

Prevalence of microbes in unpacked dried fruits – a public health alarm

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Abstract

Problem: Food borne infections and intoxications were the principal cause leading to various gastrointestinal disorders including diarrhea with devastating and fatal health consequences. Investigations related to microbial identification provided a clear picture for ensuring the food safety and this study has been limited to dried fruits only. **Design/ Methodology:** The objective of this study is to design for isolating *E. coli*, *Salmonella* sp primarily and other possible microbes from the unpacked dried fruits available in the study area. The details about the dry fruits were collected. All the unpacked dried fruits samples were analyzed for their physical properties and further analyzed for pH, moisture content and water activity. The initial qualitative screening of the dried fruits was microscopically assessed by wet mounting. Further, the samples were inoculated on appropriate culture media and the colonies were assessed for the presence of bacterial and fungal species. **Findings:** In this study, the bacterial species like *Staphylococcus* dominating followed by *E. coli*, *Salmonella*, *Bacillus cereus*, *Pseudomonas* and *Shigella*. Among fungal species, *Aspergillus*, *Rhizopus* and *Penicillium* are the possible isolates in this study. No spoilage state of the dried fruits was found. **Conclusion:** By this study, the vendors were educated appropriately in order to minimize the microbial load in dried fruits and also recommended the health authorities to inspect such unpacked fruits frequently and necessary measures will be taken to curtail the spread of food borne infections.

Keywords: 1.Unpacked dried fruits, 2.microbial contamination, 3.health issues

Introduction

Salmonella sp and *Escherichia coli* are the leading causes of food borne illnesses. Consumers have to be protected from food borne illnesses that are caused by *E. coli*. It is estimated that *Salmonella* causes more food borne illnesses than any other bacteria. *Salmonella* and *E. coli* are the common food borne pathogens affecting millions of people annually. Food borne illnesses are the principal cause leading to diarrhea or debilitating and fatal health consequences (Todd, 2014). Globally *Salmonella* is estimated to cause one million cases of food borne illnesses annually, accounting for 28 and 35% of all hospitalizations and deaths respectively. The contaminated low moisture foods (LMFs) are important vehicles for these outbreaks,

accounting for 21% of investigated *Salmonella* outbreaks reported by the Centers for Disease control and prevention (CDC) (CDC, 2019).

Worldwide LMFs were involved in numerous outbreaks, with *E. coli* and *Salmonella* infections that are responsible for 49 and 53% respectively; while an overwhelming majority (83%) of food borne outbreaks associated with LMFs between 2007 and 2018 involved *Salmonella* alone (Jayeola *et al.*, 2022). Since dried fruits have a water activity (aW) below 0.85, they are considered as low moisture foods (Larry and Beuchat *et al.*, 2013). Unlike many other LMFs, dried fruits are characterized by a unique combination of traits, including low water activity and pH, high sugar content, and exhibiting antimicrobial phenolic compounds. Dried fruits proved an increased concern as vehicles of food borne pathogens implicating outbreaks of *Salmonella* and *E. coli* infections (Gruzdev *et al.*, 2011).

The survival of *E. coli* and *Salmonella* on dried fruits is considerably lower than that on other LMFs (Beuchat *et al.*, 2013). Nonetheless, *Salmonella* and other food borne pathogens could still be recovered from certain dried fruits for weeks or months, especially variant temperatures, thoughts of non-contamination by spoilage microbes and storing for long time suggesting that the presence of microbes on dried fruit that raises food safety and public health concerns.

Food borne illnesses are highly infectious and caused by food borne pathogens that are disturbing the gastrointestinal system through contaminated food and food products. These incidences of food borne diseases were underreported and there is a difficulty in the establishment of causative agent of food contamination, hence the illness and fatality has created a burden to public health. Globally the health threats are endangering the public and it is enhanced by unsafe food. All food handlers and consumers must understand the public health importance and they must play their role by following standard hygienic practices.

