicinal plants and preferred modern treatment. The fieldwork was carried out during the period from May 2015 to May 2016. During the time, frequent visits were made to meet and have personal communication with the informants, followed by field visit for plants details. Determination of sample size was carried according to Krejcie and Morgan (1970) and Chua (2014a). Modification work done for calculation of resident number in Terengganu state with their age ranges between 50 to 75 years old and above, where the average of percentage was 2.60 % of the total residents (Oxford Fajar, 2007).

Plants verification and specimen deposition

The collected plant specimens were identified and authenticated by botanists from Universiti Sultan Zainal Abidin (UniSZA) for confirmation. After the descriptions had been prepared, the specimen then provided with voucher number as referred to procedures by Singh (1999) before deposited in UniSZA Herbarium, Besut Campus, Terengganu, Malaysia.

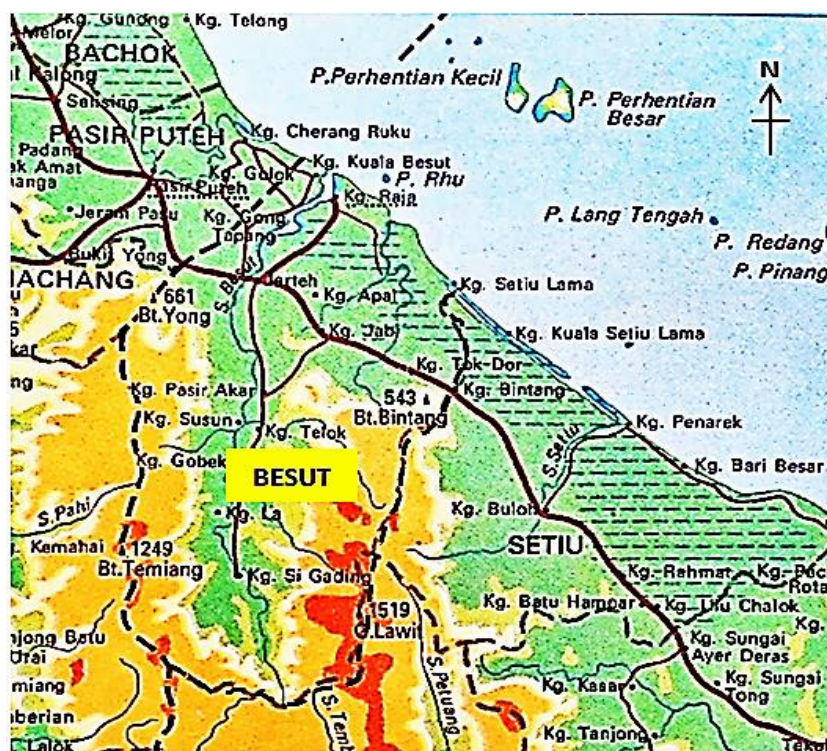


Figure 1. Map of Besut district (coordinate; $5^{\circ} 35' N$ $102^{\circ} 35' E$, not to scale), the long dash is the boundary of Besut district.

Statistical analysis

The data obtained from field observations and personal communication with the informants had been analysed to make a list of edible bitter plant uses (Das *et al.*, 2012). At the significant level, $p < 0.05$, we chose thirty best informants to compile their knowledge. Calculation for frequency and correlation for 17 species of edible bitter plants ($n=17$) had been proceeding with IBM SPSS Statistics 20 software as referred to Chua (2014b). According to Lockman (1998), a bar chart had been plotted to show the percentage of edible bitter plants in Besut that had

been used for treating certain diseases and as a supplement. In performing the hierarchical cluster analysis, we analysed and classified the variables under agglomeration schedule in Ward's method to obtain the dendrogram and to show linkage among uses of the accessions (Wan Ahmad and Mamat 2009).

