

Evaluation of the Microbiological Quality of Salad Dishes Served in Cotonou Restaurants (Benin)

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Abstract Fruits and vegetables are an essential part of the human diet. Microorganisms that are likely to be found in these foods that are most often components of the salad can be the basis of food poisoning. This work aims to evaluate the microbiological quality of the different salad dishes served in Cotonou hotels. The best known restaurants have been listed and those selected one has been through a simple random sampling. After collecting the samples, the various ingredients used in the production of these dishes were recorded after sampling for microbiological analyzes. Microbiological quality was assessed on the basis of Good Hygiene Practices and Good Manufacturing Practices. The results revealed thirteen (13) types of salad dishes. None of the thirty (30) samples analyzed met the microbiological criteria in effect. Thus, for a good follow-up of the rules of hygiene, a system of quality control must be set up in all the hotels of Cotonou in order to allow the population to always eat healthy. The results revealed thirteen (13) types of salad dishes. None of the thirty (30) samples analyzed met the microbiological criteria in effect. Thus, for a good follow-up of the rules of hygiene, a system of quality control must be set up in all the hotels of Cotonou in order to allow the population to always eat healthy.

Keywords: *public health, salad, vegetables, fruits, microbiological quality*

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1. Introduction

Fruits and vegetables are an essential part of the human diet. Over the last twenty years, research in human nutrition has shown that a balanced diet rich in fruits and vegetables ensures good health and can reduce the risk of certain diseases. As a result, one of the fastest growing agri-food sectors is pre-cut fresh products, such as salads [1]. Ready-to-eat salads are preparations made from vegetables, raw or cooked vegetables, and fresh fruits. Their consumption has increased worldwide [1]. A poor hygienic quality of the salads results mainly from a lack of hygiene and the non-respect of the good practices, is at the origin of a large number of food poisoning [2].

Fruits and vegetables are essential for a balanced diet because they have their own effects that give them specific benefits related to their nutritional composition. Rebalancing the diet by fruit and vegetables is essential. The low energy density, combined with a high nutritional density of fruits and vegetables contributes to this rebalancing and to the coverage of the recommended nutritional contributions in micronutrients. Clearly, dietary patterns that include a high amount of fruits and vegetables (at least 400 g / day) are associated with a lower prevalence of obesity, diabetes,

cardiovascular disease, certain cancers, and even osteoporosis or other chronic diseases [3].

It is estimated that 80% of heart disease, stroke and type II diabetes, as well as 40% of cancers, could be prevented by eliminating the main risk factors, including low fruit and vegetable consumption [4]. In 2004, the WHO [5] report estimates that low fruit and vegetable consumption accounts for 31% of ischemic heart disease, 11% of brain strokes and 2.7 million lives could be saved each year if the consumption of fruits and vegetables increased enough in the world. Closer collaboration between the agriculture and health sectors should be established in order to stimulate debate about the impact of agricultural policy on the prevention of Non-communicable diseases related to food.

Despite the benefits of eating fresh fruits and vegetables, this is a food safety problem as these raw foods have long been recognized as a source of infectious disease transmission. Thus, a wide range of fresh, contaminated fruits and vegetables have recently caused major outbreaks of microbial infections. Although the microflora of these foods is dominated by weathering bacteria, yeasts and molds that may affect the organoleptic and commercial qualities of these products, many pathogenic bacteria, parasites and viruses have also been isolated from raw fruits and vegetables [1].

In Benin there is almost daily presence of fruits and vegetables in the menus of restaurants and hotels and on the display of saleswomen. Unfortunately, there is a lack of hygiene in the preparation of these dishes, which are usually salads. This actively participates in the multiplication of microorganisms as soon as the environment is favorable to them. It is therefore necessary to carry out microbiological quality controls of these dishes in order to limit the risk of food poisoning. The objective is to evaluate the microbiological quality of the salad dishes served in Cotonou restaurants.

2. Materiel and Methods

2.1. Sampling

A list of the best known restaurants in Cotonou has been established. From this list, ten (10) restaurants were selected through simple random sampling in Microsoft Excel 2010. Thirty (30) salad dishes were collected in the selected restaurants. The dishes served by these different restaurants were immediately kept in sterile sampling bags and put under ice before being sent to the laboratory. After the samples for analysis, the rest of the dishes of each dish were used to identify the different ingredients used for their preparation.

2.2. Microbiological Analysis

The collected samples were evaluated by searching using standard methods, microbiological parameters of quality. These are:

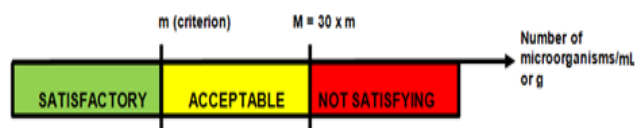
- total mesophilic aerobic flora by inoculation on Plate Count Agar medium (PCA) and incubation at 30°C for 24-48 h [6];
- Total coliforms, thermotolerants and *E. coli* on Violet Red Bile Lactose medium (VRBL) with incubation at 30 and 44°C respectively for 24 h [7];
- *Staphylococcus aureus*, on the Baird Parker medium

and incubation at 37 ° C for 24-48 [8];

- yeasts and molds on Sabouraud medium with chloramphenicol then incubation at 25°C for 3 to 5 days [9];

- Salmonella by pre-enrichment of the stock solution at 37 ° C for 19 h. Enrichment was made on RV, KM and isolation media on XLD and Hektoen media [10].

