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Examination of Various Adulterants in non-branded Mustard Oil for Forensic Considerations

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Abstract:

One of the sources of essential fatty acids is edible oils and fats which also add special flavours and helps in maintaining the integrity of the cell membrane. Due to its crucial importance in our day to day life it has been easily prone to various kind of adulterants. The prime cause of the adulteration is the plain price variations and economic gain. Mustard oil is one of preferred edible oil in northern India. Adulterants like Aregemone oil, rice bran oil, palm oil, linseed oil etc., are frequently used to adulterate the Mustard oil. Light pale cheaper oils, dyed with synthetic dyes along with the addition of allyl isothiocyanate which adds mustard pungency factor, are sometimes sold under the name of mustard oil. In the current paper simple, rapid and reliable colour test such as improved nitric acid ,azo dye test, bauduoin test, halpen's test and solvent separation techniques have been stated and TLC was performed and calculated Rf value was compared with the standard ones. 20 different samples were collected from the local area and analysed. After analysis it was found that 80% samples were found adulterated with more than one adulterants.

Keywords: *Adulteration, Mustard oil, Thin layer chromatography*

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Introduction

A vegetable oil is mixtures of triglycerides extracted from a plant. It has been part of human culture from ancient times. The term "vegetable oil" can be closely defined only to oils that are extracted from the plant parts which are liquid at room temperature. The vegetable oils that are condensed or solid at room temperature are often known as vegetable fats.

Vegetable oils are composed of triglycerides, as compared with waxes which lack glycerin in their structure. Although, many plant parts may yield oil, and in commercial practices oil is extracted primarily from seeds. To produce vegetable oils, the oil bearing plant parts is removed and collected, then crushing and pressing is perform to extract the oil.

Mechanical Extraction

For the extraction purpose, mechanical methods (crushing or pressing) or chemical methods can be used latter one is frequently in use now a days. Then, extracted oil is purified and if required refined and chemically treated. Mechanical method of extraction oils is normally practiced from thousands of years (e.g, olive, coconut etc.,) and preferred by most of the health conscious customers of the United States and Europe. Different types of mechanical extraction are like expeller-pressing extraction is one of the widely used, though the screw press, ram press and Ghani are also available in the same field.

Solvent Extraction

Solvent extraction is the process of separating a liquid from a liquid –solid system with use of a solvent. For commercial purposes chemical extraction method is preferred which produces higher yields and less expensive. This method is widely accepted by the most of the oil producing industries like soya bean and corn oils. Sparging is a process followed to remove impurities which are water soluble and add unwanted flavor and odors to the oil.

Depending upon sources and physical characteristics, fixed oils and fats can be sub classified as follows:

Oils and fats

Fats	Non-drying oils	Semi drying oils	Drying oils
Cocoa butter Kokum butter Nutmeg butter Palm oil Coconut oil	Olive oil Peanut oil Almond oil Croton oil Rice bran oil	Castor oil Mustard oil Sesame oil Rapeseed oil Cotton seed oil	Linseed oil Poppy seed oil Hemp oil Walnut oil

Mustard oil

Mustard oil is a well-known cooking oil available in our kitchen used from ancient times. For making delicious food to curing many diseases, it has been preferably used. It is also interlinked with our culture as we use this oil to illuminate diyas during many rituals. Mustard oil (sarson ka tel) is obtained from the seeds of the plant which belongs to the family brassicaceae(Cruciferae). The genus brassica consist of over one hundred fifty species of annual or biennial herbs several of which are cultivated as oil seed crops.

- Family name- Cruciferaceae
- The scientific name of black mustard –Brassica *nigra*
- Brown Indian mustard-Brassica *juncea*
- White mustard-Sinapsis *alba*

The seed contains: moisture 6.2%, fat 35.5%, nitrogenous matter 24.6%, fiber 8 %, and ash 5.3%. The seed usually content oil 30-38% of oil, some variety of it is cultivated in Uttar Pradesh and locally known as Lahi, Lahta which have higher oil content upto (42-43%).

