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Nutritional composition of common Zingiberaceae species used in traditional medicines and cooking

(Kandungan pemakanan spesies Zingiberaceae biasa yang digunakan dalam ubatan tradisional dan makanan)

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Key words: nutritional composition, Zingiberaceae, traditional medicine, cooking uses

Abstrak

Kandungan proksimat, kandungan tiamina, riboflavin, vitamin C dan kandungan asid amino sembilan spesies biasa Zingiberaceae telah dianalisis. Spesies ini ialah bonglai *(Zingiber cassumunar)*, halia *(Zingiber officinale)*, halia bara *(Zingiber officinale)*, kunyit *(Curcuma domestica)*, lempoyang *(Zingiber zerumbet)*, lengkuas *(Alpinia galanga)*, temu hitam *(Curcuma aeruginosa)*, temu pauh *(Curcuma mangga)* dan temu kunci *(Boesenbergia rotunda)*. Spesies ini telah lama digunakan dalam perubatan tradisional dan jamu untuk kecantikan dan kesihatan. Kegunaan tumbuhan ini dalam perubatan tradisional termasuk ubat-ubatan untuk sakit perut, ketakcernaan, sakit sendi, demam dan bengkak. Dalam kebanyakan spesies yang dikaji, asid amino utama ialah asid aspartik dan asid glutamik. Bagaimanapun, bonglai dan lempoyang mengandungi fenilalanina yang terbanyak. Umbisi kunyit, halia dan lengkuas yang biasa digunakan dalam masakan didapati kaya dengan lisina, sejenis asid amino perlu yang berkurangan dalam kebanyakan bijirin.

Abstract

The proximate composition, thiamine, riboflavin and vitamin C content, as well as amino acid profiles of nine common Zingiberaceae species have been analysed. The species are bonglai *(Zingiber cassumunar)*, ginger *(Zingiber officinale)*, halia bara *(Zingiber officinale)*, tumeric *(Curcuma domestica)*, lempoyang *(Zingiber zerumbet)*, greater galangal *(Alpinia galanga)*, temu hitam *(Curcuma aeruginosa)*, temu pauh *(Curcuma mangga)* and temu kunci *(Boesenbergia rotunda)*. These species have been widely used in traditional as well as herbal medicines for beauty and health purposes. The traditional medicinal uses of the zingiberaceous plants include treatment for stomach-aches, indigestion, rheumatism, fever and swelling. The main amino acids in most of the species studied are aspartic acid and glutamic acid. However, bonglai and lempoyang have phenylalanine as its main amino acid. Turmeric, ginger and greater galangal rhizomes which are commonly used in cooking, are rich in lysine, an essential amino acid deficient in most cereals.

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Introduction

Many species from Zingiberaceae or the ginger family have potential economic value as medicines, ornamentals, condiments and spices. In Peninsular Malaysia, about 30–40 species have been recorded to be useful in traditional medicine (Burkill 1966; Perry 1980; Halijah and Ahmad 1988). These species are used for treatment of various diseases or ailments, including post-partum protective treatment, cures for diarrhoea, stomach-aches, indigestion, rheumatism, fever, coughs, asthma, swellings and vermifuge. They are also used in the making of jamu, herbal medicines used for 'cures', nutrient supplements or other specific purposes. Many of these jamu contain species such as *Kaempferia* sp., *Alpinia* sp. *Curcuma* sp. and *Zingiber* sp. Zingiberaceae species are found to be rich in medicinal essential oils such as ascineol, geraniol, citral and camphor. Studies on the anti-inflamatory, antifungal effects and effects on skin diseases have also been carried out (Ahmad and Halijah 1988).

Ginger, greater galangal and turmeric are widely used in cooking by all communities in Malaysia. Ginger root can be used at its young or mature stage in beverages, sauces as well as in cooking. Turmeric rhizome is used either in fresh or powder form. Turmeric oleoresin has been used to flavour pickled products, soups, pudding mixtures and seasonings for meat and fish items. Young turmeric leaves are used mainly for flavour and aroma. Greater galangal which is less commonly used than ginger or turmeric, is grown for its rhizomes and shoots.