RESULTS AND DISCUSSION

Consumption of edible bitter plants

The consumption of edible bitter plants for purposes of alternative medicine and supplement had been listed in Table 1, as the results from the knowledge of Besut residents who aged 50 to 81 years old. The accessions were comprised of seventeen species from fifteen families. The angiosperms represented by thirteen families those are; Anacardiaceae, Bignoniaceae, Capparidaceae, Cleomaceae, Compositae, Labiatae, Musaceae, Myrtaceae, Palmae, Rhamnaceae, Rubiaceae, Sapindaceae and Verbenaceae, while Boletaceae and Polypodiaceae are two families of mushroom and fern respectively.

Edible bitter plants as medicine and supplement

The percentage among uses of selected edible bitter plants shown in the bar chart in Figure 2 with the highest number represented by digestion problems is 64.7 %. People in Besut consumed 35.3 % of bitter vegetables to improve their food appetite and the selection might be influenced by the taste. At the same time, the diabetes problems attained much attention, as 58.8 % among the listed edible bitter plants. Both purposes of hypertension and anthelmintic problems obtained 29.4 %, followed by 23.5 % of accessions consumed for fever, dizziness and headache.

The percentage of the treatments of stomach ache, diarrhoea and dysentery was 17.6 %, the same to anti-aging purpose. While, 11.8 % of edible bitter plants used for purposes of tooth-ache and gums problem, rheumatism, post-partum, flatulence, bleeding and menstrual problems. The rest had been used in minimal frequency including usage for alternative treatment and supplement for 16 health problems, as they are; chest pain, cholera, constipation, contraceptive, gastric, gout, haemorrhoid, hypotension, insomnia, itchiness, muscle pain, parturition blues, sex debility, shingles, splenomegaly and ulcer.

Correlation among uses of bitter plants

The correlations coefficients between the five highest percentages of accessions used to treat certain diseases as shown in Table 2. The value of Pearson correlation, $r = 0.633$ means there was the intermediate strength of positive correlation between the usage of 17 accessions for diabetes and the digestion problems. The positive correlation at intermediate strength also found between treatment for diabetes and food appetizer supplement with $r = 0.618$, both correlation values are at significant level, $p = 0.01$; while between the uses of digestion problems and food appetizer the value of $r = 0.545$ at the significant level, $p = 0.05$.

Dendrogram in Figure 3 shows four clusters obtained for the accessions possessed the nearest linkage at the range of distance 3/25 to 16/25 in rescaled cluster combine. Cluster 1 (C1) has the nearest linkage at distance of 3/25, based on the rescaled distance cluster combine, comprised of *Cratogeomys merriami*, *Tylopilus felleus* and *Oroxylum indicum* that were used widely as food for treating hypertension and diabetes and so as food appetizer.

Cluster 2 (C2) was represented by the well-known bitter and astringent plants; *Anacardium occidentale*, *Vernonia amygdalina* and *Cleome gynandra* that commonly found in villages and carrying the anthelmintic properties. While in cluster 3 (C3), the species of wild banana, *Musa balbisiana* and wild berry *Rhodomyrtus tomentosa* linked at the distance 13/25, both carrying the roles in treating diarrhoea. The fourth cluster (C4) comprised of *Leucas zeylanica* and the *Vitex pubescens* at the distance of 16/25, the farthest linkage, which both species are familiar in uses for flatulence treatment and related problems of the stomach.

Leucas zeylanica from Sri Lanka had been screened for antimicrobial activities and found it was active against Gram-positive bacteria. In traditional uses, the species had been consumed to treat anorexia, flatulence, colic and malaria (Rajakaruna *et al.*, 2002). While *Vernonia amygdalina*, a species that contributes to the therapeutic purpose for diabetes and hypertension had been found containing phytochemicals such as saponins, alkaloids, steroids and flavonoids. The extraction from *V. amygdalina* used as remedies against helminthic and bacterial infections have been used in various traditional medicines in Nigeria (Farombi and Owoeye, 2011). The species of *Oroxylum indicum* that was found in North East India has been reported containing major content of flavonoids. Leaves extraction used for its antioxidant, anti-inflammatory and anti-hepatotoxic properties (Deka *et al.*, 2013).