The characteristic pungent flavour of mustard oil is due to allyl isothio cyanate. Mustard oil contain about 60% monounsaturated fatty acids (42% erucic acid and 12% oleic acid) and has about 21% polyunsaturated fats (6% the omega-3 alpha-linolenic acid and 15% the omega-6 linoleic acid),

and it has about 12% saturated fats (**Sarwar *et al.*,2014)**

Large quantity of the mustard oil as traditional oil is used for edible purpose in many states of India namely J&K, Himachal Pradesh, Punjab, Haryana, Uttar Pradesh ,Rajasthan, Madhya Pradesh, Bihar, Chhattisgarh, Jharkhand, West Bengal and some regions of Maharashtra & north eastern states. Noticeably, India is the fourth largest oilseed producing country in the world.

Adulteration of Mustard Oil

Adulteration is an act of purposefully degrading the quality of food open for sale either by the admixture or substitution of inferior substances or by the removal of some valuable ingredient. Adulteration is not only the intentional addition or substitution of substances which badly affect the nature, substance and quality of food, but also their incidental contamination during the period of growth, harvesting, storage, processing, transport and distribution. "Adulterant" means any material which is or could be employed for making the food unsafe or sub-standard or mis-branded or containing extraneous matter.

Oil is adulterated if its quality is lowered or affected by the addition of substances which are injurious to health or by the removal of substances which are nutritious. Adulterated oil is dangerous because it may be toxic and can affect health and it could deprive nutrients essential for proper growth and development. Very often oil is adulterated by merchants and traders who are unscrupulous and want to make a quick profit. Mustard oil is often adulterated with cheapest oil such as Argemone oil, palm oil, sesame oil, linseed oil etc;. Adulteration is an act of adding or mixing something inferior, harmful, useless and unnecessary substance to food and food item may be considered as adulterated if its nature and quality are not up to the standard, **(Bell and Gillatt, 2004).**

REVIEW OF LITERAURE

Aparicio-Ruiz (2000) stated that analytical techniques have been developed or modified to give possible solutions to the devious adulterations at each moment. Classical tests have largely been replaced with newer technical procedures, most of which are based on gas chromatography, with some being based on high-performance liquid chromatography. Determination of trans-fatty acid and sterolic composition, together with sterol-dehydration products, have been used most frequently used to detect contamination and adulteration.

De and Bhattacharya (2000) developed a rapid spectroscopic method for detection of rice bran oil in other oils. The method is based on the characteristic UV absorption at 315 nm by oryzanol, present in rice bran oil. Rice bran oil as such, or when present in other edible oils at the level of 1.0-1.5% by wt., could be detected. The method is entirely dependent on the oryzanol content of rice bran. Rice bran oil might not be quantified if present at a very low level or if the oryzanol content in rice bran oil is very low.

Shukla *et al.*, (2005) reported that adulteration of Argemone oil in mustard oil can be detected in this test a small quantity of suspected oil successively treated with phenol and conc. Sulphuric acid a deep red color develops. Development of red color in above test is due to formation of quinonoid compound and hydrolysed sanguinarine salt which indicates the presence of Argemone oil as adulterant in test sample.

Babu *et al.*(2007) stated that consumption of adulterant mustard oil (Brassica nigra) with Argemone oil (Argemone mexicana)even for a short duration leads to a clinical condition referred as epidemic dropsy .in adulterated mustard oil causes oxidative stress and death of red blood cells .via haemoglobin formation by altering pyridine nucleotide and glutathione redox potential. Argemone Soil contaminated possess a series threat and should be checked by appropriate regularity measures. Anti- oxidant therapy provides symptomatic relief and should be seriously considered for therapeutic investigation against Argemone oil toxicity.

Shelkar *et al.* (2011) stated that number of cases of adulteration of Argemone mexicana (family: Papaveraceae) seed oil in edible has been reported as cause of epidemic dropsy .raw material for different edible oil were purchased from local super market pune. All solvent used were of analytical grade unless. Hexane, acetone, methanol and chloroform procured for mustard oil.

