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Identification of Adulterants in Cumin and Asafoetida Powders

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Abstract: Food adulteration is a major public health concern that affects the quality, safety, and authenticity of commonly consumed food products. Cumin powder and asafoetida are frequently adulterated with low-cost materials such as starch, chalk powder, sand, soapstone, artificial colours, and other foreign substances, reducing their nutritional value and purity. The present study, "Identification of Adulterants in Cumin Powder and Asafoetida Using Preliminary Evaluation, Microscopic Examination, Quantitative Analysis and Instrumental Techniques," was carried out to evaluate the quality and detect adulterants in two market brands each of cumin powder and asafoetida. The study began with the selection and collection of representative samples followed by physical examination, including colour, odour, appearance, texture, and the presence of foreign matter. Chemical tests were performed to identify common adulterants such as starch, calcium carbonate (chalk), silica (sand), soapstone, and artificial colours. The samples were then prepared for instrumental analysis through extraction, filtration, and clarification. Colour characteristics were analysed using colorimetric analysis by measuring L*, a*, and b* values. UV-Visible spectroscopy was employed to record absorption spectra, determine the maximum absorption wavelength (λmax), and compare spectral patterns among the samples. FTIR spectroscopy was used to identify characteristic functional groups and compare spectral fingerprints with standard samples to confirm the presence of adulterants. The results obtained from physical, chemical, colorimetric, UV-Visible, and FTIR analyses were compared to assess the purity and quality of each brand.

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I. INTRODUCTION

Spices are aromatic plant substances obtained from various parts of plants such as seeds, fruits, roots, rhizomes, bark, flowers, buds, or leaves. They are used in small quantities to enhance the flavor, aroma, color, and taste of food. In addition to their culinary uses, spices possess medicinal, preservative, and nutritional properties.

Examples of common spices include cumin, turmeric, coriander, black pepper, cardamom, clove, cinnamon, and asafoetida.

➢ *Importance of Spices in India*

India is known as the "Land of Spices" due to its long history of spice cultivation, consumption, and trade. Spices play a vital role in Indian agriculture, cuisine, healthcare, and economy.

- *Culinary Importance*

Spices are essential ingredients in Indian cooking. They improve the flavor, aroma, color, and overall appeal of food. Different regions of India use unique spice blends that contribute to the diversity of Indian cuisine.

- *Medicinal Importance*

Many spices have therapeutic properties and are widely used in traditional systems of medicine such as Ayurveda.

For example:

✓ Turmeric has anti-inflammatory and antioxidant properties.
✓ Cumin aids digestion.
✓ Asafoetida helps relieve indigestion and flatulence.

- *Nutritional Importance*

Spices contain vitamins, minerals, essential oils, and antioxidants that contribute to health and well-being. They help improve digestion, boost immunity, and protect the body from oxidative stress.

- *Economic Importance*

Spice cultivation provides income and employment to millions of farmers in India. The spice industry contributes

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significantly to the agricultural sector and supports rural livelihoods.

- *Export Importance*

India is one of the world's largest producers and exporters of spices. Major exported spices include chilli, turmeric, cumin, pepper, and cardamom. Spice exports earn valuable foreign exchange for the country.

- *Cultural and Religious Importance*

Spices have deep cultural significance in India. Turmeric, saffron, and cardamom are commonly used in religious rituals, festivals, and traditional ceremonies.

- *Food Preservation*

Many spices possess antimicrobial and antioxidant properties that help preserve food and extend shelf life. They are commonly used in pickles, chutneys, and processed foods.

- *Industrial Importance*

Spices are used in food processing, pharmaceutical products, cosmetics, perfumery, and essential oil industries.

II. MATERIALS

➢ *Required Samples*

Brand 1 Cumin Powder Sample,Brand 2 Cumin Powder Sample,
Brand 1 Asafoetida Sample,Brand 2 Asafoetida Sample
Glassware and Laboratory Apparatus
Test Tubes
Test Tube Stand
Beakers (50 mL, 100 mL, 250 mL)
Measuring Cylinders
Volumetric Flasks
Pipettes
Micropipettes
Glass Rods
Funnels
Watch Glasses
Filter Papers (Whatman No.1)
Mortar and Pestle
Porcelain Crucibles
White Paper Sheets
Porcelain Tile
Water Bath
Bunsen Burner
Analytical Balance
Instruments
Compound Microscope
Colorimeter
UV-Visible Spectrophotometer
FTIR Spectrophotometer
Hydraulic Pellet Press
Quartz Cuvettes
Colorimeter Cuvettes
Chemicals and Reagents
Distilled Water
Iodine Solution
Dilute Hydrochloric Acid (HCl)
Concentrated Hydrochloric Acid (HCl)
Sodium Hydroxide Solution
Ferric chloride solutin(FECL3)
Ethanol
Methanol
Glycerin

III. METHODOLOGY

➢ *Sample Collection*

Two different marketed brands of cumin powder and two different marketed brands of asafoetida were selected for the study. The collected samples were properly labelled with the sample code, date of collection, place of collection, and brand name. After collection, the samples were stored in clean, dry and airtight glass containers and protected from direct sunlight and moisture until further analysis.

