Doubtful Roll of Endogenous Gastrin in Chicken Gastric Secretion by Vagal Stimulation

There have been only a few reports on the humoral control of chicken gastric secretion[1,2]. The present investigation was designed to elucidate the participation of endogenous gastrin in the chicken gastric secretion, using the proglumide (PM), an antigastrinic[3,4]. The same experiment was also carried out on rats, to compare with chickens.

Materials and methods. White leghorn chickens, weighing 0.4–0.7 kg, and Wistar rats, weighing 0.2–0.3 kg, were used in the experiments. Gastric secretion was measured by the continuous gastric perfusion method of GHOSH and SCHILD[5] with some modifications. The experiments were carried out at room temperature and humidity of 30 °C and more than 70%, respectively.

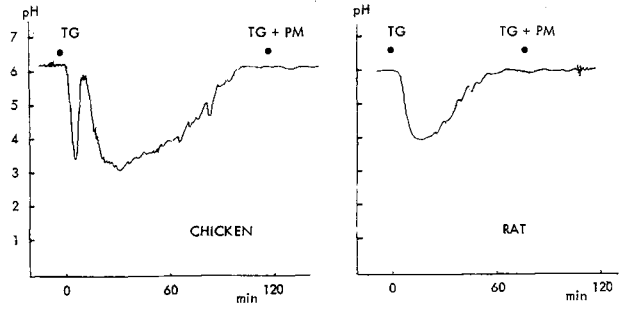

Fig. 1. Continuous recording of pH changes of gastric perfusate in chicken and rat following TG and TG + PM. TG and PM were given i.v. to chicken and rat, 0.5 μg/kg and 50 mg/kg, 1.0 μg/kg and 250 mg/kg, respectively.

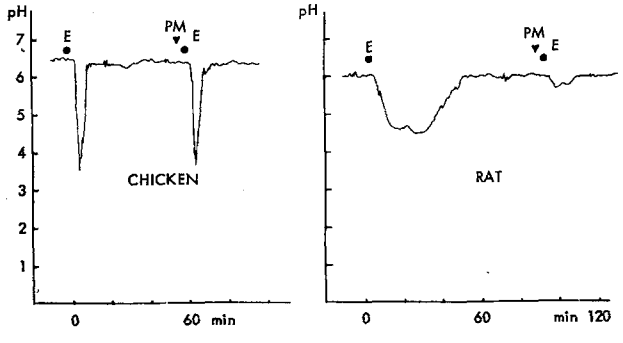

Fig. 2. Continuous recording of pH changes of gastric perfusate in chicken and rat following vagal stimulation and PM administration. PM was given 5 min before the stimulation to chicken (50 mg/kg) and rat (250 mg/kg).

The pH falls from the baseline of the gastric effluents following the stimulations induced by TG and vagal stimulation and the inhibition of PM upon them in chicken and rat

	TG injection (mean ± SD)		Vagal stimulation (mean ± SD)	
	Control (5)	PM (5)	Control (5)	PM (5)
Chicken	4.2 ± 0.7	< 0.1	4.0 ± 0.8	3.8 ± 0.8
Rat	2.4 ± 0.3	< 0.1	2.3 ± 0.3	0.2 ± 0.0

TG and PM were given i.v. to chicken and rat, 0.5 μg/kg and 50 mg/kg, 1.0 μg/kg and 250 mg/kg respectively. Numbers in parentheses indicate numbers of the experiments performed.

Following 24 h starvation, animal was anesthetized with urethane 1.3 g/kg (i.p.). After a satisfactory anesthesia level was induced, chicken was artificially respired with room air and bilaterally vagotomized. Left wing vein was cannulated for the purpose of i.v. injection. A glass cannula was implanted surgically between the gizzard and proventriculus. Care was taken to avoid the ligation of vagus trunks. It is supposed that the vagal innervation of gizzard, duodenum and the lower intestine remain intact. A silicon tube of 5 mm in diameter was inserted via the crop into the proximal proventriculus and secured to the neck. Rats were bilaterally vagotomized and thorachiostomized after anesthesia. Right jugular vein was cannulated for the i.v. injections. A stomach cannula was inserted into the distal antrum via a duodenostomy and ligated closely to the pylorus. A vinyl tube of 1.2 mm in diameter was inserted via the oesophagus into the proximal cardia and was ligated to the neck in order to prevent retrograde leakage of the perfusate.

The preparation was allowed to equilibrate for 30 min. The stomach was perfused continuously with a dilute solution of NaOH and the fluid emerging from the pylorus passed over a tube type glass electrode with which pH was recorded continuously. The stomach was perfused with $N/20{,}000$ NaOH at a rate of 1 ml/min. The pH of effluent was between 5 and 7 in more than 70% of animals. The left vagus in the cervical region was dissected free, and the distal end of it was placed on a bipolar electrode. Liquid petrolatum was placed over the nerve to prevent drying. The nerve was stimulated electrically with stimulater (Nihon Kohden Co, Ltd, Japan; MSE-3R). The stimulus parameter was 20 Hz, 2 msec rectangular, 5 V for 5 sec. The stimulus was delivered 2 or 3 times during 20 or 35 sec. The gastric responses to the treatment have been expressed in terms of the maximum deflexion of the pH record from the base line.

The following drugs were used: C-terminal gastrin tetrapeptide (TG) (Teikoku Zohki, Co, Ltd, Japan) and proglumide (PM) (Kaken Chemical, Co, Ltd, Japan). The drugs were administered i.v.

