Original Research Article

Training of university catering stakeholders in good hygiene practices: a prerequisite to controlling the risks of Collective Food Poisoning (CFP) in Senegal's university campuses.

ABSTRACT

In Senegal, public universities namely: UGB, UCAD, UIT, UADB and UASZ are often the scene of violent mood movements of students following the occurrence of a Collective Food Poisoning (CFP). These diseases are caused by the consumption of dangerous meals usually prepared by unskilled actors. This study aims to identify the shortcomings related to the lack of training of catering stakeholders in Good Hygiene Practices (GHP), by specifically determining their levels: behaviour, qualification, risk in these CFP outbreaks, bacteriological contamination of surfaces and food to which students are exposed. To do this, a questionnaire was developed and a team of investigators was formed. From 2012 to 2017, a retrospective survey was conducted. The choice of targets focused on students, restaurateurs, food vendors, residence chefs and medical workers. A system has been set up for the collection and analysis of food samples (processed fish, hot meals, unpasteurized juices and sandwiches) and surfaces (trays and hands of divers and waitresses) at the UCAD ESEA restaurant under aseptic conditions. Data processing was carried out using an Excel spreadsheet and XLStat software. We have respectively in University Restaurants, University Residences, Fast Foods and Outdoor Restaurants: (17.47; 43.24; 22.21 and 17.08), (21.05; 33.05; 14.02 and 31.88) and (65.4; 21.16; 10.96 and 2.48) for the level of actors' behaviour, qualification and percentage risk. The level of contamination of trays, divers, waitresses, processed fish, meals, unpasteurized juice and sandwiches is 50%, 48%, 55%, 74%, 100%, 94% and 91.5% respectively. In the analysis of these results, we can say that the training of actors is a priority on these university campuses. To ensure the safety of meals and the safety of students, qualified staff must be recruited and there must be ongoing training in good hygiene practices and HACCP.

KEYWORDS: CFP, Hygiene, Health, Safety, HACCP.

ABBREVIATIONS:

UGB- Gaston Berger University of Saint Louis; UCAD- University Cheikh Anta DIOP; UADB- Alioune Diop University of Bambey; UASZ- Assane Seck University of Ziguinchor; UIT- University Institute of Technology; HACCP- Hazard Analysis Critical Control Point.

1. INTRODUCTION:

Often in Senegal, social campuses are marked by violent mood movements of students following the occurrence of Collective Food Poisoning (CFP) **[5]**. These illnesses are caused by the consumption of hazardous meals, usually prepared and served by unskilled actors **[1]**. In these social campuses, most actors are not trained in hygiene and food safety standards to know these diseases, due to a lack of recruitment requiring no skills in these restaurants with high consumption of meals **[2][12]**.

At the level of these university canteens where the conditions of meal preparation by unqualified actors not trained in hygiene and food safety standards are poorly controlled, the risks of CFP are high **[6]**. Training staff in hygiene is essential and must include education tailored to listeners **[8]**. This study aims to show the importance of taking into account the training component of university catering stakeholders in hygiene and food safety standards by specifically determining the level of:

- the behaviour of the actors,
- the lack of qualification in these agents in restaurants and surroundings,

- the risk in these CFP outbreaks,
- bacteriological contamination of surfaces, food, and unpasteurized fruit juices and sandwiches in the ESEA restaurant.

2. MATERIALS AND METHODS:

2.1. Material:

2.1.1. Survey material on the level of behaviour, lack of qualification and risk in CFP homes.

In this study, the survey material used consists of:

- Sheets (physical format) of the questionnaire consisting of seven (6) parts, each of which has several headings relating to variable parameters;
- A team of trained investigators made up of students;
- An Excel spreadsheet and XLstat software for data processing and exploitation;

2.1.2. Bacteriological contamination analysis equipment at and outside the ESEA restaurant

Bacteriological analyses were carried out at the restaurant level on surfaces, processed fish and meals and outside the restaurant on unpasteurised fruit juices and sandwiches. The technical equipment shall consist of a device for taking, storing and transporting samples. Thus, the samples to be analyzed were:

