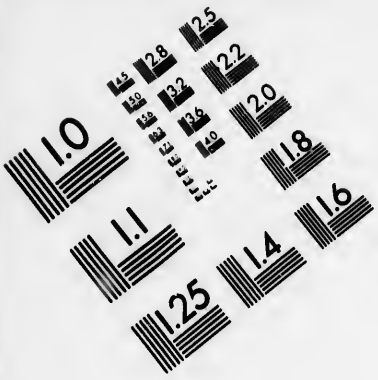


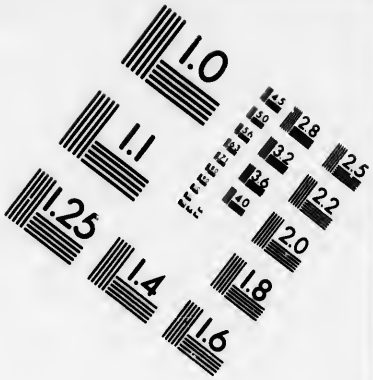


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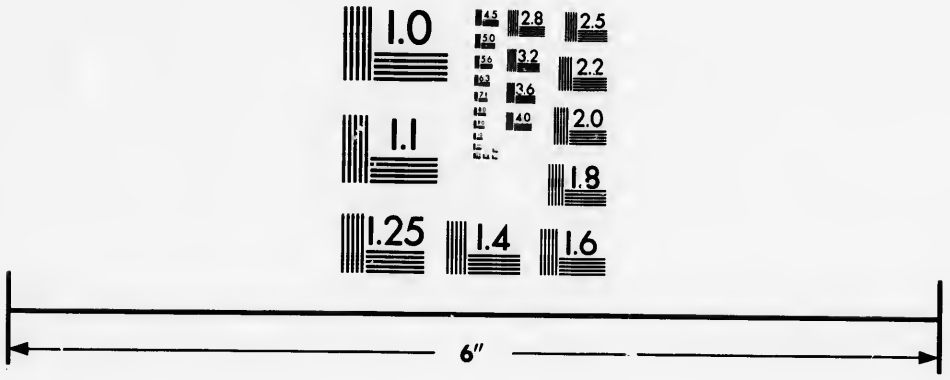


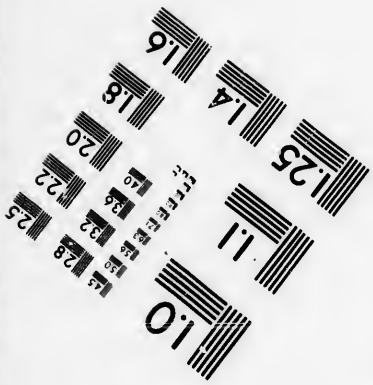


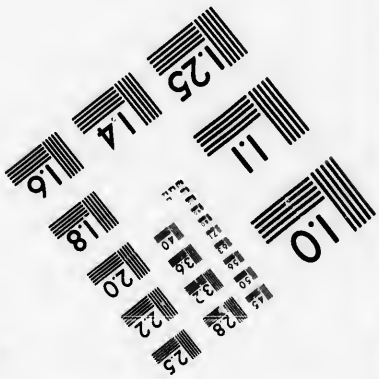


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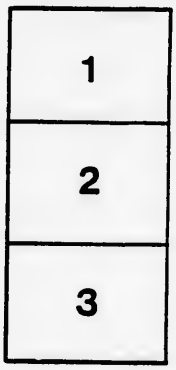


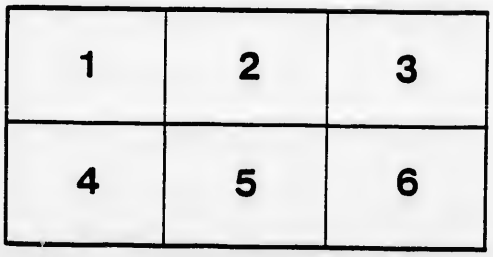

# SOME LABORATORY NOTES

ON

# PAPOID DIGESTION.

BY

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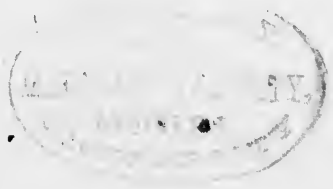
McGILL UNIVERSITY.



Reprinted from the "Canada Medical & Surgical Journal." February, 1888.

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*A Paper read by* DR. RUTTAN *before the Montreal Medico Chirurgical Society, Dec. 23rd,* 1887, *entitled*

# SOME LABORATORY NOTES ON PAPOID DIGESTION.

BY R. F. RUTTAN, B.A., M.D.,
Lecturer on Chemistry, McGill University.