Unpacked open air exposed and long stored dried fruits are having more number of microbial pathogens and they are more infectious than packed dried fruits. Food borne pathogens from dried fruits are reported in some studies which has raised a serious public health concern (Witthun *et al.*, 2002). Several factors including the type of fruits, drying methods and storage time and temperatures are involved for the survival of common food borne pathogens on dried fruits (Sushumna *et al.*, 2022). In order to curtail the food spoilages in dried fruits and related infections, there should be a good collaboration between policy makers, industries, sales persons, consumers to ensure safety of the food products.

These type of experimental analysis are not taken place much in research in order to determine the presence of infectious microbes on the surface of unpacked dried fruits. The harvested fresh fruits dried within a week have very less or no microbial load; thus inclusion of dried fruits which are not packed and are stored in the market for intermittent and long period. The details of the unpacked dried fruits provide vast information related to type of dried fruit, method, display, store and type of consumers. The unpacked dried fruits are subjected to analyze the water activity level for determining the source and type of microbes (Beuchat *et al.*, 2013). Microbiological investigations provide a clear picture to all stake holders for ensuring the food safety. This experimental study has been limited to dried fruits alone and analyzed from a single city.

This study creates awareness about the presence of infectious microbes in the unpacked dried fruits which leads to food poisoning and intoxications. Hence, the objective of the current study is designed to isolate *E. coli*, *Salmonella* sp primarily and other possible microbes from the unpacked dried fruits.

Materials and Methods

Study Design: This is designed for the purpose of analyzing the presence or absence of microbial (both bacterial and fungal) entities in the unpacked dried fruits by standard Experimental study.

Type of the Study: This is a prospective observational study carried out in the single zone of Central Tamilnadu.

Sample Size: Five samples per dried fruits were included [Tutti frutti (dried sweetened raw papaya), cherry, dates, raisins and figs). Overall, 25 samples (each five samples) were subjected for physical, chemical and hydration characterization, and microbiological investigations.

Inclusion criteria: Dried [unpacked and packed (control)] fruits

Exclusion criteria: Fresh fruits; dried within a week

Demographic details

The details about the dry fruits including period and source of harvesting, reason for unpacking, frequency of sales, type of customers and cost were collected. These data were highly useful for understanding the route of entry, proliferation status and appropriate environment for growth and development, pathogens responsible for various gastrointestinal diseases and disorders, the mode of curtailing the spread of infection.

Physico-chemical properties

All the unpacked dried fruits samples were analyzed for their physical properties based on the visual observations and further subjected to analyze pH and moisture (%) using Hanna – H1 8314 membrane pH meter. For moisture determination, 10 grams of all the test samples were weighed and dried at 105°C in furnace till reaching a fixed dry weight, and then water content was determined by comparing the weight before and after furnace drying (Abekhti *et al.*, 2013).

In general, the aW of various samples were calculated from the difference in weight between the fresh and dried fruits and expressed in gram per gram of the dried fruits (Marzec *et al.*, 2010). But in this study, we use the dried fruits directly, thus comparing with fresh fruits were not possible. The test dried fruits were then dried in desiccators at 25°C until the water activity (a_w) approximated (Jayeola *et al.*, 2022) and aW was performed using All food, Pan India aW instrument (at 25°C ± 2°C with high accuracy of ±0.003aW). The controlled humidity (0%) and temperature (25°C) was maintained until use for further quality comparison (Marzec *et al.*, 2020).

Direct Microscopy

For initial microbiological qualitative screening, the dried fruit samples were further marinated into small pieces and soaked in the sterile distilled water and the water samples will be microscopically assessed by wet mount microscopy. The quality of the sterile distilled water was confirmed by screening the same by wet mount microscopy before processing.

Culturing

Further, the samples were smashed and the pulp samples were inoculated on Nutrient, MacConkey, Eosin methylene blue, *Salmonella Shigella* (SS) agar and Sabaroud's Dextrose agar plates and incubated appropriately. The colonies were assessed for the presence of *E. coli* and *Salmonella* sp. from respective selective agar plates and possibilities of other bacterial species from Nutrient and MacConkey agar plates. Further, the isolates were impregnated for determining genus and species level using microscopy, biochemical tests and other specific confirmatory tests. In this study, total aerobic viable bacterial load were enumerated in colony count of dried unpacked fruits whose limit of detection is 30 colony forming units (CFU)/ gram (g) (Abekhti *et al.*, 2013; Lani *et al.*, 2019).

