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Safety assessment of some food products with reference to adulteration in Faisalabad, Punjab, Pakistan

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ABSTRACT

From the beginning of civilization adulteration in food has been a concern, not only decreases the quality of food products but also ill effects on health. Concerns about food safety and regulation have ensured the development of various techniques like physical, biochemical and instrumental technique for adulterants detection in food. Both branded as well as non-branded samples were selected from different regions of Faisalabad (Satiana, Chiniot, Jhang). There was presence of different adulterants in selected foods. Scorched persimmon, powder of date seed or tamarind seeds and chicory were present 33% while cereal starch was 67% in samples of coffee. Artificially colored and exhausted tea were found 75%, iron flakes 25%, leather flakes 50% and coal tar dye 75% in samples of tea leaves. Mineral acid was present 57% in samples of soda lemonade. Rhodamine B, metanil yellow and saccharin were present 33% in samples of syrups. 40% samples of beverage were adulterated with metanil yellow and saccharin. The adulterants presence range in selected items from 20% to 75% and absence of adulterants from 25% to 100% were noted. Microbial analysis was conducted of selected products for three regions (Satiana, Chiniot, Jhang) of samples so that the safety level can be declared. The ranges of microbial load in the coffee samples for these three regions (Satiana, Chiniot, Jhang) were 1.43x104 to 1.67x104, 1.65 x104 to 2.09 x104 and 1.39 x104 to 1.63 x104 respectively. The ranges of microbial load in the tea leaves samples for these three regions (Satiana, Chiniot, Jhang) were 3.47x104 to 4.46x104, 4.56 x104 to 5.33 x104 and 2.56 x104 to 3.47 x104 respectively. The ranges of microbial load in soda lemonade samples for these three regions were 4.84x104 to 5.33x104, 2.93 x104 to 3.90 x104 and 2.60 x104 to 3.70 x104 respectively. The ranges of microbial load in syrups sample for these three regions (Satiana, Chiniot, Jhang) were 4.55x104 to 5.55x104, 2.13 x104 to 2.92 x104 and 9.60 x103 to 1.22 x104 respectively. The ranges of microbial load beverages samples for

these three regions were 5.70x104 to 7.70x104, 3.60 x104 to 4.60 x104 and 3.30 x104 to 5.10 x104 respectively.

Keywords: adulteration, contamination, toxic substances, bacterial pathogenesis

1. INTRODUCTION

Food is the basic source of nourishment and sustenance of human life. It provides nutrients to human body for purpose of growth and energy (Menrad, 2003). For a healthy body, a balanced diet is required which is obtained from nutritious food products (Sudershan et al., 2009). The cases of food fraud have a long history. The food fraud is an act of increasing profit and deceiving consumer. It also includes to increase the quantity or make more grow up. Food fraud consists adulteration, counterfeiting, tempering and intentional contamination at any stage occurrence related to food supply chain (Spink and Moyer, 2011). Prevention of a food fraud incident is very different than preventing a terrorist (Spink and Moyer, 2013). Since the beginning of civilization, food adulteration is an issue not just decreases the food quality but also have numerous bad effects on health (Bansal et al., 2015).

Food adulteration term is commonly used for intentional contamination in basic food material with low quality, non-edible, cheap or toxic substances. It consists of a large number of other practices e.g. mixing, substitution, putting up decayed foods, giving fake label or concealing the quantity (Abhirami and Radha, 2015). The effects of consumption of adulterated foods may be either immediate or long-term or both. Immediate effects include food poisoning (diarrhea) and consequently dehydration. The long-term effects may be organ failure or cancer (Chowdhury, 2014; Rajput and Khan, 2023). Contaminated foods and drinks are affecting common sources of infection. Adulterants have bad health effects of range from acute signs such as vomiting, abdominal pain, allergy, asthma and headache and even psychological retardation, cardiac seize and cancer (Alauddin, 2012). The dyes used in food are highly carcinogenic and may cause paralysis, brain and liver damage, kidney stone, glaucoma, blindness, heart attack or even sudden death if taken for long time (Jahangir et al., 2017).

Rhodamine B color is a mutagenic and carcinogenic substance. It is causing toxicity to humans including reproductive or developmental toxicity, neurotoxicity, acute toxicity and carcinogenicity (Gresshma and Paul, 2012). Metanil yellow color is mostly used in food but it enhancing effect of tumor. Coffee is a commonly consumed beverage containing cereal starch, scorched persimmon, powder of date seed or tamarind seeds and chicory in coffee (Faheem et al., 2014). Tea is derived solely and exclusively from the tender shoots of varieties of the species *Camellia sinensis* produced by acceptable processes for making a tea infusion suitable for consumption as a beverage containing adulterants artificially colored tea, exhausted tea, iron flakes, leather flakes and coal tar dye in tea leaves. Soda lemonade is a commonly consumed beverage in summer season having mineral acid.

Syrups are concentrated product consisting sugar, water and flavors having adulterants like Rhodamine b, metanil yellow color and saccharin. Beverages consisting primarily of carbonated water, sugar and flavorings having adulterants like metanil yellow and saccharin. Current food adulteration scenario required proper measures for positive change through regulatory authorities (Rahman et al., 2015). The lack of good agricultural, manufacturing, and hygiene practices remains a major challenge for improving food safety for the domestic and export market (Deininger and Sur, 2007; Imran et al., 2018). Food should be without or only with acceptable and safe levels of adulterants, contaminants or any other substances that may make food hazardous to health. Also, such food can deny nutrients essential for proper body growth and development (Gahukar, 2013). Pakistan is the sixth most populated country in the world with a population of 180.1 million which is projected to reach 210.13 million by 2020. Around 20% of the population has been living below the international poverty line of US$ 1.25 per day.

