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Microbiological quality analysis of cut fruit and vegetable salads in and around Bengaluru

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ABSTRACT
Fruit and vegetable salads are well recognised for their nutritional value and are regularly associated with global foodborne disease outbreaks. This study evaluated the bacteriological quality of vegetable salads and fruits, both street and restaurant quality. A total 40 of samples were collected out of which 20 were vegetable salad samples and 20 were cut fruit samples, which included restaurant and street vendors. Bacteria were isolated using a nutrient agar medium to enumerate the count of organisms. Fruit and vegetable samples were suspended in sterile distilled water and serially diluted. To isolate bacteria, 0.1 ml of 10^{-4} and 10^{-5} dilutions were spread on nutrient agar media by using the spread plate method. Nutrient agar plates were incubated at 37 °C for 24 hours. A total of 220 bacteria were isolated from 40 samples. The results revealed that fruits and vegetable salads from street vendors had more bacterial contamination than a restaurant sample where most of the isolates are gram-positive bacteria. Out of these 33 isolates were considered for further study based on hemolytic activity and protein estimation. The antibiotic susceptibility test of the 13 antibiotics was determined against the selected bacterial isolates out of which 13 isolates exhibited resistance to the selected antibiotics.
Keywords: *Cut fruits and vegetable salads; street vendors; restaurant vendors; hemolytic activity, ABST*

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I. INTRODUCTION

Fruit and vegetable salads are an important source of nutrition and an essential ingredient in a balanced and healthy diet. They fulfil the necessary vitamins, minerals, and fats, in the right proportion for growth and development. In many countries, raw fruit and vegetable salad consumption has increased to prevent diabetes, cancer, heart disease, obesity, and other deficiencies [7].

In countries like India, where food street food vending and restaurant vending are prevalent, there is a lack of knowledge and information about the incidence of foodborne illness. Microorganisms are naturally present in fresh produce and are brought in by the wind, soil, water, animal, and human sources. Pathogenic microorganisms can enter the fresh produce in various ways, like organic fertilizers, improper handling post-harvest, water quality used for irrigation, and so on [12].

The consumption of cut fruit and vegetable salads has grown in popularity along with the population, and RTE raw foods have elevated the risk of foodborne illness. Consuming few or no fruit and vegetable salads may raise your chance of developing non-communicable diseases. The safety of raw fruit and vegetable salads is the key issue [2].

Foods, by their nature, are more prone to bacterial contamination as they provide an environment for growth and have a long history of being associated with food-borne illnesses. Environmental conditions, intrinsic factors, processing factors, and implicit factors are all contributors to the growth of microorganisms associated with ready-to-eat (RTE) fruit and vegetable salads. Which covers factors such as water activity, redid potential, pH, relative humidity, temperature, mutualism, specific growth rate, handling, and packing [1].

As fruits and vegetables can act as reservoirs for pathogens or opportunistic pathogens, the increased intake of these foods has been associated with a rise in the incidence of human illnesses and outbreaks. Produce can be infected with harmful or rotting microorganisms at any point between manufacture and consumption. Fruits and vegetables can host harmful bacteria such as *Salmonella, Escherichia coli, Bacillus cereus, Campylobacter spp., Yersinia enterocolitica, Listeria monocytogenes, and Clostridium botulinum*, as well as some viruses and parasites [3].

II. MATERIALS AND METHODS

Collection of samples: Different locations in Bangalore City, India, were chosen for collecting samples. Samples of both restaurant vending and street vending were collected from each zone with a high sale as the criterion. A total of 40 samples were collected, 20 of which were vegetable salad samples and 20 of which were cut fruit samples from restaurants and street sellers. Samples were not collected aseptically as packaging material can be a source of contamination. The samples were processed within an hour of procurement.

Bacteria enumeration and isolation: Isolation and enumeration of microbes were performed using Serial dilution followed by the spread plate technique. One piece of each kind of vegetable salad and cut fruit from each sample were processed. For bacterial isolation, 0.1 ml of 10^{-4} and10^{-5} dilutions were seeded on nutrient media using the spread plate method. All the bacterial plates were incubated at 37º C for 24 to 48 hrs under an aerobic atmosphere and the bacterial plates were kept in an inverted position.

