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PHYSICAL CHARACTERISTICS, COOKING AND EATING QUALITY OF SOME MALAYSIAN RICE VARIETIES

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RINGKASAN

Amilose dan protin adalah dua faktor yang menentukan mutu makanan beras. Amilose mengawal kejelekitan (cohesiveness) dan kelembekan (tenderness) beras. Ciri-ciri memasak seperti nisbah muai (imbibition ratio), nisbah pengambilan air dan darjat kepaduan (degree of agglutination) tidak ada kaitan dengan jenis beras.

INTRODUCTION

Rice varieties in Malaysia are classified as long, medium, and short-grain types or classes. Qualities of these grain types are evaluated on their physical appearance and rice composition in the test-milled samples. Other aspects of qualities such as nutritional, cooking and eating qualities have not been much studied although these aspects of qualities have been emphasised in the current trends of rice varietal research (MARDI, 1977).

Objective tests have been developed during the last few years in the United States for evaluation and selection of rice in a breeding programme for specific cooking characteristics (BEACHELL and STANSEL, 1963). Application of these physical and chemical tests to rice varieties in Malaysia is not being undertaken. It is imperative that these tests be carried out to determine the relationship of these values to cooking and eating quality standards and to determine the feasibility of using these tests for evaluating varieties in breeding programmes in Malaysia.

This study was carried out with the following objectives :–

1. To provide some data on the chemical composition of some local rice varieties and
2. To study the correlation between the chemical properties and eating qualities.

MATERIALS AND METHODS

Twelve non-glutinous and two glutinous rice varieties were used in this study. 100 g of each rice variety was shelled and polished by the Minghetti Sampling Mill for two minutes. The milled rice was accurately weighed. The husk and bran were aspirated, sieved and weighed separately.

The composition of milled rice was determined by using indented plates, sieves and handpicking. The head rice was further analysed into predominating class, contrasting length, chalky and immature grains, red streaked grains and damaged grains.

The moisture content of the milled rice was determined by the method described in AOAC (1975).

Crude protein was determined by the Kjeldahl method using the factor 5.95. This factor is based on the nitrogen content of the major rice protein, glutelin of 16.8 percent. Fat was measured as ether extract using Soxhlet extraction method.

The calcium and iron were determined by dry ashing at 55°C and the concentration analysed by the atomic absorption method.

The Thiamin and Riboflavin content were determined by the Method of Vitamin Assays, Association of Vitamin Chemist (1966).

Amylose determination was carried out by using the method described by JULIANO (1971).

A 50g sample of milled rice was used for the determination of imbibition and the water uptake ratios. The volumes of the cooked and uncooked rice were determined by the displacement method in a graduated cylinder.

Cooking was carried out at 98°C for 20 minutes. The amount of solid matter lost (in ml.) during cooking is the degree of agglutination.

The cooked rice was organoleptically tested for colour, cohesiveness, off-flavour and tenderness on a nine point scale.

RESULTS AND DISCUSSION

Table 1 shows the milling quality of the tested samples. The total milling yield and the head rice yield vary from 65.0 to 68.6 percent and 75.65 to 95.03 percent respectively. This indicates that the samples are of good quality. Variations in these values are attributed to several factors such as post-harvest treatments, varieties, grain types, impurities/foreign matter, chalky and immatured grains and damaged grains (WEBB and STERMER, 1972).

The chemical composition of the milled rice is given in *Table 2*. The percent ether extract is low since much of the fat is lost in the process of milling through removal of bran in producing extra well-milled white rice (GRIST, 1965). The protein content varies from 6.75 to 8.58 percent. The value is relatively low in comparison with that of other cereals (GRIST, 1965). The protein content of rice is subjected to varietal and environmental variability (BRESSANI, *et al.*, 1971 and IRRI, 1972). Studies on samples of milled rice of 35 Asian varieties by JULIANO, *et al.*, (1964) showed that protein content ranged from 5.74 to 10.96 percent which differed significantly. Differences in protein content of milled rice are also influenced by milling techniques especially the degree of bran removal (ALI, 1977).

The amylose content varies from 7.3 to 31.1 percent. Pulut Malaysia Satu and Masria being glutinous varieties, (MARDI, 1977), as expected, are low in amylose content (7.3 percent for Masria and 7.8 percent for Pulut Malaysia Satu). Variation in amylose content are in agreement with the report of RAGHAVENDRA RAO and JULIANO, (1970) who showed that non-waxy rice varieties contain 8 to 37 percent amylose. *Table 2* shows that Bahagia, Seribu Gantang, Malinja, Mahsuri, Serendah Filipina, Sri Malaysia Satu and Sri Malaysia Dua are in the high amylose content classification (more than 25 percent) while Benua, Jaya, MR7 and Topek are in the intermediate amylose content classification (21–25 percent).

