



## Analysis of Market Paneer Samples Sold in Amreli District for Presence of Adulterants

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### Abstract

*Adulteration in food is one of the oldest punishable offence; perhaps it is as parallel as the history of human civilization. Apart from others food products milk and dairy products are always the prime target of adulteration throughout the world. India is the world largest milk producing country and adulteration is one of the key hurdles uses to face by Indian dairy industry. Apart from milk other popular dairy products like paneer are always a prime target of adulteration. Therefore, a study was undertaken on the incidence of adulterants, present in the paneer samples sold by un-organized dairies and vendors in and around Amreli district of Gujarat. From the study it was observed that the presence of adulterants such as starch followed by vegetable oils are the adulterants in paneer samples. As eighty samples collected from market; 16, 3 and 1 samples were found to be adulterated with starch, urea and salts, respectively. From this study it was also revealed that Kirschner value analysis was fruitful to ascertain the quality of fat in paneer, but it needs more research indeed.*

**Keywords:** Adulteration, Chromogenic Test, Kirschner Value, Paneer

## Introduction

The history of food fraud is as old as the history of human civilization. Adulteration in food can be defined as, degradation of the quality of food by adding or substituting the natural component with foreign component/s. The food/s commonly adulterated are meat and meat products, poultry, food grains, spices, milk and milk products (Poonia *et al.*, 2016).

India is the largest milk producing (almost 180 MT) country in the year 2017-18 (MFAHD, 2019). The constant growth of the dairy sector has put the primary challenges to maintain the safety and quality of milk and dairy products. Paneer is a coagulated milk product obtained by heating and acidulation, followed by filtration and pressing. It represents south Asian variety of soft cheese. According to the FSSR (2011), chhana or paneer means the product obtained from the cow or buffalo milk or a combination thereof by precipitation with sour milk, lactic acid or citric acid. It shall not contain more than (70 %) moisture and milk fat content shall not be less than (50 %) of the dry matter basis. Bureau of Indian standard (BIS, 1983) permits maximum of 60 % moisture and minimum of 50 % fat in dry matter for paneer.

About 5% of milk produced in India is converted into paneer. Paneer market size is around 15,500 tonnes at Rs. 1860 million (USD 46.5%). The unorganized sector, local sweet shops account for most of production (Rakesh, 2016). The market size of paneer is growing at 6 to 7 % per annum. It is a rich source of animal protein available at a comparatively lower price and form an important source of animal protein for vegetarians. However, in recent years, several reports have appeared in the newspapers and research-based studies, that indicates that rampant paneer adulteration is going on in different parts of India (Maurya *et al.*, 2017 and Bhandekar *et al.*, 2019). The problem of adulteration has assumed a very serious dimension now these day throughout the country. Now a day's different hazardous chemicals like urea, neutralizer, salt, starch vegetable oils and fats are usually admixed with milk or dairy products (Poonia *et al.*, 2016 and Palsra *et al.*, 2019). By adding these types of adulterants in milk or dairy products, unscrupulous sellers not only harm the economic structure of the country but it directly affects the health of the consumer. FSSAI (2011) has recommended different analytical techniques for assessing the quality of milk or dairy products. Although the detection of adulteration of foreign fats or oil in milk fat is a challenging task indeed (Sharma *et al.*, 2018). Different fat constants of milk fat like- Reichert–Meissl value (RM value), Polenske value and Butyro Refractometer (BR) reading are generally used to assess the quality of milk fat (Kumar *et al.*, 2017); however, these techniques are time consuming and also tedious to perform. Recent trend being followed by the unscrupulous traders to adulterate milk fat in such a way that cannot be detected by simple fat constant analysis-based approaches (Hazra *et al.*, 2020).

Therefore, considering all these facts, a study was designed to assess different types of adulterants that are dominating in the market samples of paneer sold by the un-organized dairies or vendors, in different areas of Amreli district. However, in this study we tried to explore the efficacy of Kirschner value (KV) analysis of milk fat to ascertain the quality of milk fat isolated from paneer. Moreover, we tried to explore two chromogenic tests to ascertain the quality of milk fat from the paneer samples.

