



Evaluation of bacterial flora and hygienic quality in school canteen premises

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Abstract

The hygienic conditions and quality of school canteen premises where meals are prepared for students were evaluated by examining and counting total mesophilic aerobic bacteria, total coliforms, and fecal coliforms. A total of 90 samples were collected from establishment N°1, 42 from establishment N°2, and 48 from establishment N°3. The results of the bacterial flora detected were collected and analyzed. The results show that fecal coliforms were not found in any of the sites in all three establishments. Total mesophilic aerobic bacteria and total coliforms were present, but their concentrations varied depending on the sites in each establishment. The maximum value of 2.50E+02 (cfu) of total mesophilic aerobic bacteria was recorded in the toilets at establishment N°3, and a high value of about 1.08E+02 (cfu) of total coliforms was recorded in the students' toilets at establishment N°1. The abundance of bacterial flora identified is highly varied and represents a potential source of foodborne illness for the students. Moreover, better hygiene practices are necessary to maintain adequate hygiene quality and minimize the risk of foodborne illness.

Keywords: Hygiene, health, quality, coliforms, food poisoning.

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1. Introduction

The quality and safety of food and dishes, in general, are fundamental parameters for the health and safety of consumers in collective catering, especially in school canteens. In the case of school canteens, large quantities of food are prepared and served to students who are considered high-risk consumers [1, 2]. Many errors can occur throughout the meal preparation process, from the reception of raw materials to the consumption of dishes, including handling, cooking, preservation, and control of reservation parameters, among others [2, 3]. Foodstuffs from the farm, non-compliant hygiene and prevention of sanitary risks, and dish handling processes for students in school canteens can be the cause of several microbiological contaminations, including pathogenic flora, posing a danger to the health of children in the canteens. This microbial flora constitutes a true source of foodborne illnesses that remain an important public health problem. In 2005, WHO declared that 30% of the population is affected each year by a foodborne illness [4]. This assertion is confirmed by studies conducted by [5], for whom 20% of foodborne illnesses in the United States are due to food handling. In France, in 2010, 92 confirmed cases

of salmonella food poisoning caused 1,066 cases of illness and 145 hospitalizations [6]. The dishes served to students can be contaminated by different types of pathogenic or non-pathogenic germs, depending on their origin. The food contamination flora includes pathogenic enterobacteria such as total and fecal coliforms that indicate possible human contamination [7, 8]. and Total Mesophilic Aerobic Flora capable of reproducing in air at average temperatures of 30°C to 40°C. Their presence indicates a lack of hygiene.

Our study aimed to qualitatively and quantitatively evaluate the existing microbiological load, particularly the total mesophilic aerobic flora, total coliforms, and fecal coliforms, in the premises of school canteens in three establishments. Practices (GMP)" in force on the date of publication of these rules [9].

2. Materials and Methods

2.1 Identification and selection of culture sites

The description of the location of the sampling sites and the number of samples taken in the context of our study is presented in table 1.

2.2 Preparation and inoculation of cultures

Inoculations are carried out on solid culture media. 1ml of the suitable dilution is deposited onto the petri dish. 20ml of previously sterilized agar medium at 120°C is then aseptically poured after cooling to 45°C. The dish is then homogenized and incubated in an oven at a temperature of 30°C, depending on the nature of the group of microorganisms to be studied. Each inoculation is carried out in triplicate. Only plates with a colony count between 30 and 300 are selected for enumeration.

2.3 Analysis of hygienic and sanitary interest flora

2.3.1 Enumeration of total aerobic mesophilic flora

This group provides information on the overall bacterial load of the product being analyzed. PCA medium accurately reports individuals of the total population in the sample being studied. Enumeration of the total aerobic mesophilic flora was carried out on Count Agar (PCA) plates by surface inoculation of 0.1ml of dilutions ranging from 10⁻¹ to 10⁻⁷. Enumeration is carried out after 48 hours of incubation at 30°C.

