International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
www.chemijournal.com
IJCS 2021; 9(5): 01-03

Received: 03-07-2021
Accepted: 06-08-2021

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Detection of adulterants in mustard oil

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Abstract
An experimental research was undertaken to evaluate the degree of adulteration and relative contamination levels in open mustard oil as well as in popular commercial brands in Odisha. Ten samples were examined, *viz*., three were commercial samples, five were open samples and one was a raw sample grown from seed, which served as the control. During the investigation, two common adulterants, argemone oil and castor oil, were discovered. Argemone oil was identified as the primary adulterant because its concentration in some commercial oil samples and open samples was about 8 times greater than in crude oil. Castor oil was discovered as the second most common adulterant in mustard oil. No forbidden colour was found in any of the samples. The average amount of adulterant present in different mustard oil is almost 45.7%. The findings are quite concerning, as the existence of these adulterants endangers public health.

Keywords: Adulteration, Odisha, mustard oil, argemone oil, castor oil

Introduction
Food is essential for human existence but it has been liable to adulteration since ancient times [5]. Adulteration is defined as "the process of lowering the quality or character of a certain product by introducing a foreign or inferior component and removing important vitamins" (Gupta and Pancha, 2009) [3]. 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 in mustard oil. Its seeds are blackish brown, round and netted which apparently have close resemblance with mustard seeds. Due to this reason, mustard seeds are often adulterated with *Argemone mexicana* seeds either accidentally or intentionally (Nath 2019). Adulteration of edible oils with argemone oil, mineral oil, karanja or castor oil causes loss of eyesight, damage to liver, heart problem, stomach infections, or cancer [6]. Putting harmful chemicals in food is not only dangerous to customers' health, but it also damages the nutritional value of the meal (Kohda *et al.*, 2017) [2]. The Indian Council of Medical Research has stated that adulterants are hazardous and cause irreversible damage to the organs.
Although the government has been enacting and implementing various acts to combat the menace of food adulteration, it is the prime duty of the health personnel to educate consumer about various aspects of food adulteration [1, 5]. In Odisha, the local producers of mustard oil have complete control over the market. An experimental research was undertaken to evaluate the degree of adulteration and relative contamination levels in open mustard oil as well as in popular commercial brands to assess the issue.

Materials and methods
Materials
Liquid phenol, concentrated sulfuric acid (98%), petroleum ether, HCl acid, HACH DR 6000 spectrophotometer. 10 samples of mustard oil (three commercial brands, six open samples from a local market, and one crude sample from a local vendor as pure mustard oil).

Table 1: Mustard oil samples used in the study

Sample Serial Number		Different Samples
1	Control	Crude oil
2	Commercial oils	A
3		B
4		C
5	Open Samples	Sample 5
6		Sample 6
7		Sample 7
8		Sample 8
9		Sample 9
10		Sample10

Methods

Detection of Argemone oil

To detect the presence of Argemone oil, three drops of each sample were taken in separate test tubes and one drop of liquid phenol and 3 mL conc. sulfuric acid were added consecutively and shaken well.

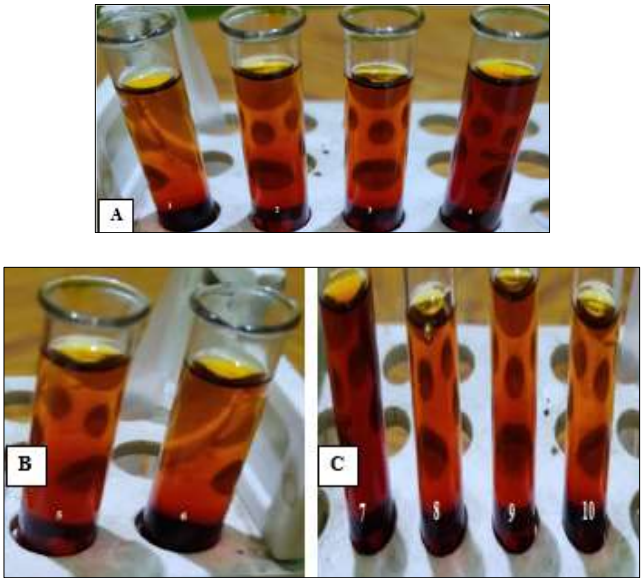

Fig 1: A-C Different oil samples after treated with liquid phenol and conc. sulphuric acid

Detection of Castor oil

For detecting the presence of Castor oil, 3 mL of samples were taken in separate test tubes and 2 mL of petroleum ether were added and shaked vigorously to completely blend the components. The tube was maintained submerged in a salt-ice combination and changes were observed.

Fig 2: A-C Turbidity formations after treating with petroleum ether.

Detection of prohibited colour

20 drops of sample were taken in 4 test tubes, each with a volume of 1 ml. Each test tube was added with 3mL, 4mL, and 2mL of pure water and HCl acid, respectively. The mixture was forcefully shaken.

Analysis of pH and density

One end of the universal indicator strip was dipped into the oil and put on a dry surface for a few seconds before being matched with the colour strip to determine the pH of the oils. Density was measure during the mathematical formula: ρ=m/V, where ρ=density, m=mass and V=volume.

