

## Original Articles

THE EXPERIMENTAL PRODUCTION OF  
SYNDROME OF EPIDEMIC DROPSY IN  
MANBy R. N. CHOPRA, C.I.E., M.A., M.D., SC.D. (Cantab.),  
F.R.C.P. (Lond.)

BREVET-COLONEL, I.M.S.

Honorary Physician to the King

C. L. PASRICHA

MAJOR, I.M.S.

R. K. GOYAL

S. LAL

and

A. K. SEN

(From the School of Tropical Medicine, Calcutta)

MUSTARD oil or certain adulterants in mustard oil have been implicated in outbreaks of epidemic dropsy by several workers. The so-called mustard-oil theory of epidemic dropsy is one of the earliest theories advanced to explain the cause of the disease and its prevalence in certain areas where mustard oil is extensively used for cooking purposes. The outbreaks in such areas are restricted to people who use mustard oil. Their neighbours who do not use mustard oil generally escape from this disease.

Sarkar (1926) recorded the production of symptoms resembling epidemic dropsy in man after the consumption of oil which had been accidentally adulterated with argemone oil (local name 'sialkata' or 'katarak' oil) and Kamath (1928) described an outbreak of epidemic dropsy in Ganjam district amongst people who do not use mustard oil and, in this outbreak, oil pressed from certain seeds, locally known as *odissimari* seeds, was implicated as an adulterant. These and similar reports did not receive the attention they deserved till the mustard oil theory was again revived by the recent experiments of Lal *et al.* (1937) in which symptoms resembling epidemic dropsy were produced in human volunteers who ate food cooked in certain samples of mustard oil which had been implicated in outbreaks of epidemic dropsy. A control series whose food was cooked in pure mustard oil remained healthy. Although these workers showed that certain samples of mustard oil when used for cooking food produced symptoms of epidemic dropsy, the nature of the substance responsible for the production of symptoms in the implicated oil was not determined. The subject was reinvestigated and a careful study of the literature generally and of the work done by Lal and his co-workers, particularly on the aetiology of epidemic dropsy, suggested further work on the part played by argemone oil in the production of this syndrome. A test for this oil was found in Stewart and Boyd's (1928) book of public health laboratory

practice. This test consists in the addition of concentrated nitric acid to the sample of oil in a test tube. The tube is shaken and a positive reaction for argemone oil is shown by the development of an orange-yellow to a deep orange-red colour in the nitric acid layer. This test is also given by Lewkowitsch and Warburton (1922).

Positive reactions for argemone oil were obtained in the majority of the samples of oils collected from houses where there had been outbreaks of epidemic dropsy. Samples of *odissimari* seeds were obtained and identified by Mr. R. L. Badhwar to be the seeds of *Argemone mexicana* from which argemone oil is expressed. In view of these findings, that mustard oils implicated in natural outbreaks of the disease gave well-marked positive reaction for argemone oil and that Kamath's oil from *odissimari* seeds was argemone oil, it was arranged to give food cooked in these oils to certain volunteers. In one group of five individuals the food was cooked in pure mustard oil (expressed in the laboratory) to which was added known quantities of argemone oil (also expressed in the laboratory) from the seeds of *Argemone mexicana*. Another group of four individuals had their food cooked in samples of mustard oil implicated in natural outbreaks of the disease and which gave a positive reaction for argemone oil. A third group of individuals received a similar diet cooked in mustard oil which did not give a reaction for argemone oil. This last group showed no ill effects. The results obtained in the other two groups are summarized in tables A and B.

In one subject in each group there was transitory diarrhoea. In the group in which oil containing argemone oil was used for cooking, granular or hyaline casts were found in the urine of three of the five individuals but without any demonstrable albumin. In this connection it may be noted that granular casts were found in the urine of 7 of 16 individuals suffering from the naturally acquired disease.

Two individuals, one in each group, complained of dimness of vision but when examined showed no evidence of glaucoma.

Two of the four individuals whose food was cooked in incriminated oil developed oedema of the legs. In one the use of incriminated oil was stopped owing to intercurrent fever. In the fourth subject, although the incriminated oil was used for 21 days, there were no ill effects. This individual was the only non-Bengalee of the series and ate a limited amount of rice, eating instead bread (in the form of *chapaties*).

