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Sanitary Quality of the Meals Served in the Canteens and Vicinity of the Lagoon Mother and Child University Hospital Centre and National Hospital and University Centre Hubert Koutoukou Maga of Cotonou (Benin)

Moussiliou Paraïso, Cyriaque Comlan Degbey*, Yasmine Bakary Ozavino, Colette Azandjeme, Charles Sossa-Jerome

Regional Institute of Public Health, University of Abomey-Calavi, Abomey-Calavi, Benin
Email: *comlancy@yahoo.fr

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Abstract

Background: Food safety is an integral part of food security. It refers to the protection of the food supply against risks of microbial, chemical and physical origin at every stage of the food chain. The study aimed to investigate the sanitary quality of meals served in the canteens and vicinity of the Lagoon Mother and Child University Hospital Centre (CHU-MEL) and National Hospital and University Centre Hubert Koutoukou Maga (CNHU-HKM) of Cotonou. **Methods:** It was a cross-sectional with a data collection period from 16 March to 22 April 2021. There were 32 vendors surveyed and 40 meals sampled for microbiological examination. We collected data on the vendors' socio-demographic characteristics, working environment, health status, knowledge and food hygiene practices. **Results:** About 83% of the meals contained pathogenic microorganisms. All meals had a temperature from 4˚C to 60˚C called the "danger zone". The level of knowledge about food hygiene was low in 65.7% of the vendors. About 47% had poor personal and clothing hygiene, food storage and service practices. **Conclusion:** These results show that the meals sold in the CHU-MEL and CNHU-HKM could present a health risk for the consumer. There is a need for improvement of the sanitary quality of the meals delivered in the canteens and vicinity of these hospitals.

Keywords

Sanitary Quality, Meals, Canteens, CHU-MEL, CNHU-HKM, Benin

1. Background

Food safety is an integral part of food security. It refers to the protection of the food supply from microbial, chemical and physical hazards at all stages of the food chain, including cultivation, harvesting, processing, transportation, retailing, distribution, preparation, preservation and consumption, to prevent foodborne illness [1]. Given the inadequacy of food to meet demand on the African continent, most people are concerned only with satisfying their hunger without paying attention to food safety [2]. Careful attention to food safety in all situations is imperative to ensure effective use of the limited available food [3].

In the hospital environment, food hygiene is an important issue. The main goal of hospital catering is patient rehabilitation and comfort. It is an integral part of the care process. Food safety plays a role in the nutritional status of populations. Pathogens and chemical contaminants in food can affect the digestion, absorption or utilization of nutrients, thereby delaying patient remission. However, it does not only concern patients but also nursing staff and visitors. As food in the workplace is a determinant of profitability, the quality of catering, including food safety, must be a priority.

The out-of-home food sector provides urban people with ready-to-eat, popular and affordable meals. These are a means for all social classes to feed themselves and generate income. However, most meals are not up to standard due to poor hygiene. According to the World Health Organization (WHO), there is little data on the burden of foodborne disease in Africa. However, available data show that food- and water-borne diarrhoea results in the death of about 700,000 people of all ages each year. Also, some authors have estimated that of the 1.5 billion episodes of acute diarrhoea occurring annually in under-five children, 70% are due to contaminated food [3]. Besides, the WHO estimates that two million people in developing countries die annually from food poisoning, acquired in part through mass catering. Unsafe food causes 1.2 million deaths annually among the elderly and children over five in South Asia and Africa.

In Benin, diarrhoea reached 101,519 cases and 253 deaths in 2016 [4]. Hygiene conditions and practices are not subject to rigorous regulation to ensure optimal hygiene conditions for customers during meal preparation [5]. Furthermore, the risk of meal contamination depends mainly on the health status of meal vendors, their hygiene, and their knowledge and practices regarding hygiene [6].

