

Original Research Article

## Evaluation of Food Adulteration among Selected Food Items - In Vitro Study

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### ABSTRACT

Adequate nutrition is a key to good health but when food gets adulterated; its beneficial effects are lowered, which on long term leads to mortality and high morbidity.

**Objectives:** To measure the adulteration in selected food products through standard testing procedure and to compare the adulterants among the standard sub-standard and loosely available food products.

**Materials and Methods:** In this in vitro study ten commonly used food products were selected. For each of these products, three of the available groups were selected i.e. standard, sub-standard and loosely available food sample. The samples were analysed using the methods prescribed by Food Standard Safety Authority of India and Directorate General Health service manual. Out of the ten food products analysed, chilli, coriander powder & salt were found to be adulterated. The statistical analysis was done using chi square test.

**Results:** On comparing the three groups, 4.6720% of added starch was found to be present only in loosely available samples of coriander powder and it was found to be statistically significant ( $p = 0.007$ ). Added starch was found in standard and loose samples of chilli powder respectively and extraneous matter was present only in sub-standard sample of salt.

**Conclusion:** It is concluded that low level of adulterants like added starch and extraneous matter are detected in the Standard, Sub-standard and loosely available samples.

**Key words:** Adulteration, Standard, Substandard, Loosely available food.

### INTRODUCTION

Food is the basic requirement of all living beings for their growth. Every citizen has the right to have access to healthy, safe and nutritious food. The health and the productivity of population depend on the nature of the food they consume and its wholesomeness in terms of their nutritive value. <sup>[1]</sup> Adequate nutrition is a key to good health but when food gets adulterated; its beneficial effects are lowered, which leads to mortality and high morbidity. Adulteration is defined as “the process by which the quality or the nature of a given substance is reduced through the addition of

a foreign or an inferior substance and the removal of vital vitamins. <sup>[2]</sup> The causes of food adulteration are: dishonesty of traders to make quick and easy money, loopholes in food adulteration act, ignorance of consumers regarding their rights and responsibilities towards food adulteration resulting in faulty buying practices. <sup>[3]</sup> It is true that adulteration primarily thrives in a period of shortages of food supply. Due to the low level income, consumers pay less attention to the quality of products and faces disadvantages in the form of adulteration. Now days, “adulteration is a health menace”. Thus food adulteration takes many

forms: mixing, substitution, concealing the quality, putting of decomposed food for sale, misbranding or giving false labels and addition of toxicants. The pity is that so called modernization has brought with it, the evils of adulteration.

The three types of adulteration namely intentional adulterants (which includes sand, marble chips, stone, mud, chalk powder, water, mineral oil and coal tar dyes), metallic contamination (includes arsenic from pesticides, lead from water, and mercury from effluents of chemical industries, etc.) and incidental adulterants (includes pesticides, D.D.T and marathon residues present on the plant product). [2,4] Toxic metals reach agricultural crops during cultivation or through industrial activities such as mining from industrial waste, waste water, pesticides and packaging material. [5]

The increasing trends in food contamination in urban areas are largely attributed to polluted environment in urban agriculture, contaminated food transport and supply chains, poor market sanitary conditions and the use of contaminated or waste water for irrigation purposes. Diarrhoea is most often; in school going children is one of the major concerns. In the age group of 1-5 years, 45% of the total sample in urban area was affected by diarrhoea as compared to 22% in rural areas. [6] According to National Institute of Nutrition in India 4, 00,000 children below five years of age die each year due to diarrhoea. [6]

To protect general public against the defective practices adopted by the trader, (Prevention of Food Adulteration Act) PFA act 1954 was enacted by Indian parliament and was amended time ago 1956, 1976 and lately in 1986 to make the act more stringent. [7] Under this act government has set some food standards to check adulteration and defaulters are imposed fine and life imprisonment depending on the nature and extent of regulation. Standards are also set by AGMARK (Agricultural Marketing), FPO (Fruit Products Order), and ISI (Indian Standards Index) to ensure

quality, hygiene, preservation, composition etc.

Unsafe food is linked to the deaths of an estimated 2 million people annually including many children. [8] Food containing harmful bacteria, viruses, parasites or chemical substances is responsible for more than 200 diseases, ranging from diarrhoea to cancers. As our food supply becomes increasingly globalized; the need to strengthen food safety systems in and between all countries is becoming more and more evident. That is why the WHO is promoting efforts to improve food safety, from farm to plate (and everywhere in between). With this in mind WHO declared Food Safety as the theme for the year 2015 on World Health Day, 7 April 2015. [9] As food adulteration increases the burden of health in the society, this study aims to evaluate the adulteration among selected food items through standard testing procedure.

