

# SECRETION OF PHOSPHOLIPIDS IN THE LARGE AND SMALL INTESTINE OF DOGS

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Little attention has been paid to the study of the principles governing secretory processes in the large intestine. Among the earliest work in this field were the investigations of G. B. Berlatskii [2], and N. D. Strazhesko [9], conducted in I. P. Pavlov's laboratory.

It was previously held that the "mucous" particles (or the solid part of the juice) form the skeleton for the feces and were not considered during its analysis. The author later showed that this component of the secretion of the caecum and the middle part of the large intestine, like the juice of the small intestine, contains most of the secreted enzyme [7].

During recent years a number of workers have shown experimentally that the secretion of the proximal part of the small intestine is rich in phospholipids [1, 5, 6, 8]. These compounds play an important role in lipid metabolism in the liver [10].

Because of these facts described above, it was interesting to examine whether the secretion of phospholipids takes place in the large intestine and with what intensity.

## EXPERIMENTAL METHOD

Experiments were conducted on dogs. A segment of the duodenum was isolated by the Thiry method and the caecum was detached from the rest of the intestine and isolated completely. The juice was collected during periodic secretion for 18-20 h after feeding. The secretion obtained was immediately centrifuged, the liquid portion was pooled, and the solid matter was placed on ice. Phospholipids were determined only in the solid portion [1]. This was ground with purified quartz sand and extracted five times with a chloroform-methanol mixture (2 : 1) by Folch's method [11]. The pooled extracts were freed from inorganic phosphorus by treatment with 0.1 and 0.01 N solutions of hydrochloric acid, evaporated on a water bath, and mineralized with concentrated sulfuric and nitric acids. Phosphorus was determined by the method proposed by K. S. Zamyckina and D. E. Grodzenskii [4]. To calculate the content of phospholipids, the number of milligrams of phosphorus was multiplied by the coefficient 23.5.

## EXPERIMENTAL RESULTS

The concentration of phospholipids per gram of the solid part of the juice from the duodenum of dog No. 1 was  $4.62 \pm 0.42$  mg, in dog No. 2 —  $5.87 \pm 0.40$  mg, and in dog No. 3 —  $5.77 \pm 0.01$  mg.

The rate of liberation of phospholipids in the secretion of the proximal portion of the intestine in the dogs investigated averaged  $0.52 \pm 0.1$ ,  $0.44 \pm 0.4$ , and  $0.75 \pm 0.08$  mg per hour of secretion. The higher secretion of phospholipids per unit time in dog No. 3 was associated with secretion of the solid part of the juice ( $108 \pm 22.5$ ,  $79 \pm 11.7$ , and  $126 \pm 13.8$  mg/h, respectively), and not with an increase in their concentration.

Investigation of the secretion of the caecum showed that the quantity of solid part of the juice secreted per hour was on the average 33.50% smaller than in the duodenum. A similar pattern was observed in an earlier investigation [7].

To compare these secretory processes in different parts of the intestine more accurately, the dimensions of the usually isolated portions of the duodenum and caecum were excised, opened up, carefully washed with tap water, and dried with filter paper, after which they were spread on squared paper and

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TABLE 1. Secretion of Phospholipids in the Juice of the Caecum

Index	Dog No. 4		Dog No. 5		No. of expts.
	limits of variations	traces	limits of variations	traces	
Solid part of juice (in mg/h)	22-87	56	26-285	86	9
Content of phospholipids in all juice (in mg/h)	Traces — 0.16	0.050	Traces — 0.14	0.077	9
Content of phospholipids per grams solid part of juice (in mg)	Traces — 1.75	0.83	Traces — 1.81	0.78	9

measured. Such measurements are not absolutely accurate, but they give an adequate idea of the relative sizes of the studied segments of the intestine.

The measurements showed that the ratio between the area of the caecum and the area of the segment of duodenum was  $0.69 \pm 0.009$  (mean of 6 experiments).

The flow of secretion of the small intestine, when calculated relative to the area of the cecum in dog No. 1 was therefore 0.36, in dog No. 2, it was 0.30, and in dog No. 3 — 0.52 mg phospholipids/h. The rate of liberation of these compounds into the secretion of the caecum was much lower, and usually lay within the range of several hundredths of a milligram (see Table 1).

In many of the experiments phospholipids were found by the method used only as traces. The concentration of these compounds in the solid part of the juice varied extremely sharply from traces to 1.81 mg/g. A low content of phospholipids was sometimes found even in experiments when the quantity of solid parts of the juice was high. This phenomenon may be explained by assuming that the solid part of the juice from the caecum and the middle portion of the large intestine, unlike the juice of the duodenum, often contains large quantities of true mucus — the secretion of the goblet cells [3].

Because of the comparatively small quantity of solid part of the juice produced during one experiment and the low concentration of phospholipids in it, it was not possible to determine accurately enough the content of these compounds; the solid part of the juice from the caecum obtained during 3 or 4 experiments was therefore investigated. The collected secretion was kept in the cold.

In these experimental conditions, the concentration of phospholipids from dog No. 4 was  $1.73 \pm 0.13$ , and from dog No. 5 —  $1.28 \pm 0.16$  mg/g solid part of the juice (results of five experiments).

The concentration of phospholipids in the secretion of the large intestine was thus only 25-35% of their concentration in the juice of the duodenum. The difference between the rate of secretion of phospholipids in the different parts of the intestine per hour was even greater. The rate for the proximal portion of the small intestine was 7-10, and sometimes more, times greater than the rate for the caecum.

It is now known that the secretion of phospholipids in the duodenal juice is not due entirely to the presence of these substances in the desquamated epithelial cells, but is an active process as shown by the increase in the concentration of these substances under the influence of special diets [5]. The low intensity of secretion of phospholipids in the caecum suggests that the phospholipids of the juice of the large intestine are less connected with general metabolism in the body, and are present in this secretion purely as structural components of the cell. Experimental verification of this suggestion, however, is required.

#### LITERATURE CITED

1. L. M. Babushkina, *Vopr. Med. Khimii*, No. 4, 254 (1958).
2. G. B. Berlatskii, *Material on the Physiology of the Large Intestine*, Dissertation, St. Petersburg (1903).
3. Z. M. Gadzhieva and I. B. Kuvaeva, *Byull. Éksp. Biol.*, No. 12, 81 (1958).
4. K. S. Zamyckina and D. É. Grodzenskii, *Byull. Éksp. Biol.*, No. 9, 79 (1953).
5. U. Z. Kadyrov, *Vopr. Pitaniya*, No. 2, 16 (1951).
6. A. S. Kainova and I. B. Kuvaeva, *Byull. Éksp. Biol.*, No. 3, 60 (1961).
7. I. B. Kuvaeva, *Fiziol. Zh. SSSR*, No. 4, 336 (1957).

8. I. B. Kuvaeva, Vopr. Pitaniya, No. 4, 30 (1962).
9. N. D. Strazhesko, The Physiology of the Intestine, Dissertation, St. Petersburg (1904).
10. G. K. Shlygin, É. N. Vasil'eva, and R. V. Narodetskaya, Dokl. Akad. Nauk SSSR, 145, No. 4, 953 (1962).
11. J. Folch et al., J. Biol. Chem., 191 (1951), p. 833.