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BACTERIOLOGICAL QUALITY OF SOME READY TO EAT VEGETABLES AS RETAILED AND CONSUMED IN SABON-GARI, ZARIA, NIGERIA

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ABSTRACT
Some ready to eat leafy vegetables on sale at Sabon-gari market, Zaria were analysed for their bacterial flora and counts. Lettuce had aerobic plate count range of 2.0 x 10^7 to 5.7 x 10^8 cfu/g, cabbage had a count range of 1.3 x 10^7 – 5.6 x 10^8 cfu/g and cucumber had a range of count of 3.0 x 10^5 to 1.9 x 10^6. The coliform index showed lettuce to have a count of 8.8 x 10^6 – 1.3 x 10^9, cabbage was 2.1 x 10^6 to 8.0 x 10^7 cfu/g and cucumber was 8.0 x 10^5 to 1.9 x 10^6. Bacillus species and Staphylococcus aureus were the predominant bacteria isolated from these vegetables. The counts were obviously above the recommended standards for ready to eat vegetables especially coliforms which should be less than 10 coliform bacteria per gram(FAO, 1979). There is the need for hygiene officials to take interest on what is offered to consumers and specify acceptable handling practices.

Key words: Quality, Vegetable, Aerobic plate count, coliform index

INTRODUCTION

A vegetable is the tender plant part which is not sweet and may be flavoured or spiced with condiments before consumption (Okigbo, 1990). These plants or plant parts may be eaten raw as salad or added to some cooked foods like rice. Vegetables are known to be reach in vitamins, iron, calcium, proteins, fats and minerals. Leafy green and yellow vegetables are valued highly for their vitamin A and iron contents. Vegetables are helpful in neutralising the acid substances produced in the course of digestion of meat, cheese and other foods as they are valued as roughages which promote digestion and helps to prevent constipation (Oyenuga and Fetuga, 1985).

While growing, vegetables may be exposed to many sources of contamination like contaminated sewage used in watering the gardens from where these vegetables are grown. *Salmonella* species and other pathogens are derived from raw and treated sewage (Edel et al, 1999).

Contamination of vegetables can be reduced depending on the use of good agricultural practices in growing the vegetables, good hygiene practices during harvesting, picking, transporting and processing particularly washing. The importance of washing vegetables properly especially those eaten raw is to effectively remove from the vegetables any pathogenic microorganisms which may cause infections upon ingestion. Chlorine containing solutions or other antibacterial compound have been employed to reduce the number of contaminating microorganisms in such vegetables (Lund, 1983).

Some food borne outbreaks have been reported to be due to field contamination before these greens are even harvested (APA, 2007). This exercise is essentially to establish the bacteriological load of some fresh leafy vegetables that are usually not cooked before consumption.

MATERIALS AND METHODS

Thirty samples each of lettuce, cabbage and cucumber were collected from five different retailers in Sabon gari market, Zaria over a period of three months. The samples were taken to the laboratory and analysis carried out instantly.

A). Total aerobic plate count of bacteria

Bacterial counts, were carried out according to standard methods (Speck, 1988). Twenty-five grams of the vegetable was washed in sterile 223ml buffered peptone water from which 1ml was transferred to the first test tube containing 9mls of the diluent. This was repeated for the other three sets of tubes to dilute to 10^{-5}. From the last dilution 1ml was pipetted and dropped in pre- sterilized plates in duplicate. A molten plate count agar was poured into the plates and gently rocked to spread and cooled. The plates were packed and incubated at 37^0C for 24hrs at the end of incubation, the plates were removed and colonies counted and multiplied by the dilution factor.

Biochemical tests: Identification and characterization of isolates were done by carrying out biochemical tests that included coagulase, motility, indole, oxidase, citrate, malonate, methyl red, Voges Proskauer (MRVP), Triple iron sugar (TSI).

B). The coliform index:

The coliform index of the vegetables was determined by using the plate count technique. Eosin MacConkey agar was inoculated with 0.1ml from the diluted sample and then incubated at 37^0C for 24 hrs after which the plate was removed and the colonies counted. The number of colonies was multiplied with the dilution factor to arrive at the index (FAO, 1979).

RESULTS

The average total bacterial counts and the coliform index for the cabbage is as shown in Table 1. Cabbage had average count of 2.3 x 10^8 cfu/g. Cabbage from retailer Cb3 had the highest count of 5.6 x 10^8 cfu/g. the coliform index was highest at 8.0 x 10^7 cfu/g (retailer Cb4). The average coliform index was 2.7 x10^7 cfu/g.