For quality checking and maintaining negative control, the sterile distilled water used for smashing the samples were also plated. All the samples were inoculated in subjective agar plates in duplicate for fungal identification and triplicate for bacteria, and the mean values of bacterial counts were recorded as CFU/g (Neha and Surbhi, 2021). All the data were analyzed statistically and reported as mean and standard

deviation with coefficient of variance (CV) and p-value less than 0.05 is considered to be statistically significant.

Results

The basic information about the details of source and period of collection, reason for unpacking, frequency of sales, type of customers were collected and impregnated in table 1. Accordingly, most of the vendors collected the dried fruits (5 different dried fruits from 5 different locations) from other wholesale vendors and very few were interested to visit the harvesting site and collect the fresh fruits and performed the drying mechanism in their area. All the vendors informed that they won't discard any dried fruits even after expiry; and they are selling the expired dried fruits in low cost and large quantity.

The physical properties based on the visual observations of all the dried fruits subjected for this investigation were described for its texture, size, watery nature and colour. By nature, each and every fresh and dried fruits having its own physical properties; if deviations found, then it may not be considered for consumption and the detailed physical properties verses location of collection of the dried fruits were depicted in table 2.

The higher mean pH value was observed among tutti frutti (6.26) followed by dates and figs with 4.48 and 3.94 respectively and the p value showed significant. The higher mean percentage moisture was recorded as 28.12% (cherry) followed by dates (22.7%) and raisins (18.56%). While determining the water activity levels, it was identified that the cherry (1.06) showed greater value compared with other dried fruits and the detailed statistical description of various fruits were tabulated (Table 3).

The direct microscopic observations of various dried fruits (n=25) showed presence of mono (as cocci and as motile bacilli) [13 (52%)], di (cocci and motile bacilli) [9 (36%)] and poly (cocci, motile and non motile bacilli) [3 (12%)] bacterial combinations among 25 samples of dried fruits isolated from 5 different locations. The sterile distilled water used for culture media preparations showed no microscopic cells and debris. All the packed dried fruits are not shown microbial shades except tutti frutti; the microscopic observation of tutti frutti showed some bacterial cells (trace of cocci). The figure 1 explained the detailed description of the wet mount microscopy.

Out of five locations included in this study, the location one and five which are semiurban areas showed maximum number of isolates of 12 and 11 respectively; where *Staphylococcus* dominated with 4 samples (except tutti frutti in location one and Cherry in location five) followed by *Salmonella* with 3. In location 3, *Staphylococcus* dominated except in figs followed *E. coli* and *Salmonella*. In the location 4, *Shigella* species isolated which was not isolated in any location. No growth was identified in the dates of location 2.

Among dried fruits included in this study, tutti frutti showed maximum isolation of *Salmonella* with 4 possibilities followed by *Pseudomonas* and *Staphylococcus*. No other fruits showed *Shigella* growth except tutti frutti of location 4. All the samples showed *E. coli* growth in Cherry followed by *Staphylococcus* and *Salmonella*. While processing figs from five locations, *Bacillus cereus* isolated from three locations except 1 and 5. *Salmonella* growth dominated with all five samples in Raisins followed by *Staphylococcus*. The date samples showed maximum isolates of *Staphylococcus* followed by *Pseudomonas*.

Staphylococcus was considered as a dominating isolates with 16 samples. *Bacillus cereus* isolates (n=6) were possible in figs followed by raisins and tutti frutti; dates and cherry were free from *B. cereus*. Eleven isolates of *Salmonella* recorded (five raisins samples, four tutti frutti and two cherry). Isolates of *Shigella* species and *Shigella dysenteriae* are possible only in tutti frutti, other samples were free from *Shigella*. All five cherry samples had *E. coli* followed by figs, no *E. coli* found among tutti frutti. Out of 25 samples, *Pseudomonas* isolation was possible among five samples.