The interpretation of the results was carried out according to the three-class plan as follows



2.3. Statistical Analysis

The results obtained were submitted to a descriptive statistic. These results were tabulated and the different appearance frequencies of the dish types were calculated in Microsoft Excel.

3. Results

3.1. Listed Type of Salad Dishes and Ingredients Used for Their Production

In total, thirteen (13) types of salad dishes were listed. In these hotels, the most popular salad dishes were those with sausage shells and those with shrimp avocado with a frequency of appearance of 13.33% each (Table 1).

3.2. Microbiological Characteristics of Salad Dishes Analyzed

Table 2 shows the microbiological quality of the samples. From the analysis this table, it appears that all the salad samples analyzed were of unsatisfactory hygienic quality.

Table 1. Type of salad dishes and ingredients used for their production

Types of salad	Basic Ingredients	Frequency (%)
Pilsli cheese salad	Lettuce leaves, cut of Peulh cheese and spices	10.00
Cabbage salad with smoked bacon	Lettuce leaves, cabbage, bacon and spices	3.33
Shells salad with sausages	Coquillettes, sausages, lettuce leaves, spices	13.33
Peasant salad	Potato, green leaf, smoked diced bacon, boiled eggs and spices	6.66
Monegasque salad	Potato, tomato, olive and spices	10.00
Salad: washed raw vegetables mix: lettuce leaves, tomato	Tomato, green leaf, boiled egg, fresh onion and herbs and spices	6.66
Avocado salad with shrimp	Avocado, shrimp and spices	13.33
Beet salad with poultry ham	Beetroot, poultry ham, lettuce leaves, lettuce leaves and spices	10.00
avocado salad with boiled eggs	Avocados, eggs, garlic, onion, lettuce leaves	6.66
Beet salad with boiled eggs	Leaves of lettuce, beetroot, eggs	3.33
Piedmontese salad	Potato, tomato, eggs, ham cubes, pickles, mayonnaise, vinaigrette, lettuce leaf and spices	6.66
Oriental salad	Pepper, tomato, garlic, lettuce leaves and spices	6.66
Mixed salad	Leaves of lettuce, potato, tomato, carrot	3.33

Table 2. Microbiological quality of the samples (CFU/g)

	TF	CT	E.c	Stap	ASR	Sal
Peulh Cheese Salad (PCS)						
PCS 1	$8.4.10^5$	$6.8.10^2$	<10	<10	<10	-
PCS 2	$8.6.10^5$	$7.1.10^2$	<10	<10	<10	-
PCS 3	$2.8.10^5$	$1.5.10^3$	$> 3.10^3$	<10	<10	-
Cabbage Salad with Smoked Bacon (CSSB)						
CSSB 4	$1.6.10^5$	$8.9.10^2$	<10	<10	<10	-
Salad of Coquillettes with Sausages (SCS)						
SCS 5	$1.1.10^4$	$7.5.10^2$	< 10	< 10	<10	-
SCS 6	$1.1.10^4$	$7.4.10^2$	<10	<10	<10	-
SCS 7	$1.1.10^5$	$7.1.10^2$	<10	<10	<10	-
SCS 8	$3.1.10^4$	$6.2.10^2$	<10	<10	$1.5.10^2$	-
Peasant salad (PS)						
PS 9	$1.7.10^6$	$6.4.10^2$	< 10	< 10	$1.5.10^2$	-
PS 10	$2.7.10^6$	$5.4.10^2$	<10	<10	<10	-
Monegasque Salad (MS)						
MS 11	$1.6.10^4$	$1.3.10^3$	< 40	< 10	<10	-
MS 12	$4.6.10^4$	$1.5.10^3$	<10	<10	<10	-
MS 13	$1.6.10^4$	$1.2.10^3$	<10	<10	<10	-
Mixing Washed Vegetables (MWV)						
MWV 14	$8.1.10^5$	$> 2.10^4$	<10	<10	<10	-
MWV 15	8,4.10 ⁵	$> 3.10^4$	<10	<10	<10	-
Avocado Salad with Shrimps (ASS)						
ASS 16	$>3.2.10^5$	$>3.1.10^4$	$>3.10^4$	<10	$1.5.10^2$	-
ASS 17	$>3.10^6$	3.10^4	$2.1.10^2$	<10	<10	-
ASS 18	$>3.1.10^4$	$>3.10^4$	$>3.10^3$	<10	$1.5.10^2$	-
ASS 19	$>3.10^6$	$>3.10^3$	2.10^2	<10	<10	-
Beetroot Salad with Poultry Ham (BSPH)						
BSPH 20	$>3.10^6$	$>3.10^4$	<40	<10	<10	-
BSPH 21	$>3.10^6$	$>3.10^3$	< 40	<10	$1.5.10^3$	-
BSPH 22	$1.6.10^5$	$7.5.10^2$	$> 3.10^3$	<10	<10	-
Avocado Salad with Hard Eggs (ASHE)						
ASHE 23	$2.6.10^5$	$8.9.10^2$	$> 3.10^3$	<10	<10	-
Beet Salad with Hard Eggs (BSHE)						
BSHE 24	$5.4.10^4$	$7.5.10^2$	$2.1.10^2$	<10	<10	-
BSHE 25	$1.1.10^4$	$2.8.10^2$	< 40	< 10	< 10	-
Piedmontese Salad (PS)						
PS 26	5.10^3	$4.5.10^2$	<10	<10	<10	-
PS 27	$6.5.10^3$	$2.8.10^2$	< 10	< 10	<10	-
Oriental Salad (OR)						
OS 28	$3.8.10^5$	$6.2.10^2$	$1.5.10^4$	<10	<10	-
OR 29	$8.3.10^5$	$> 3.10^4$	$4.3.10^4$	< 10	<10	-
Mixed Salad						
MS 30	$8.4.10^4$	$4.5.10^2$	$1.5.10^2$	<10	$1.5.10^2$	-
Normes	m : 10^7	m : 10	m : 10	m : 10^2	m : 10^3	Absent dans 25g
	M : 10^8	M : 10^2	M : 10^2	M : 10^4	M : 10^4	