## Materials and Methods

### Collection of Milk and Procurement of Market Samples of Paneer

Buffalo milk, was used for the preparation of paneer samples; milk samples were collected from the Amreli district's local dairy farmers. Paneer samples were collected from local unorganized dairies of Amreli, district (10 talukas of Amreli). Total 80 paneer samples were collected.

### Palm Oil

Palm oil was used as an adulterant in the present investigation. Branded refined Palm oils was procured from (Vishwas cooking oil) Rajkot, Gujarat. Non-Branded palm oil was procured from local market of Amreli. The oil was kept under room temperature in packed bottle till its further use as an adulterant.

### Preparation of Pure and Oil Adulterated Paneer Samples

Paneer samples were prepared by the method of Aneja *et al.* (2002). Pure paneer samples were prepared from milk without oil adulteration. Milk was adulterated by mixing vegetable oil to milk @ 5%, 10 and 20%; thereafter paneer

samples were prepared as same manner as discussed earlier.

### **Extraction of Fat from Paneer Samples**

Fat was extracted in paneer samples by the method earlier discussed by Rakesh (2016) using solvent extraction method.

### **Detection of Adulterants in the Market Samples of Paneer**

One g paneer sample was taken in a porcelain dish and 5 ml of warm distilled water was mixed. It was stirred and mix the sample till it was soluble in water. All the samples were analyzed for six different adulterants like starch, urea, nitrate, neutralizer, salt and formaldehyde by the method suggested by FSSAI (2011).

### **Determination of Kirschner Value (KV)**

Kirschner value of different paneer fat samples were determined by the method described in Ghatak and Bandyopadhyay (2014). Accurately 5.0 g of fat sample was weighed in a polenske flask and then saponified with 20.0 g of glycerol and 2.0 ml of 50% (w/w) sodium hydroxide solution on a direct flame. Then 93 ml of freshly boiled distilled water was added followed by 50 ml of dilute sulphuric acid. The flask was immediately connected with the distillation apparatus and 110 ml of the distillate was collected within 19 to 21 minutes. The flask was replaced with 25 ml cylinder and the flame was removed. The collected distillate was cooled in a water bath maintained at 15°C for 10 min. Then, it was filtered through a dry Whatman No.4 filter paper and 100 ml of the filtered distillate were titrated against 0.1 N sodium hydroxide solution using 0.1 ml phenolphthalein indicator. Add 0.5 g of silver sulfate was added to neutralize the solution which was obtained after titration sodium hydroxide. Left the flask in the dark cupboard for 1 hour with occasional shaking. The content of the flask was filtered through a dry Whatman No.4 filter paper and 100 ml of the filtered distillate was taken into polenske flask. Then, 35 ml of cold distilled water was added followed by 10 ml of dilute sulphuric acid. The flask was immediately connected with the distillation apparatus and 110 ml of the distillate was collected within 19 to 21 minutes. The collected distillate and filtered through a dry Whatman No.4 filter paper and 100 ml of the filtered distillate were titrated against 0.1 N barium hydroxide solution using phenolphthalein (0.1ml) as an indicator. Similarly, a blank test was also performed by similarly using all reagents.

### **Chromogenic Test 1**

Chromogenic test was performed by the method earlier described by Ramani *et al.* (2019) and the details method as described -

Two ml of fat was taken in a clean dry test tube. There after 1 ml of Ferric chloride solution (0.008 M) was added in that test tube and there after 0.3 ml Potassium fericyanide solution (0.03 M) was added in that test tube and mix it for 30 seconds; thereafter observe the colour change for pure fat sample's colour would be green and adulterated fat sample's colour used to be changed green to blue.

### **Chromogenic Test 2**

Another Chromogenic test was performed by the method earlier described by Ramani (2019) and the details method as described:

One ml of fat was taken in a clean and dry test tube. There after 2 ml of DPPH (2,2-diphenyl-1-picrylhydrazyl) solution was added in that test tube and kept it for 30 seconds; thereafter observe the colour. For pure fat sample's colour would be violet and adulterated fat sample's colour used to be changed violet to yellow. Market paneer samples were analyzed by both of these chromogenic tests.

