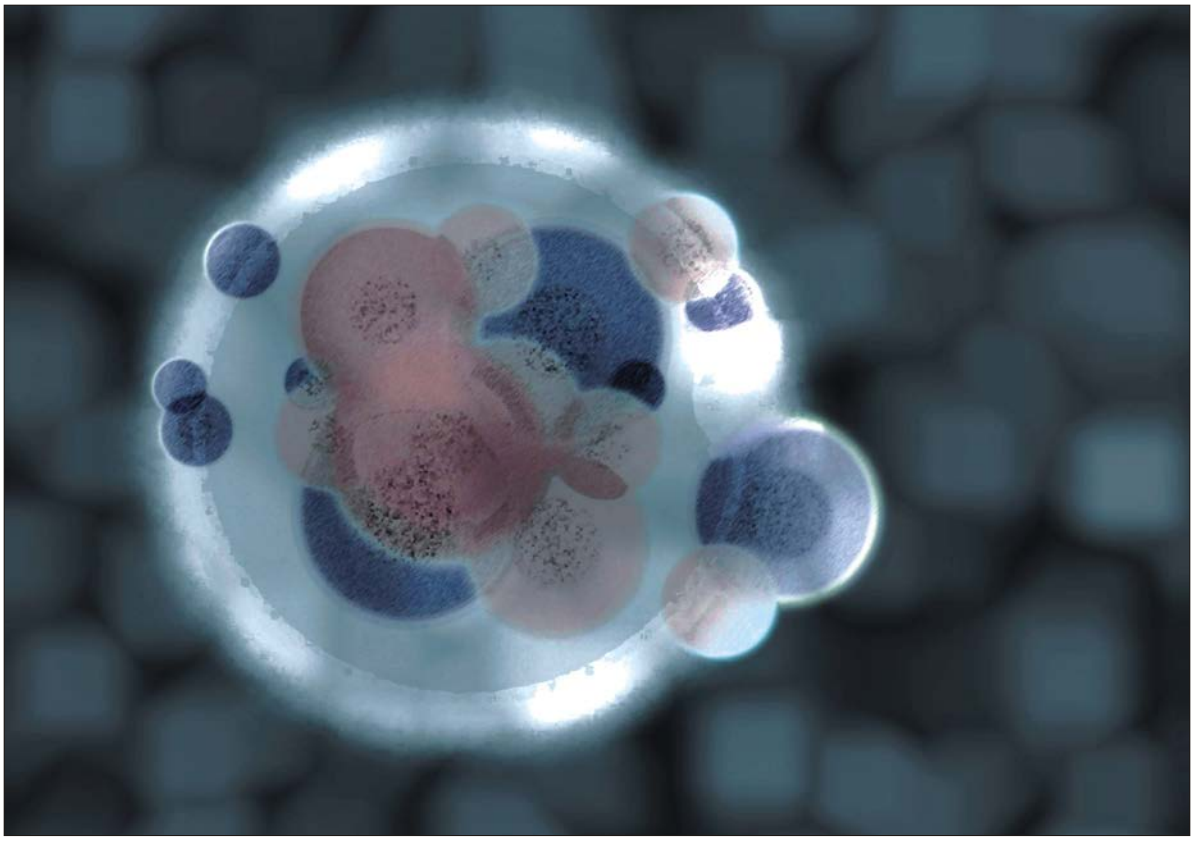

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Bacteriological Quality of Salad Vegetables Sold in Amravati City (India)

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Abstract: Salad vegetables are consumed without any heat treatment, sometimes without washing and peeling and therefore the possibility of food borne diseases is more. Vegetables get contaminated with pathogenic microorganisms while growing in field or orchards or during harvesting, post harvesting handling, processing and distribution. Total 50 samples of different salad vegetables were analysed and 86 bacterial pathogens were isolated. Among them *Escherichia coli* was found to be predominant (38.3%), followed by *Enterobacter aerogenes* (20.9%), *Pseudomonas* sp. (16.2%), *Staphylococcus aureus* (15.1%), *Salmonella* sp. (5.8%) and *Shigella* sp. (3.4%). The presence of *Escherichia coli, Enterobacter aerogenes* and *Pseudomonas* sp. is observed on all samples of salad vegetables. The present study revealed the potential hazard of street vended salad vegetables, therefore needs vigorous washing of vegetables with safe running water before consuming to reduces the number of microorganisms.

Key words: Salad vegetable, bacterial contamination, *E. coli*, coliforms

INTRODUCTION

Salad vegetables are consumed without any heat treatment, sometimes without washing and peeling and therefore the possibility of food borne diseases is more. Vegetables can become contaminated with pathogenic microorganisms during harvesting through human handling, harvesting equipment, transport containers, wild and domestic animal[1]. The pathogenic microorganisms, which reside in intestinal tracts of animals or humans, are more likely to contaminate vegetables through faces, sewage, untreated irrigation water or surface water[2]. Unsafe water used for rinsing the vegetables and sprinkling to keep them fresh is also a source of contamination[3]. Several outbreaks of gastro enteritis have been linked to the consumption of contaminated fresh vegetables and fruits. The world's largest reported vegetable borne outbreak, occurred in Japan in 1996 in which 11,000 people affected and about 6,000 cultures were confirmed. The outbreak involved the death of three children and was carried by *Escherichia coli*[4].