-: Absence, TF: Total Flora; CT: Total Coliforms; Ec: *Escherichia coli* β -glucuronidase positive; Staph: Staphylococcus with positive coagulase; ASR: Anaerobic Sulphito-Reducers; Sal: Salmonella.

4. Discussion

The overall objective of this work is to evaluate the microbiological quality of salad served in Cotonou restaurants. Results showed thirteen (13) types of salad dishes. Among the salad dishes listed, the most popular were sausage-flavored salad dishes and shrimp avocado salad dishes, with a frequency of 13.33% each; followed by dishes of Peulh cheese salads, Monegasque salad dishes and beet salad dishes with poultry hams (10% respectively). These results differ from those of authors [11] in FES, which has listed four other types of salad dishes. The microbiological quality evaluation showed the total flora was isolates in all samples but was in conformity with the norm criteria. These results differ from those obtained by [11], which obtained 21.45% compliant samples. Indeed, this could be explained by a good mastery of the process of sanitation during the production of these different dishes of salad. Note the total flora is an indicator of the level of hygiene and good control of the manufacturing process [12].

None of the samples were in compliance for coliforms. These results do not agree with those of authors [13] who reported a microbial load of 4.1% in coliform bacteria on 220 samples of salad dishes. The high microbial load of total coliforms may be the result of ineffective heat treatment of different components of salad dishes, poor disinfection methods, or the presence of the presence of plant raw unwashed or improperly decontaminated. In Cotonou, leafy vegetables and fruits are grown outdoors. Vegetables are usually exposed to microbial contamination by contact with soil, dust, water and different harvesting methods or post-harvest treatments. Therefore, they harbor different types of pathogenic microorganisms for humans and for the plant itself [14]. From the 30 samples analyzed, ten (10) had an *E. coli* microbial load that exceeded the standard requirements (33.3% non-compliant sample). A different observation was made by authors [15] who showed on 42 vegetable salad samples, a high level of non-compliance caused by faecal coliforms were 98% including *E. coli*. The contribution of non-resident microflora via manure, emptying or irrigation water, transportation and individual management by retailers may be the cause [16]. Potential sources of these pathogens are soil, faeces (animal and human), water (irrigation, cleaning), animals (including insects and birds), product management, harvesting and harvesting treatment and transportation equipment [17]. However, for Anaerobic Sulfito Reductors (ASRs), only one non-compliant sample was observed. Contamination by ASRs, even if it is low, is largely sufficient to constitute a risk for the consumer. In fact, the presence of ASRs is an indicator of telluric contamination not controlled by technological treatments and would result from contaminated raw material and a lack of cooling.

Considering all the germs all of samples were of unsatisfactory hygienic quality. This result does not agree with those of authors [11] who obtained 69% of non-compliant sample and those of [18] who had noted 32.70% of nonconformity. The high level of non-compliance that we noted could be related to a lack of hygiene, whether physical, clothing, technical or local [19].

According to authors [20], the contamination of food by total flora and faecal coliforms denotes, respectively, non-compliance with the good practice rules and the violation of hygiene rules. Consumers are therefore exposed to the risk of food poisoning.

5. Conclusion

The present work has made it possible to evaluate the microbiological quality of the salad dishes sold at some of the Cotonou restaurants in relation to good hygiene practices and good manufacturing practices within these hotels. The presence of some microorganisms, thus rendering the quality of these dishes unsatisfactory, is very dangerous for the health of the consumer.

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