Foodborne illness outbreaks are common in Africa and remain a public health problem despite progress toward prevention [7]. In Benin, according to the 2014 multiple indicator cluster survey, the prevalence of diarrhoea among children under five was 10% [6] [8]. In Chad, suggestions were made to organise vendors into groups to raise awareness and train them on good hygiene practices and good manufacturing practices. However, good hygiene, especially hand washing with soap, is essential for prevention. Thus, meal vendors are becoming a public health priority; they are a crucial link between food and consumers [6].

In the hospital system, poor finances, lack of adequate transport, and shortage

of time mean that many health workers cannot go home for family meals. However, when the collective catering system at their workplace is not working, they are forced to buy meals on the street at a lower price. Given the extent of this practice in Benin, it is of paramount importance to monitor the hygiene practices of vendors and the microbiological quality of the meals offered. Several studies have focused on the issue of street food quality in Benin, but very few, notably, have looked at workplace catering, especially in hospitals. In 2019, Tya *et al.* looked at the hygiene practices of vendors and the microbiological quality of the meal served in Cotonou streets [9].

The present study aims to investigate the sanitary quality of the meals served in the canteens and vicinity of the Lagoon Mother and Child University Hospital Centre (CHU-MEL) and National Hospital and University Centre Hubert Koutoukou Maga (CNHU-HKM) of Cotonou (Benin).

2. Methods

2.1. Study Area

The study took place at the CHU-MEL and CNHU-HKM. The CHU-MEL was born on 7 October 2002 from the merger of two neighbouring health establishments created in 1958: the Lagoon maternity hospital and the maternal and child health centre. The CHU-MEL is a public facility, a reference hospital for gynaecology-obstetrics and paediatrics. It has a canteen which provides breakfast and lunch meals from Monday to Friday. The canteen serves hospital staff, patients and visitors. However, attendance is low. Indeed, the hospital staff seem to be dissatisfied with the price-quality ratio. Meals start at 300 F CFA ($0.5) for breakfast and 1500 F CFA ($2.3) for lunch. The CHU-MEL formerly had a kitchen to provide food for inpatients. Unfortunately, this kitchen has been inactive since 10 January 2020 due to a lack of resources.

The second centre used for this study was created in 1962 and became the National Hospital Centre in 1963. By decree n˚73/008 of 10 January 1973, it became the CNHU-HKM, allowing students from the Faculty of Health Sciences (FSS) to do their practical training there. It is a reference structure at the national level in Benin [8]. Within the CNHU-HKM, there is a refectory and a canteen. The canteen is used more than the refectory because of the more affordable prices. In addition, the CNHU-HKM is in partnership with an external structure providing meals to students and inpatients.

2.2. Study Type

It was a cross-sectional with a data collection period from 16 March to 22 April 2021.

2.3. Study Population

The study population was categorized into primary and secondary targets. The primary targets were meals prepared and sold in the canteens and vicinity of the

CHU-MEL and CNHU-HKM. They were the biological material of the study. The secondary targets were the meal vendors in the canteen and vicinity of the CHU-MEL and the CNHU-HKM. We did not include street vendors, vendors who had not been present on the premises for more than three months, had not given informed consent to participate in the study, or those unable to answer questions freely due to their condition.

2.4. Sampling

We counted meal vendors in the vicinity of the CHU-MEL and CNHU-HKM to establish a list of available meals and their frequency of consumption. After numbering these, we determined the number of meals for microbiological analysis and selected them by a simple random draw. The sample size of the meals was 40, with 15 meals for the CHU-MEL and 25 for the CNHU-HKM. This choice is due to financial constraints and the fact that the CNHU-HKM has more catering suppliers than the CHU-MEL. We conducted an exhaustive sampling of meal vendors at CHU-MEL and CNHU-HKM.

2.5. Data Collection

We administered a questionnaire to the vendors and observed their health status, working environment and hygiene practices. The questionnaire covered the socio-demographic characteristics, knowledge and practices regarding food hygiene.

The collection of meal samples took place in two phases:

- First phase: A census of the different vendors found in the immediate surroundings of the CHU-MEL and the CHNU-HKM allowed us to draw up a list of the different meals available as well as their frequency of consumption. After numbering these, the number of meals to be analyzed per sales site was set in a reasoned manner and a selection of these was thus made by simple random draw without replacement.