MATERIALS AND METHODS

Apparatus Required

- Measuring cylinder

- Test tube
- Beaker
- Dropper
- Separating funnel

Chemicals Required

- Nitric acid
- Hydrochloric acid
- Salicylic acid
- Sodium nitrite
- Furfural solution
- Sodium sulphate
- Hexane

Collection of Samples

20 samples were collected from different local market of Allahabad like Kydgang, Allahpur, Sangam and Chakka etc; and labelled as S1, S2, S3, S4, S5, S6, S7, S8, S9, S10, S11, S12, S12, S13, S14, S15, S16, S17, S18 ,S19 ,S20 .Standard sample of mustard oil , palm oil, sesame oil ,linseed oil ,castor oil and rice bran oil was also collected .

Test for rice bran oil

1 ml of suspect oil sample of mustard oil is taken in a clean test tube and mixed with 2ml of 10% sodium hydroxide solution and shaken for 5 min to form an emulsified solution (A). Now, 2 drops of aniline in another test tube is taken and dissolved in dilute HCl .Thereafter, it is cooled at 0-5°C, followed by addition of 2ml of 5% sodium nitrite solution (B). Now, mix solution A and B and shake for few seconds. Development of orange red colour indicates the presence of rice bran oil in suspected mustard oil.

Test for Argemone Oil

1ml of suspected oil was taken in a dry test tube and mix successively 0.5 ml of 2% of salicylic acid in methanol, and 2ml of conc. nitric acid, followed by 2-4 drops of conc. Sulphuric acid and gently shaken for few seconds. A crimson red colour or deep orange –red colour develops within 20-30 seconds if Argemone oil adulteration is present.

Test for Sesame Oil

5ml of suspected mustard oil in a 25 ml of measuring cylinder is taken with a glass stopper and 5ml of hydrochloric acid and 0.4ml of furfural solution was added. Shaken vigorously for 2 minutes and allow the mixture to separate. Development of pink color indicates the presence of sesame oil.

Test for Palm Oil

5ml of suspected mustard oil was taken and dissolve in equal volume of hexane. Then, solution was transferred in separating funnel after passing through anhydrous sodium sulphate. 3 ml of DMF was added and gently shaken for 1 minutes and allow the solution to settle till the two layers clearly separate. The lower layer was drawn off and rejected. A second washing was done if the DMF layer was found deeply coloured. The hexane solution was collected in a porcelain dish and the solvent evaporated on a water bath. The treated oil sample was then transferred to a test tube and observed under ultraviolet light. Greenish Yellow fluorescence under UV light confirms the presence of palm oil in suspected oil sample.

Test for Castor Oil

1ml of suspected mustard oil was taken in a test tube and dissolves it in 10 ml of petroleum ether, shaken vigorously for 2 minutes and 1-2 drops of molybdate reagent was added .Instantaneous development of white turbidity indicates presence of castor oil as an adulterant in test sample.

Test or cotton seed oil

5 ml of suspected oil sample was taken in a dry test tube and add to it an equal solution of the sulphur [1.0 % (w/v) solution of sulphur in carbon disulphide and then equal volume of amyl alcohol was added. Mix thoroughly by shaking and heat the tube on spirit lamp for 3 minutes .Appearance red colour at the end indicates the presence of cotton seed oil.

Chromatographic Analysis

For separation and qualitative determination of adulterant oil added in the suspected sample, TLC was performed using appropriate solvent system.

Application of Sample

Capillary tubes were used for the application of sample on TLC plate .suspected and standard samples were spotted side by side.

Development of chromatographic plate

After spotting the sample, TLC plate was placed in development chamber completely saturated with the vapours of solvent used. The plate was kept and covered tightly with a lid to avoid evaporation of solvent .The Rf value was calculated using formula:

Rf = distance travelled by solute /distance travelled by solvent

For Argemone oil test

Solvent System

Butanol: Acetic Acid: Water (70:20:10) used as solvent system for Argemone adulterant.