Although Zingiberaceae species of medicinal importance have been studied for their phytochemical and pharmaceutical properties (Zakaria and Ibrahim 1986; Ahmad and Halijah 1988), there is limited information on their nutritional composition (Halijah and Zubaidah 1988; Halijah et al. 1988; Hashimah et al. 1988; Tee et al. 1988). A study was, therefore, conducted to investigate the nutrient composition of nine common Zingiberaceae species for compiling nutrient composition data. In this paper, the proximate, thiamine, riboflavin and ascorbic acid compositions, and amino acid profiles of bonglai *(Zingiber cassumunar)*, ginger *(Zingiber officinale)*, halia bara *(Zingiber officinale)*, turmeric *(Curcuma domestica)*, lempoyang *(Zingiber zerumbet)*, greater galangal *(Alpinia galanga)*, temu hitam *(Curcuma aeruginosa)*, temu pauh *(Curcuma mangga)* and temu kunci *(Boesenberigia rotunda)* are discussed.

Materials and methods

Nine common species of Zingiberaceae were analysed for proximate, thiamine, riboflavin, ascorbic acid and amino acid composition. Rhizomes of bonglai *(Zingiber cassumunar)*, ginger *(Zingiber officinale)*, halia bara *(Zingiber officinale)*, tumeric and young leaves *(Curcuma domestica)*, lempoyang *(Zingiber zerumbet)*, greater galangal *(Alpinia galanga)*, temu hitam *(Curcuma aeruginosa)*, temu pauh *(Curcuma mangga)* and temu kunci *(Boesenberigia rotunda)* were obtained from three markets as well as from MARDI and Universiti Putra Malaysia. Duplicate samples were taken from three homogenized composite mixtures for immediate moisture determination. The proximate, thiamine, riboflavin and ascorbic acid contents of the samples were determined according to the standard methods of AOAC (1984) as compiled by Institute for Medical Research (Tee et al. 1987). To determine the amino acid profiles, Waters PICO-TAG HPLC system was used (Anon. 1986). Samples of rhizomes and young turmeric leaves were sliced, ground and dried at 75 °C for 24 h. Samples containing about 40 mg crude protein were used. Hydrolysis was accomplished with 6 *N* HCl using Waters PICO-TAG workstation (Anon. 1986). After hydrolysis, the hydrolysate was derivatised with freshly prepared phenylisothiocynate (PITC) reagent to produce phenylthiocarbomyl amino acids. About 20 µL of derivatised aliquot of food hydrolysate was injected and

chromatographed using Waters PICO-TAG HPLC system. Alpha amino butyric acid (AABA) was used as the internal standard and amino acid standard (Pierce Chemical Co.) was used for comparison. The Waters PICO-TAG HPLC system comprises two pumps for delivery of two eluents consisting of sodium acetate trihydrate with triethylamine and acetonitrile with water, an automated gradient controller, an automated sampler, a data module integrator, a 15 cm PICO-TAG column for separating the amino acids, a column heater and an UV detector.

Results and discussion

The proximate composition of nine Zingiberaceae species is given in *Table 1*. Caloric content of the fresh samples calculated using Atwater factors for 100 g of each sample ranged from 33 kcal to 86 kcal. Moisture content of all fresh samples exceeded 76%. Protein content was lowest in lempoyang and temu pauh (0.4%), and highest in temu hitam (2.4%). Fat content was below 1.2% in all samples analysed with the exception of turmeric leaves which contained 2.8%. Crude fibre content was high in turmeric leaves (about 6%); it was below 3% in other samples. The proximate composition of fresh ginger and galangal rhizomes as well as dried turmeric as given in the Malaysian food composition table (Tee et al. 1988) are included in *Table 1* for comparison. All of the ginger rhizomes analysed and fresh rhizomes listed in the food composition table (Tee et al. 1988) had less than 6% carbohydrate. The soluble carboyhdrates analysed by Hashimah et al. (1988) ranged from 2.14 g to 5.96 g.

Data on thiamine, riboflavin and vitamin C are presented in *Table 2*. In ginger, galangal and turmeric rhizomes, the amounts of thiamine and riboflavin present are comparable with those found in other *Zingiber* species. The turmeric leaves are a good source of vitamin C and have larger amounts of riboflavin and thiamine than the other *Zingiber* species. Riboflavin, thiamine and vitamin C data from Tee et al. (1988), Hashimah et al. (1988) as well as English

Table 1. Proximate composition of some common Zingiberaceae species (per 100 g)

