https://doi.org/10.29321/MAJ.10.A03282

Madras agric. J. 63 (2) : 100 — 102, February, 1976.

Changes in Carbohydrates During Development of Grain in Rice (*Oryza sativa* L.)

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ABSTRACT

There was a progressive increase in the content of total carbohydrates in the developing grain of all the five strains. The same trend was noticed in the starch and amylose accumulation. A steady decrease was noted in the content of amylopectin which indicated an inverse trend to that of amylose. The starch iodine blue value also showed an inverse relationship with amylose during development. Regarding sugar fractions, sucrose was most predominant in all the varieties and a declining value was seen at the time of maturity. The contents of glucose and fructose also showed similar trends.

INDRODUCTION

Changes in carbohydrates occur till maturity in rice grains depending upon several factors. Paul *et al.* (1971) recorded in rice, a continuous increase of starch content during development of the grain. A study was undertaken to investigate the carbohydrate status of the developing grains at well defined stages of maturity in five rice varieties.

MATERIALS AND METHODS

A potculture study with five rice strains *viz.*, padma, ASD 14, ADT 27, CO 33 and CO 35 was carried out. Fertilizers N, P, K at the rate of 50 : 25 : 25 lb/ac. and green manure at the rate of 2500 lb/ac. were applied as basal dressing. The study was continued to the stage after flowering and the samples were collected at 5 day intervals ie, 10th, 15th, 20th, 25th and 30th day after commencement of flowering and biochemical investigations with regard to carbohydrate status were made. Total carbohydrates were estimated by colorimetric method (Somogyi. 1952). The starch was estimated according to the method of McCready *et al.* (1950). Amylose, amylopectin, starch iodine blue values were estimated by spectrophotometer method (Simpson *et al.* 1965). Sugar fractions were estimated by unidimensional paper chromotography method as suggested by Block *et al.* (1958).

RESULTS AND DISCUSSION

Total carbohydrates: In all the strains there was a progressive increase in the content of carbohydrates in the developing grains. ASD 14, ADT 27 and CO 33 had maximum contents at the time of harvest while Padma and CO 35 had the lowest. In respect of strains which

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had high contents, the maximum accumulation of carbohydrate was between 20th and 30th days.

Starch: The starch content also indicated a progressive increase in the grain (Table 1). Similar observations were made by Paul et *al.* (1971) in rice. The interesting feature was, that high quantity of starch accumulated within a period of 15 to 20 days. It has been suggested by Mc Kee et *al.* (1955) that starch is the principal storage product and in the developing grain maximum content is stored as starch. It was also suggested that the carbohydrate reaching the seed as sucrose, was transformed into starch.

TABLE 1. Showing the distribution of total carbohydrates, starch, amylose, amylopectin and starch-iodine blue values in the developing grain of the five varieties of rice expressed in percentage.

Varieties	Stages days after flowering				
	I 10	II 15	III 20	IV 25	V 30
Total carbohydrates					
Padma ...	6.25	9.75	12.25	15.50	15.00
ASD. 14 ...	6.00	10.25	13.00	13.00	22.50
ADT. 27 ...	8.25	12.25	13.80	21.50	20.25
Co. 33 ...	12.25	9.75	13.00	16.25	21.00
Co. 35 ...	6.25	6.75	10.75	14.00	16.25
Starch					
Padma ...	45.00	65.35	74.00	75.00	84.00
ASD. 14 ...	45.00	65.35	62.00	89.28	83.00
ADT. 27 ...	48.50	72.00	74.25	74.25	88.30
Co. 33 ...	40.50	40.50	49.28	50.40	74.25
Co. 35 ...	40.50	48.50	74.25	84.00	84.00
Amylose					
Padma ...	17.50	20.00	22.50	22.00	25.00
ASD. 14 ...	11.00	17.50	20.00	27.50	27.85
ADT. 27 ...	15.50	15.00	17.50	22.50	27.85
Co. 33 ...	15.00	25.50	22.00	28.00	30.00
Co. 35 ...	11.00	17.50	17.50	25.00	25.00
Amylopectin					
Padma ...	82.50	80.00	77.50	78.00	75.00
ASD. 14 ...	89.00	82.50	80.00	72.50	72.15
ADT. 27 ...	84.50	85.00	82.50	77.50	72.15
Co. 33 ...	85.00	74.50	78.00	72.00	70.00
Co. 35 ...	89.00	82.50	82.50	75.00	75.00
Starch-iodine blue value (% of transmittance)					
Padma ...	18.50	17.00	13.50	7.50	7.00
ASD. 14 ...	48.00	12.50	11.50	12.50	13.00
ADT. 27 ...	64.00	49.00	40.00	40.00	39.00
Co. 33 ...	59.00	42.00	27.00	25.00	20.00
Co. 35 ...	17.00	15.00	14.00	12.50	13.00

Amylose: The amylose content in the developing grain showed a progressive increase in trend from the 15th day of flowering. The short grain type such as ADT 27 and CO 33 had higher amylose content and alkali spreading during development. In all the five strains with increase in amylose content has been accepted to be an important character which conditions, the cooking quality of rice. With increase in amylose content, the cohessiveness decreased and in breeding programme, rice with high amylose contents may be preferred.

Amylopectin: A steady decrease was noted in the content of amylopectin during the development of grains in all the strains. Thus, it followed an inverse trend to that of amylose. In rice with average quality, the amylopectin fraction was reported to be synthesized at relatively faster rate than the amylose content. It was also noted in barley and other cereals that progressive increase in amylose is a desirable character in the cooking quality. This naturally means a proportionate decrease in the synthesis of amylopectin and this is possible since amylopectin is complimentary to amylose in the make up of starch.

Starch - Iodine - blue value: The starch iodine blue value showed a decreasing trend in the developing grain. The values indirectly showed the amylose content. This was clear with all varieties at all stages. Williams et *al.* (1958) reported high correlation between iodine blue value and quantitative amylose value for rice varieties. This relationship can be also altered by environmental factors or nutritional status of the crop.

Sugar fractions: Among the fractions of sugars, sucrose was the most prominent, in the case of all the five strains. In all the varieties a decreasing trend was seen at the time of maturity. It is possible that sucrose is converted into starch after a stage of development which is responsible for lowering the content of sucrose at the final stage. The subsequent decrease has been correlated with rapid synthesis of starch. The decline in sucrose value coincided with initiation of starch synthesis suggesting that the polysaccharides are produced at the expense of simple sugar. Regarding glucose and fructose also a similar trend was evident, although the content was comparatively low.

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