The sterile distilled water had no microbial growth in any of the culture plates. Further, the microscopically identified packed tutti frutti showed bacterial growth and confirmed as *Staphylococcus* sp,

which is a normal skin flora. No fungal growth observed. The data variations of bacterial isolates among dried fruits samples verses location, samples and bacteria were depicted in table 4 and figure 2.

The monofungal isolation was possible with *Aspergillus* species in location 1; difungal (*Aspergillus* and *Rhizopus*) was found among three locations and one location had trifungal (*Aspergillus*, *Penicillium* and *Rhizopus*). No fungal growth was observed while processing tutti frutti; whereas *Aspergillus* and *Rhizopus* were isolated from cherry, figs and dates; and only *Aspergillus* isolated from Raisins. Out of 20 fungal isolates, *Aspergillus* sp. (n=13; 65%) followed by *Rhizopus* sp. (n=6; 30%) and *Penicillium* sp. (n=1; 5%) (Table 5 and Figure 3).

The growth of the bacterial isolates was determined by CFUs/g of the five dried fruit samples which were collected from five different locations. The bacterial CFUs were found lesser in all samples except in tutti frutti; only one sample of dates showed nil growth and the detailed counts of CFU were pictured in figure 4.

Discussion

This study is highly useful for understanding the route of entry, proliferation status and appropriate environment for growth and development, pathogens responsible for various gastrointestinal diseases and disorders, the mode of curtailing the spread of infection especially with dried fruits. While interviewing with the vendors, they told that they purchased from the whole sale market and not having any ideas of method of drying. Commercially, the pretreatment process of dried fruits remove the humidity faster before they dry naturally; this is processed by physical and chemical methods which retain the colors, aroma and nutritional levels. By Microbiological point of view, the processes takes place for drying is to ensure hygiene by curtailing microbial entry, growth and reactions (Kaveh *et al.*, 2020; Alp and Bulantekin, 2021).

In this study, none of the vendors are trained for antimicrobial maintenance of dried fruits. The knowledge about the expiry, spoilage state, maintenance strategies, storage methods, risk of contamination, reusable steps and time of disposal are lacking among vendors. After drying, the fruits are to be preserved to extend the shelf-life, which is largely useful to ensure the quality and safety. Canning, drying, freezing, freeze drying, inert gases, irradiation, preservatives, spray drying, sugar crystallization and vacuum packing are the common mode of drying the fruits (Yadav and Singh, 2014).

The physical observations of the test dried fruits included in this study were described to understand the colour, size, texture and watery nature. Among them, texture of dried fruits is considered as the important quality that attributes the food products thereby, soft to hard, shrunked and sticky observed. No studies so far highlighted the physical characteristics as a whole. The changes takes place in the dehydrated fruits affects structure. The size of the dried fruits is ranged from square to irregular. In common, the drying of fruits takes place by frictional properties between the fruits and surface materials; thus the structure varied (Keramat *et al.*, 2008).

The water content of the dried fruits plays a vital role in the colonization of microbes. The pretreatment process while air drying may reduce water content from 30 to 70% (Yadav *et al.*, 2014) provides a maximum dried environment to reduce the microbial entry. In nature, low and high contents of dry mass and tannins respectively are most important while drying fruits (Agata *et al.*, 2010).

The pH of the dried fruits provides the picture of acidic and alkaline state, thereby the type, source and variance of the microbes analyzed. In this study, the mean highest pH level was identified among tutti frutti (6.26 ± 0.42) and minimum level was 3.7 ± 0.35 among cherry. This indicated that the tutti frutii is high source of bacterial spoilage and cherry with fungal colonization leads to consumer health risk. Bacterial cells lodging on the surface of dried fruits are directly exposing to internal tissues with high acidic environment showed minimal, also making it to difficult for attributing the pH level as a factor that are largely influencing the inactivation rate of bacteria (Alp and Bulantekin, 2021); but fungal growth is encourageable.

