

# Argemone Oil, A Common Adulterant Of Mustard Oil In India : Threat To Human Health

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**Abstract** - Food is declared adulterated if a substance is added which depreciates or injuriously affects it. Adulterated food is dangerous because it may be toxic and can affect health and it could deprive nutrients essential for proper growth and development. Mustard oil is widely used for cooking in North India and Eastern India. In Bengal, Orissa, Assam, Meghalaya and Manipur, it is the traditionally preferred medium for cooking food. The oil makes up about 30% of the mustard seeds. It can be produced either from black mustard (*Brassica nigra*), brown Indian mustard (*B. juncea*), and white mustard (*B. hirta*) seeds. Due to close resemblance with mustard seeds, *Argemone mexicana* seeds are often mixed as an adulterant with mustard seeds, while extracting oil for edible purposes. Such oils are tremendous health hazard. The Argemone oil contains toxic alkaloid sanguinarine which is able to resist normal cooking temperatures and hence appears to be heat stable. Sanguinarine can be retained in the gastrointestinal tract, liver, lung, kidney, heart and serum up to 96 hours after ingestion, due to binding to plasma proteins. This may lead to a condition similar to epidemic dropsy. It is a form of edema of extremities due to poisoning by *Argemone Mexicana*. Epidemic dropsy occurs as an epidemic in places where use of mustard oil as cooking medium and as massage oil is common.

**Keywords** - Adulteration, Mustard oil, Argemone oil, Sanguinarine, Epidemic dropsy

## 1. INTRODUCTION

Adulteration is either intentional by removing substances to food or altering the existing natural properties of food knowingly. Unintentional adulteration is usually attributed to ignorance's, carelessness or lack of facilities for maintaining food quality. Incidental contamination during the period of growth, harvesting, storage, processing, transport and distribution of foods are also considered. Adulteration and contamination are encountered in food consumed at the household level of India, in the food service establishments and business firms, and also when sold as street foods (H. Jana and D. Basu, 2019). Mustard Oil is one of the major oil seeds from which edible oil is produced and it is mostly used oil for cooking in Northern, Eastern, North-Eastern & Central India. The seeds of *Argemone Mexicana* plant are a source of Argemone oil, used for adulteration. This plant is a ubiquitous weed, found growing abundantly in wastelands, cultivated fields and on roadsides all over the country during late winter mainly during the months of March to May. Its seeds are blackish brown, round and netted. These seeds apparently have close resemblance with mustard seeds. Due to this reason, mustard seeds are often adulterated with *Argemone mexicana* seeds either accidentally or intentionally. These seeds are mixed with mustard seeds during extraction of mustard oil. It contains toxic alkaloids namely Sanguinarine and Dihydro-sanguinarine. Argemone oil may cause eye disease leading to blindness. Regular consumption of it may also cause disease called epidemic dropsy. Epidemic dropsy occurs due to the use of contaminated mustard oil (with which Argemone oil is completely miscible) for cooking and massage (N.N. Sood et al., 1985). When mustard oil is adulterated either deliberately or accidentally with argemone oil, proteinuria (specifically loss of albumin) occurs, with a resultant edema as would occur in nephrotic syndrome. Ingestion of argemone oil causes hypertension, glaucoma, dropsy, diarrhea, vomiting and anemia. The toxicity is attributed to the presence of the alkaloid sanguinarine, which is also carcinogenic (A.K. Shukla, A.K. Dixit and R.P. Singh, 2005). Argemone oil toxicity poses a serious threat to human health and should be checked by appropriate regulatory measures.

### *Argemone Mexicana* :

- *Argemone mexicana* (Mexican prickly poppy) is a species of poppy found in Mexico and now widely naturalized throughout the tropics and sub-tropics as an agricultural weed.
- *Argemone mexicana* is introduced and naturalised and occurs as wasteland weed in almost every part of India. In many parts it is reported as crop weed also. It grows abundantly all over the India mainly during the months of March to May.
- Its seeds are very numerous, nearly round or spherical, covered in a fine network of veins, brownish black and about 1 mm in diameter.
- These seeds apparently have close resemblance with *Brassica nigra* (mustard) seeds. Due to this reason, mustard seeds are often adulterated with *Argemone mexicana* seeds either accidentally or intentionally. Several significant instances of argemone oil poisoning have been reported in India and other countries.
- The oil of *Argemone mexicana* seeds is pale yellow in colour and is almost tasteless. It is a non-edible oil known as argemone oil or katkar oil. It has a specific gravity of 0.920 and remains clear at -8°C. It contains toxic alkaloids namely Sanguinarine and Dihydro-sanguinarine.