### **Analysis of Data**

All the data were represented as mean value  $\pm$  standard error mean and analysis with one-way ANOVA.

## **Result and Discussion**

## Market Sample Analysis

In India, the popularity of Paneer is gaining day by day all over the country especially in state like Gujarat, where majority of the population are vegetarian. Therefore, its growing popularity has resulted tremendously increase in the rate of adulteration which fetch more profit. Earlier in a different survey-based study, conducted by Kabariya and Ramani (2018), reported the rampant adulteration of milk in Amreli district. Therefore, it is needs of time to ascertain the quality of paneer samples sold in different region of Amreli district.

It was observed form the analysis that total 16 samples of paneer were found to be adulterated with starch and 3 samples of paneer were found to be adulterated with urea and 1 sample of paneer was found to be adulterated with salt. However, out of eighty samples no samples were found to be adulterated with formaldehyde or neutralizers. Earlier, Rakesh (2016) reported adulteration in paneer samples sold in different regions of Delhi, NCR and Karnal. Bhandekar *et al.* (2019) reported that adulterated paneer (with starch) samples were sold in different regions of Nagpur city.

**Table 1:** Number of market samples of paneer found adulterated with different adulterants

S. No.	Name of Adulterants	Number of Collected Samples	Positive
1	Starch	80	16
2	Urea	80	3
3	Neutralizers	80	0
4	Detection of Nitrate	80	0
5	Salt	80	1
6	Formaldehyde	80	0

## Kirschner Value (KV) Analysis

KV measures specifically fatty acid like (C<sub>4:0</sub>) butyric acid. Butyric acid is a signature fatty acid present in bovine milk fat. Earlier few researchers reported for failure of R.M, P-Value or B.R reading to ascertain the quality of milk fat (Pathania *et al.*, 2019). Therefore, we tried to explore the KV analysis to ascertain the quality of milk fat isolated from pure paneer samples and adulterated paneer samples.

**Table 2:** Kirschner value of pure and adulterated (palm oil at different level) paneer samples.

Sample	Adulterant	Level of adulteration (%)	Mean value
PP (Pure Paneer)	-	0	25.29±0.38 <sup>a</sup>
PP	PO (Palm Oil)	5	24.35±0.21 <sup>b</sup>
PP	PO	10	23.40±0.22 <sup>c</sup>
PP	PO	15	22.06±0.39 <sup>d</sup>
PP	PO	20	20.80±0.53 <sup>e</sup>

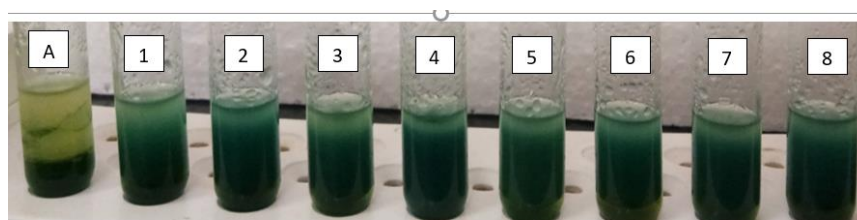
(Data represent as mean value with three replications. Means with different superscripts letters are significantly different ( $P < 0.05$ ) from each other.)

It was recorded from Table 2 that KV of pure fat isolated from paneer samples were almost 25.29 and KV of palm oil was recorded zero that could be due to absence of butyric acid in palm oil. It was also observed from Table 2 that the KV decreased with the addition of palm oil. The KV for pure fat was significantly ( $p < 0.05$ ) higher than fat samples adulterated with palm oil. The mean value of KV for fat samples adulterated with palm oil @ 5 %, 10 %, 15 % and 20 % were 24.35, 23.40, 22.06 and 20.80, respectively. Butyric acid is the unique fatty acid in milk fat, almost 2.5% of total fatty acid present in milk fat. Therefore, the KV of milk fat was higher than palm oil and that was statistically highly significant indeed. Whenever, the palm oil used to adulterate with pure fat samples (paneer fat) the concentration of butyric acid decreased so the value of KV used to be decreased. From the observation, it could be concluded that based on KV analysis palm oil could be detected in ghee to tune of @ 5%. A very recent study by Mor *et al.* (2018) who reported that KV may change at different temperature applied during clarification of milk fat. In a different study

Kehar (1956) observed that KV of milk fat depends on season. So, it is very hard to get the effect of KV value on adulteration by analyzing limited samples. Therefore, in this study we have not tried KV analysis to ascertain the quality of milk fat isolated from market samples of paneer.