- Surfaces of the trays;
- Surfaces of divers' hands;
- Surfaces of waitresses' hands;
- Raw products (processed fish);
- Cooked products (hot meals);
- Five categories of unpasteurized fruit juice sold around the ESEA restaurant (Bouye, Bissap, Ginger, Ditakh and Tamarind);
- Five categories of sandwiches sold around the ESEA restaurant (Meat, cowpea, peas, Fatayas and Hamburgers);

2.2 Methods:

2.2.1. Methods for investigating the level of behaviour, lack of qualification, risk in CFP outbreaks and application of the Paréto method

2.2.1.1. Survey methods on the level of behaviour, lack of qualification and risk in CFP homes

As for the survey, we proceeded with a retrospective survey from 2012 to 2017 targeting students, restaurateurs, food vendors, residence chefs and medical facility workers in the five (5) social campuses of UGB universities, UCAD, UIT, UADB and UASZ represented by red stars on the map of Senegal in Figure 3. The application of the sampling method from the sample size estimation table (95% confidence level ± 5%) of Krejcie and Morgan **[14]** made it possible to find the sample size which is 384 people to be surveyed in these five (5) universities. The distribution was made on a pro-rata basis in the universities according to the target given for each. Thus the samples are established in Table 1 below. This part of the survey aims to identify the training needs of catering stakeholders in Good Hygiene Practices (GHP), by specifically determining their levels: of behaviour, qualification and risk in these CFP outbreaks.

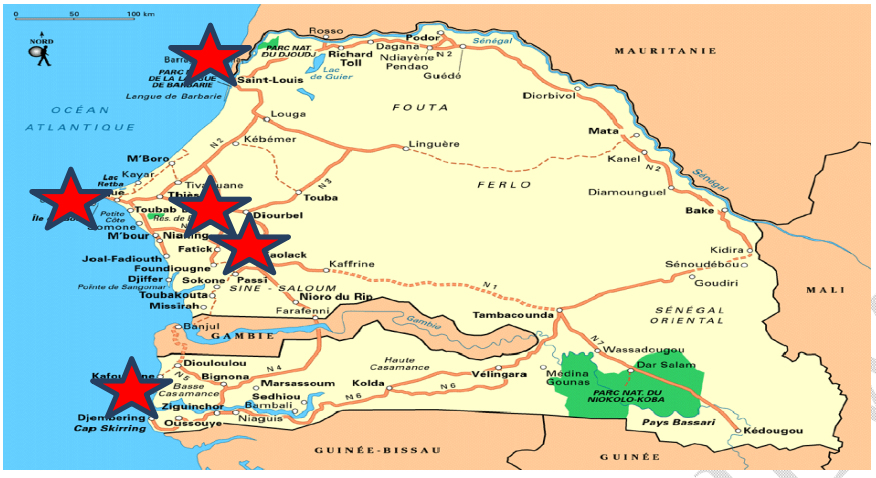

Figure 1: Map of Senegal: the red stars designate from top to bottom: UGB, UCAD, UIT, UADB and UASZ.

Table 1: Sampling method from the Krejcie and Morgan sample size estimation table (95% confidence level ± 5%)

	TARGETS	UGB	UCAD	UIT	UADB	UASZ	TOTAL
POPULATION	Number of students	11.441	75.111	4.173	3.500	3.525	97.750
	Number of residences	15	47	10	9	5	86
	Number of restaurants	2	8	4	5	1	20
	Number of canteens	22	46	7	7	6	88
	Number of doctors	1	15	1	1	1	19
	Total in VA	11.481	75.227	4.195	3.522	3.538	97.963
	Total in VR (%)	11,72	76,79	4,28	3,60	3,61	100
	TOTAL SHEETS	**45**	**295**	**16**	**14**	**14**	**384**
	SAMPLES	**UGB**	**UCAD**	**UIT**	**UADB**	**UASZ**	**TOTAL**
SAMPLES	Number of students	23	211	5	3	3	245
	Number of residences	8	21	3	3	3	38
	Number of restaurants	4	28	3	3	3	41
	Number of canteens	8	20	3	3	3	37
	Number of doctors	2	15	2	2	2	23
	TOTAL SHEETS	**45**	**295**	**16**	**14**	**14**	**384**