Experiment

10 ml of sample in a separating funnel and dissolve in 15 ml diethyl ether .5ml conc. HCL was added and shaken vigorously for 2-3 min. then, allow to settle for separation. Transfer the acid layer to 25ml beaker and placed over water-bath and evaporated till dryness. The residue obtained was dissolved in 1ml of chloroform and acetic acid (9:1) and Spotted on TLC plate with the help of spotting capillary. Spot side by side Argemone oil extract and plate was developed in Butanol: Acetic Acid: Water containing beaker and covered .The developed plates were visualised in ultra violet light and golden yellow florescence of spot was observed and reported.

TLC for rice bran oil

Solvent System

Benzene -acetic acid (100:1) v/v

Procedure

Taken 20 ml of the oil in a 100ml capacity separating funnel and added to it equal volume of aqueous potassium hydroxide. The contents was shaken gently but constantly for 10 minutes .keeps the separating funnel on a stand for about 45 minutes to allow the separation of alkali layer. Drawn the alkali layer and neutralise with dilute HCL solution confirms the neutralisation with blue litmus paper.

Extract solution with diethyl ether (20ml x3 times) .Washed the diethyl ether extract with distilled water and dried on anhydrous sodium sulphate. Solvent was evaporated on hot water bath and spotted the residue in chloroform on TLC.TLC was developed in pure Benzene: Acetic Acid mixture and visualised in iodine chamber.

Control sample of rice bran was also spotted and compare in the same identical condition.

TLC for Castor Oil

Solvent System

Hexane: diethyl ether (1:1) v/v

Procedure

10 ml of suspected oil sample was taken in a separating funnel and add 10ml of absolute alcohol. Vigorously shaken for one minutes and allowed to separate the 2 layers .lower oil layer was discarded and upper alcohol layer was collected into a 25ml beaker and concentrate alcohol extract about 2ml. Alcoholic extract and standard castor oil was spotted on TLC plate and developed in developing tank containing hexane: solvent ether (1:1) up to 8 cm. Plates were air dried and kept in iodine chamber for visualisation**.**

Result and Discussion

Nitric Acid Test

Nitric acid test was performed for the determination of Argemone in collected oil samples. All samples of mustard oil collected from different local area of Allahabad were subjected to nitric acid test .Observation of nitric acid test for samples were reported in Table- 4.1.

Appearance of notable orange colour of chemical reaction test shows positive reaction as shown in fig.4.3 and presence of Argemone adulterant in sample.

Figure – 4.1 Positive Test of Argemone oil showing crimson red color, 4.2 Negative test of Argemone showing brownish red color

Absence of any notable colour to the applied test in sample S1, S2, S3, S4, S5, S6, S8, S9, S10, S11, S12, S13 ,S14 ,S15, S16, S17 ,S18, and S20 . Fig4.3 shows negative reaction and indicates the absence of Argemone Mexicana as adulterant in mustard oil sample.

Table-4.1 Result of Argemone oil as adulterant in mustard oil sample through modified nitric acid.

Sample No.	Observation	Inference of Argemone
S1	Reddish brown colour	Absent
S2	Orange colour	**Present**
S3	Reddish brown colour	Absent
S4	Reddish brown colour	Absent
S5	Reddish brown colour	Absent
S6	Reddish brown colour	Absent
S7	Crimson red colour	Absent
S8	Reddish brown colour	Absent
S9	Reddish brown colour	Absent
S10	Dark Brown	Absent
S11	Reddish brown colour	Absent
S12	Reddish brown colour	Absent
S13	Dark Brown	Absent
S14	Reddish brown colour	Absent
S15	Reddish brown colour	Absent
S16	Reddish brown colour	Absent
S17	Reddish brown colour	Absent
S18	Reddish brown colour	Absent
S19	Orange Red colour	**Present**
S20	Reddish Brown colour	Absent

Sample 1-20 were subjected to nitric acid test for identification of Argemone oil as adulterant in mustard oil after chemical test it was found that sample no 2 and sample no 19 shows the positive result. This clearly indicates adulteration of sample 2 and sample 19 with Argemone oil.