The average bacterial plate count for lettuce and the coliform index is as shown in Table 2. Lettuce had average bacterial count of 2.5 x 10^8 cfu/g and average coliform index of 3.3 x 108 cfu/g. The aerobic plate count was highest at 4.8 x 10^8 cfu/g (retailer Lt3) and the coliform index was highest at 1.3 x 10^9 cfu/g from retailer Lt4.

Table 3 is the aerobic plate cpunt and coliform index of cucumber. The average aerobic plate count was 1.1 x 10^6 cfu/g with the highest count occurring with retailer Cu4.. The average coliform index in cucumber was 6.3 x 10^6 cfu/g. with retailer Cu 2 recording the highest count. The predominant species identified were *Bacillus* sp. *Staphylococcus aureus* and the coliform (Table 4).

Table 1: Aerobic plate count and coliform index of cabbage in Sabon-gari

Source of sample	Total aerobic plate count cfu/g	Coliform index cfu/g
Cb1	1.3 x 10^7	2.1 x 10^6
Cb2	1.1 x 10^8	1.8 x 10^7
Cb3	5.6 x 10^8	1.5 x 10^7
Cb4	2.7 x 10^8	8.0 x 10^7
Cb5	1.0 x 10^8	1.8 x 10^7
Average	2.1 x 10^8	2.7 x 10^7

Cb = cabbage

Table 2: Aerobic plate count and coliform index of lettuce in Sabon-gari

Source of sample	Total aerobic plate count cfu/g	Coliform index cfu/g
Lt1	5.7 x 10^8	8.8 x 10^6
Lt2	2.0 x 10^7	7.9 x 10^7
Lt3	4.8 x 10^8	1.6 x 10^8
Lt4	6.9 x 107	1.3 x 10^9
Lt5	1.0 x 10^8	1.4 x 10^8
Average	2.5 x 10^8	3.4 x 10^8

Lt = Lettuce

Table 3: Aerobic plate count and coliform index of cucumber in Sabon-gari

Source of sample	Total aerobic plate count cfu/g	Coliform index cfu/g
Cu1	3.0 x 10^5	1.9 x 10^6
Cu2	3.0 x 10^5	1.6 x 10^7
Cu3	1.0 x 10^6	8.0 x 10^5
Cu4	1.9 x 10^6	2.0 x 10^6
Cu5	1.6 x 10^6	1.1 x 10^7
Average	1.3 x 10^5	6.3 x 10^6

Cu = Cucumber

Table 4: Predominant bacteria isolates from the various sources

Source	Isolates identified
1	*Bacillus* species
2	*Bacillus* species and *Staphylococcus aureus*
3	*Salmonella* sp., *Staphylococcus aureus* and *Bacillus*
4	species
5	*Bacillus* species and *Staphylococcus aureus*
	Bacillus species and *Staphylococcus aureus*

DISCUSSION

The result obtained has shown that microorganisms are abundant on the surface of vegetables. The aerobic mesophilic count and the coliform index showed that cabbage , lettuce and cucumber all had high counts that are far above the specifications. These high counts could be attributed to the unhygienic practices right from the farm to the market.

Coliforms are usually indicators of intestinal contaminants from man and animals. This may not be too surprising since most often the source of watering the gardens is usually sewage from domestic sources and run off water that is mostly used for irrigation purposes in this community. According to Frank-Peterside and Waribor(2006), bacterial load on leafy vegetables increase with time during storage. If the counts are these high then they pose dangers to consumers. The *Staphylococcus aureus* isolated was an indication of poor hygienic practices by both the farmers and sellers. The condition of sales makes the vegetables predisposed to contamination especially as practised in Zaria where the source of water in the garden and in the market is questionable (Caron and Walker, 2004).

The presence of Bacilli species in the three vegetables may be said to be due to environmental factors. The survival of Bacillus depends on several factors such as nature of the organism, resistance to a new physical environment and ability to form spores (Godon, 1977). Endospores of Bacillus are more resistant than the vegetative cells to harsh weather conditions and even to antimicrobial treatments (Codex Alimentarius, 2007).

