Original Research Article

Adulteration in Commonly Used Cooking Oils of Kolkata: Evaluation of Consumer Perception and Detection of Adulterants

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ABSTRACT

Background: Oil forms an integral part in our everyday cooking and its adulteration can pose several effects on human health.

Objective: The present study explored the effect of income on the perception of consumers towards adulteration in commonly used cooking oils of Kolkata and detected adulterants in unpackaged and packaged oil samples through chemical tests.

Method: A structured Knowledge, Attitude and Practice questionnaire was prepared and used to obtain relevant information regarding the personal details, buying practices of consumers and oil consumption pattern of the respondents. The chemical adulterants were evaluated according to the protocols of the Food Safety and Standards Authority of India (FSSAI).

Results: It was observed that respondents belonging to high income groups had higher level of awareness regarding oil adulteration. Furthermore, chemical analysis revealed that 39.28% of the unpackaged samples and 31.25% of the packaged samples were adulterated.

Conclusion: It is concluded that the level of awareness of the respondents belonging to high income group was comparatively higher than the low income group and adulteration was practiced in both the categories of oil samples. Publicizing food adulteration-related laws and different aspects of food adulteration via mass media could play a crucial role in raising consumer awareness which would thereby help in maintaining good health.

Keywords: Adulteration, Awareness, Cooking oils, Income, Packaged, Unpackaged.

INTRODUCTION

Food is essential for human existence but it has been liable to adulteration since ancient times. [1] Food adulteration includes various forms of practices, such as mixing, substituting, concealing the quality of food by mislabeling, putting up decomposed or expired food and adding toxic substances. It is an age-old problem that affects people at all societal strata. The health hazards can result from either addition of deleterious substances or removal of a vital component. [2,3] Acts of food adulteration are intentional, unintentional or natural. Intentional food adulteration is usually performed for financial gain. Unintentional adulteration is the result of ignorance or the lack of facilities to maintain food quality. Natural adulteration occurs due to the presence of certain chemicals, organic compounds or radicals that occur naturally in foods and is injurious to health but not added intentionally or unintentionally. [4]

Vegetable oils and fats have a big contribution in our diet as cooking or frying oils, salad oils or in food product formulations. They are important from

nutritional and economical point of views. However, their authenticity is a serious issue. [5] Edible oil fraud usually involves misleading the purchaser as to the true nature, substance or quality of the oil demanded. The offence is in the form of adulteration which generally involves the dilution of pure edible oil with less expensive one. Cheaper oil which is adulterated may also be represented as if it were some oil of greater (pure) oil quality. [6] 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. [7]

The intake of adulterated oils and trans-fats in the human diet has had negative health repercussions, including cardiovascular disease, causing millions of deaths annually. [8] Mustard oil adulterated with argemone oil and butter yellow has been reported to cause gall bladder cancer and may lead to epidemic dropsy, glaucoma and loss of eyesight. [9, 10] Olive oil is often substituted with lower cost alternatives which poses problem for people with certain food allergies. [11] Adulteration of edible oils with mineral oil causes damage to the liver and cancer. Substitution of edible oils with karanja oil is associated with liver damage as well as heart problems, whereas, castor oil is responsible for indigestion, dysentery, ulcer and throat irritation. [12] Canola oil provides consumer with many health benefits as it is low in saturated fat along with a good ratio of omega-6 to omega-3 polyunsaturated fats, and has become one of the most susceptible food materials adulterated with other vegetable oils of lower quality, which is a serious threat to the health of consumers. [13] Also, a study significantly linked the quality of edible oils used at home to an individual's good health as evidenced by instances of food adulteration especially that of edible oils with argemone oil which led to death of hundreds of people. [14]

To protect general public against the defective practices adopted by the trader, Prevention of Food Adulteration Act (PFA), 1954 was enacted by the Indian parliament, which has now been replaced with a food safety law and body called the Food Safety and Standards Authority of India (FSSAI). [15] 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, 16] As the practice of adulteration is posing threat to human health in the society, this study aims to analyze the perception of consumers towards adulteration in commonly used cooking oils of Kolkata and evaluate them through standard testing procedures.

