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Bacterial contamination of vegetables sold at Oba market Akure in Southwest Nigeria

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Abstract

Vegetables provides nutrients vital for health and maintenance of the body. As good and beneficial vegetables are, it can also be an harbinger for transmission of contamination and bacterial infections when not properly handled especially in the course of buying and selling in the market for consumption.

A cross sectional study was conducted between January and March 2022, to assess the level of bacterial contamination of vegetables, this is the basis of the objective of this study.

Method: Selected vegetables were purchased from local vendors from market. lt was processed for examination in the Microbiology laboratory where standard cultural techniques was carried out to identify, isolate and characterize the bacterial isolated.

Result: Of the 280 vegetables samples examined, 102 (36.4%) were positive for bacteria while 178 (63.6%) had no bacteria isolated. The bacteria pathogens isolated were; *Escherichia coli, Staphylococcus aureus, Salmonella species* and *Proteus mirabilis*

Conclusion; There was bacterial contamination from the result. The role of Environmental Health Officers to educate and sensitize the local vendors to monitor and ensure vegetables are properly displaced in shelves and provided in hygienic manner will reduce the contaminations and bacterial infection.

Keywords: Contamination; Vegetables; Bacterial infection; Oba market

1. Introduction

Vegetables are highly beneficial components of balanced diet which play pivotal role for maintenance of health and prevention of diseases (1).They are rich in carbohydrate, vitamins, minerals and fibre contents. The risk of disease transmission is much higher among fruits and vegetables consumed in raw and or unwashed (2,3,6, 7). Sequel to this , World Health Organization (WHO) recommended the intake of a minimum of 400g of fruits and vegetables per day not only for the prevention of chronic diseases, cancer, diabetes but also for the prevention and alleviation of several micronutrient deficiencies (4,5). Notable among the vegetables used in this study are; Waterleaf (*Talinum triangulare*) the edible leaves are soft,succulent and highly nutritious.it has short life span, takes an average of only 30 – 45 days from planting to harvesting (8).Plant quality and freshness is best when harvested in the morning when transpiration is minimal. The leafy produce of this crop is highly perishable start wilting a few hours after harvest (9) The leaf and root extracts are used for treating asthma, fresh cuts, scabies, anemia and high blood pressure (10)

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Cochorus olitorius L (Ewedu) is a fast growing annual herbs up to 4m tall with fibrous stem.The leaves are ovale-lancelate to lanceolate 60 to 100mm long and 20 -40 mm wide*. Cochorus olitorius* grows in tropical and subtropical regions throughout the world. All the parts of the plants have always been used as medicine to treat many sicknesses. (11). The species Olitorius is from latin and means pertaining to vegetables (12).

Tomato (*Solanum lycopersicum*) Tomato is the edible berry of the plant commonly known as the tomato plant.It is shinny and smooth, it has many small seeds most tomato are red.The tomato is green when it is unripe.Tomatoes contains many health promoting compounds and are easily integrated as a nutritious part of a balanced diet. (13). In addition to consuming the fresh fruits, consumers uses tomatoes in processed products such as soups, juices and sauces (14.15)

Ugwu (*Telfairia occidentalis)* Fluted pumpkin is a tropical vine grown in West Africa as a leafy vegetable and for its edible seed. Otherwise known fluted gourd,ugwu and lkong-uborg in their native .lt botanical name is *Telfalria occidentalis*. The creeping looking plant is characterized by fleshy fluted goards with hard edible seeds (15) Rich in Vitamin A and C while vitamin A improves eyesight and promote healthy skin and hair.Vitamin C helps in healing wound forming scar tissue as well as maintaining healthy bones, skin and teeth. (16).

Vegetables can be contaminated with enteric bacteria of medical and public health importance during cultivation, harvest, transportation and further processing. As a result, they have been mentioned in many of previous food –borne outbreaks (17). The poor personal and environmental hygiene and poor health system commonly observed in developing countries make the prevalence to be highest the population in those countries (1,5). Several factors may contribute to contamination of vegetables .They may exposed to bacterial contamination in the pre-harvest and post-harvest handling (19,20).Use of insufficiently treated wastewater for irrigation is an important risk factor for contamination of vegetables cultivated using irrigation in developing countries (19).Contamination of soil with animal wastes and increased application of improperly composted manures to soil has also similar role .Poor or inappropriate hygienic practice during production, transport, processing and preparation of handlers including consumers also contribute in vegetable contaminations (21).lt is not enough to depend merely on chemotherapeutic intervention to control infectious diseases, therefore, the need for concerted effort to reduce and eliminate the potential sources of infection. To cope up with this effort, periodic detection of medically important infections contaminants of vegetables and associated practices seek priority attention (22)

2. Material and methods

A cross –sectional study was conducted from January to March 2022 in local market of Oja Oba Akure. Southwest Nigeria. The weather condition during our data collection period was hot and dry during January and February, and the minor rainy season starts in March.

2.1. Sample collection

A structured questionnaire administered to local vendors by face to face interview was used to collect data about factors associated with parasitic contamination of vegetables.About 200gms of vegetables were purchased from three local markets (Oja –oba ,Oja Oshodi, Oja isolo) .Variable numbers of samples were collected from each vegetable type based on their abundance in the markets. 88 (31.4%) *Lycopersicon esculentum* (Tomato*)* 78 (27.9%) *Talinum triangulaire (Waterleaf)*62 *(22.1%) Fluted pumpkin (Ugwu*) and 52 (18.6%) *Cochorus olitorius* totally 280 samples were collected, put in sterile bags, labeled and transported through transporting cold box to the Microbiology laboratory of the university Medical centre for microbiological analysis.This was done within 24h after collection.

