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A STUDY ON THE COOKING AND EATING QUALITY CHARACTERISTICS OF SOME EGYPTIAN RICE VARIETIES

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Abstract

The cooking and eating quality properties of ten Egyptian rice varieties and new strains were investigated. Grain length, grain width, grain shape (L/W ratio), gelatinization temperature (GT), gelatinization consistency (GC), amylose content and protein content were determined. Besides, sensory tests were also done, i. e. rice : water ratio, cooking time, kernel expansion, breakage percentage, whiteness, hardness, stickiness, odour and taste.

The results showed that the short grain varieties had lower amylose content than the long ones, while low differences were obtained in the other traits. The short grain varieties required less water and shorter cooking time. The results showed also significant correlation coefficients between the amylose content and rice : water ratio, cooking time, hardness and stickiness.

In general the study showed that the short grain varieties with low amylose content may have more acceptable taste for the Egyptian consumers than the long grain with high amylose content.

Keywords: rice, cooking, quality.

Introduction

Rice is one of the major field crops in Egypt. It is a crucial commodity of the nation. It is an essential food crop preferred by a large group of the population to any other carbohydrate rich food.

Cooking and eating quality characteristics of rice have never been a serious problem in Egypt since nearly more than 95% of the rice area is planted by japonica rice varieties because of its moistness, tenderness, gloss and taste. Recently, however, emphasis of development of long grain indica rice has brought into focus the problem of cooking and eating quality in the breeding program. Newly released indica rice (IR 28) and indica/japonica hybrid (Giza 175) are mostly of high amylose content which cook dry and hard and are, therefore, not acceptable to the local consumer. As a result, the extension of these cultivars has been adversely affected, even though

they generally have higher yield potential and are resistant to blast, the major disease in Egypt.

Unfortunately, the cooking and eating quality characteristics of the commercial rice varieties grown in Egypt are poorly investigated. Keeping in view the need for such information, the present investigation was undertaken to study the cooking and eating quality characteristics of some Egyptian rice varieties and new lines depending on the dietary habit and the manner in which rice is cooked and consumed in Egypt.

Materials and Methods

This experiment was conducted at the Rice Research and Training Center (RRTC) Sakha, Kafr El-Sheikh, Egypt, during the 1988 season to investigate the cooking and eating quality characteristics of some Egyptian rice varieties and strains. These characteristics were the gelatinization temperature (GT), gel consistency (GC) and the amylose content. Besides, some other cooking and eating quality traits, namely, rice : water ratio, cooking time, kernel expansion, breakage percentage after cooking, whiteness, cooked kernel hardness, stickiness, odour and taste were tested according to the dietary habit and the manner in which rice is cooked and consumed in Egypt. Moreover, the protein content was also tested.

Ten Egyptian rice varieties and strains were used in this study. These varieties were Giza 171, Giza 172, Giza 175, Reiho and Gz 2175–5–6 (short grain), Giza 181, IR 28 and IR 19743–46, (long grain), and Gz 1368 S–5–2 (medium grain).

Samples were dehulled in Satake testing husker and polished in Dayton milling machine at the Grain Quality Lab., RRTC, Sakha, Egypt. Specific physico-chemical tests were used to determine the cooking and eating quality according to LITTLE et al. (1958), JULIANO (1984), CAGAMPANG et al. (1973), AZEEZ and SHAFI (1966), and IRRI Annual Report (1970). On the other hand, 100 g of milled rice samples were cooked and served to a panel of 10 judges for evaluation. The samples were evaluated for rice : water ratio, cooking time, kernel expansion, breakage percentage after cooking, whiteness, cooked kernel hardness, stickiness, odour and taste according to PERYAM and SHAPIRO (1955). The samples were evaluated using ten point scale for each property with maximum scores of 70 and a limit of acceptability of 50 scores. Correlation coefficients between amylose content and the other traits were also estimated according to TOMAR (1981).