- Second phase: The actual data collection phase, which consisted in questioning and observing the sellers on the one hand and taking the meals to be analyzed on the other hand, in order to represent reality more faithfully during the sale, most of the meals were purchased in containers commonly referred to as "take-out" provided by vendors. Meals were transported in insulated bags. They were transported to the Laboratory of the University Clinic of Hospital Hygiene of the CNHU-HKM in Cotonou for microbiological and physicochemical analyzes (Table 1).

2.6. Primary Outcome

The primary outcome was the sanitary quality of the meals served in the canteens and vicinity of the CHU-MEL and CNHU-HKM. It had two components:

- the microbiological and physicochemical quality of the meals;
- the factors related to the meal vendors.

Table 1. Techniques and tools for collecting data by targe.

Data sources	Data collection techniques	Data collection tools	Targets
Observation by the researcher	Observation	Observation form	○Hygiene practices ○Working environment ○Apparent health
Information provided by participants	Questionnaire	Questionnaires	Meal vendors
Microbiological analysis	Laboratory	○Sampling bags ○Packaging for direct consumption	○Food ○Empty packaging

We assessed the first component through the presence of pathogenic micro-organisms and physicochemical contaminants in the meals. The factors related to the meal vendors included: socio-demographic characteristics, health status, working environment, knowledge and practices regarding food hygiene.

2.7. Operational Aspects of the Variables

We defined criteria (sub-components) for each component of the primary outcome. Subsequently, we assigned scores to the criteria. The scale of the scores was:

- 1: if the criterion assessed was in line with the expected standard;
- 0: if the criterion does not meet the expected standard.

The sum of the scores obtained by each criterion defined the observed score for the component. The observed score for the primary outcome is the sum of the observed scores for the two components. The rating of the primary outcome and the two components is the ratio (expressed as %) between the observed scores and expected scores. The rating was categorized according to the Varkevisser scale [10]:

- Good: rating from 80% to 100%;
- Average: rating from 60% to 80%;
- Poor: rating from 0% to 60%.

2.8. Data Analysis

The data analysis was performed using Stata 11. First, we describe the study population. We presented the quantitative variables with a normal distribution using their mean and standard deviation while the skewed variables were described using their median and interquartile range. We calculated the proportions for categorical variables. Then, we presented the results of the microbiological analyses.

3. Results

Most meal vendors came from the vicinity of the CHU-MEL and the CNHU-HKM canteen (**Figure 1**).

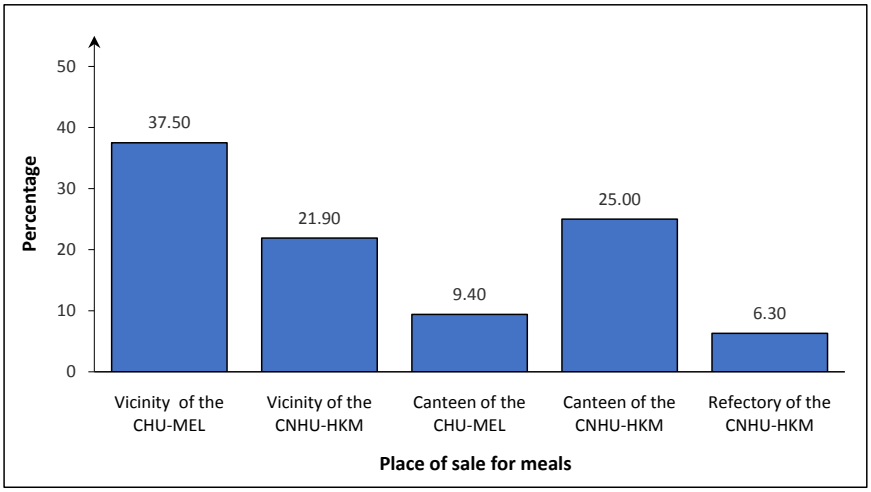

Figure 1. Location of meal vendors (n = 32).