➢ *Physical Examination*

The physical examination of the standard and marketed samples was carried out to identify visible differences and possible foreign matter. Approximately 2–3 g of each sample was placed separately on a clean white tile or Petri dish and examined under good lighting.

The colour, appearance and uniformity of each sample were observed and compared with the standard sample. The samples were also examined for visible foreign materials such as husk, stones, sand, starch, chalk powder and resin particles. A small quantity of each sample was rubbed between the fingers to assess its texture and determine whether it was fine, coarse, smooth or gritty. The odour of each sample was also examined and compared with that of the standard. All observations were recorded, and differences that could indicate adulteration were noted. Particular attention was given to colour variation, coarse particles, foreign seeds, husk particles, sawdust and stone particles.

➢ *Chemical Tests*

Chemical tests were performed for the preliminary identification of common adulterants in cumin powder and asafoetida.

- *Chemical Tests for Cumin Powder*

✓ *Test for Starch – Iodine Test*

A small quantity of cumin powder was taken in a test tube and distilled water was added. The contents were shaken well, followed by the addition of 2–3 drops of iodine solution. The development of a dark colour was considered indicative of the presence of starch.

✓ *Test for Chalk Powder*

About 1 g of cumin powder was taken and 5 mL of dilute hydrochloric acid was added. The mixture was observed for the development of effervescence or bubbles, which would indicate the possible presence of chalk powder.

✓ *Water Float Test for Light Adulterants*

The water floatation test was performed to detect light adulterants such as husk and sawdust. About 100 mL of

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distilled water was taken in a beaker, and 2 g of cumin powder was added. The mixture was stirred gently and allowed to stand for 2–3 minutes. The floating and settling behaviour of the sample components was then observed.

- *Chemical Tests for Asafoetida*

✓ *Test for Starch – Iodine Test*

An asafoetida solution was prepared and iodine solution was added. The development of a dark colour was observed for the preliminary detection of starch adulteration.

✓ *Test for Chalk Powder*

A small quantity of asafoetida sample was taken and dilute hydrochloric acid was added slowly. The sample was observed for the formation of effervescence or bubbles as an indication of possible chalk powder adulteration.

✓ *Test for Gum*

The asafoetida sample was dissolved in water and stirred continuously. The resulting texture and any precipitation or sticky mass formation were observed. The development of a sticky mass or precipitate was considered an indication of possible gum adulteration.

- *Colorimetric Analysis*

Colorimetric analysis was carried out for the detection and comparative evaluation of adulterants in cumin powder and asafoetida.

- *Cumin*

✓ *Detection of Starch in Cumin Powder*

For the detection of starch, 1 g of cumin powder was weighed into a beaker and 20 mL of distilled water was added. The mixture was stirred thoroughly and filtered. From the filtrate, 5 mL was transferred into a test tube and 2 drops of iodine solution were added. The reaction was allowed to stand for 2 minutes. The absorbance was then measured at 620 nm using distilled water as the blank.

✓ *Detection of Metanil Yellow in Cumin Powder*

For the detection of Metanil Yellow dye, 1 g of sample was extracted with 10 mL of ethanol. The extract was filtered, and 5 mL of the filtrate was treated with 2 mL of concentrated hydrochloric acid. The development of colour was observed, and the absorbance was measured at 520 nm.

- *Asafoetida*

✓ *Detection of Starch in Asafoetida*

For the detection of starch in asafoetida, 1 g of the sample was dissolved in 20 mL of warm water. The solution was filtered, and 5 mL of the filtrate was treated with 2 drops of iodine solution. The absorbance was subsequently measured at 620 nm.

✓ *Detection of Colophony Resin in Asafoetida*

For the detection of colophony resin, 1 g of asafoetida sample was dissolved in 10 mL of ethanol and the extract was filtered. To the filtrate, 2 mL of acetic anhydride was added, followed carefully by 1 mL of concentrated sulphuric acid along the side of the test tube. The colour developed was observed, and the absorbance was measured at 540 nm. UV–Visible Spectroscopic Analysis

UV–Visible spectroscopic analysis was performed to compare the spectral characteristics of standard and marketed samples.

