



## Review Article

JMR 2018; 4(6): 283-287  
November- December  
ISSN: 2395-7565  
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www.medicinarticle.com  
Received: 10-10-2018  
Accepted: 19-12-2018

## Public Health challenges associated with street-vended foods and medicines in a developing country: A mini-review

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### Abstract

The steady growth of urban population has necessitated the proliferation of wayside food and medicines vendors. These vendors include a large population of individuals with very little or no knowledge and training on basic food safety and drug matters. They are neither properly trained nor fully aware of the serious health dangers posed by microbial contamination of their wares. Therefore, from place of preparation to roadsides where the foods are sold, the chances of contamination by pathogens are significantly high. Some of these street vended foods and medicines are ready-to-eat salads, vegetables, fruits, cooked foods, herbal remedies and concoctions, which can be consumed directly from the point of purchase. Poor hygiene at the point of preparation is sufficient to cause food borne outbreak of epidemiological significance while the medicines innumerable health consequences and consequent public health challenge. Poor storage system and frequent unhygienic exposure of prepared vegetable salads and medicines add to their microbial load. Some of the communities in developing countries do not have good sources of portable water for the preparation of these vital life products. It is not unlikely that some of these products are prepared with faecally contaminated water taken from local ponds and open streams. Daily interactions with *Escherichia coli*, *Shigella spp* and *Salmonella spp* which cause diarrhoea, dysentery and other serious gastrointestinal disturbances have been adequately documented. The target of this review is to highlight major public health concerns associated with foods and medicines vended in Nigeria, a developing country.

**Keywords:** Public health, food, medicines, street vendors, developing country.

### INTRODUCTION

Roadside food and/or medicine vendors constitute an important part of exploding urban populations in major parts of developing nations. They provide ready-to-eat foods and medicine concoctions. Vegetables and fruits are rich in minerals, vitamins and fibres [1]. They contain a wide variety of phytochemical compounds such as carotenoids and flavonoids that are capable of preventing some of the processes involved in the development of cancer and cardiovascular diseases [2, 3, 4, 5]. The varieties they present coupled with numerous mouth-watering advertisements on these vended foods and medicines make them appealing to the unguarded public. These public health products undergo several steps in their production chains. Those steps are not under any form of quality control and so, the safety of the final products cannot be guaranteed [5]. Street vended foods offer convenient access to ready meals to those that do not have cooking utensils or skills or convenience to prepare them at home regularly [6], while poverty and poor accessibility of good drugs (among other factors) have encouraged the patronage of these roadside medicine vendors [7]. The overall health benefits of these ready-to-eat foods vended on the streets in developing countries are numerous [8, 9, 10]. A research conducted by Eni, *et al.*, detailed medicinal and therapeutic properties of vegetables and concluded that "fresh fruits and vegetables promote good health but harbour a wide range of microbial contaminants" [11]. There is an increased demand for vegetables due to their known health benefits. This has also resulted in uncontrolled vending of vegetables and fruits in Nigeria and other developing countries [12]. At times, vegetables for making salads are irrigated with untreated urban wastewater and these wastewaters had been reported to contain ova of parasites and pathogenic bacteria and fungi [13]. A research study by Usuoge *et al.* on wheat bread sold in Nigerian market showed that the total fungal count (*Penicillium*, *Rhizopus*, *Mucor*,

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Geotricum, Oidium, and Saccharomyces) was beyond acceptable limit, which is 100 CFU per gram of flour [14]. According to the World Health Organization (WHO), waterborne and foodborne diarrhoeal disease kills about two million people annually [15]. Concoctions (herbal medicines) made by these vendors have no known quantity of active principles, are prepared in the least hygienic environment and carried about in public places like markets and motor parks with mouth-watering advertisements.

Since these street vended foods and medicines are readily available at affordable prices, controlling and ensuring their safety in most developing countries like Nigeria is still a major public health challenge [16]. Vegetables, fruits and herbal medicines are frequently exposed to pathogenic and nonpathogenic microorganisms when they are in contacts with unclean water, air, dust, soil and even through unhygienic postharvest operations [11]. Concoctions are exposed to poor storage conditions and poor packaging with no knowledge of the effect of the packaging materials on those concoctions. Also, these herbal products are mostly liquid preparations which may be affected by pH changes due to degradations of the active constituents/principles. In a research conducted by [17] to evaluate the level of microbial contaminations of prepared vegetable salads sold at outlets in Awka, Nigeria, it was shown that the samples collected from standard fast-food joints had significantly lower microbial count than the sample collected from street vendors. Also, Anagu *et al.*, reported the spread of pathogenic organisms from contaminated street vended Zobo and Soya Milk Drinks in Awka Metropolis, Nigeria [18]. The five most frequently isolated microorganisms from vended foods and medicines include *Salmonella* spp, *Shigella* spp, *E. coli*, *Staphylococcus* spp, *Bacillus* spp [19, 20, 21, 22].