2.3.2 Enumeration of total coliforms

These are bacteria commonly found in the human or animal digestive tract. They ferment lactose with a decrease in pH that is indicated by a color change. They are also considered as indicators of the hygienic quality of the product being analyzed. The culture medium used is Desoxycholate Lactose Agar (DCL). Enumeration is carried out after 48 hours of incubation at a temperature of 37°C.

2.3.3 Enumeration of fecal coliforms

The culture medium used is Desoxycholate Lactose Agar (DCL), and enumeration is carried out after 48 hours of incubation at a temperature of 44.5°C.

3. Results and discussion

3.1 Results

3.1.1 Total aerobic mesophilic flora abundance

The abundance level of total aerobic mesophilic flora at Establishment 1 varies between a maximum value of 1.80E+02 recorded in the staff toilets and a minimum value of 2.00E+01 recorded in the locker room (Figure N° 1). The abundance level of total aerobic mesophilic flora, at Establishment n°2, varies between a maximum value of 2.00E+02 recorded in the kitchen premises and a minimum value of 5.90E+01 recorded on the workbenches (Figure N° 2). The abundance rate of total aerobic mesophilic flora at establishment n°3 varies between a maximum value of 2.50E+02 recorded in the toilets and a minimum value of 0.00E+00 recorded in the cold room (Figure N° 3).

3.1.2 Abundance of total coliforms

Enumeration of total coliforms at establishment n°1 revealed values ranging from 1.08E+02 recorded in the students' toilets to a minimum value of 1.00E+00 recorded in the locker room (Figure N° 4). The enumeration of total coliforms at establishment 2 recorded values ranging from 7.40E+01 in the kitchen to a minimum value of 1.00E+00 in the cafeteria (Figure N° 5). The enumeration of total coliforms at establishment n°3 allowed recording of values ranging from 9.00E+01 recorded in the toilets to a minimum value of 0.00E+00 recorded at the cold room level (Figure N° 6).

3.1.3 Abundance of fecal coliforms

The evaluation of faecal coliforms, the results observed confirm the absence of this type of bacteria at the level of the premises of the three establishments (Figure N° 7, 8 and 9).

3.2 Discussions

It is recommended to discuss problem of hygiene in school canteen premises and to present the risks associated with foodborne illnesses due to the presence of microorganisms. However, we have selected a number of microorganisms that are likely to be found in the premises and are known for their hygienic interest and toxic power, capable of affecting the sanitary quality of the food consumed and therefore causing health damage to students. Foodborne illnesses represent a considerable number of deaths worldwide in developing countries [10, 11]. In Morocco, between 2000 and 2004, 7,118 cases of foodborne illnesses were reported, of which more than 86% were of bacterial origin [12, 13]. The results of the samples taken on the sites showed very high levels of total aerobic mesophilic flora and total coliforms in the toilets of establishment n°3 with a value of approximately (2.50E+02 cfu of TAMF) and in the staff toilets (1.75E+02 cfu of TAMF), and those of the students with a value of (1.69E+02 cfu of TAMF) and (1.08E+02 cfu of total coliforms) recorded in establishments n°1 and n°3 and in the kitchen of establishment n°1. The results show that cleaning and disinfection of the premises, particularly in the toilets for students and staff, do not respect hygiene programs and procedures, and this bacterial load exceeds international standards [14, 15]. This kind of bacteria is a real source of contamination and infections for canteen students and staff [16]. Low levels of TAMF were recorded in the changing room of establishment n°1 (2.20E+01 cfu) and on the bench of establishment n°2 (5.09E+01 cfu). We recorded a total absence of this type of germ in the cold room of establishment n°3. The recorded results for total coliforms were relatively low in the changing room and the refectory, and a total absence of total coliforms in the cold room. These results were explained by the low attendance of students and staff, which does not promote the growth and multiplication of this type of bacteria. The total coliforms searched belong to the group of Citrobacter, Enterobacter, Escherichia, Klebsiella and Serratia, and generally all species are non-pathogenic, except for certain strains of Escherichia coli (E. coli) and rare opportunistic pathogenic bacteria [17, 18].

