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Gantt, W. Horsley 1892-1980.

Publication/Creation

St. Louis : [publisher not identified], 1929?]

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EFFECT OF COFFEE AND TEA ON GASTRIC SECRETION*

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THE almost universal use of coffee and tea as beverages among civilized people is an important reason why we should thoroughly understand their action. In many European countries indeed they furnish the main water intake, especially in Russia where the drinking of quantities of weak tea is a habit prevalent among all classes.

The purpose of our experiments was to find out the chemical action on the secretion of the stomach of coffee and tea when taken with food.

As is well known, the secretion of the stomach to any substance which is eaten consists of two components: the "psychical" or nervous secretion, and the chemical secretion. This was shown first in 1852 by Bidder and Schmidt and later by the sham feeding experiments of Pavlov.¹ As the nervous secretion, being a conditioned reflex, varies with each individual according to whether he likes or dislikes tea or coffee and with many other factors, we desired to eliminate this so as to get the pure chemical or unconditioned effect.

We first tried to introduce the mixture of bread and tea into the stomach through a stomach tube. Here we met with several difficulties: the food passed slowly along the tube and often clogged; it was difficult to prevent the animal from seeing the food and tasting it when the tube tip was pulled out over the tongue; the introduction of the tube evoked the passive-defensive reaction in the dog which might have a disturbing influence on the gastric secretion.

Our dog had already a stomach pouch, according to Pavlov's method, so that the secretion could be collected and measured accurately. In order to overcome the above-mentioned difficulties, we made a gastric fistula in the large stomach, and began our experiments about three weeks after operation when the secretion had returned to normal.

Our dog was about three years old, and had been used in the laboratory for more than a year previously, having shown a constant and regular gastric secretion.

The experiments were done as follows: no food was given the morning of the experiment, the last feeding being on the previous evening at 6 P.M. The stomach was first washed clean with ordinary water at room temperature; if there was any secretion we waited until it disappeared or until the contents of the stomach became alkaline. The dog was put on its back, and the bread and tea mixture was introduced through the gastric fistula. Every precaution was

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Received for publication, September 28, 1928.

TABLE I
COMPARISON OF TEA AND WATER ON GASTRIC SECRETION

150 GM. DISTILLED WATER PLUS 100 GM. BREAD INTRODUCED INTO GASTRIC FISTULA				150 GM. TEA PLUS 100 GM. BREAD INTRODUCED INTO GASTRIC FISTULA			
Order of experiment	1st	4th	7th	Average 13'	2d	3d	Average 13:49 min.
Latent period	15 min.	11	—	13'	—	16'	15'
First hour	3.0 c.c.	3.0 c.c.	2.4 c.c.	2.8 c.c.	2.4 c.c.	2.4 c.c.	3.5 c.c.
Second hour	1.7	2.1	0.9	1.57	—	1.6	2.0
Third hour	1.4	2.1	—	1.75	—	0.9	1.6
Fourth hour	0.7	1.6	—	1.15	—	0.8	1.3
Total				7.9 c.c.			7.3 c.c.

TABLE II
COMPARISON OF COFFEE AND WATER ON GASTRIC SECRETION

150 GM. DISTILLED WATER PLUS 100 GM. BREAD INTRODUCED INTO GASTRIC FISTULA				150 GM. COFFEE PLUS 100 GM. BREAD INTRODUCED INTO GASTRIC FISTULA			
Order of experiment	1st	5th	7th	Average 26 min.	3d	4th	Average 24 min.
Latent period	24	32	30	26 min.	15	29	22
First hour	1.1 c.c.	1.0 c.c.	2.0 c.c.	1.3 c.c.	2.0 c.c.	1.2 c.c.	1.6 c.c.
Second hour	0.6	0.6	0.8	0.58	0.9	0.8	0.7
Third hour	0.5	—	0.9	0.7	1.6	1.5	1.07

taken to keep the animal from seeing and smelling the food in order to prevent any psychical secretion.

The dog was returned to the stand, the latent period noted by testing with litmus the reaction in the stomach pouch, and the gastric juice therefrom collected and measured every fifteen minutes.

