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A comparative study of hidden characteristics of canola & mustard oil

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Abstract
Canola oil comes from the seeds of the canola plant and it is low in saturated fat, high in monounsaturated fatty acid (MUFA), and polyunsaturated fat (PUFA) like omega-3 fatty acids. The oil is produced from pressed canola seed, which are harvested from pods obtained from the canola plant. Mustard oil is used for two different oils that are made from mustard seeds as fatty vegetable oil and as an essential oil. The present study conducted for the analysis of hidden characteristics i.e. nutritional, chemical and adulterants of canola oil and mustard oil; study of compositional differences in respect of fatty acid profile, cholesterol, tocopherols and oxidative stability. Mustard oil contains higher level of erucic acid (42.8%) and linoleic acid (18.2%) whereas, it contains lower oleic acid (17.4%) and linolenic acid (15.8%) 'Canola' which is a registered trade mark of Canadian Oil Association denotes the seeds having less than 2 per cent erucic acid in its oil. Mustard oil was found healthier than Canadian based oil as mustard oil contains higher amount of tocopherol (38.32mg/100g) but lower amount of sterols (606.32mg/100g) than other rapeseed oils. The ω-6/ω-3 ratio of mustard oil is 0.87.

Keywords: Canola oil, linoleic acid, erucic acid, mustard oil, fatty acids

Introduction
Lipids which constitute both products from plant and animal kingdom with varying fatty acid composition are an integral part of human diet and nutrition around the world (FSSAI, 2017) [1]. Fats and oils play a major functional role in providing palatability to the food thus providing nutrition. Furthermore, they are rich sources of dietary energy which is equivalent twice the amount of dietary energy provided by sugar. They constitute fatty acid which provide nutrition as well carry essential fat soluble vitamins. Further, fats and oil provide palatability and texture to the natural and processed products. A large number of species and subspecies of oilseeds are grown in India. India is third largest mustard producing country in the world [2], with 12 per cent of world's total production grown domestically. The crop accounts for nearly one-third of the oil produced in India, making it the country's second most important edible oil after groundnut (Damodaran and Hegde, 2004) [3].

Due to the similar genetic make-up, mustard and rapeseed seeds share the same growing areas throughout India. A large number of species and sub-species of oilseed are cultivated in India with the name of rapeseed/mustard seed, including *Torah, Rai, Yellow Sarson, Brown Sarson, Rape/Karan Rai, Taramira* and *Swedi.* Traditionally, the rapeseed/mustard seed grown in India contains a huge amount of glucosinolates and euric acid, and does not conform to the international standard, "Canola quality." The rapeseed/mustard seed produced in India is mainly for domestic consumption, and is mostly consumed in the central, eastern and northern parts of the country. A study by CUTS on the rapeseed/mustard seed sector in Rajasthan found that 82 % of the rural consumers use oil as their staple edible oil, with monthly consumption varying between two and four kilograms per family in the state (Pahariya, 2006) [4].

Rapeseed (*Brassica napus*) / mustard oil (*B. juncea)* content typically varies between 36 and 42 %; average oil recovery is approximately 34 to 35 % (Srinivasan, 2005) [5]. Only 24-40% of mustard oil can be taken from mustard seeds which has higher level of erucic acid content and glucosinolates whereas it contains lower level of saturated fatty acid profile than all edible vegetable oils. It constitutes erucic, oleic, linoleic and α-linolenic acid and a little less than 60% of monounsaturated fatty acids comprising 42% erucic acid and 12% oleic acid. Further, contains 21% polyunsaturates comprising 6% ω-3 α-linolenic acid and 15% ω-6 linolenic acid. It has 12% saturated fats (as per USDA National Nutrient Database).

