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Composition of Rambutan Seeds.

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ABSTRAK

Tiga klon biji rambutan (R4, R7 dan R169) telah dianalisis. Analisis proksimat menunjukkan bahawa biji-biji rambutan mengandungi 11.9–14.1% protein, 37.1–38.9% lemak kasar (ekstrak eter petrolium), 2.8–6.6% serabut kasar dan 2.6–2.9% abu pada dasar berat kering. Kandungan kelembapan biji rambutan adalah 34.1–34.6%. Profail asid amino protein biji rambutan menunjukkan bahawa mutu protein biji adalah baik. Komponen utama asid lemak biji rambutan adalah C16:0 (4.36–4.86%); C18:0 (5.93–7.49%); C18:1 (37.91–40.15%); C20:0 (36.14–36.77%) dan C20:1 (6.92–7.27%).

ABSTRACT

The seeds of three rambutan clones (R4, R7 and R169) were analysed. Proximate analysis of the seeds showed that they contained 11.9–14.1% protein, 37.1–38.9% crude fat (peroleum ether extract), 2.8–6.6% crude fibre and 2.6–2.9% ash on a dry weight basis. The seeds contained 34.1–34.6% moisture. The amino acid profile of the seed protein showed that the protein was of good quality. The major fatty acids in rambutan seed fat were C16:0 (4.36–4.86%); C18:0 (5.93–7.49%); C18:1 (37.91–40.15%); C20:0 (36.14–36.77%) and C20:1 (6.92–7.27%).

INTRODUCTION

Rambutan *(Nephelium lappaceum,* L) is one of the seasonal fruits grown in Malaysia. The total acreage of rambutan plantations in Peninsular Malaysia during 1985 was estimated at 16,925 ha. and it is expected that the total area will increase to 24,341 ha. in 1990 and 49,730 ha. by the year 2000 (Malaysian Agriculture Directory and Index, 1986). Rambutan are usually eaten fresh. The rambutan canning industry is well-established in Thailand and canners in Malaysia are also producing canned rambutans in syrup (Kheiri and Mohd. Nordin Mohd. Som, 1979). The rambutan fruits are deseeded during processing and the seeds remain as a wasted by-product of the canning industry. There is potential for exploitation of this by-product but this can only be realized when more information on the composition of the kernel and its components are known.

Kheiri and Mohd, Nordin Mohd. Som (1979) studied the physicochemical characteristics of rambutan kernel fat of 13 rambutan clones widely grown in Malaysia. They suggested that by fractionation of the rambutan kernel fat, a solid fraction could find application in the formulation of speciality fats. There is, however, little knowledge about the other components of the rambutan seeds. Previous studies have shown that residues left after oil extraction from various seeds and kernels, which are cakes or meals rich in protein, are generally considered as by-products and can be used for farm animals (Patel and Patel, 1972; Patel *et al.,* 1972; Sri Kantha and Erdman, 1984).

This paper reports the composition of the seeds of three clones of rambutan grown in Malaysia.

MATERIALS AND METHODS

Three different clones of rambutans, R4, R7 and R169 were obtained from the farm of Universiti Pertanian Malaysia. The rambutans used were harvested when ripe. At this stage of ripeness, the

rambutans were suitable for fresh table consumption. The total soluble solids of the juice of the flesh of R4 and R7 varieties was 18.5° Brix while that of the R169 variety was 21.5°Brix. The total soluble solids was measured using an Erma hand refractometer. The fruits were deskinned and deseeded. The seeds were then dried in an oven at 60°C to a moisture content of 3.5%. They were then finely ground using a Micromill and were defatted with petroleum ether (b.p. 40–60°C) for at least 8 hours in a Soxhlet apparatus. The defatted seeds and the fats were stored in glass bottles with screw-capped lids in a cold room (5°C) before further analyses.

Analyses of Rambutan Seeds

A.O.A.C. (1975) adapted methods were used for the analyses of moisture, nitrogen, crude fat and ash. The methods used have been described in detail in a previous paper (Augustin and Ling, 1987). In addition to the determination of fat content using petroleum ether as a solvent, the fat extracted using a 2:1 mixture of chloroform: methanol was quantified.

A modified method by Spitz (1973) was used for the determination of amino acid composition of rambutan seed. The sample was accurately weighed (ca. 0.1 g) and to it was added 1 ml norleucine, 1.5 ml distilled water and 2.5 ml concentrated HCl. The mixture was flushed with nitrogen for 1 min and the test-tube was capped and placed in an oven at 105° for 24 hrs. The hydrolysed sample was neutralized with 10 ml citrate buffer (pH 2.2) and the volume made up to 25 ml. The sample was filtered and the filtrate was analysed using a Technicon Model Amino Acid Analyser. For recovery studies, the samples were spiked with known amounts of amino acid standards.

