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Dietary Fiber Composition of Common Vegetables and Fruits in Malaysia

H. Osman

Department of Food Science and Nutrition, Universiti Kebangsaan, Malaysia, 43600 UKM-Bangi, Malaysia

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ABSTRACT

Dietary fiber analyses were carried out using Southgate's method (Southgate, 1978) on 15 types of leafy vegetables and five types each of fruit-vegetables, leguminous vegetables and fruits. The non-cellulosic fractions were always higher than the cellulosic and lignin fraction. Total dietary fiber contents were highest in leguminous vegetables (3·3–6·8 g/100 g), followed by the leafy vegetables (1·2–4·8 g/100 g) and finally, the fruit-vegetables (1·4–4·2 g/100 g). The fiber contents of fruit samples were relatively low (1·5–2·9 g/100 g). In comparison with crude fiber values, the dietary fiber values were always higher.

INTRODUCTION

The importance of dietary fiber in human diet has been well established. Efforts have been made by several countries to include the dietary fiber composition, instead of only crude fiber, in the Food Composition Table (Kritchevsky, 1982; Hurt & Crocco, 1986) to be used as reference for nutritionists, dieticians and food technologists (Lanza & Butrum, 1986). Fruits and vegetables, being rich in dietary fiber content, have been used extensively in high-fiber diet formulations. In Malaysia, the current practice of documenting fiber content as crude fiber (Tee *et al.*, 1988) is misleading (Schaller, 1978). Mistakes in calculating dietary requirement could lead to a diet with an 'overdose' of fiber, which, in turn, could produce undesirable effects, especially with therapeutic diets. Presently, no serious attempt has

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been made to analyze and tabulate the dietary fiber content of Malaysian fruits and vegetables. This paper will present the dietary fiber composition of some vegetables and fruits, common in the Malaysian diet.

MATERIALS AND METHODS

The samples were obtained from a local fresh market and supermarket. Samples, in duplicate, were weighed, dried to constant weight, ground into powder and kept in capped bottles. The extraction of plant cell wall materials (cellulosic, non-cellulosic and lignin) and hydrolyses were performed using the Southgate method (Southgate, 1978) but the final quantifications of sugar and uronic acid concentrations were done using the

TABLE 1
Leafy Vegetables

	Type	*NC*	*C*	*L*	*Total*	*CF*[a]
1.	Cabbage (*Brassica oleracea*)	1·4 ± 0·1	1·1 ± 0·2	0·5 ± 0·1	3·0	0·6
2.	'Cekor manis' (*Sauropus androgynus*)	1·9 ± 0·2	1·1 ± 0·2	1·1 ± 0·1	4·1	1·9
3.	Chinese cabbage (*Brassica campestris*)	0·7 ± 0·1	0·4 ± 0·1	0·3 ± 0·1	1·4	0·6
4.	'Kangkong' (*Ipomoea aquatica*)	0·7 ± 0·1	0·6 ± 0·1	0·6 ± 0·2	1·9	1·0
5.	Indian mustard (*Brassica juncea*)	0·5 ± 0·1	0·4 ± 0·2	0·3 ± 0·2	1·2	0·7
6.	Chinese mustard (*Brassica chinesis*)	0·6 ± 0·2	0·3 ± 0·2	0·3 ± 0·1	1·2	ND
7.	'Kai-lan' (*Brassica alboglabra*)	1·3 ± 0·3	0·7 ± 0·3	0·5 ± 0·1	2·5	0·6
8.	Lettuce (*Lactuca sativa*)	0·6 ± 0·2	0·4 ± 0·1	0·3 ± 0·1	1·3	0·5
9.	Spinach, white (*Amaranthus viridis*)	1·7 ± 0·3	1·1 ± 0·4	0·8 ± 0·2	3·6	0·7
10.	Spinach, red (*Amaranthus gangeticus*)	1·7 ± 0·4	1·4 ± 0·3	1·0 ± 0·1	4·1	1·5
11.	Tapioca leaf (*Manihot esculenta*)	2·4 ± 0·4	1·6 ± 0·3	0·8 ± 0·2	4·8	2·0
12.	Wolfberry leaf (*Lycium chinesis*)	2·1 ± 0·3	0·8 ± 0·2	0·6 ± 0·2	3·5	0·9

NC = Non-cellulosic carbohydrate; C = cellulosic carbohydrate; L = Lignin; Total = NC + C + L g/100 g sample; CF = Crude Fiber; ND = No Data.
[a] Tee *et al* (1988).

modified GLC procedure of Jones and Albersheim (1972), and Selvendran *et al.* (1979) in the form of alditol acetate on SP-2330 capillary column (0·32 mm i.d. × 30 mm length; Supelco Inc., Bellefonte, PA, USA).