The target of this review is to highlight major public health concerns associated with foods and medicines vended in Nigeria, a developing country.

## MATERIAL AND METHODS

Research works on microbial contamination of street vended foods and medicine published between 1990 and 2017 were sought for using the following keywords: Public health, food, medicines, street vendors and developing country. As much as seven hundred and sixty eight journal articles were extracted from Google scholar and Pubmed databases. The criteria for inclusion in the articles evaluated included emphasis on specific food borne pathogens, common contaminants of herbal medicine and their health ramifications in developing countries. Also, the microorganisms must have been isolated and identified in the publications. Fifty five met the criteria and were evaluated in full and included in this review.

## RESULTS AND DISCUSSION

### The Public Health

In 1920, Winslow Charles-Edward Amory defined Public Health as “the science and art of preventing disease, prolonging life and promoting human health through organized efforts and informed choices of society, organizations, public and private, communities and individuals.” It is a conscious and consistent effort by an individual or society to prevent or remove threats to health within a given population. Health as described by the World Health Organization is a “state of complete physical, mental and social well-being and not merely the absence of diseases” [23]. Hunger, food security, water and sanitation are parts of a broader threat to human health targeted in Millennium Development Goals of 2000 [24]. Availability of water and

food could still pose danger to human wellbeing if the pathogens are not deliberately removed during processing and preparations. While some of the pathogens utilize raw vegetables and fruits as their natural habitats, unhygienic handling of these food materials would certainly increase their bioburden and thus concerns to public health [25, 26, 27].

### Health Benefits of Fruit and Vegetable Salads

Salad includes mixture of chopped or sliced food substances that are majorly fruits and vegetables [28]. Vegetables commonly used in preparing salads are cucumber, pepper, carrots, tomatoes, spring onions and red onions [29]. These fruits and vegetables used for salads preparations are rich sources of human dietary requirements which include vitamins, carbohydrates, proteins, fats, minerals and phytochemicals that serve as antioxidants, phytoestrogens, and anti-inflammatory agents [1, 30, 31]. They also contain dietary fibres, flavonoids, carotenoids and other phyto nutrients that reduce the risk of heart related disorder and cancer. Berg *et al.*, suggested that microbiota of plants are immunostimulatory and they also contribute to diversity of microflora in the gut [32]. Due to all these highlighted benefits of fruits and vegetables, they are encouraged and recommended to United States consumers [31, 33]. Some metabolic diseases such as obesity could also be prevented by high intake of vegetable foods [1]. At least 400g of fruits and vegetables daily is recommended globally by World Health Organization [34].

### Sources of Contamination of Foods

Foods are prone to microbial contaminations from the point of cultivation to when they are consumed by individuals. Use of untreated waste-water for irrigations and unhygienic post-harvest handling of fruits and vegetable materials have been identified as the primary sources of their contaminations [35, 36]. Therefore, the microbial load of a given food substance depends on their level of exposure to contaminants at any point. Holding temperature and pH of ready to eat salads are considered as the major factors that determine the growth of foodborne pathogens. Fruit and vegetable salads are subject to six to seven fold microbial load contaminations when exposed to various types of cutting [37, 38, 39]. Other possible sources of contaminations are soil-borne microbes, animal dungs, untreated water or water from dirty reservoir, transport equipment, crevices of blending machines, unwashed hands of food handlers [40, 41, 42].

### Pathogens Associated With Fruits, Vegetable and Medicines Vending

Table 1 shows that common pathogens associated with food and water borne diseases are frequently isolated from raw vegetables, fruits and mixed salad. Microbes, which include Gram positive bacteria, Gram negative bacteria, yeasts, viruses, protozoa, and acid-fast pathogens, are frequently isolated from food substances and medicines sold in some developing countries, including Nigeria. *E. coli* and *Streptococcus faecalis* which are commonly associated with faecal contaminations have also been isolated in lettuce, cabbage, cucumber, tomato and mixed fruits and vegetable salads. Raw green pea, onions and green beans have also been found to harbour pathogens such as *S. aureus*, *B. cereus*, *Salmonella* spp and *Klebsiella* spp. Other pathogens which have also been frequently isolated from vegetables vended on the streets include yeast, *Cladosporium* spp, *Penicillium* spp, *Rhizopus* spp, *Aspergillus* spp, *Proteus* spp, *Aeromonas hydrophila*, *Yersinia enterocolitica* and *Serratiaspp* etc. All these organisms have been implicated in several human ailments which include diarrhoea, dysentery, typhoid, nausea and feverish conditions. Pathogenic protozoa such as *Giardia lamblia*, *Taenia* eggs and *Entamoeba coli* are also associated with street vended foods.