2.2.1.2. Application of the Paréto method

Given the values found, an application of the Vilfredo Pareto principle seems essential. In this part, the problem to be solved according to the principle of Paréto is the determination of the main source of CFP for a perfect mastery of prevention by the heads of the administrative structures in charge of students' social issues. Thus, in principle, the following steps were followed:

- Step 1: Determination the problem to be solved. This is the determination of the main source of CFP in the social campuses of the universities of Saint-Louis, Dakar, Thiès, Bambey and Ziguinchor of Senegal.
- Step 2: Determine the causes of the problem. All CFP cases and their sources are recorded in the questionnaire. Step 3: Source Categorization These sources are categorized into four: (University Restaurants, University Residences, Fast Food Restaurants, and Outdoor Restaurants) and classified according to the model.
- Step 4: Assign values. These values are assigned by the survey and percentages are calculated.

2.2.2. Methods for bacteriological analysis of contamination at the ESEA restaurant level (surfaces, processed fish and meals) and outside the restaurant (unpasteurised juices and sandwiches).

For these bacteriological analyses, only one restaurant located on an outdoor campus is chosen at UCAD; it is the ESEA located on a campus peripheral to the large campus. During the five (05) series of official analyses, four (4) germs on the surface (Total Aerobic Mesophilic Flora, *Staphylococcus aureus*, thermotolerant or faecal coliforms and *Escherichia coli*) and five (5) germs in food products (Total Aerobic Mesophilic Flora, *Staphylococcus aureus*, Thermotolerant or faecal Coliforms, Sulphito-reducing Anaerobes and *Salmonella*) were sought. The total number of samples analyzed was obtained according to the nature of the medium or the type of product; thus:

For surfaces located at the restaurant level:

- trays: 3 samples per series which give 15 samples per restaurant or 15 samples;
- divers: 3 samples per series which give 15 samples per restaurant or 15 samples;
- waitresses: 3 samples per series which give 15 samples per restaurant or 15 samples;

For food products located at the restaurant level:

- processed fish: 1 sample per series, which gives 5 samples per restaurant or 5 samples;
- hot meals: 3 samples per series (the first at the beginning of the service, the second in the middle of the service and the third towards the end of the service) which gives 15 samples per restaurant or 15 samples;

For the food products sold around this restaurant, two were chosen:

On the one hand, sandwiches:

- 5 categories of sandwiches sold in these campuses: (meat, cowpea, peas, Fataya and hamburger) among which two categories are concerned by this part of the study: meat sandwich and cowpea;
- 2 samples per series which give 10 samples per restaurant area or 10 samples;

On the other hand, unpasteurized fruit juices:

- 5 categories of fruit juices are sold in these campuses: (Bouye, Bissap, Ginger, Ditah and Tamarind) among which two categories are concerned by this part of the study: bouye and bissap juice;
- 2 samples per series which give 10 samples per restaurant area or 10 samples;

The normative references, growing conditions and horizontal methods of two- or three-class enumeration from Table 2 were used.

Table 2: Standards, culture media and incubation temperature used for the analysis of different

microbiological flora.