Chromatographic Analysis

The developed chromatogram of suspected samples and standard Argemone was visualised in U.V light (366 nm) and the bright yellow colour fluorescence of spot was observed and reported. Chromatogram of suspected sample S7, S19 and standard Argemone shown in fig-4.3 ,fig-4.4 and Fig -4.5 respectively.

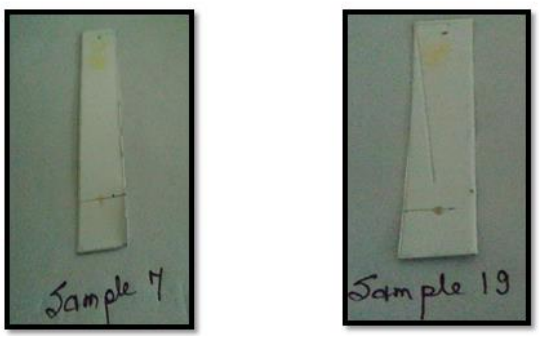


Figure – 4.3. Developed TLC plate of sample 7, 4.4. Developed TLC plate of sample 19

Figure – 4.5 Developed TLC plate of Argemone oil

Table-4.2 Result of Chromatographic analysis of Argemone oil as adulterant in mustard oil

The data collected from the chromatogram were recorded and Rf value were calculated using formula-distance travelled by solute (sample) / distance travelled by solvent. It was found that Rf value of suspected sample S7 and S19 similar with standard Argemone oil.

S. No.	Sample	Distance travelled by Solvent (cm)	Distance travelled by sample (cm)	Rf Value
1.	Argemone oil standard	8	7.6	0.96
2.	S7	8	7.8	0.98
3.	S19	8	7.5	0.94

Azo dye test

Azo dye test was performed for determination of rice bran oil in collected oil samples. All samples S1- S20 collected from different local area of Allahabad was subjected to azo dye. Azo dye reaction was observed and reported in table-4.2

Appearance of notable orange red colour clearly indicates the presence of rice bran oil and positive reaction as shown in fig -4.6 and absence of orange red colour indicates negative reaction as shown in fig – 4.7 and absence of rice bran oil adulterant in samples

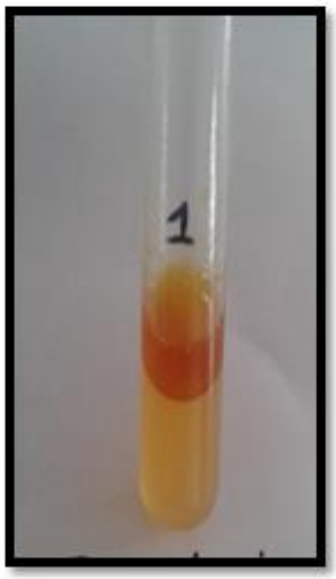


Figure – 4.6. Positive Reaction of Rice Bran oil showing orange colour, 4.7. Negative Reaction of Rice Bran oil showing yellowish colour

Sample S1, S2, S6, S8, S9, S11, S14, S17, S18, shows positive test for rice bran adulterant in mustard oil. Sample S3,S4,S5,S7,S10,S12,S13,S15,S17,S20 shows negative test for rice bran oil adulterant in mustard oil.

Table-4.3 Result of rice bran oil adulterant in mustard oil through Azo dye chemical test

Sample No.	Observation	Inference of rice bran oil
S1	Orange red	**Present**
S2	Orange red	**Present**
S3	Yellow	**Absent**
S4	Yellow	**Absent**
S5	Yellow	**Absent**
S6	Orange red	**Present**
S7	Yellow	**Absent**
S8	Orange red	**Present**
S9	Orange red	**Present**
S10	Yellow	**Absent**
S11	Orange red	**Present**
S12	Yellow	**Absent**
S13	Orange red	**Absent**
S14	Orange red	**Present**
S15	Orange red	**Absent**
S16	Orange red	**Absent**
S17	Orange red	**Present**
S18	Reddish Pink	**Absent**
S19	Orange red	**Present**
S20	Yellow	**Absent**

Chromatographic analysis of rice bran oil

Figure- 4.8. Developed TLC plate of standard, 4.9. Developed TLC plate of sample 11