Disease burden is enormous with unsatisfactory maternal and child health conditions despite the fact that Pakistan expends 2.5% of its gross domestic product on health (Akhtar et al., 2014). Safety status of Pakistani foods is highly detrimental as a wide range of food products especially street-vended foods have been found to be chemically and microbiologically contaminated. Global campaign to create awareness on bacterial pathogenesis and the magnitude of food borne illness especially diarrhea, gastroenteritis and respiratory tract infection were continued to grow among children in Pakistan (Akhtar et al., 2014; Emmanuel et al., 2017). There is a rapid increasing requirement for more accurate detection method adulterations in food (Zhang et al., 2011). Adulteration is a global issue which increasing with each day of passing. As far as Pakistan is concerned, food safety issue is very much undermined. There is an ever-increasing list of food items that are adulterated on daily basis. The present research has been designed to check the adulterants in selected food items. The objectives of the study were as follow:

Objectives

Selection of various products according to food groups from Faisalabad region.
Safety assessment of selected food products with reference to adulteration.
Interpretation and compilation of results for consumer awareness.

2. MATERIALS AND METHODS

Raw material

The samples of honey, Jaggery, sugar, sugar powder, brown sugar, coffee, tea, beverages, syrups and soda lemonade, candies, supari and jalebi were collected from different regions (Satiana, Chiniot, Jhang) of Faisalabad. Samples types were branded or non-branded as per availability. All chemicals and reagents of analytical grade were purchased from scientific stores.

Preparation of raw material

Grinding of coffee sample was done through grinder and mixed well to get a homogenous sample.

Adulterants in Coffee

Coffee was tested for cereal starch, scorched persimmon, powder of date seed or tamarind seeds and chicory.

Cereal starch

Iodine solution was dropped on coffee samples. Appearance of developed blue color showed presence of cereal starch was done by method expressed in.

Scorched persimmon

One tea spoon of coffee powder was taken and dropped it on a moisturized blotting paper. 3 ml of 2 % aqueous solution of sodium carbonate was poured slowly and carefully on it. A red coloration indicated the presence of powder of scorched persimmon stones in the coffee powder was done by following the method of.

Powder of date seeds

Coffee floated and date seeds powder settled down in water was done by method expressed in.

Powder of tamarind seeds

Coffee floated and tamarind seeds powder settled down in water was done by following the method of.

Chicory

Coffee powder sample was gently sprinkled on the surface of water in a glass. The coffee floated over the water but chicory settled down within a few seconds. The falling chicory powder particles leave behind them a trail of color, due to large amount of caramel was done by method expressed in.

Adulterants in Tea leaves

Tea leaves were tested for artificially colored tea, exhausted tea, iron flakes, leather flakes and coal tar dye.

Artificially colored tea

A filter paper was taken and put few tea leaves on it. Water was sprinkled to wet the filter paper. Staining of the filter paper immediately showed presence of artificially colored tea was done by method expressed in.

Exhausted tea

Little slaked lime dropped on glass plate and then sprinkled a little tea dust on lime. Red, orange or other shades of color spreading on the lime showed the presence of coal tar color. In case of genuine tea there was only a slight greenish yellow color due to chlorophyll, appeared after some time was done by following the method of.

Iron Flakes

Iron flakes presence in tea leaves samples attracted by magnet was done by method expressed in.

Leather Flakes

Tea leaves containing leather flakes when burnt so smell comes out presence of adulterant in tea leaves was done by following the method of.

Coal Tar Dye

When presence of coal tar dye in tea leaves sample so on moistened white blotting paper colors developed was done by method expressed in.

Adulterant in soda lemonade

Soda Lemonade samples were tested for presence or not of mineral acid.

Mineral acid

2 drops of the lemonade soda poured on a metanil yellow paper-strip. Appearance of violet color was indicated the presence of mineral acid in aerated water. The color impression gets retained even after drying the paper (metanil yellow paper strips was prepared by soaking filter paper strips in 0.1 % aqueous solution and then drying the paper-strips) was done by following the method of.

Adulterants in Syrups

Syrups samples were tested for presence or not of these adulterants rhodamine b, metanil yellow color and saccharin.

Rhodamine B

Small quantity of syrup sample was taken in a test tube and then 3 ml of carbon tetra chloride added in it. So, shaked well to mix the contents test tube. The mixture turned colorless and addition of a drop of hydrochloric acid brought the color back, when food contains rhodamine b color was done by method expressed in.

Metanil yellow color

Extracted color with luke-warm water from syrup sample. Few drops of concentrated hydrochloric acid added in it. Magenta red color developed showed presence of metanil yellow in syrup sample was done by following the method of.

Saccharin

Two spoons of syrup sample along with little quantity of water were added in a test tube, few drops of hydrochloric acid was added along with 10 ml of solvent ether. The sample and chemicals were shaked well. The ether layer decanted into a test tube or a beaker and the ether evaporated spontaneously. One drop of water (warm) was added into the residue and tasted. Sweet taste indicated the presence of saccharin. Small quantity of sample tasted. Saccharin produced lingering sweetness on tongue for a considerable time and a bitter taste left at the end was done by method expressed in.

Adulterants in Beverages

Beverages samples were tested for metanil yellow and saccharin adulterants.

Metanil yellow

Color extracted with luke-warm water from beverage sample. Few drops of concentrated hydrochloric acid was added in it. Magenta red color developed showed presence of metanil yellow in beverage sample was done by following the method of.

Saccharin

Two spoons of beverage sample was added with little quantity of water in a test tube. Few drops of hydrochloric acid was added along with 10 ml of solvent ether. Sample along with mixed well and ether layer decanted into a test tube or a beaker. The ether was evaporated spontaneously and one drop of water (warm) added to the residue and taste. Sweet taste indicated the presence of saccharin. A small quantity of sample was tested. Saccharin produced lingering sweetness on tongue for a considerable time and bitter taste left at the end was done by method expressed in.