B. juncea containing lower levels of linoleic acid and higher levels of oleic and linolenic acids compared with *B.napus.* Therefore, it has raised concern about possible oxidative stability differences between the oils and once the oil is extracted, the remaining part of the seed is used to produce mustard/rapeseed meal, an important source of poultry and cattle. This represents a significant source of oil meal in the country, supplying on average about 3 to 3.2 million tonnes of meal annually. Typically, the mustard/ rapeseed seed sector has been the most unorganized sector in the country when compared to other edible oils in India; almost 90 % of producers operate as small oil mills throughout the mustard/ rapeseed growing belt (Dohlman, 2003) [6].

Mustard Oil may provide a protective effect in connection with patients having acute myocardial infarction, possibly due to the presence of α-linolenic acid. It has been found that the omega-3 PUFA present in rapeseed/mustard oil reduces the risk of chemically induced cancer (Varshney, 2005) [7]. However, higher levels of erucic acid are unsuitable for human consumption. Oils having low erucic acid are recommended for human consumption because oils high in erucic acid may cause an accumulation of triacylglycerol in the hearts of animals. The major source of erucic acid is seed oils of the Crucifereae family, which includes rapeseed, mustard, crambe, and wallflower. The erucic acid is known very crucial raw material for oleo chemical industry. Erucic acid and its derivatives possess varieties of superior properties in slipping, softening, antifoaming, emulsifying, and corrosion inhibiting. All these properties offer erucic acid and its derivatives wide applications in the production of pharmaceuticals, soaps, detergents, cosmetics, plastics, lubricants, rubbers, coatings, Further, Canola oil is a production of Canada, containing lower levels of erucic acid and glucosinolate but is completely different from those of rapeseed oil which contains high erucic acid.

Canola oil is a common ingredient in food products, such as mayonnaise, salad dressings, and margarine. Canola oil was created through the hybridization of rapeseed oil, an oil used for industrial purposes. Clinical studies conducted over the past 20 years involving thousands of healthy volunteers, examined the role of canola oil in lowering blood cholesterol levels and reducing risk of coronary heart disease, cancer, diabetes and high blood pressure (Myths Debunked) [8]. The studies confirmed that when used as part of a balanced diet, canola oil has been shown to lower blood cholesterol levels and have a beneficial effect on clot formation, thereby decreasing the risk of heart disease and stroke. Canola oil contains just 7% saturated fat compared to, for example, 15% for olive oil, 19% from peanut oil and 12% for sunflower oil (Thacker, 2009) [9]. Furthermore, canola oil is dangerous when hydrogenated, which is common in processed foods. Manufacturers hydrogenate the oil because it prolongs processed food shelf life.

This research highlights the comparative study of hidden characteristics (fatty acid profile, quality, adulterant and nutritional analysis) of canola & mustard oil. Quality analysis is done by determining iodine value and peroxide values and adulterant analysis is by titrimetric method. High-performance liquid chromatography (HPLC) and Gas Chromatography Mass Spectrophotometry (GC-MS) are the two major analytical instruments being used in this research study for lipid profile and nutritional analysis of both canola and mustard oil.

2. Materials and methods

2.1. Collection of samples

For the above study, kacchidhani mustard oil has been collected from patanjali store and Canola oil is collected from grocery store of defence canteen.

2.2. Nutritional analysis using HPLC and GC-MS

Nutritional analysis of canola and mustard oil was determined by analyzing tocopherol, cholesterol content and fatty acid profile. For tocopherol content, 10 g of oil sample taken in amber colored round bottom flask. 70-100 ml of ethanol, 0.5 g ascorbic acid and 25 ml of 50 % KOH added. Now reflux for 45 minutes in water bath at 80 ℃. Sample mixture cooled it and added with 100 ml water plus 30 ml ethanol to it. Transferred it in separating funnel. Extracted with petroleum ether thrice. Washed with water 3 times and evaporated it in vacuum rotary evaporator. 5 ml ethanol added to it and vials were filled for analysis by HPLC. For cholesterol content, 5 g of sample taken onto which 7g KOH and 10 ml glycerol with 5 ml methanol were added to it. Mixture was refluxed for 1hour at 90 ℃ and transferred to separating funnel with 5 ml of water added water to it. Extracted with petroleum ether three times in 50:50:30 ratio. Fat layer obtained after the extraction was separated and the remaining was transferred in separating funnel. Mixture was washed with water thrice, filtered with anhydrous sodium sulphate and evaporated using vacuum rotary evaporator. Processed solution obtained were filled in the vials and subjected for HPLC analysis. For fatty acid profile, 0.2 ml of methanol and KOH was added to 0.1 g of oil sample. It was incubated in a water bath for 10 minutes at 70 ℃. Sample was cooled it. 1 ml of methanolic HCL was added and incubated in a water bath for 10 minutes at 70 ℃. Sample was cooled it again. Now 10 ml of petroleum ether was added, well mixed and it was incubated for 10 minutes at room temperature, allowing layer to separate. Solution obtained was analyzed by GC-MS.