3.1. Socio-Demographic Characteristics of the Meal Vendors

The mean age of the meal vendors was 37.9 ± 8.6 years, with extremes ranging from 22 to 57 years. The median number of years spent in meal sales was five years, with extremes ranging from one to 25 years.

3.2. Health Status of the Meal Vendors

Of the 32 meal vendors, 21 (65.6%) said having carried out the required clinical examinations before starting to sell meals. These clinical examinations were: stool examination, cytobacteriological examination of sputum and intradermal reaction tests (tuberculosis). Only one vendor reported illness during the 30 days before the survey.

3.3. Hygiene Practices of Meal Vendors

3.3.1. Personal Hygiene and Clothing Practices

75% of sellers were not wearing smocks or aprons.

59.4% did not have their hair protected and 62.5% of them did not wash their hands with soap and water (Table 2).

3.3.2. Equipment and Environmental Hygiene for Selling Meals

Most sales locations were clean, with no insects or toilets in the surrounding area. Most of the kitchen and vending equipment complied with hygiene recommendations (Table 3).

3.3.3. Hygiene Practices for Storing and Serving Meals

All the vendors did not follow hygienic food storage and serving practices (Table 4).

3.3.4. Assessment of Hygiene Practices of Meal Vendors

In 46.9% of the vendors, personal hygiene and hygiene of clothing and food storage and serving methods were poor. On the other hand, the hygiene of equipment and the environment for selling meals was good for 68.7% (Table 5).

Table 2. Personal hygiene and clothing practices of meal vendors in the canteens and vicinity of the CHU-MEL and CNHU-HKM (n = 32).

Items of personal hygiene and clothing practices	Number	Percentage
Hand injuries		
Yes	2	6.3
No	30	93.7
Wearing a headdress/scarf on the head		
Yes	13	40.6
No	19	59.4
Wearing rings/bracelets		
Yes	4	12.5
No	28	87.5
Wearing a gown/shield		
Yes	8	25.0
No	24	75.0
Wearing gloves		
Yes	0	0.0
No	32	100.0
Wearing bibs		
Yes	19	63.3
No	11	36.7
Wearing clean clothes		
Yes	28	87.5
No	4	12.5
Salespeople's nails trimmed		
Yes	30	93.7
No	2	6.3
Systematic hand washing after sales		
Yes	12	37.5
No	20	62.5
Wash hands with soap and water		
Yes	12	37.5
No	20	62.5

Table 3. Equipment and environmental hygiene for selling meals in the canteens and vicinity of the CHU-MEL and CNHU-HKM (n = 32).

Items of equipment and environmental hygiene	Number	Percentage
Cleanliness of the sales site		
Yes	23	71.9
No	9	28.1
Presence of insects/animals near meals		
Yes	7	21.9
No	25	78.1
Existence of sewers/drainage channels near the sales site		
Yes	11	34.4
No	21	65.6
Existence of toilets near the place of selling the meals		
Yes	0	0.0
No	32	100.0
Presence of rubbish bins near the place of sale		
Yes	16	50.0
No	16	50.0
Cleanliness of tables and benches		
Yes	26	81.2
No	6	18.8
Cleanliness of used kitchen linen		
Yes	21	65.6
No	11	34.4
Good condition of worktops		
Yes	25	78.1
No	7	21.9
Clean dishwashing water		
Yes	25	78.1
No	7	21.9
Good general condition of kitchen utensils used		
Yes	26	81.3
No	6	18.7

Table 4. Hygiene practices for storing and serving meals in the canteens and vicinity of the CHU-MEL and CNHU-HKM (n = 32).