Table 1: Location of sampling sites and number of cultures to be taken

| Establishments | Premises | Number of sites per premises | Number of cultures per site | | |
|------------------|-----------------|---------------------------------|-----------------------------|--------------------|--------------------|
| | | | FMAT | Total Coliforms | Fecal Coliforms |
| Etb no. 1 | Student toilets | 6 sites | 18 cultures | 18 cultures | 18 cultures |
| | Staff toilets | 3 sites | 9 cultures | 9 cultures | 9 cultures |
| | Kitchen Storage | 7 sites | 21 cultures | 21 cultures | 21 cultures |
| | Area Student | 3 sites | 9 cultures | 9 cultures | 9 cultures |
| | Cafeteria | 5 sites | 15 cultures | 15 cultures | 15 cultures |
| | Student locker | 1 site | 3 cultures | 3 cultures | 3 cultures |
| | Room Cold | 5 sites | 15 cultures | 15 cultures | 15 cultures |
| Etb no. 2 | Room Kitchen | 5 sites | 15 cultures | 15 cultures | 15 cultures |
| | Storage area | 2 sites | 6 cultures | 6 cultures | 6 cultures |
| | Cafeteria | 3 sites | 9 cultures | 9 cultures | 9 cultures |
| | Workbench | 2 sites | 6 cultures | 6 cultures | 6 cultures |
| | Cold room | 2 sites | 6 cultures | 6 cultures | 6 cultures |
| Etb no. 3 | Student toilets | 3 sites | 9 cultures | 9 cultures | 9 cultures |
| | Kitchen Storage | 5 sites | 15 cultures | 15 cultures | 15 cultures |
| | Area Student | 2 sites | 6 cultures | 6 cultures | 6 cultures |
| | Cafeteria | 4 sites | 12 cultures | 12 cultures | 12 cultures |
| | Cold room | 2 sites | 6 cultures | 6 cultures | 6 cultures |

