

THE EXCRETION OF UROPEPSINOGEN IN DOGS

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Translated from *Byulleten' Éksperimental'noi Biologii i Meditsiny*, Vol. 56, No. 11,
pp. 75-79, November, 1963

Original article submitted December 25, 1962

Contrary opinions are held regarding the excretion of pepsinogen in the urine and of pepsin in the gastric juice. Some workers [1, 2, 7] claim that a strict parallelism exists between the excretion of pepsin and uropepsin. Others [10, 12] assert that no direct relationship is present between the secretion and excretion of pepsin. Some workers [8, 9] found that uropepsinogen is absent from the urine of man and animals after gastrectomy. It has also been shown [11] that the intravenous injection of pepsin into dogs has no effect on the excretion of uropepsinogen whereas injection of pepsinogen leads to a sharp increase in its concentration in the urine.

The object of this investigation was to study the changes in the level of uropepsinogen in dogs receiving various food stimuli (200 g bread, 200 g meat, and 600 ml milk). In a second series of experiments the relationship between the excretion of pepsin and uropepsinogen was studied after injecting morphine into dogs.

The use of morphine enables the part played by the vagus nerve centers in the work of the gastric glands and heart to be determined [6, 7]. The centers of the cardiac and gastric branches of the vagus nerve are in constant tonic excitation as a result of the action of the chemical constituents of the blood and of reflex influences. The cerebral cortex has an inhibitory influence on the tone of the vagal centers. Morphine, according to A. I. Smirnov's findings [5], abolishes the inhibitory action of the cerebral cortex and allows the tonic action of the centers to be displayed for a period of between 10 and 12 h. In fasting dogs (16-18 h after eating) a small dose of morphine (0.005-0.01 g) causes prolonged secretion by the gastric glands. The secretion of gastric juice begins after 15-20 min, and during the first 3 h it is possible to collect 100-200 ml of pure gastric juice from a fistula [6].

Experiments were conducted on dogs with an isolated gastric pouch and fistula of the urinary bladder in order to examine the relationship between the secretion of pepsin and excretion of uropepsinogen without the influence of food stimuli.

EXPERIMENTAL METHOD

The pepsin in the gastric juice and the uropepsinogen in the urine were collected for hourly periods and determined in Pyatnitskii units. The method used as a modification of that described by Age and Mench-Thygesen based on the chymosin action of pepsin. N. P. Pyatnitskii's suggested method of activation of the pepsinogen in the urine is as follows. Two drops of 2% hydrochloric acid is added to 0.5 ml urine in a test tube. The tube with its contents is allowed to stand for 3 h at room temperature. After this time (or next day) the uropepsin is determined (in the same way as the pepsin in the gastric juice).

EXPERIMENTAL RESULTS

In the first series of experiments (with the action of food stimuli) 6 dogs with a permanent fistula of the urinary bladder were used. The experiments were begun in the morning, after the dogs had fasted for 18-20 h. Four experiments were carried out on each dog using each food stimulus. During the first hour (control period) urine was collected while the stomach was empty. After administration of the food stimulus (firstly bread, secondly meat and, finally, milk) the experiments were continued for 12 h, during which time the urine was collected hourly and the uropepsin determined.

It will be seen from Table 1 that, on the average over a period of 12 h, in response to bread 24 units of uropepsin was secreted, to meat - 22 units, and to milk - 18 units. The results of the experiments confirmed I. P. Smirnov's findings.

TABLE 1. Mean Data Showing Excretion of Uropepsin (in Conventional Units) in Response to Food Stimuli (24 experiments on 6 dogs)

Stimulus	Test	Time after application of stimulus (in hours)													
		control	1	2	3	4	5	6	7	8	9	10	11	12	total
Milk (600 ml)	Diuresis (in ml)	7.5	55	158	83	27	23	12	14	12	10	11	14	16	442
	Content of uropepsin in 1 ml	0.179	0.030	0.010	0.021	0.064	0.073	0.095	0.1	0.114	0.120	0.120	0.103	0.105	
	Amount of uropepsin excreted per hour	1.342	1.763	1.643	1.692	1.744	2.134	1.142	1.4	1.377	1.204	1.323	1.442	1.683	18.5
	Diuresis (in ml)	10	10	24	20	30	23	6	8	11	8	5	1	3	152.5
Meat (200 g)	Content of uropepsin in 1 ml	0.164	0.142	0.08	0.158	0.070	0.116	0.417	0.235	0.123	0.127	0.213	1.076	0.47	
	Amount of uropepsin excreted per hour	1.644	1.428	1.192	2.772	2.11	3.03	2.51	1.914	1.458	1.016	1.039	1.076	1.41	21.8
	Diuresis (in ml)	2	5	55	50	38	20	15	13	17	8	7.5	3.5	4	232
	Content of uropepsin in 1 ml	0.209	0.089	0.046	0.06	0.109	0.151	0.164	0.158	0.144	0.142	1.158	0.171	0.171	
Bread (200 g)	Amount of uropepsin excreted per hour	0.419	0.449	2.54	3.02	4.149	3.036	2.472	2.061	2.451	1.139	1.88	0.599	0.685	23.7

TABLE 2. Mean Data Showing Excretion of Pepsin and Uropepsin (in Conventional Units) after Injection of Morphine

