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Safety Aspects of Local Tropical Food Production: Essential Oil Incorporation as a Safe Approach

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Abstract

Local food production can be seen worldwide, and there are several local wisdoms on food production. There are many problems on local food production, including the problem of microbiological contamination, which is considered a great concern. The safety consideration is required. In the tropical world, the problem of local tropical food production should be specially discussed. There are many cases of problematic microbiological contamination, and the quality management is still the issue for further development. A safe and acceptable approach to increase the safety and shelf life of tropical foods is the use of essential oils.

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1. Introduction

Local food production is widely observable throughout the world and there exist several local wisdoms on this. Good examples are the local ways of producing fermented foods and drinks. Among the problems on local food production, we can mention microbiological contamination as a great concern (1). Pathogens can grow and survive on tropical fruits in a wide range of temperatures for time frames long enough to cause illness. Tropical fruits are an extensive and diverse group, and cannot be categorized or regulated under the same umbrella (2). "The production of raw materials" is the first stage of the food chain to be focused in control of microbial contamination (3). Any microbial contamination in food during the production can be a big public health problem (4). In the tropical world, the problem of local tropical food production should be specially discussed. "Production environment" is an important source of contamination (2). There are many cases of problematic microbiological contamination, and the quality management is still the issue for further development.

2. Examples of important outbreak due to contamination in local tropical food production

In fact, there are many possible pathogens that cause contamination in foods during the local production. In the tropical world, contamination by parasites is considered a specific problem. "Cyclosporacayetanensis, Cryptosporidium and Giardia" are good examples of common parasitic pathogens, which are identified in food (5). In addition, many bacteria can also be seen as contaminants in tropical foods. The contamination during food production is an important concern in tropical food production business. The risk due to poor quality control in local tropical food production system can be expected. A good example is the local tropical food production, namely "Pla-ra" or local anchovy sauce in Southeast Asia, which is reported as a problem of bacterial contamination (6-9).

Of interest, the problem of contamination in local tropical food production can, sometimes, cause a big problematic outbreak. A good example is the case of botulism relating to the poor quality of local tropical food production. In Southeast Asia, the local

production of canned bamboo shoot can be commonly seen, which is considered a risk for generation of botulism. In 2007, a big outbreak of botulism due to contaminated local canned bamboo shoot products was reported in Thailand; this is believed to be the biggest outbreak (117 cases) in the tropical medicine record (10). "Improper canning procedures for bamboo shoot preservation" is identified as the root cause of the outbreak (11). Another good example is the case of acute hepatic encephalopathy due to severe aflatoxicosis reported from Malaysia (12). Mycotoxin has been detected in the fungal contaminated local Chinese noodle products (12).

3. Increasing the safety of local tropical food product: Policy and governmental approach

Local tropical food production is widely practiced in the developing tropical countries, and classified as an important small–medium enterprise. The local governments usually promote the local production to stimulate the local economy. However, a common forgotten issue is the quality management of local food production (13).

The potential for major outbreaks exists, and preventive strategies are needed to ensure the safety of these products. Preventive strategies should be implemented and well documented from harvest to production, including good agricultural practices (GAPs) during harvest, good manufacturing practices (GMPs), sanitation operating procedures (SOPs), and hazard analysis critical control points (HACCP) in the post-harvest handling or processing facilities.

Thomson et al. noted that "food safety" should be an important issue in "International trade standards (14). Locally, there should be a specific local agency to correspond for the quality of the local tropical food production. Also there should be a system for contamination and disease surveillance. Finally, the education to the local food producers should be considered since it is the starting point of the chain. If the local food producers have good knowledge and properly practice, reduction in contamination is highly expected.

4. Application of essential oils

Nowadays, every society requires more safe and high quality, preservative-free foods with extended shelf-life (15). Food safety has received more attention due to increasing rate of new food-borne diseases. There are also new concerns about the application of herbal products with additional functional properties instead of synthetic chemical preservatives (16). Among the natural antimicrobials, essential oils (EOs) have been widely investigated due to their anti-microbial (anti-fungal, anti-bacterial, anti-viral), anti-oxidant, anti-mutagenic and anti-carcinogenic properties (17). EOs (also called volatile or ethereal oils) are aromatic oily liquids obtained from plant materials (buds, flowers, leaves, bark, twigs, seeds, herbs, wood, fruits and roots) (18).