Microbiological Evaluation

The samples of honey, Jaggery, sugar, sugar powder, brown sugar, coffee, tea, beverages, syrups and soda lemonade, candies, supari and jalebi were collected from different regions of Faisalabad. And analysis of microbial level of these food items were done by expressed method in.

Total Plate count

The total plate count (TPC) is intended to indicate the level of micro-organisms in the product.

Preparation of normal saline solution

A normal saline solution was prepared by using NaCl 8.9 g/L for the dilution of samples.

Sterilization of glass ware

The glassware used during the present study including glass bottles, glass flasks, glass Petri-plates, screw-capped test tubes etc., were washed in the detergent and soaked into the distilled water before air drying. The sterilization was carried out in hot air oven at a temperature of 171°C for 30 minutes.

Media preparation

Plate count gar was prepared and autoclaved at 121°C for 15 minutes.

Samples preparation

Six sterilized test tubes were taken and labeled as 10-1, 10-2, 10-3… 10-6. 9mL of normal saline was poured into each test tube. 1 ml of homogenized sample was shifted into the first test tube and contents were mixed well by gentle shaking. Then sample was transferred from first test tube to second one and mixed thoroughly. Similarly, 1mL sample from second test tube was shifted into third test tube. By using above procedure other serial dilutions were also prepared.

Pouring the plates

1ml contents from each test tube dilution on the surface of Nutrient agar plates and spread well and incubated at 37°C for 24 hours.

Colony counting

The average number of colonies was counted from those dilutions that showed the colonies size ranging from 30 to 300 with the help of colony counter.

$$\text{Total Plate Count (cfu/ml)} = \frac{\text{Average number of colonies} \times \text{dilution factor}}{\text{Volume factor}}$$

3. RESULTS AND DISCUSSIONS

Detection of adulterants

Adulterants in Beverages

Adulterants in Coffee

Five different types of adulterants named cereal starch; scorched persimmon, powder of date seed, tamarind seeds powder and chicory were analyzed in coffee samples collected from different regions of Faisalabad. The results given in Table 1 showed significant regarding adulteration of coffee depicted that 33% coffee samples were adulterated with scorched persimmon, powder of date seed, tamarind seeds powder and chicory while 67% samples were adulterated with cereal starch. Coffee is adulterated from many ways. Coffee powder is adulterated with powder obtained from tamarind seed (Nagvanshi, 2015). The scorched persimmon, powder of date seed, tamarind seeds powder and chicory are adulterants used in coffee due to the consumption of these types of adulterants can cause problems of diarrhea, giddiness and joint pains in humans. Bansal et al., (2015) studied commonly used adulterants like chicory, tamarind seeds and date seed powder in coffee samples. Srivastava, (2015) studied that chicory and tamarind seed powder used as an adulterants in coffee samples.

The result for the presence or absence of adulterants was found significant ($p< 0.05$). Powder of scorched and cereal starch are those types of adulterants also used to increase weight of coffee these adulterants caused serious problems of the stomach disturbances. Abhirami and Radha, (2015) noted that there was presence of chicory in coffee which cause diarrhea. But starch was not found in samples of coffee. Study showed that there were 28 percent presence of adulterants in coffee samples. Awasthi et al., (2014) studied that fifty percent of coffee samples were contained adulterants. Srivastava, (2015) detailed that date and tamarind seeds powder were utilized in coffee samples causing diarrhea.

Table 1 Adulterants in Coffee

Coffee		Adulterants				
		Cereal starch	Scorched persimmon	Powder of date seed	Tamarind seeds powder	Chicory
Absent	No. of Samples	3	6	6	6	6
	%	33	67	67	67	67
Present	No. of Samples	6	3	3	3	3
	%	67	33	33	33	33
Total	No. of Samples	9	9	9	9	9
	%	100	100	100	100	100
X2		9.00*	9.00*	9.00*	9.00*	9.00*
p		<0.05	<0.05	<0.05	<0.05	<0.05

Adulterants in Tea leaves

Five different types of adulterants named artificially colored tea, exhausted tea, iron flakes, leather flakes and coal tar dye were evaluated in tea samples. The results given in Table 2 showed significant ($p<0.01$) variation regarding adulteration of tea leaves. These results represented that 75% tea samples were adulterated with artificially colored tea, exhausted tea and coal tar dye while 25% samples were adulterated with iron flakes and 50% samples were adulterated with leather flakes. Leather flakes and iron flakes are caused constipation and black color stool. Leather flakes and coal tar dye are those types of adulterants which are carcinogenic. Bansal et al., (2015) studied commonly used adulterants presence in tea leaves samples.

Srivastava, (2015) analyzed that artificial pigments or dye, already utilized leaves and iron fillings in tea samples. Nagvanshi, (2015) studied exhausted tea and coal tar dyes leaves adulterants presence in tea leaves. Tea leaves exhausted tea noted in one sample of total three samples. These types of adulterants caused liver disorder and malnutrition in children (Abhirami and Radha, 2015; Khan and Abbas, 2017). Stated that tea leaves have not adulterants in these collected samples. It was noted that exhausted tea leaves present in tea leaves samples (Rahman et al., 2015).

