



Review Article

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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

REFERENCES

1. Joannes LS, Beate L. Health Benefits of Fruits and Vegetables. *Advances In Nutrition*. 2012; 3:506-516. <https://doi.org/10.3945/an.112.002154> PMID:22797986 PMCID:PMC3649719
2. Mashhadi NS, Ghiasvand R, Askari G, Hariri M, Darvishi L, Mofid MR. Anti-Oxidative and Anti-Inflammatory Effects of Ginger in Health and Physical Activity: Review of Current Evidence. *International Journal of Preventive Medicine*. 2013; 4(Suppl 1):S36–S42. PMID:23717767 PMCID:PMC3665023
3. Sahdeo Prasad, Amit K Tyagi. Ginger and Its Constituents: Role in Prevention and Treatment of Gastrointestinal Cancer, *Gastroenterology Research and Practice*, vol. 2015, Article ID 142979, 11 pages, 2015. doi:10.1155/2015/142979 <https://doi.org/10.1155/2015/142979>
4. Kundu SK, Islam T. Prevalence of Pathogenic Bacteria Isolated from Two Selected Salad Vegetables and Antibioqram Profile of *Klebsiellaspp.* 2015; 13(June):9-17.
5. Söderqvist K, Thisted Lambertz S, Vågsholm I, Boqvist S. Foodborne bacterial pathogens in retail prepacked ready-to-eat mixed ingredient salads. *Journal of Food Protection*. 2016; 79(6):978-85. <https://doi.org/10.4315/0362-028X.JFP-15-515> PMID:27296602

