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# A survey of the microbial quality of some instant powdered beverages sold in Accra, Ghana

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## Abstract

This study reports on seventy seven samples of instant beverages which were randomly sampled and analyzed for the aerobic plate counts and for the presence of some selected pathogens. With the exception of four samples, all other samples were below the maximum permissible levels set by the Ghana Standards Authority for aerobic plate counts for dried products requiring reconstitution. Pathogens such as *E. coli* and *Salmonella* were not detected in any of the samples analyzed. Yeasts and moulds were also not present in samples analyzed. All the samples can be classed as Level 1 under the Australian guidelines for the microbiological examination of ready-to-eat (RTE) foods with Aerobic Plate Counts levels of $<10^4$ cfu/g being classed as satisfactory.

***Keywords:*** Instant beverages; Microorganisms; Microbial quality

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## 1. Introduction

With changes in lifestyle and in the quest for convenient ready-to-eat or easy to prepare meals, some food industries have found a way of meeting the changing needs of the consumer. This is through the production of instant beverages with low water activities which may contain milk and/or sugar and need to be reconstituted with only either hot or cold water to be consumed instantly. Instant beverages are defined by the International Food Information Service (IFIS, 2009) as 'dried beverages formulated and processed in a manner giving rapid solubility in water or other liquids'. In a way, these instant beverages can be classed as ready-to-eat (RTE) foods because of the minimum effort and resources needed before they can be consumed. Instant beverages are available in mini sachets that can be easily opened by ripping the top corner with the fingers. Foods with low water activities have an extended shelf life due to the fact that microorganisms and enzymes do not get the water that they need to be active (Jay et al., 2005) and thus, it is expected that these instant beverages would have a prolonged shelf life. As a result of the way these products are packaged, they offer an added advantage of easy transportation.

In Ghana, instant milk-based beverages are packaged attractively and are sold at affordable prices for the Ghanaian consumer. Since a lot of Ghanaians patronise these products, and some of the products do not go through any intervention steps to reduce microorganisms present, it is very important that the products are free from harmful microorganisms. The study therefore aimed to evaluate the microbial quality of these instant beverage drinks and any potential health risks that consumption may pose to consumers.

Some authors have identified microorganisms which are significant for specific food products. For example, it has been suggested that at water activities below 0.9, most bacteria will not flourish in foods but yeasts and moulds would most likely grow (Jay et al., 2005). Microorganisms which are considered to be important for dairy products include *Salmonella, Escherichia coli, Bacillus cereus,* and *Staphylococcus* (Ryser, 2012).

Standard Plate Count (SPC) also referred to as aerobic plate count / total viable count is one of the most common tests applied to indicate microbial quality of food. The SPC is used to determine the microbial shelf life limit of the product (Forsythe, 2000). It has been stated that bacterial spoilage occurs when the bacterial population of food reaches $10^7$–$10^8$/g or $cm^2$ or ml (ICMSF, 2005). The food type and the processing through which the food has gone through are the determinants of the significance of its SPC results. Foods are therefore grouped into 3 levels (NSW Food Authority, 2009). Foods in the Level 1 group are to ready-to-eat foods (such as Instant Beverages) which have been cooked in the manufacturing/preparation process and require no further heating prior to consumption (NSW Food Authority, 2009).

*Salmonella* is an important human pathogen and has been reported to be the most common bacteria in dairy products causing diseases in the world (Ryser, 2012). The presence of *Salmonella* in RTE foods is considered unacceptable irrespective of the level of contamination (Alakomi and Saarela, 2009). The presence of *Escherichia coli* in RTE foods is undesirable because it indicates either poor hygienic conditions which have led to contamination or inadequate heat treatment (Jay et al., 2005). Ideally, *E. coli* should not be detected and their presence is also an indicator of faecal contamination (ICMSF, 2005) and as such levels of <3cfu/gram have been given as the satisfactory criteria for this organism (NSW Food Authority, 2009).

Levels exceeding 100cfu per gram are unacceptable and indicate a level of contamination which may have introduced pathogens which, if present in the food prior to processing, may have survived (NSW Food Authority, 2009).

Yeasts and moulds cause various degrees of spoilage of foods. They grow on virtually any type of foods, be it fresh farm produce or processed foods. Several food-borne moulds and possibly yeasts may be hazardous to humans because of their ability to produce toxins (Tournas et al., 2001). There have been reported health cases implicating toxins which had been produced by *Staphylococcus* in milk powders (ICMSF, 2005). Due to this, it is important that the organism is not present in instant milk-based beverages.