Items of hygiene practices for storing and serving meals	Number	Percentage
Use of the same hand to serve food and take/give money		
Yes	26	81.3
No	6	18.7
All utensils are systematically washed after use on prepared food		
Yes	13	40.6
No	19	59.4
Meals sold in plastic bags		
Yes	21	65.6
No	11	34.4
Spoons sterilised in boiling water before use by customers		
Yes	19	59.4
No	13	40.6
Food kept hot or cold throughout the sale		
Yes	18	56.3
No	14	43.7
Sauces kept in pans, not on the stove		
Yes	17	53.1
No	15	46.9
Cold food stored in coolers containing ice		
Yes	19	59.4
No	13	40.6

Table 5. Rating of hygiene practices of meal vendors in the canteens and vicinity of the CHU-MEL and CNHU-HKM (n = 32).

Rating of hygiene practices	Number	Percentage
Personal hygiene and clothing practices		
Good (8 - 10)	6	18.7
Average (6 - 7)	11	34.4
Poor (0 - 5)	15	46.9
Equipment and environmental hygiene for selling meals		
Good (8 - 10)	22	68.7
Average (6 - 7)	3	9.4
Poor (0 - 5)	7	21.9
Hygiene practices for storing and serving meals		
Good (6 - 7)	6	18.7
Average (4 - 5)	11	34.4
Poor (0 - 3)	15	46.9

3.4. Microbiological and Physicochemical Quality of the Meals

The meals were taken at five locations: the CNHU-HKM canteen, the CNHU-HKM refectory, the vicinity of the CNHU-HKM, meals delivered by external service providers for CNHU-HKM staff and inpatients, the CHU-MEL canteen and the vicinity of the CHU-MEL.

3.4.1. Microbiological Quality of the Meals

The mean concentrations of microorganisms tested in meals were above acceptable standards (Table 6).

3.4.2. Microbiological Quality of the Transport Packaging of Meals

The empty analysis of plastic trays (to take away) commonly used by vendors to serve meals to customers who do not wish to eat on site showed the presence of microorganisms in these packaging. The table presents the results of the microbiological analysis of a sample of trays purchased on the sites of the CNHU-HKM canteen, the CNHU-HKM refectory in Cotonou and the immediate surroundings of the CHU-Mel.

The presence of pathogenic microorganisms is noted in the empty trays both at CNHU-HKM and at CHU-Mel (Table 7).

Table 6. Mean counts of microorganisms in all 40 samples.

Microorganisms tested	Acceptable values	Mean ± standard deviation	Min	Max
TAMF	3.10^5 à 1×10^6	***$1.24 \times 10^6 \pm 6.88 \times 10^5$**	150	9.76×10^6
Total coliforms	-	4918.5 ± 640.1	0	39,600
Fecal coliforms	10 à 100	***3155.2 ± 276.4**	0	18,960
Enterococci/Faecal Streptococci	1 à 100	***2094 ± 445**	0	18,900
Staphylococci	1 à 1000	***4320 ± 542.9**	0	26,010
Coagulase Positive Staphylococci (Presumed Pathogenic)	100 à 1000	66.7 ± 23.4	0	1200
Lactic acid bacteria	100 à 10000	3372.7 ± 542.3	0	27,960
Yeasts/Molds	100 à 1000	***2802 ± 902.2**	0	20,520
Salmonella	Abs/25g	0	0	0
Escherichia coli	10 à 100	***950.2 ± 414**	0	10,200

* Values exceeding recommended standards, TAMF: Total Aerobic Mesophilic Flora.

Table 7. Microbiological analysis of packaging used to transport meals.

Location	TAMF (CFU/100 cm^2)	Enterobacteriaceae/ coliforms	Enterococci
Packing refectory of the CNHU-HKM	52	Not present	Not present
Packing vicinity of the CNHU-HKM	62	*Present	Not present
Packing 1 vicinity of the CHU-MEL	97	*Present	Not present
Packing 2 vicinity of the CHU-MEL	71	*Present	Not present

3.4.3. Physico-Chemical Quality of the Meals

The mean ph of the meals was 4.8 ± 0.7, with extremes ranging from 3.29 to 6.47. The most acidic meal was "Adoyo" (fermented maize juice). The least acidic was "maize paste + vegetables + fish + onion". In addition, 22 out of 40 meals (55.0%) had a ph of more than 4.6 and 18 meals (45%) had a ph of 4.6 or less.