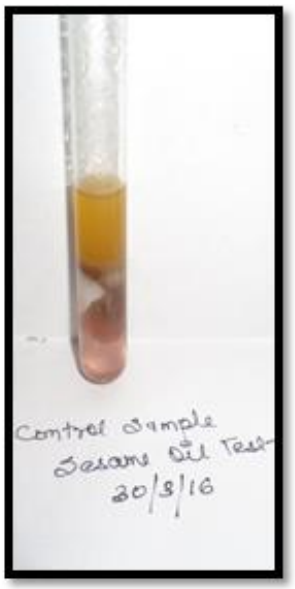
Table 4.4 Result of chromatographic analysis of rice bran oil in mustard oil

Serial no	Sample	Distance travelled by solvent	Distance travelled by solute	Rf value
1	Standard	8	5.9	0.74
2	S1	8	5.6	0.70
3	S2	8	6.2	0.78
4	S6	8	6.0	0.76
5	S8	8	5.6	0.70
6	S9	8	6.2	0.78
7	S11	8	5.7	0.72
8	S14	8	6.0	0.76
9	S17	8	5.6	0.70
10	S18	8	6.2	0.78

Data collected from the chromatogram was recorded and Rf value was calculated. Rf value of suspected samples shows some similarities with standard sample of rice bran oil**.**

Baudouin chemical test was performed to determine the sesame oil adulterant in collected mustard oil sample S1-S20. Appearance of pink colour tint at the end of the reaction confirms the presence of sesame oil adulterant.

Baudouin test for sesame oil test



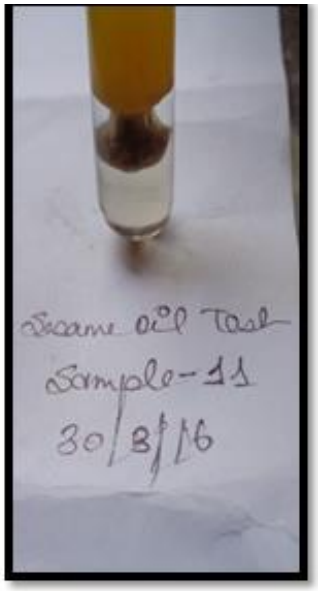


Figure – 4.10. Positive test of sesame oil showing pink colour, 4.11. Negative test of sesame oil showing no colour

On the basis of observations, it was found that sample S1, S2, S3, S7, S8, S13, S18 was adulterated with sesame oil.

Table-4.5 Result of sesame oil as adulterant in mustard oil through chemical test

Sample No.	Observation	Inference
S1	Pink colour	**Present**
S2	No pink colour	Absent
S3	No pink colour	Absent
S4	Pink colour	**Present**
S5	No pink colour	Absent
S6	No pink colour	Absent
S7	Pink colour	**Present**
S8	Pink colour	**Present**
S9	No pink colour	Absent
S10	No pink colour	Absent
S11	No pink colour	Absent
S12	No pink colour	Absent
S13	Pink colour	**Present**
S14	No pink colour	Absent
S15	No pink colour	Absent
S16	No pink colour	Absent
S17	No pink colour	Absent
S18	Pink colour	**Present**
S19	No pink colour	Absent
S20	No pink colour	Absent

Castor oil test

All sample subjected to mlolybdate test for the presence of castor oil as adulterant. Presence of white turbidity confirms the castor oil adulterant in mustard oil as shown in fig-4.12

Fig -4.12 showing white turbidity for the presence of castor oil

Table -4.6 Result of castor oil as adulterant in mustard oil analysed through molybate test

Sample No	Observation	Inference
S1	No turbidity	**Absent**
S2	No turbidity	**Absent**
S3	No turbidity	**Absent**

S4	No turbidity	**Absent**
S5	White turbidity	**Present**
S6	No turbidity	**Absent**
S7	No turbidity	**Absent**
S8	No turbidity	**Absent**
S9	White turbidity	**Present**
S10	No turbidity	**Absent**
S11	No turbidity	**Absent**
S12	No turbidity	**Absent**
S13	No turbidity	**Absent**
S14	White turbidity	**Present**
S15	No turbidity	**Absent**
S16	No turbidity	**Absent**
S17	Brown turbidity	**Absent**
S18	No turbidity	**Absent**
S19	No turbidity	**Present**
S20	White turbidity	**Absent**

On the basis of above observation, it was found that castor oil adulterant was present in S5, S9, S14 and S20 samples.