Results and Discussion

Physicochemical Properties of Rice Grains

The means of physicochemical properties and protein content of the rice grains for the studied varieties are shown in *Table 1.* The long grain varieties ranged between 6.02 and 6.46 mm in length and from 2.13 to 2.16 mm in width, however, the short ones ranged between 5.06 to 5.64 mm in length, and from 2.41 to 2.92 mm in width. These grain shapes (length/width ratio) differed from 2.81 to 3.11 mm in case of long grain varieties and from 1.73 to 2.19 mm for the short ones. The lowest value of grain shape 1.73 mm was determined for Reiho, while the highest value (2.30 mm) was measured for the new line Gz 1368–8–2–5.

Table 1
Some physicochemical properties of grains for ten Egyptian rice varieties

Variety	Grain length	Grain width	Grain shape	* GT	** GC	Amylose content	Protein content
Giza 171	5.64	2.42	2.19	5	91	19.45	6.30
Giza 172	5.21	2.82	1.84	6	95	19.70	7.20
Giza 159	4.95	2.81	1.76	6	100	20.05	7.10
Giza 175	4.97	2.41	2.11	3	36	25.51	8.30
Reiho	5.06	2.92	1.73	7	100	18.11	6.60
Giza 2175	5.14	2.68	1.92	7	100	18.91	6.20
Giza 181	6.63	2.13	3.11	5	82	20.71	7.60
IR 28	6.02	2.15	2.81	1	37	27.11	8.20
IR 19743	6.46	2.16	2.99	1	38	26.31	10.10
Giza 1368 S–2–5	5.43	2.36	2.30	4	32	26.11	7.60

* GT: Gelatinization temperature
** GC: Gel consistency

The cooking and eating quality of rice is generally determined by the gelatinization temperature, gel consistency and amylose content. In the present investigation, the gelatinization temperature (GT) ranged from 1 (for IR 28 and IR 19743–46) to 7 (for Reiho and Gz 2175–5–6). These results indicate that Reiho and Gz 2175–5–6 rice varieties are less resistant and take short time for cooking. On the other land, the lowest gel consistency (GC) scores were recorded for the varieties Gz 1368–S–5–2, IR 28, IR 19743–46 and Giza 175. While the highest GC scores (100 mm) were recorded for the varieties Giza 159, Reiho and Gz 2175–5–6. These results were in agreement with those reported by JULIANO et al. (1984).

Table 2
Means of panel teast characters of some Egyptian rice cultivars and strains

Varity	Rice:Water	Cook. time	Expansion	Breakage	Whiteness	Hardeness	Stickness	Oder	Taste	Total score
	1:1	20.00	9.00	8.00	9.00	7.00	8.00	9.00	9.00	59.00
Giza 171	1:1.5	22.00	8.00	7.00	9.00	6.00	8.00	9.00	8.00	55.00
	1:2	19.00	5.00	5.00	9.00	5.00	5.00	8.00	7.00	44.00
	1:1	23.00	8.00	9.00	9.00	8.00	8.00	9.00	9.00	60.00
Giza 172	1:1.5	22.00	7.00	8.00	9.00	9.00	7.00	9.00	8.00	57.00
	1:2	22.00	6.00	6.00	9.00	5.00	6.00	8.00	7.00	47.00
	1:1	20.00	7.00	8.00	7.00	7.00	7.00	8.00	7.00	51.00
Giza 159	1:1.5	24.00	6.00	6.00	7.00	6.00	6.00	8.00	7.00	46.00
	1:2	23.00	5.00	7.00	7.00	6.00	6.00	8.00	5.00	44.00
	1:1	22.00	4.50	8.00	6.50	5.00	5.00	6.50	4.50	40.00
Giza 175	1:1.5	22.00	4.50	8.00	6.50	5.00	5.00	6.50	5.50	41.50
	1:2	21.00	4.50	5.50	7.00	4.50	4.50	7.00	4.50	37.50
	1:1	19.00	8.00	8.00	9.00	8.00	8.00	9.00	9.00	59.00
Reiho	1:1.5	23.00	7.00	8.00	9.00	7.00	6.00	9.00	7.00	53.00
	1:2	22.00	7.00	6.00	9.00	6.00	5.00	9.00	6.00	48.00
	1:1	20.00	9.00	9.00	9.00	8.00	8.00	9.00	9.00	60.00

