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Investigation of Food Adulterants in Chilli Powder, Coriander and Tea by Chemical and Physical Methods

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Abstract

The investigation of adulteration present in food products like chilli powder, coriander powder and tea by performing various physical and chemical tests was conducted for the samples collected including locally available samples and brands as well. Chilli powder Sample 4 (collected from local market) was found to be adulterated with red salts, oil soluble coal tar and brick powder. In case of coriander powder, sample 4 was found to be adulterated with dung/saw dust. Most of the Tea samples were free from coal tar, cereal starch and chicory as adulterants.

Keywords: Food adulteration; Chilli powder; Coriander; Tea

1. Introduction

Food is one of the major necessities of life and its quality is directly linked to human health and wellbeing^[1]. As the demand increases for food products, the low supply and profit motives have led to various practices of food adulteration^[2]. Adulteration is the intentional or unintentional addition or mixing of inferior, cheap or harmful substances in food items, thereby not only reducing their quality but also causing serious health risks, ranging from mild digestive disturbances and different allergies to chronic illnesses and even life-threatening conditions^[3,4].

Among various food products, chilli powder, coriander powder, and black tea particularly have a high risk of adulteration due to their high consumption, powdered or fragmented form, and ease of mixing with extraneous matter^[5].

Various adulterants are mostly found in chilli powder to enhance its appearance and increase profit rates. Data sources indicate that during 2021-2022, India was the leading producer and exporter of dried red chilli powder globally, with an output of approximately 1.98 million tonnes of red chilli. Moreover, 70% of the total dried chili is exported, while the remaining 30% is turned into various products. Given its increased market demand, it has emerged as one of the most sought-after species for financially driven adulteration^[6-7].

Coriander powder, produced from crushed coriander seeds, is a flexible spice utilized in numerous culinary traditions globally. Common applications include cooking, seasoning, salads for enhanced flavor, marinades, baking, pickling, homemade spice mixtures, and herbal treatments. In certain cultures, coriander powder is utilized for its alleged health benefits, including aiding digestion and lowering inflammation.

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The substances like sawdust or ground rice may be added to bulk up the weight of the coriander powder. Substances like turmeric or artificial colors are added to enhance the appearance of the powder. Some artificial flavoring agents are added in case of inferior quality coriander to mask its taste^[8-11].

Similarly, black tea can be adulterated with iron filings and colored leaves to imitate quality. These adulterants not only affect the purity of food but also cause potential harm to human health. Artificial colors and attachment of heavy bodies on the surface of tea can lead to increase in its weight attracting the manufacturer to utilize these techniques in the form adulterants. Literature data reveals that tea has been adulterated with different types of azo dyes such as sunset yellow, tartrazine, carmosine, brilliant blue and indigo carmine. In addition to this, starch, sand, china clay, french chalk, iron fillings, chicory, lather flakes, caffeine have also been reported as potent adulterants in tea^[12-13].

The present work focuses on detecting the presence and extent of adulteration in chilli powder, coriander powder and black tea by performing simple laboratory tests. The impact of adulterants in chilli powder, coriander, and tea on human health is described in Table 1^[14].

Table 1 Disorders caused due to adulterated chilli powder, coriander powder and Tea

Food Item	Adulterants	Disease/Disorder
Chilli powder	Brick powder	Stomach disorder
	Red lead soluble salts	Metal toxicity, cancer, lead poisoning
	Oil soluble coal tar	Heart diseases, damaged to liver tumor
Coriander powder	Saw dust/ dung	Stomach problems
	Common salt	High blood pressure
Tea	Coal tar	Cancer
	Chicory	Digestive issues, reduce nutrient absorption
	Cereal starch	Stomach and digestive problems
	Catechu	Low blood pressure impact on blood clotting and Theophylline

2. Methodology

The methods used for detecting adulterants are given below. Four different samples were collected and the following standard procedures were referred to detect adulteration and qualitative differences between the samples with reference to pure samples.

Samples were collected from grocery shop consisting of brands and local products from Pune city including camp and kondhwa area.

2.1. Chilli Powder ^[2]

2.1.1. To detect the presence of red lead salts

5 ml dilute nitric acid was added to the 1 gram sample of chilli powder. The solution was filtered. 2 drops of potassium iodide was added to the filtrate. Formation of yellow colored precipitate indicated the presence of red lead salts.

2.1.2. To identify the presence of oil soluble coal tar

2g of chilli powder sample was taken. Few ml of ether was added and the test tube was shaken well. Ether layer was poured into a test tube having 2 ml of dilute HCl. It was shaken properly. Pink to red colour of the lower acid layer indicated the presence of oil soluble coal tar in the sample.

2.1.3. To detect the presence of brick powder

1 gram sample of chilli powder was added to beaker containing water, brick powder settled at the bottom, while the pure chilli powder floated.

2.2. Coriander Powder

2.2.1. Iodide test for starch

A 0.2 g of coriander powder sample was taken in a test tube. A 1 ml of iodide solution (Lugols solution) was added. A blue-black coloration indicated the presence of starch.

