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Research Article

Comparative study of physiochemical properties of available commercial grade Mustard oil of Bangladesh

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ABSTRACT

Mustard oil, commonly used vegetable oil in Bangladesh containing low saturated fat compared to other cooking oils and enriched with essential vitamins. The purpose of the present study was to evaluate the quality of commercially available mustard oil samples and also to inspect the physicochemical properties according to standard procedures. Therefore, nine commercial grade samples of Bangladesh were collected and subjected to physiochemical tests like density, pH, moisture content, saponification value, iodine value, acid value, ester Value, and peroxide value etc. according to the the standard procedures of AOAC directed titrimetric method.The obtained results were compared with the standard values of BSTI .Statistical analysis like Mean ± SD and one sample t-test were performed on all the obtained data.

The pH value (4.73±0.14) of all samples was within acidic region, moisture content value was0.19±0.05 density was0.78±0.03. The saponification value of all samples was177.36±2.88 ,the Iodine value was 106.78±1.84 and Ester value was 176.2±2.89 that was quite normal within the range .In terms of acid value (1.12±0.04), all samples were outside the specified range(P value was significantly different $P<0.05$) . The peroxide value (10.03±0.18) of some mustard oil samples were found to comply with the specification (P value was not significantly different $P<0.05$) and five of them have relatively higher range. The consumers using this specious product must be careful because it may be harmful even physicochemical parameters are outside of the specifications.

Keywords: Saponification value; iodine & peroxide value; acid &ester Value; density; pH; moisture content.

INTRODUCTION:

Oils and fats are important parts of human diet and more than 90 percent of the world production from vegetable, animal and marine sources is used as food or as an ingredient in food products. Oils and fats are a rich source of dietary energy and contain more than twice the caloric value of equivalent amount of sugar. Their functional and textural characteristics contribute to the flavor and palatability of natural and prepared foods. They contain certain fatty acids which play an important role in nutrition and are also carriers of fat soluble vitamins. Mustard oil is a vegetable oil and is obtained from seeds of the mustard plant. The oil is extracted from clean and sound mustard seeds, which belong to species of brassica. Large quantity of the mustard oil as traditional oil is used for edible purpose in many countries specifically in south Asia. It is often used for cooking in south Asia. It is the traditionally preferred oil for cooking. The oil makes up about 30% of the mustard seeds. It can be produced from black mustard (Brassica nigra), brown mustard (Brassica juncea), and white mustard (Brassica hirta) (Alim, A. et. al.,2012). Mustard is widely used in Bangladesh. It is mostly used as a condiment on meat as an ingredient in mayonnaise, vinaigrette, in marinades and barbecue sauce. It can also be used as a base for salad dressing when combined with vinegar and olive oil. Mustard

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is a popular accompaniment to many first foods. Dry mustardsold in tins also used in cooking and can be mixed with water to become prepared mustard. Powdered mustard is simply a name for finely ground mustard seed. Mustard that is stored for a long timetends to separation results in mustard water(Cristina, C. *et. al.*, 2012).

Mustard oil is a very strong stimulant. This oil acts like an appetizer and increases hunger. It is considered as an irritant, antibacterial, Insect repellent, Antifungal, Hair vitalizes, Diaphoretic, Tonic, Anti arthritic and anti-rheumatic. This can also be used for curing cold, cough, body pains and aches, congestion caused by cold, headache and importantly its massage is very effective for muscular growth speciallygums are strengthens and also protects from decay. (Adler, J. and Holub, J. ,1997).

Materials

In Bangladesh there are two kinds of mustards are cultivated. They are *Brassica nigra*(black mustard) and *Brassica alba*(white mustard).

This commercial grade mustard oil are produced commercially in the factory and sold in the market which are available in the shops. Nine commercial samples of grade-I mustard oil classified by BSTI were collected directly from supermarkets in Dhaka and further physicochemical studies(Arabia, S.*et.al.*,2013) were performed on them.

Methods

Iodine Value: The average degree of unsaturation of a lipid is measured by Iodine value. This value is expressed as the grams of iodine absorbed per 100g of lipid and it is directly proportional to the degree of unsaturation and inversely proportional to the melting point (M.P.) of lipid.

The higher iodine value indicates the presence of greater number of C=C double bonds and high susceptibility of lipid to oxidative rancidity due to high degree of unsaturation. The standard IUPAC procedure was used to determine the iodine number (IUPAC, Standard Methods, 1987, 7th edition).