2.3. Quality analysis

Quality analysis of canola and mustard oil was determined by analyzing peroxide and iodine value. For peroxide value, 30 ml of PV solution (3:2 ratio of chloroform and glacial acetic acid) and 0.5 ml of saturated KI were added to 5 g of sample. Using starch indicator, sample was titrated with 0.05 N thiosulphate solution. Titre values noted and peroxide values were calculated as per the formula. For iodine value, 25 ml of carbon tetrachloride was added to 0.2 to 0.3 g of filtered oil sample. 25 ml of WIJS solution was added to sample. Immediately stoppered the flask and KI added in excess. Kept the flask at dark place for 30 minutes. Stopper removed and rinsed with water. Sample was titrated with 0.1 N thiosulphate solution till light brown color. Starch indicator was added. Solution was then titrated till colorless end and iodine values were calculated as per the formula.

2.4. Adulterant analysis using Thin Layer Chromatography (TLC) and turbidity occurrence

Adulterant analysis of canola and mustard oil was determined by analyzing presence of argemone and mineral oil content in the sample. For argemone oil content, 10 g of oil sample was taken in 250 ml separating funnel and 15 ml of diethyl ether added to it. It was vigorously shaken and allowed gas to evaporate. 10 ml of concentrated HCL was added to the solution. Kept it for some time. Middle layer or acid layer was collected in a round bottom flask and evaporated in vacuum rotatory evaporator. Argemone solution (1:1 ratio of

chloroform and acetic acid) was added to it. TLC plates were made using mobile phase as a ratio of n-hexane and acetone as 3:2 and results were observed under UV lamp. For mineral oil content, 1 ml of sample was dissolved in a 25 ml of alcoholic KOH in a test tube. It was allowed to boil and 25 ml of water was added to the sides of test tube. If turbidity occurs, it indicate the presence of mineral oil. The turbidity occurrence is directly proportional to the amount of mineral oil present.

3. Results and discussion

Present investigation was an attempt to comparative study of mustard and canola oil. Both mustard and canola oils are essential oil having different impact on food sector (Hocking, 1997) [10]. Both have different lipid profile in case of various fatty acids composition, iodine value, peroxide value, tocopherol value, etc. Mustard oil has high tocopherol, iodine and peroxide values than canola oil. Mustard oil is found to be a good indicative for coronary heart disease patients as it has significant low levels of erucic acid than canola oil, which is responsible of cholesterol content.

3.1. Nutritional and quality properties of oil samples:

The hidden characteristics (nutritional, quality, adulteration) of two oils mustard versus canola were investigated and listed in Table 1. The comparative study is done with regard to canola oil make it evident that mustard oil is the better option than canola oil variety.

Table 1: Study of tocopherol and sterol values by HPLC, peroxide value by titrimetric method, argemone oil and mineral oil content for mustard and canola oil samples.