Flores Wanted on surfaces, food, meals and fruit juices	Normative References						
	Standards used	environments of culture	Temperatures (in °C), incubation times (in h) and atmosphere	Criteria: (m) (Number of standard germs / g of food or surfaces tested)			
				Surfaces used	Fish costs elaborate	Meal and Sandwiches	Fruit juice
Total Aerobic Mesophilic Flora (TAMF) at 30°C	NF EN ISO 4833	Standard agar (PCA: Plate Count Agar)	30°C pendant 24h en aérobiose	10^2	10^5	$3.\ 10^5$	$3.\ 10^3$
Staphylococcus aureus	NF V08-057-1	(BP: Rabbit Plasma Brain Heart Broth)	37°C for 48h in aerobiosis	10	10^2	10^2	$< 10^2$
Coliforms thermotolerant or "faecal" 44°C	NF V08-060	Bile Sodium Azide Aesculin Agar (BEA)	44°C for 48h in aerobiosis	10	10	10	$< 10^2$
Sulfo-Reducing Anaerobes (ASR) at 37°C	XP V 08-61	Tryptose Sulphite Cycloserine Agar (TSC) Liquid Thioglycolate	37°C for 24h in anaerobiosis	30	10	30	30
Escherichia coli	ISO 16649-2	TBX Agar	44°C for 24h in anaerobiosis	10	10	10	10^2
Salmonella	NF V08-6579	Rappaport Vassiliadis (RV) Selenite-cystine (BSC) broth Brilliant Green Agar (GBA)	37°C for 24 to 48 hours under aerobiosis	Absence /25g	Absence /25g	Absence /25g	Absence /25g

3. RESULTS AND DISCUSSIONS:

3.1. Results on the level of staff behaviour and lack of qualifications

Table 3: Level of staff behaviour and lack of qualifications

Dimensions	Results in %				
	University restaurant	Student Housing	Fast-Food	Restaurant Exterior	Total
Behaviour	17,47	43,24	22,21	17,08	100
Qualification	21,05	33,05	14,02	31,88	100

The results of the study are respectively in University Restaurants, University Residences, Fast Foods and Outdoor Restaurants: (17.47; 43.24; 22.21 and 17.08) and (21.05; 33.05; 14.02 and 31.88) for the level of behaviour of actors and their qualification in percentage. Bad behaviour is noted especially among students who ignore the internal regulations of the structures in charge of social work and prepare meals at university residences, fast-food agents and then among internal and external restaurateurs. These values are better than those of ESSOMBA J. A. (2000) **[4]** and lower than those of DIALLO M. L. (2010) **[3]**. These results are the consequence of the lack of qualification of the actors at the level of these sectors. The values obtained on the level of lack of qualification are close to those of ESSOMBA J. A. (2000) **[4]** but remain much lower than those of DIALLO M. L. (2010) **[3]** where staff are regularly trained in hygiene rules in collective catering following standards **[8]**.

3.2. Results on the level of risk in CFP outbreaks and the determination of the major source of CFP by applying the Paréto method

3.2.1. Results on the level of risk in CFP outbreaks

Table 4: Level of risk in CFP homes

Dimensions	Results in %				
	University restaurant	Student Housing	Fast Food	Restaurant Exterior	Total
CFP risk level	65,4	21,16	10,96	2,48	100

The results of the study on the level of CFP risk in these four outbreaks are respectively 65.4; 21.16; 10.96 and 2.48% for University Restaurants, University Residences, Fast Foods and Outdoor Restaurants. These values show that the risk is higher in university restaurants followed by university residences and fast-food restaurants but remains higher than those of DIALLO M. L. (2010) **[3]** where the risk of CFP is low because of sustained training for qualified personnel.

3.2.2. Results of the determination of the major source of CFP by applying the Paréto method

Table 5: Cumulative frequencies and frequencies

Ranking	Sources of CFP	Frequencies	Cumulative Frequencies
1	Restaurants Academics	65,4	65,4
2	Residential homes Academics	21,16	86,56

3	Fast-Foods	10,96	97,52
4	Outdoor Restaurants	2,48	100

The results expressed as a percentage and as a cumulative percentage show that at 86.56%, the risk of occurrence of CFP is in restaurants and university residences at the level of all campuses. This is illustrated by the Paréto diagram in the following Figure 2.

