

Research Article

Evaluation on the sensory preference and microbiological properties of street vended ice cream

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Abstract

Local street-vended ice cream in the Philippines has been called “dirty” ice cream due to unsanitary manufacturing processes. This study aims to understand the sensory preference of college students of University of Santo Tomas in Manila, Philippines on street vended ice cream and their awareness on the possible health hazards linked to the product. Also, this study aims to determine the bacteriological quality of street-vended ice cream per variant. Three different ice cream variants were evaluated by 100 college students and microbiological tests were also conducted. In the three different samples tested, cheese-flavoured street-vended ice cream showed the highest rate in the overall acceptability in terms of taste, appearance and texture. On all three samples, *Enterobacter gergoviae*, which is known to cause opportunistic infection amongst immune compromised individuals, was found to be present.

Keywords: food safety, *Enterobacter gergoviae*, sensory attributes, Philippines.

Introduction

Ice cream is a well-known dessert and snack among all ages in many countries. Warke *et al* [1] stated that ice cream is one of the major products in the dairy industry and continues to dominate attention of a large segment of the population. Its mixture is made of dairy products (e.g. whole milk, condensed milk, milk powder, cream), sweeteners (sugar, glucose), emulsifiers, stabilizers and colourings. Ice cream can also serve as a topping, add-on or mix-in for other desserts [2]. In the Philippines, tropical climate has contributed to the popularity of ice cream as a “summer treat”. It is in line with other Filipino cold desserts as reported by Gimena [2], like fruit shakes, ice scramble and *halo-halo* (mixed sweetened fruit, beans, tapioca pearls, agar, added with crushed ice and evaporated milk).

Street vended homemade ice cream in the Philippines is also called “*sorbetes*”. Its usual and popular flavours are “*keso*” (cheddar cheese flavoured ice cream with cheese bits), “*tsokolate*” (brown coloured chocolate flavoured ice cream) and *ube* (violet/purple coloured, taro flavoured ice cream that has some small bits of real taro). The peddler of the said street vended ice cream, popularly called as “*sorbetero*”, markets the street-vended ice cream. The ice cream carts can keep the ice cream from melting especially under the hot tropical sun because it is stuffed with shaved ice and salt. Salt is added to decrease the temperature of the melting ice. The brine is cooler than the ice alone; therefore, it has the capacity to facilitate removal of heat from the sides of ice cream containers [3].

According to Gimena [2], local ice cream is often considered as “dirty ice cream” due to its native flavours and less aseptic production procedures. In the study of Orallo *et al* [4] regarding microbial analysis of ice cream produced by big and small scale manufacturers in Metro Manila, ice cream from small scale manufacturers were proven to be positive with faecal coliforms which indicates the presence of faecal contamination in this food item. The Total Coliform Count was beyond what was set by the Bureau of Food and Drugs (BFAD). Despite the microbial contamination of street-vended ice cream, some Filipinos would still continue to patronize it because it is cheaper [2].

The critical part is that the majority of ice cream consumers are young children including those of vulnerable age [5]. Food contamination may lead to different illnesses of the gut like loose bowel movement or diarrhea. Further, diarrhea may result in death because it causes dehydration [6].

Ice cream, in general, is vended both in packed containers (e.g. cups, cones, cylindrical metal and plastic containers with cover) and in exposed containers at some retail stores or ice cream parlours which is served by hand in scoops, cones or sundae cups across the counter. Thus the microbiological characteristic of the ice cream during retail marketing can also be determined by the post-manufacture management of the item as well as efficiency and sanitary environment during frozen storage [1]. The Filipino sorbetes or street-vended ice cream is placed in an exposed container and served in scoops.

According to Soukoulis, *et.al.* [7], the quality of ice cream is influenced by several sensory attributes which are flavour, texture, melting quality, package, and appearance. These attributes also affect the consumer preference for different variants of ice cream. In this study, researchers have focused on the effects of flavour, texture and appearance on the overall preference of street vended ice cream. Also, the study will investigate the microbiological quality of common variants of street-vended ice cream.

Materials and Methods

Three different variants of street-vended ice cream were given to consumers for sensory assessment, a 15 g portion of ice cream samples in a 60ml plastic cup were served; each consumer was provided with water for palate cleansing. Panelists are 100 Thomasian students, who were untrained. Respondents were asked to evaluate the sample without any break and ice cream

samples were examined for the Degree of Liking (DOL) using a seven point Hedonic scale with the following definition: 1 = dislike a lot, 3 = neither like nor dislike, 5 = like a lot.

