

BIOCHEMICAL CHANGES DURING MATURATION AND DEVELOPMENT OF RICE GRAIN (*Oryza sativa*)

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ABSTRACT

Reducing sugar, starch, protein and its different fractions and trace elements Fe, Mn and Zn were estimated in the grains of 4 rice cultivars, ES 1-2-3, CRM 13-3241, CR 237 -I and HPU 741 during maturation and development period. The content of reducing sugar was found to decrease whereas that of starch and protein increased during maturation. Variation differences in the contents of these nutrients have also been discussed.

Key words: Biochemical changes, Rice grain.

Ripening or maturity may be understood as a process by which the grains attain a stage, at which they possess ideal nutrient contents for human consumption. It has been seen by different workers that nutrient contents of rice grains vary with cultivars, climatic factors, etc. (Petileskaya, 1986; Taira and Chang 1986; Shrivastava and Nanda, 1979). The present investigations were undertaken to study the nutrient contents of grain of four rice cultivars growing in the West Bengal agroclimatic conditions, from panicle initiation to harvesting stage.

MATERIALS AND METHODS

Cultivars, ES 1-2-3, HPU 741, CR 237-1 and CRM 13-3241 were sown and fertilizer N, P₂O₅ and K₂O were applied at the recommended dose on the seed bed @ 100, 100 and 80 kg/ha respectively of which 50% N, full dose of P₂O₅ and K₂O were given as basal and rest N was applied as top dressing after 15 days of sowing. Nitrogen was applied in the form of urea. Recommended fertilizer dose was also applied in the main field @ 120 kg N, 60 kg P₂O₅ and 60 kg K₂O of which 50% N, full dose of P₂O₅ and K₂O was applied as basal and 25% of N was applied 25 days after transplanting and remaining 25% of N was applied 50 days after transplanting.

Undiseased seeds with same mature spikelets from panicles were collected at 5 days interval. They were collected 5 times from milking stage to harvesting from each plot. Seeds were dried in an oven at 45°C. The dried materials were ground and were sieved by siever. Then the powdered seeds were transferred to polythene bag and was finally kept in a desiccator. The dry powdered seeds were used during the time of different analysis.

Iron, Zn and Mn were analysed from the aliquot of the wet oxidation of rice grains in an Atomic Absorption Spectrophotometer (Hitachi Model - 207). The starch and sugar were determined following the procedure described by Yoshida *et al.* (1972). Total soluble protein was estimated by the colorimetric method of Lowery *et al.* (1951) as modified by Hartee (1972). Total soluble proteins were further fractionated into three sub-fractions by salting out techniques using (NH₄)₂SO₄ as the precipitant and followed by the method of Lowery *et al.* (1951) as modified by Hartee (1972).

RESULTS AND DISCUSSION

Change in reducing sugar and starch:

The change in content of reducing sugar and starch of all the four varieties observed at

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different stages of growth are presented in Table 1. Two of the varieties, ES 1-2-3 and CRM 13-3241 showed initially a low sugar content followed by a sharp increase upto 12 days after flowering. This was, however, followed by a gradual decrease in ES 1-2-3 and for CRM 13-3241, it was found to be decreased and increased alternately with time. In case of CR 237-1 and HPU 741, sugar content initially went down with increase in the number of days after flowering followed by an increase and finally decrease as also observed in the first two varieties.

All the four varieties behaved almost similarly in respect of their starch content. Initially all of them were found to have a lower starch content which gradually increased with the days after flowering. A very interesting

correlation was found between changes in the content of starch and reducing sugar. The content of reducing sugar was found to decrease and that of the starch increase irrespective of varieties. This may be due to gradual transformation of reducing sugar formed during photosynthesis into the stored polysaccharide-starch. In other words, it may be inferred that in course of maturation of rice grain, biosynthesis of starch from photosynthates like reducing sugar is accelerated. This is quite in agreement from the physiological point of view that the seeds that are ultimate aim of maturation are to be made rich in stored carbohydrate.

Change in protein:

Change in total proteins and their fractions were studied. All the four varieties behaved in a

Table 1. Changes in reducing sugar, starch and trace elements and protein during maturation of Rice Grains

Name of varieties	Days after flowering	Sugar mg/100 mg	Starch mg/100 mg	Trace element content			Protein mg/100mg	Protein Fraction A mg/100mg	Protein Fraction B mg/100mg	Protein Fraction C mg/100mg
				Fe ppm	Mn ppm	Zn ppm				
ES 1-2-3	7	2.1	26.1	600	96.3	94	6.5	3.5	2.0	0.9
	12	4.9	58.2	390	93.8	87	8.4	5.6	1.8	1.1
	17	3.9	67.8	685	100.0	72	7.6	5.1	1.6	1.0
	22	3.2	75.6	825	100.8	95	8.2	5.4	1.7	1.1
	27	2.4	78.3	270	77.1	90	8.3	5.4	1.6	1.2
CR 13-3241	7	0.8	51.3	225	75.4	75	6.6	3.9	1.5	1.1
	12	3.2	67.8	215	69.2	60	8.3	5.5	1.8	0.9
	17	2.9	71.7	310	76.7	79	7.8	4.4	1.9	1.4
	22	3.9	74.9	195	67.9	53	7.9	4.5	1.8	1.6
	27	2.1	78.6	210	75.4	57	8.2	5.3	1.8	1.6
CR 237-1	7	3.1	37.2	225	68.8	67	6.2	3.8	1.7	0.8
	12	2.1	56.4	222	91.3	67	8.5	5.5	1.8	1.1
	17	2.6	64.5	212	66.7	73	7.7	4.9	1.7	1.1
	22	3.1	72.3	230	69.2	87	8.2	5.2	1.6	1.3
	27	2.3	77.1	220	65.0	68	8.4	5.3	1.6	1.4
HUP 741	7	3.3	28.8	193	66.7	70	5.6	3.2	1.2	1.1
	12	3.2	56.1	203	67.5	60	8.2	4.2	2.0	1.9
	17	3.9	67.8	210	68.8	60	7.4	4.7	1.5	1.3
	22	3.2	71.7	223	75.4	144	8.6	5.3	1.8	1.4
	27	2.1	75.0	213	70.2	172	8.5	5.5	1.6	1.3

more or less similar manner in respect of total protein content (Table 1). Initially they showed a sharp increase followed by a periodic pattern. But on an average all the four varieties indicated increase in protein with time. In case of fraction - A, general trend in all the four varieties were, however, found to be increasing with time. In respect of fraction - B, the variety ES 1-2-3 showed distinctly different pattern from the others which behaved similarly. In respect of fraction - C, the variety CRM 13-3241 differed from the others. The general trend was that the protein content increased of protein fractions with maturity. This is quite reasonable and expected, because in course of maturation a large number of enzymatic reaction come into play and so more proteins are synthesized from amino acids. Besides, seed protein need to be synthesized for storage, maintenance as well as attainment of the various structures of the seed. As regards to the protein fractions, the difference may be due to varietal nature.

Change in trace element :

The change in respect of Fe was found to be much significant in case of variety ES 1-2-3, the average trend being sharp increase in Fe content with time. The sudden fall on the 27th day is, however, confusing and inconclusive. The other three varieties were not found to respond significantly. In respect of Zn the variety HPU 741 was found to show quite significant

changes compared to others, the general trend being an increase with time. In respect of Mn, the susceptible varieties are CR 237-1 and HPU 741. Varietal differences was found to be similar with protein as discussed above.

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