The fatty acid composition of the extracted seed fat was determined by gas chromatography. Boron trifluoride acid methyl esters (IUPAC, 1979). A sample of 0.8 ul of the prepared fatty acid methyl esters was injected into the gas chromatograph (Phy Unicam Series 204). The gas chromotograph was fitted with a 10% SP 2330 glass column (160 cm x 4 mm i.d.) and a flame ionization detector. The injector, detector and column temperatures were 250°C, 250°C and 190°C respectively. The flow rate of the carrier gas (nitrogen) was 40 ml/min. The identification of fatty acids was made through comparison of retention times for standard fatty acids and the % distribution of the fatty acids were calculated from the peak areas.

RESULTS AND DISCUSSION

The weight for the various parts of the rambutan fruits used in this study are given in Table 1. The average weight of a seed of the R4 variety was 1.28 g while that for the R7 and R169 varieties were 2.30 g and 1.85 g respectively. The seeds constituted 5.6–7.4% of the total weight of the fruit. Kheiri and Mohd. Nordin Mohd. Som (1979) have reported the weight for the various parts of 13 rambutan clones grown in Malaysia, including that of R4, R7 and R169 clones. They found that the rambutan seed of R4, R7 and R169 clones comprised 6.3–8.8% of the weight of the fruits. These minor differences between the data of Kheiri and Mohd. Nordin Mohd. Som (1979) and our data may stem from differences in maturity of fruits at harvest and different soil and weather conditions during growth of the rambutan tree.

TABLE 1
Proportions of different parts of rambutan fruits on a fresh weight basis[a]

Clone	No. of fruit	Total weight of 10 fruits (g)					% of whole fruit		
		Whole	Skin	Pulp	Seed	Waste	Skin	Pulp	Seed
R4	10	229.6	124.5	90.8	12.8	1.5	54.2	39.5	5.6
R7	10	310.6	143.1	140.9	23.0	3.6	46.1	45.4	7.4
R169	10	293.9	190.0	84.2	18.5	1.2	64.7	28.7	6.3

[a] Mean result of 10 determinations.

TABLE 2
Composition of rambutan seeds[a]

Composition (%)	Clone R4	Clone R7	Clone R169
Moisture	34.6	34.2	34.1
Composition (dry weight basis)			
Ash	2.6	2.9	2.9
Protein	11.9	12.3	14.1
Fat[b] (petroleum ether extract)	37.1	38.9	37.9
Crude Fibre	2.8	6.6	4.8

a Average of 2 determinations. The differences between duplicate analysis were $< 0.1\%$ for ash content, $< 0.7\%$ for protein content and $< 0.5\%$ for crude fibre content.

b Average of 4 determinations. The average differences between analysis was $< 0.9\%$ for fat content.

Table 2 gives the proximate analysis of the seeds. The seeds contained 34.1–34.6% moisture. The ash, protein, fat (petroleum ether extract) and crude fibre contents of the seeds on a dry weight basis were found to be 2.6–2.9%, 11.9–14.1%, 37.1–38.9% and 2.8–6.6% respectively. Rambutan seeds have a low protein content in comparison to winged bean seeds which contain 29.3–39.0% protein (Sri Kantha and Erdman 1984), a comparable protein content to that of corn kernels which contain 10.1% protein (El Alaily *et al.*, 1976) and a high protein content compared to plam kernel and mango seed kernel which contain 8.3% (Tang and Teoh, 1985) and 6.1–6.8% protein, respectively (Augustin and Ling, 1987).

The amino acid composition of rambutan seed protein is given in Table 3. Recovery studies showed that average recoveries of 80–100% were obtained for lysine, histidine, arginine, aspartic acid, threonine, serine, glycine, valine, leucine, isoleucine and phenylalanine. Average recoveries of 110–120% were obtained for alanine and glumatic acid, 70–80% for proline and tyrosine and 35–45% for the S-containing amino acids cysteine and methionine. As acid hydrolysis was carried out, the content of tryptophan in the sample could not be determined as tryptophan is destroyed during acid hydrolysis. The amino acid composition of the protein from rambutan seeds from clones R4, R7 and R169 are similar. Rambutan seed protein is high in glumatic acid and aspartic acid. In comparison, mango seed protein was also found to be high in glumatic acid and aspartic acid (Augustin and Ling, 1987; Dhingra and Kapoor, 1985). Another seed high in these amino acids is lupin seed (Duran and Cerletti, 1979) and it has been noted that the high content of glumatic acid and aspartic acid is a rather common feature in seed proteins (Cerletti, 1983). Rambutan seed protein was found to be high in lysine (5.1–7.1 g/100 g protein). As a comparison, soyabean has a lysine content of 6.3 g/100 g protein while the FAO Reference Protein has a lysine content of 4.2g/100 g protein. A comparison of the amino acid composition of the protein in rambutan seed with that of the FAO standard protein shows that the rambutan seed protein is of good quality.