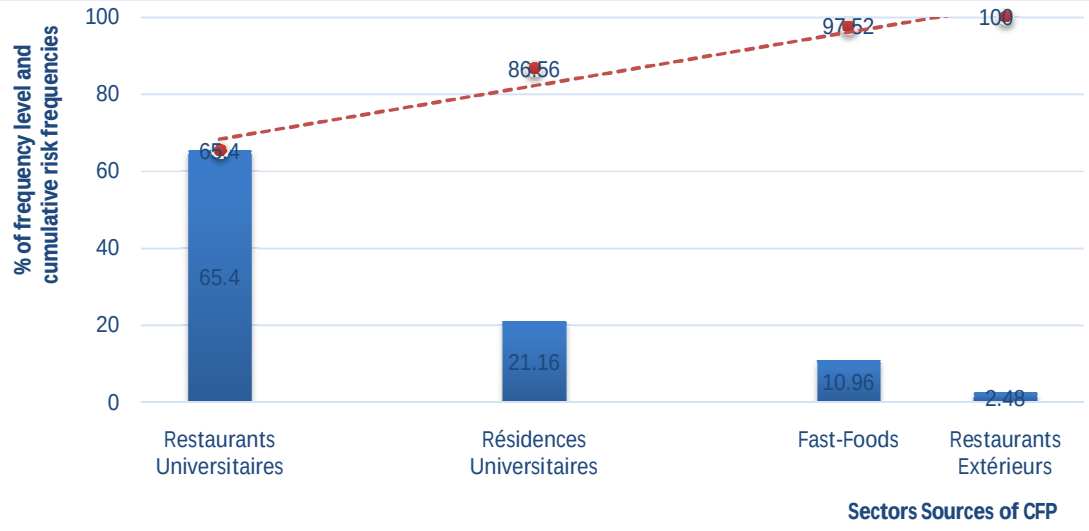

Figure 2: Pareto diagram determining the main source of CFP by the 80/20 frequency law and cumulative risk frequency curve

In analyzing the results of this method, we note that more than 86% of the risk of CFP appearing in these university social campuses is at the level of two sectors: restaurants and university residences where students handle food and meals without any preventive measures. The principle of Paréto (80/20) remains verified in the sense that 86.56% of the risk of the appearance of CFP comes from these two outbreaks generally and particularly in university restaurants. The values found by DIALLO M. L. (2010) **[3]** which aim for the zero-risk level are better than that of the present study which is however close to those of ESSOMBA J. A. (2000) **[4].**

3.3. Bacteriological results of contamination at the university restaurant level (surfaces, processed fish and meals) and outside the restaurant (unpasteurized juices and sandwiches).

3.3.1. Bacteriological results of surface contamination at ESEA Restaurant

The results of the study on surface contamination in this university restaurant are shown in Figure 3 below.