The mean temperature of the meals was 36.7˚C ± 11.7˚C, with extremes ranging from 6.9˚C to 57˚C. The coldest food was "dêguè", and the hottest was "pounded yam + groundnut sauce + crincrin + sheep meat". All the meals sampled were at a temperature from 4˚C to 60˚C called the "danger zone".

4. Discussion

The discussion focuses on three main points: the extent to which we achieved our objectives, the quality and validity of the results and the comparison of our results with other studies.

The study aimed to investigate the sanitary quality of meals served in the canteens and vicinity of the CNHU-HKM and CHU-MEL. The data collected from the targets were processed and analysed. The primary results are as follows: 1) of the meals, 82.93% contained pathogenic microorganisms, 2) the knowledge of food hygiene showed a low level in 65.7% of the vendors, 3) there was a poor level of personal hygiene, clothing and storing and serving meals practices; 100% of the meals had a temperature from 4˚C to 60˚C, known as the "danger zone". Given the findings, we can state that we have achieved our objectives.

Our study focused on the microbiological quality of the meals. Besides, we assessed the hygiene knowledge and practices of the vendors using a questionnaire survey and observation, respectively. Like any other study, our study might contain some biases, such as social desirability biases related to the observer. To prevent a change in the vendors' behaviour, we kept them unaware of our visit. A team of three trained dieticians collected data. A pre-test was run to correct any shortcomings of the tools. The administration and completion of the data collection tools by interviewers reduced bias resulting from misunderstanding. They checked whether the forms were complete and accurate. We ensured the data quality despite the biases inherent in self-report studies. We also encountered constraints related to the availability of vendors and the disinterest noted among some. In our study, we observed the hygiene practices of the meal vendors at the time of the sale. Ideally, we studied hygiene practices covering the preparation of meals. It provided a general picture of some hygiene practices adopted by the vendors.

In our study, microbiological analyses revealed that 82.93% of the meals contained pathogenic microorganisms. This result is close to the one found in the paper by Tevi *et al.* (2015) on the quality of meals for inpatients at CNHU-HKM [11]. Our finding is also close to one of Ahoyo *et al.* regarding the contamination of meals sold on the streetside in Cotonou [7]. In addition, other studies have found lower proportions. A paper by Tya *et al.* conducted in Benin reported a

frequency of 60% on street food [9]. This difference might result from the composition of the biological material. A study by Zbadi *et al.* (2014) in Morocco reported that 40% of meals were contaminated [12]. Itiblitse *et al.* (2016) in Togo found that 33.3% of the meals analysed contained microorganisms [13]. These differences might relate to the vendors' poor personal hygiene and clothing and the different types of microorganisms investigated in these studies. In addition, in the present study, the search for pathogens was not done by food category. In Benin, there is still no regulation on food quality parameters. The Ministerial Regulation of November 2015 of the Grand Duchy of Luxembourg served as a basis for assessing the microbiological criteria applicable to foodstuffs [14].

The assessment of the knowledge of food hygiene rules showed a low level in 65.7% of the vendors. No vendor could determine the ideal temperature for cooking or storing food. Besides, 75% said that the best method of defrosting meat was to let it cool to room temperature. These results differ from those of Sharif *et al.* who found that 83.83% of the food handlers had excellent knowledge of risky food categories, foodborne diseases, food storage temperatures, and sources of food contamination [6]. These differences might reflect that most of the vendors in our study claimed not to have received food hygiene training. In addition, Sharif *et al.* focused only on food handlers in military hospitals [6].

In our study, 46.9% of the vendors had poor personal and clothing hygiene. Indeed, 75% of the vendors did not wear a smock or apron. Our results are similar to those of Tya *et al.* These authors reported that 77.65% of the vendors did not wear a gown or apron [9]. Furthermore, 59.4% did not have their hair protected, and 62.5% washed their hands with plain water. On the other hand, one study showed that the percentage scores for knowledge, attitude and practice among food handlers in military hospitals were 84.82, 88.88 and 89.43, respectively [6]. These differences might reflect the type of meals sold in this study and the context.