Identification of microbial isolates: Following 24 hrs to 48 hrs of incubation, bacterial isolates were purely cultured followed by Gram staining. The bacterial isolates were cultured onto different selective media and differential media like *Pseudomonas* isolation agar, Baird Parker's agar, *Salmonella Shigella* agar, Eosin Methylene Blue agar, Brain heart infusion agar, MacConkey agar, Tryptone Glucose Yeast Extract agar, and MacConkey agar.

Protein estimation: A total of 220 isolates were subjected to protein analysis. Overnight incubated cultures were subjected to protein estimation by Lowry's (1951) method [9].

Hemolysis: 220 isolates were subjected to a micro-hemagglutination test, and 33 isolates were positive for hemolytic activity. Among these 33 isolates, 4 exhibited β-hemolysis and 29 exhibited α- hemolysis. 33 isolates were cultured on blood agar to confirm the same.

Antimicrobial susceptibility test: The bacterial isolates were checked for antibiotic sensitivity to standard antibiotics by the Kirby-Bauer disc diffusion method, antibiotic susceptibility disc containing the following antibiotics Gentamycin (10 mcg), Levofloxacin (5 mcg), Rifampicin (5 mcg), Vancomycin (5 mcg), Clindamycin (10 mcg), Erythromycin (10 mcg), Trimethoprim (10 mcg), Linezolid (30 mcg), Ceftazidime (10 mcg), Cefazolin (30 mcg), Penicillin (1 unit), Ampicillin/ Sulbactam (10/10 mcg) and Ertapenem (10 mcg). The diameter of the zone of inhibition was measured and tabulated (Table 1) [6].

Table 1: Antibiotic susceptibility testing – zone size interpretative chart

Antimicrobial agent	Symbol	Levels	Resistance mm or less	Intermediate mm	Sensitive mm or more
	GEN	10 mcg	12	13-14	15
Levofloxacin	LE	5 mcg	16	17-20	21
Rifampicin	RIF	5 mcg	22	23-25	26
Vancomycin	VA	5 mcg	14	15-19	20
Clindamycin	CD	10 mcg	22	23-25	26
Erythromycin	E	10 mcg	19	20-30	31
Trimethoprim	TR	10 mcg	18	19-26	27
Linezolid	LZ	30 mcg	20	21-22	23
Ceftazidime	CAZ	10 mcg	19	19-21	22
Cefazolin	CZ	30 mcg	19	20-22	23
Penicillin	P	1 unit	25	26	27
Ampicillin/ Sulbactam	A/S	10/10 mcg	11	12-14	15
Ertapenem	ETP	10 mcg	18	19-21	22

III. RESULTS

A total of 40 samples were collected, of which 20 were vegetable salad samples and 20 cut fruit samples, including restaurant and street vendors. A total of 220 bacteria were isolated (Fig 1-2). In salad samples, cucumber and carrot exhibited more isolates when plated. Papaya and bananas were more prone to contamination in fruit samples. The growth of bacterial isolates was maintained on nutrient agar (Fig 3). Out of 220 isolates, the majority of the isolates were gram-positive when compared to gram-negative organisms (Fig 4 and 5), (Table 2). All the isolated cultures were subjected to protein analysis by Lowry's method, isolate SS07-4 exhibited the highest protein concentration of 0.76 mg/ml. Based on protein estimation, isolates were selected for further study (Table 3). Isolates were cultured on different selective and differential media, out of which 2 isolates exhibited a green metallic sheen on Eosin Methylene Blue agar medium. On Braid Parker's agar medium, 4 isolates displayed a black colour with a hollow zone. Four isolates demonstrated pyocyanin synthesis, which aids in the identification of *Pseudomonas* sp. on *Pseudomonas* isolation agar. Five isolates were lactose fermenting strains and exhibited a zone of acid-precipitated bile and the rest of the cultures were negative for lactose fermenting when cultured on MacConkey agar. Two isolates cultured on Salmonella- Shigella agar exhibit H_2S production and are non-lactose fermenters (Fig 7-12) Thirty-three cultures were further cultured on blood agar to check the hemolytic activity out of which 13 isolates exhibited hemolysis (Fig 13), (Table 4). Antibiotic susceptibility patterns of 33 isolates were checked against 13 antibiotics, isolates exhibited varied results for each antibiotic. Among 33 isolates, 5 isolates were found to be resistant to 9 antibiotics, 1 isolate was found to be resistant to 8 antibiotics, and 7 isolates were resistant to 7 antibiotics. The rest of the cultures exhibited sensitivity to the majority of the antibiotics. Gentamycin was the most effective of the 13 antibiotics tested, inhibiting the growth of 32 isolates, while Clindamycin was the least effective, inhibiting the growth of only 1 isolate (Fig 13-14, Table 5-7).