RESULTS AND DISCUSSION

The overall results (Tables 1, 2, 3 and 4) showed that the leguminous vegetables provide the most abundant dietary fiber when compared to other types of vegetable. Their dietary fiber (DF) contents range from 3·2 g/100 g for mung bean sprout, up to 6·8 g/100 g for lady's finger. In the case of leafy vegetables, the young tapioca leaf and *cekor manis*, deserve special mention because these two vegetables are widespread in most rural back gardens. They are rich in dietary fiber content when compared to the other commercially important vegetables, such as cabbage and spinach. In the fruits group, the highest value obtained was for *Musa* sp. var. brangan (total DF = 3·6 g/100 g). These locally available fruits and vegetables are easily available, cheap and rich in nutrients (Tee *et al.*, 1988). In analysis of this nature, some variations of DF content can be expected from the different samples, chiefly due to the difference in maturity during harvest and biochemical changes during storage/marketing due to the natural post-harvest process of ripening and senescence. In the case of leguminous vegetables, the total DF can be expected to rise after harvest due to the thickening of the fiber sheath sclereids during senescence, and hence they

TABLE 2
Leguminous Vegetables

	Types	*NC*	*C*	*L*	*Total*	*CF*[a]
1.	Four-angled bean (*Psophocarpus tetragonolobus*)	1·6 ± 0·5	1·0 ± 0·2	3·3 ± 0·2	5·9	2·1
2.	French bean (*Phaseolus vulgaris*)	1·1 ± 0·3	1·0 ± 0·2	2·1 ± 0·2	4·2	1·5
3.	Kidney bean (*Dolichos lablab*)	1·0 ± 0·2	0·9 ± 0·2	1·7 ± 0·2	3·6	1·8
4.	Lady's finger (*Hibiscus esculentus*)	2·3 ± 0·4	1·2 ± 0·2	3·3 ± 0·4	6·8	1·0
5.	String bean (*Vigna sinensis*)	1·3 ± 0·3	0·8 ± 0·2	1·6 ± 0·2	3·5	1·4
6.	Mung bean sprout (*Phaseolus aureus*)	1·1 ± 0·2	0·6 ± 0·2	1·5 ± 0·1	3·2	0·7

NC = Non-cellulosic carbohydrate; C = cellulosic carbohydrate; L = Lignin; Total = NC + C + L g/100 g samples; CF = Crude Fiber.

[a] Tee *et al.* (1988).

TABLE 3
Fruit-Type Vegetables

	Types	*NC*	*C*	*L*	*Total*	*CF*[a]
1.	Egg plant (*Solanum melongena*)	1·4 ± 0·3	0·7 ± 0·2	0·8 ± 0·1	2·9	1·0
2.	Ridged gourd (*Luffa acutangula*)	1·9 ± 0·4	9·6 ± 0·4	1·7 ± 0·2	4·2	0·6
3.	Snake gourd (*Luffa vulgaris*)	1·0 ± 0·2	0·8 ± 0·1	0·5 ± 0·1	2·3	ND
4.	Bitter gourd (*Momordica charantia*)	2·0 ± 0·3	0·7 ± 0·2	1·5 ± 0·1	4·2	0·9
5.	Tomato (*Lycopersicum esculentum*)	0·6 ± 0·2	0·5 ± 0·2	0·3 ± 0·1	1·4	0·5

NC = Non-cellulosic carbohydrate; C = cellulosic carbohydrate; L = Lignin; Total = NC + C + L g/100 g sample; CF = Crude Fiber, ND = No Data.
[a] Tee *et al.* (1988).