In order to eliminate any daily variation in the secretion, control experiments were done on the alternate days, using a mixture of bread and a volume of water equal to that of the tea. Both the tea and coffee were made very strong by boiling for five minutes 3 to 5 gm. of tea or 5 gm. ground coffee with 150 c.c. of water. Three experiments were done in a week on alternate days.

The results of our experiments are shown in Tables I and II. (These tables are not to be compared with each other, as the experiments with coffee and tea were done at an interval of several months.)

DISCUSSION

In the human, Miller, Bergheim, Rehfuß and Hawk² compared the action of 1,000 c.c. of coffee or tea with water. This amount of coffee and tea plus the test meal of rice, they found, produced nervous symptoms such as palpitation, flushing, shivering, etc., and delayed the secretion, but finally the same acidity was reached as from the test meal alone (cited by Babkin³).

Kestner and Warburg⁴ found in a dog with a duodenal fistula that coffee produces a slight gastric flow and tea very little.

Kestner and Knipping⁵ state that the action is due only to those substances entering into solution, i.e., 25 to 30 per cent of the weight of roasted coffee. In 25 gm. of a watery extract made from 100 gm. of ground coffee there are, besides other things, 1.7 gm. of nitrogenous compounds, about 1.5 gm. of which is caffeine; also 5.2 gm. of oil and 4.1 gm. of mineral substances.

Thirty to 40 per cent of the weight of tea enters into solution, and 2 per cent of the resulting solution is caffeine. Thus in a cup of coffee made from 7.5 gm. of coffee there is 0.1 gm. caffeine, but in a cup of tea prepared from 2 gm. of tea leaves, only 0.02 gm. caffeine. These authors remark that nothing of nutritive value is present, neither albumin nor vitamins, and that their effect comes from the action of the caffeine on the nervous system and on the gastric secretion. Bickel and Eweyk,⁶ however, state that the influence on the stomach secretion is not from the caffeine but from the products arising during the process of roasting.

The use of coffee and tea as palatable beverages taken with food should not be overlooked. In this capacity they may aid digestion in two ways: first, by the stimulation of the "psychical" or nervous juice, and second, by adding to the water intake. That the nervous secretion may be considerable has been well established by the sham feeding experiments carried out in the laboratory of Prof. Pavlov.⁷ The gastric juice obtained by five minutes of fictitious feeding in a dog with an esophageal fistula so that none of the food enters the stomach, but is only swallowed and dropped out from the fistula, may last for three hours and almost equal that produced by bringing the food directly into the stomach through a fistula, i.e., the chemical secretion.

As regards the water intake on the flow of gastric juice, Prof. Pavlov says: "If tea and coffee through their water content help to supply a water

deficiency in the body, they may become extremely important factors in digestion. In my experiments with sham feeding it was shown that if the animal was deprived of fluid the gastric secretion gradually sunk, and after several days became zero. As soon as water was given, the secretion began. If the water intake is too low all of the secretions will be greatly decreased." (Personal communication for this paper.) Of course, from this point of view, coffee and tea have no specific value, and are of use only in so far as they insure a sufficient amount of water for digestion, and they could be substituted by any other aqueous beverage provided it were taken in the same quantity.

SUMMARY

The chemical action of a mixture of tea and bread on the stomach secretion was found to be practically the same as a mixture of bread with an equal amount of water. A mixture of coffee and bread produced a slightly greater amount of gastric juice during the first two hours. The latent period (the beginning of the secretion) was not affected in either case. The increase in juice was very little, 0.3 c.c. for the first hour in the stomach pouch, or about 3.0 c.c. for the whole stomach. The nervous element was eliminated by introducing the mixture through a gastric fistula, and the collection of the juice was from a miniature Pavlov's stomach.

We may conclude that the effect of even very strong coffee and tea on the stomach secretion depends almost entirely upon the individual, i.e., upon the nervous secretion, and upon the water content, there being little or no chemical influence due to the tea and coffee per se.

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