Not only the green leafy vegetables but also the mushroom had been considered as a source for its bitter compound and consumed as healing food. *Tylopilus felleus* or bitter boletus was believed to be effective in treating diabetes and hypertension. That was the same in the usage of two mushrooms from Nigeria, *Schizophyllum commune* and *Ganoderma resinaceum*, which were both consumed as food for health, treating diabetes and to prevent hypertension (Oyetayo, 2011). The bitter taste of some plants attracts people to consume it as alternative medicine where it may ignite signal and stimulate special perception to make people who take bitter taste of vegetables to be increased in food taking and absorb more nutrient (Ong, 2009). There was a wide range of purposes among bitter plants, especially the edible type such as *Morinda citrifolia* (Figure 4) which normally taken as food for a certain person in treating body disorders, improve food appetite, to prevent illnesses and to promote better health. There were similarities in purposes of some accessions in Besut which also had been used in Kuala Terengganu district (Ong *et al.*, 2011).

The percentage of edible bitter plants used as medicine and supplement showed in the bar chart in Figure 2, for best representation for the numerical data with different categories (Indrayan and Satyanarayana, 2006). While from the represented branches in the dendrogram, the distance of relationships among edible bitter plants showed potential among seventeen accessions ($n = 17$), where some were used for treating the same diseases or used as the same purpose of supplement. The ways of consuming were mostly by eating fresh, cooked or pickled form and some were taken in decoction.

