THE INFLUENCE OF ALCOHOL ON ABSORPTION OF GLUCOSE. Part I.

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It is generally stated in modern text-books of Physiology that the stomach has no power of absorbing either water or dissolved substances with the exception of a few compounds such as alcohol, chloral hydrate and strychnine.

Examination of older literature shows that Tappeiner(1) (1880), investigating the absorptive power of the stomach in cats and dogs, concluded that glucose and peptone were both absorbed slightly from water solution and definitely absorbed to a greater extent from dilute alcoholic solutions.

Anrep(2) and later Segall(3) working with dogs with gastric fistulæ concluded that the stomach absorbed both glucose and peptone.

v. Mering(4) and simultaneously Brandl(5) studied absorption from the stomach also in dogs with gastric fistulæ. v. Mering came to the same conclusion as Edkins(6) that water was not absorbed: with regard to dissolved substances he found considerable absorption of glucose and peptone from water solutions and an increased absorption of glucose in the presence of alcohol. Brandl, whose experiments were all performed on one dog, records very high figures for the absorption of glucose, peptone and sodium iodide with a definite increase in the presence of alcohol. His work is open to adverse criticism since he found absorption of water from quite concentrated solutions which was denied by v. Mering. Other workers, as Ryan(7) and Brequet(8), state that alcohol does not enhance the absorption of strychnine by the stomach and according to Tchekounov(9) saccharose is not absorbed in the slightest degree from water or alcoholic solutions in the stomach.

Most experiments carried out on the effect of alcohol on intestinal absorption, with the exception of those of Nakamura(11) have been done on dogs with Thiry-Vella fistulæ. It must be urged against this method that there always results a catarrhal condition of the gut and

therefore it cannot constitute a reliable method for studying physiological absorption (see the discussion in Schäfer's *Textbook of Physiology*, 1898, I, p. 557). Scanzoni(10) employed T.-V. fistulæ and found that various drugs which acted as stimulants (including alcohol) had a much smaller effect on intestinal absorption than on gastric absorption. Nakamura's(11) conclusion, working with the "acute" experiment in animals anæsthetised by A.C.E. mixture, was that alcohol does not promote intestinal absorption.

The above brief review of past work on absorption by the stomach and the effect of alcohol on absorption from the alimentary canal generally shows that no definite statements can be made.

Using decerebrate animals in the absence of anæsthetics (ether was used in the operation of decerebration) N. Edkins and M. M. Murray(12) found that alcohol accelerated the absorption of CO_2 in the stomach. Experiments were then undertaken with the same operative procedure to see if alcohol accelerated absorption generally.

In the present investigation attention was first directed to the disappearance of glucose alone from the stomach cavity and then to the effect that alcohol exhibited on the rate of disappearance.

Method.

Cats were anæsthetised with ether, the carotids ligatured and decerebration performed by trephining. The respiratory centre functioned spontaneously. The animals were immersed in a saline bath at 37° C. The stomach was exposed, the œsophagus ligatured and a tube tied into the pylorus. Great care was taken to maintain the circulation intact, the appearance of the blood vessels readily informing on this point. The stomach was thoroughly washed out with warm saline; 25 c.c. of glucose solution with or without alcohol was introduced, and the glucose remaining in the introducing tube was washed into the stomach. Every experiment consisted of two parts, each part lasting for an hour, in one period glucose alone was given, in the other both sugar and alcohol. The actual concentration of the sugar was practically identical in all cases, viz. 20 p.c. The strength of the alcohol was 10 p.c., in most cases the actual amount of alcohol present being 2·5 c.c. In some of the later experiments this strength was doubled. At the end of the hour the contents were withdrawn into a 200 c.c. graduated flask and the stomach washed out with water until the volume was approximately 200 c.c. The order of the administration of glucose alone and glucose with alcohol was alternated in successive experiments. The estimations of glucose

in the solutions introduced and removed were made by Bertrand's method. All solutions removed from the stomach were freed from any protein by the Folin-Wu technique. Any loss that might have occurred in the process of introduction and removal by adsorption or mechanical adhesion to the gastric mucous membrane was estimated by introducing a known volume of solutions and immediately removing the same, and such determinations showed that any error in the results from this cause would not exceed 0·05 grm.

RESULTS.

Periods of one hour; 25 c.c. of 20 p.c. glucose introduced either in water or in 10 p.c. alcohol. Total glucose 5 grm.

Disappearance of glucose from stomach.

A.

Exp.	1st hour glucose with alcohol (grm.)	2nd hour glucose alone (grm.)
I	0·881	0·46
II	0·625	0·0
III	0·475	0·0
IV	0·72	0·58
Mean	0·68	0·26

B.

Exp.	1st hour glucose alone (grm.)	2nd hour glucose with alcohol (grm.)
V	0·41	1·006
VI	0·31	0·31
VII	0·28	0·58
VIII	0·38	0·44
IX	0·28	0·60
X	0·28	1·06
Mean	0·32	0·67

From the foregoing table it can be seen that glucose disappeared from the liquid in the stomach to the extent of approximately 0·3 grm. per hour. Also that with one exception the disappearance of glucose when given with alcohol was greater irrespective of whether the glucose alone was given in the first or second period. In the presence of alcohol the absorption of glucose was 0·67 per hour, that is, the disappearance with alcohol was at twice the rate that it was without.

Other experiments to test the rate of absorption of glucose with or without alcohol in the intestine showed that the influence of alcohol was here less marked. In these experiments about 100 cm. length of small intestine was taken distal from the duodenum. Tubes were tied into either end and the loop was well washed out to remove all contents. Into the loop was introduced either glucose or glucose with 10 p.c. alcohol. In these experiments the periods were half-hours.

RESULTS.

Disappearance of glucose from small intestine.

Exp.	1st half-hour glucose with alcohol (grm.)	2nd half-hour glucose alone (grm.)
I	0·813	0·541
II	0·733	0·46
III	0·645	0·432
IV	0·88	0·81
V	0·82	0·66
Mean	0·78	0·59

These experiments were complicated by the fact that in some cases tape-worms were not completely removed. No great stress can therefore be laid upon the precise values of the estimations; they can only be regarded as indicative.

It is better perhaps to speak of the disappearance of glucose than its actual absorption. J. Mellanby(13) has pointed out that etherisation and decerebration will cause variable fluctuations of the blood sugar level. No reliance therefore could be placed on simultaneous estimations of the blood sugar as far as relationship between disappearance of sugar from the alimentary canal and variations in the amount in the blood were concerned.

It seems however permissible to state that alcohol influences the rate of disappearance of glucose from the stomach, and in work which is now proceeding the effect of alcohol is being further studied under conditions in which etherisation and decerebration are eliminated and the results so far indicate that the disappearance corresponds definitely to absorption into the blood.

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