THE LYMPHAGOGIC ACTION OF THE PHILIPPINE MANGO, MANGIFERA INDICA LINNÆUS

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The transient rashes occurring in the Philippines during the hot season are often popularly ascribed to eating the Philippine mango, *Mangifera indica* L., which ripens at this time. The mango seems to intensify the ordinary "prickly heat" symptoms, and individuals in the Islands who have a tendency to this affection often find relief when they eliminate the fruit from their dietary. We have also had occasion to observe that the nursing child may be affected when mangos are eaten by the mother; these observations will be reported in a separate paper by one of us (Concepción).

The almost universal distribution of the mango in tropical countries and the large part that the fruit shares in tropical dietaries make the problem of "mango rash" an important one. Such rashes are commonly ascribed to the mango by the Philippine practioners of medicine, but we have been unable to find any description of these effects in the literature. The present investigation was carried on to get some experimental evidence as to whether or not the mango is to be classed with such rash-producing substances as crustaceans, mollusks, etc., which Heidenhain[1] designated physiologically as lymphagogues of the first class.

The lymphagogues of the first class include "peptone," albumen, extracts of liver and intestine, and especially extracts of crustaceans, mollusks, and leeches. The physiological effects are a marked fall in blood pressure, an increased flow of lymph richer in solids than the normal, an inhibition of the clotting power of the blood, deep narcosis, anuria, and increased secretory action of the pancreas, salivary glands, and liver. Subsequent injections are progressively less effective. The apparent similarity of the effects of the lymphagogues of the first class with anaphylactic shock is of extreme interest. This similarity has been repeatedly pointed out.

[1] *Arch. f. d. ges. Physiol.* (Pflüger) (1891), 49, 209.

Rashes sometimes occur after the ingestion of strawberries, and a lymphagogic effect for these has been demonstrated by Clopatt [2] and by Mendel and Hooker.[3] Our work has shown conclusively that the mango is also to be included with Heidenhain's lymphagogues of the first class.

Dogs, anæsthetized with ether only, were used in the 14 experiments performed. Extracts of the dried mango pulp (3 experiments) were less effective than the strained and centrifugalized raw juice which we employed in the remainder of the series. Mendel and Hooker arrived at a similar conclusion with strawberry extracts. Lymph was collected from the thoracic duct. The dogs had not been fed since the day preceding. Injections of the mango juice, at 30° C., were made from a burette into the saphenous vein. Determinations of the total solids of the lymph, collected over ten-minute periods, were made in 6 experiments. The samples were dried on the water bath and then heated in the oven at 105° C. until the weight was constant. Blood pressures were recorded graphically with a mercury manometer in the usual way. Blood samples (about 5 cubic centimeters) were collected in test tubes from the femoral artery, a clean, dry, glass cannula being employed each time. Sufficient blood to wash out the cannula was allowed to pass through before the sample (in duplicate) was taken. The blood was considered to have clotted when the tubes could be reversed without spilling.

The results of two of the experiments in which the total solids of the lymph were determined are given in Tables I and II. These experiments show an increased flow of lymph of almost three times the normal. This lymph is richer in solids than the samples collected before the injection. Blood pressure underwent the typical fall to be expected from lymphagogic substances. The clotting time of the blood is slightly extended in experiment 10 (Table I), but is shortened in experiment 11 (Table II). We have observed this unexpected result in several of our experiments. Every sample of lymph which we collected promptly clotted.[4]

That the mango juice may produce the typical inhibition of

[2] *Skandin. Arch. f. Physiol.* (1900), 10, 403.

[3] *Am. Journ. Physiol.* (1902), 7, 380.

[4] Experiments have been reported in dogs with thoracic fistula in which the clotting time of the blood was only slightly, if at all, affected by proteose injections, while the coagulability of the lymph was delayed. Spiro and Ellinger, *Zeitschr. f. physiol. Chem.* (1897), 23, 135; Chittenden, Mendel, and Henderson, *Am. Journ. Physiol.* (1889), 2, 142.

blood clotting is shown in the following experiment in which no thoracic fistula was made:

Experiment 11, June 25, 1914.—Male dog, weighing 5.8 kilograms. Normal blood obtained at 9.40 a. m. clots in fifteen minutes. At 9.45 a. m. the dog received a rapid injection of 40 cubic centimeters of fresh mango juice. Blood pressure fell immediately from 178 to 45 millimeters. Blood samples obtained five, ten, and thirty minutes after injection failed to clot in twenty-four hours.

That a certain degree of tolerance or immunity results from consecutive injections, both for lymph flow and blood pressure, is shown in experiment 12 (Table III). In this experiment only from 17 to 20 cubic centimeters of the juice were given at a single injection, as the dogs do not withstand very well the repeated administration of larger amounts. In the latter case, the second injection may be nearly as efficient as the first, as shown in experiment 8 (Table IV).