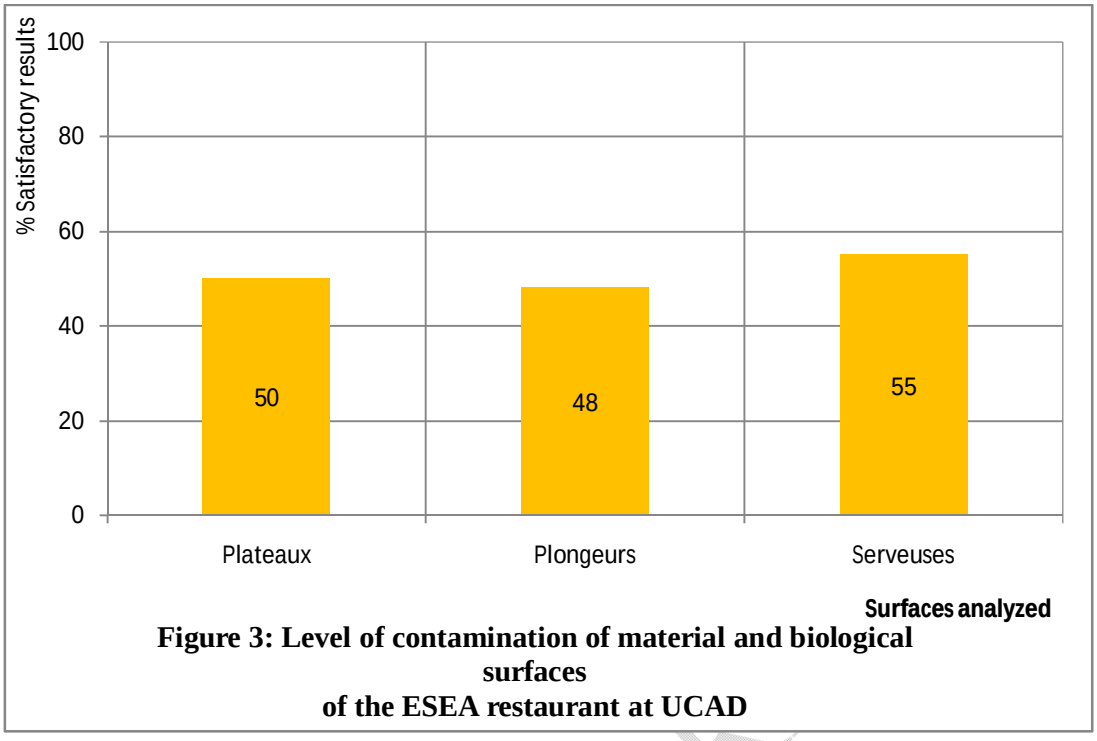

Figure 3: Level of contamination of material and biological surfaces of the ESEA restaurant at UCAD

The results of the study reveal non-compliance with the hygiene rules of cleaning and disinfection of surfaces which are 50%, 48% and 55% satisfactory respectively for trays, divers and waitresses. These results on the bacteriological survey of the surfaces of the materials and biology of this restaurant located in one of the peripheral campuses are much less satisfactory than those found by NJUEYA et al. (2006) **[10]** which are between 60 and 80% satisfaction.

3.3.2. Bacteriological results of food contamination at ESEA Restaurant

The results of the food contamination study in this university cafeteria are shown in Figure 4 below.

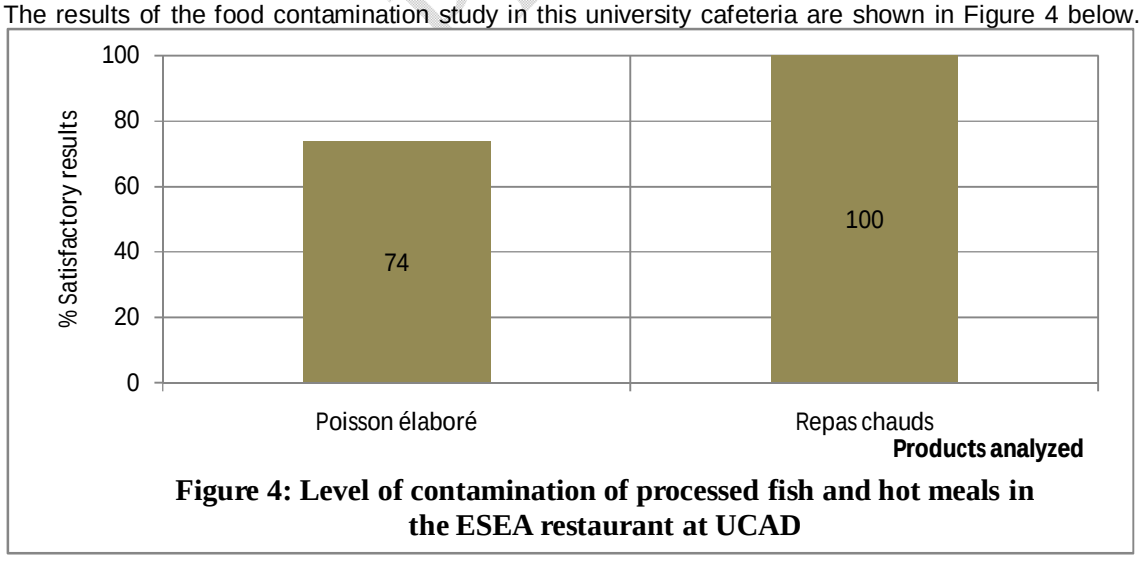

Figure 4: Level of contamination of processed fish and hot meals in the ESEA restaurant at UCAD