- *Argemone mexicana* is used as a medicinal plant in several countries. Its yellow juice is used in the treatment of Jaundice, cutaneous infections, eye diseases etc. In Nigeria, it is used as a stimulant. In Mexico, the seeds are considered as an antidote to snake venom. In India, the smoke of the seeds is used to relieve toothache.

**Figure 1: Argemone Seed****Figure 2: Mustard Seed**

#### **Reasons for adulteration**

- To increase the weight as well as volume by showing lower prices
- Increased food demand for the rising population
- To get more profit
- Illiteracy of general public
- Lack of consciousness of general public for proper food consumption
- Lack of appropriate food laws
- Political leaders are not raising their voices
- Lack of government initiatives

#### **Detection of argemone oil in mustard oil**

- A small quantity of argemone-containing mustard oil is mixed with a phenol and conc. sulphuric acid, a deep red colour is developed. Pure mustard oil does not give this reaction at all. The red colour likely to be due to the formation of quinonoid ring and hydrolysed sanguinarine salt.
- 2-3 drops of the adulterated mustard oil is taken in a dry test tube and mixed successively with one drop of liquid phenol and 2-4 ml of conc. sulphuric acid and the mixture is shaken properly. A deep red colour develops within 10-20 seconds if argemone oil is present as adulterant.
- 5 ml mustard oil is taken in test tube and mixed with 5 ml of conc. nitric acid. The mixture is shaken. Appearance of yellow orange colour indicates the presence of argemone oil.
- 5 ml mustard oil is taken in test tube and added 2 ml conc. Hydrochloric acid to it. The mixture is shaken for one minute. The test tube is then kept gently in a boiling water bath for 2 min. The acid and oil layers are separated clearly and added 1 ml of the ferric chloride reagent in the test tube. Appearance of reddish brown, needle shaped crystalline precipitate is obtained.

#### **Symptoms of *Argemone Mexicana* toxicity**

Lal and Dasgupta observed that a minimum concentration of 1% of *Argemone* oil as an adulterant was necessary to produce clinical features. Ramasastri and Babu have proposed a maximum permissible upper limit of 0.01% in edible oils. Persons of all ages are affected, except breast-fed infants and toddlers who have no mustard oil in their diets.

Mustard oil adulterated with argemone oil and butter yellow has been reported to cause gall bladder cancer. Similarly, argemone oil mixed with edible oils can lead to epidemic dropsy, glaucoma and loss of eyesight (Shubham Yadav, 2018). Common symptoms of argemone adulteration are watery diarrhoea and vomiting. In a few cases diarrhoea was not a common feature at the outset but it usually precedes the onset of oedema. Initially Gastrointestinal disturbances have been reported by various investigators in 52–80% of cases. Intermittent or continuous fever, ranging from 99°F to 100.5°F, is noted commonly but is seldom high-grade. Arthralgias, myalgias, and low backache are also seen. Significant hair loss is observed occasionally (R.S.Wadia et al. 1971).

Bilaterally symmetrical pitting oedema of the lower limbs extending from the ankles up to the scrotum and abdominal wall is a constant feature. Palpitations, exertional breathlessness and orthopnoea may be seen. Tachycardia, elevated jugular venous pressure and wide pulse pressure are common. Clinical evidence of cardiomegaly may be found (L.M. Sanghvi, S.N. Misra and T.K. Bose, 1960). Cough and breathlessness are common symptoms. Initially exertional, the breathlessness may be seen at rest and on recumbency when cardiac failure develops. Pneumonia is seen in some cases (MJ Shah et al. 1969).