- *Preparation of Standard Cumin Extract*

Accurately 1 g of genuine cumin powder was weighed and transferred into a 100 mL volumetric flask. Approximately 50 mL of 95% ethanol was added, and the mixture was shaken thoroughly for 30 minutes. The volume was then made up to 100 mL with ethanol. The extract was filtered through Whatman No. 1 filter paper, and the clear filtrate was collected for analysis.

- *Preparation of Test Extracts*

One gram each of Brand 1 and Brand 2 cumin powder was weighed separately. Extracts were prepared using the same procedure as that followed for the standard sample. The extracts were filtered, and the clear filtrates were collected for spectroscopic analysis.

- *Spectral Analysis*

The UV–Visible spectrophotometer was switched on and ethanol was used as the blank. The standard extract was transferred into a quartz cuvette and scanned over the wavelength range of 200–400 nm. The wavelength of maximum absorption (λmax) and absorbance were recorded. The same procedure was repeated for the Brand 1 and Brand 2 extracts, and their spectra were compared with that of the genuine cumin sample.

➢ *UV–Visible Analysis of Asafoetida*

The asafoetida samples were subjected to UV–Visible spectroscopic analysis following the extraction and spectral comparison approach described for the samples in the study. The resulting absorption spectra, λmax values and absorbance values were compared among the standard and marketed samples to identify variations associated with adulteration. The study used UV–Visible spectroscopy as one of the instrumental approaches for comparing the chemical composition of the samples.

- *FTIR Spectroscopic Analysis*

FTIR spectroscopy was used as an instrumental technique for the identification and comparison of characteristic functional groups present in the standard and marketed samples. The spectra were compared with the standard samples to identify changes in characteristic absorption peaks and fingerprint regions that could indicate adulteration.The FTIR analysis was performed as part of the comparative evaluation of standard and marketed cumin powder and asafoetida samples. The study considered the FTIR spectral fingerprint and characteristic functional group regions for the detection and confirmation of adulterants.

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- *Comparative Evaluation of Samples*

The results obtained from physical examination, chemical tests, colorimetric analysis, UV– Visible spectroscopy and FTIR spectroscopy were compared for the two marketed brands of cumin powder and asafoetida. The observations from each analytical method were interpreted collectively to evaluate the purity, quality and extent of adulteration in the samples. The combined analytical approach was used to compare the marketed samples with the corresponding standard samples and to determine differences suggestive of adulteration.

IV. RESULTS AND DISCUSSION

The present study evaluated two market brands of cumin powder and asafoetida for the presence of adulterants using physical examination, chemical tests, colorimetric analysis, UV–Visible spectroscopy, and FTIR spectroscopy.

Physical and chemical tests showed that Brand 1 of both cumin powder and asafoetida was comparatively pure, with only minor adulteration. In contrast, Brand 2 showed significant adulteration. Cumin powder Brand 2 contained starch, husk, sawdust, and higher inorganic matter, while asafoetida Brand 2 showed the presence of starch, gum, and resin adulterants.

Colorimetric analysis showed higher absorbance values in Brand 2, confirming greater adulteration. UV–Visible spectroscopy revealed noticeable changes in λmax and absorbance in Brand 2 compared to the standard sample, indicating variation in chemical composition. FTIR spectroscopy further confirmed the presence of adulterants through changes in characteristic functional group peaks.

Overall, the results indicated that Brand 1 was of better quality and closer to the standard sample, whereas Brand 2 showed a higher level of adulteration. The combined analytical methods proved effective for the detection and comparison of adulterants in cumin powder and asafoetida.

V. CONCLUSION

The present study successfully identified adulterants in two market brands of cumin powder and asafoetida using physical examination, chemical tests, colorimetric analysis, UV–Visible spectroscopy, and FTIR spectroscopy. The results showed that Brand 1of both samples was comparatively pure and closely matched the standard, whereas Brand 2 exhibited significant adulteration with starch, husk, gum, resin, and other foreign materials. Among all the methods used, FTIR and UV–Visible spectroscopy provided reliable confirmation of adulteration, while the physical and chemical tests served as simple and effective preliminary screening methods.

Overall, the study demonstrated that the combined analytical approach is useful for evaluating the quality, purity, and authenticity of spices and can help ensure consumer safety and prevent food adulteration.

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