The results obtained on the fish elaborate reveal non-compliance with the rules of conservation in a cold room with a satisfaction rate of 74%. This satisfaction rate of 74% found on the fish elaborated is higher than that found by Seydi et al. (1992) **[13]** which is 31.3%. As for hot meals, the study values (100% satisfaction) are close to those of GOUSSAULT et al. (1983) **[7]** which are 97.8% satisfaction.

3.3.3. Bacteriological results of contamination of unpasteurized juices and sandwiches sold in the vicinity of the ESEA restaurant

The results of the study on the contamination of food outside this university restaurant are shown in Figure 5 below.

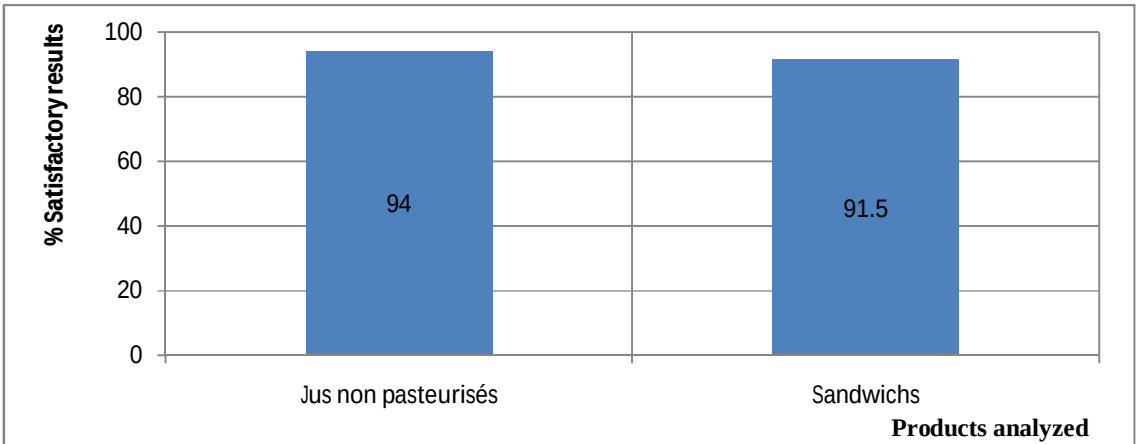

Figure 5: Contamination of unpasteurized juices and sandwiches sold around the ESEA restaurant at UCAD

The bacteriological results obtained on samples of unpasteurized fruit juice sold in the vicinity of the ESEA university restaurant, located in a peripheral campus of UCAD, are 94% satisfactory. Contrary to the finding of OUATTARA Y. et al. (2018) **[11]** who notes a presence of pathogens in homemade juices, the bacteriological results of the study that revealed a total absence of pathogenic bacteria are identical to those of Ndiaye et al. (2015) **[9]**.

4. CONCLUSION:

This study reveals that training in good hygiene practices is necessary to redress the behaviour of actors, build their capacity, reduce the level of risk of CFP outbreaks and improve prevention measures for these diseases. This training is all the more important because inside restaurants, few agents are trained, but outside, actors prepare unpasteurized juices and sandwiches at home without any control and expose them for sale to students on these university campuses. To preserve food safety and guarantee their safety throughout the catering chain in these Senegalese universities, it is necessary to train all stakeholders in good hygiene practices and the HACCP method while adopting sustained awareness campaigns for them.

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List of figures:

List of tables: