BIOCHEMICAL STUDIES ON RICE STARCH. IV. THE ACTION OF ENZYMES ON RICE STARCH. II.

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In the first communication on this subject, the writer stated that the substances transformed from the reserve starch by germination were different, due to the influence of temperature on the reaction; when the seeds germinated at a low temperature, the simple sugars formed were composed mostly of sucrose with some maltose, and the formation of maltose is favorable at a high temperature. In the chemical reactions in vitro, the temperature is regarded as only changing the reaction velocity. Chemical reactions of combination and intramolecular transformation, in general, only take place within certain limits of temperature, and cannot be accomplished outside those limits. However, we can hardly believe that sucrose will form from starch at 20°, while maltose at a higher temperature.

The writer, therefore, took up the study of the reaction products from rice starch in vitro by the action of the rice diastase prepared from the germinated rice at 20°C. and 35°C. in order to learn what the chemical changes that occur in the plant tissues at different temperatures.

The rice diastase used in the present experiment was prepared from the rice seedlings by the method proposed by Sherman and Schlesinger and acted on the rice starch, both the rice diastase and the rice starch were obtained from the grains produced in the same rice field, 1928, which were used in the previous experiments.

In the experiment, the rice diastase acted on 15 gr. of the rice starch in 3% solution for 3 hours at 20° and 35°C. respectively. The reaction products were treated with 80%, 90% and absolute alcohols to separate by fractional precipitation as in the case of the rice seedlings, and the separated products were examined as to their rotatory power and reducing power in their aqueous solutions, and also the reaction for the iodine solution, and also for the Pinoff reagent, and the results are summarized in the following table:

Reaction Products at 20°C.

Fraction	Yield	$[\alpha]_D$	R.P.	Iodine test	Pinoff's test
80% alcohol ppt.	2.6 gr.	160	7	wine red	—
90% alcohol ppt.	1.0	137	23	brown	—
abs. alcohol ppt.	0.1	83	46	nil	—
Sum	3.7				

Reaction Products at 35°C.

Fraction	Yield	$[\alpha]_D$	R.P.	Iodine test	Pinoff's test
80% alcohol ppt.	3.6 gr.	179	74	wine red	—
90% alcohol ppt.	2.3	117	26	brown	—
abs. alcohol ppt.	1.2	95	43	nil	—
Sum	7.1				

In vitro, 50% of the starch by the rice diastase at 35° were converted into simpler sugars, and at 20°C. only 33% were transformed, while in the germinated seeds, 20% and 17%, of starch were converted into simpler substances; at the corresponding temperatures. From the comparison of these figures we have learned that the transformation of starch will be performed in a parallel way both in vitro and in vivo, and also that the disappearance of the sugar molecule by decomposing into carbon dioxide and water will happen in vivo while in vitro it is never met with.

The 80% alcohol precipitate in both cases as in vitro, which shows a wine red colour to iodine, and is judged to be composed mostly of dextrins from the data of the rotatory power and the reducing power, and these results agree quite well with these in the corresponding state in vivo.

The 90% alcohol precipitate was assumed also from its physical and chemical properties to be composed mostly of maltose with some glucose while the absolute alcohol precipitate was predominant in glucose in two cases, and both of the precipitates was lacking in sucrose as indicated in the Pinoff test.

The fact that the formation of reducing sugars is favorable at high temperature, was already noticed by the writer in the germination of seeds.

To the writer's interest, the formation of cane sugar was actually noticed in vivo, but not in vitro. We noticed further a great difference between in vivo and in vitro, in the chemical reactions which take place in the starch molecule, the decomposition of starch into carbon dioxide and water, the so-called respiration, prevailed in the case of in vivo.

In closing, the writer would like to offer her hearty thanks to Prof. Komatsu of Kyoto Imperial University, for these experiments were performed under his kind direction and neverfailing encouragement.

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