For some time it has been known that the stems, leaves and unripe fruit of a plant called *Carica papaya* contain a ferment capable of digesting proteids. This plant is found in the East and West Indies and in South America. The natives of many localities where this plant is indigenous make a practice of rolling their fresh meat in caraca leaves to make it tender and easier of digestion. From the juice of this plant Dr. Finkler of Bonn University has made an albuminous preparation containing the ferment, which is now attracting much attention under the name of Papoid.

Wurtz, however, was the first to isolate the ferment, to which he gave the name of *papaïn*, and ascribed to it certain definite and characteristic reactions.

About 90 per cent. of commercial papoid is soluble in water; the residue consists chiefly of coagulated albumen. The solution contains globulin, but it is highly probable that the ferment is quite independent of this albuminoid, as the globulin may be precipitated, leaving in the solution a large part, if not all, of the ferment.

As papoid contains the ferment papaïn and also some albumen on which it may act, care must be taken to keep it dry. The unsatisfactory results obtained by some in its use are no doubt due to previous exposure of the sample to moisture. A solution

of papoid will always give the peptone reaction on standing a few hours.

The greatest differences of opinion have been expressed by different experimenters as to the conditions most favorable to the activity of papoid. Albrecht (*Schmidt's Jhrbuch*, Bd. 190) states that papaïn digestion is hastened by the presence of hydrochloric acid. Wurtz, on the other hand, shows that papaïn digestion is essentially a neutral one, which is most rapid and thorough at a temperature of about 40°. Rossbach has recorded a few experiments—at variance with most others—in which he claims that this ferment is not more active in a warm solution than in a cold one. As papaïn is a vegetable product, this seems highly probable, but the careful experiments of Dr. Sidney Martin fully prove that a moderate degree of heat increases the activity of this ferment just as it does that of any other. The fact remains, however, that papaïn has powerful digesting action at ordinary temperatures—50°–70°F.

Dr. Martin has published at some length a series of carefully made experiments on the nature and action of papaïn in the *Journal of Physiology*, Vols. V and VI, and the results of the following experiments, where they run parallel with his, closely correspond with the results obtained by this author.

In each of the following experiments the digestion mixture consisted of 1 gramme of pure dry fibrin in powder, which was boiled in 20 cc. of water and allowed to stand for 12 hours to soften. To this was added 10 cc. of a 1 per cent. solution of the ferment to be used and standard acid or alkali to required strength, making the whole mixture up to 50 cc. The digestions were carried on in an incubator kept at a constant temperature of 37°–38°C., and at the end of a variable time the undissolved fibrin was filtered off on a small, tared filter, and after thorough washing was dried at 100° to constant weight. Thus the undigested fibrin could be weighed in the same condition as before it was submitted to the action of the ferment, and any experimental error caused by the presence of a variable quantity of moisture was eliminated. It is not easy to understand how relative digestion can be accurately determined by those who experiment with proteids of such indefinite and variable composition as "hard-boiled egg," "fresh meat," and "freshly coagulated

albumen;" yet many of the published results on papoid digestion have been based on experiments in which their substances were weighed before and after the action of the ferment.

EXPERIMENT I.—Digestion mixture consisted of 1 gramme fibrin, 10 cc. of a 1 per cent. solution of papoid or pepsin in a neutral medium; time 20 hours; temperature 37–38°C. Experiment done in duplicate:

| | *Undigested fibrin.* | *Per cent. digested.* |
|---|---|---|
| Papoid (*a*)..... | .187 grm. | 81.3 per cent. |
| Papoid (*b*)..... | .13 " | 87.0 " |
| Pepsin (*a*)..... | .903 " | 9.7 " |
| Pepsin (*b*)..... | .883 " | 11.7 " |

EXPERIMENT II.—Conditions the same as in I, but in an acid medium of .3 per cent. hydrochloric acid; time 20 hours; temperature 37–38°C.:

| | *Undigested fibrin.* | *Per cent. digested.* |
|---|---|---|
| Papoid (*a*)..... | .972 grm. | 2.8 per cent. |
| Papoid (*b*)..... | .923 " | 7.7 " |
| Pepsin (*a*)..... | .08 " | 92.0 " |
| Pepsin (*b*)..... | .04 " | 96.0 " |

EXPERIMENT III.—Pepsin in .3 per cent. hydrochloric acid and papoid in a neutral medium; other conditions as before; time 15 hours:

| | *Undigested fibrin* | *Per cent. digested.* |
|---|---|---|
| Papoid (*a*)..... | .378 grm. | 62.2 per cent. |
| Papoid (*b*)..... | .322 " | 67.8 " |
| Pepsin (*a*)..... | .232 " | 76.8 " |
| Pepsin (*b*)..... | .281 " | 71.9 " |