Glaucoma has been reported in various epidemics in 0–12% of cases (M.K. Rathore, 1982). This is a later manifestation occurring after about 4 weeks. If undetected, it may lead to severe visual impairment. Moderate to severe anaemia is one of the commonest manifestations (P.C. Sengupta and L.E.Napier,1940).

Anaemia is common and may be multifactorial in origin due to bleeding from the gastrointestinal tract, bone marrow suppression, and shortened red cell life span (P.C. Sengupta and L.E. Napier LE,1940).

The epidemic dropsy is known to cause abortion among pregnant women because of hemangiomatous changes in the endometrium and placenta(MJ Shah et al. 1969).

### **Physiopathology of Epidemic dropsy**

The exact disordered physiological processes associated with epidemic dropsy are not well understood. Sanguinarine is responsible to produce widespread capillary dilation coupled with increased capillary permeability and as a result produces clinical features similar to epidemic dropsy. The main effects of *Argemone* oil are on the blood vessels where they cause leakage of protein-rich plasma components into the extravascular compartment which leads to reduce plasma osmotic pressure (N.K. Chakravarty, R.N. Chaudhuri and G.Werner, 1955). The hypoproteinaemia found in dropsy may result from leakage of protein-rich plasma into extravascular tissue, poor intake, diarrhoea, and may be from mild hypotoxicity or protein-losing enteropathy. Increased permeability of the small capillaries leads to oedema. Release of protein-rich fluid from the pulmonary capillaries in the interstitial tissues of the alveoli produces interstitial pulmonary oedema with manifestations of mild hypoxia, respiratory alkalosis, restrictive ventilatory defects, increased alveolar to arterial oxygen gradient, and derangement of diffusion capacity. *Argemone* alkaloids, are also responsible for the azotemia and renal failure seen in some patients. The kidneys show vascular and glomerular congestion and patchy tubular lesions (K.K.Upreti et al.,1989). The diarrhoea and vomiting observed in the acute stage may be due to direct toxicity of *Argemone* oil to the intestinal absorptive cells. Anaemia is common and may be multifactorial in origin due to bleeding from the gastrointestinal tract, bone marrow suppression, and shortened red cell life span (P.C. Sengupta and L.E.Napier,1940)

### **Health hazards caused by argemone oil adulteration in India**

Epidemic dropsy is an acute non-infectious disease resulting from use of edible oils adulterated with *Argemone mexicana* (mexican poppy) seed oils. It occurs as an epidemic form in places where mustard oil is commonly used as cooking mediums. Lyon reported the first four cases of epidemic dropsy from Bombay in 1877. Epidemics have also been reported from Calcutta (1877) and since then cases were reported from West Bengal, Bihar, Orissa, Madhya Pradesh, Uttar Pradesh, Gujarat, Haryana, Maharashtra, Delhi, Jammu and Kashmir, Assam, Rajasthan and Punjab.

In the month of September, 1973 the National Institute of Commercial Disease, Delhi informed about few cases of suspected epidemic dropsy.

The epidemic in 1998 at New Delhi was the large outbreak. Around 2552 toxicity cases were reported along with 65 deaths. Even after that the epidemics occurred at Gwalior (2000), Kannauj (2002) and Lucknow (2005), Panchmahal and Dungarpur (2012) districts of India.

The disease is seen mostly in epidemic form but isolated cases also occur occasionally. Both sexes are affected equally. In India the incidence reaches its peak in July to August when newly extracted oil harvested towards the end of summer is sold. Due to a decrease in toxicity during storage of oil, the incidence is lowest in April.

In the month of August 2011, there was a outbreak of epidemic dropsy in a single family at village Fatehgarh in the district SBS Nagar, Punjab. Dropsy is a disease that occurs in epidemics; isolated cases are seldom seen and reported. The reasons for this outbreak being restricted to a particular family can only be explained if the contamination of mustard seeds with argemone seeds occurred at the household level as the mustard oil was extracted from the seeds of the plants cultivated in their own land. Because of their low socio-economic background, the family was not aware of contamination of mustard seeds with that of argemone seeds, which had led to the outbreak.

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