Table 2
Means of panel teast characters of some Egyptian rice cultivars and strains

Varity	Rice:Water	Cook. time	Expansion	Breakage	Whiteness	Hardeness	Stickness	Oder	Taste	Total score
Giza 2175	1:1.5	21.00	8.00	7.00	9.00	7.00	7.00	7.00	7.00	52.00
	1:2	21.00	6.00	5.00	9.00	6.00	6.00	7.00	6.00	44.00
	1:1	23.00	5.00	7.00	10.00	7.00	6.00	9.00	6.00	50.00
Giza 181	1:1.5	23.00	6.00	7.00	10.00	6.00	7.00	9.00	8.50	53.50
	1:2	20.00	7.00	6.00	10.00	6.00	8.00	10.00	9.00	57.00
	1:1	33.00	5.00	7.00	8.00	7.00	4.00	6.00	5.00	42.00
IR 28	1:1.5	32.00	7.00	6.00	8.00	6.00	6.00	7.00	7.00	47.00
	1:2	25.00	6.00	5.00	8.00	6.00	5.00	7.00	6.00	43.00
	1:1	23.00	7.00	7.00	8.00	7.00	6.00	5.00	4.00	44.00
IR 19743	1:1.5	22.00	8.00	6.00	8.00	6.00	8.00	6.00	6.00	48.00
	1:2	23.00	8.00	6.00	8.00	6.00	7.00	6.00	5.00	46.00
	1:1	24.00	7.50	8.00	7.00	8.50	7.50	8.00	8.00	53.00
GZ 1368	1:1.5	24.00	6.50	5.50	7.00	7.50	6.50	8.00	7.00	48.00
	1:2	22.00	6.00	6.00	7.00	6.00	5.00	8.00	6.00	44.00

The amylose content varied from 27.1 to 18.1%. The highest percentage was recorded for IR 28, while the lowest percentage was found for Reiho. It is clear in general that all the japonica type varieties had low amylose content, while the indica type varieties had a high amylose content. This result indicates that the japonica rice varieties under this study were more sticky than the indica type varieties when cooked.

The protein content ranged between 6.2–10.1% for the studied varieties the highest value being found for IR 19743, while the lowest one for Gz 2175. On the other hand, indica type varieties showed higher protein percentage (7.6–10.1%) than japonica type varieties (6.2–7.2%).

The Panel Test Characters

According to the total score recorded by the best ten judges, panel test characteristics are presented in *Table 2.* The results show that, the rice : water ratio was 1:1 for all the short grain varieties except Giza 175, while it was 1:1.5 for the long grain varieties except Giza 181 (1:2).

The cooking time differed according to the rice : water ratio. With 1:1 ratio the cooking time ranged between 19 min (Reiho) and 33 m in (IR 28) and from 20 min to 32 min for Giza 159 and IR 28, respectively, with 1:1.5 ratio, while, with 1:2 ratio IR 28 also had the longest (25 min) while Giza 171 had the shortest (19 min) cooking time.

The expansion of the grains after cooking was the highest for Giza 171 and Gz 2175–5–6, while the lowest valuewas recorded for the two rice varieties Giza 175 and Giza 181. Moreover, the breakage percentage as given in *Table 2* was the highest for all the tested varieties when the rice : water ratio was increased. The IR 28 variety had the highest breakage percentage followed by Giza 175, while the lowest value was recorded for Giza 172 and Gz 2175–5–9 rice varieties.