Chromatographic Analysis of castor oil in mustard oil

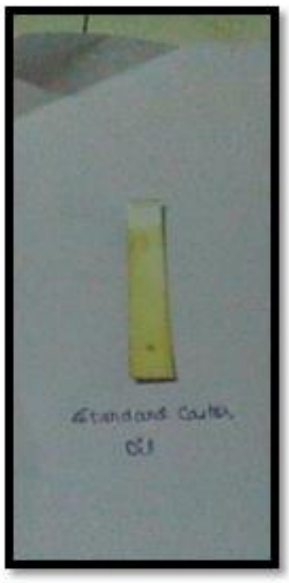


Figure – 4.13. Showing TLC plate of S19, 4.14. Showing TLC plate of standard sample

Table 4.7 Result of chromatographic analysis of castor oil as adulterant in mustard oil

Serial No.	Sample	Distance travelled by solvent	Distance travelled by solute	Rf value
1	**Standard**	**8**	**2.2**	**0.27**
2	**S5**	**8**	**2.6**	**0.32**
3	**S9**	**8**	**2.4**	**0.30**
4	**S14**	**8**	**2.1**	**0.26**
5	**S19**	**8**	**1.9**	**0.23**

Rf value of standard and suspected samples were compared and its shows similarities with standard one.

Cotton Seed Oil Test

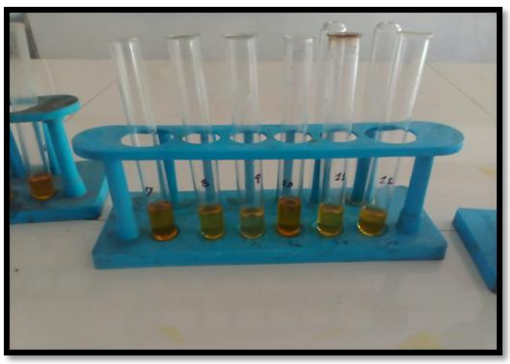


Figure -4.15 shows the cotton seed oil test of various sample

All sample subjected for analysis of cotton seed oil as adulterant shows negative responses. Hence, it was found that no sample were adulterated with cotton seed oil.

Palm oil test

Solvent extraction method was applied to all samples for determination of palm oil. Figure shows greenish yellow fluorescence under U V chamber clearly confirms the presence of palm oil adulterants in samples.

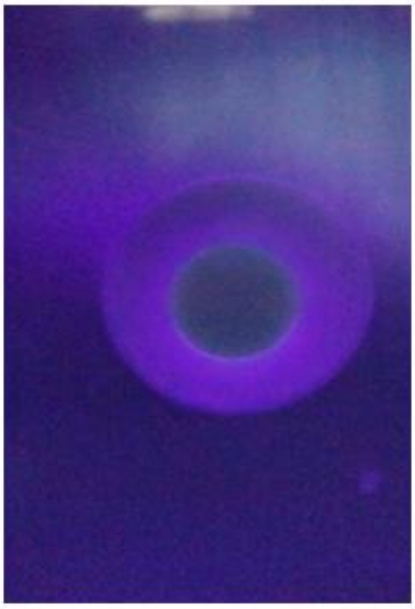


Figure – 4.16. Presence of greenish yellow fluorescence, 4.17 Absence of greenish yellow fluorescence

Table-4.8 Result of palm oil as adulterant in mustard oil samples

Sample no	Observation	Palm oil
S1	Greenish yellow fluorescence	**Present**
S2	Greenish yellow fluorescence	**Present**
S3	Greenish yellow fluorescence	Absent
S4	Greenish yellow fluorescence	**Present**
S5	Fluorescence absent	Absent
S6	Greenish yellow fluorescence	**Present**