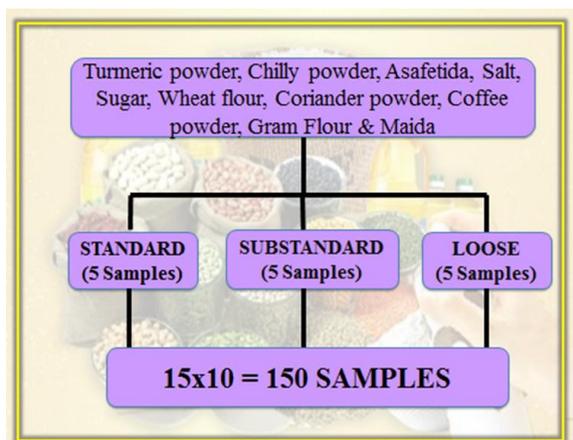
## **MATERIALS AND METHODS**

In this in- vitro study food samples were collected from various wholesale and retail shops in the Avadi municipality of Thiruvallur District.

Ten commonly used food products were selected for evaluating the food adulteration. For each of these products, three of the available groups were selected i.e. Standard (FSSAI), sub-standard (packed but not FSSAI) and loosely available food sample. The Food Safety & Standard Authority of India is an agency of the ministry of health and family welfare, government of India. [10] It has been established under food safety and standard act, 2006. The FSSAI has been created for laying down science based on standards for articles of food and to regulate their manufacture, storage, distribution, sale and import to ensure availability of safe and whole food for human consumption. FSSAI is responsible for protecting and promoting public health through regulation and supervision of food safety. The Sub-standard food is a packed food as per the

manufacturer choice with the absence of FSSAI label on the packed products. The loosely available food samples are those items left loose and put into packaging before being sold.

Thus a total of 150 samples, five for each food groups were taken for the study. The selected food products were turmeric powder, chilli powder, Asafoetida, salt, sugar, wheat, coriander powder, coffee powder, gram flour and Maida. Each sample was collected and packed separately (in a zip pouch) of about 50gms each in quantity and it was analysed in the laboratory. Various adulterants in each of the sample were tested using the methods prescribed by FSSI (Food Standard Authority of India) and DGHS manual (Directorate General of Health Service).<sup>[10,11]</sup>



### **FSSAI method for detection of common adulterants in food**<sup>[10]</sup>

#### **Determination of Chalk in sugar**

Dissolve 10 gm of sample in a glass of water, allow settling, chalk will settle down at the bottom.

#### **Determination of urea in sugar**

On dissolving in water it gives a smell of ammonia

#### **Determination of chalk powder in Maida and wheat flour**

Shake sample with dil. Hcl effervescence indicates chalk

#### **Determination of soapstone or earthy material in Asafoetida**

Shake little portion of the sample with water and allow to settle. Soap stone or

other earthy matter will settle down at the bottom

#### **Determination of coloured saw dust in turmeric powder**

Take a tea spoon full of turmeric powder in a test tube. Add a few drops of concentrated hydrochloric acid. Instant appearance of pink colour which disappears on dilution with water shows the presence of turmeric if the colour persists, metanil yellow (an artificial colour) a not permitted coal tar colour is present.

#### **Determination of Brick powder, salt powder or talc powder in chillies powder**

Take a tea spoon full of chilli powder in a glass of water. Coloured water extract will show the presence of artificial colour.

#### **DGHS method for detection of common adulterants in food**<sup>[11]</sup>

#### **Determination of lead chromate in turmeric powder**

Ash about 2 gm of the ground sample. Dissolve the ash in 4-5 ml of dilute sulphuric acid (1:7 v/v) in a test tube and add 1 ml of diphenylcarbazide solution 0.2% (w/v) in 95% ethyl alcohol. The development of a violet colour indicates the presence of lead Chromate.

#### **Determination of added starch in Turmeric powder, Chilli powder Coriander powder**

Extract about 3 gm of the ground sample accurately weighed with five 10 ml portions of ether on a filter paper that will retain completely the smallest starch granules. Evaporate the ether from the residue and wash with 150 ml of 10 % ethyl alcohol. Carefully wash off the residue from the filter paper with 200 ml of cold water. Heat the undissolved residue with 200 ml of 2.5 % dilutes HCl in a flask equipped with reflux condenser for two and half hour. Cool and neutralise with Sodium carbonate solution and transfer quantitatively to a 250 ml volumetric (standardised) flask and make up to volume. Determine reducing sugars in the solution by Lane and Eynon Volumetric method using Fehling solution and

methylene blue as internal indicator for the presence of starch.

#### **Determination of foreign resin in asafoetida**

Add a few drops of 9% aqueous ferric chloride solution to 5 ml of alcoholic extract. Appearance of olive green colour in the mixture shows absence of foreign resins. Appearance of blackish precipitate or coloration in the mixture shows absence of foreign resins in compounded asafoetida.