Ice cream samples for microbial identification were collected from a local vendor situated in the area of University of Santo Tomas. Three samples were subjected for microbial growth identification. Chocolate, cheese and taro (purple yam) were the chosen flavours for sampling since these were the available flavours produced on the day of collection. Also, these are the common variants consumed by buyers. Samples were collected between 3pm to 6pm. All batches of the tub where each representative samples were taken were freshly produced the very same day. Representative amount of each flavour was placed in individual sterile containers and immediately transported to the laboratory for analysis.

Statistical analysis used to interpret data is Basker's table for appearance, texture and flavour preference. For the overall liking, analysis of variance was used to determine the significant difference among the different ice cream variants. All statistical analyses used $p < 0.05$ level of significance.

Results and Discussion

Sensory evaluation

Of the choices offered, 94% of the panelists liked cheese-flavoured street vended ice cream based on appearance. This can be accounted to the use of cheddar cheese by local manufacturers for cheese-flavoured ice cream. Cheddar cheese, according to USDA [8], has a colour of medium yellow-orange with a uniform bright colour and an attractive sheen. This visual characteristic of cheese affects food perception and drives consumer preferences.

For the other two ice cream samples, 85% of consumers liked the brown colour of chocolate variant and 83% of them preferred the purple colour of taro variant (Figure 1). Preference of chocolate-flavoured ice cream can be accounted to colour-flavour associations. Singh [9] mentioned that initial perception of food happens within the first 90 seconds of observation. Colour is commonly used as a basis for the initial judgment of food. Further, consumer judgment is approximately 60 to 90% based on appearance [9]. Recent study by Wadhvani and McMahon [10] noted that consumer buying decisions can be influenced on the basis of colour. This can also affect the cooking and eating decisions of the consumers.

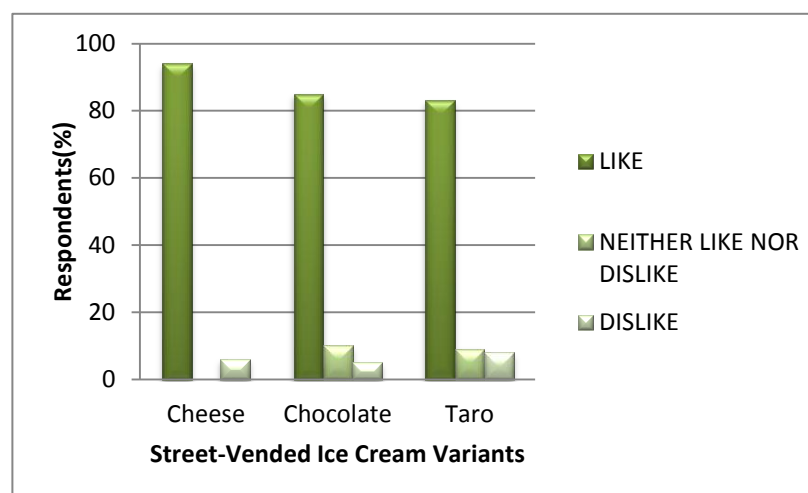


Figure 1. Appearance Preference of Consumers on Street-Vended Ice Cream.

According to Kemp, *et.al.* [11], texture perception is complex. Food texture can be characterized into two components, character notes and rheology [12]. Character notes are the perceptible texture attributes of food, which are of three types: mechanical and geometric [13]. This is observed among the panelists, wherein 89% of them extremely liked the cheese flavoured street vended ice cream in terms of texture (Figure 2). This type of ice cream is usually sold with cheddar cheese bits. The presence of cheese bits gives the mechanical texture of the sample. Mechanical properties, such as chewiness and hardness, which are the reactions of food in terms of stress [12].

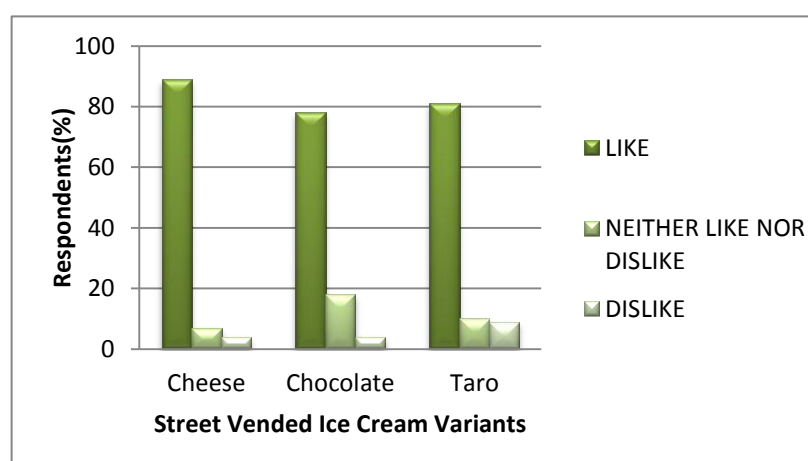


Figure 2. Texture Preference of Consumers on Street-Vended Ice Cream.