Table 1. Edible bitter plants consumed as alternative medicines and supplements

Family/species	Local name	Habitat	Part used	As medicine / supplement for	Consuming methods
Anacardiaceae <i>Anacardium occidentale</i> Linn.	Keteroh (EBP 1)	Wild, shrub	Young leaf (in 14 days)	Diarrhoea, dysentery, anthelmintic	Eaten raw as salad with rice
Boletaceae <i>Tylopilus felleus</i> (Bull.) Karst.	Kulat gelam (EBP 2)	Wild, mushroom	Whole mushroom (lasting in 3 - 4 days)	Hypertension, diabetes, dizziness, food appetizer	Boiled mushroom eaten together with rice
Bignoniaceae <i>Oroxylum indicum</i> Vent.	Beka (EBP 3)	Wild, tree, wayside	Young leaf (in 1 - 2 week emergence), young pod (in 2 months)	Hypertension, diabetes, anthelmintic, food appetizer	Fresh leaf, blanched and cooked pod eaten as vegetables with rice
Capparidaceae <i>Cratogeomys religiosa</i> G. Forst.	Dala (EBP 4)	Wild, tree	Young leaf, flower (in about 7 - 8 days)	Diabetes, hypertension, food appetizer	Pickle eaten as salad with rice
Cleomaceae <i>Cleome gynandra</i> Linn	Maman (EBP 5)	Wild, herb	Stem, leaf	Diabetes, food appetizer, anthelmintic, rheumatism	Pickle eaten as salad with rice
Compositae <i>Vernonia amygdalina</i> Del.	Pokok pahit (EBP 6)	Cultivated, shrub	Leaf	Hypertension, diabetes	Young leaf eaten raw in small size, decoction of old leaf taken orally
Labiatae <i>Lencas zeylanica</i> R. Br.	Ketumbit (EBP 7)	Wild, herb	Stem, leaf, flower	Flatulence, constipation	Eaten raw as salad with rice
Musaceae <i>Musa balbisiana</i> Colla	Pisang benggala (EBP 8)	Cultivated, herb	Young fruit (1 month, before the seeds hardened)	Diarrhoea, fever, rheumatism	Pickle eaten as salad or cooked, taken with rice
Myrtaceae <i>Syzygium polyanthum</i> Wight.	Serai kayu (EBP 9)	Wild, tree	Young leaf (about 7 days before mature)	Bleeding, women on menstrual, diarrhoea, headache, toothache, anti-aging, contraceptive	Eaten raw as salad with rice
<i>Rhodomyrtus tomentosa</i> Wight.	Kemunting (EBP 10)	Wild, shrub	Young leaf (about 5 days emergence), young fruit (grey colour)	Hypertension, diarrhoea, headache, dysentery, parturition blues, diabetes	Slices of young leaf added into nasi kerabu salad, decoction of young fruit taken orally
Palmae <i>Nypa fruticans</i> Wurm.	Nipah (EBP 11)	Wild, palm tree	Young and mature fruits	Ulcer, gout, shingles, sex debility, toothache, headache, anthelmintic, digestive problems	Part of young fruit cooked as a dish, part of mature fruit used as tea
Polypodiaceae <i>Acrostichum aureum</i> Linn.	Piai (EBP 12)	Wild, swamp fern	Young frond (under 2 weeks)	Hypotension, anthelmintic, digestive problems	Blanched fronds eaten as salad with rice
Rhamnaceae <i>Zizyphus mauritiana</i> Lam.	Bidara (EBP 13)	Cultivated, tree	Leaf, fruit	Menstrual tonic, fever, gingivitis, digestive problem, chest pain, anti-aging	Leaf juice taken orally, young fruit eaten raw
Rubiaceae <i>Morinda citrifolia</i> Linn.	Mengkudu besar (EBP 14)	Cultivated, shrub, tree	Young leaf (about 8 - 12 days)	Diabetes, post-partum, ulcer, food appetizer, fever, splenomegaly, anti-aging	Young leaf blanched, eaten as salad with rice
<i>Morinda elliptica</i> (Hook. f.) Ridl.	Mengkudu kecil (EBP 15)	Wild, tree	Young leaf (about 10 days)	Diabetes, post-partum hypertension, cholera, food appetizer, haemorrhoid	Young leaf blanched, eaten as salad with rice
Sapindaceae <i>Lepisanthes rubiginosa</i> (Roxb.) Leenh.	Terajan, mertajam (EBP 16)	Wild, tree	Young leaf (about 7 days), ripe fruit	Diabetes, hypertension, stomach-ache, insomnia, skin problem, itchiness	Young leaf chewed and put on problem skin, fruit eaten fresh in small quantity
Verbenaceae <i>Vitex pubescens</i> Vahl.	Halban, leban (EBP 17)	Wild, tree	Young leaf (about 5 - 7 days)	Muscle pain, fever, stomach-ache, flatulence, gastric, parturition blues	Young leaf eaten raw as salad with rice

Further research is possible and necessary for better documentation about edible plants that contain bitter taste for more details of their morphological, phytochemicals and potential on how they can be commercialised. The accessions can be divided into similar functions and possible for a test such as phytochemicals, antioxidant properties, antimicrobial, anthelmintic, anti-inflammatory and anti-arthritic. Although the bitter principles are rarely found poisonous and edible, further pharmacological and toxicological studies need to be done to confirm the potential, risks or adverse effects that may occur from the consumption of the plants (Sequin, 2012).