The moisture content and water activity of the dried fruits included in this study showed maximum of 28.12 ± 2.58 and 1.06 ± 0.23 among cherry respectively; whereas the lesser had found among figs with

15.34±1.74 (moisture content) and 0.7±0.09 (aW). The data were statistically significant ($p=0.05$) for moisture content conversely, insignificant for aW ($p=0.02$). The moisture content is an important indication for dried fruits, thereby the lesser moisture content curtail the microbial growth (Miranda *et al.*, 2011). Additionally, the size, structure, color, flavor, texture, aeration and nutritional value of the dried fruits are determined by influencing the major parameters including aW (Radojcin *et al.*, 2021). While storing and displaying the unpacked dried fruits for selling, the vendors are not much concentrating on the moisture that leads to acquiring microbes from the environment. The storage and proper maintenance including temperature of the dried fruits are inversely proportional to shelf life and quality of the product (Romeo *et al.*, 2010).

The wet mount microscopy of dried fruits included in the study showed certain bacterial cells ranging from trace to numerous. The tutti frutti showed some bacterial cells likely to be trace of cocci mainly due to the unhygienic handling contamination. Education is required among the vendors for maintaining the hygienic and microbe free unpacked dried fruits for public health importance. The culture plates dominating with *Staphylococcus* followed by *E. coli*, *Salmonella*, *Bacillus cereus*, *Pseudomonas* and *Shigella* as described in table 4. The same type of observation was also made by other studies (Witthuhn *et al.*, 2005; Zhuosheng *et al.*, 2021; Akbas and Ozdemir, 2008). Scanty data about *Pseudomonas* and *Shigella* isolation observed in some dried fruits (Ntuli *et al.*, 2017).

Generally, fruits are rich in carbohydrates, fibers, proteins, essential vitamins and minerals supporting the human health in various aspects. Now a days, all age groups and genders are much concentrating on balanced diet; thereby consumption of fruits and vegetables increasing; leads to reducing the nutritional deficiencies and risk of various diseases (Tango *et al.*, 2018). The increasing demand of dried fruits and their products are continuing due to non-availability of the fresh fruits throughout the year; but researchers and nutritionists always thinking about the comparativeness of nutritional values of fresh fruits and its dried conditions. Despite the entire nutrition is not available in the dried fruits, the passion of modern dish, storage, long period of usage and easy transportation motivates to prefer dried fruits.

Naturally, the fresh and raw fruits are largely contaminated with various saprophytic and pathogenic microorganisms such as *E. coli*, *Staphylococcus aureus*, and *Salmonella* spp (Buyukunal *et al.*, 2015). While the same fruits dried by various methods, the colonization of same microorganism are questionable. The factors that influencing the microbial contamination in dried fruits are usually done when contact with dust, soil, and wastewater during harvest and post-harvest periods, method of drying, complete or partial drying, storage methods, logistics and vendor display (Buyukunal *et al.*, 2015).

The colonized microbes on dried fruits may cause serious diseases including abdominal distress, nausea and vomiting, diarrhea with or without fever and headache, abdominal cramps, lethargy, low blood pressure and pulse rate, and even death (Alp and Bulantekin, 2021). In fresh fruits, the environment for microbial growth is suitable thereby the colonization and stress behavior of the microbes are neutral, whereas in dried fruits, the stress environments for the microbes are high, thus making them more infectious while consuming that provide more option for colonization, thereby infection state increased.

Generally, microflora in vegetables is associated with bacterial groups while the fruit flora generally consists of yeasts and molds. Dried fruits provide shelter for pathogenic microbes where it can survive even at low water activity (Finn *et al.*, 2013). Bacteria are considered as the confronted cell which can survive at various stress environments including diverse temperatures, higher osmolality and acidic pH (Singh *et al.*, 2017). In response to the dry environment, the microbes accumulate biofilm formation, filamentation and osmoprotectant molecules (glutamate, potassium chloride and trehalose) (Chitrakar *et al.*, 2019; Finn *et al.*, 2013).