Compared to the cheese-flavoured street vended ice cream, the less preferred street vended ice cream variants are taro at 81% and chocolate at 78% (Figure 2). Both of these variants have similar rheological properties. The use of taro as a flavouring for street-vended ice cream gives it a starchy and homogenous texture [14]. The starchy texture contributes to the viscosity in the street-vended ice cream, which is a rheological property of food. In addition, the texture of chocolate-flavoured street vended ice cream is due to the presence of cocoa butter. This ingredient influences the creaminess and richness of chocolate-flavoured ice cream, through the fat content [15].

When it comes to flavour, cheese-flavoured street-vended ice cream had the most number of respondents, at 87%, who liked it (Figure 3). Chocolate-flavoured street-vended ice cream had 87% of the respondents who liked the variant (Figure 3). On the other hand, 4% of the respondents disliked the chocolate-flavoured street-vended ice cream (Figure 3). In contrast, taro-flavoured street-vended ice cream had the least number of respondents, with 80%, who liked its flavour. Also, 11% of the panelists for taro variant were uncertain in terms of flavour preference (Figure 3).

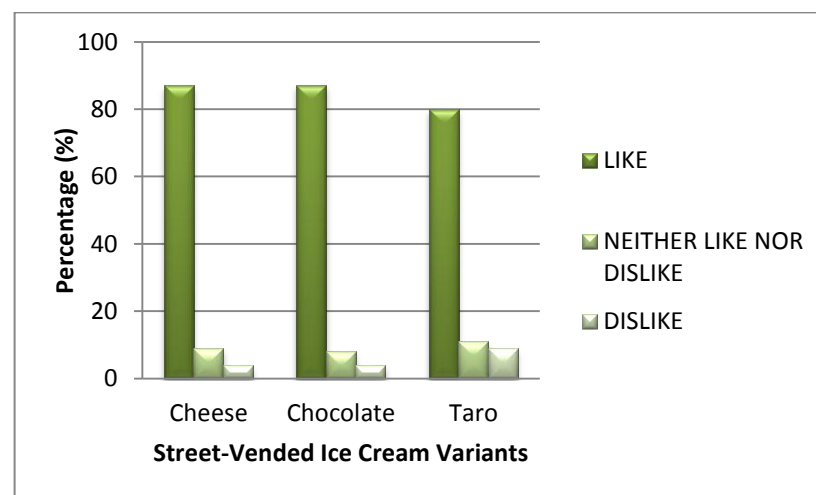


Figure 3. Flavour Preference of Consumers on Street-Vended Ice Cream.

The preference for cheese-flavoured and chocolate-flavoured street-vended ice cream is due to its high-fat content. Cheddar cheese has approximately 33 grams of fat content and cocoa butter contributes to the fat content of chocolate-flavoured street-vended ice cream [8]. Cocoa butter in chocolate is composed of three fatty acids. In quantity, 30-37% of fatty acids are monosaturated oleic acid. The other fatty acids are 32-37% of saturated stearic acid and 23-30% of saturated palmitic acid [16]. According to Montmayeur and le Coutre [17], energy-dense food that is rich in fat are more palatable than are low-energy-density food such as root crops. High-fat food, which contains sugar or salt, have higher sensory appeal [18].

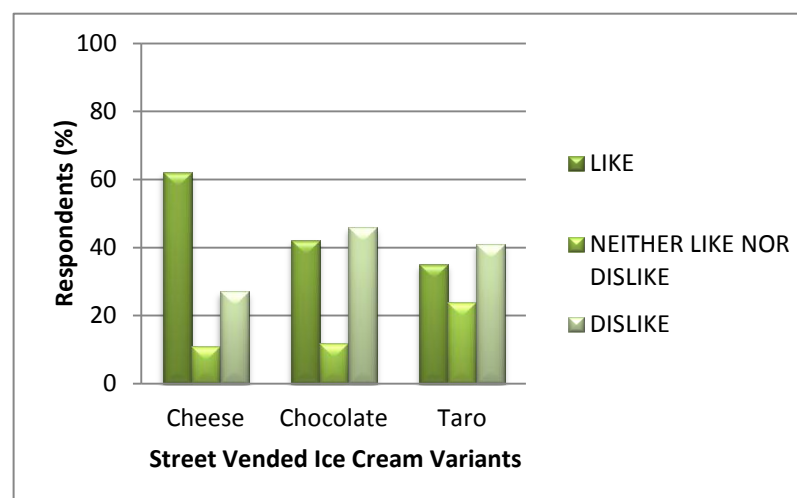


Figure 4. Consumer Overall Preference of Street Vended Ice Cream.