Species	Part	Energy (kcal)	Moisture (g)	Protein (g)	Fat (g)	Carbohydrate (g)	Fibre (g)	Ash (g)
Bonglai	Rhizome	36	90.30	0.6	1.0	6.30	1.4	0.5
Ginger	Mature rhizome	43	87.90	0.7	0.9	8.10	1.7	0.7
Ginger*	Young rhizome	52	86.10	2.1	1.0	8.60	1.7	0.5
Ginger**	Young rhizome	–	88.46	–	–	2.14	–	–
Ginger***	Peeled rhizome	26	90.40	0.8	0.4	4.80	–	–
Halia bara	Rhizome	67	80.10	1.7	0.2	14.80	2.4	0.8
Turmeric	Rhizome	35	89.30	0.9	0.5	6.90	1.7	0.8
Turmeric	Young leaf	35	86.70	2.3	2.8	0.20	6.1	1.9
Turmeric*	Dried rhizome	335	14.20	2.3	5.0	70.10	3.2	5.2
Turmeric**	Fresh rhizome	–	83.91	–	–	5.96	–	–
Lempoyang	Rhizome	45	88.50	0.4	0.7	8.90	1.3	0.3
Lempoyang**	Young rhizome	–	89.10	–	–	2.79	–	–
Greater galangal	Rhizome	71	81.50	0.8	0.7	13.00	1.6	1.4
Greater galangal*	Rhizome	72	89.90	0.9	0.7	6.50	1.6	0.4
Temu hitam	Rhizome	86	76.80	2.4	0.4	18.30	1.1	1.0
Temu pauh	Rhizome	47	88.10	0.4	1.2	8.60	1.1	0.5
Temu pauh**	Young rhizome	–	81.12	–	–	3.75	–	–
Temu kunci	Rhizome	33	90.30	0.7	0.4	6.70	1.0	0.9

Source: *Tee. et al. (1988)
**Hashimah et al. (1988)
***English and Lewis (1991)

Table 2 . Vitamin composition of nine Zingiberaceae species (mg/100 g weight)

Species	Part	Thiamine	Riboflavin	Ascorbic acid
Bonglai	Rhizome	0.02	0.03	3.40
Ginger	Mature rhizome	0.04	0.06	5.78
Ginger*	Young rhizome	0.04	0.04	5.30
Ginger**	Young rhizome	–	–	2.83
Ginger***	Peeled rhizome	0.09	0.06	11.00
Halia bara	Rhizome	0.03	0.04	17.06
Tumeric	Young leaf	0.01	0.05	2.07
Tumeric*	Dried rhizome	0.03	0.12	0
Tumeric**	Fresh rhizome	–	–	1.83
Lempoyang	Rhizome	0.02	0.02	1.65
Lempoyang**	Young rhizome	–	–	6.38
Greater galangal	Rhizome	0.03	0.01	0.93
Greater galangal*	Fresh rhizome	0.02	0.4	0
Temu hitam	Rhizome	0.02	0.09	4.22
Temu pauh	Rhizome	0.03	0.04	1.95
Temu pauh**	Young rhizome	–	–	15.46
Temu kunci	Rhiozme	0.03	0.06	0.47

Source: *Tee. et al. (1988)
**Hashimah et al. (1988)
***English and Lewis (1991)

and Lewis (1991) are included in *Table 2* for comparison.

Amino acid composition is one of the common criteria for nutritive quality of protein in food. In this study, only acid hydrolysates were used for quantitation of amino acids. Tryptophan which is destroyed by acid hydrolysis, was not analysed. The amino acid composition of the Zingiberaceae species studied is shown in *Table 3.* The main amino acids in all the samples except bonglai and lempoyang are aspartic acid and glutamic acid. Bonglai and lempoyang have rather high phenylalanine content of over 19 g/100 g protein. Turmeric, greater galangal and ginger are rich in lysine, an essential amino acid deficient in most cereals, especially wheat.

Conclusion

Nine Zingiberaceae species commonly used in traditional medicines and cooking have been studied. Bonglai and lempoyang which are commonly used in traditional medication, are found to have high phenylalanine content. While turmeric leaves are a good source of vitamin C, turmeric, greater galangal and ginger rhizomes are rich in lysine, one of the essential amino acids commonly lacking in cereals. The nutritional composition of the species studied and other zingiberaceous species is important as most of these species are believed to be good for health and are commonly used in traditional health supplements and medications.

References

Anon. (1986). *PICO-TAG amino acid analysis system. Operator's Manual*. Milford, MA: Waters Pub.

AOAC (1984). *Official methods of analysis of the Association of Official Analytical Chemists* 14th ed. (Williams, S., ed.). Virginia: Assoc. of Official Anal. Chem.