In this study, *Aspergillus* isolates dominated followed by *Rhizopus* and *Penicillium* (Figure 3); correlated the previous study highlighted the various species of *Aspergillus* (*A. flavus* and *A. niger* and *A. fumigatus*). The uncontrolled and unlicensed marketing of unpacked dried fruits in developing countries like

India provide lodgment for various fungal pathogens that cause systemic infections along with aflatoxin and other fungal toxins leads to major clinical complications (Abbas *et al.*, 2004; Abbas *et al.*, 2019). *Penicillium* spp., were isolated from Dates and second predominance of *Rhizopus* spp. showed the possibilities of fungal entry when the dried fruits are unpacked which was documented in previous reports (Rossetto *et al.*, 2005; Abbas *et al.*, 2019).

This laboratory based experimental study highlighted the presence of bacterial and fungal contamination in the test dried fruits which are defined as rich source of nutrients even though the growth factors are minimally available. This cause mild to severe health issues while consuming the contaminated dried fruits. In this study, the spoilage state of the dried fruits is not found. Care should be taken while purchasing such unpacked dried fruits for consumption. The surface cleaning of the unpacked dried fruits also suggested for consumers. Vendors have to be educated appropriately in order to minimize the microbial load in the products and also teach them about the personal and environmental hygiene. This study recommends the health authorities to inspect such unpacked fruits available in local markets frequently and take necessary measures to curtail the spread of food borne infections.

Conclusion

Six bacterial isolates (*Staphylococcus*, *E. coli*, *Salmonella*, *B. cereus*, *Pseudomonas* and *Shigella*) were possible in this study by screening the five different dried fruits collected from five locations of the study area. Among fungus, *Aspergillus*, *Rhizopus* and *Penicillium* were isolated. Further, this work is extended with various unpacked dried fruits throughout the region in order to explore more possible microbial species associated with food borne infections and intoxications.

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Table 1: Categorical response among vendors (n=5)

Category	Response	Number (%)
Source of harvesting	Purchase from other vendors	4 (80)
	Direct harvesting and drying by own	1 (20)
Reason for unpacking	No facility	4 (80)
	Costly	4 (80)
	Easy to handle	5 (100)
	Easy to display	5 (100)
Frequency of sales	More than 10 customers/ day	4 (80)
	Predominantly during evening time	5 (100)
Type of customers	Upper middle class	3 (60)
	Middle class	4 (80)
	Lower middle class	5 (100)
	Lower class	5 (100)
	Below poverty line	5 (100)
	Children	5 (100)
Period of collection	1 to 2 weeks	2 (40)
	2 to 4 weeks	3 (60)
	4 to 6 weeks	3 (60)
	6 to 8 weeks	2 (40)