S. No.	Parameters	Samples	
		Mustard oil	Canola oil
1	Tocopherol value (ppm)	8.75161	3.3122
2	Sterol value (ppm)	Nil	Nil
3	Iodine value	110	112
4	Peroxide value (meq of active oxygen/ kg oil)	10	12
5	Argemone oil	Nil	Nil
6	Mineral oil	Nil	Nil

The hidden characteristics reveal that kacchighani has higher oxidative stability owing to higher value of antioxidants and lower peroxide and iodine values (Chauhan, 1986) [12]. Oxidative stability is an essential parameter in judging the quality of the oil. Furthermore, both the oil samples found free of adulteration of argemone, linseed and mineral oils. The results show that canola oil has lower oxidative stability due to less value of tocopherol present in it as shown in fig.1. Further canola oil has higher iodine and peroxide values (fig.1). Also the balance of ω-6/ω-3 ratio (1:1 to1:4) was found in a good range in case of mustard oil.

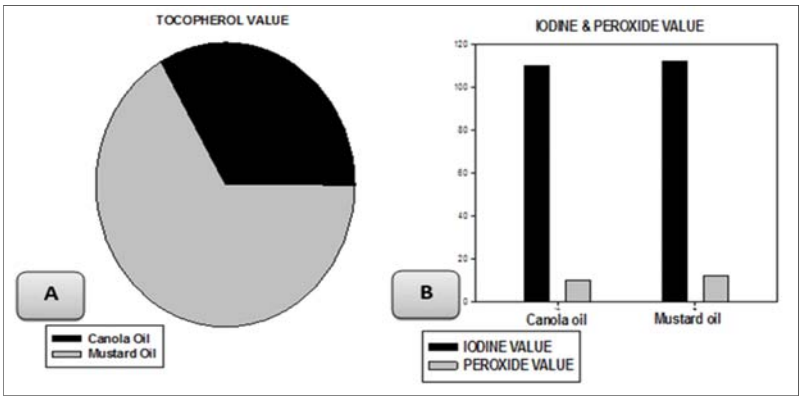

Fig 1: Lipid profile of mustard and canola oil. A; Mustard oil has significant high level of tocopherol. B; both mustard & canola oils have comparatively equal iodine and peroxide values.

3.2. Fatty acid profile of mustard and canola oil

Fatty acid profile of mustard and canola oil samples were done using GC-MS analytical instrumental techniques as shown in fig.2. Fatty acid composition of palmitic acid, stearic acid, oleic acid, linoleic acid, linolenic acid, gonodoic acid, erucic acid present in mustard and canola oil analyzed as listed in Table 2.

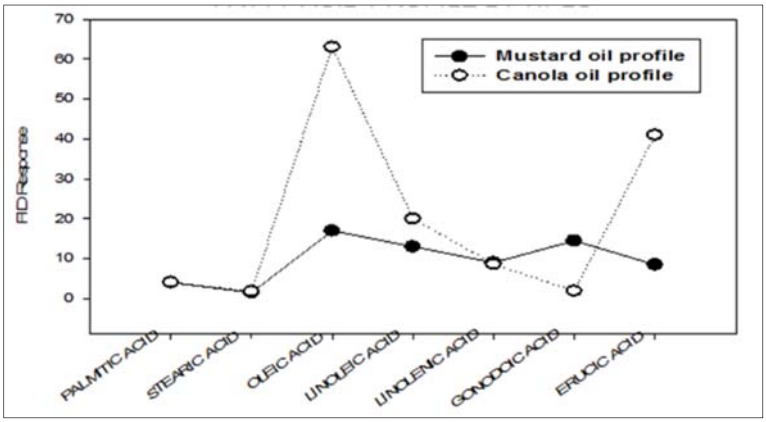

Fig.2: Fatty acid profile of mustard and canola oil

Table 1: Composition of fatty acids present in mustard and canola oil samples

S. No.	Parameter (fatty acids)	Mustard oil	Canola oil
1	16:0 (Palmitic Acid)	4	4.1
2	18:0 (Stearic Acid)	1.5	1.8
3	18:1(Oleic Acid)	17	63
4	18:2 (Linoleic Acid)	13	20
5	18:3 (Linolenic Acid)	9	8.6
6	20:1 (Gonodoic Acid)	14.5	1.9
7	22:1 (Erucic Acid)	8.5	41

From the comparative studies of fatty acid profiles of oil samples, mustard oil is found to be a good indicative for coronary heart disease patients as it has significant low levels of erucic acid than canola oil, which is responsible for increase the concentration of adrenal cholesterol causing fibrotic changes in myocardium, liver weight and cholesterol level (Canvin, 1965) [13].