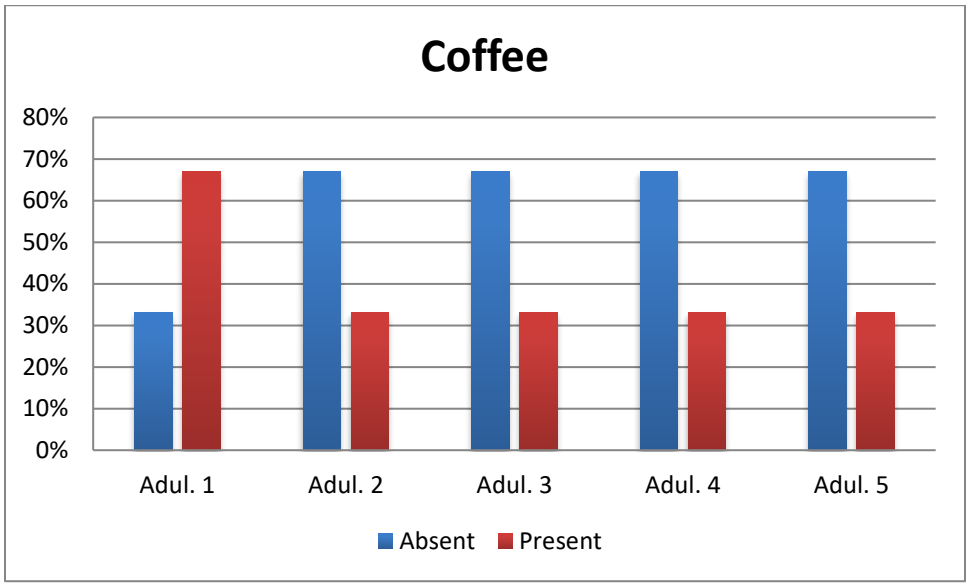

Figure 1 Adulterants in Coffee

Adul. 1= Cereal starch, Adul.2= Scorched persimmon, Adul.3= Powder of date seed, Adul.4= Powder of tamarind seeds, and Adul.5= Chicory

Table 2 Adulterants in Tea Leaves

Tea leaves		Adulterants				
		Artificially colored tea	Exhausted tea	Iron flakes	Leather flakes	Coal tar dye
Absent	No. of Samples	3	3	9	6	3
	%	25	25	75	50	25
Present	No. of Samples	9	9	3	6	9
	%	75	75	25	50	75
Total	No. of Samples	12	12	12	12	12
	%	100	100	100	100	100
X2		12.00**	12.00**	12.00**	12.00**	12.00**
P		<0.01	<0.01	<0.01	<0.01	<0.01

Adulterant in Soda lemonade

Soda lemonade samples collected from different regions of Faisalabad were tested for adulterant like mineral acid. Significant ($p< 0.01$) difference was observed regarding presence or absence of adulterant (Table 3) demonstrated that 43% samples of soda lemonade were free from mineral acid. Bhatt et al., (2012) noted that in terms of adulteration all the stores have adulterated food on the other hand branded items contains a lesser amount of percentage of adulterants other than the locally available items. Detected mineral acid addition in soda lemonade loose motion cause to human being.

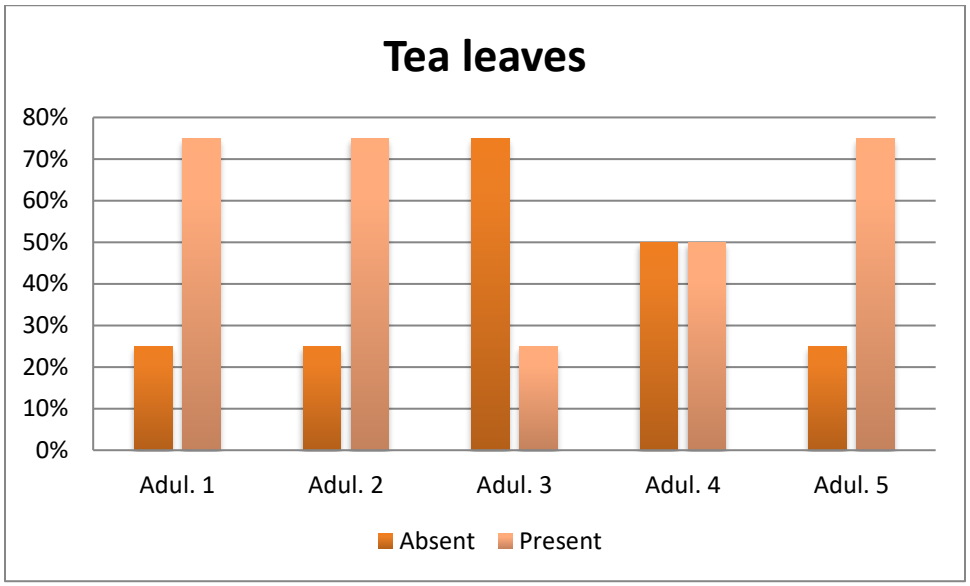

Figure 2 Adulterants in Tea Leaves

Adul. 1= Artificially colored tea, Adul.2= Exhausted tea, Adul.3= Iron flakes, Adul.4= Leather flakes and Adul.5= Coal tar dye

Adulterants in Syrup

Three different types of adulterants named rhodamine b, metanil yellow color and saccharin in syrups were evaluated in samples collected from different regions of Faisalabad. The results given in Table 4 showed significant ($p< 0.01$) variation regarding adulteration of syrups illustrated that 36% syrups samples were adulterated with rhodamine b and metanil yellow while 27% samples were adulterated with saccharin. Studies from numerous countries have revealed that using saccharin in syrups. Dixit et al., (2011) stated that amongst non-permitted colors, Rhodamine B (10.9%) and metanil yellow (0.10%) were most widespread colors. Gresshma and Paul, (2012) reported that Rhodamine B was found to be illegally in different foods. There were 75 samples studied at 40 percent of presence level of Rhodamine B.

Adulterants in Beverages

Adulterants named metanil yellow color and saccharin were analyzed in collected samples from different regions of Faisalabad. Significant ($p< 0.01$) difference was observed regarding presence or absence of adulterants (Table 5), with 60% samples of beverages were free from metanil yellow color and saccharin. It has been seen that 20.94% of the total samples contained the metanil yellow in a significant amount. Further, 63.79% and 36.21% of the positive samples showed the contamination of metanil yellow above the maximum permissible limit and below the maximum permissible limit respectively (Nath et al., 2015). Hammud et al., (2014) studied that the utilization of saccharin by beverage industries.

