Microbial Contaminants in Fresh Tomato Wash Water and Food Safety Considerations in South-Eastern Nigeria

Ofor, M.O., Okorie, V.C., Ibeawuchi, I.I., Ihejirika, G.O., Obilo, O.P. and Dialoke, S.A.
Department of Crop Science and Technology, School of Agriculture and Agricultural Technology
P.M.B. 1526 Owerri, Imo State, Nigeria. mariofor2002@yahoo.com

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Abstract
Water used for the washing of fresh tomatoes in major markets in South-eastern Nigeria has been shown to possess a high level of microbial contamination. Bacterial isolates may include *Bacillus cereus*, *Lactobacillus spp*. and *Staphylococcus aureus*. The fungal isolates consist of *Penicillum spp*., *Aspergillus niger*, and *A. oryzae*. Even the apparently 'Potable' water obtained from Bore-holes also exhibits the presence of some bacterial and fungal isolates. Although there is the absence of feacal indicators like *Escherichia coli*, *Shigella* and *Clostridium*, the outbreak of food borne diseases may be imminent. This is possible with the ingression of microorganisms from the wash water (containing dirty soil, organic materials etc.) into the tomato fruits. The presence of *Aspergillus spp*. (which are established to be carcinogenic) in the water, may pose a serious health problem to consumers since microorganisms can be drawn into the fruits through osmotic action. Other postharvest handling processes like packaging, transportation and storage are also affected. Focus should be drawn towards ensuring Good Agricultural Practices (GAP) especially with regards to water quality during the food chain especially in areas where the cold-chain is inefficient or absent. [Life Science Journal. 2009; 6(3): 80– 82] (ISSN: 1097 – 8135).

Key Words: Contamination, microorganisms, tomatoes, wash-water.

Introduction

Microorganisms that are capable of causing human disease may be found on raw produce. These according to Hernandez-Brenes (2002a), may form a part of the fruit or vegetable micro-flora as incidental contaminants from the soil, dust and surroundings; or may be introduced through poor production and handling practices such as the application of untreated manure, the use of irrigation water or unsanitary handling practices. According to FAO (1998), food borne microorganisms such as bacteria, viruses and parasites are often referred to as biological hazards. Fungi which are capable of producing toxins are also included in this group of hazards. Bacteria pathogens being a part of the environment can easily contaminate fruits and vegetables when these commodities are not properly handled prior to consumption (Hernandez-Brenes, 2002a). The desire to address the issue of food safety problems is borne from the fact that a large number of bacterial pathogens have been implicated in food borne outbreaks, associated with the consumption of fresh fruits and vegetables (Beuchat, 1998) and to safeguard the health of the consumers.

The safety of foods has a wide reaching effect on world trade. For some countries, export of fruits and vegetables make up close to half of the total agricultural exports (Brady, 2002). Therefore, unsafe imports may pose a threat to the health of the people consuming them and result in significant economic loss for the exporting country. In Nigeria, most of the tomatoes consumed in the South-east are grown and transported from the Northern parts of the country.

Water as a Veritable Source of Contamination

Water contaminated with feacal material, infected food handlers and animals in the fields may be vehicles for contamination of produce with parasites that may be passed on to humans consuming the raw produce (Hernandez-Brenes, 2002a). According to FAO/WHO (1984), illness due to contaminated food is 'the most widespread health problem in the contemporary world.'

Water quality is important in reducing contamination during post harvest cooling, washing and sanitizing operations. Therefore, water used for post harvest operations should be potable and free of disease-causing organisms (Hernandez-Brenes, 2002a). Water sanitation has become imperative since it has been observed that for some commodities e.g. apples, mangoes and tomatoes, when warm fruit or vegetable is placed in cold water, a pressure differential is generated that results in infiltration of the water into the product. Where the wash water is contaminated *ab-initio*, further contaminants like microorganisms and dirt from the dirty fruits can all get drawn into the interior of the commodity. The reduction of pathogens on produce is important to reduce food borne illness, to decrease spoilage, and to improve appearance and nutritive value (Hernandez-Brenes, 2002a). Washing and cleaning fruits and vegetables is a common practice to reduce surface contamination. The first attempt at washing tomato fruits in South-eastern Nigeria occurs at the market places, where a limited amount of water is used to wash several baskets of tomato fruits. Bacterial isolates like *Bacillus cereus*, *Lactobacillus spp*. and *Staphylococcus aureus*; and fungal isolates like *Penicillum spp*., *Aspergillus niger*, and *A. oryzae* were identified in the wash water collected from some major markets in this area (Ofor, Unpublished Data). *Aspergillus* spp is however known to produce aflatoxin B_1, a potent carcinogen (Rao *et al*., 1982). Even the apparently 'Potable' water obtained from Bore-holes also exhibits the presence of some bacterial and fungal isolates. There was however the absence of feacal indicators like *Escherichia coli*, *Shigella* and *Clostridium*.

Contaminants and Food Safety in Humans

The presence of *Aspergillus* spp in association with the tomato wash water could pose a deadly threat to human safety due to its production of aflatoxin. According to FAO (1998), chemical contaminants in raw fruits and vegetables may be naturally occurring or may be added during agricultural production, post-harvest handling and other unit operations. Some of these naturally occurring chemical hazards include allergen (from weed), mycotoxins (e.g. aflatoxin), alkaloids etc. The inclusion of grasses in the baskets used as packaging for these tomato fruits could also pose a danger with respect to naturally occurring chemicals like allergen in grass (weed).