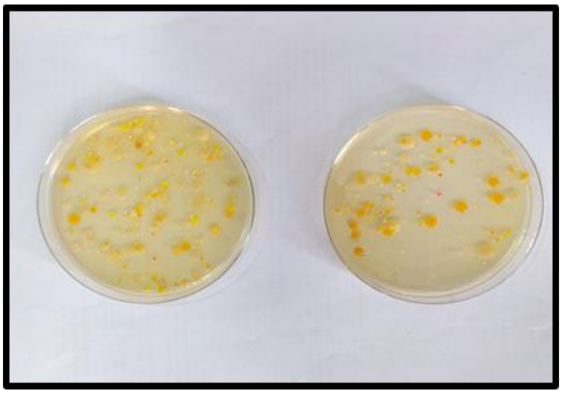

Fig 1: Growth of isolates from street fruit sample on Nutrient agar medium

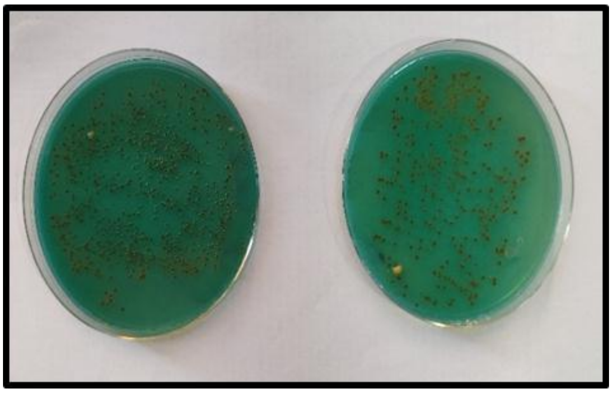

Fig 2: Growth of isolates from street salad sample on Nutrient agar medium

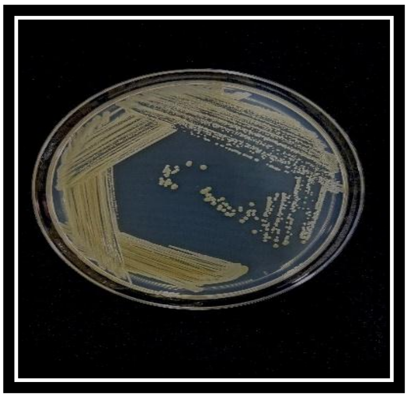

Fig 3: Maintenance of culture on nutrient agar

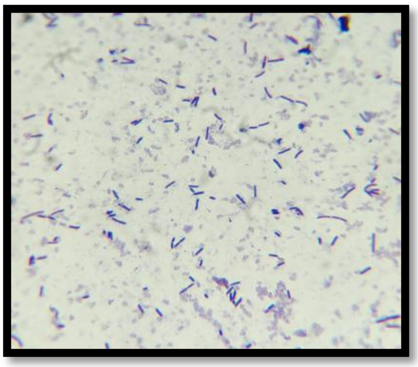

Fig 4: Gram-positive rods in chain

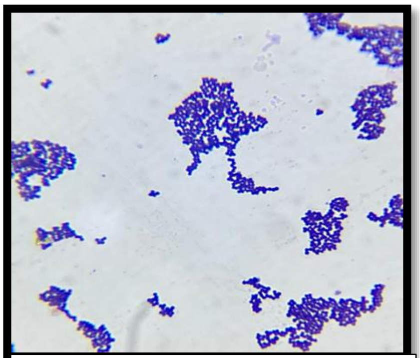

Fig 5: Gram-positive cocci in clusters

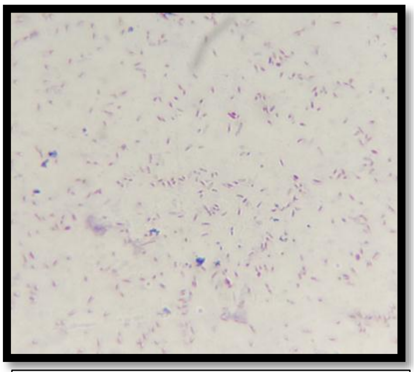

Fig 6: Gram-negative rods in singles

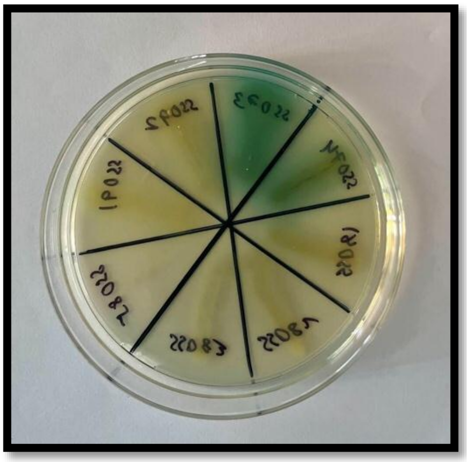

Fig 7: Growth of isolates on *Pseudomonas* isolation agar

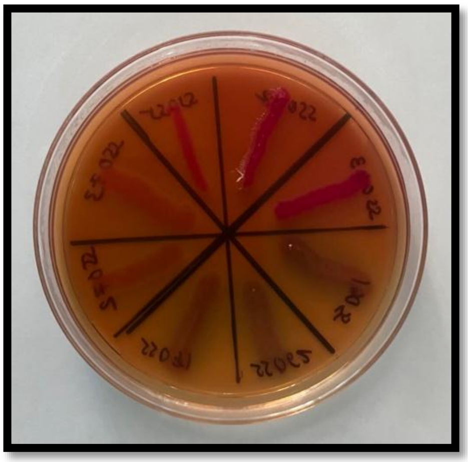

Fig 8: Growth of isolates on MacConkey agar

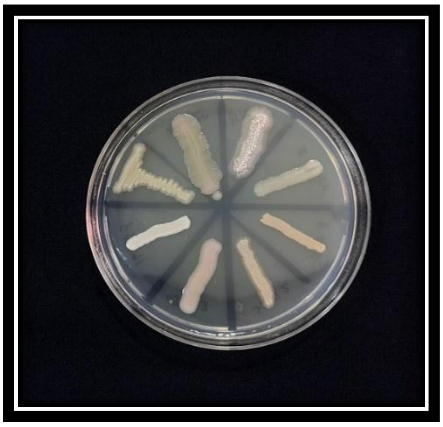

Fig 9: Growth of isolates on Brain heart infusion agar medium

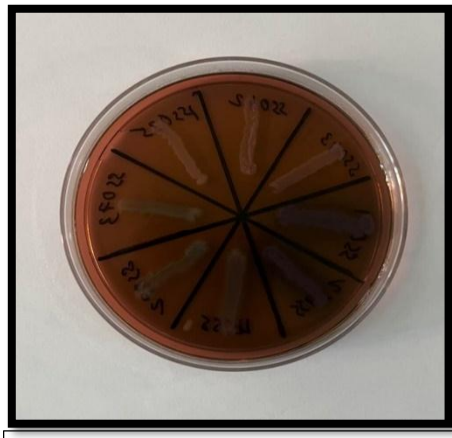

Fig 10: Growth of isolates on Eosin Methylene Blue agar medium

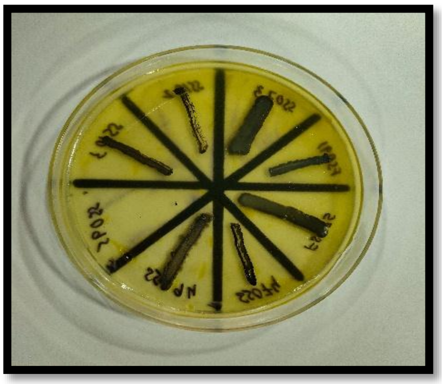

Fig 11: Growth of isolates on Baird Parker's agar medium

Fig 12: Growth of isolates on *Salmonella Shigella* agar medium

Fig 13: Growth of isolates on blood agar exhibiting hemolysis

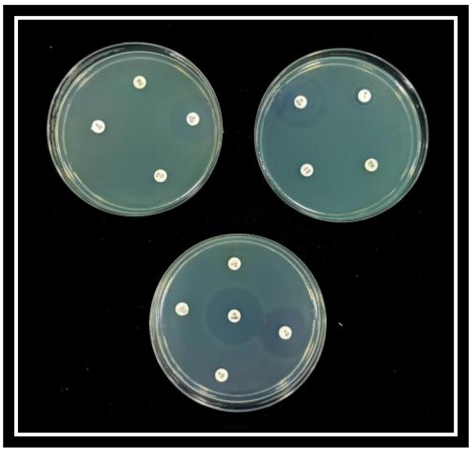

Fig 14: Antibiotic sensitivity of SS07-4 isolate

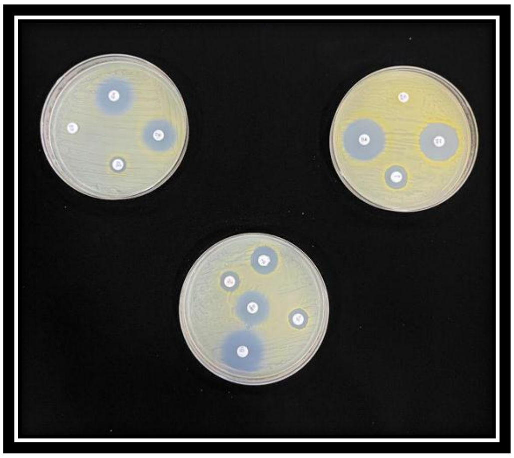

Fig 15: Antibiotic sensitivity of SS10-1 isolate

Table 2: Colony character and Gram's stain character of bacterial isolates