Table 3 Adulterant in Soda Lemonade

Soda lemonade		Adulterant
		Mineral acid
Absent	No. of Samples	9
	%	43
Present	No. of Samples	12
	%	57
Total	No. of Samples	21
	%	100
X2		21.00**

p		<0.01

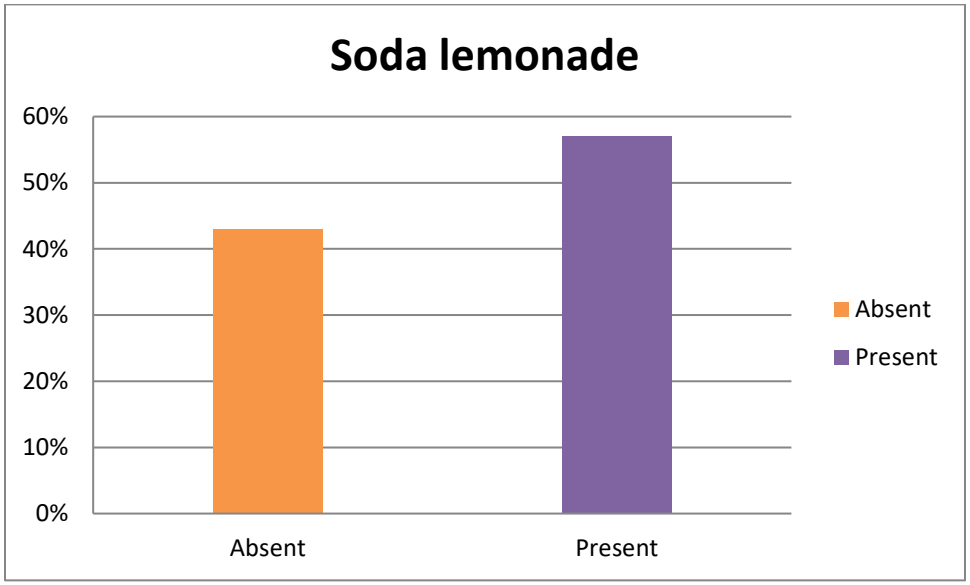

Figure 3 Adulterant in Soda Lemonade
Adul. 1= mineral acid

Table 4 Adulterants in Syrups

Syrups		Adulterants		
		Rhodamine b	Metanil yellow	Saccharin
Absent	No. of Samples	21	21	24
	%	64	64	73
Present	No. of Samples	12	12	9
	%	36	36	27
Total	No. of Samples	33	33	33
	%	100	100	100
X2		33.00**	33.00**	33.00**
p		<0.01	<0.01	<0.01

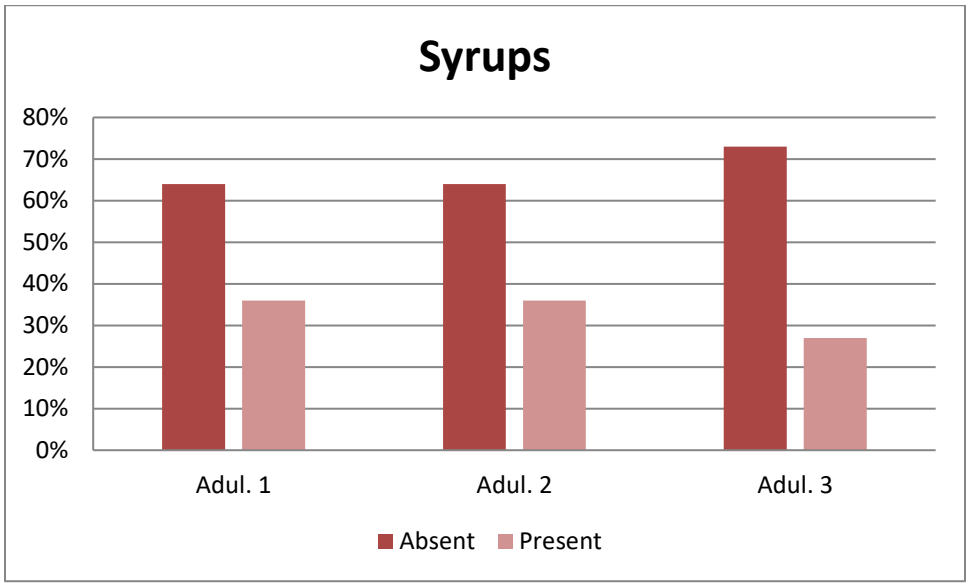

Figure 4 Adulterants in Syrups

Adul. 1= Rhodamine b, Adul.2= Metanil yellow color, Adul.3= Saccharin

Table 5 Adulterants in Beverages

Beverages		Adulterants	
		Metanil yellow	Saccharin
Absent	No. of Samples	9	9
	%	60	60
Present	No. of Samples	6	6
	%	40	40
Total	No. of Samples	15	15
	%	100	100
X2		15.00**	15.00**
p	0.0047	<0.01	<0.01

Total Plate Count of Beverages

Total Plate Count of Coffee

The coffee samples were collected from three regions of Faisalabad (Satiana, Chiniot, Jhang). Statistical results of total plate count (TPC) illustrated non-significant variation in total plate count (Table 6). The mean values of TPC (Table 7) from three regions of coffee samples were 15500±1200, 18700 ±2200 and 15100±1200 respectively. Results demonstrated that it ranged from1.43x104 to 1.67x104, 1.65 x104 to 2.09 x104 and 1.39 x104 to 1.63 x104. The microbial load in the coffee samples may be due to low level of quality control in supply chain. Highest value of TPC was 2.09 x104 cfu in region 2 and lowest value 1.39 x104 in region 3 as can be seen from (Figure 6). The microbial load in the coffee samples may be due to poor quality handling, storage and stock of market conditions.