## 2. Methodology

Seventy seven samples of Instant milk-based powdered beverages were analysed in the Food Microbiology Laboratory for *Salmonella*, aerobic plate counts at 30°C, yeasts and moulds, *Staphylococcus, Escherichia coli* and coliforms. The pHs of the various samples were also measured. Some of the samples contained either strawberry, tiger nuts, coffee, coconut or cocoa flavours while some were not flavoured. The methods used for the analysis were all standard methods adopted from ISO and NMKL.

### 2.1. Microbiological analysis

10g of each sample was weighed and homogenised with 10ml of distilled water (pH of 7.2). The pH of each homogenate was checked with a Radiometer pH meter after it had been calibrated using standard buffers. 10g of each sample was aseptically weighed into sterile bags and mixed with 90mls of sterile salt peptone solution (SPS). Each mixture of sample and diluent was blended in a stomacher (Lab Blender, Model 4001, Seward Medical London, England) for 30 seconds at normal speed. Appropriate ten-fold dilutions were prepared from each sample with a sterile diluent (SPS) and the samples were analysed for the presence of aerobic mesophilic organisms, coliform bacteria, *Staphylococcus*, *Escherichia coli*, yeasts and moulds.

Aerobic mesophilic bacteria were enumerated using Plate Count Agar (PCA, Oxoid CM0325; Oxoid Ltd., Basingstoke, Hampshire, England) using the pour-plate method. The plates were incubated under aerobic conditions at 30°C for 72hrs. *Staphylococcus aureus* was enumerated and detected using Baird-Parker Agar Base (BP, Oxoid CM0275; Oxoid Ltd., Basingstoke, Hampshire, England) and Blood Agar Base (BAB, Oxoid CM0055; Oxoid Ltd., Basingstoke, Hampshire, England), using the spread plate method. The plates were incubated at 37°C for 48hrs. Coliforms were enumerated using Tryptone Soya Agar (TSA, Oxoid CM0131; Oxoid Ltd., Basingstoke, Hampshire, England) using the pour plate method. The plates were incubated at 37°C for 24hours. *Escherichia coli* was enumerated by the pour plate method using Tryptone Soya Agar (TSA, Oxoid CM0131; Oxoid Ltd., Basingstoke, Hampshire, England) Violet Red Bile Agar (VRBA Oxoid CM0107; Oxoid Ltd., Basingstoke, Hampshire, UK). The plates were incubated at 44°C for 24hrs. Colonies were confirmed using EC Broth (Oxoid CM853), pH 6.9, followed by Tryptone Water (Oxoid CM87), pH 7.5, all incubated at 44°C for 24 hours. Yeasts and moulds were enumerated using Dichloran Rose Bengal

Chloramphenicol Agar (CM1148) by the pour plate method. The plates were incubated at 25°C for 5 days. 25g of the sample was pre-enriched in a 225ml of non-selective medium buffered peptone water (CM0509) at 37°C for about 18 hours. 0.1ml of the pre-enriched sample was transferred into 10ml of Rappaport-Vassiliadis soya peptone broth (CM0866) which had been pre-warmed to 42°C. The culture in the RVS was incubated at 41.5°C for 24 hours after which confirmation test was carried out by streaking on Xylose Lysine Desoxycholate (XLD) agar (CM0469). The plates were incubated at 37°C for 24 hours.

## 3. Results

The pHs of the various samples analyzed ranged from 5.48 to 7.01. The numbers of *Escherichia coli*, *Staphylococcus aureus,* coliforms and Yeasts and moulds in the analyzed samples were below the enumeration limit of the microbial analysis. *Salmonella* was not detected in 25g of any of the samples analysed. Despite the absence of these organisms in the products analyzed, aerobic mesophiles were present in 69 samples whiles in the other 8 samples, they were beyond the enumeration limits of the test procedure (Figure 1).