No.	Fruit/Vegetable	Isolate	Colony characteristics	Gram classification
1.	Cucumber	SSO1-7	Circular, raised, entire, white	Gram-positive rods in chain
2.	Carrot	SS01-6	Circular, raised, entire, yellow	Gram-positive cocci in clusters
3.	Tomato	SS02-5	Irregular, flat, undulated, cream	Gram-positive rods in chain
4.	Tomato	SSO3-2	Irregular, raised undulate, cream	Gram-positive rods in singles-
5.	Carrot	SSO3-4	Circular, flat, entire, cream	Gram-positive rods in chain
6.	Carrot	SSO3-5	Circular, flat, entire, translucent	Gram-negative short rods in singles
7.	Cucumber	SSO4-2	Circular, flat, undulate, translucent	Gram-negative short rods in singles
8.	Cucumber	SSO4-3	Circular, flat, entire, cream,	Gram-positive rods in chain
9.	Cucumber	SSO6-1	Circular, flat, entire, cream	Gram-positive rods in chain
10.	Onion	SSO6-2	Irregular, raised, undulate, white	Gram-positive rods in singles
11.	Carrot	SSO7-1	Circular, flat, entire, cream	Gram-positive rods in singles
12.	Carrot	SSO7-2	Irregular, raised, undulate, white	Gram-positive rods in chain
13.	Tomato	SSO7-3	Circular, flat, entire, white	Gram-positive cocci in clusters
14.	Onion	SSO7-4	Circular, raised entire, translucent	Gram-negative short rods in singles

15.	Cucumber	SSO8-1	Irregular, flat, undulate, white	Gram-positive short rods in singles
16.	Carrot	SS08-2	Circular, raised, entire, light yellow	Gram-negative short rods in singles