The iodine value of mustard oil wasdetermined by "Hanus method". All the samples were weighed and dissolved in a suitable organic solvent and a known excess of iodine chloride was added. The following reaction occurred in these procedures

$$R\text{-}CH{=}CH\text{-}R \xrightarrow{+\ IB_{excess}} R\text{-}CHI\text{-}CHBr\text{-}R + IB_{remaining}$$

The amount of reactedIBr were determined by measuring the amount of IBr remaining after the reaction has gone to completion and the remaining IBr were determined by adding excess potassium iodide to the solution to liberate iodine, then titrating with a sodium thiosulfate ($Na_2S_2O_3$) solution in the presence of starch to determine the concentration of iodine released:

$$IB_{remaining} + 2KI \longrightarrow KBr + KI + I_2$$

$$I_2 + \text{starch} + 2Na_2S_2O_3\ (\text{blue}) \longrightarrow 2NaI + \text{starch} + Na_2S_4O_6\ (\text{colorless})$$

A known mustard oil sample was treated with iodine bromine (IBr) in glacial acetic acid and unreacted iodine bromine is reacted with potassium iodide which converts it to iodine. The iodine concentration is then determined by titration with standard sodium thiosulphate. According to standard procedure

Iodine Value = {(B – S) × Normality of $Na_2S_2O_3$ × 12.69}/ weight of sample (gm)

(*Where, B is the volume of 0.1 N* $Na_2S_2O_3$ *required to titrate the blank (ml), S is the volume of 0.1 N* $Na_2S_2O_3$*required to titrate the sample (ml), 12.69 is the atomic weight of iodine, N is the normality of* $Na_2S_2O_3$ *and weight of the oil in grams.*

Peroxide Value: Peroxide Value (PV) along with other physicochemical tests is very useful for predicting shelf life study. The measure of peroxides contained in the oil is called Peroxide value. Peroxide value (PV) was determined according to the IUPAC titrimetric method. This is determined by measuring iodine released from potassium iodide. 5 g of mustard oil samples, 30 ml of glacial acetic acid-chloroform mixture (3:2; v/v) and 0.5 ml saturated KI were added and kept in dark for 1

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minute. The solution was then titrated against standard $Na_2S_2O_3$ solution using starch indicator.

Peroxide Value = (Normality of $Na_2S_2O_3$ × volume of $Na_2S_2O_3$ × 1000) / Weight of oil (gm)

Acid Value:

The presence of proportion of free fatty acid in oil or fat is defined as the number of milligrams of caustic potash required to neutralize the acid in 1gm of the sample. The normal acid value for most samples exists within 0.5.
A high acid value indicates a state oil or fat stored under improper conditions. The value is a measure of the amount of fatty acids which have been liberated by hydrolysis from the glycerides due to the action of moisture, temperature and lypolytic enzyme lipage.

Acid value = {(Volume of KOH × Normality of KOH ×56) / (Weight of sample × 1000)} × 100%

SaponificationValue:

The breaking down of a neutral fat into glycerol and fatty acids with the presence of alkali is known as Saponification.The number of mg of potassium hydroxide required to neutralize the free acids and to saponify the esters in 1 g of the substance. This is a measure of the average molecular weight of the tri-acyl-glycerol in a sample.

The smaller the saponification number the larger the average molecular weight of the tri-acyl-glycerol present. Saponification value is inversely proportional to the mean molecular weight of fatty acids (or chain length).

$$R\,COOH + KOH \rightarrow R\,COOK + H_2O$$

$$KOH + HCl \longrightarrow KCl + H_2O$$

The oil sample is saponified by refluxing with a known exceed of alcoholic potassium hydroxide solution. The alkali required for saponification is quantified by titration of excess potassium hydroxide with standard hydrochloric acid.

Saponification value = {(B - S) × Normality of HCl × 56.1} / Weight of sample

Here, B is the volume of HCl used in blank (ml), S is the volume of HCl used in oil (ml) and 56.1 is the Equivalent weight of potassium hydroxide.

Ester Value:

The mg of KOH required to react with glycerin (glycerol / or glycerin) after saponify one gram of fat is defined as ester value. It is calculated from the saponification Value *(SV)* and the acid Value (AV).Thisiscrucial for the determination of the percentage of glycerin.

It is defined as the number of milligrams of KOH required to combine with fatty acids present in the glyceride form in 1 gm of oils or fat or it is a measure of actually how much amount of glyceride is present in a sample of oil, which is saponiable.