Dose of 1% mor- phine so- lution (in ml)	Test	Control	Time after injection of morphine (in hours)									Total during 9 h	Total experi- ment
			1	2	3	4	5	6	7	8	9		
1	Volume of gastric juice (in ml)	—	8	10	28	11	15	—	—	—	—	72	72
	Content of pepsin in 1 ml Amount of pepsin secreted per hour	—	8	3.5	2.5	2.4	3.6	—	—	—	—	—	—
	Volume of urine (in ml)	—	64	35	70	25.4	54	—	—	—	—	249.4	249.4
	Content of uropepsin in 1 ml	24	17	15	30	18	12	10	11	4	5	122	146
	Amount of uropepsin ex- creted per hour	0.04	0.057	0.055	0.046	0.046	0.053	0.064	0.022	0.035	0.65	—	—
		0.96	0.969	0.84	1.380	1.748	1.636	0.64	0.79	0.28	0.325	5.61	6.57
2	Volume of gastric juice (in ml)	—	8	16	20	10	12	10	7.5	—	—	83.5	83.5
	Content of pepsin in 1 ml	—	9.23	13.33	66.7	10	4.06	5.06	5.7	—	—	—	—
	Amount of pepsin secreted per hour	—	73.84	213.28	133.04	100	81.2	50.6	42.8	—	—	694.8	694.8
	Volume of urine (in ml)	15	10	23	16	10	3	3	4	3	6	78	93
	Content of uropepsin in 1 ml	0.25	0.093	0.076	0.087	0.129	0.094	0.086	0.076	0.086	0.092	2	—
	Amount of uropepsin ex- creted per hour	0.38	0.933	1.745	1.392	1.29	0.28	0.258	0.305	0.258	0.542	0.003	7.383

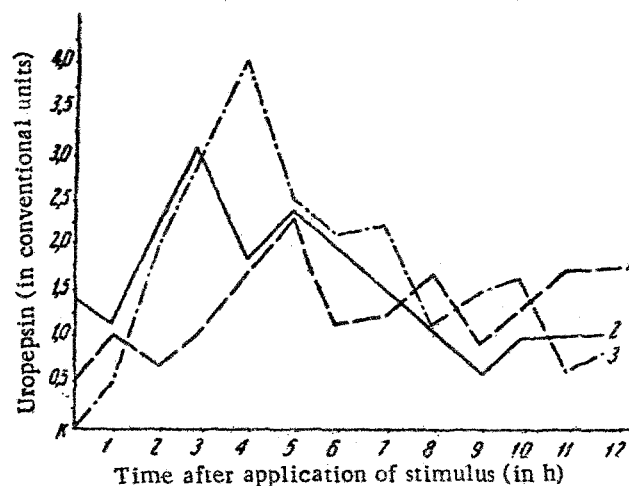


Fig. 1. Excretion of uropepsin by hours during secretion of gastric juice in response to bread (1), meat (2), and milk (3) in the dog Nerka.

The curves in Fig. 1 show that the maximum of uropepsin excretion (amount per hour) fell during the 3rd-4th hour after stimulation with bread, during the 2nd-3rd hour after stimulation with meat, and during the 4th-5th hour after stimulation with milk. These maxima correspond to the maxima of the classical curves of the secretion of gastric juice obtained by Pavlov when using the same food stimuli.

In the second series of experiments the action of morphine was studied in two dogs weighing 10-11 kg. The operation to form a gastric pouch was performed by Pyatnitskii's method [3]. In this operation hardly any blood is lost, the dogs rapidly recover, and a large volume of gastric juice is obtained, because 1/5 of the stomach is isolated instead of 1/10. Because of the tube passed through the fistula into the stomach, the secreted gastric juice does not irritate the skin of the dog's abdominal wall. Altogether 13 experiments were carried out: 6 on one dog and 7 on the other. A dose of morphine of 0.001 g/kg caused a considerable secretion for 5-6 h, and a dose of 0.002 g/kg for 7 h.

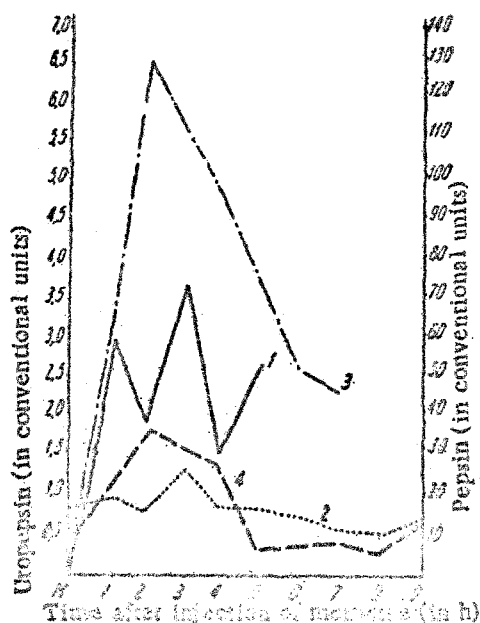


Fig. 2. Excretion of uropepsin and pepsin after injection of 1 ml of 1% morphine solution (1, 2) and 2 ml of 1% morphine solution (3, 4).

The results given in Table 2 show that the excretion of uropepsinogen in general reflects the secretion of pepsin in the gastric juice. The parallelism observed between the secretion of pepsin (per hour) and the excretion of uropepsin is demonstrated in Fig. 2. The highest values of both pepsin and uropepsin were observed at the 1st and 3rd hours after injection of morphine in a dose of 0.001 g/kg, and at the 2nd and 3rd hours after injection of a dose of 0.002 g/kg.

SUMMARY

Excretion of uropepsin in response to various food stimuli (bread - 200 g, meat - 200 g, milk - 600 ml) was studied in 6 dogs for 13 hours. The maximum of uropepsinogen excretion appeared in response to bread during the 3rd-4th hour, to meat in the 2nd and 3rd hour and to milk in the 4th-5th hour. The action of morphine was studied on two dogs with a stomach pouch and fistula of the urinary bladder. Gastric secretion in response to morphine injection in two dogs (0.001 and 0.002 g/kg of body weight) confirmed the parallelism between the pepsin and uropepsinogen excretion.

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