MATERIALS AND METHODS
A. Survey

Survey was conducted amongst the low and high income group responders of the industrial and domestic sectors of Kolkata. The respondents from the industrial sector comprised of low income hawkers and high income chefs, whereas low and high income families were included under the domestic sector. Therefore, a total of 100 subjects, 50 belonging to each of the low and high income groups (out of which 25 each from domestic and industrial sectors respectively) were selected by Quota sampling method belonging to the age group of 25-40 years. The income segregation criteria was Rs. 20,000 per month, with a family income of less than or equal to Rs. 20,000 considered as the low income category. Keeping in mind the objectives of the present study, a structured KAP (Knowledge, Attitude, Practice) questionnaire was prepared which aimed at attaining the relevant information regarding the personal details, buying practices of consumers and oil consumption pattern of the respondents. The level of awareness was assessed by combining the data obtained from the knowledge, attitude and practices of the respondents.

B. Chemical analysis of oil samples

The oils selected for analysis were mustard, soybean and coconut oil. Control,

unpackaged and packaged oil samples were collected for each oil sample. Cold pressed samples of mustard, soybean and coconut oil were used as controls. A total of eight unpackaged and packaged samples for mustard and soybean oils were collected and analysed. Since unpackaged samples for coconut oil were not available, only four packaged samples were taken for analysis. (Table 1)

Table 1: Variety and number of unpackaged and packaged oil samples analyzed in the present study		
Samples	Unpackaged (n)	Packaged (n)
Mustard oil	4	4
Soyabean oil	4	4
Coconut oil	0	4
Total	8	12
n = Number of samples analyzed.		

Chemical tests as per the Food Safety and Standards Authority of India (FSSAI) protocol were performed in all the oil samples. [17-18] Commonly found adulterants, which when consumed causes detrimental impact on the health were chosen for detection. The tests were conducted for the detection of common adulterants such as argemone oil, cottonseed oil, mineral oil, castor oil, karanja oil, presence of cyanide and prohibited colour.

Statistical Analysis

After completing the survey, the data was tabulated and organized according to the objectives of the study for appropriate analysis using Microsoft Office Excel, 2007 and EViews software (Econometric views, Version 9.5, HIS Markit Developer). A multilinear regression analysis was performed in order to evaluate the relationship, if any, between the income level of respondents and the level of awareness. After completing the chemical analysis, the data was tabulated for appropriate qualitative analysis and represented in the form of graphs. P-value was estimated using GraphPad software (California) to compare adulteration between unpackaged and packaged oil samples. A p-value of ≤ 0.05 was considered to be statistically significant.