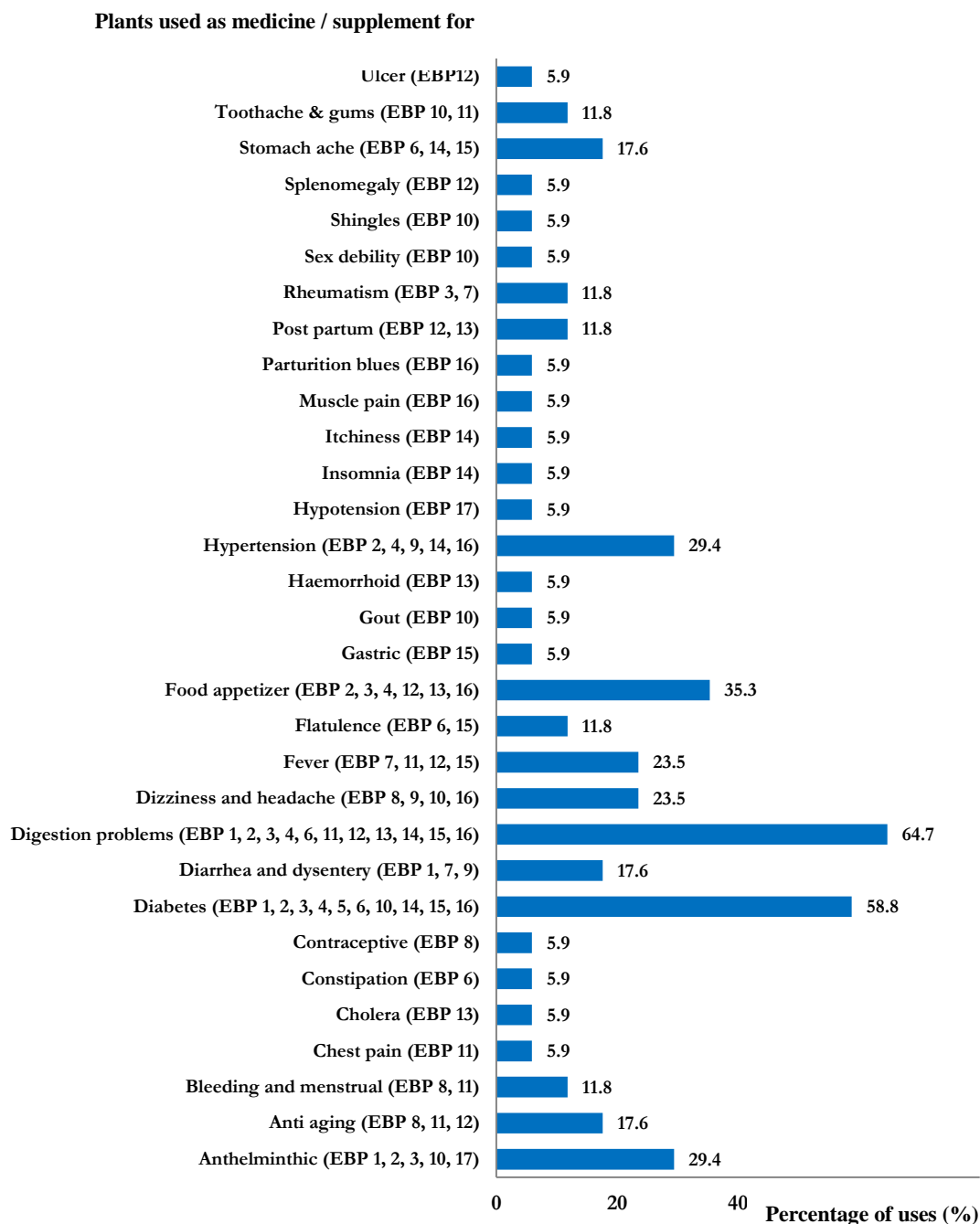


Figure 2. Medicinal and supplemental uses of edible bitter plants (numbered as EBP 1 to EBP 17); each plant may occur in different uses.

Table 2. Correlations between medicinal or supplemental uses with the consumption of bitter plants

		Correlations				
		Digestion problems	Diabetes	Food appetizer	Hypertension	Anthelmintic
Digestion problems	Pearson Correlation	1	.633**	.545*	.207	-.064
	Sig. (2-tailed)		.006	.024	.426	.808
	N	17	17	17	17	17
Diabetes	Pearson Correlation	.633**	1	.618**	.278	.015
	Sig. (2-tailed)	.006		.008	.280	.953
	N	17	17	17	17	17

** . Correlation is significant at the 0.01 level (2-tailed)

* . Correlation is significant at the 0.05 level (2-tailed)