In the Nigerian postharvest system, packaging of tomatoes in cane baskets, lined with grasses, portends a potential problem of massive proliferation of inocula. As a part of a Good Agricultural Practice (GAP) programme, Hernandez-Brenes (2002b) suggests that the background information about the land being used for agricultural production should be maintained. This according to FDA (1998) will help identify situations that could increase the risk for fresh produce contamination. Important information about the history of the land could include whether the land was previously used for animal feeding, for domestic animal production, as a garbage or toxic waste disposal site, or for mining, oil or gas exploration activities.

It is generally believed that ground water is less likely than surface water to be contaminated with pathogens, since ground water loses much of its bacterial and organic compound content, after filtration through rock and clay layers (Butler *et al*., 1993). However, according to Hernandez-Brenes, (2002b), the bacterial content of ground water may vary from a few to a few hundred organisms per milliliter. A great potential for contamination of the ground water by surface water exists under certain conditions as with shallow, old or improperly constructed wells. Although there is no available data to show that these organisms can survive at standard borehole depths (approximately 100 – 150 ft), it is possible that the organisms were present in the surface storage tanks. Since water-borne disease is usually as a result of faecal contamination of water supplies, it is more efficient to determine if faecal contamination is present than to actually look for the presence of pathogens.

Faecal indicator bacteria are used to identify when faecal contamination has occurred. According to U.S.EPA (2001), coliform bacteria serve as the indicator organisms for faecal contamination, with laboratory assays commonly performed to search for total and faecal coliform bacteria as well as enumeration of *Escherichia coli*. The maximum contamination level (MCL) for total coliforms / *E. coli* in drinking water is zero. Although faecal indicator organisms may be absent in the tomato wash water, the presence of other pathogenic bacteria like *Staphylococcus aureus* and *Bacillus* spp. is significant.

Nevertheless, caution still needs to be taken because according to Suslow (2006), recent laboratory research has demonstrated the high potential for human pathogens to become internalized into tomatoes, and extensive field surveys of fresh market tomatoes have shown that detectable levels of contamination are rare. In a situation where the tomato wash water is cloudy in nature, a heavy microbial load is suspected. Turbidity is seen as a measure of water cloudiness and indicates water quality and filtration effectiveness. Higher turbidity levels are often associated with higher levels of pathogenic organisms (U.S.EPA, 2000).

Another area that requires urgent attention is the nature of transportation. The transportation of mixed loads, sometimes incompatible produce in terms of ethylene production, causes a lot of physiological damage to the fruits. Also, fumes from ill-maintained vehicles as well as fumes from petroleum products when these fruits are transported on fuel tankers could also be harmful to human health.

Precautions in Human Food Safety issues (Fresh Tomatoes)

Field temperature of the tomato fruits should be lowered by harvesting in the cool of the day (either early morning or late evening). Dirt, soil and other debris should be washed off the tomato fruits at the harvest sites before packing. Necessary measures to prevent animal access to crop fields, water sources and other related areas should be ensured. Awareness on the use of chlorination to disinfect the tomato wash water should be created and possibly, training workshops to demonstrate the use should be organized for market retailers.

The initial wash to remove surface dirt can be with hot water alone, or with water containing food grade detergents or permanganate salts (Beuchat, 1998). Placing warm produce in cool water has been found to result in a pressure differential. This creates suction effect that causes surface contaminants or contaminants in the water, to be drawn into the flesh of the commodity, where they are protected from subsequent disinfecting treatments (Bartz and Showalter, 1981).

The maintenance of the water temperature, 5^0c above the internal temperature of the produce will help prevent this suction effect (Zhuang *et al*., 1995). Awareness on temperature management of the water needs to be created. This is to avert possible cases of food poisoning, due to the infiltration of microorganisms into the tomato fruits, during washing. This can generally be affected in our present day handling system, by washing the fruits in the cool of the morning or away from the direct heat of the sun. It is therefore suggested that to avoid the infiltration of potential food-borne pathogens such as *Salmonella* and *E. coli* into natural openings or harvest wounds of fresh-market tomatoes, or other fruits and vegetables, great attention should be paid to the state of the wash water. Primary and secondary sources of water should be identified to avoid any possible pathogen contamination and proper maintenance of water storage tanks should be ensured.

Improved transportation means are advocated, if possible, refrigerated vehicles. Where refrigerated vehicles are not available, the use of well stacked packages with adequate ventilation spaces should be used in trucks with light coloured tarpaulin covers, to disperse light rays. Feeder roads connecting farms to major collection sites should be graded, while delays to the trucks bringing the produce to the destination markets in the southeast should be reduced to the barest minimum.

Small-scale tomato processing plants should be set up in States where tomatoes are produced in large quantities, so as to ensure that no produce is wasted. Other processing methods like drying, which are meant to use up excess production, should be carried out in more hygienic manner using solar driers, instead of the conventional open-air sun drying. Where the tomatoes are perceived to be severely damaged, both pathologically and physiologically, they should be thrown away, not consumed under any circumstances, no matter the low price. Be informed – Spoilt tomatoes could be carcinogenic!

Correspondence to:
Ofor Mairan O.
Department of Crop Science and Technology,
School of Agriculture and Agricultural Technology,
P.M.B. 1526 Owerri, Imo State, Nigeria.
mariofor2002@yahoo.com

Conclusion

An epidemic concerning infection with human pathogenic microorganisms will only be an illusion as long as the faecal indicator organisms like *E. coli*, *Salmonella*, *Shigella* and *Clostridium* do not find their way into areas where tomato fruits are produced. The use of Good Agricultural Practices (GAPs) during growing, harvesting, sorting, packaging, and storage operations for fresh fruits and vegetables is the key to preventing these pathogen contaminations.

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