EXPERIMENT IV.—Papoid and pancreatin in 1 per cent. solution of sodium carbonate; other conditions as before; time 18 hours:

| | *Undigested fibrin.* | *Per cent. digested.* |
|---|---|---|
| Papoid..... | 37 grm. | 63 per cent. |
| Pancreatin..... | .02 " | 98 " |

EXPERIMENT V.—Papoid in .2 per cent. solution of sodium carbonate and pancreatin in a 1 per cent. solution; other conditions as in Experiment 1; time 20 hours:

| | *Undigested fibrin.* | *Per cent. digested.* |
|---|---|---|
| Papoid..... | .131 grm. | 86.9 per cent. |
| Pancreatin ..... ..... | .122 " | 87.3 " |

EXPERIMENT VI.—In order to determine the conditions under which papoid is most active, its action on 1 grm. of fibrin in the presence of different quantities of alkali was estimated with the following result; time 18 hours:

| | *Undigested fibrin.* | *Per cent. digested.* |
|---|---|---|
| Papoid + 1 per ct. $Na_2 CO_3$ | .44 grm. | 56 per cent. |
| + 5 " ..... | .28 " | 72 " |
| + 2 " ..... | .12 " | 88 " |
| in neutral solution... | .18 " | 82 " |
| In 3 p.c. hydrochloric acid... | .96 " | 4 " |

EXPERIMENT VII.—The action of papoid in neutral solution on diphtheritic membrane compared with that of pepsin:

(*a*) Papoid digested completely .3 grm. of diphtheritic membrane in 20 hours.

Pepsin had only partially dissolved the same weight of membrane at the end of 36 hours.

(*b*) Papoid dissolved completely .5 grm. of membrane in 23 24 hours.

In these experiments a 5 per cent. solution of papoid or of pepsin was added to the undivided membrane, and the whole kept wet during the time specified. The membrane was reduced to a clear fluid jelly by papoid, but only partially attacked by the pepsin under the same conditions.

EXPERIMENT VIII.—Does acid destroy the proteolytic action of papoid as it does that of trypsin?

To ascertain this, .2 grm. of papoid was added to 1 gramme of fibrin in a .3 per cent. solution of hydrochloric acid in duplicate. Both mixtures were made up to 50 cc. and left in the incubator for three hours. At that time one mixture was estimated and the other made faintly alkaline with sodium carbonate and left in the incubator for 13 hours longer.

The acid mixture showed no digestion,—no reaction indicating peptones could be obtained.

At the end of 13 hours the other mixture gave a residue of .23 grm., showing that 77 per cent. had been digested.

The proteolytic ferment of papoid is therefore not destroyed by being kept in an acid medium for three hours at blood heat; its action is only suspended.

The conclusions to be drawn from these experiments are obvious. Papoid evidently contains a powerful proteolytic ferment which resembles trypsin both in the conditions under which it is most active and in its mode of digestion. It corrodes the fibrin, dissolving each piece away from the surface to the centre, and does not gelatinize the whole mass like pepsin. Moreover, one can readily obtain leucin in the products of digestion. Tyrosin could not be obtained by the writer, but its presence was determined by Dr. Martin, who worked with larger digestion mixtures.

Papoid, as shown in Experiment II, is quite inactive in small quantities in an acid medium of .3 per cent. hydrochloric acid. A certain amount—3 to 7 per cent. of the fibrin—was dissolved by it, but no true digestion occurred, as peptones in any quantity were absent.

The results of Experiment VIII, however, show that although it is inactive in acid its functions are only suspended, the ferment is not killed. This is interesting, in view of the frequent use of papoid for treatment of dyspepsia. If the stomach be normally acid, its activity will probably be suspended entirely; if, however, the acidity be very slight, papoid will probably act. Its greatest action, however, takes place in the small intestines, where the medium is alkaline or neutral. The ferment is most energetic in a faintly alkaline medium, about .2 per cent. of sodium carbonate.

Papoid is especially useful for removal of diphtheritic membrane. The conditions present in the pharynx are just those which retard the action of pepsin and pancreatin, but do not influence papoid. The medium in which it is required to act is practically a neutral one and the temperature low, there is present, besides, a large excess of the products of digestion which does

not affect papoid—indeed it is most energetic in a concentrated medium. Moreover, papoid has been shown clinically to lessen very greatly the disagreeable fœtor of the disease. Painting on a 5 per cent. solution, freshly made, every two or three hours has been found to give the best results: the fœtor disappears in a few hours and the membrane in from 12–18 hours becomes thin and glairy.

It would seem to be especially indicated in these forms of dyspepsia in which peptic digestion is greatly impaired and where the secretion of gastric juice is very weak.

Papoid, therefore, promises to be a powerful auxiliary in combatting those two great diseases—diphtheria and dyspepsia.