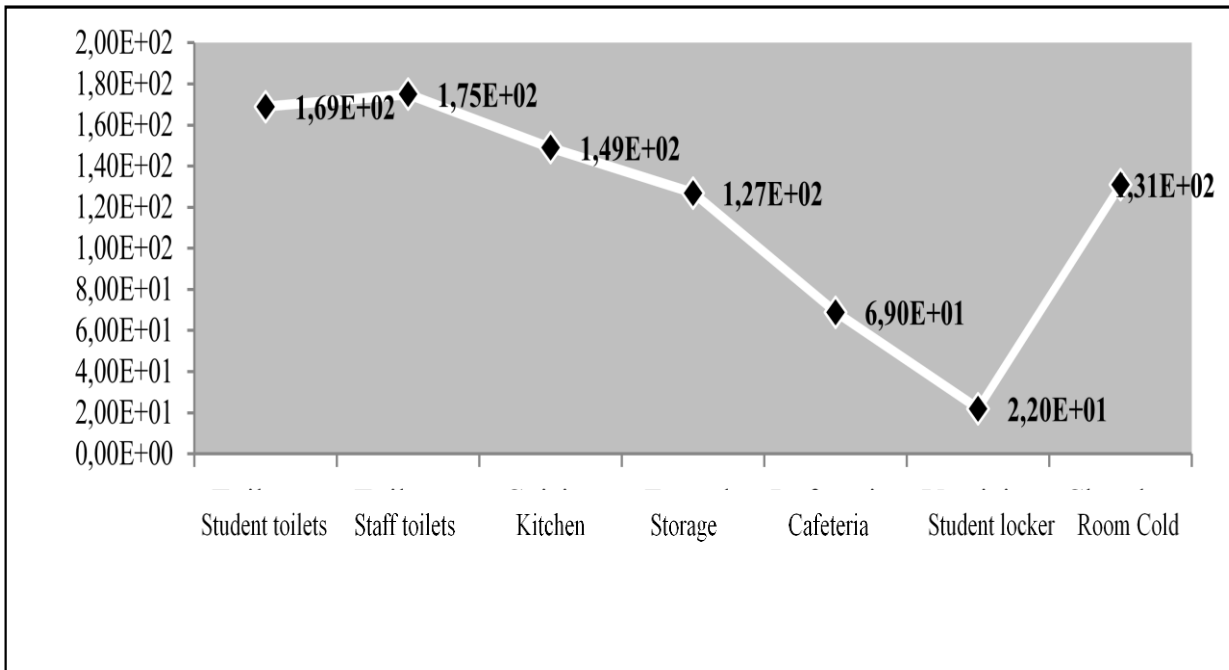


Figure 1: Enumeration of Total Aerobic Mesophilic Flora (CFU) at Establishment No. 1

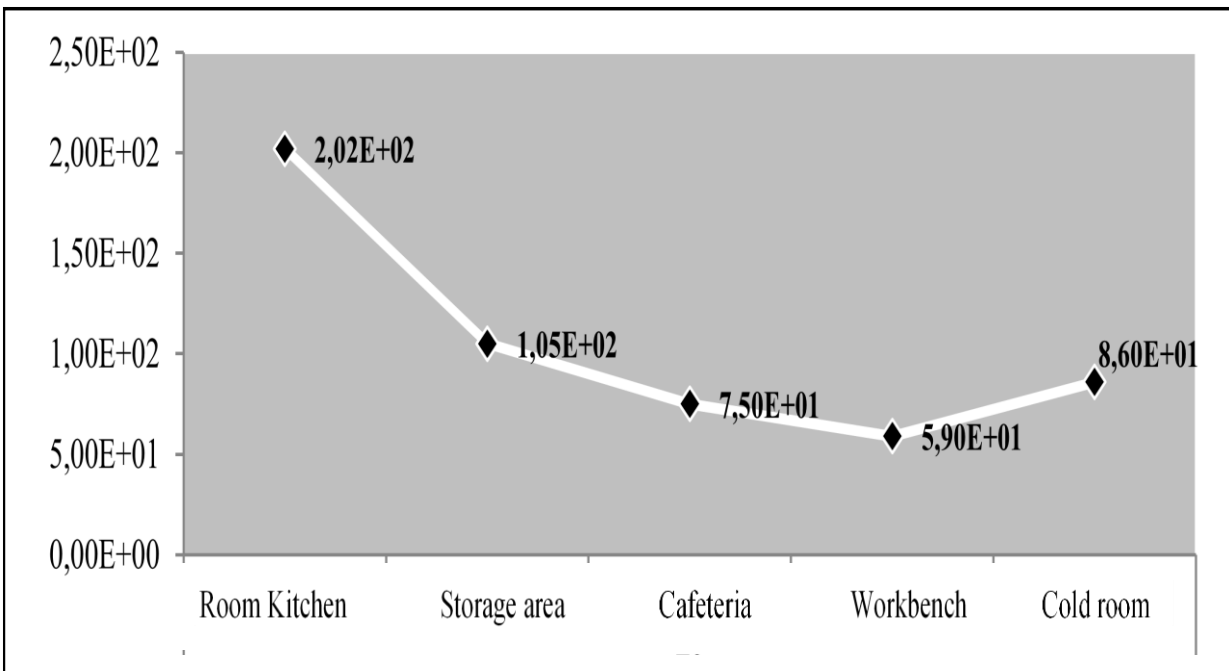


Figure 2: Enumeration of Total Aerobic Mesophilic Flora (CFU) at Establishment No. 2