Ester Value (EV) = Saponification Value (SV) – Acid Value (AV)

Density: Density is an important physical characteristic of matter and it can increase or decreaseIt is simple to find the density of an object and see the effect of density. The standard range of density of mustard oil is 0.73gm/ml to 0.76gm/ml

Density is defined as the ratio of an object's mass to its volume. You can express this mathematically as density (abbreviated with the Greek symbol rho) is equal to mass (m) divided by volume (V).
Density, ρ = Mass (m) / Volume (v)

P^HValue: $P^H$is an important indicator in food processing to make sour bread not too sour, cheese with a bite, or beer that is just perfect. Constant pH measurement and controlled addition of buffering agents compensates for intangible process variations and assures reliable product quality.

pH is the negative of the base-10 log of the activity of the hydrogen ion in an aqueous solution. Solutions with a pH less than 7 are acidic and solutions with a pH greater than 7 are basic or alkaline. Mustard oil

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samples were taken in a beaker and directly measured by digital P^H meter.
The P^H value of mustard oil is 3.5 to 6.0

Moisture Content: The quantity of water contained in a material, such as oil or fat, soil, rock, ceramics, fruit, or wood is called Moisture content. This is used in a wide variety of scientific and technical areas which can range from 0 (completely dry) to the value of the materials' porosity at saturation. It can also be given on a volumetric or mass (gravimetric) basis.
Oil or food moisture analysis involves the whole coverage of the food items in the world because foods are comprised in a considerable amount of water rather than other ingredients.

Moisture content of the food material is important to consider the food is suitable before the consumption, because moisture content affects the physical, chemical aspects of food which relates with the stability for the storage of the food for a long period of time.This also determine the actual quality of the food before consumption and to the subsequent processing in the food sector by the food producers.

The standard range of moisture content of mustard oil is 0.1 to 0.25max.Moisture content of oils and fats is the loss in mass of heating at 105±1°C under operating conditions specified.
Moisture content (%) = {Moisture obtained (initial weight – final weight)} / Weight of oil (initial) × 100

Statistical Analysis: All determinations were done in triplicates and the data generated were presented by Mean ± SD. Then, data weresubjected to one sample t-test and statistical significant differences among the means were separated using SPSS.

Result and Discussion:

Different mustard oil samples were analyzed for iodine value, peroxide value, acid value, saponification value, ester value, density, pH and moisture content according to the abovementioned standard procedures through titrimetric method.

Table 1: Results of different specifications are given bellow

Sample Name	P^H	Moisture content	Density	Saponification value	Iodine value	Acid value	Ester value	Peroxide value
Sample-1	4.67	0.24	0.82	181.43	106.51	1.073	180.36	10.00
Sample-2	4.86	0.22	0.78	178.78	103.46	1.052	177.73	9.80
Sample-3	4.94	0.25	0.77	180.11	110.38	1.104	179.01	9.80
Sample-4	4.52	0.2	0.75	174.83	107.34	1.135	175.38	10.10
Sample-5	4.63	0.18	0.76	176.15	106.23	1.156	174.99	10.01
Sample-6	4.75	0.2	0.77	173.15	106.78	1.093	172.06	10.30
Sample-7	4.81	0.12	0.76	174.83	107.89	1.125	173.65	10.20
Sample-8	4.78	0.15	0.75	180.11	106.78	1.156	178.95	9.90
Sample-9	4.59	0.13	0.82	176.81	105.67	1.177	173.71	10.20
Mean ± SD	4.73±0.14	0.19±0.05	0.78±0.03	177.36±2.88	106.78±1.84	1.12±0.04	176.2±2.89	10.03±0.18

