and sulfur-free" acid chlorides by the action of silicon tetrachloride on the corresponding organic acid.

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NOTES

Action of Ethylene on Pure Starch.—It has been found that fruits and vegetables treated with ethylene have a higher sugar content than the same kind of fruits and vegetables not treated with the gas.[1]

Because ripening is known to be accompanied by change of starch into sugar the attempt to change pure starch into sugar by the use of ethylene was made.

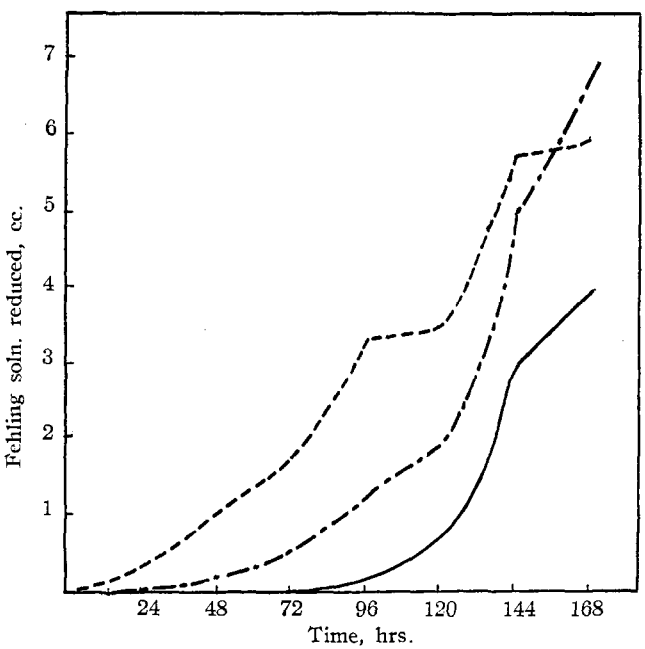

Fig. 1. ----, 10-min. boil; — — —, 5-min. boil; —— 1-min. boil.

Dry starch (both corn and wheat starch were used) was placed in an atmosphere of ethylene at 21° and atmospheric pressure and, as shown by the Fehling test, was partially changed into a reducing sugar. The action was slow and was accompanied by a change in color from pure white to a pale, yellowish tint. No quantitative determination of the rate of conversion of dry starch was made, merely a qualitative test. Untreated starch showed no change in the same length of time. The same kind of

[1] Harvey and Regeimbal, "Physiology of Blanching Celery," *Proc. Am. Assoc. Advancement Sci.*, Washington Meeting, vol. 79, **1924.**

starch, when made into an emulsion with water, was converted into sugar much more rapidly. A similar starch emulsion free from ethylene showed only a minute change even upon long boiling or upon standing for several weeks. The temperature varied from 21 to 24°. Water saturated with ethylene did not reduce Fehling solution. The starch emulsion absorbed about as much of the gas as did pure water, and no further absorption took place when the emulsion was allowed to stand, although the percentage of reducing sugar increased steadily.

Three starch emulsions of different "boiling times" but of the same concentration (1 g. of starch in 100 cc. of water) were saturated with ethylene at approximately 22° and allowed to stand. The first had been boiled one minute, the second five and the third ten minutes and all were allowed to cool to room temperature before they were saturated with the gas. The temperature varied between 20 and 24° while the emulsions were standing.

The rate of conversion of the starch to sugar was found to be affected by the time of boiling; for example, the ten-minute boil was changed more rapidly than the one-minute. The rate was slow at the beginning of the action, but such was to be expected. This "period of incubation" is especially noticeable in the data for the one-minute boil.

TABLE I

CONVERSION OF STARCH TO SUGAR

	Fehling soln., cc.						
Time, hrs.	24	48	72	96	120	144	168
No. 1	0.0	0.0	0.0	0.1	0.4	3.0	4.0
No. 5	.0	.2	.5	1.2	1.9	5.0	7.0
No. 10	.3	1.0	1.8	3.3	3.5	5.8	6.0

No. 1 boiled one minute, No. 5 boiled five minutes, No. 10 boiled ten minutes, before saturation with ethylene. In each case a 10cc. sample of the well-stirred emulsion was used for the titration. No. 5 showed 57% of reducing sugar at the end of 168 hours, when these observations were discontinued.

The presence of the plateaus in the curve for the ten-minute boil has not been explained at the present time.

It seems demonstrated that an enzyme need not be present, as has been thought, for the conversion of starch into sugar by the action of ethylene. The presence of ethylene alone seems sufficient. The chemistry of the reactions is not known, but it is thought that the gas acts as a catalytic agent, since no absorption was noticed even upon long standing.

This work will be continued at higher temperatures and pressures.

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