17.	Tomato	SS08-3	Irregular, raised, undulate, cream	Gram-positive rods singles
18.	Cucumber	SS08-5	Circular, flat, entire, orange	Gram-positive cocci in clusters
19.	Carrot	SS09-1	Circular, flat, entire, cream, translucent	Gram-negative rods singles
20.	Carrot	SS09-2	Circular, flat, entire, cream, translucent	Gram-negative short rods in singles
21.	Cucumber	SS09-3	Circular, raised, entire, pink	Gram-positive cocci in clusters
22.	Cucumber	SS09-4	Irregular, raised, undulate, white	Gram-positive rods in chain
23.	Carrot	SS09-5	Circular, raised, entire, light yellow	Gram-negative rods in singles
24.	Onion	SS09-6	Circular, raised, entire, yellow	Gram-positive cocci in clusters
25.	Cucumber	SS10-1	Circular, raised, entire, yellow	Gram-positive cocci in clusters
26.	Carrot	SS10-2	Circular, raised, entire, orange	Gram-negative short rods in singles
27.	Tomato	SS10-3	Circular, raised, entire, orange	Gram-positive cocci in clusters
28.	Cucumber	SS10-6	Circular, raised, entire, cream	Gram-negative short rods in singles
29.	Papaya	FS06-1	Circular, raised, entire, white	Gram-positive cocci in clusters
30.	Papaya	FS06-3	Circular, raised, entire, orange	Gram-negative short rods in singles
31.	Banana	FS07-5	Circular, raised, entire, yellow	Gram-positive cocci in clusters
32.	Papaya	FS09-1	Circular, flat, entire, cream	Gram-positive cocci in clusters
33.	Papaya	FS09-3	Circular, flat, entire, cream	Gram-positive rods in chain