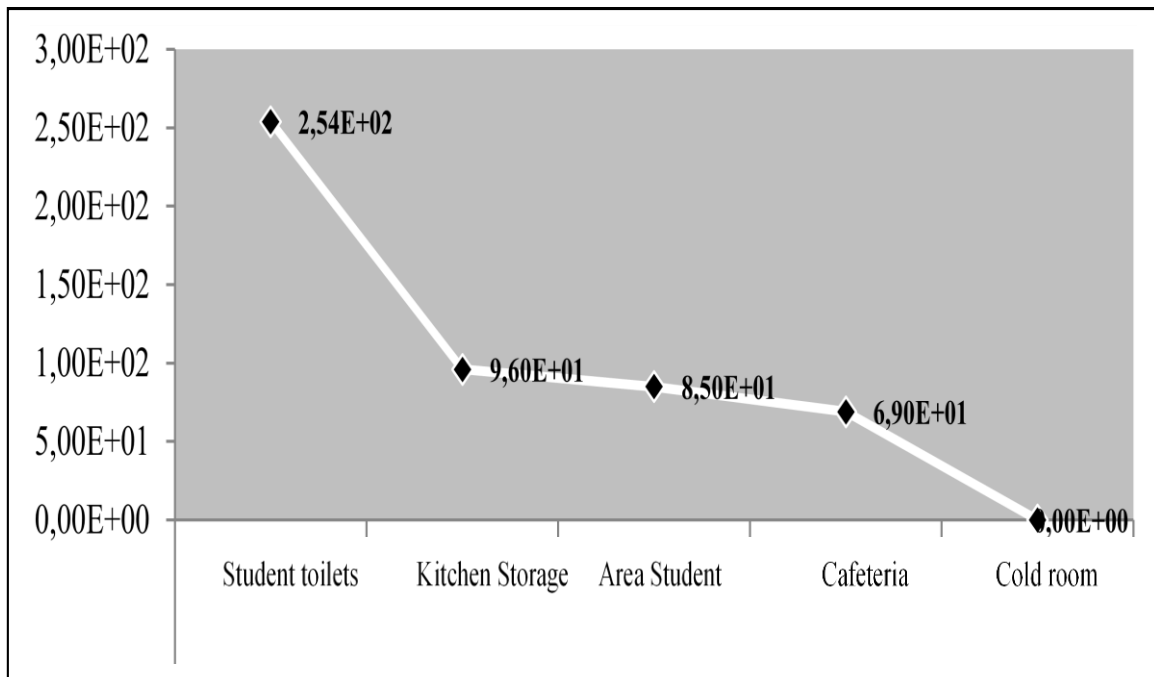


Figure 3: Enumeration of Total Aerobic Mesophilic Flora (CFU) at Establishment No. 3