Vishwanathan and Kaur[5] examined salad vegetables such as carrots, radishes, tomatoes, lettuce, cabbage, cucumbers, coriander and reported presence of *Staphylococcus aureus, Escherichia coli, Enterobacter* sp. *Klebsiella* sp., *Providencia* sp. and *Pseudomonas aeruginosa* (>10^{10} cfu g^{-1}). Pingulkar *et al.*[6] analysed microbiological quality of fresh leafy vegetable, salad components and ready to-eat salads and reported faecal coliforms, *Listeria* and *Yersinia* (10^{6}-10^{8} cfu g^{-1}). SNDT University's Ramakrishna Bajaj Consumer Education and Testing center[7] examined the microbiological quality of salad vegetables in Mumbai and reported the presence of *Escherichia coli* and *Salmonella* sp. Harris *et al*[2] observed incidence, growth and survival of pathogens in fresh and fresh cut produce such as carrot, cucumber and tomatoes in United States and isolated *Listeria monocytogenes, Salmonella, Escherichia coli* and *Clostridium botulinum*. McMahon and Wilson[8] analysed the occurrence of enteric pathogens and *Aeromonas* sp. organic vegetables of Northern Ireland. Warmier *et al.*[9] studied on human pathogens growing on salad vegetables and leafy herb salad and identified the potential of *Escherichia coli* and *Listeria monocytogenes* to grow on vegetables. Beuchat[10] reported the presence of *Aeromonas, Bacillus Cereus, Campylobacter, Escherichia coli, Salmonella, Shigella* and *Staphylococcus* sp. on Salad vegetables such as spinach, cucumber, coriander tomato, carrot and radishes.

In Amravati it has been observed that the local farmers are using municipal waste water discharged in Ambanala for irrigation and washing purposes which is suspected to be the primary source of contamination of microorganisms in vegetables[11]. Hence a sanitary survey was under taken to examine bacterial flora present on salad vegetables sold in local markets or by street vendors in Amravati City.

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MATERIALS AND METHODS

Salad vegetable collection: Total 50 samples of different salad vegetables such as beet, carrot, coriander, cucumber, fenugreek, radish and spinach were collected from various local markets and street vendors of Amravati City. Vegetables samples were brought in sterile containers and analysed within 3 h of collection.

Isolation and identification of pathogenic bacteria by pour plate method: A 25 g of vegetable samples were weighed, rinsed in 250 mL beaker containing 100 mL of sterile distilled water and rinsed water samples were diluted to 10^{-2} and 10^{-4}. 0.1 mL of each dilution was inoculated on Mac-Conkey agar medium and plates were incubated at 37°C for 24 h for isolation of bacterial pathogens. The plates were examined for colony characters. The isolated colonies were subcultured and maintained on nutrient agar. From these 50 salad vegetable samples, 86 bacterial pathogens were isolated and identified on the basis of morphological, cultural and biochemical tests, such as, Indole, Methyl-red, Voges Proskaeur, Citrate utilization and Triple Sugar Iron agar tests.

RESULTS AND DISCUSSION

Vegetables get contaminated with pathogenic microorganisms while growing in field or orchards or during harvesting, post harvesting handling, processing and distribution. Total 50 samples of different salad vegetables were analysed and 86 bacterial pathogens were isolated. Among them *Escherichia coli* was found to be predominant (38.3%), followed by *Enterobacter aerogenes* (20.9%), *Pseudomonas* sp. (16.2%), *Staphylococcus aureus* (15.1%), *Salmonella* sp. (5.8%) and *Shigella* sp. (3.4%). The presence of *Escherichia coli, Enterobacter aerogenes* and *Pseudomonas* sp. is observed on all samples of salad vegetables. In which *Escherichia coli* was found to be predominant on coriander followed by carrot, radish, spinach, beet, fenugreek and cucumber. The *Pseudomonas* sp. were predominant on spinach and radish. *Salmonella* sp. were present on beet, coriander, cucumber and radish. Only spinach and carrot were contaminated with *Shigella* sp. (Table 1).

High prevalence of coliforms in salad samples indicates the possible potential of salad vegetables to cause food borne illness and contamination may be due to the post harvest handling[5]. Apart from this, *Enterobacter aerogenes, Pseudomonas* sp. and *Staphylococcus aureus* were also present. Out of which *Enterobacter aerogenes* are present in sewage, faeces, soil and water and commonly come in contact with vegetables. The isolation of enteropathogens of public health significance is a cause of concern since salads are consumed raw. The prevalence of *Pseudomonas* sp. on vegetables is quite significant indicating the diverse physiology of organism. The contamination of *Staphylococcus aureus* may be due to its carriage in nasal passages of food handlers or by infected workers[10]. The contamination of *Salmonella* sp. and *Shigella* sp. in vegetables is due to washing of the vegetables with contaminated water, handling of vegetables by infected workers, vendors and consumers in the market place which helps to spread pathogenic microorganisms.

The present study revealed the potential hazard of street vended salad vegetables, considering the handling practice usually carried out by vendors and environment in which they display salad vegetables and the possibility of food related outbreaks of disease; vigorous washing of vegetables with safe running water before consuming required to reduces the number of microorganisms. The street vended foods are significant part of urban food supplies of street vended foods with the minimal risk of food borne disease, following control measures should be undertaken to reduce microbial load on vegetables. The Government intervention is also required to protect consumers and to ensure that the standard of safety of such foods is attainable in the context of prevailing local situation.

Table 1: Presence of pathogenic bacterial flora on various vegetables

Vegetables	No. of samples	*E. coli*	*E. aerogenes*	*Pseudmonas.* sp.	*S. aureus*	*Salmonella* sp.	*Shigella* sp.
Beet	7	4	5	1	1	2	-
Carrot	7	5	4	1	3	-	1
Coriander	7	8	2	2	2	1	-
Cucumber	7	3	3	1	2	1	-
Fenugreek	8	4	1	1	2	-	-
Radish	7	5	2	3	-	1	-
Spinach	7	4	1	5	1	-	2
Total	50	33	18	14	13	5	3
	%	38.3	20.9	16.2	15.1	5.8	3.4

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