All the five individuals whose food was cooked in mustard oil containing known quantities of argemone oil developed well-marked oedema. Two of them (A 3 and A 4) in addition showed well-marked flush and cardiac symptoms (dilatation and murmur).

Food cooked in oil containing 5 per cent argemone oil was apparently relished by all, but the food cooked in 10 per cent argemone oil soon led to loss of appetite.

TABLE A

The results of taking food cooked in mustard oil containing known quantities of argemone oil. The argemone oil was expressed from *Argemone mexicana* seeds and mixed in proportion of 2 to 10 per cent with pure mustard oil (expressed from mustard seeds). Two ounces of this oil was used for cooking the daily food of each individual

	1	2	3	4	5
Age, weight	30 years, 89 lb.	31 years, 91 lb.	35 years, 125 lb.	45 years, 108 lb.	24 years, 113 lb.
No symptoms for	8 days	8 days	7 days	8 days	6 days
Early symptoms—					
(1) Lack of appetite	(1) 9th day	(1) 9th day	(1) 8th day	(1) 9th day	(1) 4th day
(2) Aches and pains	(2) 13th day	(2) 12th day	(2) 9th day	(2) 11th day	(2) 7th day
The use of oil containing argemone oil stopped on	14th day	14th day	14th day	14th day	8th day
Edema appeared on	26th day	32nd day	21st day	21st day	15th day
Edema lasted for	10 days	4 days	42 days	40 days	14 days
Flush appeared on	No flush	No flush	Slight flush on 26th day lasting 31 days.	Well-marked flush on 23rd day lasting 33 days.	No flush
Heart symptoms	Nil	Nil	Systolic murmur on 27th day lasting 4 days.	Systolic murmur on 27th day lasting 5 days.	Nil
Recovery in	10 days	4 days	42 days	40 days	Later influenzal pneumonia.

TABLE B

The results of taking food cooked in mustard oil collected from houses where there had been outbreaks of epidemic dropsy. This oil gave a positive reaction for argemone oil and was estimated (colorimetrically) to contain about 5 to 10 per cent of argemone oil. Two ounces of the 'incriminated' mustard oil was used for cooking the daily food of each individual

Subjects	1	2	3	4
Age, weight	20 years, 113 lb.	40 years, 118 lb.	40 years, 101 lb.	32 years, 96 lb.
No symptoms for	12 days	No symptoms developed in this individual	13 days	No symptoms developed in this individual.
Early symptoms—				
(1) Lack of appetite	(1) 19th day	Nil	(1) 19th day	Nil
(2) Aches and pains	(2) 19th day		(2) 19th day	
The use of incriminated oil stopped on	21st day	13th day*	21st day	21st day
Edema appeared on	22nd day	..	22nd day	†
Edema lasted for	13 days	..	10 days	..
Flush appeared on	No flush	..	No flush	..
Heart symptoms	Nil	..	Nil	..
Recovery in	13 days	..	10 days	..

\*The use of 'incriminated' oil in this patient was stopped early owing to the development of intercurrent fever.

† Although this individual took the full amount of incriminated oil no symptoms developed. The diet of this subject (a non-Bengalee) differed from the diet of all others in that the intake of rice was limited and he took bread (as *chapaties*) once a day.

It appears that the principle or principles present in argemone oil have a cumulative effect, and, provided sufficient quantity of the oil is consumed, symptoms appear after an interval, even though the consumption of argemone oil or incriminated oil is stopped (see A 5). The oil used at the time of an outbreak can be pure and innocuous but it is the oil used some days before the onset of symptoms which is responsible.

Argemone oil is definitely more toxic to laboratory animals than mustard oil and various other bland oils. When argemone oil is heated to a stage when it 'fumes' well (at 240°C. for about 15 minutes) the oil (although it still gives a positive nitric acid test) is not toxic to animals. The toxic constituents are either destroyed or evaporated at this temperature. Heating at 100°C. or 150°C. has no appreciable effect in its toxicity to animals. Experiments are in progress to determine whether the toxic substance is present in the distillate or is destroyed at a temperature of 240°C.