### Chromogenic Test 1 for Detection of Palm Oil in Paneer

When 2 ml of pure fat or adulterated fat (5 %, 10 %, 15 % and 20 %) level of adulteration) samples were allowed to react with the set chromogenic solution; it was observed that green colour persisted in pure fat samples even after 2 minutes while samples with 5, 10, 15 and 20 % level of adulterated samples used to be changed (deep blue) after 1 minutes. However, for fat sample adulterated with 5% palm oil; the green colour changed to deep blue colour. Hence, this said protocol condition able to detect even 5% level palm oil adulteration in paneer samples. This said protocol was adopted to study the market sample analysis of paneer. It was observed in plate 1 that eight market samples of paneer samples were found adulterated with vegetable oil. It was observed in plate 1 that for pure paneer's fat sample (prepared in lab as control) the colour was green but for eight market samples the colour was changed to blue.

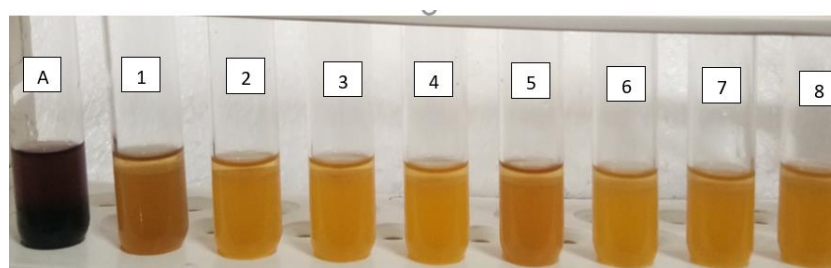


**Plate 1.** Chromogenic Test 1 for Analysis of Market Sample of Paneer.

A) Control Paneer; 1) Market Sample 1; 2) Market Sample 2; 3) Market Sample 3; 4) Market Sample 4; 5) Market Sample 5; 6) Market Sample 6; 7) Market Sample 7; 8) Market Sample 8

### Chromogenic test-2 for Detection of Palm Oil in Paneer

When 1 ml of pure fat or adulterated fat (5, 10, 15 and 20 % level of adulteration) samples were allowed to react with the set chromogenic solution; it was observed that violet colour persisted in pure fat even after 2 minutes while samples with 5, 10, 15 and 20 % level of adulteration the colour was changed (yellow) after 1 minutes. However, for fat samples adulterated with 5% palm oil; the violet colour changed to yellow colour. Hence, this said protocol condition was able to detect even 5% level of palm oil adulteration in paneer. This said protocol was adopted to study the market sample analysis of paneer. It was observed in Plate 2 that eight market samples of paneer samples were found adulterated with vegetable oil. It was observed in plate 2 that for pure paneer's fat sample (prepared in lab as control) the colour was violet but for eight market samples the colour was changed to yellow. Therefore, it can be concluded that these two chromogenic test protocols could be efficient to detect oil adulteration in milk as well as paneer.



**Plate 2.** Chromogenic Test 2 for Analysis of Market Sample of Paneer.

A) Control Paneer; 1) Market Sample 1; 2) Market Sample 2; 3) Market Sample 3; 4) Market Sample 4; 5) Market Sample 5; 6) Market Sample 6; 7) Market Sample 7; 8) Market Sample 8

## Conclusion

Adulteration in milk or dairy products is very serious and consequential issue that are frequently noticed in different countries including India. Paneer is a very delicious food and it has an integral relation with the culinary culture of Indian society. The present study revealed that KV could not be fruitful for assessing the quality of milk fat in dairy products although chromogenic tests were efficient to detect adulteration of foreign fats in milk fat. However, it was

also observed that apart from oil, others adulterants like starch urea are predominant adulterants that were detected in market samples of paneer sold by the different dairies in Amreli district.

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## Conflict of Interests

There is no conflict of interest.

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