Table 3: Concentration of total protein in selected bacterial isolates

No.	**Isolate**	**Concentration of protein in mg/ml**
1.	SSO1-7	0.19
2.	**SS01-6**	**0.66**
3.	SS02-5	0.49
4.	SSO3-2	0.60
5.	SSO3-4	0.53
6.	**SSO3-5**	**0.62**
7.	SSO4-2	0.33
8.	SSO4-3	0.44
9.	SSO6-1	0.60
10.	SSO6-2	0.62
11.	SSO7-1	0.40
12.	SSO7-2	0.60
13.	SSO7-3	0.09
14.	**SSO7-4**	**0.76**
15.	**SSO8-1**	**0.71**
16.	SS08-2	0.17
17.	SS08-3	0.37
18.	SS08-5	0.30
19.	SS09-1	0.28
20.	SS09-2	0.17
21.	SS09-3	0.20
22.	SS09-4	0.18
23.	SS09-5	0.56
24.	SS09-6	0.11
25.	SS10-1	0.53
26.	SS10-2	0.17
27.	SS10-3	0.20
28.	SS10-6	0.19
29.	FS06-1	0.19
30.	FS06-3	0.14

31.	FS07-5	0.40
32.	FS09-1	0.37
33.	FS09-3	0.10

Table 4: Haemolytic activity of the isolates by micro hemagglutination

No.	**Isolate**	**Hemolytic activity**
1.	SSO1-7	α - hemolysis
2.	**SS01-6**	**β - hemolysis**
3.	SS02-5	α - hemolysis
4.	SSO3-2	α - hemolysis
5.	SSO3-4	α - hemolysis
6.	**SSO3-5**	**β - hemolysis**
7.	SSO4-2	α - hemolysis
8.	SSO4-3	α - hemolysis
9.	SSO6-1	α - hemolysis
10.	SSO6-2	α - hemolysis
11.	SSO7-1	α - hemolysis
12.	SSO7-2	α - hemolysis
13.	SSO7-3	α - hemolysis
14.	**SSO7-4**	**β - hemolysis**
15.	**SSO8-1**	**β - hemolysis**
16.	SS08-2	α - hemolysis
17.	SS08-3	α - hemolysis
18.	SS08-5	α - hemolysis
19.	SS09-1	α - hemolysis
20.	SS09-2	α - hemolysis
21.	SS09-3	α - hemolysis
22.	SS09-4	α - hemolysis
23.	SS09-5	α - hemolysis
24.	SS09-6	α - hemolysis
25.	SS10-1	α - hemolysis
26.	SS10-2	α - hemolysis
27.	SS10-3	α - hemolysis
28.	SS10-6	α - hemolysis
29.	FS06-1	α - hemolysis
30.	FS06-3	α - hemolysis
31.	FS07-5	α - hemolysis
32.	FS09-1	α - hemolysis
33.	FS09-3	α - hemolysis