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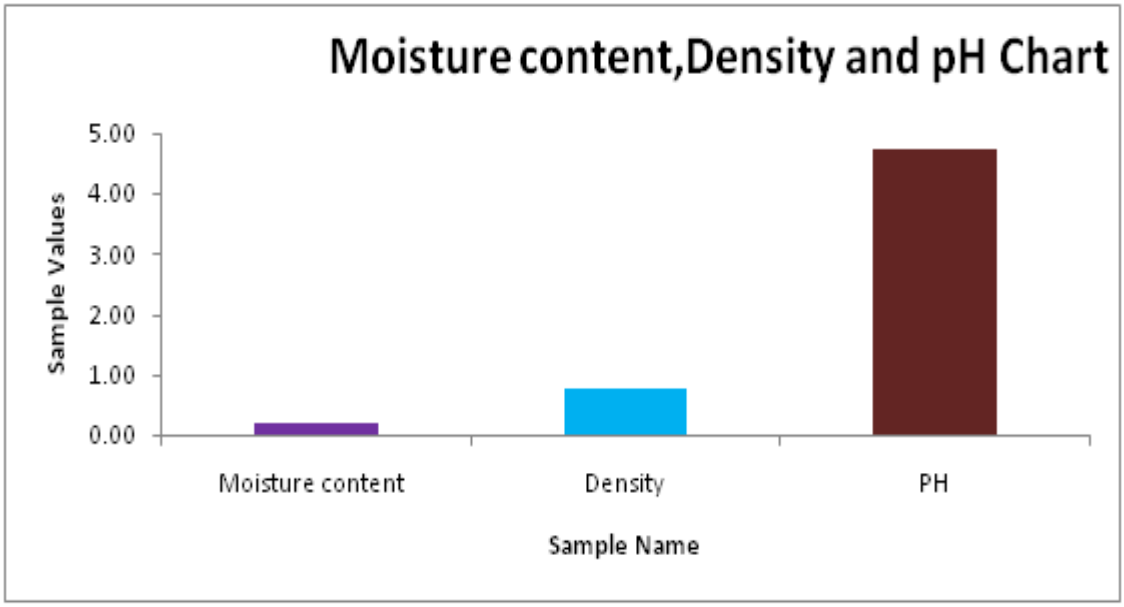

Figure 1:

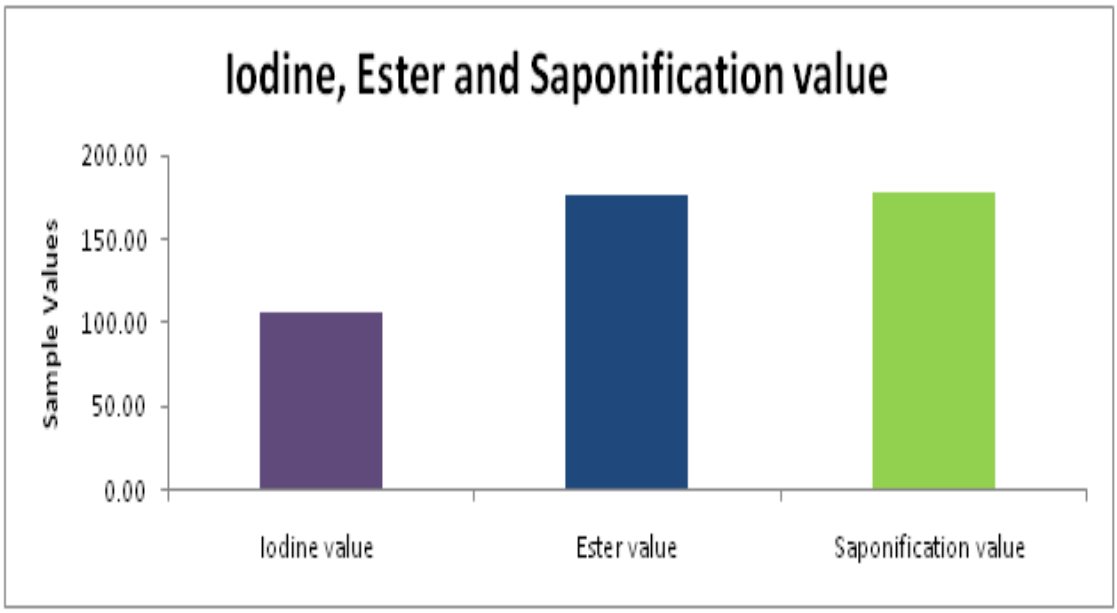

Figure 2:

Acid Value:

Table 2: One-Sample t-test

	Test Value = 0.6					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Acid value	34.883	8	.000	.52000	.4856	.5544

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Peroxide Value:

Table 3: One-Sample t-test

	Test Value = 10					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Peroxide value	.574	8	.582	.03444	-.1040	.1729

Table 4:

Sample Value	**Acid value**	**Peroxide value**
Mean ± SD	1.12±.045	10.03± 0.18

After this study, the physical and chemical properties of various mustard oil samples were complies with the specification except some oil samples were not meet the terms of specifications.

The pH value of all samples were within acidic region (from 4.52 to 4.94).Moisture content were (lowest value 0.12 and highest value 0.25) that were slightly higher than the standard value 0.1 and Density were from 0.75 to 0.82

The range of saponification value of all the samples was from 173.15 to 181.43 which were within the specified standard range (188-193). The Iodine value of all the samples ranges from lowest value 103.46 and highest value 110.38 also within the standard range 110-129.