Figure 1: Wet mount microscopic observations of dried fruits

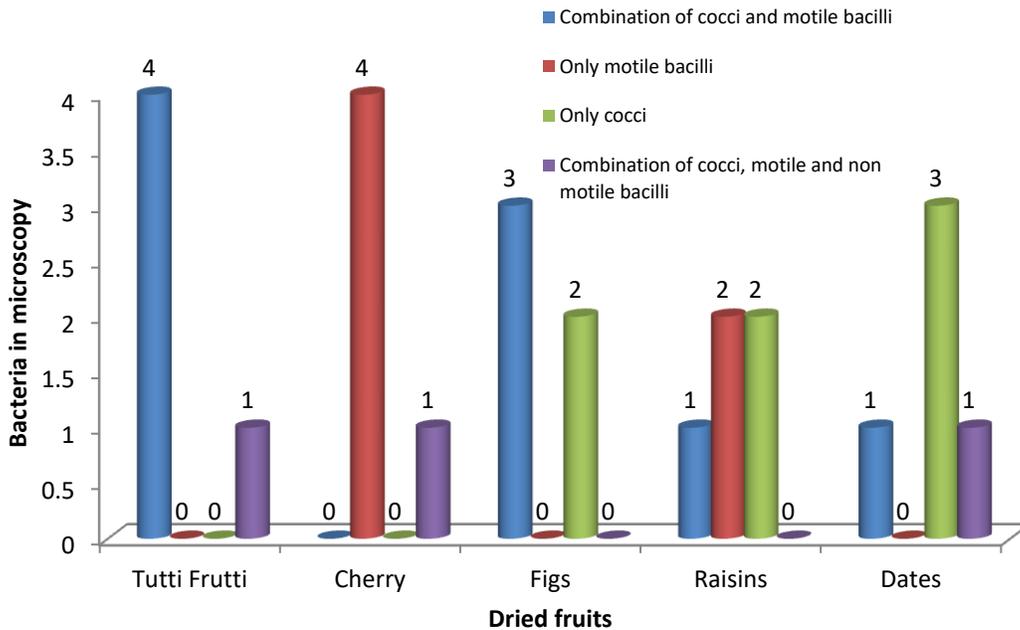


Table 2: Location wise physical properties of dried fruits

Samples	Physical properties of dried fruits verses location (in numbers)																			
	Texture					Size and shape					Watery nature					Colour				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Tutti Frutti	a	a	a	a	a	a,c	a,c	b,c,d	a,b,c	c,d	a	a	a	a	a	a	a	a	a	a
Cherry	b	b	b	b	b	b,e	a	b	b	a	b	b	b	b	b	b	b	b	b	b
Figs	c	c	c	c	c	a,e	a,f	a,b,f	a,f	a,e	c	c	c	c	c	c	d	d,e	d,e	c
Raisins	d	d	d	d	d	a	a,b	b	b	a	a,b	a,b	c	a,b	a,b	d	f	f	d	e
Dates	e	e	e,f	d	e	b	a	a	a	a	c	b	b	b	b	f	e,f	e	e,f	e

[**Location:** 1 - Semiurban area; 2 - Rural -collected during festival time; 3 - Urban - crowd area; 4 - Urban - high crown area; 5 - Semiurban area; **Texture:** a - little hard, b - soft, seeds are removed and fruit cut in the middle, c - peeled dried and sliced into fragments, d - dry but slightly sticky, e - shrunked with seeds and f - shiny; **Size and Shape:** a - smaller, b - medium, c - square, d - rectangle, e - round, f - uneven; **Watery nature:** a - sticky, b - watery and pulpy, c - completely dried; **Color:** a - artificial colors, b - red, c - buff and brown, d - pale brown, e - dark brown, f - black]

Figure 2: Possible bacterial isolates from dried fruit samples (n=25) from various locations (n=5)

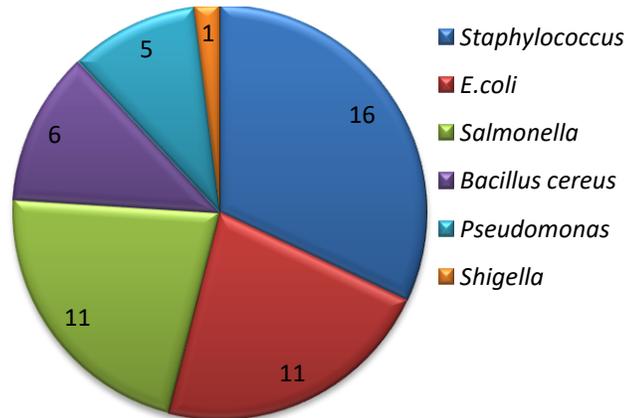


Table 3: Comparative analysis of mean value of pH and water activity of dried fruit samples

Category	Mean±SD and Coefficient of variance (CV) of dried fruit samples in five locations					
	Tutti Frutti	Cherry	Figs	Raisins	Dates	P value
pH	6.26±0.42 and 6.64	3.7±0.35 and 9.56	3.94±0.43 and 11.0	3.86±0.18 and 4.71	4.48±0.3 and 6.77	0.002*
Moisture (%)	17.56±0.76 and 4.35	28.12±2.58 and 9.18	15.34±1.74 and 11.34	18.56±1.02 and 5.50	22.7±0.97 and 4.26	0.05*
Water activity (aW)	0.8±0.06 and 7.75	1.06±0.23 and 22.15	0.7±0.09 and 13.45	0.84±0.06 and 7.05	0.82±0.06 and 7.48	0.02**

[*Significant and **not significant]