Coliforms are usually indicators whose presence will normally indicate the probable presence of pathogenic organisms. There is high count of coliforms in these vegetables which could be attributed to the use of domestic sewage to water the vegetables in the respective farms and gardens. Kim and Harrison (2008) demonstrated that *E. coli* can be transferred to vegetables even through iced water. A related study on the bacterial quality of vegetables in Kano also showed a high count of bacteria and coliform index (Aliyu *et al,* 2005)

A potential hazard exists for persistent pathogen populations to be transferred to harvested vegetables indirectly through contaminated water or by direct cross-contamination by proximity to animal production compounds or facilities, or from inadequately composted animal manure and biosolids (Committee on the Use of Treated Municipal Wastewater Effluents and Sludge in the Productionof Crops for Human Consumption 1996; FDA 1998). From the results obtained it was quite obvious that eating these vegetables can expose the consumer to a lot of risks. Therefore it is recommended that these vegetables be thoroughly washed before consumption especially where they are not going to be cooked before consumption.

Conclusion and Recommendations

The bacterial counts and the coliform index obtained were high (Table 1).. These vegetables are usually consumed without heating thus there is the probability of consumers contracting pathogens if they get in contact with the vegetables. There is therefore the need for government to mount campaigns on good handling practices to sales men/women and preparation of these vegetables like washing with salt and clean water since these vegetables are highly patronized.. this could help in reducing the microbial contents eventually before consumption.

REFERENCES

Aliyu, Y.U, Bassey, S.E and Kawo, A.H (2005). Bacteriological quality of vegetables sold in some shops around Kano metropolis, Nigeria. *.Biological and Environmental Sciences Journal for the Tropics* 2(1): 145 - 148

APA (2007). Lettuce, leafy green and *E. coli*. Science Daily. Retrieved Nov. 12 2007 from http:// www.sciencedaily.com/releases/2007/09/070 902193834 htm. Retrieved on 23/10/2008

Caron, D and walker, D (2004). Green lafy vegetables. http//agudel.edu/xtension/horticulture/pdf/h g/hg-15pdf. Retrieved on 15/08/2008

Codex Alimantarius, 2007). Code of hygiene practice for fresh fruits and vegetables, Secretariate of the CODEX Alimetarius Commission, Joint FAO/WHO food Standard programme, viale delle Terme di Caracalla, Rome Italy. Pp 170 – 171

Collins, C.H and Lyne, P.M (1979). Microbiological Methods. Butterworths, London. Pp 292

Committee on the Use of Treated Municipal Wastewater Effluents and Sludge in the Production of Crops for Human Consumption (1996). Water Science and Technology Board, Commission on Geosciences Environment and Resources, National Research Council. 1996. Public health concerns about infectious disease agents. Use of reclaimed water and sludge in food crop production. Washington, DC: National Academy Press. Pp 89-99.

Edel, W.G; Schothorst, P.A; van, M and Kampelmacher, E.A (1999). Effluent in the spread of Salmonella. Zentrabatt Fiir Bakterologic Infektion Shramkheiten and hygiene 221: 547 – 549.

Food and Agricultural Organization, FAO, (1979). *Manuals of food Quality Contro*l 4: Microbiological Analysis. FAO of the United Nations Publications, Rome, Italy. FAO and Nutrition paper 14(4): C11-c12

Food and Drug Administration (FDA, 1998). Center for Food Safety and Applied Nutrition.1998 Oct 26. Guide to minimize microbial food safety hazards for fresh fruits and vegetables [Guidance for Industry]. <http://www.foodsafety.gov/~dms/ prodguid.html>. Accessed 2008 Aug 11.

Frank-Peterside, N and Waribor, O (2006). Bacteria associated with spoilage of fluted pumpkins leaves and their effect on the chlorophyll content. *Nigerian Journal of Microbiology*. 20(1): 751 - 756

Godon, R.E (1977). The Genus *Bacillus* in Hand book of Microbiology: vol 1&2; CRC press Inc. Cleeveland, Ohio, USA. Pp 319 - 336

Kim, J.K and Harrison, M.A (2008). Transfer of E, coli 0157:H7 to Romaine lettuce due to contact water from melting ice. Journal of Food protection 71 (2): 252- 256

Lund, B.M (1983).*Bacteria associated with fresh and stored fruits and vegetables*. Advance course in Food microbiology, University of Surrey. AFC Food Research Institute, Colney lane, Norwich Mr4, 7UA Pp 1-17.

Okigbo, B.N (1990). *Vegetables in Tropical Africa*. Proceedings of a workshop held at Arusha Tanzania, Vegetable Research Development Centre Publications: Pp 157 – 161

Oyenuga, V.A and Fetuga, B.L 99175). Dietary importance of fruits and vegetables. Caxton press Limited, Ibadan, Nigeria. Pp 1- 12