**Table 1:** Vegetable salad materials and the organisms that frequently isolated from them

Pathogens	Street Vended food and medicines Products	References
<i>Staphylococcus aureus</i>	Mixed fruit/vegetable salad	[12]
<i>Bacillus cereus</i>	Mixed raw vegetables	[43]
<i>Salmonella Enteritidis</i>	Mixed vegetable Salad	[16]
<i>E. coli</i>	Lettuce, cabbage, carrot, tomato	[13]
<i>Klebsiellaspp.</i>	Mixed raw vegetables	[43]
Yeast	Lettuce, cabbage, carrot, tomato	[13]
<i>Streptococcus agalactiae</i>	Vegetable food salad	[44]
<i>L. monocytogenes</i>	Fresh vegetable juice	[45]
<i>Cronobacter sakazakii</i>	Mixed vegetable salad	[46]
<i>Campylobacter spp.</i>	Prepared salad	[24]
<i>Proteus spp</i>	Vegetable food sample	[44]
<i>E. aerogenes</i>	Beat, carrot, coriander, cucumber, radish, spinach	[47]
<i>Shigella sonnei</i>	Carrot, Radish, Spinach	[47]
<i>Pseudomonas aeruginosa,</i>	Vegetable food sample	[44]
<i>Micrococcus spp</i>	Mixed Vegetable Salad	[16]
<i>Aeromonas hydrophila</i>	Salad vegetables and fruits	[48]
<i>Serratia spp</i>	Vegetables	[49]
<i>Staphylococcus spp</i> and <i>Microsporium spp.</i>	Herbal anti-infective products	[21]
<i>L. monocytogenes</i>	Mixed baby spinach	[50]
<i>Y. enterocolitica</i>	Mixed ingredient salad	[50]
<i>Giardia lamblia</i>	Fresh salad vegetables	[51]
<i>Entamoeba coli</i>	Fresh salad vegetables	[13]
<i>Taenia</i> eggs	Fresh salad vegetables	[13]
<i>Hymenolepis nana</i>	Fresh salad vegetables	[13]
<i>Salmonella typhi</i>	Vegetables	[52]
<i>Vibrio cholera</i>	Vegetables	[52]
<i>Enterobacter aerogenes</i>	Mixed vegetables	[13]
<i>Pseudimonas spp.</i>	Mixed vegetables	[13]
<i>Enterococcus</i>	Lettuce, cabbage, carrot, tomato	[13]
<i>Enterobacter faecalis</i>	Vegetable food sample	[44]
<i>Alternia spp</i>	Plantain pudding	[53]

### Populations at Risk

It is difficult to pin down a particular population or demography as most risk population since the consumption of fruits and vegetables are encouraged globally. However, high increases in consumption of vegetables by the elderly and immunocompromised individuals have been reported [54,55]. These are populations at most risk of contracting diseases by ingestion of pathogen infested fruits and vegetables. Lack of education or essential health tips in some communities are also predisposing factors that those communities among most risk populations. Vegetarians are also at risk of contracting foodborne pathogens due to their high consumption of vegetables and fruits. Fruits and vegetables vended on roadsides are also attractive meals for travellers. In summary, eating fruits and vegetables because of their health benefits without adequate attention to the potential hazard posed by their possible microbial contaminations puts the consumers at risk of contracting the dangerous pathogens associated with foodborne ailments.

### View Points

All the reviewed articles showed that unhygienic handling of food materials and herbal concoctions at the point of preparations is the most common source of contamination. Most reviewed publications suggested that storage of these health products at ambient temperature encourages the growth of major pathogens. Frequent and unhygienic exposure, contamination due to water sources, heavily contaminated raw food materials and herbal medicines, inadequate reheating, inadequate initial cooking and contamination of food substances by utensils were all highlighted. Important actions to be taken to reduce contaminations include; frequent washing of hands during food preparation, use of clean portable water in food preparation, decrease the length of time which ready-to-eat meals are stored at ambient temperature, proper heating and reheating and thorough washing of utensils.

The review provided an insight on the public health challenges associated with street vended foods and medicines especially in developing countries where there are inadequate enlightenment/training and/or inadequate or weak regulations. While the vendors are required to undertake conscious and consistent hygienic approaches in preparation of street vended foods, consumers are also encouraged to wash their hands properly and take other necessary steps to ensure consumption of uncontaminated food.

### CONCLUSION

While street vended fruits and vegetables offer essential vitalities to consumers, the potential health hazards arising from lack of adequate regulations and control of food vendors' operations are quite significant. Based on the reviewed publications, the following are recommendations to reduce frequency of microbial contaminations of street vended foods and medicines in developing countries like, Nigeria:

1. Creating continuous health awareness programmes using all available public and social media to properly educate food vendors and households on proper hygienic protocols in preparation of various foods and so encourage the adoption of hygienic practices at all levels of food and medicines processing
2. Adequate and enforceable environmental sanitation regulations.
3. Decreasing the length of time which ready-to-eat meals are stored at ambient temperature.
4. Continuous monitoring of street-vended food by Public Health personnel.
5. Enforcement of the requisite sections of the laws restricting street-vending of medicines

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