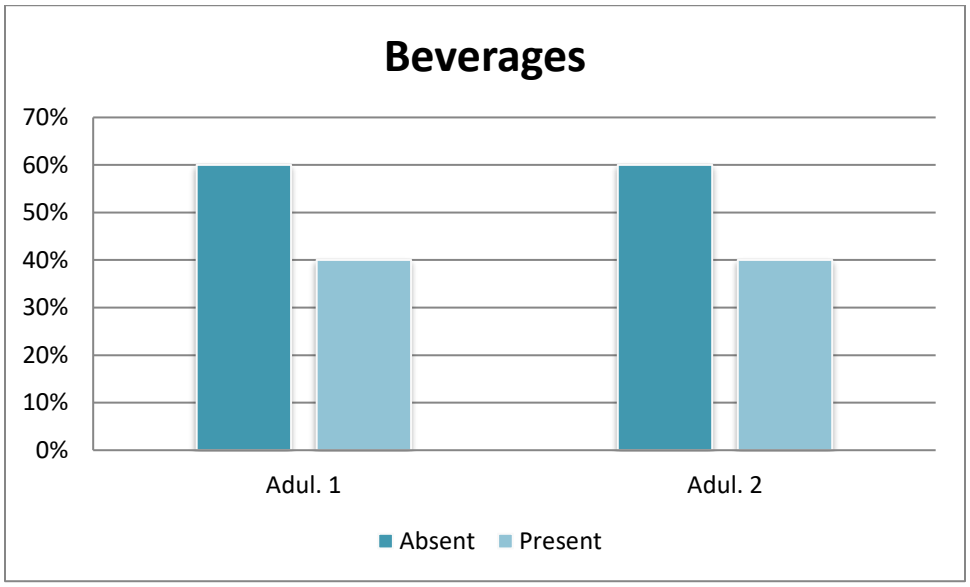

Figure 5 Adulterants in Beverages
Adul. 1= Metanil yellow color and Adul.2= Saccharin

Total Plate Count of Tea Leaves

The tea leaves samples were collected from three regions of Faisalabad. Statistical results of total plate count (TPC) illustrated significant variation in total plate count (Table 8). The mean values of TPC (Table 9) from three regions of Faisalabad of tea leaves samples were 39600±4950, 49450 ±3850 and 28583.33±5253.887 respectively. Results demonstrated that it ranged from 3.47x104 to 4.46x104, 4.56 x104 to 5.33 x104 and 2.56 x104 to 3.47 x104. The microbial load in the tea leaves samples may be due to low level of quality control in supply chain. Highest value of TPC was 5.33 x104 cfu in region 2 and lowest value 2.56 x104 in region 3 as can be seen from (Figure 7). The microbial load in the tea leaves samples may be due to poor quality handling, storage and stock of market conditions.

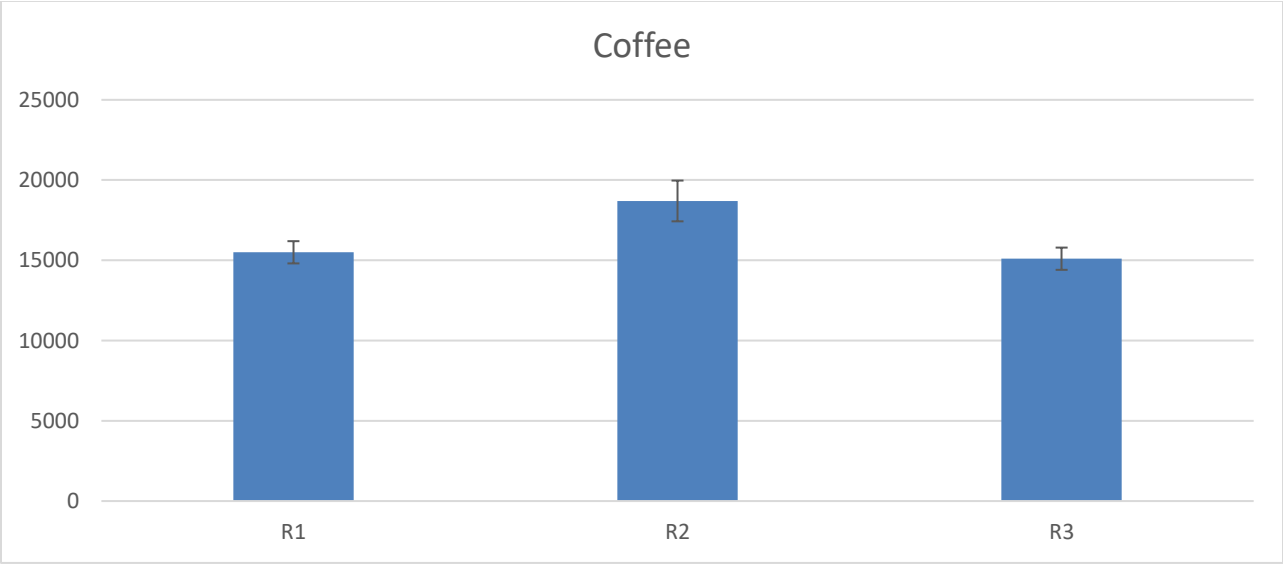

Figure 6 Total Plate Count of Coffee samples

Table 6 Analysis of Variance for Microbial Count of Coffee samples

S.O.V	DF	SS	MS
Region	2	2.336E+07	1.168E+07ns
Error	6	1.544E+07	2573333ns
Total	8	3.880E+07	