Most of the sales sites were clean, with no insects or toilets in the immediate environment. Most of the kitchen and vending equipment complied with hygiene recommendations. Indeed, 21.9% of the worktops used were in good condition, and 34.4% of the sales sites (around the health centres) were near sewers and wastewater pipes. These results differ from those of Tya *et al.*, who reported that 65% of the working boards used were in poor condition (dirty and cracked), and 53.95% of the vendors and hawkers sell in unhygienic locations near gutters, garbage bins, rubbish at room temperature and the mercy of dust and flies [9]. In addition, none of the sales sites in our study was next to a toilet. This result differs from the paper by Kouamé *et al.*, which showed that 25% of the sales sites were within 15 km of latrines [15]. These differences may reflect that our study sites were directly related to the health system.

In our study, 43.7% of the vendors did not have a system for maintaining the meal temperature during the sale. This result is similar to the one found in the study of Tya *et al.* [9]. These authors mentioned that 97% of the vendors used

the same hand to serve the meal and to take or give money. In our study, we found 81.3%. We note that 65.6% of sales were in plastic bags. In 2017, Kouakou *et al.* reported a similar result on the knowledge, attitudes and practices of food vendors in schools in Bouaké on food hygiene [16].

Study limitation:

Our study was interested in the microbiological quality of the meals as well as the sellers of the latter. The knowledge and the level of hygiene of the sellers were evaluated respectively thanks to a survey by questionnaire and an observation.

This study, like any study, could be subject to certain biases, in particular social desirability related to the presence of the observer. In order to avoid any change in behavior among the sellers, they were not informed of our arrival. The data was collected by a team of three (03) nutritionist dietitians. They were trained and a pre-test was done to correct the shortcomings of the tools. The administration and completion of the data collection tools by the interviewers allowed us to reduce the biases that could arise from a misunderstanding of the latter. They were also supervised to verify the completeness and accuracy of the sheets. It should be noted that the measures taken have made it possible to guarantee the quality of the data recorded despite the biases specific to studies that use declarative data. We also encountered certain constraints related to the: availability of sellers at the time of the survey and the disinterest noted among some.

5. Conclusion

Our study on the sanitary quality of the meals served in the canteens and vicinity of the CHU-MEL and CNHU-HKM reveals the following essential elements: most of the meals contained pathogenic microorganisms; the level of knowledge of vendors in food hygiene is low; nearly half of the vendors surveyed had poor personal hygiene and clothing practices; hygiene practices observed during the storage of meals are poor. The meals sold at the various sites investigated could present a health risk for the consumer.

Ethics Approval and Consent to Participate

The study was conducted in accordance with the Declaration of Helsinki, and approved by the internal institutional ethical review board of the Regional Institute of Public Health. Informed consent was obtained from all subjects involved in the study.

Data Availability Statement

Data are available from the corresponding author upon request.

Author Contributions

M.P. contributed to the conceptualisation, methodology, validation, formal

analysis, data curation, and writing, revising and editing of the original draft. C.C.D. helped with the conceptualisation, methodology, investigation and revising of the original draft. Y.B.O. attended to the conceptualisation, methodology, investigation and revision of the original draft. C.A. and C.S.J. participated in the conceptualisation and revision of the original draft.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

[1] Organisation des Nations Unies pour l'Alimentation et l'Agriculture, Commission de l'Union Africaine (2019) Vue d'ensemble régionale de la sécurité alimentaire et la nutrition en Afrique 2019: Limiter les dommages causés par les ralentissements et les fléchissements économiques à la sécurité alimentaire en Afrique. FAO.

[2] Organisation de Nations Unies pour l'Alimentation et l'Agriculture (1996) Rapport du Sommet mondial de l'alimentation. FAO.