The overall preference of street-vended ice cream in Figure 4 shows that the cheese-flavoured street-vended ice cream is the most preferred variant by 30% of the panelists. In the conducted sensory evaluation, 16% of respondents liked a lot cheese-flavoured street vended ice cream while 15% of them disliked slightly the cheese variant. Meanwhile, 21% of panelists extremely liked the chocolate-flavoured street vended ice cream (Figure 4). About 18% of the panelists disliked a lot the chocolate ice cream variant. For the taro-flavoured street-vended ice cream, 10% of respondents liked the ice cream with taro flavour while 20% of them disliked slightly the taro variant (Figure 4).

The preferences of panelists in terms of different sensory attributes, which are appearance, texture and taste, contribute to the overall liking of variants of street-vended ice cream. Based on research by Moskowitz, *et.al.* [19], overall liking is the integration of different sensory inputs based from food product properties. In the study, it was observed that cheese had the highest mean rankings among the three variants of street-vended ice cream (Table 1). In terms of the three sensory attributes tested, cheese variant of street-vended ice cream was mostly preferred by the respondents.

Table 1. Means scores on consumer overall preference of street vended ice cream at level of $p < 0.05$.

Means scores	Taro	Cheese	Chocolate
	3.96 ^a	4.99 ^b	4.03 ^a

*** Dissimilarity of letters indicates significant difference.

Microbial evaluation

The three samples were labeled AA for chocolate flavour, BB for ube (purple yam) flavour and CC for cheese flavour. From the samples, 50 microlitres were inoculated in 500 microlitres of Brain heart infusion broth for bacterial cultivation and to increase the growth of microorganisms (Fig.5). Broth samples were incubated at 35°C for 24 hours [20]. Broth solution of AA, BB and CC were plated using the four steak pattern on Tryptic Soy Agar supplemented by 5% sheep's blood to support the growth of gram positive, gram negative and yeast cells and to visualize the presence of hemolysis for easy differentiation [20]. The streaked plates were incubated at 35°C for 24 hours.

Presence of bacterial growth is monitored daily. All AA (Fig. 6), BB (Fig. 7) and CC (Fig. 8) yielded heavy growth of mixed microorganisms after 24 hours of incubation. Colonies from each plate are identified based on their morphological characteristics, such as colour, shape, hemolytic effect and consistency. Individual organisms are then further identified by gram staining to assess if they are gram positive bacilli/cocci or gram negative bacilli/cocci.

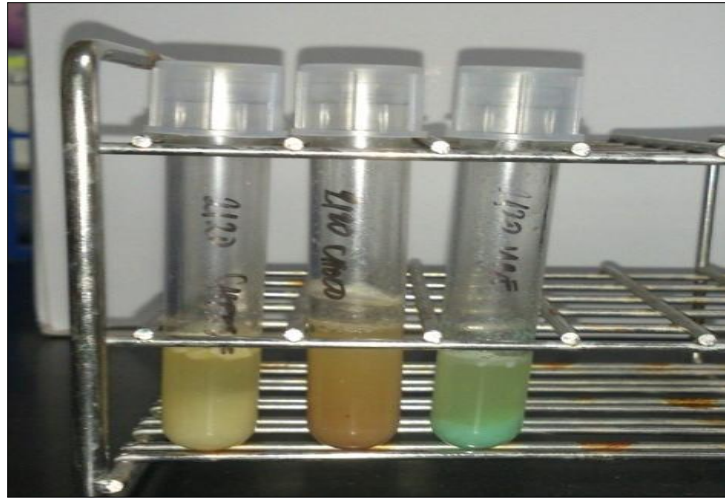


Figure 5. Inoculation of Street-Vended Ice Cream
(Left to Right: Cheese, Chocolate and Taro-Flavoured).



Figure 6. Bacterial growth present in Cheese-flavoured Street-vended Ice Cream.