Results. TG administration. The typical recordings of the effects of TG on the gastric secretion in chicken and rat were illustrated in Figure 1. Given in a single injection, TG (0.5 μg/kg) produced a biphasic pH fall in chicken 3 or 5 min after injection. The effect lasted for 60 to 90 min and several succesive administrations could be performed in a chicken with reproducible responses. In rat the administration of TG (1.0 μg/kg) caused the typical monophagic pH fall 5 or 8 min after injection.

TG + PM administration. As shown in Figure 1 and in the Table, PM injected simultaneously with TG inhibited the effect of a standard dose of TG completely in chicken and rat.

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Electrical stimulation. Vagal stimulation caused relatively reproducible responses in gastric secretion in both animals (Figure 2 and Table). In chicken, a transient but precipitous pH fall, which returned to baseline 6 to 12 min after stimulation, was observed. In rat the stimulation produced a loose pH fall which returned to baseline 40 to 60 min after the stimulation.

Electrical stimulation and PM administration. The gastric secretory response to vagal stimulation was inhibited more than 80% by the 5 min premedication with PM 250 mg/kg in rat. In chicken, however, the pH fall was not inhibited by the premedication of PM 50 mg/kg at all (Figure 2 and Table).

Discussion. There is a negative view about the existence of gastrin in chicken[1]. BLAIR et al.[6], however, extracted gastrin from the chicken upper intestine, and tested it by bioassay in cat. Using radioimmunoassay, KETTERER et al.[7] investigated the distribution of gastrin and found it in the duodenum alone. POLAK et al.[8] demonstrated gastrin in chicken and quail in the gizzard, duodenum and intestine by means of immunohistochemical and ultrastructural technics.

In mammals, vagal stimulation has been used for many years to release gastrin from the mucosa of the pyloric gland area of stomach. According to the concept presented by UVNAS[9], the hormone release into the circulation is neurally mediated and controlled by the vagus nerves. Further supporting evidence for vagal control of gastrin was presented by FYRO[10]. He demonstrated a depletion in gastrin stores after prolonged electrical vagal stimulation. Further, LANCIAULT et al.[11] determined the electrical vagal stimulation elevated portal serum gastrin in dog.

In the present study, the enhancement of the gastric secretion caused by vagal stimulation was inhibited in more than 80% by PM 250 mg/kg which also inhibited the effect of TG 1.0 μg/kg completely. On the other hand, in chicken the gastric secretory enhancement caused by the vagal stimulation was never inhibited by PM 50 mg/kg, although the effect of TG 0.5 μg/kg in chickens was inhibited by this dose. It must be admitted that PM, known as an antiulcerous drug, has an inhibitory effect on the stimulated gastric secretion in dog and rat by the several stimulants, especially TG[3,4,12,13].

Results obtained from the present experiments indicate that the enhancement of chicken gastric secretion resulting from electrical stimulation of the vagi is not due to the endogenous release of gastrin.

Zusammenfassung. Nachweis, dass i.v. Tetragastrin (TG) und elektrische Vagusreizung eine stark erhöhte Magensekretion bei narkotisierten Hühnern und Ratten verursachte. Proglumid, ein Antigastrinikum, unterdrückte die Wirkung von TG bei beiden Tierarten, während die vermehrte Sekretion durch Vagusreizung nur bei Ratten, nicht aber bei Hühnern, von Proglumid unterdrückt wurde.

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Sex and Calcium Transport Through the Duodenal Wall of Rats

It has long been observed[1] and repeatedly confirmed[2–5] for animals of both sexes that calcium absorption from the intestinal tract diminishes with age. The same effect of age was found for calcium transport through the duodenal wall[6]. WALLING and ROTHMAN[7] have also pointed to the pronounced age-sensitivity of the active calcium transport.

The purpose of our experiment was to find out to what extent calcium transport through the wall of the duodenum in rats of different age is influenced by sex.

Material and method. Calcium transport was determined on a duodenal segment from male and female 4-week- to 16-month-old rats, by the in vitro method of the 'everted intestinal sac'[8]. There were altogether 150 animals (71 males and 79 females) in groups of 8 to 20 rats. Until the day before the experiment, the animals were on a standard diet with 1.2% calcium and 0.8% phosphorus. The experimental procedure was identical to that described before[9], except that the intestinal segments were incubated in 2.5 ml instead of 15 ml of modified Krebs-Ringer solution. The composition of the medium/l was as follows: 135 m*M* NaCl, 11 m*M* KCl, 0.05 m*M* $CaCl_2$ and 10 m*M* sodium phosphate buffer pH 7.4.

Calcium-45 (Radiochemical Centre, Amersham, England) was added to the mucosal solution in the form of chloride and the activity of the solution was about 10 μCi in 100 ml. After a 45-min incubation of the samples, the solution activity was measured on the serosal (S) and

Table I. The number of animals and the mean ratio of ^{45}Ca in the serosal (S) to that in the mucosal fluid (M) with the standard error of each mean

Age (months)	^{45}Ca (S/M ± SE)			
	No of rats			
	♀	♂	♀	♂
1	18	20	2.07 ± 0.14	2.02 ± 0.14
2	18	20	1.85 ± 0.16	2.39 ± 0.18
3	9	10	0.87 ± 0.13	1.11 ± 0.18
4	8	10	0.71 ± 0.09	0.61 ± 0.03
8	10	10	0.41 ± 0.07	0.39 ± 0.03
16	8	9	0.26 ± 0.03	0.30 ± 0.03