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Carbohydrate composition of rice varieties after cooking by different methods

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The present work was to determine the starch, amylose and sugar contents of rice after cooking by four methods. The study revealed that cooking results in slight increase 2.6 to 4.3 per cent in starch content over uncooked rice samples, but there was no significant difference among cooking methods. Starch content was significantly less in basmati varieties after cooking compared to coarse varieties. The amylose content in cooked rice was not influenced significantly by any of the cooking method as compared to raw samples. Total soluble, reducing and non-reducing sugars in cooked rice samples showed significant decrease upon cooking compared to raw samples.

Key Words : Cooking, Amylose, Microwave, Solar, Starch, Rice

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INTRODUCTION

Rice (*Oryza sativa* L.), is one of the most important cereal crops in the world, in addition to wheat and maize. It is a main carbohydrate source in many Asian countries. It provides 23 per cent more calories of energy than that provided by wheat and maize crops (Wang *et al.,* 2005). It is usually consumed as a whole grain after cooking, and in a regular Asian diet, can contribute for 40 to 80 per cent of the total calorie intake (Paramita *et al.,* 2002; Singh *et al.*, 2005; Hossain *et al.*, 2009 and Cai *et al.*, 2011). It is an immense source of starch. Rice starch is digested so quickly than any other high starchy food and this aspect make it distinctive among other cereals. The amylose content is great determinant of rice cooking and eating characteristics. In major rice producing areas of the world intermediate amylose contents of rice is like most. Different cooking methods like open pan and pressure cooking for cooking of rice are practiced since long. Use of microwave for cooking is increasing day by day due to faster speed. The sun seems to provide a good alternative for cooking as it is free, without unhealthy smoke or chances to burns. Thus, solar cooking is considered 'a solution looking for a problem'. The starch content varies with the cooking methods *viz.*, traditional methods or home-made or microwaved method etc. (Sun *et al.*, 2010). The starch content of milled rice become swollen on cooking by absorbing moisture and some solid content is also dissolved on cooking due to the gelatinization of the starch granules. There are two types of starch in rice: amylose and amylopectin. Amylose is a long straight starch molecule that does not gelatinize during microwave cooking (Chiu *et al.*, 2011) and hence rice with more amylose content tends to cook fluffy, with separate grains. Keeping this in view, the present work was undertaken to determine the carbohydrate

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composition of rice cooked by four cooking methods.

METHODOLOGY

Basmati (Improved Pusa Basmati-I, Taraori Basmati [HBC 19] and CSR 30) and coarse (HKR 47, HKR 127 and IRBB 60) rice varieties were obtained in a single lot from Rice Research Station, Kaul, CCSHAU, Hisar. All the six rice varieties were cleaned, washed twice, and soaked for 30 minutes in distilled water prior to cooking with ordinary, pressure, microwave, and solar cooking methods. Cooking time and water uptake for individual rice samples were standardised. For ordinary cooking, rice grains were cooked in a sauce pan covered with lid using seed to water ratio as 1 : 2.5 w/v., and for pressure cooking, microwave, and solar cooking it was 1 : 2 w/v, 1 : 2.5 w/v and 1 : 2 w/v, respectively. Further, all the cooked rice samples were dried in hot air oven at 55-60°C to a constant weight, ground in an electric grinder (cyclotec, M/S Tecator, Hoganas, Sweden using 0.5 mm sieve size) to fine powder and packed in air tight containers at room temperature until further nutrient analysis. Respective raw samples of all the rice varieties were also analysed for comparision.

The total soluble sugars were extracted according to the method of Cerning and Guilbot (1973). Starch was extracted from the sugar free pellet by the method of Clegg (1956). Quantitative determinations of total soluble sugars and starch were carried out by using anthrone reagent according to the method of Yemm and Willis (1954) and reducing sugars by Somogyi (1945) method. The amount of non-reducing sugar was calculated as the difference between total soluble sugars and reducing sugars. Amylose content was determined by using iodine solution (Juliano, 1971).

Statistical analysis of the obtained data was carried out using Completely Randomized Design according to the standard method (Panse and Sukhatme, 1961) to find the level of significant differences due to cooking and among cooking methods by OPSTAT software.

OBSERVATIONS AND ASSESSMENT

The data presented in Table 1 indicated that basmati varieties, Improved Pusa Basmati-I and Taraori Basmati had significantly ($P<0.05$) less starch content after cooking (76.90 to 78.40 g/100 g) as compared to all three coarse varieties (81.63 to 81.90 g/100 g). The increase in starch content after cooking over the raw control was slightly higher in coarse varieties (3.6 to 4.2%) as compared to basmati varieties (2.8 to 3.4%). Cooking brought about an increase of 2.6 to 4.3 per cent in starch content over uncooked rice samples. But, the differences in starch content as affected by various cooking methods were observed to be non-significant among each other. The results of present study are in agreement with those of Marsono and Topping (1993) who reported an increase in total starch content of microwave and rice cooker

Table 1 : Carbohydrate content (g/100 g) of rice as influenced by cooking methods and varieties (on dry wt. basis)

Treatments		Starch	Amylose	Total soluble sugars	Reducing sugars	Non-reducing sugars
Raw sample		77.35	22.27	2.55	0.61	1.95
Cooking method						
Ordinary		80.64	21.80	1.81	0.25	1.56
Pressure		80.38	22.71	1.87	0.26	1.61
Microwave		79.32	22.33	1.94	0.27	1.68
Solar		80.02	22.09	1.91	0.26	1.64
CD ($P\leq0.05$)	Raw v/s Method	1.42	NS	0.06	0.01	0.06
CD ($P\leq0.05$)	Among Methods	NS	NS	0.06	0.01	0.06
Variety						
IPB-I		76.90	21.86	2.01	0.27	1.75
TB (HBC19)		78.40	22.41	2.08	0.26	1.82
CSR 30		79.86	24.14	1.86	0.26	1.61
HKR 47		81.83	22.88	1.91	0.27	1.64
HKR 127		81.90	18.17	1.66	0.25	1.41
IRBB 60		81.63	23.94	1.78	0.26	1.52
C.D. ($P\leq0.05$)		1.83	0.97	0.07	0.01	0.07

IPB-I - Improved Pusa Basmati-I and TB - Taraori Basmati NS=Non-significant cooked samples. The higher values of starch in cooked samples might be due to better starch hydrolysis by α-amylase and amyloglucosidase. Khatoon and Prakash (2006) observed a non significant increase in total starch content in pressure and microwave cooked samples. They also reported slightly less starch content in Basmati and Bangara Tegalu rice as compared to Gowri sanna and Jeera rice varieties after cooking.

The data reported in Table 1 revealed that variety CSR 30 and IRBB 60 had significantly ($P<0.05$) higher amylose content than other varieties and least amount was recorded in variety HKR 127 after cooking. Cooking did not result in any significant change in amylose content as compared to raw rice. Also, no significant difference was observed in amylose content among cooking methods. In earlier studies, Sagum and Arcot (2000) reported that boiling consistently decreased the amylose in all rice varieties but the decrease was significant only in japonica variety. The slight decrease in amount of amylose in ordinary cooking might be due to the fact that during cooking the amylose can be leached out from the intact starch granules, leading to a change in the proportion of amylose and amylopectin (Schweizer *et al*., 1986). Sagum and Arcot (2000) also reported non significant increase in amylose content of Doongara and Inga rice varieties under pressure cooking compared to raw. This could be attributed to the process of reterogradation.

All the three types of sugars (total soluble, reducing and non-reducing) decreased significantly ($P<0.05$) upon cooking as compared to raw rice (Table 1). On the mean basis, total soluble sugars as a result of microwave cooking (1.94 g/100 g) were significantly more as compared to ordinary (1.81 g/100 g) and pressure (1.87 g/100 g) cooking methods but statistically similar to that of solar cooking (1.91 g/100 g) method. The reducing sugars were almost equal in microwave, solar and pressure cooked rice; ordinary cooked rice had less reducing sugars than rice cooked by microwave method but was at par to solar and pressure cooked rice. Among cooking methods, microwave cooked samples had significantly ($P<0.05$) higher non-reducing sugars (1.68 g/100 g) than pressure (1.61 g/100 g) and ordinary (1.56 g/100 g) methods but almost at par with solar (1.64 g/100 g) cooking method on mean basis. Also, pressure cooking method was at par to solar as well as ordinary cooking method as far as its effect on non-reducing sugars was noticed. This decrease in sugars content might be due to washing and soaking of rice prior to cooking, which is mainly due to diffusion of sugars after getting solubilized (Jacorzymski *et al*., 1981; Jood *et al*., 1986 and Akinyele and Akinlosotu, 1991). After cooking, the total soluble and non-reducing sugars were significantly higher in variety Taraori Basmati as compared to all other varieties. Also, another basmati variety Improved Pusa Basmati-I was significantly superior to other varieties. However, in respect of reducing sugars, variety HKR 47 was significantly superior to other varieties. Variation in sugar content of rice varieties have been reported earlier by many workers (Singh *et al*., 1998; Deka, 1998 and Singh, 2005). These variations may be due to differences in genetic makeup of varieties, agro-climatic conditions in which these are grown and the processing techniques.

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