2.2.2. Silver nitrate test for salt

A test tube containing 0.50 gram of coriander powder was taken. 5 ml of water was added and mixed well. A few drops of silver nitrate solution were added into it. The formation of a white precipitate confirmed the presence of salt.

2.2.3. Water test for Dung/Sawdust

1 gram coriander powder sample was transferred in a beaker containing water. Dung or Sawdust floated on the surface. (It can be detected by its foul smell)

2.2.4. pH Test:^[5]

A 1 gram of coriander powder was added in distilled water. The pH was measured using a pH strip.

Pure coriander powder generally has a pH between 5.5 and 7 (slightly acidic to neutral nature); deviation from this range indicates adulteration or contamination with alkaline substances, affecting its taste, aroma, and overall quality.

2.3. Tea^[2]

2.3.1. Cold Water Test

A 2 g of tea was added to cold water in a test tube and a change in the color was observed. *If the color changes immediately after addition, it could detect presence of fake tea leaves.*

2.3.2. Test for Cereal starch

A 2 gram of tea sample was taken in a beaker and 50 ml distilled water was added to it. The contents were heated to produce color. Potassium permanganate solution and diluted hydrochloric acid (1:1) were added to it to decolorize the mixture. Then of 1% aqueous solution of iodine was added. Blue coloration indicated adulteration of tea samples with the serial starch.

2.3.3. Test for Chicory

The tea samples were boiled in a test tube with 2 drops of concentrated HCl and 15 drops of potassium ferrocyanide solution was added and liquid was again boiled till dark green color appears. The liquid turns brown and murky, if chicory is present in tea samples, otherwise a precipitate settles at the bottom, leaving a supernatant solution of light yellow color.

2.3.4. Test for Coal Tar

A 1 gram sample of tea was taken in a test tube, and then 5 ml of concentrated HCl was added to the test tube containing the tea sample. The appearance of a pink or crimson color indicated the presence of coal tar dye in tea samples.

2.4. Test for Catechu

To 5ml water, Tea sample was added and then few drops of lead acetate solution were added to the solution in the beaker. The solution was then filtered and few drops of silver nitrate were added. Appearance of grayish cloudiness indicated the presence of catechu.

3. Results and discussions

3.1. Chilli Powder

- Sample 4 was adulterated with red lead salt. Samples 1, 2 & 3 were free from red lead salt.
- Sample 4 was adulterated with oil soluble coal tar. Samples 1, 2 & 3 contained no oil soluble coal tar.
- The samples 2, 3 & 4 contained brick powder. Sample 1 was free from brick powder.

Table 2 Presence of adulterants in Chilli powder

Food Item	Sample 1	Sample 2	Sample 3	Sample 4
Oil soluble coal tar	Absent	Absent	Absent	Present
Brick powder	Absent	Present	Present	Present
Red lead salt	Absent	Absent	Absent	Present

3.2. Coriander Powder

- The Samples 1, 2, 3 & 4 were free from salt.
- Only sample 4 was adulterated with dung/sawdust.
- Sample 4 was having pH 8, which indicated adulteration.
- All the samples were free from starch as an adulterant.

Table 3 Presence of adulterants in Coriander powder

Food Item	Sample 1	Sample 2	Sample 3	Sample 4
Salt	Absent	Absent	Absent	Absent
Starch	Absent	Absent	Absent	Absent
Sawdust/dung	Absent	Absent	Absent	Present
pH	Absent	Absent	Absent	Present

3.3. Tea

- Only sample 4 contained artificial colors.
- No samples contained coal tar.
- The samples 1 & 3 contained catechu.
- No samples contained cereal starch.
- All samples consisted of no chicory as an adulterant.

Table 4 Presence of adulterants in Tea

Food Item	Sample 1	Sample 2	Sample 3	Sample 4
Artificial colours	Absent	Absent	Absent	Present
Coal tar dye	Absent	Absent </td <td>Absent</td> <td>Absent</td>	Absent	Absent
Chicory	Absent	Absent	Absent	Absent
Strach	Absent	Absent	Absent	Absent
Catechu	Present	Absent	Present	Absent



Figure 1 a) Brick powder test b) Oil soluble coal tar test c) Red lead salt test



Figure 2 a) pH test b) Salt test c) Saw dung test d) Starch test



Figure 3 a) Catechu test b) Chicory test c) Coal tar test d) Cold water test e) Starch test

4. Conclusion

In our efforts to investigate the food adulterants^[15], we evaluated various samples at local area in Pune city from brands and local vendors or manufacturers and tested them for possible adulterants. It was observed that the samples from local vendors are found to be more adulterated in comparison to the samples of brands. It is an urgent need to collaborate and enforce stringent regulatory requirements for preserving food products' quality both before and after processing to prevent its hazards on human health.

Compliance with ethical standards

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Disclosure of conflict of interest

The authors declare no conflicts of interest regarding this manuscript.

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