[3] Bailly, J.-D., Brugere, H. and Chardon, H. (2012) Microorganisme et parasites des viands: Les connaitre pour les maitriser de l'élévateur au consommateur. Centre d'Information des Viandes, Paris.

[4] Ministère de la Santé (Bénin) (2017) Annuaire des Statistiques Sanitaires 2016. MS.

[5] Bendech, M.A. (2013) Alimentation de rue à Bamako au Mali: Problématique et approches d'intervention. *Mali Santé Publique*, **3**, 116-118.

[6] Sharif, L., Obaidat, M.M. and Al-Dalalah, M.-R. (2013) Food Hygiene Knowledge, Attitudes and Practices of the Food Handlers in the Military Hospitals. *Food Science & Nutrition*, **4**, 245-251. https://doi.org/10.4236/fns.2013.43033

[7] Ahoyo, T.A., Ahissou, H., Kounon, F., Aminou, T. and Dramane, K. (2010) Etude de la qualité bactériologique des aliments vendus sur le campus de l'Université d'Abomey Calavi au Bénin. *International Journal of Biological and Chemical Sciences*, **4**, 1083-1092. https://doi.org/10.4314/ijbcs.v4i4.63045

[8] Institut National de la Statistique et de l'Analyse Économique. (2014) Rapport Final—Enquête par grappes à indicateurs multiples (MICS). INSAE.

[9] Tya, T.A. (2019) Alimentation de rue à Cotonou: Pratiques d'hygiène des vendeurs et qualité microbiologique des repas. Mémoire: Licence en Nutrition et Diététique. Faculté des Sciences de la Santé.

[10] Varkevisser, C.M., Pathmanathan, I., Brownlee, A.T., Development WHOP on HSR and IDR Centre (Canada) (1993) Elaboration et mise en oeuvre de programmes de recherche sur les systèmes de santé. CRDI.

[11] Tevi, M.L. (2015) Etude de la qualité de l'alimentation des personnes Hospitalisées au CNHU/HKM de Cotonou-Bénin. Mémoire: Licence en Nutrition et Diététique. Faculté des Sciences de la Santé.

[12] Zbadi, L., Lalami, A.E.O, Baroudi, A., Marsou, Z. and Benbrahim, K.F. (2014) Microbiological Quality Assessment of Hospital Food in a Public Hospital in Fez (Morocco). *Journal of Advanced Biotechnology and Experimental Therapeutics*, **4**, 286-296. https://doi.org/10.24297/jbt.v4i1.1629

[13] Itiblitse, R.K.B. (2016) Etude de la qualité nutritionnelle des repas servis dans les cantines scolaires de la préfecture de Zio au Togo. Mémoire: Licence en Nutrition et Diététique. Faculté des Sciences de la Santé.

[14] Ministère de la santé du Grand-Duché de Luxembourg (2018) Critères microbiologiques applicables aux denrées Alimentaires—Lignes directrices pour l'interprétation. Ministère de la santé du Grand-Duché de Luxembourg.

[15] Kouame, K.A., Bouatenin, K.M.J.-P., Coulibaly, W.H., Djue, Y.F. and Dje, K.M. (2020) Evaluation des connaissances, des attitudes et des pratiques en matiere d'hygiene et de securite alimentaire des vendeurs de la viande de poulets braisee en Cote d'Ivoire. *Agronomie Africaine*, **32**, 413-421.

[16] Kouakou, K. (2017) Connaissances, attitudes et pratiques des vendeurs d'aliments dans les établissements scolaires de Bouaké en hygiène alimentaire. Thèse de Médecine. Université Alassane Ouattara.

Abbreviations

CHU-MEL: Lagoon Mother and Child University Hospital Centre (Centre Hospitalier et Universitaire de la Mère et de l'Enfant Lagune); CNHU-HKM: National Hospital and University Centre Hubert Koutoukou Maga (Centre National Hospitalier Universitaire Hubert Koutougou MAGA); FSS: Faculty of Health Sciences (Faculté des Sciences de la Santé); WHO: World Health Organization.