#### **Determination of iron fillings in coffee powder**

Spread the entire quantity of the sample in a thin and uniform layer on a polythene sheet, run a powerful magnet over the sample repeatedly till no more iron fillings cling to the magnet. Collect the iron fillings in a clean dry and previously weighed petridish.

#### **Determination of artificial colour in Gram flour, coriander powder, chilli powder, turmeric powder, coffee powder**

- I. Preparation of standard curve: Stock solution: Weigh 0.1 g m of each reference colour and dissolve in 0.1N HCl in separate 100 ml volumetric flasks and make up the volume with 0.1N HCl in each case.
- II. Working standard: Pipette 0.25, 0.5, 0.75, 1.0, 1.25 and 1.5 ml of stock solution of each of the reference colours into series of clean and dry 100 ml volumetric flasks and dilute to volume with 0.1N HCl. Determine the optical densities of each of the reference colours at the respective wave length of maximum absorption. Obtain the standard curve for each colour by plotting optical density against concentration.

#### **Detection of extraneous matter (glass, metal, wood, stones, sand, cigarette butts) in salt**

Thoroughly mix the sample & weigh 100-200gm depending on the nature of the material (10-20gm in case of small sized spices) and spread in an enamelled tray. Separate extraneous matter and other

refractions by hand. Weigh each fraction and calculate percentage.

Once the adulteration is evaluated from the selected food items, the data was analysed using Statistical Package for Social Sciences (SPSS) version 16. The Kruskal - Wallis test was used to compare the proportion of adulterants among three different groups and Man-Whitney test was used to compare the proportion of adulteration within the groups. The p-value was established at less than 0.05(confidence interval (CI: 95%).

## **RESULTS**

A total of ten food products were selected in the study for evaluating the food adulteration using standard testing procedure. Of these 10 food products, seven products were not found to be adulterated in all three groups. They were turmeric powder, Asafoetida, Sugar, Wheat, Coffee powder, Gram flour, and Maida. The adulteration was identified in the FSSAI sample of chili powder, loosely available samples of coriander powder and chili powder and in the substandard sample of salt.

#### **Identifying the adulteration in selected food products**

Out of 15 samples of coriander powder the frequency of adulterant was found to be present in four loosely available samples. None of the adulterant was found among the substandard and FSSAI samples. The difference noted was found to be statistically significant  $p=0.007$  (table-1).

Out of 15 samples of chili powder the frequency of adulterant was found to be present in three loosely available samples and one FSSAI sample. The five substandard samples did not show the presence of adulteration. The difference noted was not found to be statistically significant  $p=0.077$  (table-1).

Out of 15 samples of salt the frequency of adulterant was found to be present in one substandard sample. None of the adulterant was found among the loosely available and FSSAI samples. No

significant difference was noted between the groups  $p=0.368$  (table-1).

**Table 1: Frequency of adulterants in checked food samples.**

Food products	Adulterants present	Substandard samples n=5	Loose samples n=5	Standard samples n=5	P value
Coriander powder	Added starch	0	4	0	0.007
Chilli powder	Added starch	0	3	1	0.077
Salt	Extraneous matter	1	0	0	0.368

### Comparing the adulterants among the FSSAI, Sub-standard and loosely available food products.

Presence of added starch in coriander powder was found only in loosely available sample with the mean value of 4.6720% (S.D =4.15997) and it was found to be statistically highly significant  $p=0.007$  (table -2). The presence of added starch in chilli powder with the mean value of adulteration in standard sample was found to be 0.6520% (S.D=1.4579) and in loosely available sample was 3.3620% (S.D=3.13240) and it was absent in sub-standard samples. But the difference noted was not found to be statistically significant  $p=0.077$  (table -2).

The presence of extraneous matter in salt was found only in substandard food sample with the mean value of 0.0002% (S.D= 0.00045). But it was not found to be statistically significant  $p= 0.368$  (table-2). On comparing the adulterants among

three groups within coriander powder, the difference noted between the packed and loosely available groups was found to be statistically significant ( $p= 0.019$ ). Also, the difference between the loosely available and standard groups was found to be statistically significant  $p=0.019$  (table-4). On comparing the adulterants among three groups within chilli powder, the difference noted between the substandard and loosely available groups, between the loosely available & standard groups and between substandard & standard groups were not found to be statistically significant ( $p>0.05$ ).

On comparing the adulterants among three groups within salt, the difference noted between the substandard and loosely available groups, between the substandard & standard groups and between the loosely available & standard group were not found to be statistically significant ( $p=1.000$ ) (table- 2).