TABLE 4
Fruits

	Types	*NC*	*C*	*L*	*Total*	*CF*[a]
1.	Banana					
	Musa sp. var. mas	0·8 ± 0·2	0·6 ± 0·1	0·4 ± 0·1	1·8	1·7
	Musa sp. var. brangan	1·5 ± 0·3	1·4 ± 0·3	0·7 ± 0·1	3·6	0·5
	Musa sp. var. rastali	1·7 ± 0·2	0·9 ± 0·2	0·4 ± 0·1	2·0	1·0
	Musa sp. var. tanduk	1·6 ± 0·3	1·4 ± 0·2	0·9 ± 0·1	2·9	0·5
	Musa sp. var. nangka	1·1 ± 0·3	0·6 ± 0·2	0·5 ± 0·1	2·2	1·2
	Musa sp. var. embun	1·0 ± 0·2	0·9 ± 0·2	0·4 ± 0·1	2·3	0·6
2.	Guava (*Psidium guajava*)	1·1 ± 0·4	0·5 ± 0·2	1·3 ± 0·3	2·9	6·8
3.	Mango (*Magnifera indica*)	0·9 ± 0·3	0·5 ± 0·1	0·5 ± 0·1	1·9	1·9
4.	Papaya (*Carica papaya*)	0·7 ± 0·2	0·6 ± 0·2	0·4 ± 0·2	1·7	0·5
5.	Pineapple (*Ananas comosus*)	0·8 ± 0·2	0·5 ± 0·1	0·2 ± 0·1	1·5	0·6

NC = Non-cellulosic carbohydrate; C = cellulosic carbohydrate; L = Lignin; Total = NC + C + L g/100 g sample; CF = Crude Fiber.
[a] Tee *et al.* (1988).

become very 'stringy' during mastication. Furthermore, the high DF content can also be attributed to the high content of lignins, which are normally located in the seed coat. However, in the case of fruits, the reverse was true: their dietary fiber contents, especially the non-cellulosic fractions, were found to be lower than when they were at maturity or early ripening stages (Osman *et al.*, 1986). These changes were due to the degradation of pectic compounds during the ripening process, and this was indicated by the higher uronic acid levels. These facts have been well established in the literature. In order to minimize the variabilities of the banana samples, only the ripeness stage 4 fruits, according to CSIRO ripeness index (Anon, 1985), were chosen to represent the optimum ripeness.

From the data obtained, it can be shown that, using crude fiber (CF) as a measure of fiber intake, can be misleading. This has also been shown by Schaller (1978). All the analytical data showed that the DF values are always higher than CF values. It should be mentioned that the use of CF values in the formulation of a high fiber diet can lead to an overestimation of the total fiber intake. Nutritionally, the DF contribution of each food component must be viewed in terms of the overall daily diet.

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REFERENCES

Anon. (1985). *The Ripening Banana: Standard Colour Index Numbers for Ripening Banana.* Division of Food Research, Commonwealth Scientific and Industrial Research Organisation, Melbourne, Australia.

Hurt, H. D. & Crocco, S. C. (1986). Dietary fiber: marketing implications. *Food Tech.*, **40**(2), 124–6.

Jones, T. M. & Albersheim, P. (1972). A gas chromatographic method for the determination of aldose and uronic acid constituents of plant cell walls polysaccharide. *Plant Physiol.*, **49**, 926–36.

Kritchevsky, D. (1982). Dietary fiber in health and disease. In *Food Carbohydrates*, ed. D. R. Lineback. AVI, Westport, CT, pp. 286–307.

Lanza, E. & Butrum, R. R. (1986). A critical review of food dietary fiber analysis and data. *J. Am. Diet. Assoc.*, **6**, 732–43.

Osman, H., Chiew, Y. Y. & Nik Ismail, N. D. (1986). Compositional changes during ripening of banana. In *Proc. 12th Mal. Biochem. Soc. Conf.*, ed. H. M. Sidek, M. N. Embi, O. Omar, R. Mohamed & Z. M. Ali. Malaysian Biochemical Society, Kuala Lumpur, Malaysia, pp. 157–9.

Schaller, D. (1978). Fiber content and structure in foods. *Amer. J. Clin. Nutr.*, **31** (Suppl.), 99.

Selvendran, R. R., March, J. F. & Ring, S. G. (1979). Determination of aldoses and uronic acid content of vegetable fibers. *Anal. Biochem.*, **96**, 282–92.

Southgate, D. A. T. (1978). Dietary fiber: Analysis and food sources. *Amer. J. Clin. Nutr.*, **31**, S107–S10.

Tee, E. S., Ismail, M. N., Azudin, M. N. & Khatijah, I. (1988). *Nutrient Composition of Malaysian Foods*. Institute of Medical Research, Kuala Lumpur, Malaysia.