Ahmad, A. R. and Halijah, I. (1988). Potensi tumbuhan famili halia (Zingiberaceae) sebagai sumber bahan ubat. *Proc. Seminar on Malaysian traditional medicine* 10–11 June 1988, Kuala Lumpur, p. 162. Kuala Lumpur: Univ. of Malaya

Burkill, I. H. (1966). *A dictionary of the economic product of the Malay Peninsular* Vol. 2, 2nd ed., 1 323 p. Kuala Lumpur: Ministry of Agric & Co-operative

Table 3. Amino acid profiles of nine Zingiberaceae species (g/100 g protein)

Species	Aspartic acid	Glutamic acid	Serine	Glycine	Histidine	Arginine	Threonine	Alanine	Proline	Tyrosine	Valine	Isoleucine	Leucine	Phenylalanine	Lysine
Bonglai	8.0	7.2	3.4	4.9	0.8	1.5	1.5	1.2	4.4	2.4	3.1	2.7	4.8	19.3	2.2
Ginger	15.4	8.7	3.6	3.7	4.5	7.4	3.8	4.1	5.5	1.7	4.0	3.1	5.2	3.8	9.6
Halia bara	18.2	8.4	3.5	3.6	0.9	1.2	2.5	2.3	6.0	3.5	5.0	3.6	5.1	8.9	3.2
Tumeric	14.4	9.1	4.2	3.5	3.5	7.7	4.1	3.5	4.8	1.6	4.7	3.1	6.2	4.5	6.8
Tumeric (young leaf)	9.2	11.4	3.3	3.8	1.8	1.8	2.3	2.3	7.1	3.6	7.0	2.9	4.9	3.5	3.8
Lempoyang	8.0	8.7	3.5	3.3	2.0	1.3	3.4	2.1	4.7	1.9	1.3	3.4	5.1	23.0	2.4
Greater galangal	24.0	5.3	3.0	3.3	3.6	4.0	1.0	4.0	2.3	1.2	4.9	2.1	3.5	2.6	8.4
Temu hitam	11.8	10.9	4.6	3.7	1.8	3.2	4.1	3.5	4.1	2.7	6.1	4.2	6.8	4.5	2.3
Temu pauh	13.4	14.9	5.9	6.2	1.9	3.5	1.0	3.0	6.2	2.6	6.4	3.9	8.2	5.0	0.7
Temu kunci	7.6	15.0	3.3	3.7	0.5	2.4	4.7	2.5	7.9	2.3	4.2	3.8	6.5	3.3	1.9

English, R. and Lewis, J. (1991). *Nutritional values of Australian foods* Canberra: Dept. of Community Services and Health

Halijah, I. and Ahmad, A. R. (1988). Several ginger plants (Zingiberaceae) of potential value, p.159–61. *See* Ahmad and Halijah (1988)

Halijah, I., Khatijah, H., Munawirah, P. and Mashitah, M. D. (1988). Comparative studies of several species of *Zingiber* with medicinal properties p. 165–9. *See* Ahmad and Halijah (1988)

Halijah, I. and Zubaidah, R. (1988) Distribution of K, Na, Ca, Mg, Fe, and Zn in four species of the Zingiberaceae family. *Malaysian J. Sci.* ***10:*** 25–9

Hashimah, M. H., Halijah, I. and Zubaidah, R. (1988). Preliminary studies on some nutritional composition of the edible gingers. *Proc. 7th Fed. of Asia and Oceania biochem. symp*. (Theme: Advances in biochemistry and biotechnology in Asia and Oceanian) Kuala Lumpur, p. E1–20. Kuala Lumpur: Univ. Of Malaya

Perry, Z. M. (1980). *Medicinal plants of East and Southeast Asia* p. 436–44 . Camb., Mass: MIT Press

Tee, E. S., Mohd. Ismail, N., Mohd. Nasir, A. and Khatijah, I., compilers (1988). *Nutrient composition of Malaysian foods* Serdang: ASEAN Sub-commiteee on Protein (Food Habits Research and Development)

Tee, E. S., Siti Mizura, S. I., Kuladevan, R., Young, S. I., Khor, S. C. and Chin, S. K. (1987). *Laboratory procedures in nutrient analysis of foods* Kuala Lumpur: Inst. of Med. Res.

Zakaria, M. B. and Ibrahim, H. (1986). Phytochemical screening of some Malaysian species of Zingiberaceae. *Malaysian J. Sc.* ***8:***125–8

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