RESULT

1. Knowledge, attitude and practice of consumers towards oil adulteration
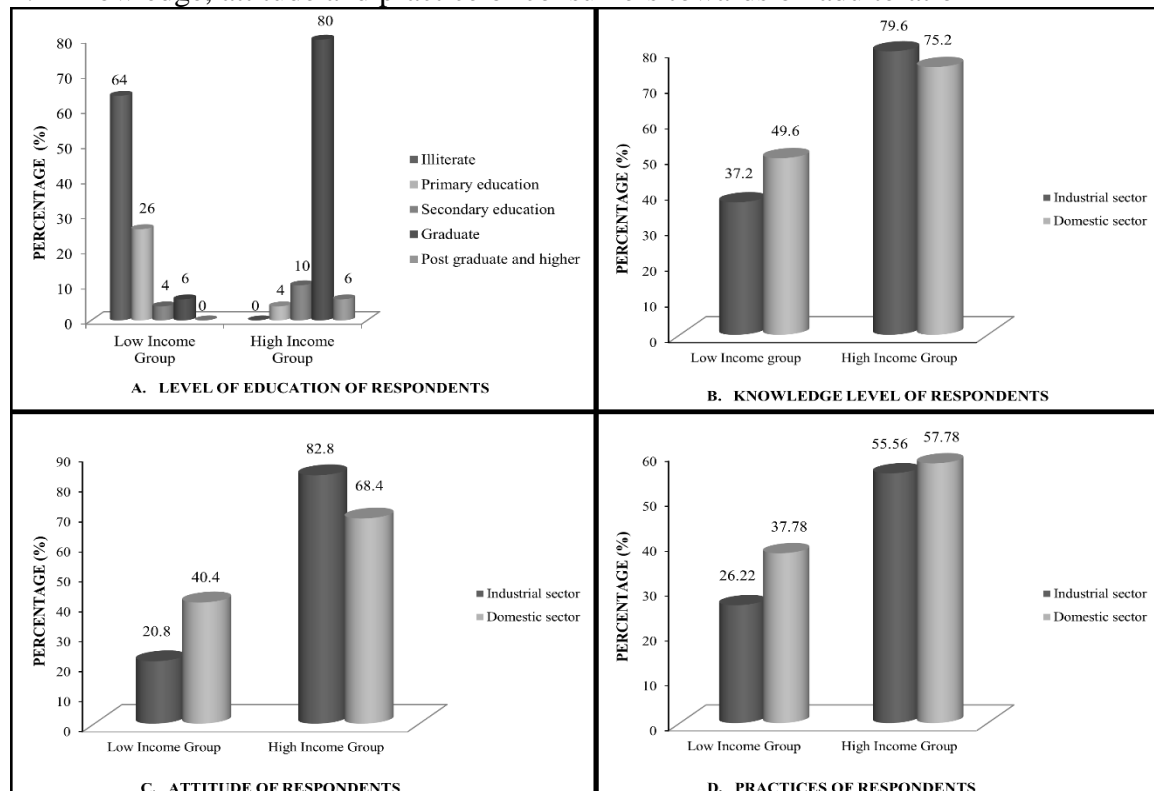

Figure 1: Level of education, knowledge, attitude and practices of consumers

The present study focuses on the awareness of low and high income groups towards adulteration, with special emphasis on oil adulteration and performing chemical analysis on various oil samples. A survey was conducted with the aid of a KAP questionnaire. To study the knowledge, attitude and practice of respondents, their educational qualifications were determined. Figure 1A shows the level of education of the consumers. For the purpose of representation and analysis, the data collected from the industrial and domestic sectors were combined for both the low and high income groups. It was seen that 64% of respondents belonging to the low income group were illiterate, 26% had completed primary education, 4% had completed secondary education, whereas only 6% were graduates. On the other hand, majority (80%) of respondents of the high income group were graduates, 4% were primary pass outs, 10% gained secondary education, 6 % had a masters or post- doctoral degree and none were illiterate. Low income group were majorly illiterate and few had appeared for their board examinations, probably due to lack of economic support or conservative family background. High income group respondents had higher educational qualifications due to full financial support towards education and more access to information due to which they had higher level of awareness regarding adulteration in cooking oils.

From figure 1B, 1C, 1D, it was seen that the Knowledge, Attitude and Practices of high income group respondents belonging to industrial and domestic sectors were comparatively greater than their low income counterparts. The hawkers had low level of awareness compared to that of chefs. Moreover, low income families also manifested reduced awareness regarding adulteration compared to the high income families. People under the high income category were seen to have higher educational level and were found to be more aware of this issue as they keep updating themselves through newspapers and other sources. They were able to gain more information from the resources made available to them, were more aware about the current trends in the food industry and often made healthy food choices. Also, adequate knowledge and attitude regarding the same equipped them with better practices in the usage of cooking oils.

