

Changes of microbial load in packet orange juice after expiration date

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Fruit juice is popular product in the markets worldwide, with a market potential of approximately 230 million liters. Fruit juice although nutritious and beneficial for health can also serve as a vehicle for foodborne diseases. Most commercially available products are labelled with a use by date. These are applicable at a consumer and food handler levels, instructing them on the amount of days after opening within which a product must be consumed. It is important to identify the changes that occur after expiration date to have a better understanding of when food spoilage occurs and how long foods may be preserved, in order to reduce food wastage. The current study attempted to identify the changes that occur in orange juice after the expiration date printed on the product packaging. One to seven days after expiration results showed very little change. Increase in the microbial load was observed after day 14, after which a steady increase was observed in total viable bacteria, fungus, *E. coli*, and *Staphylococcus* spp. No changes were observed in other examined organisms.

Key words: Fruit juice; Date expired juice; Microbial quality; Public health

Fruit juice is popular product in the markets worldwide, with a market potential of approximately 230 million liters (1, 2). Along with its likable taste it also possesses various nutrients, bioactive compounds and vitamins such as Vitamin C (3-6). Its popularity can also be attributed to the quick paced lifestyle of modern times, where access to convenient and complete nutrition is very important (7). The composition of most commercially available fruit juices include water, sugar, color, preservatives, fruit pulps, carbohydrate, proteins, minerals, Vitamin A and C, cholesterol and other additives (1, 3-6).

Juices can also serve as a vehicle of food borne illness, allowing the growth of spoilage causing microorganisms in its nutrient rich medium (6-8). In most cases pasteurization is able to eliminate most pathogens but some manage to remain in dormant forms (2, 9). The major source of contamination is the water used in the products, others include pH, hygienic practices and temperature (10-12). Raw materials, returned bottles and aerial vectors can also be considered as factors contributing to spoilage of juices (10, 13).

Most commercially available products are labelled with a use by date. These are applicable at a consumer and food handler levels, instructing them on the amount of days after opening within which a product must be consumed (14). It is difficult for manufacturers to

establish an accurate use by date due to practical limitations such as the marketplace complexities (15). Often, tests such as Accelerated Shelf-Life tests (ASLTs) are used to identify shelf life by selecting and analysing kinetic elements which are responsible for contamination as well as calculate what the shelf life might be in storage conditions (16). Spoilage refers to microbiological changes as well as the presence of clouds, discoloration, presence of particulates and gas buildup (13, 17). These changes indicate how long a product is deemed safe for the consumers. How long after the factory declared sell-by or use by date, do these changes and the first indications of spoilage occur.

The current study attempted to identify the changes that occur in orange juice after the expiration date printed on the product packaging. This study attempts to report on the changes that occur in orange juice after it has expired and also to determine the proper time at which a product can be discarded.

MATERIALS AND METHODS

Sample collection. All samples were purchased from supermarkets and transported to the laboratory as soon as possible. Conditions were kept as close to household practices as possible.

Microbiological analysis. 1 ml of each sample was subjected to serial dilution up to 10^{-3} after which they were plated on Nutrient agar and incubated at 37 °C for 24 hours for total viable bacteria. It was also plated on Sabouraud Dextrose Agar and incubated at 25 °C for 48 hours for fungal count. Juice was also plated on Mannitol Salt Agar (MSA) and MacConkey Agar (MAC) for the detection of *Staphylococcus* spp. and *Escherichia coli*, respectively. Biochemical tests were performed to confirm the identity of the pathogens. Cetrinide agar, Listeria agar, *Salmonella-Shigella* agar and Thiosulfate-citrate-bile salts-sucrose agar for the detection of *Pseudomonas*, *Listeria*, *Salmonella* and *Vibrio* spp., respectively (6-8, 18).

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RESULTS AND DISCUSSION

Fruit juice remains a popular product due to some nutritional benefit it possesses, yet it continues to serve a vehicle of food borne illnesses (1, 6-8, 11). Current study attempted to observe the changes in microbial growth in fruit juice after the factory set use by date. Being able to assess the changes after expiration, will allow consumers to have a better understanding of when food products are safe for consumption. This will also contribute towards less food wastage, as foods will not be thrown away just because of the date on the packets. It will also provide consumers with a guideline. Packet fruit juice, purchased from a super-shop was used in the experiment. Tests of this nature, which rely on predictive microbiology and risk assessment may serve as a guideline towards improving the standards of fruit juices allowing the interpretation of the behavior of microorganisms and pathogens which cause spoilage (3, 6-8).

As seen in Table 1, a sample of packet fruit juice exhibited counts of 10^4 cfu/ml of total viable bacteria (TVB). No other bacterial growth was observed before expiration. Results of TVB before expiration seen in the current study, are similar to that of Noor et al. (11), as they also found their counts of TVB to be within the range of 10^4 cfu/ml. Study by Khanam et al. (12) found TVB ranging from 10^5 to 10^8 cfu/ml, before expiration. Their counts of fungus were above 10^5 cfu/ml, whereas this study found no fungus. As seen in Table 2, 1 to 7 days after expiration results showed minimal changes. Increase in the microbial load was observed after day 14 after which a steady increase was observed in TVB, fungus, *E. coli*, and *Staphylococcus* spp. No changes were observed in other examined organisms. Sufficient data was not available on the growth of microorganisms

TABLE 1. Presence of microorganisms in packed orange juice before expiration date

Organism	Packed orange juice before expiration (cfu/ml)
Total viable bacteria	1.4×10^4
Total fungus	0
<i>E. coli</i>	0
<i>Staphylococcus</i> spp.	0
<i>Pseudomonas</i> spp.	0
<i>Listeria</i> spp.	0
<i>Salmonella</i>	0
<i>Vibrio</i> spp.	0

after expiration date from other studies as they mostly reported on those which are still consumable state. This increases the importance of the current study, as it allows the better understanding of the patterns of spoilage microorganisms after expiration date, particularly due to the difficulty involved in monitoring the effect of spoiled foods on the consumers (1-19).

CONCLUSIONS

The standards of fruit juices available in Bangladesh need to be improved as most studies have shown high counts prior to expiration. It is also to be noted that significant changes in microbial growth after expirations was only observed after 14 days from the date. The current study used imported fruit juice, which showed lower levels of microorganism and according to the result of the study, it can be assumed that the juice is safe for consumption between 10 to 13 days after expiration.

TABLE 2. Presence of microorganisms in packed orange juice samples after expiration date

Organism	Packed orange juice after expiration (cfu/ml)				
	Day 1	Day 7	Day 14	Day 21	Day 28
TVB	1.6×10^4	2.9×10^4	3.1×10^5	3.2×10^5	4.5×10^7
Total fungus	0	0	1.5×10^2	2.6×10^2	1.5×10^3
<i>E. coli</i>	0	0	3.0×10^1	4.5×10^2	0
<i>Staphylococcus</i> spp.	0	1.0×10^2	3.9×10^2	1.9×10^3	4.5×10^4
<i>Pseudomonas</i> spp.	0	0	0	0	0
<i>Listeria</i> spp.	0	0	0	0	0
<i>Salmonella</i> spp.	0	0	0	0	0
<i>Vibrio</i> spp.	0	0	0	0	0

*Day refers to days after expiry date.

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