of the other 2 active amino-acids is the chief factor upon which their secretagoguic activity depends.

These studies were conducted on 8 Pavlov gastric pouch dogs, at least 3 being used for each amino-acid studied, and 2 of the animals serving throughout the entire series of observations. Secretion was followed for 6 hours subsequent to the administration of 100 cc. portions of M/20 amino-acid solutions by stomach tube to the fasting animals. The test solutions were always given after a preliminary observation period had revealed that the gastric glands were in a resting condition.

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Meat Extractives as Stimulants for Secretion of Pepsin.

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As a result of the experiments conducted by Lobassow,[1] Sirotinin,[1] and of other workers in Pavlov's laboratory, and of the fractionation studies of Krimberg and Komarov[2] and others, the extractives of muscle have been recognized as potent stimuli for the secretion of gastric juice; their relation to the secretion of the particular component of gastric juice, pepsin, has received much less attention. We have conducted experiments on Pavlov gastric pouch dogs, using solutions of 4 different muscle extractive preparations and of 3 of these combined with starch, to determine what effect these materials might have on the secretion of pepsin. Secretion was followed during a preliminary period and then for 6 hours after administration of the test solution, and, in some cases, a second dose of the test material was given. At least 3 animals were used in the tests of each preparation and 2 were subjects throughout the entire study. Free and total acidities were titrated to the endpoints of Töpfer's reagent and of phenolphthalein respectively; total chloride concen-

* These data form a part of the dissertation submitted by Elizabeth R. B. Smith to the Faculty of the Graduate School, Yale University, in partial fulfillment of the requirements for the degree of doctor of philosophy, May, 1933.

[1] Babkin, B. P., *Die Äussere Sekretion der Verdauungsdrüsen*, Berlin, 1928.

[2] Krimberg, R., and Komarov, S. A., *Biochem. Z.*, 1926, **176**, 73; *Ibid.*, 1928, 194, 410.

tration was determined by the method of Van Slyke[3] and peptic activity by the procedure of Gilman and Cowgill.[4]

The first commercial meat extract† to be examined stimulated the flow of juice as determined by volume, but not the secretion of pepsin unless starch was added to the solution (Table I). In the latter case, we found, as had Lobassow,[1] that the enzyme content of the juice was markedly increased suggesting the stimulation of the flow of pepsin through mechanical factors.

TABLE I.
Secretion of Gastric Juice and of Pepsin during the First Hour after Administration of Various Preparations of Muscle Extractives.

Preparation Used	Gastric Juice			
	Volume cc./hr.	Acid m.-eq.*	Chloride m.-eq.	Total Pepsin units
Meat extract: "Lemco"	7.5	101	159	750
"Lemco" with starch	8.1	113	152	1013
Meat extract: "Armour"	7.3	111	157	730
"Armour" with starch	7.5	100	159	600
Meat stock: "Homemade"	7.5	112	160	750
Meat extract, fluid: "Valentine's"	7.4	115	161	864
"Valentine's" with starch	7.7	106	159	880

* Milli-equivalents per liter. See Kalkstein, D., *Yale J. Biol. and Med.*, 1930, **2**, 353.

Trials with another commercial meat extract‡ likewise gave negative results as regards the secretion of pepsin. With this material the peptogoguic activity was absent, whether the test material was given alone or was administered together with starch, although the flow of gastric juice was considerable during the first hour after administration (Table I).

A meat stock preparation made in the laboratory from defatted fresh beef muscle was no more effective in promoting the secretion of pepsin than were the 2 commercial preparations mentioned above (Table I).

The fourth material investigated was a commercial preparation of the extractives marketed in fluid form.§ In contrast to the others tested, this product appeared to promote the secretion of gastric pepsin. A second administration of the test solution at the end

[3] Van Slyke, D. D., *J. Biol. Chem.*, 1923, **58**, 523.

[4] Gilman, A., and Cowgill, G. R., *J. Biol. Chem.*, 1930, **88**, 742.

† "Lemco" made in Argentina from beef muscle and repacked in London, England, by Oxo, Limited.

‡ Furnished by Armour and Company, Chicago, Ill.

§ Furnished by Mr. Braxton Valentine of the Valentine Meat Juice Company, Richmond, Virginia.

TABLE II.
A typical protocol showing effect of administration of fluid preparation of muscle extractives (Valentine's) on secretion of gastric juice, and particularly its constituent pepsin.

Time hr.	Gastric Juice Volume cc./hr.	Chloride total m.-eq.*	Acid Free m.-eq.	Acid Total m.-eq.	Pepsin Per cc. units	Pepsin Total units	Remarks
							15 cc. "meat juice" with 35 cc. water by stomach tube
1	5.2	159	108	118	150	780	No mucus
2	1.5	155	77	91	100	150	" "
3	0.3	—	—	—	100	—	" "
							Dose repeated
4	4.0	161	97	112	200	800	No mucus
5	0.2	—	—	—	100	—	" "
6	0.4	—	—	—	92	—	" "

*Milli-equivalents. See footnote to table I.

of the third hour of the experimental period resulted in an increase in the pepsin concentration as well as in the total amount of pepsin secreted, so that the values for the fourth hour equalled or exceeded those of the first hour (Table II). Inasmuch as this second dose was effective, the apparent peptic increase could not be due simply to a flushing effect on the glands. If, however, the second dose was given at the end of the second instead of the third hour of the secretory period, no increase in either the flow of juice or the secretion of pepsin could be observed. There may be, therefore, a refractory period for these glands during which they do not react to a repeated stimulus. Administration of starch along with the fluid preparation of extractives did not markedly increase the amount of pepsin secreted (Table I), indicating that in this case the stimulation by the chemical exciter, *i. e.*, the meat extract, has approached the physiological maximum so that the addition of a further mechanical stimulation does not increase the enzyme output. It would seem from these results that the findings of Zeliony and Sawitsch[5] and others, that mechanical stimulation is the principal factor in the secretion of gastric pepsin, do not account fully for all the factors involved, because in our study a definite chemical excitation has been induced.

The quantities of the 4 extractive preparations given to the dogs were such that the secretion during the first hour after administration was approximately the same for each in a given animal (Table I). Therefore, the positive peptogoguic effect observed with the

[5] Zeliony, G. P., and Sawitsch, W. W., *Compt. rend. soc. biol.*, 1914, **77**, 50.

fluid preparation of extractives could not have been due to a more massive dose in this instance.

These experiments are purely preliminary in nature. Further studies are necessary in order to determine the nature of the peptogoguic substance. Fractionation of the fluid extract and careful study of the action of each fraction will be required.

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On the Digestion of Animal Forms by the Oyster.

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Numerous workers have interpreted living organisms in the faeces of oysters as proof of unavailability of such forms as food. Nelson[1] demonstrates that living organisms in the faeces of the oyster are the result of the incomplete separation of food particles from undigestible matter, inherent in the oyster's feeding mechanism. Protozoa, rotifers, nematodes, copepods and their larvae, larvae of polychaete worms, of snails, clams. oysters and tunicates and even small fish eggs comprise up to 80% of the stomach contents in summer. All of these organisms save the lamellibranch larvae were disintegrating, hence it was concluded that they were being digested. Savage[2] found only 10% organisms in the stomach contents of oysters in English waters. Yonge[3] reports extensive studies on the enzymes of the digestive tract of the oyster and of related molluscs. The extracellular enzymes are a powerful amylase and a glycogenase, both derived from the crystalline style. Berkeley's[4] finding of an oxidase in the style is confirmed, but no extracellular lipase or proteose could be demonstrated. Yonge confirms for the oyster the work of List[5] on the phagocytic activity of the "digestive gland" of Mytilus and he extends the observations of Vonk[3] on the importance of phagocytes in digestion in the oyster.

[1] Nelson, T. C., *J. Morph.*, 1918, **31**, 53; *Rpt. N. J. Agr. Expt. Sta.*, 1920, **325**; PROC. SOC. EXP. BIOL. AND MED., 1923, **21**, 166; *Biol. Bull.*, 1925, **59**, 86.

[2] Savage, *Ministry Agr. and Fish*, 1925, **8**, Ser. 2. No. 1. London.

[3] Yonge, C. M., *J. du Cons. Internat.*, 1931, **6**, 175 (includes all other references).

[4] Berkeley, C., *J. Exp. Zool.*, 1923, **38**, 477.

[5] List, T., *Fauna u. Flora d. Golfes v. Neapel*, 1902, **27**.