The mean score for whiteness was the highest for cooked Giza 181 and the lowest for Giza 175. The differences in whiteness between the other varieties were low according to the acceptable score. The acceptable score for hardness was the lowest for Giza (4.5) and highest for Giza 172 (9).

Data in *Table 2* also revealed that the stickiness increased with increasing rice : water ratio for the short grain varieties which indicated that these varieties do not require an increased water ratio during cooking, according to the judges. Moreover, the varieties Reiho, Giza 171, Giza 172 and Giza 191 were the most acceptable varieties due to their odour and taste, while the least acceptable ones were Giza 175 and IR 19743–46.

The overall acceptability, using a 70 point scale, ranged between 60 and 37.5. The most acceptable varieties were Giza 172 followed by Gz 2175–5–6, while the least acceptable were Giza 175, IR 28 and IR 19743–46.

Correlation Coefficients between the Physicochemical Properties and the Cooking and Eating Quality Characters

Table 2 showed that the rice : water ratio was positively correlated with the gelatinization temperature (GT) and amylose content, only. These results revealed that high amylose rice absorbed more water during cooking compared to low amylose rice THENAMMAI et al. (1975), SOOD (1978), TOMER and NANDA (1982), and MADAN and BHAT (1984) reported similar findings.

Negative and significant correlation coefficients were estimated between cooking time and grain length, GT and gel consistency (GC) while highly significant positive correlation was found between cooking time and amylose content.

Table 3
Correlation coefficients between the physicochemical properties and panel test characters of rice

Characters	Grain length	Grain widht	Grain shape	* GT	** GC	Amylose content	Protein content
Rice : water ratio	0.093	0.001	0.023	0.311*	0.033	0.631**	0.127
Cooking time	−0.217*	0.176	−0.224	−0.543**	−0.368*	0.445**	−0.078
Kernel expansion	0.107	0.193	0.159	0.298*	0.257*	0.290*	0.165
Breakage	0.309*	0.05	0.077	−0.123	0.243	0.031	−0.009
Whiteness	0.007	−0.203	−0.168	0.065	0.088	−0.277*	0.113
Hardness	0.264*	0.088	0.236	0.644**	0.491**	−0.368**	0.291*
Stickiness	−0.193*	0.12	−0.007	−0.048	0.432**	−0.534**	0.031
Odour	0.131	0.215	0.113	0.123	0.003	0.011	0.052
Taste	−0.188*	−0.136	0.287*	0.15	0.434*	−0.263*	0.219

* GT: Gelatinization temperature
** GC: Gel consistency

The data represented in *Table 3* indicated that kernel expansion was positively correlated with GT, GC and amylose content. MADAN and BHAT (1984) reported that the elongation of rice during cooking might be dependent on variety and duration of storage of rice. Moreover a significant positive correlation coefficient was obtained between the amylose content and elongation ratio of rice. Thus, increase in length during cooking of high

amylose rice was higher than that of low amylose rice. The same results were reported by JULIANO and GONZALES (1987).

Breakage percentage after cooking was positively correlated with grain length, and cooked grain whiteness was correlated with the amylose content (*Table 3*). Moreover, the hardness of the grains after cooking was positively correlated with grain length, GT, GC, amylose content and protein content. Similar results were reported by RAGHAVAIAH and KAUL (1970) and MADARI and BHAT (1984). Moreover, cooked rice hardness was measured by JULIANO and GONZALES (1987) using an Ottawa Texture measuring system. They reported that the hardness value was affected not only by the amylose content, but also by the gel consistency and protein content.

Stickiness was positively correlated with GC and negatively with the amylose content. The same findings were suggested by JULIANO and GONZALES (1987). Positive and significant correlation coefficients were estimated between taste and grain shape and GC, while they were negative with grain length and amylose content. Thus, rice with short grain and low amylose content may have more acceptable taste than high amylose rice.

Thus, it can be concluded from the present study that Giza 172 and Gz 2175–5–6 were the best from the point of view of cooking quality acceptability. Moreover, the amylose content is the most important index of eating quality.

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