Figure 3: Possible Fungal isolates

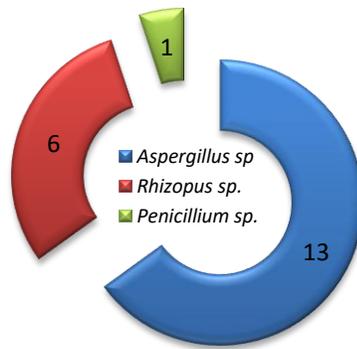


Table 4: Bacterial isolation from dried fruit samples

Samples	Location wise possible bacterial isolates				
	1	2	3	4	5
Tutti Frutti	Salmonella, Bacillus cereus	Salmonella, Pseudomonas	Pseudomonas, Staphylococcus, Salmonella	Shigella sp, S. dysenteriae	Salmonella, Staphylococcus
Cherry	E. coli, Salmonella, Staphylococcus	E. coli, Staphylococcus	E. coli, Staphylococcus	E. coli, Staphylococcus, Pseudomonas	E. coli, Salmonella
Figs	E. coli, Staphylococcus	Bacillus cereus	E. coli, Bacillus cereus	E. coli, Bacillus cereus	E. coli, Staphylococcus
Raisins	Salmonella, Bacillus cereus, Staphylococcus	E. coli, Salmonella	Salmonella, Staphylococcus	Salmonella, Staphylococcus	Bacillus cereus, Staphylococcus, Salmonella
Dates	Pseudomonas, Staphylococcus	Nil	E. coli, Staphylococcus	Staphylococcus	Pseudomonas, Staphylococcus

[Location: 1 – Semiurban area; 2 – Rural –collected during festival time; 3 – Urban – crowd area; 4 – Urban – high crown area; 5 – Semiurban area]

Figure 4: Determination of bacterial CFUs in culture plates

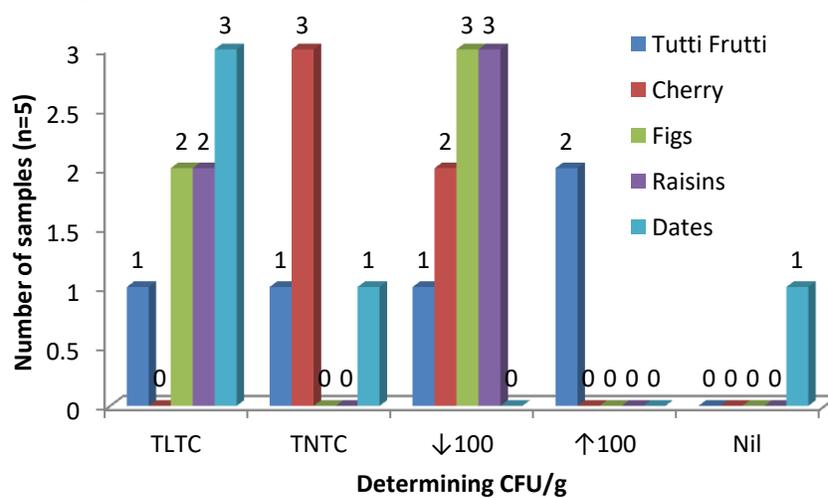


Table 5: Fungal isolation from dried fruit samples

Samples	Location wise possible fungal isolates				
	1	2	3	4	5
Tutti Frutti	Nil	Nil	Nil	Nil	Nil
Cherry	Aspergillus sp	Aspergillus sp	Nil	Rhizopus sp, Aspergillus sp	Aspergillus sp
Figs	Aspergillus sp	Aspergillus sp	Aspergillus sp	Rhizopus sp	Rhizopus sp, Aspergillus sp
Raisins	Nil	Rhizopus sp	Rhizopus sp	Aspergillus sp	Aspergillus sp
Dates	Aspergillus sp	Aspergillus sp	Nil	Aspergillus sp, Rhizopus sp, Penicillium sp	Nil

[**Location:** 1 – Semiurban area; 2 – Rural –collected during festival time; 3 – Urban – crowd area; 4 – Urban – high crown area; 5 – Semiurban area]