Table 7 Mean Values of Coffee samples

Region	Coffee
R1	15500±1200
R2	18700±2200
R3	15100±1200

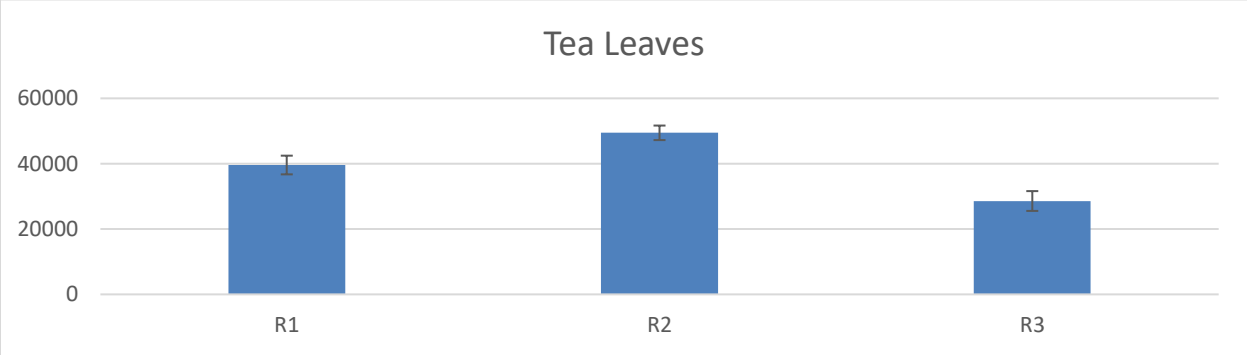

Figure 7 Total Plate Count of Tea Leaves samples

Table 8 Analysis of Variance for Microbial Count of coffee samples

S.O.V	DF	SS	MS
Region	2	6.517E+08	3.259E+08*
Error	6	1.338E+08	2.231E+07*
Total	8	7.856E+08	

Table 9 Mean Values of tea leaves samples

Region	Tea Leaves
R1	39600±4950ab
R2	49450±3850a
R3	28583.33±5253.887b

Total Plate Count of Soda lemonade

The soda lemonade samples were collected from three regions of Faisalabad. Statistical results of total plate count (TPC) illustrated significant variation in total plate count (Table 10). The mean values of TPC (Table 11) from three regions of Faisalabad of soda lemonade samples were 50850±2450, 33650±4926.713 and 32300±5671.86 respectively. Results demonstrated that it ranged from 4.84x104 to 5.33x104, 2.93 x104 to 3.90 x104 and 2.60 x104 to 3.70 x104. The microbial load in the soda lemonade samples may be due to low level of quality control in supply chain. Highest value of TPC was 5.33 x104 cfu in region 1 and lowest value 2.60 x104 in region 3 as can be seen from (Figure 8).

The microbial load in the soda lemonade samples may be due to poor quality handling, storage and stock of market conditions. Results indicated that all the commercial samples were below the detection limit for the viable microorganisms. Results of analysis of those home-made tiger-nut samples revealed that 67% (16 samples) total plate counts while the rest of samples were free from these

microorganisms. Results reflected that there exists a rather high contamination level in home-made tiger-nut beverages. There were 16 samples total plate counts ranged from 3.65-6.47 log cfu ml-1. The rest of the examined samples (eight samples) were free of viable bacteria (8x103cfu ml-1).

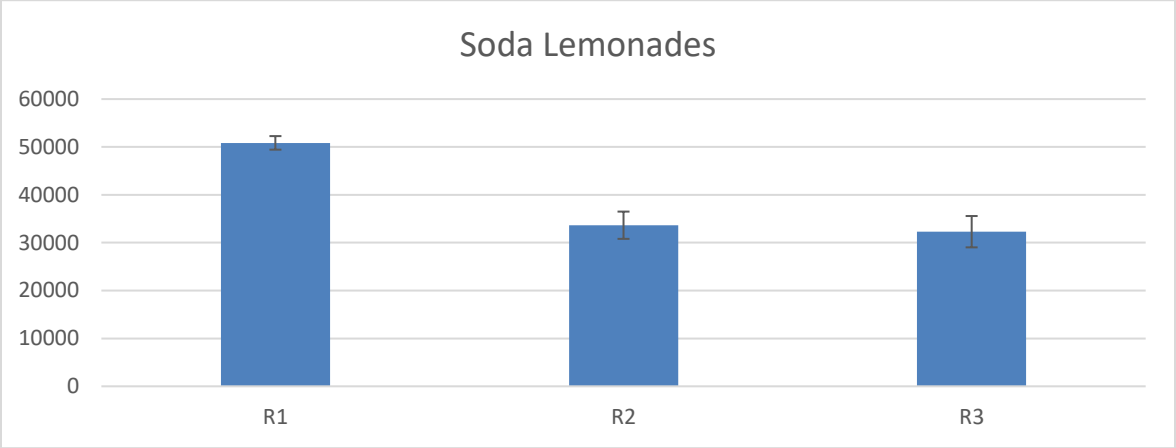

Figure 8 Total Plate Count of Soda lemonade samples

Table 10 Analysis of Variance for Microbial Count of Soda Lemonade samples

S.O.V	DF	SS	MS
Region	2	6.424E+08	3.212E+08*
Error	6	1.247E+08	2.080E+07*
Total	8	7.672E+08	

Table 11 Mean Values of Soda Lemonade

Region	Soda Lemonade
R1	50850±2450a
R2	33650±4926.713b
R3	32300±5671.86b

Total Plate Count of Syrups

The syrups samples were collected from three regions of Faisalabad. Statistical results of total plate count (TPC) illustrated significant ($p< 0.01$) variation in total plate count (Table 12). The mean values of TPC (Table 13) from three regions of Faisalabad of syrups samples were 50600±5029.662, 25650±3993.432 and 10900±1300 respectively. Results demonstrated that it ranged from 4.55x104 to 5.55x104, 2.13 x104 to 2.92 x104 and 9.60 x103 to 1.22 x104. The microbial load in the syrups samples may be due to low level of quality control in supply chain. Highest value of TPC was 5.55x104 cfu in region 1 and lowest value 9.60 x103 in region 3 as can be seen from (Figure 9). The microbial load in the syrups samples may be due to poor quality handling, storage and stock of market conditions.