**Table: 2 Presence of adulterant in samples tested**

S.no	Food products	Adulterant	Food groups	Mean (%) of adulterant	Standard Deviation	P value
1.	Coriander powder	Added Starch	Substandard	0.0000	0.0000	0.007
			Loose	4.6720	4.15997	
			Standard	0.0000	0.0000	
2.	Chili powder	Added Starch	Substandard	0.0000	0.0000	0.077
			Loose	3.3620	3.1324	
			Standard	0.6520	1.4579	
3.	Salt	Extraneous matter	Substandard	0.0002	0.00045	0.368
			Loose	0.0000	0.0000	
			Standard	0.0000	0.0000	

## DISCUSSION

Food adulteration is a common malpractice and an age-old problem which causes serious effects on health of people. An adulterant is also defined as “any cheap outside item which looks the same as the original foodstuff, which mixes very well with it and is not easy to detect”. [12]

In the current study the commonly found adulterant among selected food samples are extraneous matter and added

starch. Extraneous material include any objectionable substances in foods, such as foreign matter (for example, glass, metal, plastic, wood, stones, sand, cigarette butts), undesirable parts of the raw plant material, filth (namely, mold, rot, insects and rodent parts, excreta, decomposition. Added Starch or amyllum is a carbohydrate consisting of a large number of glucose units joined by glycosidic bonds. Pure starch is a white,

tasteless and odourless powder that is insoluble in cold water or alcohol.

The study was conducted to evaluate the adulteration among turmeric powder, chilli powder, Asafoetida, salt, sugar, wheat, coriander powder, coffee powder, gram flour and Maida. The results obtained in this study testify that the samples were found to be adulterated. It was further observed that added starch was found to be present in coriander and chili powder. Extraneous matter was found to be present in salt.

In the present study, added starch was found to be present in four loosely available samples of coriander powder and it was found to be statistically significant ( $p=0.007$ ) whereas in a study conducted by Nidhi Gupta et al (2009) in Gujarat, dung and chalk powder was found to be present in loose coriander powder. [2]

In another study conducted by Bhatt Shuchi R et al (2012) in Uttar Pradesh it was found that horse dung, leaf powder, and soil was present in coriander powder, whereas none of the coriander powder samples, showed positive reaction to adulteration test in a study conducted by Abidfaheem T.K et al (2013) in Udupi. The absence of adulterant may be due to the reason that the detection was done through simple detection methods in home set up. [1,13]

In the present study added starch was found to be present in three loosely available samples and one FSSAI sample of chilli powder whereas in a study conducted by the Nidhi Gupta et al (2009) in Gujarat, starch and oil soluble coal tar dyes was found to be present in the substandard products of chili powder. [2] In another study conducted by Abidfaheem T.K et al (2013) in Udupi artificial colour was found to be present in chili powder, whereas brick powder and chalk powder was found to be present in a study conducted by B. Gowri and K.P Vasantha Devi (2012) in Dindigul. [1,14]

In the present study, extraneous matter was found to be present in one substandard sample of salt whereas in a

study conducted by Nidhi Gupta et al (2009) in Gujarat earthy material; white powdered stone and chalk powder were found to be present in the salt. [2] In a study conducted by B. Gowri and K.P Vasantha Devi (2012) in Dindigul among self- help group, chalk powder was found to be present in salt. In the present study none of the samples showed the presence of adulterants in turmeric powder whereas in a study conducted by Nidhi Gupta et al (2009) in Gujarat, it was found that chalk powder was present in the samples of turmeric powder. [2] In another study conducted by Abidfaheem T.K et al (2013) in Udupi, metanil yellow was found to be present in turmeric powder. [1]

In the study conducted by Mohamed Ziyaina et al (2014) presence of lead and cadmium was found to be present in turmeric powder. [5] This could be due to the use of heavy metal containing fertilizers or from a practice of growing plants with sewage sludge. Whereas in a study conducted by Bhatt Shuchi R et al (2012) in Uttar Pradesh, yellow colour, synthetic colour and lead chromate was found to be present in turmeric powder. [13]

In the present study all the three groups of wheat flour showed the absence of adulterant whereas in a study conducted by Nidhi Gupta et al (2009) in Gujarat among low income group, bran particles was found to be present in wheat flour. [2]

### **Limitations**

The detection of adulteration has been limited to only 10 specific food products. Samples taken on each group of food product was small (5 samples). Only a few of the well-known branded food products were examined. The result of this study cannot be extrapolated to all other areas with regard to loosely available samples because the study done in one locality.

### **CONCLUSION**

The present study reveals that some amount of adulterant was found in the samples of coriander powder, chilli powder

and salt. On comparison, the least amount of adulterants was found in FSSAI which was followed by packed and loosely available samples respectively. Among the various commonly used food products tested, adulteration was significantly found more in loosely available samples of coriander powder with added starch. So it is recommended to choose standard items with FSSAI mark over packed and loosely available items for clean, safe and nutritious food. Although the networks of public health laboratories to check adulteration are available, the problem of adulteration still exists. We can reduce this problem to a large extent when consumer's education is coupled with efforts taken in monitoring the quality of products kept for sale, with the help of public health laboratories.

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