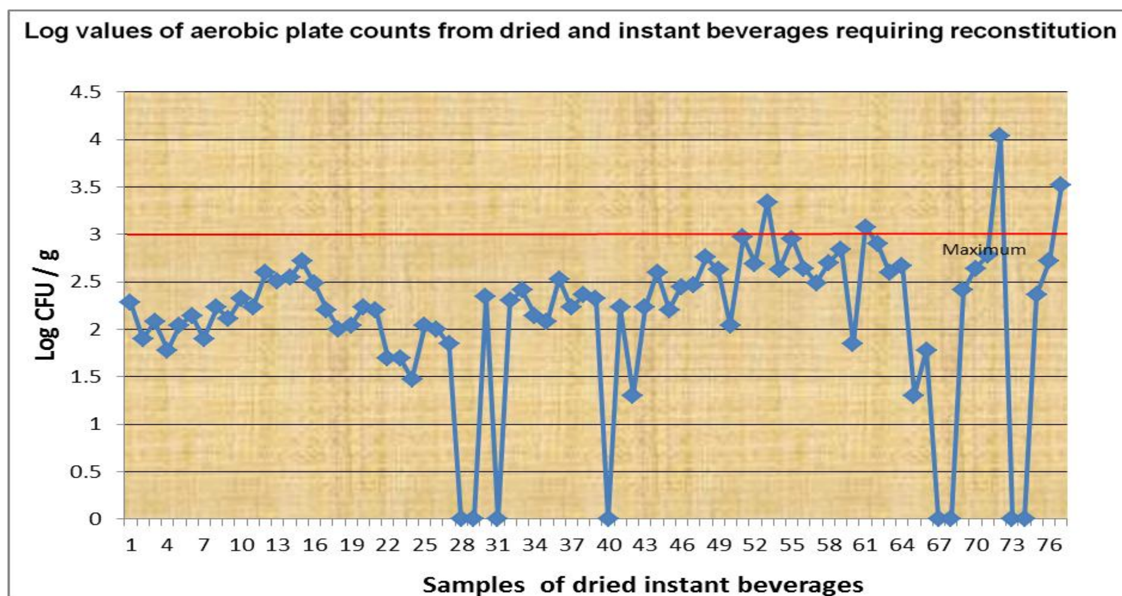


**Fig. 1.** Aerobic mesophiles in 77 instant milk-based beverages

## 4. Discussion

Poor hygienic and processing conditions lead to the presence of microorganisms in foods which cause spoilage and adversely affect the health of consumers (Marriott and Gravani, 2006). In this research, it was

found out that the products analyzed did not contain detectable numbers of *Escherichia coli*, Coliforms, *Staphylococcus aureus*, Yeasts and Moulds. *Salmonella* was also not detected in 25g of all the products analyzed. In a similar research which assessed the microbial quality of powdered milk in Bangladesh, there were no Coliforms and *Salmonella* in any of the samples analyzed (Ahmed and Anwar, 2006). In that research, even though Yeasts and Moulds were found in four samples, the counts were very low implying that the products were of good quality and could be consumed by consumers. The results obtained in this research indicate that the products were produced under hygienic conditions and had received adequate heat treatment (NSW Food Authority, 2009).

In the Ghanaian Standard 955 document, the maximum permissible levels for Aerobic Plate Count for dried products requiring reconstitution must be 3 log cfu/g. From Figure 1 it can be observed that 5.19% of the sample size exceeded this maximum level with counts ranging from $1.2 \times 10^3 - 1.1 \times 10^4$cfu/g.

A total of 94.81% were below the maximum permissible levels, with log counts below 3cfu/g. Microbial activity in products with low water activities is limited due to the lack of adequate water (Jay et al., 2005). The results obtained in this study indicate that the majority of products had low numbers of aerobic mesophiles which is possibly due to the low water activity of the products.

In comparison to the Ghanaian standards for aerobic plate counts, the Australian guidelines state that ready-to-eat products, which are classed under level 1 and have aerobic plate counts $<10^4$cfu/g are satisfactory (NSW Food Authority, 2009). With the Ghanaian Standard being more stringent, it serves as a check for instant powdered beverage producers which produce in Ghana or produce in other countries and want to export to Ghana. These producers would therefore strive to be within the Ghanaian standards and in the process, develop shelf stable products of good microbial quality.

## 5. Conclusion

On the whole, all 77 samples of instant milk-based beverages analysed are of good quality. They can therefore be classed as Level 1 under the Australian guidelines for the microbiological examination of ready-to-eat foods with Aerobic Plate Counts levels of $<10^4$cfu/g being classified as satisfactory. Consumption of these instant powder beverages would pose no risk to public health.

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