6. Soncy K, Anani K, Djeri B, Adjrah Y, Eklu MM, Karou DS, *et al.* Hygienic quality of ready-to-eat salads sold in the street and a modern restaurant in Lomé, TOGO, 2015; 9:2001–2010.
7. Olike Chinwendu. The fight against fake drugs by NAFDAC in Nigeria. 44th International Course in Health Development (ICHHD) September 24, 2007 – September 12, 2008 KIT (Royal Tropical Institute) Development Policy & Practice/Vrije Universiteit Amsterdam, 2008. <http://apps.who.int/medicinedocs/documents/s18405en/s18405en.pdf>. Accessed on 19th August 2017
8. Al Mamun M, Rahman SMM, Turin TC. Microbiological quality of selected street food items vended by school-based street food vendors in Dhaka, Bangladesh. *International Journal of Food Microbiology*. 2013; 166(3):413-418. <https://doi.org/10.1016/j.ijfoodmicro.2013.08.007> PMID:24029025
9. Mohammad S, Owda A. Bacteriological Quality of Fresh Vegetables Salad in Schools Canteens and Restaurants in Gaza strip, 2017; 25(1):1-12.
10. Ganguli A, Bansal S, Malik N, Rana AK, Ghosh M. Microbiological quality and safety of two popularly consumed raw, street vended foods in India. *Food Science and Biotechnology*, 2004; 13(4):417–420.
11. Eni AO, Oluwawemitan IA, Solomon OS. Microbial quality of fruits and vegetables sold in Sango. *African Journal of Food Science*. 2010; 4:291-296.
12. Orji JO, Ayogu TE, Nnachi AU, Obaji M, Efunshile AM, Okeh CO, *et al.* Bacteriological quality of mixed fruits/vegetables salads and selected ready-to-eat vegetables sold in Abakaliki Metropolis. *World Journal of Pharmaceutical and Life Sciences*. 2017; 3(3):157-163.
13. Avazpour M, Nejad MR, Seifipour F, Abdi J. Assessment of the microbiological safety of salad vegetables from different Restaurants in Ilam. *Journal of Paramedical Sciences (JPS) Spring*, 2013; 4(2):2008-4978.
14. Usuoge POA, Enabulele OI, Enweani IB, Akpe AR, Ekundayo AO. Mycological and Physico- Chemical quality of wheaten white bread flour made for Nigerian market. *Global Journal of Medical Research*. 2011; 11(2):5-8.
15. Woldt Monica, Moy Gerald G. Literature Review on Effective Food Hygiene Interventions for Households in Developing Countries. Washington, DC: FHI 360/FANTA. PMCid:PMC4578523, 2015.
16. Asiegbu CV, Lebelo SL, Tabit FT. The food safety knowledge and microbial hazards awareness of consumers of ready-to-eat street-vended food. *Food Control* 2016; 60:422-429. <https://doi.org/10.1016/j.foodcont.2015.08.021>
17. Agu KC, Orji MU, Onuorah SC, Egurefa SO, Anaukwu CG, Okafor UC, *et al.* Comparative Bacteriological Analysis of Ready-to-Eat Vegetables Salad Sold by Various Food Vendors in Awka. *American Journal of Life Science Researches*. 2014; 2(4):458-465.
18. Anagu Linda, Okolocha Emeka, Ikegbunam Moses, Ugwu Malachy, Oli Angus, Esimone Charles. Potential Spread of Pathogens by Consumption of Locally Produced Zobo and Soya Milk Drinks in Awka Metropolis, Nigeria. *British Microbiology Research Journal*. 2015; 5(5):424-431, Article no. BMRJ.2015.044. DOI:10.9734/BMRJ/2015/8486 <https://doi.org/10.9734/BMRJ/2015/8486>
19. Ameko E, Achio S, Alhassan S, Kassim A. Microbial safety of raw mixed-vegetable salad sold as an accompaniment to street vended cooked rice in Accra, Ghana. *African Journal of Biotechnology*. 2012; 11(50):11078-11085. <https://doi.org/10.5897/AJB11.2604>
20. Pesewu GA, Agyei JNYK, Gyimah KI, Olu-taiwo MA, Codjoe FS, Anim-baidoo I, *et al.* Bacteriological Assessment of the Quality of Raw-mixed Vegetable Salads Prepared and Sold by Street Food Vendors in Korle-Gonno, Accra Metropolis, Ghana, 2014; 2:560-566.
21. Razzaq R, Farzana K, Mahmood S, Murtaza G. Microbiological analysis of street vended vegetables in Multan City, Pakistan: A public health concern. *Pakistan Journal of Zoology*. 2014; 46(4):1133-1138.
22. Ujam NT, Oli AN, Ikegbunam MN, Adikwu MU, Esimone CO. Antimicrobial Resistance Evaluation of Organisms Isolated from Liquid Herbal Products Manufactured and Marketed in South Eastern Nigeria. *British Journal of Pharmaceutical Research*. 2013; 3(4):548-562. <https://doi.org/10.9734/BJPR/2013/3554>
23. World Health Organization. The role of WHO in public health, accessed 19 April 2011.
24. Little CL, Gillespie IA. Prepared salad and public health. *Journal of Applied Microbiology*. 2008; 105:1729-1743. <https://doi.org/10.1111/j.1365-2672.2008.03801.x> PMID:18397258
25. Elson R. Personal hygiene of the food handler. In: McLaughlin J, Little CL (Eds.), *Hobbs' Food Poisoning and Food Hygiene*. Arnold, London. 2007; 169-179.
26. Daryani A, Ettehad GH, Sharif M, Ghorbani L, Ziaei H. Prevalence of intestinal parasites in vegetables consumed in Ardabil. *Iran Food Control* 2008; 19:790-794 <https://doi.org/10.1016/j.foodcont.2007.08.004>
27. Collins JE. Impact of changing consumer lifestyles on the emergence/re-emergence of foodborne pathogens. *Emer. Inf. Dis.*, 2001; 3:1-13.
28. Uzeh RE, Alade FA, Bankole M. The microbial quality of pre packed mixed vegetable salad in some retail outlets in Lagos Nigeria. *African Journal of Food Science*. 2009; 41:270-272.
29. Osamwonyi OU, Obayagbona ON, Aborisade TW, Olisaka NF, Uwadiae E, Igiehon ON. Bacteriological Quality of Vegetable Salads Sold at Restaurants Within Okada Town, Edo State, Nigeria. *Journal of Pharmacy and Biological Sciences (IOSR-JPBS)*. 2013; 5(2):87-90.
30. Pollack S. Consumer demand for fruit and vegetables: Changing Structure of Global Food Consumption and Trade. Washington, DC: Economic Research Service/United States Department of Agriculture. 2001; 49-54.
31. James JB, Ngarmsak T. Processing of fresh cut tropical fruits and vegetables: A technical guide (Bangkok: FAO, 2011), 2011.
32. Berg G, Mahnert A, Moissl-Eichinger C. Beneficial effects of plant-associated microbes on indoor microbiomes and human health? *Front. Microbiol*. 2014; 5:15. doi: 10.3389/fmicb.2014.00015.
33. Lych SR, Stoltzfus JR. Iron and ascorbic acid: proposed fortification levels and recommended iron compounds. *J. Nutr.* 2003; 133:2978-2984.
34. WHO. World Health Organization. Fruit and vegetable promotion initiative. A meeting report. 2003; 25-27/08/03. Available from: <http://apps.who.int/iris/handle/10665/68395> [Accessed 21 July,2017].
35. Beuchat LR. Ecological factors influencing survival and growth of human pathogens on raw fruits and vegetables. *Microbes and Infection*, 2002; 4: 413-423, [https://doi.org/10.1016/S1286-4579\(02\)01555-1](https://doi.org/10.1016/S1286-4579(02)01555-1)
36. Amoah P, Drechsel P, Abaidoo RC, Klutse A. Effectiveness of common and improved sanitary washing methods in selected cities of West Africa for the reduction of coliform bacteria and helminth eggs on vegetables. *Tropical Medicine and International Health*, 2007; 12(Suppl.):S40–S50. <https://doi.org/10.1111/j.1365-3156.2007.01940.x> PMID:18005314
37. Farmer JJ. Enterobacteriaceae: Introduction and identification, in P.R. Murray, E.J. Baron, M.A. Pfaller, F.C. Tenover and R.H. Tenover (Eds). *Manual of clinical microbiology*, 6. (Washington D. C: American Society for Microbiology, 1995), 1995; 438-448.
38. Garg N, Churey JJ, Splittstoesser DF. Effect of processing conditions on the micro flora of fresh-cut vegetables. *Journal of Food Protection*. 1990; 53:701-703. <https://doi.org/10.4315/0362-028X-53.8.701>
39. Chukwu OOC, Olabode OA, Chukwu ID, Enweani IB, Nimzing L. Effects of Temperature, P.H & Sodium Chloride concentration variation on the survival of *Listeria monocytogenes* in cabbage & lettuce juice. *Nigerian Journal of Biotechnology*. 2007; 18(1-2):7-12.
40. Adjirah Y, Soncy K, Anani K, Blewussi K, Karou DS, Ameyapoh Y, *et al.* Socio-economic profile of street food vendors and microbiological quality of ready-to-eat salads in Lomé. *International Food Research Journal*. 2013; 20(1):65-70.
41. Enweani IB, Esumeh FI, Akpe RA, Akharume EE, Aghaiyo ID, Igbinaduwa IN, *et al.* Isolation of *Listeria* species from water bodies, sewage and soilsamples. *Journal of Applied and Basic Sciences*. 2003; 1:87-90.
42. Hannan A, Rehman R, Saleem S, Khan MU, Qamar MU, Azhar H. Microbiological analysis of ready-to-eat salads available at different outlets in Lahore, Pakistan. *International Food Research Journal*. 2014; 21(5):1797-1800.
43. George AP, Jeffery NYKA, Kwakye IG, Michael AOT, Samuel OD, Francis SC, *et al.* Bacteriological Assessment of the Quality of Raw-mixed Vegetable Salads Prepared and Sold by Street Food Vendors in Korle-Gonno, Accra Metropolis, Ghana. *Journal of Health Science*. 2014; 2:560-566.
44. Yeboah-Manu D, Kpeli G, Akyeh M, Bimi L. Bacteriological Quality of ready to eat foods sold on and around University of Ghana campus. *Research Journal of Microbiology*. 2010; 5(2):130-136. <https://doi.org/10.3923/jm.2010.130.136>
45. Enweani IB, Chukwu OO, Onochie CC, Otobo DI. The fate of *Listeria monocytogenes* in selected fresh vegetable juice as affected by temperature, pH and vinegar. *Nigeria Journal of Microbiology*. 2001; 15(2):57-63.
46. Abdelraouf AE, Hashem ZA, Samia MAO. Bacteriological Quality of Fresh Vegetables Salad Sold in Schools Canteens and Restaurants in Gaza Strip-Palestine. *IUG Journal of Natural Studies*. 2017; 25(1):1-12.
47. Winslow CEA. The Untilled Field of Public Health". *Modern Medicine*. 1920; 2:183-191. <https://doi.org/10.1126/science.51.1306.23>
48. Poorna V, Randhir A. Prevalence and growth of pathogens on salad vegetables, fruits and sprouts. *International Journal of Environmental Hygiene and Health*. 2001; 203:205-213. [https://doi.org/10.1078/S1438-4639\(04\)70030-9](https://doi.org/10.1078/S1438-4639(04)70030-9)
49. Bibek R. *Fundamental food microbiology* (London: CRC Press, 2005), 2005.
50. Söderqvist K. Is your salad safe to eat? Aspects of foodborne zoonotic bacteria in ready-to-eat leafy vegetables and mixed-ingredient salads.