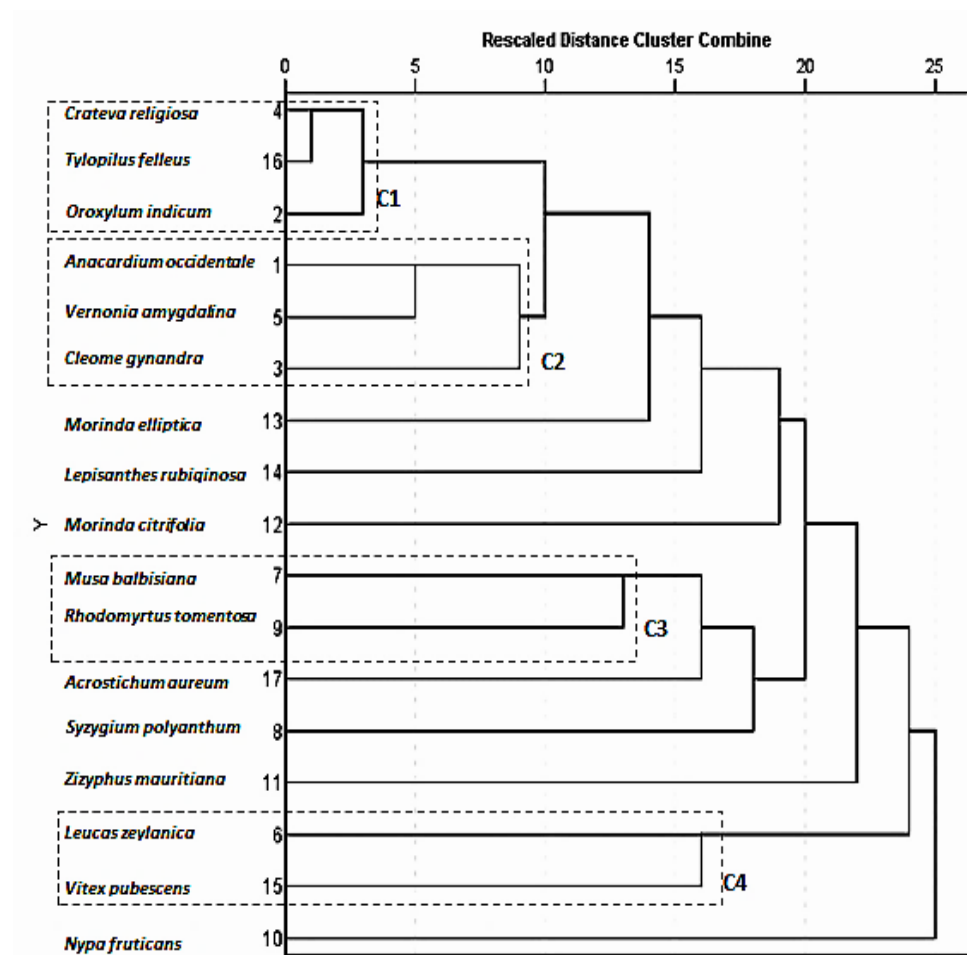


Figure 3. Dendrogram of average linkage among edible bitter plants in a cluster of similar uses.

CONCLUSIONS

To obtain the information of edible bitter plants consumption in Besut, personal communication between the researcher and the elderly was important and their willingness to share ideas was helpful. The diseases treated with the consumption of the edible bitter plants that had been revealed from their life experiences had been listed and successfully documented. Most of the knowledge may disappear if the conservations steps not to be taken; as the

young generation not interested neither to the alternative medicine, nor the bitter taste of any plants. The species of *Morinda citrifolia* found as highest number in uses among all accessions. At least 31 health problems were believed had been cured and treated with the consumption of 17 species of edible bitter plants. Diabetic people were found consumed 10 species; *Anacardium occidentale*, *Oroxylum indicum*, *Tylophilus felleus*, *Crateva religiosa*, *Cleome gynandra*, *Vernonia amygdalina*, *Rhodomirtus tomentosa*, *Morinda citrifolia*, *Morinda elliptica* and *Lepisanthes rubiginosa* for their treatment and supplement. While, with the same 10 previous accessions, there were another three species were consumed for digestion problems; *Nypa fruticans*, *Acrostichum aureum* and *Zizyphus mauritiana*. People in Besut gave the highest attention for digestion problem with the highest percentage, 64.7 % in consuming edible bitter plants, followed by purposes of treating a diabetic, 58.8 % and 35.3 % as food appetizer.