2. Level of awareness of low and high income group respondents belonging to industrial and domestic sectors

Figure 2A shows the level of awareness of people belonging to the industrial sector. It can be seen that the low income group respondents had decreased level of awareness ranging between 10-56% whereas high income group respondents had moderate level (58- 83%) of awareness regarding adulteration in oils. The hawkers displayed lower level of awareness compared to that of chefs. People under the high income category were seen to have higher educational level and were found to be more aware of adulteration as they keep updating themselves through newspapers and other sources. Figure 2B shows the level of awareness of responders belonging to the domestic sector. People belonging to low income families had low level of awareness (31-69%) as compared to high income families (51-80%). Figure 2C depicts the level of awareness of responders belonging to industrial and domestic sectors, the first 25 responders taken from the low income group followed by people belonging to high income category. It was seen that the low income families from the domestic sector had a slightly higher awareness level than low income hawkers of the industrial sector. As majority of the subjects taken from the domestic sector were domestic servants in households, they might have been exposed to several information regarding the current trends of the food industry. Furthermore, the high income chefs displayed an increased awareness level compared to high income families.

This might be due to more of practical knowledge of the chefs and also their involvement in purchasing oils from large scale traders.
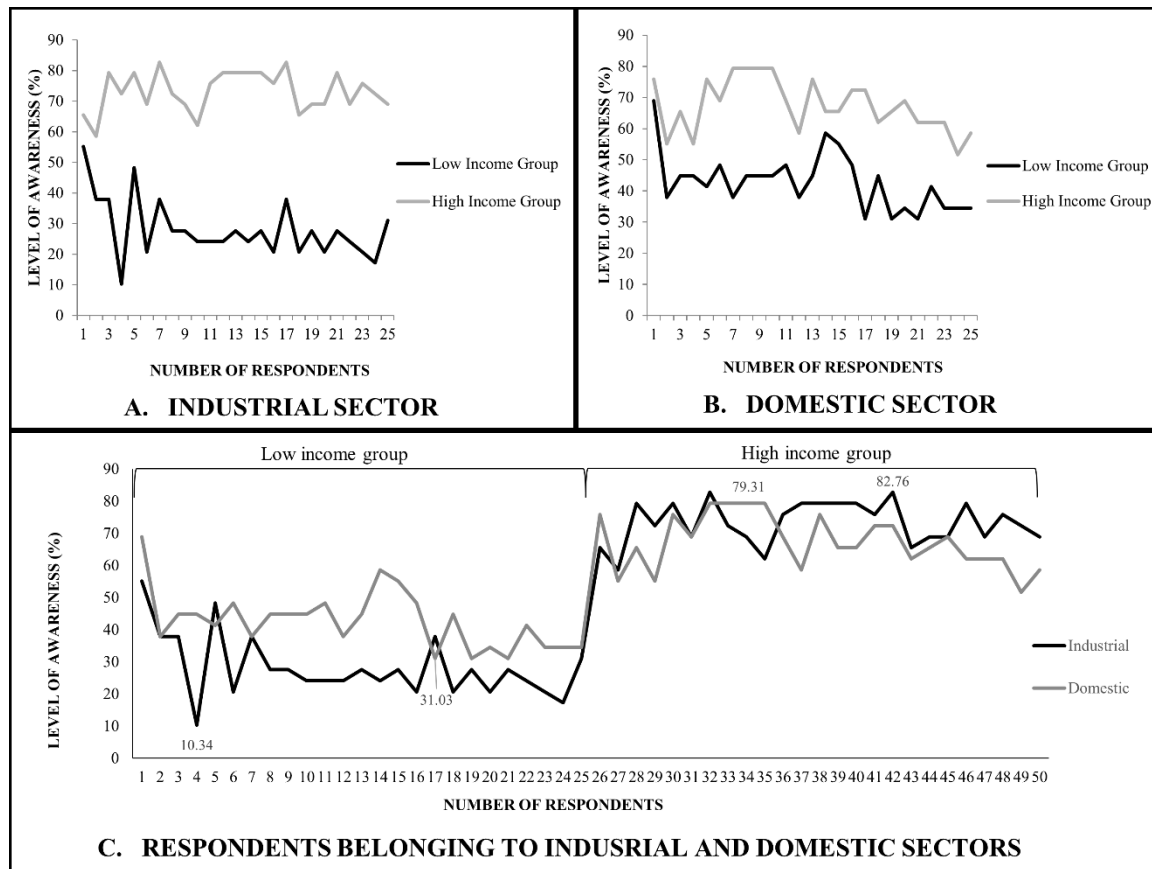