4. Conclusion

Both mustard and canola oils are essential oil having different impact on food sector. Both have different lipid profile in case of various fatty acids composition, iodine value, peroxide value, tocopherol value, etc. Analytical instruments like; HPLC and GC-MS are being used to characterize these variables. Mustard oil has high tocopherol, iodine and peroxide values than canola oil. Mustard oil is found to be a good indicative for coronary heart disease patients as it has significant low levels of erucic acid than canola oil, which is responsible for increase the concentration of adrenal cholesterol causing fibrotic changes in myocardium, liver weight and cholesterol level. It is concluded that there has been several debunking myths that mustard oil lead to heart diseases. But the research done proves that kacchidhani (of patanjali brand), is obtained by cold press extraction of oil from mustard seeds so that the natural properties, antioxidants and essential oil (allylisothiocynate) of the mustard seed is retained in extraction process not only play a crucial role in curing diabetes but also cures cancer and abdominal diseases. Thus mustard oil is more valuable and nutritious food product for human consumption than any of the other rapeseed oil.

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6. References

1. Manual of method of analysis of food (oils and fats), FSSAI. Manuals of methods of analysis. 2017.
2. Rapeseed/mustard plants grow all over the world, but their cultivation is mainly confined to India, China, Canada, Germany, France, Australia and the United States.
3. Damodaran T, Hegde DM. Oilseeds Situation: A Statistical Compendium, Directorate Oilseeds Research, Indian Council of Agricultural Research, Hyderabad. 2005; 1(4):5.
4. Pahariya NC. Impact Assessment of Trade Liberalisation in Oil seed Sector, Case Study of Rajasthan, CUTS International. 2006. http://www.cuts-citee.org/documents/Oilseed-study-final.doc accessed in 2007.
5. Srinivasan PV. Impact of Trade Liberalisation of India's oil seed and edible oils sector, Indira Gandhi Institute of Development Research (IGIDR). 2005, 20.
6. Dohlman ES, Persaud Landes R. India's Edible Oil Sector: Imports Fill Rising Demand, United States Department of Agriculture (USDA). 2003; accessed in 2007, 11. http://www.ers.usda.gov/publications/OCS/nov03/OCS090301/ocs090301.pdf,
7. Varshney V. Oil's not well," *Down to Earth,* February 15, 2005; accessed in 2007. http://www.downtoearth.org.in/full6.asp?foldername=20050215&filename=news&sid=31&page=1&sec_id=50.
8. American N (n.d.). Canola Oil; the Myths Debunked. http://www.canolacouncil.org/oil-and-meal/canola-oil/canola-the-myths-debunked/.
9. Thacker PA, Petri D. The Effects of Canola or Mustard Biodiesel Press Cake on Nutrient Digestibility and Performance of Broiler Chickens, Asian-Aust. J. Anim. Sci. November 2009; 22(11):1531-1539.
10. Hocking PJ, Kirkegaard JA, Angus JF, Gibson AH, Koetz EA, Comparison of canola, Indian mustard and linola in two contrasting environments. I. Effects of nitrogen fertilizer on dry matter production, seed yield and seed quality. Field Crops, 1997; 49:107-125.
11. Downey RK, Rimmer SR, Agronomic improvements in oilseed Brassicas. Adv. Agron. 1993; 50:1-66.
12. Chauhan YS, Bhargava SC. Comparison of pods of the terminal raceme of rapeseed (Brassica campestris var. Yellow Sarson) and mustard (Brassicajuncea) cultivars. J. Agric. Sci. Camb. 1986; 107:469-473.
13. Canvin DT, The effect of temperature on the oil content and fatty acid composition of the oils from several oilseed crops. Can. J. Bot. 1965; 43:63-69.