Table 5: Antibiotic sensitivity of the isolated bacteria to common antibiotics

SL.NO	**ISOLATES**	**GEN**	**LE**	**RIF**	**VA**	**CD**	**E**	**TR**	**LZ**	**CAZ**	**CZ**	**P**	**A/S**	**ETP**
1.	SSO1-7	S	S	R	S	R	S	I	S	R	S	R	S	S
2.	**SS01-6**	S	I	R	R	R	I	R	R	R	S	I	S	R
3.	SS02-5	S	S	R	S	R	I	S	S	R	S	I	S	R
4.	SSO3-2	S	S	R	R	R	R	S	R	S	S	R	S	S
5.	SSO3-4	R	S	R	S	R	R	R	I	R	R	R	R	I
6.	**SSO3-5**	S	S	R	R	R	R	R	R	S	R	I	S	S
7.	SSO4-2	S	S	R	S	R	I	I	S	I	S	S	S	R
8.	SSO4-3	S	S	R	R	R	R	R	R	R	I	I	S	S
9.	SSO6-1	S	S	R	R	R	R	I	R	S	R	I	S	S
10.	SSO6-2	S	S	R	S	I	I	R	S	R	R	R	R	S
11.	SSO7-1	S	S	R	S	R	R	R	S	S	S	R	S	R
12.	SSO7-2	S	S	I	S	R	R	R	R	R	I	I	S	S
13.	SSO7-3	S	S	S	S	I	I	R	S	R	S	R	S	R
14.	**SSO7-4**	S	S	R	R	R	R	R	R	S	R	R	R	S
15.	**SSO8-1**	S	S	R	R	R	R	R	R	S	R	I	R	S
16.	SS08-2	S	S	S	S	S	S	R	S	S	S	S	S	S
17.	SS08-3	S	S	R	R	R	R	R	R	I	R	I	I	S
18.	SS08-5	S	S	R	R	R	R	R	R	I	R	I	S	S
19.	SS09-1	S	S	S	I	I	I	R	S	R	S	R	S	I
20.	SS09-2	S	S	R	I	R	I	I	S	R	S	R	S	S
21.	SS09-3	S	S	S	S	I	S	R	S	R	S	S	S	S
22.	SS09-4	S	S	I	S	R	R	S	S	R	I	S	S	S
23.	SS09-5	S	S	R	R	R	R	R	R	I	R	R	I	R
24.	SS09-6	S	S	S	S	S	S	I	S	R	S	S	S	S
25.	SS10-1	S	I	R	R	R	R	R	R	S	R	I	R	R

26.	SS10-2	S	S	S	I	I	R	R	R	I	S	S	S	S
27.	SS10-3	S	S	S	S	I	I	R	S	S	S	S	S	S
28.	SS10-6	S	S	S	I	R	R	R	R	I	S	S	S	I
29.	FS06-1	S	R	S	I	R	R	R	S	R	S	I	S	I
30.	FS06-3	S	R	S	S	R	S	R	S	S	S	S	S	S
31.	FS07-5	S	S	R	R	R	R	R	R	I	R	R	I	R
32.	FS09-1	S	S	S	I	I	I	R	S	R	S	R	S	R
33.	FS09-3	S	S	S	S	I	I	R	S	S	S	S	S	S

NOTE: R- RESISTANCE, I – INTERMEDIATE, AND S- SENSITIVE

Table 6: Antibiogram pattern of the isolates

Isolate	No. of Antibiotics to which the isolate is resistant	No. of Antibiotics to which the isolate is intermediate	No. of Antibiotics to which the isolate is sensitive
SSO1-7	4	1	8
SS01-6	9	2	2
SS02-5	4	2	7
SSO3-2	6	0	7
SSO3-4	9	2	2
SSO3-5	7	1	5
SSO4-2	3	3	7
SSO4-3	7	2	4
SSO6-1	6	2	5
SSO6-2	6	2	5
SSO7-1	6	0	7
SSO7-2	5	3	5
SSO7-3	3	3	7
SSO7-4	9	0	4
SSO8-1	8	1	4
SS08-2	1	0	12
SS08-3	7	3	3
SS08-5	7	2	4
SS09-1	3	4	6
SS09-2	4	3	6
SS09-3	2	1	10
SS09-4	3	2	8
SS09-5	7	3	3
SS09-6	9	2	2
SS10-1	3	3	7
SS10-2	1	2	10
SS10-3	4	3	6
SS10-6	5	3	5
FS06-1	3	0	10
FS06-3	5	3	5
FS07-5	9	2	2
FS09-1	4	3	6
FS09-3	1	2	10

Table 7: Effect of the antibiotics against isolates

Antibiotics	No. of isolates showing resistance to antibiotic	No. of isolates showing intermediate to antibiotic	No. of isolates showing sensitivity to antibiotic
Gentamycin	1	0	32
Levofloxacin	3	2	28
Rifampicin	19	2	12
Vancomycin	12	7	14
Clindamycin	24	8	1
Erythromycin	19	10	4
Trimethoprim	26	4	3
Linezolid	14	1	17
Ceftazidime	15	7	11
Cefazolin	11	3	19

Penicillin	12	11	10
Ampicillin/ Sulbactam	5	3	25
Ertapenem	9	5	19

IV. DISCUSSION

The present study was conducted to investigate the presence of pathogenic microorganisms in Ready-To-Eat (RTE) cut fruit and vegetable salads from restaurants and street vendors. In salad samples, cucumber and carrot exhibited more isolates when plated. Papaya and bananas were more prone to contamination in fruit samples. The total bacterial load in fruits and vegetable salads from the restaurant and street vendors was compared. Fresh vegetable salads and fruits can be contaminated with a pathogenic bacterium in different steps from cultivation to consumption. Bacteria can cause major public health concerns [8].