S7	Greenish yellow fluorescence	**Present**
S8	Fluorescence absent	Absent
S 9	Greenish yellow fluorescence	**Present**
S10	Greenish fluorescence	**Present**
S11	Greenish fluorescence	**Present**
S12	Fluorescence absent	Absent
S13	Greenish yellow Fluorescence	Absent

S14	Greenish yellow Fluorescence	**Present**
S15	Fluorescence absent	Absent
S16	Fluorescence absent	Absent
S17	Yellowish fluorescence	**Present**
S18	Greenish yellow fluorescence	**Present**
S19	Fluorescence absent	Absent
S20	Greenish fluorescence	**Present**

Table 4.9 Comparative results of Adulterants present in different oil samples

Sample No	Argemone oil test	Castor oil test	Cotton seed oil	Sesame oil test	Rice bran oil	Palm oil test
Sample 1				✓	✓	✓
Sample 2					✓	✓
Sample 3						
Sample 4				✓		✓
Sample5		✓				
Sample 6					✓	✓
Sample7	✓			✓		✓
Sample8				✓	✓	
Sample9		✓			✓	✓
Sample10						✓
Sample11					✓	✓
Sample 12						
Sample 13				✓		
Sample14		✓			✓	✓
Sample 15						

Sample 16						
Sample 17					✓	✓
Sample 18				✓		✓
Sample 19	✓				✓	
Sample 20		✓				✓
Total	**2**	**4**	**0**	**6**	**9**	**12**

Above mentioned table shows adulteration of different sample with various adulterant oil. Sample 3, sample 12, sample 15 and sample 16 were found unadulterated. 20 % mustard oil samples were found unadulterated and 80% were found adulterated with other oil. The present study conducted to determine the presence of adulterants such as Argemone oil, sesame oil, cotton seed oil, castor oil and palm oil in mustard oil. Despite various preventive step taken by government to protect the health and rights of consumers,some shopkeepers and traders still using adulterant frequently. The modified nitric acid test ,azo dye test ,Boudouin test ,halphen's test ,molybdate method and solvent partition have been reported for the detectiotn of adulteration in mustard oil.

For identification of various adulterant in mustard oil different test was performed and the result obtained was similar to Shukla *et al. (*2005). The procedure or test used to check the adulterant were taken from well-known and widely accepted publication like FSSAI and ISI was similar to Abhirami and Radha (2015).

Conclusion

The Present study entitled "Examination of various adulterant in non –branded mustard oil for forensic considerations "In which chemical and chromatographic analysis was carried out. The samples were collected from different areas of Allahabad. After collection of samples, different chemical test like azo-dye test for rice bran oil, modified nitric acid test for Argemone, halpen's test for cotton seed oil, molybdate test for castor oil, modified baudouin test for sesame oil and solvent separation method visualised under UV light for palm oil was performed. The result of chemical reaction was reported in the before mentioned tables. The samples showing positive reaction was then followed by TLC method. Rf values of the samples were calculated and compared with standard samples.

Adulteration is a matter of concern these days and had reached its peak in food commodities as food is the essential need of livelihood and easily flourish in markets of India. On the basis of chemical test and TLC techniques it was found that 2 samples were adulterated with Argemone(which causes dropsy ,loss of eyesight heart diseases) ,9 samples with rice bran oil,6 samples with sesame oil, 4 samples with castor oil(causes stomach problems),12 samples with palm oil . No positive reaction was observed in halphen's test .Therefore, concluding the absence of cotton seed oil adulterant in mustard oil.

From this study it was concluded that mustard oil is still being mixed with other cheaper oil for making fast money. This study shows simple, reliable and reproducible methods for identification of adulterant in mustard oil which reveals the present risk of consumer health and provides awareness to people. After analysis it was found that 10% samples were found adulterated with Argemone oil, 20% with castor oil, 30% with sesame oil, 45% with rice bran oil and 60% with palm oil. Clearly, indicating the presence of adulterated mustard oil in the market mainly with palm oil.

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