Figure 2: Level of awareness of low and high income group respondents belonging to industrial and domestic sectors

3. Qualitative analysis of oil samples

After having gained sufficient information on the Knowledge, Attitude and Practice of the respondents through the survey and the role of edible oils in everyday cooking, there was a need to ensure whether the oil consumed by the people were free from adulterants or not. Also, common citizens may not have sufficient knowledge about the quality and purity of oil they consume. Thus, qualitative chemical analysis was performed to identify adulterants in commonly used cooking oils. The experiments were conducted on commonly available unpackaged and packaged oil samples. Tests were performed on oil samples for detection of seven commonly found adulterants namely argemone oil, cottonseed oil, mineral oil, castor oil, karanja oil, cyanide and prohibited colour. Out of these seven adulterants, mustard and soybean oil samples were found to be adulterated with argemone oil, mineral oil, karanja oil and cyanide, whereas, none of the samples contained cottonseed oil, castor oil and prohibited colour. Coconut oil samples were found to be devoid of adulterants. The level of adulteration was found to be almost similar in all unpackaged and packaged samples taken together. (p= 0.3614) There was a significant difference between unpackaged and packaged oil samples adulterated with argemone and mineral oil with p-values of 0.0154 and 0.0359 respectively. However, the presence of karanja or castor oil and cyanide as adulterants did not show significant difference between the unpackaged and packaged oil samples. (Table 2)

Table 2: Percentage of argemone, mineral, karanja, cyanide as adulterants in unpackaged and packaged cooking oil samples analyzed		
Adulterant	Cooking oil samples (%)	
	Unpackaged	Packaged
Argemone oil	87.50 ± 0.35*	33.33 ± 0.49*
Mineral oil	100 ± 0.00*	58.33 ± 0.51*
Karanja oil	87.50 ± 0.35	66.67 ± 0.49
Cyanide	0.00 ± 0.00	8.33 ± 0.29
Total percentage of adulterants	39.28 ± 0.49	31.25 ± 0.47
Results expressed as Percentage ± SD Statistical differences between the groups were determined by t-test ($p \leq 0.05$) *Significant differences		

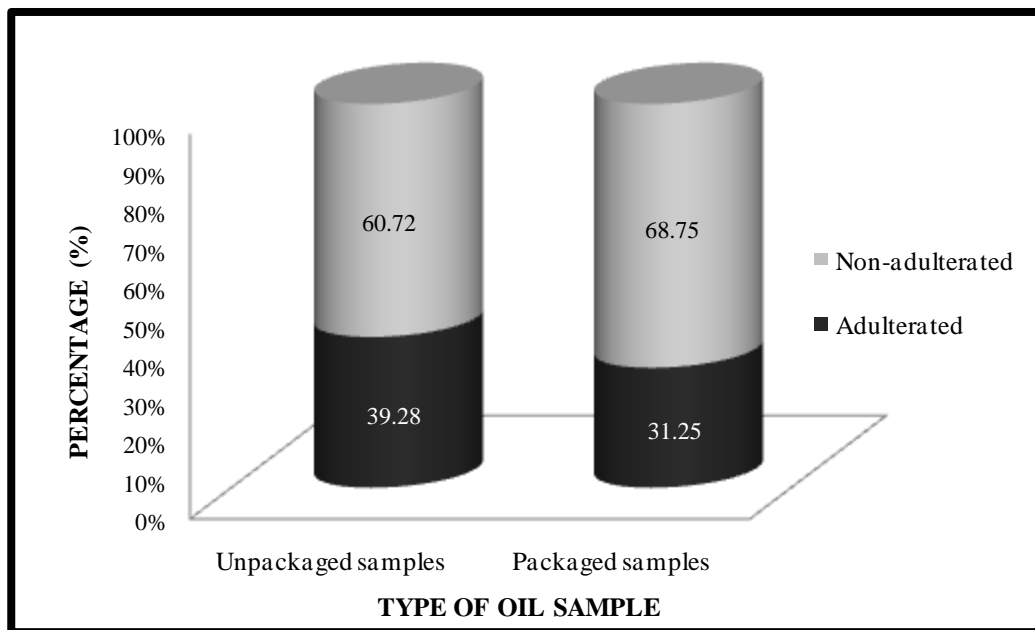4. Comparison of adulterants in unpackaged and packaged oil samples