Presumption about the safety of EOs is their safety based on their long history of application over a wide range of human exposures without known adverse effects. There is a requirement to specify the chemical constituents and the concentration range of Eos, which should be evaluated safely (19). EOs are generally recognized as safe (GRAS) at flavoring concentrations. In the European countries, safe EOs include: carvacrol, carvone, cinnamaldehyde, citral, p-cymene, eugenol, limonene, menthol and thymol. Estragole and methyl eugenol have been deleted from the safe list in 2001. Due to the low costs of assay for safety evaluation, the procedures of safety evaluation of any added flavoring materials are applicable in most countries. Specification of biological origin, as well as physical and chemical properties with chemical assays is a necessary part of the safety evaluation of an EO. Also upper limit of the concentration of congeneric groups in the EO, target constituents, and the amount of trace unidentified constituents are key specifications (20).

As mentioned earlier, a great problem in public health is food-borne illnesses caused by consumption of foods contaminated with pathogenic bacteria and/or their toxins. Natural antimicrobials can be applied in foods, e.g. fresh fruits and vegetables, for anti-fungal effects, improvement of the quality, and nutritional value of the foods (17, 18).

In Europe, The most consumed tropical fruits are: banana, mango, pineapple, avocado and papaya (21). The importation of tropical fruits into the European countries is still subject to problems that adversely impact fruit quality. Transport-related losses are significant, and lead to wastage of top-quality products. In addition, the cost of these losses is distributed across both ends of the food-supply chain in the producer countries of the South and during the sale to the European consumers (22).

Post-harvest losses of tropical fruits are also significant, ranging from 10% to 85%, both in the developed and the developing countries. These losses may be physiological, pathological or mechanical. Spoilage as a result of parasites is the most common that causes the most damage, and is the hardest to prevent, because the pathogenic organisms are so varied with each type that require a specific action. It is worth noting that out of the total of 100,000 fungi, less than 10% are pathogenic for plants, and around 100 species are responsible for the majority of post-harvest damage (2).

International food-resource agencies recommend a substantial reduction of post-harvest losses to meet future food needs of the world population. Most of the industrial processes used for fruit disinfection require the application of chemical compounds such as fungicides, bactericides and insecticides, which often lead to the presence of residual traces of these products (23). Increased awareness of environmental protection is driving the European populations to turn

to consume biological products, and a niche economic opportunity is thus opening up for tropical fruits.

Many plants contain natural active materials with wide diverse effects. Some have the property of inhibiting microscopic fungi, and thus offer an alternative to chemical treatments with synthetic molecules. Anti-fungal activity of EOs is well documented, and several studies have been conducted on their post-harvest use (24, 25). The advantage of Eos is their bio-activity in the vapour phase, which makes them attractive candidates for fumigation use. In general, even though their anti-fungal activities can be easily demonstrated *in vitro*, their activities in real conditions have received relatively little attention. In the past few years, there has been renewed interest in extracts from aromatic and other plants with anti-fungal activity. Ranasinghe et al. (2005) found that combining EOs of clove and cinnamon with modified atmosphere packaging can extend the storage life of banana without affecting its organoleptic and physico-chemical properties (26).

Regnier et al. (2010) indicated that EOs rich in R-carvone could be valuable alternatives to synthetic fungicides for the post-harvest management of avocado fruit (27).

As mentioned above, in the tropical world, contamination by parasites is the specific problem. Some studies showed that EOs have anti-parasite activity. *Cryptosporidium parvum* has become recognized as a cause of water and food borne diseases in both humans and animals. Abu El Ezz et al. (2011) observed that onion and cinnamon oils were effective against the experimental infection of mice with *Cryptosporidium parvum* (28). Onion showed to be more potent than cinnamon in this regard. Also, Almeida et al. (2007) found that *Ocimumbasilicum* EO has anti-giardial activity (29).

5. Conclusion

An issue that requires continued examination is the routes of pathogen transmission onto tropical foods. The potential initial sources of pathogen contamination should be investigated along with the risks attached to these sources. Determining where pathogen contamination may occur, and how to prevent it, is essential to the continued safety of tropical foods. Understanding the degree of fruit contamination entering the post-harvest environment and cross-contamination potential during the post-harvest processing, shipping, storage, and retail is becoming increasingly important for risk managers. Given the direction legislation is taken in most countries, and the regulatory lowering of the allowable residual levels of some molecules in fruits and vegetables, alternatives to the use of chemical treatments should be developed and implemented to allow the export of good-quality products. In addition, reduced use of chemical treatments is also a response to consumer demand for wholesome and healthy foods.

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