INCORPORATION OF RADIOACTIVE METHIONINE INTO PROTEINS OF DIFFERENT PARTS OF THE GASTRO-INTESTINAL TRACT

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The object of this investigation was to determine the relationship between the intensity of incorporation of radioactive methionine into the tissue proteins of the gastro-intestinal tract and the secretory activity of the digestive glands. For this purpose a comparative study was made of the radioactivity of different parts of the gastro-intestinal tract at different times after injection of labeled S^{35}-methionine. The effect of substances stimulating secretion on incorporation of the isotope into proteins was also investigated.

EXPERIMENTAL METHOD

Experiments were conducted on rats of both sexes weighing 150-250 g. S^{35}-methionine was injected intraperitoneally in a dose of 10,000 impulses/min/g body weight. The rats were kept without food for 20 h before the investigation. The animals were sacrificed in a fasting state 20 and 40 min, and 1, 2, 4, 8, 13, 24, and 48 h after injection of the isotope. To stimulate secretion, meat broth (100 g meat to 100 ml water) was introduced into the stomach in a volume of 4-5 ml, or pilocarpine hydrochloride was injected intramuscularly in a dose of 5 mg/100 g body weight, at the same time as the injection methionine was given. In all the series of experiments in which substances stimulating secretion were administered, the animals were sacrificed 1 h after injection of the radioactive methionine. The material for investigation included the pancreas, the duodenum, one piece each from the small and large intestine, and the stomach divided into its divisions (esophageal, cardial, fundal, and pyloric regions). Proteins were precipitated with 10% trichloroacetic acid solution, alcohol, alcohol-ether mixture, and ether and dried at 60°. The radioactivity of the protein preparation was measured with an end-type counter in a B apparatus and was expressed in impulses/min/10 mg dried protein.

EXPERIMENTAL RESULTS

Investigations of the animals taking part in the experiment in a fasting state showed that the radioactivity of the proteins from different parts of the gastro-intestinal tract varied depending on the functional state of the part selected and the interval of time elapsing between injection of S^{35}-methionine and the investigation. The results given in Table 1 show that radioactive methionine was very rapidly incorporated into the tissue proteins of the gastro-intestinal tract, and especially into the proteins of the pancreas and the fundal region of the stomach, i. e., areas of the highest secretory activity. According to data in the literature [1], it is in the fundal portion of the rat's stomach that hydrochloric acid and pepsin are formed. The radioactivity of the proteins also fell especially rapidly in the pancreas and the fundal portion of the stomach, so that 24 h after injection of the methionine the radioactivity of the proteins in these areas was lower than in certain other parts of the gastro-intestinal tract. The rapid fall in the radioactivity of the proteins in areas of greatest secretory activity may be attributed to the spontaneous elimination of proteins containing the S^{35} label in the gastric and pancreatic juices.

After introduction of meat broth into the stomach, the radioactivity of the proteins (Table 2) of most parts of the gastro-intestinal tract was higher than in the fasting state (a statistically significant difference was obtained for the pancreas, small intestine, and pyloric and esophageal portions of the stomach). Our findings agreed with those

TABLE 1. Radioactivity of Proteins of the Alimentary Tract of Rats Taking Part in the Experiment in a Fasting State, Depending on Time of Investigation (M ± m from 3 determinations)

Organ investigated	Time elapsing after injection of radioactive methionine								
	20 min	40 min	1 h	2 h	4 h	8 h	13 h	24 h	48
Stomach (Esophageal portion)	115±42	109±33	59±14	201±50	115±18	150±11	255±41	197±18	183±19
Stomach (Cardial)	186±22	213±91	256±10	309±52	298±32	272±70	183±20	180±13	211±16
Stomach (Fundal)	279±22	395±70	426±16	588±35	517±84	381±20	291±9	219±23	200±13
Stomach (Pyloric)	151±28	156±37	192±8	285±23	243±33	277±26	264±13	282±29	207±45
Duodenum	226±33	388±44	355±72	526±47	417±26	467±50	445±37	460±78	307±50
Small intestine	196±9	319±20	374±54	387±77	427±68	480±2	380±31	389±37	277±20
Large intestine	106±16	113±24	161±62	262±37	269±13	283±42	232±19	284±10	229±23
Pancreas	751±64	1 317±253	1 290±92	1 646±78	1 268±58	832±71	327±45	283±8	244±4

TABLE 2. Radioactivity of Proteins of Alimentary Tract of Rats Receiving Meat Broth or Pilocarpine 1 h After Injection of S^{35}-Methionine (impulses/min/mg dry protein)

Organ investigated	Fasting		After administration of meat broth			After injection of pilocarpine		
	N	M ± m	N	M ± m	t	N	M ± m	t
Stomach (Esophageal portion)	12	110±11	11	249±55	2.5	16	273±42	3.8
Stomach (Cardial ")	13	304±17	11	298±11	0.3	16	273±13	1.5
Stomach (Fundal ")	13	533±26	11	554±38	0.5	16	460±23	2.1
Stomach (Pyloric ")	13	256±12	11	300±19	2.0	16	283±20	1.2
Duodenum	13	470±25	11	514±51	0.8	16	513±40	0.9
Small intestine	13	414±27	11	553±21	4.0	15	538±34	3.0
Large "	13	262±27	8	289±14	0.9	15	311±23	1.4
Pancreas	12	1327±78	11	1774±121	3.1	16	1107±17	2.1

obtained experimentally by É. É. Martinson and co-workers [2]; administration of meat broth in their experiments increased the intensity of incorporation of radioactive methionine into the proteins of the gastric mucous membrane. Consequently, in the period of active secretion of the digestive glands evoked by meat broth the rate of incorporation of radioactive methionine into the proteins of the gastro-intestinal tract was increased.

After stimulation of the secretion with pilocarpine (Table 2) a lower level of radioactivity was found in the area with greatest secretory activity—the fundal portion of the stomach and the pancreas—than in the proteins of the same areas in the animals investigated in a fasting state (the difference was statistically significant). The radioactivity of the proteins of the esophageal portion of the stomach and small intestine was higher than in the control animals (investigated in a fasting state). The difference between the radioactivity of the proteins in other parts of the gastro-intestinal tract was not significant. The decrease in the radioactivity of the proteins of the fundal portion of the stomach and of the pancreas following injection of pilocarpine was evidently due to the rapid elimination of proteins containing incorporated S^{35} label in the gastric and pancreatic juices. There are reports in the literature of a decrease in the intensity of incorporation of radioactive amino acids into the proteins of the gastro-intestinal tract after injection of pilocarpine or of another powerful stimulant of secretion—histamine [2, 3].

Analysis of the results of these experiments shows that the secretory function of the digestive glands is closely bound up with protein metabolism: the most intensive incorporation of radioactive methionine into proteins was observed in areas with the greatest secretory activity, and as a result of spontaneous secretion or of increased secretion following administration of pilocarpine the greatest decrease in radioactivity took place in these areas.

Hence, the radioactivity of the tissue proteins of the gastro-intestinal tract was the resultant of two processes: incorporation of the labeled amino acid into the proteins and the secretion of proteins in the digestive juices. Depending on the time of the investigation and the administration of substances stimulating secretion, one or other of these processes was observed to be predominant.

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