Rambutan seed have a high fat content. The fat content of rambutan seeds (37.1–38.9%) is higher than than of winged bean seeds which have 15.0–20.4% fat (Sri Kantha and Erdman, 1984), mango seed kernels which contain 6.1–6.8% fat (Augustin and Ling, 1987) and corn kernels which have 6.2% fat (El Alaily *et al.*, 1976). In comparison, palm kernels contain 49% fat (Tang and Teoh, 1985). The fat extracted using a chloroform: methanol mixture (2:1) was 39.0%, 42.5% and 41.3% respectively for seeds from clones R4, R7 and R169. A mixture of chloroform:methanol can extract 1.9–3.4% more fat from rambutan seeds in comparison to petroleum ether. The fat content (petroleum ether extract) of the seeds used in this study were slightly higher (1.1–5.2% higher) than those previously reported for R4, R7 and R169 (Kheiri and Mohd. Nordin Mohd. Som, 1979).

TABLE 3
Amino acid composition (g per 100 g protein) of rambutan seeds as compared to the FOA Reference Protein.

Amino acid	Rambutan seed[a]			FAO References Protein[d]
	Clone R4	Clone R7	Clone 169	
Essential				
Isoleucine	3.29	3.34	3.29	4.2
Leucine	5.55	5.78	5.48	4.8
Lysine	5.07	7.13	6.26	4.2
Methionine	1.43	1.63	1.35	2.2
Phenylalanine	2.49	3.17	3.32	2.8
Tryptophan	b	b	b	1.4
Valine	4.51	5.11	4.21	4.2
Histidine	1.29	1.68	1.35	–
Non-essential				
Alanine	4.83	4.69	4.65	
Arginine	5.01	5.75	4.63	
Aspartic acid	8.61	9.80	7.24	
Cysteine	1.82	c	1.45	
Glumatic acid	13.13	14.95	10.85	
Glycine	9.61	9.92	8.51	
Proline	2.69	1.96	2.93	
Serine	5.14	5.56	4.44	
Threonine	3.59	5.41	4.50	
Tyrosine	2.58	2.77	3.29	

[a] Average of 2 determinations. The % recoveries for the amino acids are given in the text.

[b] Tryptophan was not determined.

[c] Cysteine was not detected.

[d] FAO (1970).

TABLE 4
Fatty acid composition of rambutan seed fat

Fatty acid (% by area)	Rambutan		
	Clone 4	Clone 7	Clone 169
C14:0	0.02	0.03	0.02
C16:0	4.86	4.62	4.36
C16:1	0.95	0.98	1.30
C18:0	5.93	6.16	7.49
C18:1	40.15	39.18	37.91
C18:2	1.41	1.54	1.21
C20:0	36.14	36.77	36.46
C20:1	7.27	7.23	6.92
C22:0	2.57	2.53	2.71
C22:1	0.69	0.63	0.80
C24:0	–	–	–
Others	0.01	0.33	0.82

Table 3 shows that the fatty composition of the three varieties are similar. Rambutan seed is high in C18:1 and C20:0 acids, with these acids accounting for 37.91–40.15% and 36.14–35.77% of the fatty acids respectively. The other major fatty acids are C16:0 and C20:1 which are present in amounts of 4.36–4.86%, 5.93–7.49% and 6.92–7.27% respectively. Kheiri and Mohd. Nordin Mohd. Som (1979) also reported the fatty acid composition of the seed fat from eight rambutan clones including that from R4, R7 and R169. The major features of the reported fatty acid profiles (Kheiri and Mohd. Nordin Mohd. Som, 1979) are similar to that obtained in this work in that the major fatty acids were also C18:0 (8.3–41.0%), C20:0 (34.7–50.1%) and C20:1 (1.0–6.3%). However, it was nevertheless noted that the % of C18:0 present in seed fat from clones R4, R7 and R169 reported by Kheiri and Mohd. Nordin Mohd. Som, (1979) were relatively higher (11.4–12.5%) than that of % C18:0 found in this study (5.93–7.88%). Differences in the fat content and fatty acid composition of the seeds may be expected with different age of maturity of the rambutan fruits and differing growth conditions for trees.

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