Figure 3: Comparison between unpackaged and packaged oil samples

Figure 3 depicts a comparison between all the unpackaged and packaged oil samples taken together. It was observed that even though a higher percentage of adulteration was observed in unpackaged samples (39.28%), adulteration was also seen in packaged oil samples (31.25%). Taking into consideration, all the oil samples together for the presence of adulterants, minor difference in percentage was observed between the unpackaged and packaged samples with a calculated p-value of 0.3614. It can be inferred that the term packaged does not necessarily mean that the content within is pure for consumption. The slight difference in percentage might be because of the easy practice of adulteration by the vendors in unpackaged or local oil samples. People should be made more aware and always check for standard certifications like ISI mark, AGMARK, Food Safety and Standards Authority of India (FSSAI) logo before purchasing branded packaged oil. [19]

DISCUSSION

The deliberate contamination of food material with low quality, cheap and non-edible or toxic substances is called food adulteration. Adulteration is the addition of ingredients which are not permitted in food and are added because of business profit only. [20] Adulteration can cause several problems in edible oils application and industry.

A survey was conducted to study the perception of low and high income group respondents towards adulteration in commonly used cooking oils of Kolkata, where it was found that the level of awareness of high income group was significantly greater as compared to that of low income group. According to a research

article, a highly significant difference in the extent of awareness regarding food adulteration, for the respondents with low and high family income was observed. [21] However, in another study conducted in Dantiwada village, income level of women did not show any significant effect on the awareness level of the women regarding food safety and consumer protection. [22]

In the present study, the commonly found adulterants from the chemical analysis were argemone oil, mineral oil, karanja oil and cyanide. The level of adulteration was found to be similar in unpackaged as well as packaged samples of mustard and soybean oil and absent in coconut oil samples. Similarly, previous studies have also stated that adulteration was commonly practiced in both branded and non-branded foods in daily life. From local to the big markets, adulteration is found to be prevalent everywhere. [23] Increase in consumer awareness would enable careful selection of ingredients thereby further aiding in maintenance of good health.

CONCLUSION

The study was carried out to first analyze the perception of consumer towards adulteration in commonly used cooking oils and then evaluate them through standard testing procedures. It was observed that the high income group individuals were comparatively more educated than low income group and income plays a significant influence among consumers. It was observed that all the respondents were into the practice of reusing oils for cooking. People having lower income preferred unpackaged over packaged oil samples in terms of quality which formed the basis for detection of adulterants in unpackaged versus packaged samples. The results of the chemical analysis on commonly consumed cooking oils indicated that adulterants were present in both unpackaged and packaged samples of mustard and soybean oil. Adulterants were found to be absent in coconut oil samples. Even though more

number of unpackaged oil sample was found to be adulterated (39.28%), 31.25% of the packaged sample also contain adulterants which may not guarantee the purity of packaged products. People should be made more aware regarding healthy food safety practices and steps to combat the practice of adulteration.

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