Figure 4. *Morinda citrifolia* Linn. (mengkudu besar) tree.

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REFERENCES

- Baliano, A. P., Alves, F. S., Pereira, A. C. H., Aquije, G. M. D. F. V., Lenz, D., Andrade, T. U. & Edringer, D. C. (2015). Centennial knowledge of medicinal plants held in communities in Espirito Santo, Brazil. *Ethnobotany Research & Applications* **14**: 155-162.
- Burkill, I. H. (1935). A dictionary of the economic products of the Malay Peninsula. Volume I & II. Governments of the Straits Settlements and Federated Malay States, London. 2402 pp.
- Burkill, I. H. (1966). A dictionary of the economic products of the Malay Peninsula volume I & II. Ministry of Agriculture and Co-operatives, Kuala Lumpur. 2444 pp.
- Chua, Y. P. (2014a). Kaedah dan statistik penyelidikan buku 1 - kaedah penyelidikan edisi ketiga. McGraw Hill Education, Kuala Lumpur. 386 pp.
- Chua, Y. P. (2014b). Kaedah dan statistik penyelidikan, buku 2 - asas statistik penyelidikan edisi ketiga. McGraw Hill Education, Kuala Lumpur. 336 pp.

- Das, P. R., Islam, M. T., Mahmud, A. S. M. S., Kabir, M. H., Hasan, M. E., Khatun, Z., Rahman, M. M., Nurunnabi, M., Khatun, Z., Lee, Y., Jahan, R. & Rahmatullah, M. (2012). An ethnomedicinal survey conducted among the folk medicinal practitioners of three villages in Kurigram district, Bangladesh. *American-Eurasian Journal of Sustainable Agriculture* **6**(2): 85-96.
- Deb, D., Sarkar, A., Barma, B. D., Datta, B. K. & Majumdar, K. (2013). Wild edible plants and their utilization in traditional recipes of Tripura, Northeast India. *Advances in Biological Research* **7**(5): 203-211.
- Deka, D. C., Kumar, V., Prasad, C., Kumar, K., Gogoi B. J., Singh, L. & Srivastava, R. B. (2013). *Oroxylum indicum* - a medicinal plant of North East India: An overview of its nutritional, remedial and prophylactic properties. *Journal of Applied Pharmaceutical Science* **3**(1): 104-112.
- Farombi, E. O. & Owwoye, O. (2011). Antioxidative and chemopreventive properties of *Vernonia amygdalina* and *Garcinia biflavonoid*. *International Journal of Environmental Research and Public Health* **8**(6): 2533-2555.
- Huffman, M. A. (2001). Self-medicative behavior in the African great apes: An evolutionary perspective into the origins of human traditional medicine. *Bioscience* **51**: 651-661.
- Indrayan, A. & Satyanarayana, L. (2006). Biostatistics for medical, nursing and pharmacy students. Prentice Hall of India Private Limited, New Delhi, India. 295 pp.
- Ismail, S. (2000). Sayuran tradisional ulam dan penyedap rasa. Penerbit Universiti Kebangsaan Malaysia, Selangor, Malaysia. 228 pp.
- Kewessa, G., Abebe, T. & Demissie, A. (2015). Indigenous knowledge of the use and management of medicinal trees and shrubs in Dale district, Sidama zone, Southern Ethiopia. *Ethnobotany Research & Applications* **14**: 171-182.
- Krejcie, R. V. & Morgan, D. W. (1970). Determining sample size for research activities. *Educational and Psychological Measurement* **30**: 608.
- Lockman, H. (1998). Excel 7.0: Windows 95 peringkat permulaan. Dewan Bahasa dan Pustaka, Kuala Lumpur. 295 pp.
- Majlis Daerah Besut (MDB). (2015). 1.2.2 Data penduduk, <http://mdb.terengganu.gov.my/rancangan-tempatan-daerah-besut-2008-2020>, retrieved 1st May 2016.
- Najafi, S. (2013). Phytochemical screening and antibacterial activity of leaf extract of *Ziziphus mauritiana* Lam. *International Research Journal of Applied and Basic Sciences* **4**(11): 3274-3276.
- Ong, H. C. (2004). Tumbuhan liar khasiat ubatan dan kegunaan lain. Utusan Publications and Distributors, Kuala Lumpur. 241 pp.
- Ong, H. C. (2006). Tanaman hiasan khasiat makanan. Utusan Publications and Distributors, Kuala Lumpur. 293 pp.
- Ong, H. C. (2008a). Rempah-ratus khasiat makanan dan ubatan. Utusan Publications and Distributors, Kuala Lumpur. 255 pp.
- Ong, H. C. (2008b). Vegetables for health and healing. Utusan Publications and Distributors, Kuala Lumpur. 244 pp.
- Ong, H. C. (2009). Sayuran: Khasiat makanan dan ubatan. Utusan Publications and Distributors, Kuala Lumpur. 156 pp.
- Ong, H. C. (2011). Sayuran 2: Khasiat makanan dan ubatan. Utusan Publications and Distributors, Kuala Lumpur. 189 pp.