Total Plate Count of Beverages

The beverages samples were collected from three regions of Faisalabad. Statistical results of total plate count (TPC) illustrated significant ($p< 0.01$) variation in total plate count (Table 14). The mean values of TPC (Table 15) from three regions of Faisalabad of beverages samples were 67000±10000, 41000±5000 and 42000±9000 respectively. Results demonstrated that it ranged from 5.70x104 to 7.70x104, 3.60 x104 to 4.60 x104 and 3.30 x104 to 5.10 x104. The microbial load in the beverages samples may be due to low level of quality control in supply chain. Highest value of TPC was 7.70x104 cfu in region 1 and lowest value 3.60 x104 in region 2 as can be seen from (Figure 10). The microbial load in the beverages samples may be due to poor quality handling, storage and stock of market conditions.

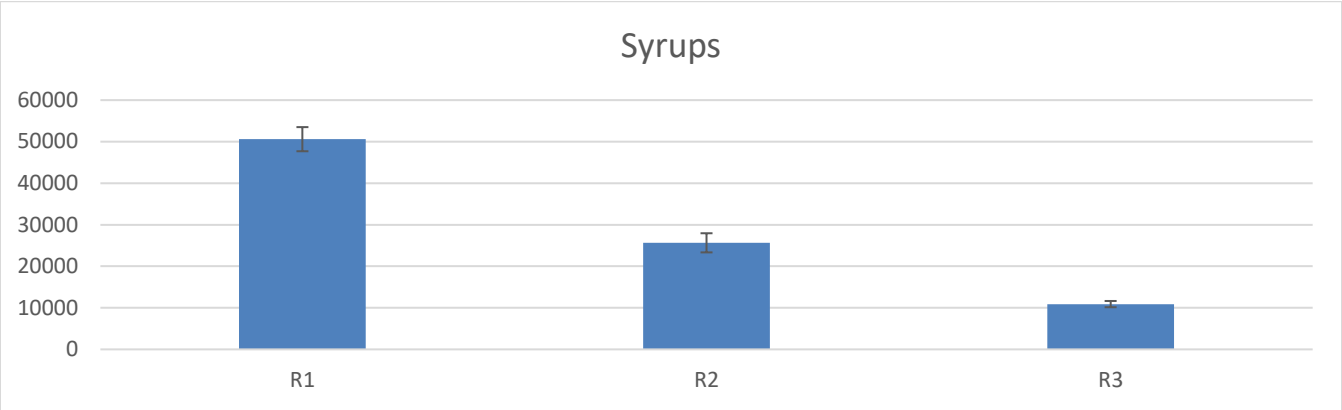

Figure 9 Total Plate Count of Syrups samples

Table 12 Analysis of Variance for Microbial Count of syrups samples

S.O.V	DF	SS	MS
Region	2	2.420E+09	1.210E+09**
Error	6	8.573E+07	1.428E+07**
Total	8	2.506E+09	

Table 13 Mean Values of syrups samples

Region	Syrup
R1	50600±5029.662a
R2	25650±3993.432b
R3	10900±1300c

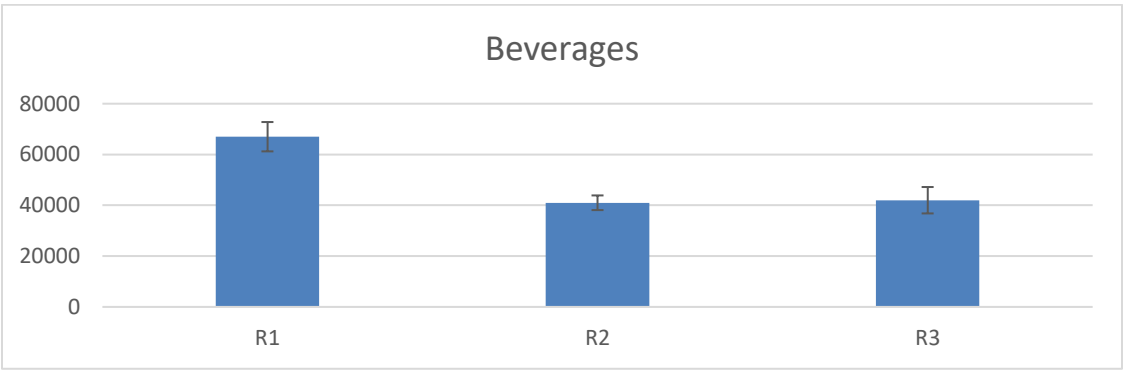

Figure 10 Total Plate Count of Beverages samples

Table 14 Analysis of Variance for Microbial Count of Beverages samples

S.O.V	DF	SS	MS
Region	2	1.302E+09	6.510E+08*
Error	6	4.120E+08	6.867E+07*
Total	8	1.714E+09	

Table 15 Mean Values of Beverages Samples

Region	Beverages
R1	67000±10000a
R2	41000±5000b
R3	42000±9000b

4. CONCLUSION

These products have to be consumed by ensuring their safety status rather than using them at harmful level. The food adulteration is an issue not just decreases the food quality but also have numerous bad effects on health. It is concluded that the selected food products were affected by adulteration and their safety level has to be addressed and further checked with highly sophisticated analytical techniques for in depth study.

Informed consent

Not applicable.

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This study has not received any external funding.

Ethical approval

In this article, the product ethical regulations are followed as per the ethical committee guidelines of National Institute of Food Science and Technology, University of Agriculture, Faisalabad, Pakistan; the authors observed the safety assessment of some food products with reference to adulteration in Faisalabad, Punjab, Pakistan. The "brand name" of the product not mentioned in content and "brand image" not displayed as image in the article. The product ethical guidelines are followed in the study for observation, identification & experimentation.

Conflict of Interest

The author declares that there are no conflicts of interests.

Data and materials availability

All data associated with this study are present in the paper.

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