Results and Discussion

Argemone oil

Argemone oil was detected in all 10 samples examined. The absorbance at 290 nm was measured by the spectrophotometer (Figure 4). The presence of red colour following the test suggests the presence of argemone oil. The red colour was present in every sample, although not at the same intensity. The average was determined to be 0.457. Sample 8 (an open sample) had the highest concentration of argemone oil adulteration.

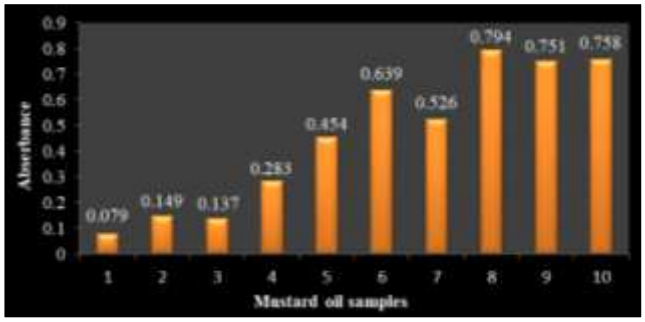

Fig 3: Absorbance at 290 nm for argemone oil test.Sample-1 crude oil (control), sample 2-4commercial oil and sample 5-10 open samples.

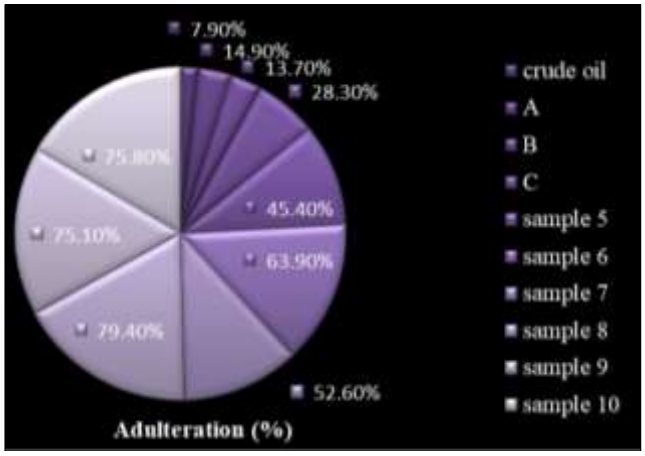

Fig 4: Argemone oil in different mustard oil samples Crude oil-control, A-C Commercial brands, Sample 5-10 open samples

Castor oil

The presence of castor oil is indicated by the rapid development of turbidity. Castor was detected in 5 samples (Table 3.2). The test result for crude oil and three commercial oil samples were negative. However, five open mustard oil samples taken for the study revealed the presence of castor oil in considerable quantities.

Table 2: Castor oil in different samples

Sample number		Sample name	Presence of impurities	Result
1	Control	Crude Oil	-	Clear
2	Commercial oil	A	-	Clear
3		B	-	Clear
4		C	-	Clear
5	Open samples	Sample 5	+	Small bubbles condensed at bottom
6		Sample 6	+	Small bubbles condensed at bottom
7		Sample 7	+	Small bubbles condensed at bottom
8		Sample 8	++	Condensed about 0.5 Ml
9		Sample 9	-	Clear
10		Sample 10	++	Condensed about 0.3 Ml

Prohibited colours

For the forbidden colour test, all of the samples yielded negative results. If a forbidden colour was used as an adulterant, it should have been in the water or acid layer. As no rose hue was noted, it indicates the absence of forbidden colour in the samples.

pH

The oil samples' pH ranged from 3.53to 5.86 at 30°C, with a mean of 5.09. There are no strict guidelines for maintaining the pH stability of mustard oil. A lower pH indicates that the oil has more acidic ingredients. 4.66 is the pH of crude mustard oil.

Density

The oil samples were analysed for density at 30ºC.The readings ranged from 812.4 to 941.7 kilogrammes per cubic metre, with an average of 875.6 kilogrammes per cubic metre. The density of crude mustard oil was found to be 886.33 kg/m^3.

Conclusion

Argemone oil and mineral oil were found in all samples at varying concentrations. According to the study, argemone oil may occasionally arise unintentionally due to the similarity of the argemone plant with the mustard oil plant or can occur when argemone seed is intentionally added to mustard seed during processing or when argemone oil is added. Open mustard oil had a very high concentration of Argemone oil. All samples were devoid of prohibited hue. No major differences from crude oil were discovered in other physical characteristics like density and pH. As a result, it was clear that some of these adulterants were present in local mustard oil, either purposefully or accidentally. However, the widespread use of argemone oil constitutes a significant health risk like pigmentation, transport, phagocytosis, ageing, and protein oxidation and many health hazards. Argemone oil (AO) is a common adulterant of mustard oil in India and causes serious pathophysiological consequences leading to outbreaks of epidemic dropsy among consumers, oxidative stress and death of red blood cells.

Acknowledgements

The authors are thankful to the President, Dean of Academics and Dean of Biological Sciences, AIPH University, Bhubaneswar for providing all the facilities for the study.

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