TABLE 1. MILLING QUALITY OF SOME MALAYSIAN RICE VARIETIES

		Rice Variety													
		Bahagia	Benua	Jaya	Malinja	MR 7	Mat Candu	Serendah Filipina	Sri Malaysia Dua	Seribu Gantang	Mahsuri	Sri Malaysia Satu	Topek	Masria	Pulut Malaysia Satu
I.	**Premilling Condition (%)**														
	a. Moisture content	13.9	13.0	14.0	14.1	14.1	13.0	13.0	14.0	13.0	13.0	14.1	13.0	14.2	14.2
	b. Impurities/ Foreign matter	–	0.3	–	–	–	2.7	0.2	–	0.2	0.1	–	0.5	–	–
II.	**Milling Component (%)**														
	a. Total rice	66.2	64.9	68.6	66.8	65.5	65.7	64.2	65.9	68.4	65.1	65.3	65.0	65.2	66.6
	b. Bran	11.9	12.3	114.0	12.9	12.5	12.5	13.2	12.6	10.8	10.9	13.0	12.5	12.8	12.4
	c. Husk	21.9	22.8	20.0	20.3	22.0	21.8	22.6	21.5	20.8	23.0	21.7	22.5	22.0	21.0
III.	**Quality of Milled Rice**														
A.	Rice composition (%)														
	a. Head rice	84.29	75.65	90.82	78.59	88.40	81.74	90.81	88.92	95.03	96.97	77.03	87.38	80.83	88.14
	b. Broken	15.71	24.35	9.18	21.41	11.60	18.26	9.19	11.08	4.97	3.03	22.97	12.62	19.17	11.86
B.	Head Rice Composition (%)														
	a. Predominating variety	96.59	99.19	96.31.	96.95	96.68	97.95	99.49	97.95	98.21	99.69	91.25	93.49	97.53	96.59
	b. Contrasting length	0.18	9.61	–	–	0.35	–	0.34	0.17	–	–	0.40	1.76	0.95	1.70
	c. Chalky/immatured grains	1.79	–	2.73	2.10	3.80	1.86	–	1.19	0.92	–	7.55	4.04	–	–
	d. Red grains	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	e. Damaged grains	1.44	0.20	0.96	0.95	0.17	0.19	0.17	0.69	0.77	0.31	0.80	0.71	1.52	1.71
C.	Milling degree*	E	E	E	E	E	E	E	E	E	E	E	E	E	E

*E – Extra well milled.

TABLE 2. CHEMICAL COMPOSITION OF SOME MILLED RICE (DRY WEIGHT BASIS)

Varieties	% ether extract	% crude protein	% amylose	Ca/100 gm mg	Fe/100 gm mg	Thiamin mg/100 g	Riboflavin mg/100 g
Bahagia	0.37	6.72	26.6	6.31	1.40	0.07	0.05
Benua	0.45	7.65	24.5	6.86	1.12	0.08	0.05
Jaya	0.15	7.64	23.0	7.71	0.84	0.06	0.06
Malinja	0.38	6.75	26.1	6.80	0.85	0.07	0.06
MR 7	0.56	8.17	24.1	6.99	0.84	0.08	0.05
Mat Candu	0.56	6.78	24.3	7.13	1.11	0.07	0.06
Serendah Filipina	0.54	7.43	31.1	6.59	0.84	0.07	0.06
Sri Malaysia Dua	0.38	8.58	28.8	7.84	0.78	0.06	0.05
Seribu Gantang	0.74	6.91	28.6	7.09	1.12	0.07	0.06
Mahsuri	0.30	7.76	29.4	6.32	0.82	0.08	0.06
Sri Malaysia Satu	0.37	6.89	27.5	7.13	0.85	0.07	0.05
Topek	0.69	8.58	20.2	8.14	0.77	0.07	0.06
Masria	0.62	7.76	7.8	8.57	0.86	0.07	0.06
Pulut Malaysia Satu	0.43	7.20	7.3	7.82	1.24	0.07	0.06