Doctoral thesis' Swedish University of Agricultural Sciences Uppsala 2017, 2007.

51. Abougrain AK, Nahaisi MH, Madi NS, Saied MM, Ghenghesh KS. Parasitological contamination in salad vegetables in Tripoli-Libya. *Food Control* 2010; 21:760-762 <https://doi.org/10.1016/j.foodcont.2009.11.005>
52. De Oliveira MA, de Souza VM, Bergamini AMM, de Martinis ECP. Microbiological quality of ready-to-eat minimally processed vegetables consumed in Brazil. *Food Control*, 2011; 22:1400-1403.
53. Ohenhen RE, Enweani IB, Ogiehor IS, Uwabor K. Microorganisms associated with the preparation of plantain pudding in Western Nigeria. *African Journal of Biotechnology*. 2006; 5(22):2077-2088.
54. Tauxe R, Kruse H, Hedberg C, Potter M, Madden J, Wachsmuth K. Microbial hazards and emerging issues associated with produce - A preliminary report to the National Advisory Committee on Microbiologic Criteria for Foods. *Journal of Food Protection*. 1997; 60(11):1400-1408. <https://doi.org/10.4315/0362-028X-60.11.1400>
55. Lake R, Hudson A, Cressey P, Gilbert S. Risk profile: *Listeria monocytogenes* in ready-to-eat salads. Christchurch, New Zealand:Institute of Environmental Science & Research Limited, 2005.