2.2. lsolation of bacteria

Samples were transported to sterile packet and analyzed for isolation and identification of pathogenic bacteria following standard methods. About 25gms of vegetable samples were rinsed thoroughly with sterile water and tenfold serial dilutions of each rinse water was made and 1ml of 10 -2 ,10-4, 10-5, 10-6 was pipetted into MacConkey, Salmonella Shigella agar, Mannitol salt agar and Nutrient agar using the pour plate technique. The plates were allowed to solidify, inverted and incubated at 370C for 24h for colony formation. The characteristic morphological properties of each pure culture observed. Bacterial pathogens isolated were identified on the basis of morphological, cultural and biochemical tests following standard techniques and protocol (23).

3. Results

A total of 280 vegetable samples were collected from local markets and examined for bacterial contamination. Vegetables were collected from three markets Oja oba, (170, 60.8%)Oja lsolo (68,24.2%) and Oja oshodi (42, 15%). Vegetables collected were Tomato (88, 31.4%), Waterleaf (78, 27.9%) Ewedu (52, 18.6%) and Ugwu (62, 22.1%). Results of this study showed that 102 (36.4%) vegetable samples were contaminated with bacteria. Waterleaf (36, (35.3%) was the most frequently contaminated vegetable followed by Tomato28, (27.4%) next to it is Ugwu 22, (21.5%) and the least is Ewedu 16, (15.7%). Four species of bacteria were isolated, *Escherichia coli*, *Staphylococcus aureus Salmonella* species and *Proteus mirabilis* .*Escherichia coli* 42 (41.2%) being the commonest bacterial contaminant of vegetables while Ewedu (*Cochorus olitorius*) is the least vegetable contaminated. Table 1.

4. Discussion

Bacterial contamination rate of vegetables in this study was considerable. Data was collected in the dry season so the tendency of contamination due to flood was less in this study. Waterleaf (*Talinum triangulare*) was the most frequently contaminated vegetable from the present study (35.3%). The reason why this is so is because Waterleaf has large surface area which enables it to attach contaminants as compared to smooth surfaced vegetable of Tomato (27.5%)which was the next contaminant with narrow exposed outer surface.

Among the four bacterial species identified, *Escherichia coli* was the highest contaminants which accounted 42 (41.2%) of the total bacteria isolated.This was in consonance with findings from Istabul 41.7%, Brazil 40 -41.5% but unlike Vietnam 100%.*Escherichia coli* is a faecal coliform bacterium usually excreted in stool which is obvious to be abundant in the environment where open defaecation is common. Consequence to this, farmers also use human excreta as a natural fertilizer this accelerates rate of contamination of vegetable cultivated in such farms. However, the rate of *Escherichia coli* contamination in this study is at par as compared to previous studies from lstabul, Brazil (24,25) which are in the same range but highest with study from Vietnam (26). Studies from Sudan indicated *Staphylococcal* species as the most frequent bacterial isolates (28), these differences might be due to variation in the time (season) of data collection and sensitivity of laboratory methods used. Higher contamination rate of *Staphylococcus aureus* was also observed in previous study conducted in lndia 56 -74% (27). We are unable to detect other bacterial species like *Klebsiella, Pseudomonas* and *Shigella* which were found in similar report. All those variations might be due to differences in ecological abundance of the bacteria, culture techniques used and the time of data collection. The handling and delivery of vegetables from one market to another can enhance transmission of contaminations of bacteria from the source of local purchase to the other, therefore the need to maintain simple hygiene is a necessity to minimize contamination.

Table 1 Frequency distribution of bacterial contamination among vegetables sold in Oja-oba market Akure

Vegetable type	**Number examined**	***E.coli***	***S. aureus***	***Salmonella* spp**	***Proteus mirabilis***	**Total number**
Tomato	88	12	8	6	2	28
Waterleaf	78	15	12	5	4	36
Ewedu	52	8	6	1	1	16
Ugwu	62	7	8	3	4	22
Total	280	42	34	15	11	102
		41.2%	33.3%	14.7%	10.8%	

Table 2 Factors associated with bacterial contamination of vegetables sold at Oja-oba market Akure. January to March 2022

Variables	Category	Number examined	Rate of contamination
Vegetables	Tomato	88	31.4%
	Waterleaf	78	27.9%
	Ewedu	52	18.6%
	Ugwu	62	22.1%
Washed before display	Yes	47	16.8%
	No	233	83.2%
Market	Oja-oba	170	60.8%
	Oja-isolo	68	24.2%
	Oja –oshodi	42	15%
Means of display	On the floor	204	72.8%
	On table/shelf	76	27.2%
Handled by who	No formal education	15	5.3%
	Primary school	202	72.2%
	Secondary schl./above	63	22.5
Sources of vegetables	Farmers	252	90%
	Large scale vendor	28	10%

5. Conclusion

It is evidenced that contamination of bacterial in the vegetables was considerable in this study. *Escherichia coli* was the most frequent isolated bacteria while Waterleaf (*Talinum triangulare*) was the most frequently contaminated vegetable. As part of strategy to reduce incidence of contamination the need for public health officials to holds talks, seminars on regular basis to market women and advise on safe handling and display in hygienic manner will go a long way to reduce the contaminations.

Compliance with ethical standards

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Disclosure of conflict of interest

The authors declare no conflict of interest.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

Authors Declaration

The authors declare that the work presented in this manuscript is original and that any liability for claims relating to the consent of this manuscript will be borne by them.

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