XXXII. AN INVESTIGATION OF THE RATES OF DIGESTION OF STARCHES AND GLYCOGEN

III. HUMAN LIVER AMYLASE

By GERTRUDE EVELYN GLOCK

From the Department of Physiology, Bedford College, University of London

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As far as the author is aware, no work has been published on the action of human liver amylase. The action of animal liver amylase preparations from the cat, rat, pig, ox, guinea-pig, rabbit and frog on glycogen and potato starch has already been reported in this *Journal* [Glock, 1936], the present investigation being undertaken as an extension of this.

Two human liver preparations have been employed, both obtained from normal people who died from multiple injuries as a result of accidents. In each case, the liver was cut into small pieces and placed in acetone as soon as possible after death. The subsequent treatment of the material was identical with that previously employed [Glock, 1936]. The maltase activity of both human liver preparations was tested and found to be positive. Different samples of human serum were shown to have slight maltase but no amylase activity. The amylase was estimated according to the method of Baltzer [1935]. Compton [1921] and Barnes & MacKay [1936] found that human serum had no maltase activity.

The digestion mixtures were set up as previously described for the animal liver preparations and the same estimations were performed, i.e.

- (1) Unchanged polysaccharide.
- (2) Total reducing power.
- (3) Reducing power due to sugar alone.
- (4) Reducing power after acid hydrolysis.
- (5) Lactic acid.

The results are given below (Tables I and II).

Table I

Substrate	...	...	...	...	Glycogen									
Enzyme	...	...	...	...	Human liver amylase 1									
Time in hr.	...	...	...	...	2	6	19	24	30	42	48	66	114	
% polysaccharide gone	...	...	...	...	5.0	9.5	20	23	26	31.2	35	39.3	49.3	
% polysaccharide left	...	...	...	...	95	91.5	80	77	74	68.8	65	60.7	50.7	
% formation of total reducing substances calc. as maltose	...	...	...	...	3.4	6.4	13.5	17.4	18.1	20	23.3	28.4	36.4	
% formation of sugar calc. as maltose	...	...	...	...	2.5	5.9	12.9	15	17.3	18.6	21.9	26	33.7	
% formation glucose on hydrolysis calc. from maltose	...	...	...	...	—	—	—	—	100	—	99	102	99	
% formation lactic acid	...	...	...	...	—	—	—	—	—	—	7.7	—	—	
Evidence for glucose as given by osazone	No	No	No	No	No	No	No	No	No	No	Some	Yes	Yes	

Table II

Substrate	...	...	...	...	Glycogen		Potato starch	
Enzyme	...	...	...	...	Human liver amylase 2			
Time in hr.	...	...	...	...	66	114	66	114
% polysaccharide gone	...	...	...	...	36.66	48.93	81.61	91.84
% polysaccharide left	...	...	...	...	63.34	51.07	18.39	8.16
% formation of total reducing substances calc. as maltose	...	...	...	...	35.37	47.33	56.52	76.4
% formation sugar calc. as maltose	...	...	...	...	33.52	47.32	49.3	72
% formation glucose on hydrolysis calc. from maltose	...	...	...	...	98	97	97	96
Evidence for glucose as given by osazone					Some	Yes	Yes	Yes

On comparing these results with those obtained with animal liver amylases, it is seen that human liver preparations behave rather like rat liver preparations. In both cases, maltose alone is formed in the early stages of hydrolysis, in the case of the human liver preparations up to about 42 hr. and in the case of the rat liver preparations up to about 6 hr., but, as digestion proceeds, glucose is produced in addition. It has been shown in the case of the rat liver preparation, that this glucose could result from the action of the maltase in the blood of the liver preparation. Although the maltase activity of human serum is considerably less than that of the rat, the glucose formed by the human liver preparations might also conceivably be produced by the blood maltase contained in it, since glucose did not appear until a relatively late stage in hydrolysis (i.e. 48 hr.).

By calculation, it was found that in the case of preparation 2, after 66 hr. hydrolysis, the sugar formed consisted of 81 % maltose and 19 % glucose, and after 114 hr. of 32 % maltose and 68 % glucose. In contrast to the rat liver preparations, however, the formation of reducing sugar followed a hyperbolic curve.

SUMMARY

1. The course of hydrolysis of glycogen and potato starch by two acetone-extracted and dried human liver preparations was followed.
2. The preparations were shown to possess positive maltase activity. Human serum was found to have slight maltase but no amylase activity.
3. Maltose was the sole end-product in the early stages of hydrolysis, but after 48 hr. this was gradually transformed into glucose.

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