- Ong, H. C., Norlia, A. & Sorayya, M. (2012). Traditional knowledge and usage of edible plants among the Temuan villagers in Kampung Tering, Kuala Pilah, Negeri Sembilan, Malaysia. *Indian Journal of Traditional Knowledge* **11**(1): 161-165.
- Ong, H. C., Ruzalila, B. N. & Milow, P. (2011). Traditional knowledge of medicinal plants among the Malay villagers in Kampung Tanjung Sabtu, Terengganu, Malaysia. *Indian Journal of Traditional Knowledge* **10**(3): 460-465.
- Oxford Fajar. (2007). Atlas moden Malaysia dan dunia 12th edition. Oxford Fajar Sdn. Bhd., Selangor. 160 pp.
- Oyetayo, O. V. (2011). Medicinal uses of mushrooms in Nigeria: Towards full and sustainable exploitation. *African Journal of Traditional Complement Alternative Medicine* **8**(3): 267-274.
- Rajakaruna, N., Harris, C. S. & Towers, G. H. N. (2002). Antimicrobial activity of plants collected from serpentine outcrops in Sri Lanka. *Pharmaceutical Biology* **40**(3): 235-244.
- Redwick, A. J. A. (1999). Phytochemical modification of taste: An insect model. p. 221-229. In *Biologically Active Natural Products: Agrochemicals*. Cutler, H. G. and Cutler, S. J. (eds.) CRC Press, USA. 299 pp.
- Ridley, H. N. (1890). On the so call tiger's milk (susu rimau) of the Malays. *Journal of the Straits Branch of the Royal Asiatic Society* **22**: 341-344.
- Sequin, M. (2012). The chemistry of plants—perfumes, pigments and poisons. RSC Publishing, Cambridge, United Kingdom. 215 pp.
- Singh, G. (1999). Plants systematics. Science Publishers, United State of America. 258 pp.
- Sukup, A., Berhaman, A. & Mashitah, Y. (2000). Tumbuh-tumbuhan yang digunakan dalam perubatan tradisional oleh kaum Rungus Matunggong, Kudat, Sabah. In: *Proceedings of The Seminar on Medicinal and Aromatic Plants*. 12-13 September 2000, Kuala Lumpur, Malaysia. p. 238-241.
- Wan Ahmad, W. M. A. & Mamat, M. (2009). Data analysis using SPSS for undergraduates: A technical approach. Penerbit UMT, Terengganu, Malaysia. 216 pp.
- Whitmore, T. C. (1973). Tree flora of Malaya a manual for foresters. Volume 2. Longman, Kuala Lumpur. 444 pp.