The outstanding facts established by these experiments are—

1. Argemone oil when present in oil used for cooking gives rise to certain symptoms. The most marked effect is oedema of the legs and in some the development of a generalized flush and cardiac involvement. Similar symptoms are produced by the use of mustard oil implicated in outbreaks of epidemic dropsy and which gives a positive reaction for argemone oil.

2. Whether the condition produced is identical or not with the naturally-occurring epidemic dropsy cannot be definitely said at present, but there is no doubt that the use of oil containing argemone oil is harmful to man. There appears to be little doubt that consumption of adulterated oil produces symptoms which cannot be distinguished from those encountered in the naturally-occurring disease.

3. From the evidence available it appears that the adulteration of mustard oil with argemone oil may or may not be intentional on the part of those who grow the mustard plant, or of those who express or sell the oil. The plant *Argemone mexicana* is widespread, its seeds bear a superficial resemblance to mustard seeds and may be harvested along with them. It is possible that, because oil can be obtained from the seeds of this plant, efforts are not made to exclude these seeds in the harvesting of mustard seeds.

4. An oil containing argemone oil can be rendered harmless provided the oil is heated well. This is based on animal experiment and awaits confirmation by careful observations in man.

5. The plant *Argemone mexicana*, because of the ill effects produced in man by the oil expressed from it, must be considered as one of the poisonous plants of India. This plant is found widespread in mustard fields.

(Continued at foot of next column)

## ERADICATION OF *HYMENOLEPIS NANA* INFECTION

By P. A. MAPLESTONE, D.S.O., D.S.C., M.B., B.S., D.T.M.  
and

A. K. MUKERJI, M.B.

(From the Helminthological Research Department,  
School of Tropical Medicine, Calcutta)

INFECTION with the dwarf tapeworm (*Hymenolepis nana*) is cosmopolitan and by no means uncommon, particularly in tropical and sub-tropical countries, but it rarely gives rise to symptoms which possibly accounts for the fact that efficient treatment of this condition never appears to have attracted a great deal of attention.

Consultation of the standard books on tropical medicine and parasitology reveals the fact that most of the usual anthelmintics (flox mas in some form or other, oil of chenopodium, thymol, hexylresorcinol and carbon tetrachloride) are all casually referred to by one or other author as being effective, but no detail is given. One of the most remarkable things about this subject is that in the sections devoted to treatment no book comments on the peculiar life history of this worm, and it is tacitly assumed that if a single dose of the chosen anthelmintic is given and no worms or eggs are found in the stool a day or two later the case is cured.

The main point of importance in the life history of this worm is that it does not need an intermediate host, and that once infection is acquired the eggs hatch in the intestine and the embryos enter the submucous coat of the intestinal villi where they grow and emerge into the lumen of the gut, reach maturity, deposit more eggs some of which hatch in the gut, and the cycle continues indefinitely. Also, on account of this characteristic of auto-infection, a single egg ingested in the beginning may eventually

(Continued from previous column)

### Summary

It has been shown by feeding experiments in man that the oil expressed from the seeds of *Argemone mexicana* can produce signs and symptoms of epidemic dropsy.

### REFERENCES

- Kamath, A. V. (1928). Report on the Investigation of an Outbreak of Epidemic Dropsy in Surada, a Village in Ganjam District. *Indian Med. Gaz.*, Vol. LXIII, p. 555.
- Lal, R. B., and Roy, S. C. (1937). Investigation into the Epidemiology of Epidemic Dropsy. *Indian Journ. Med. Res.*, Vol. XXV, p. 239.
- Lewkowitsch, J., and Warburton, G. H. (1922). *Chemical Technology and Analysis of Oils, Fats and Waxes*. Vol. II, p. 142. Macmillan and Co., Ltd., London.
- Sarkar, S. L. (1926). Katarak Oil Poisoning. *Indian Med. Gaz.*, Vol. LXI, p. 62.
- Stewart, A. D., and Boyd, T. C. (1928). *Public Health Laboratory Practice*. Oxford University Press, London.