In terms of acid value, all samples were outside the specifiedrange (P value was significantly different P<0.05) may be due to the improper storage condition. The peroxide values of some mustard oil samples were found to comply with the specification (P value was not significantly different P<0.05) and among five of them have relatively higher value, but remain within the critical range might also be degradation with environmental factors.

CONCLUSION

Mustard oil is a traditionally necessary component of the foodin Bangladesh because of high energy value and other useful purposes. Hence, quantity and quality of it deliriously affect human health as well as its imbalance intake may often lead to chronic unbearable diseases such as the cardiovascular disease, rheumatoid arthritis etc.

All physiochemical properties were determined according to the standardprocedures and the values meet the standard except in some cases like acid and peroxide value. Changeability in some physiochemical characteristics indicates the risk alertof these oils to consumer health. This emphasizes the crucial need for persistent control and in time detection of potentialcontamination sources as well as proper maintenance and storage. This present study may be helpful in many areas not only to improve the quality of oil but also to provide public awareness not to expose such type of edible oils for long periods many times. Further study is needed to get more authentic data of oil samples in Bangladesh.

REFERENCES

1. Cristina, C., Aparecida, L., Gonçalves, G., &Ferracini, H. (2012). Study of the effectiveness of quick tests based on physical properties for the evaluation of

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used frying oil, 26, 525–530. https://doi.org/10.1016/j.foodcont.2012.01.008

2. Zahir, E., Saeed, R., Hameed, M. A., &Yousuf, A. (2017). Study of physicochemical properties of edible oil and evaluation of frying oil quality by Fourier Transform-Infrared (FT-IR) Spectroscopy. Arabian Journal of Chemistry, 10, S3870–S3876. https://doi.org/10.1016/j.arabjc.2014.05.025
3. Alim, A., Iqbal, Z., &Dutta, P. C. (2012). Studies on the characterization and distribution of fatty acids and minor components of high-erucic acid mustard oil and low-erucic acid rapeseed oil, 24(4), 281–287.
4. Arabia, S., Pradesh, H., & Pradesh, H. (2013). Biochemical characterization of Mustard Oil (Brassicacampestris L .) with special reference to its fatty acid composition, 1(1), 1–9.
5. Yadav, R. P., &Kumari, B. (2015). Ultrasonic Studies on Mustard Oil : A Critical Review, 4(8), 517–531.
6. Adler, J., &Holub, J. (1997). Effect of garlic and fish-oil supplementation on serum and lipoprotein concentrations in hypercholesterolemic.
7. Barthel, G., Grosch, W., &Forschungsanstalt, D. (n.d.). Peroxide Value Determination-Comparison of Some Methods, 3.
8. Henderson, R. A., Jensen, R. G., Lammi-keefe, C. J., Ferris, A. M., &Dardick, K. R. (1992). Effect of Fish Oil on the Fatty Acid Composition of Human Milk and Maternal and Infant Erythrocytes I, 27(11), 863–869.
9. Agricultural, W., Station, E., Crops, V., & Crops, V. (1943). Mustard oil in crucifers and their relation, 67(2), 49–64.
10. Comparative Evaluation Of Quality Characteristics Of Oils Extracted From Some Selected Legumes And A Cereal. (2014), 8(7), 66–69.
11. Sanders, T. A. B. (1993). Marine oils : metabolic effects and role in human nutrition.
12. Spangenberg, J. E., Macko, S. A., &Hunziker, J. (1998). Characterization of Olive Oil by Carbon Isotope Analysis of Individual Fatty Acids : Implications for Authentication, 4179–4184.
13. Wendlinger, C., Hammann, S., & Vetter, W. (2014). Various concentrations of erucic acid in mustard oil and mustard. FOOD CHEMISTRY, 153, 393–397. https://doi.org/10.1016/j.foodchem.2013.12.073
14. IUPAC, Standard Methods: Standard Methods for the Analysis of Oils, Fats and Derivatives, 7thedition. (International Union of Pure and Applied Chemistry, Blackwell, Oxford, 1987).
15. NIS, 1992. Nigerian Industrial Standards. Standard for Edible Vegetable Oil, pp. 5–12
16. A.O.A.C 1984, official method of analysis.
17. ISO 5725. Precision of test methods. Determination of repeatability and reproduce-bility by inter-laboratory tests.1986.
18. I.S.I Hand book of food analysis (part XIII) – 1984, page 62.
19. A.O.A.C 17th edition, 2000, official method of analysis.
20. B.S.T.I Bangladesh standard, specification for mustard oil.

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