TABLE 3. COOKING CHARACTERISTICS AND ORGANOLEPTIC EVALUATION OF SOME VARIETIES OF COOKED RICE

Varieties	Cooking Characteristics			Organoleptic Evaluation			
	Imbibition Ratio	Water Uptake Ratio	Degree of Agglutination	*Colour	*Cohesive-ness	*Off Flavour	*Tender-ness
Bahagia	4.64	3.46	16	9	9	7	5
Benua	4.81	3.73	14	9	8	7	7
Jaya	4.47	3.50	22	9	7	7	5
Malinja	4.63	3.52	32	9	7	7	5
MR 7	4.44	3.28	15	9	7	7	5
Mat Candu	4.79	3.58	13	9	8	7	7
Serendah Filipina	4.66	3.57	15	9	8	7	6
Sri Malaysia Dua	4.13	3.08	10	9	8	7	5
Seribu Gantang	4.40	3.70	15	8	8	7	5
Mahsuri	4.79	3.91	10	9	7	7	7
Sri Malaysia Satu	4.46	3.30	20	9	7	7	7
Topek	4.54	3.49	28	7	7	7	5
Masria	3.63	3.12	15	5	3	5	8
Pulut Malaysia Satu	4.87	3.76	30	8	2	5	9

***Scores**

Colour
1 (brown) – 9 (white)

Cohesiveness
1 (pastry) – 9 (flaky grains)

Flavour
1 (very strong) – 9 (none)
off flavour

Tenderness
1 (very tough) – 9 (very tender)

The calcium content of the milled rice used in this study varies from 6.31 to 8.14 mg/100g, while the iron content varies from 0.77 to 1.4 mg/100g.

The thiamin and riboflavin vary from 0.06 to 0.08 mg/100g and 0.05 to 0.06 mg/100g respectively. The value differed with varieties and are affected by geographical location (KIK, 1955) and the agree of milling (DESIKACHAR, 1955).

Table 3 gives the cooking quality and the organoleptic evaluation of some Malaysian rice varieties. The cooking quality is best expressed in terms of its imbibition ratio, i.e. the ratio of the volume of the cooked rice to that of the uncooked rice. From these results it indicates that the imbibition ratio of the grains is not related to the grain type.

The water uptake ratio which is defined as the water absorbed by a specific weight of rice at a given temperature in a given length of time varies from 3.08 to 3.91. The higher the water uptake ratio, the greater the amount of water absorbed by the rice during cooking. The results also indicate that the water uptake ratio is not related to the grain type.

Amylose and protein are the two most important factors that govern the eating quality of rice. Their correlation with eating and cooking qualities is given in *Table 4*.

Results of this study showed that protein is negatively correlated with amylose and colour of cooked rice but it is not significant.

Amylose also controls the cohesiveness and tenderness of rice. As the amylose content increases, the rice changes from being distinctly sticky to distinctly flaky. Increase in amylose content also prevents the cooked rice from being too tender, much to our local preference. Rice with higher amylose content also showed that tendency of being whiter in colour.

The percent ether extract is highly correlated with the colour of the cooked rice ($r = 0.5356^{**}$). The higher the percent ether extract, the darker is the colour of the cooked rice.

There is negative correlation between calcium content and the imbibition ratio, colour, cohesiveness and off-flavour. Calcium can thus be regarded as another important factor in the eating quality of rice.

TABLE 4. CORRELATION COEFFICIENTS BETWEEN COOKING AND EATING QUALITIES WITH PROTEIN AND AMYLOSE CONTENT

Cooking and Eating Quality	Protein	Amylose	Calcium
Imbibition Ratio	−0.3495	0.2942	−0.6920*
Water Uptake Ratio	−0.3406	0.1230	−0.4957
Degree of Agglutination	−0.1803	−0.4155	0.2687
Colour	−0.2473	0.7298**	−0.7370**
Cohesiveness	0.0165	0.9230**	−0.5407*
Off Flavour	0.0047	0.9214**	−0.5944*
Tenderness	−0.1867	−0.6301*	0.2240

** Very significant
* Significant

Varieties such as Benua, Mahsuri, Mat Candu, Serendah Filipina, Sri Malaysia Satu and Sri Malaysia Dua have very high organoleptic scores *(Table 3)*. VARUGHESE (1977) stated that "long and slender type" of rice are popular to Malaysian consumers and that a good cooking quality rice is one that is "slightly fluffy and soft"

A high amylose content long grain rice is desirable to ensure a good cooking quality rice, with white colour, well separated grains and not too tender to meet the demand of Malaysian consumers.

SUMMARY

Amylose and protein are the two most important factors that govern the eating quality of rice. Amylose controls the cohesiveness and tenderness of rice. Cooking characteristics such as swelling number (imbibition ratio), water uptake ratio and degree of agglutination do not relate to grain type.

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