Figure 7. Bacterial growth present in Taro-flavoured Street-vended Ice Cream.



Figure 8. Bacterial growth present in Cheese-flavoured Street-vended Ice Cream.

Table 2. Bacterial growth characteristics of different street-vended ice cream variants.

Chocolate	Taro	Cheese
Flat, dry, g-b	Spreading, flat, NH, g-b	Mucoid, g-b
Mucoid, g-b	Mucoid, g-b	Spreading, BH, g+b
Small, white, g+b	Mucoid, flat, g-b	Mucoid, concave, g-b

All street-vended ice-cream samples, yielded three different growths in Table 2. Upon morphological identification, organisms are purified by isolating them and re-streaking colonies in selective and enrichment media. Gram Positive cocci and bacilli are isolated on

Tryptic Soy Agar (TSA) and gram negative bacilli are isolated in MacConkey Agar. Plates were further incubated at 35°C for 24 hours. Bacterial isolate plates were checked for purity prior to species identification.

Once bacterial purity is attained, broth solution is created by mixing colonies with sterile 9% normal saline solution (NSS) and equilibrated to 1.0 McFarland solution for gram negative bacilli. Broth solutions are then processed using the Vitek 2 machine by Biomeriux.

Table 3. Species identification on different street-vended ice cream variants.

Chocolate	Taro	Cheese
<i>Acinetobacter baumannii</i>	<i>Enterobacter cloacae</i>	<i>Enterobacter gergoviae</i>
<i>Enterobacter gergoviae</i>	<i>Enterobacter gergoviae</i>	<i>Bacillus</i> spp.
<i>Bacillus</i> spp.	<i>Enterobacter cloacae</i>	<i>Klebsiella pneumoniae</i>

Based on observations, *Enterobacter gergoviae* is present in all of the ice cream samples. Also, *Enterobacter cloacae* is found on taro-flavoured street-vended ice cream. Although it is a normal gut flora it can also cause diseases such as urinary tract infection (UTI) and respiratory infections. They are also considered as biosafety level 1 organisms both in the United States and Canada. *Bacillus* species isolated from chocolate and cheese samples are contaminants usually found in the soil. Only two species of *Bacillus* are considered pathogenic to humans, namely *B. anthracis* that causes anthrax and *B. cereus* that leads to gastrointestinal disease. Enterobacter species are usually ubiquitous in the environment. Contamination of ice cream can be sources such as dust, soil, equipment and hands of handling personnel either during storage of ice cream samples in the machine and selling.

In the chocolate-flavoured street-vended ice cream sample, *Acinetobacter baumannii* is identified. This presence can be attributed to the habitat of *A. baumannii*. This organism is commonly recovered from soil, water, animals and humans [21]. The water used in preparation of the ice cream sample maybe contaminated. Also, this could indicate the need for proper handling of raw materials during manufacturing of ice cream to avoid contamination. *Acinetobacter* species are usually found on human skin and are frequently isolated from the throat and respiratory tract of hospitalized patients [21]. *A. baumannii* is a gram-negative bacteria that can cause bacteremia, pneumonia, meningitis, urinary tract infection, and wound infection [22].

Klebsiella pneumoniae is found in cheese –flavoured street-vended ice cream. This is also a gram-negative bacteria that can lead to pneumonia, bloodstream infections, wound infections, and meningitis (Siegel et.al. 2006). It can be pathogenic once aspirated in the lungs especially for people with weakened immune systems and those suffering from debilitating disease. Growth of microorganisms of the ice cream sample can be due to the mode of transmission of *K. pneumonia* which is through direct contact. According to Goff and Hartel [23], the different groups of organisms isolated in the street-vended ice cream variants also suggests that soil, water, personnel and air might be the sources of contamination for open ice cream.

Conclusion

Significant difference in sensory properties was found in the three flavoured street-vended ice cream in terms of the overall acceptability, appearance, texture and flavour. The consumer results indicated that cheese flavoured street-vended ice cream was preferred more than taro and chocolate flavours. The inclusion of cheddar cheese bits in cheese flavoured ice cream had a positive impact on the acceptance by consumer.

It is noted that majority of the microorganisms that grew on each samples were predominantly gram negative bacilli and a few of gram positive bacilli which are known common contaminants found on the soil. On all three samples, *Enterobacter gergoviae* is isolated. Isolation of these organisms in food consumed by people can pose shows the need for compliance of proper handling techniques during preparation and selling of street-vended ice cream especially to students. Also, there must be a safety monitoring and risk assessment for the street-vended products, such as ice cream, to prevent contamination.

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