Clopatt has shown that the quantities of sugar and salts, in the berry extracts employed, were too small to ascribe the marked results obtained to a lymphagogic effect of the second class (Heidenhain). Mendel and Hooker calculated that the maximum amount of sugar used in the largest injection of strawberry extract would not exceed 0.2 gram per kilogram of body weight of the dog used. The mango pulp has the following composition:

Composition of mango pulp.[5]

	Per cent.
Water	82.8
Solids	17.2
Sugar (as invert sugar)	13.24
Acid (as citric acid)	0.18
Protein	0.22
Crude fiber	2.6
Ash	0.45

The sugar given in experiment 10 (Table I) amounts then to only about 0.3 gram per kilogram of body weight. Furthermore, the increase in total solids of the lymph collected after the injection of the mango juice is characteristic of the first and not of the second class, or crystalline, lymphagogues. With the second class, in fact, there is usually a diminution of the total solids. The additional evidence of the constant fall in blood pressure, the observation that the mango juice may produce

[5] Pratt and del Rosario, *This Journal, Sec. A* (1913), 8, 59.

the characteristic inhibition of the clotting powers of the blood, and the diminished response to consecutive injections indicate that the effects of the mango are similar to those of lymphagogues of the first class.

TABLE I.—*Experiment 10, June 14, 1914. Male dog, weighing 11.0 kilograms.*

Time.	Lymph in 10 minutes.	Total solids.	Blood pressure.	Blood clots.	Remarks.
	cc.	*Per cent.*	*mm.*	*Min.*	
10.17-10.27 a. m.	4.5	6.3			The lymph clots.
10.23 a. m.				11	
10.51 a. m.			120		Injection of 25 cc. of fresh mango juice.
10.52 a. m.			76		
10.52-11.02 a. m.	12.5	7.8			The lymph clots.
10.54 a. m.				11.5	
10.58 a. m.				12.0	
11.05 a. m.				15.0	
11.12-11.22 a. m.	5.0	6.6			Do.
11.21 a. m.			110		
12.01-12.11 p. m.	4.5	6.3			Do.
12.12 p. m.			116		

TABLE II.—*Experiment 14, July 8, 1914. Female dog, weighing 6.6 kilograms.*

Time.	Lymph in 10 minutes.	Total solids.	Blood pressure.	Blood clots.	Remarks.
	cc.	*Per cent.*	*mm.*	*Min.*	
10.51-11.01 a. m.	5.5	5.0			The lymph clots.
10.59 a. m.				14	
11.15 a. m.			140		Injection of 40 cc. of fresh mango juice.
11.16-11.26 a. m.	16.0	5.7			The lymph clots.
11.17 a. m.			65		
11.20 a. m.				6	
11.27-11.37 a. m.	18.0	5.3			Do.
11.30 a. m.			134	9	
11.40 a. m.				7	
11.40-11.50 a. m.	11.0	5.1			Do.
11.50 a. m.-12 m.	8.5	4.3			Do.
12 m.				13	

TABLE III.—*Experiment 12, June 4, 1914. Male dog, weighing 9.4 kilograms.*

Time.	Lymph in 10 minutes.	Blood pressure.	Blood clots.	Remarks.
	cc.	*mm.*	*Min.*	
10.14–10.24 a. m.	3			The lymph clots.
10.22 a. m.			15	
10.39 a. m.			13	
10.39–10.49 a. m.	3			Do.
10.51 a. m.		154		
10.52 a. m.				Injection of 17 cc. of fresh mango juice.
10.52–10.52.45 a. m.		98		
10.53–10.53.30 a. m.		134		There seems no explanation for this transient rise in blood pressure.
10.54–11.04 a. m.	8			The lymph clots.
10.56 a. m.		68		
10.57 a. m.			8.5	
11.00 a. m.		120		
11.06 a. m.		146		
11.07–11.17 a. m.	6			Do.
11.18 a. m.			11	
11.19 a. m.		145		
11.19.30 a. m.				Injection of 17 cc. of fresh mango juice.
11.20.30–11.30.30 a. m.	4.5	80		The lymph clots.
11.21.30 a. m.		104		
11.22 a. m.			10	
11.27 a. m.		122		
11.32.30 a. m.		145		Injection of 20 cc. of fresh mango juice.
11.33 a. m.		82		
11.34–11.44 a. m.	4			The lymph clots.
11.35 a. m.		99		
11.35.30 a. m.			8.5	
11.45.30 a. m.		150		
11.46 a. m.				Injection of 20 cc. of fresh mango juice.
11.46.30 a. m.		90		
11.47 a. m.		114		

TABLE IV.—*Experiment 8, May 5, 1914. Male dog, weighing 9.5 kilograms.*

Time.	Lymph in 10 minutes.	Blood pressure.	Blood clots.	Remarks.
	cc.	*mm.*	*Min.*	
11.15–11.25 a. m	5			The lymph clots.
11.20 a. m			10	
11.31–11.41 a. m	5.5			Do.
11.32 a. m			14	
11.55 a. m		161		Injection of 25 cc. of fresh mango juice.
11.56 a. m		74		
11.56 a. m.–12.06 p. m	12			The lymph clots.
12.57 p. m			17.5	
12.03 p. m			15	
12.07–12.17 p. m	13			Do.
12.12 p. m			12	
12.18–12.28 p. m	8			Do.
12.23 p. m		124		
12.31 p. m		186		Injection of 25 cc. of fresh mango juice.
12.32 p. m		64		
12.32–12.47 p. m	11.5			The lymph clots.
12.34 p. m			10	
12.39 p. m		70	10	Blood pressure remained low and the dog was killed.