The study exhibited that the salad bacterial contamination includes *Staphylococcus*, *Salmonella*, and *Yersinia*. Carrots and onions were mainly contaminated. Identification and enumeration of these isolates were performed by inoculating the cultures on selective media [13].

Akoachere *et al.*, (2018) isolated 6 bacterial species from salad samples, in which *Staphylococcus aureus* was the predominant organism and *Serratia marcescens* was the least. Bacterial enumeration was carried out using the pour plate technique. Specific media like Salmonella-Shigella agar, Mannitol salt agar, and MacConkey agar plates were used in duplicates for the spread plate method for particular organisms [2].

The pathogenicity potential of the isolates was evaluated by screening for hemolysin production on blood agar, resulting in the categorization of 102 bacterial isolates as α-hemolytic (n =5, 4.9%), β-hemolytic (n =5,4.9%), or γ-haemolytic (n =92, 90.2%). *Klebsiella pneumoniae subsp. ozaenae*, *Enterobacter hormaechei*, *Shigella flexneri*, *Escherichia fergusonii* and *Klebsiella pneumoniae subsp. rhinoscleromatis* composed the α-hemolytic cluster, whereas *Enterobacter ausburiae*, *E. hormaechei*, *E. sichuanensis*, and *Klebsiella pneumoniae subsp. rhinoscleromatis* classified into the β-hemolytic strains [1].

Allaith (2018) measured the hemolytic activity of bacterial samples by culturing them on blood agar. The result supports the production of hemolysins by 27 bacterial isolates isolated from salad [4].

The Antibiotic Susceptibility test carried out by Akoachere *et al.*, (2018) revealed that Erythromycin resistance was highest against all the 426 isolates tested except for 96 isolates of *Staphylococcus aureus* that were susceptible to erythromycin. One Shigella isolate was resistant to all antibiotics tested [2].

Waturangi *et al*., (2019) performed ABST using the Kirby Bauer method for E. coli isolates obtained from fruit and vegetable salads. 8 antibiotic discs were used, which are ampicillin (10μg), Ciprofloxacin (5μg), Gentamycin (10μg), Kanamycin (30 μg), Streptomycin (10μg), Trimethoprim (5μg), Polymyxin B (300U), Nalidixic Acid (30μg). The majority of Isolates exhibited resistance to Polymyxin B (61.11%), Streptomycin (55.56%), Kanamycin (38.89%), Gentamycin (25% In), Trimethoprim (33.33%), and Ampicillin (22.22%) [14].

The study conducted by Amare *et al.*, (2019) revealed that clindamycin (88.23%) was the most effective antibiotic against *S. aureus* isolates, followed by tetracycline, gentamycin, ciprofloxacin chloramphenicol, and trimethoprim-sulfa methoxy-azole with 85.3, 85.3, 79.4, 79.4, and 61.7% sensitivity, respectively. Penicillin resistance was higher in S. aureus isolates (73.53%). In the case of *E. coli* isolates the susceptibility to gentamycin was higher (93.33%), followed by ceftriaxone and chloramphenicol, each with 86.67% sensitivity [5].

The antibiogram analysis conducted by Padamadan *et al*., (2016) revealed that the isolated coliforms, E. coli, were resistant to Amikacin, Ampicillin, Cefixime, and Klebsiella spp. were resistant to Ampicillin, Cefixime, and Cefotaxime. Such drug-resistance properties may cause these pathogens to pose serious health risks due to the ineffectiveness of commonly used antibiotics [11]

V. CONCLUSIONS

In light of public health, fruit and vegetable salads may often contain a variety of microbiological contaminants. Therefore, it is crucial to make sure that good manufacturing practices (GMPs) and good agricultural practices (GAPs) are both used during production. Farmers need to be educated on the need to prevent human, animal, and other waste-related contamination of fresh produce that could pose a health risk. On the other side, fresh food post-harvest handling and washing should be prioritized. As a result, to reduce the danger of food spoiling and health problems, both farmers and marketers should take the required measures to prevent the contamination of the produce.

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