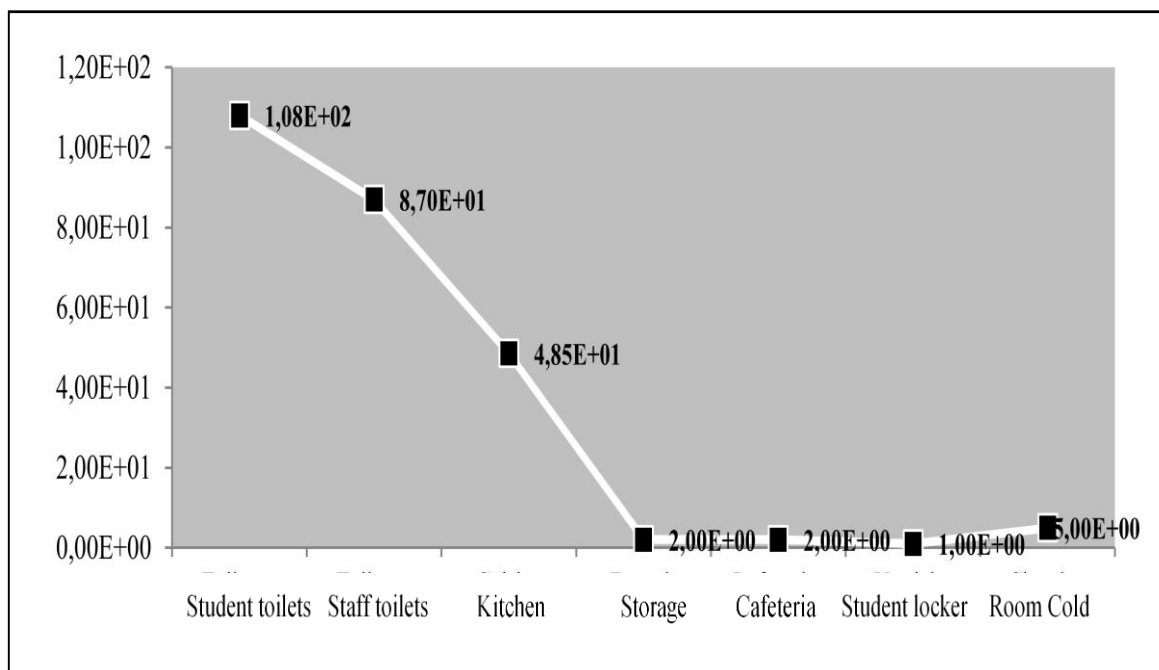


Figure 4: Enumeration of TC (CFU) at establishment No. 1

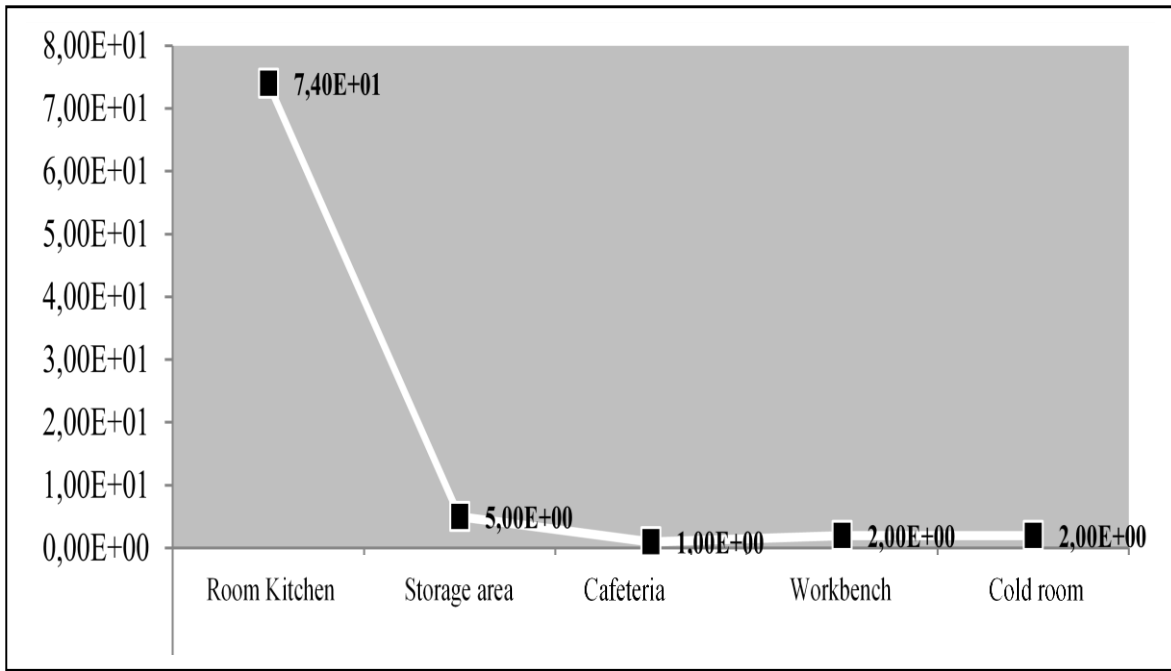


Figure 5: Enumeration of TC (cfu) at establishment No. 2

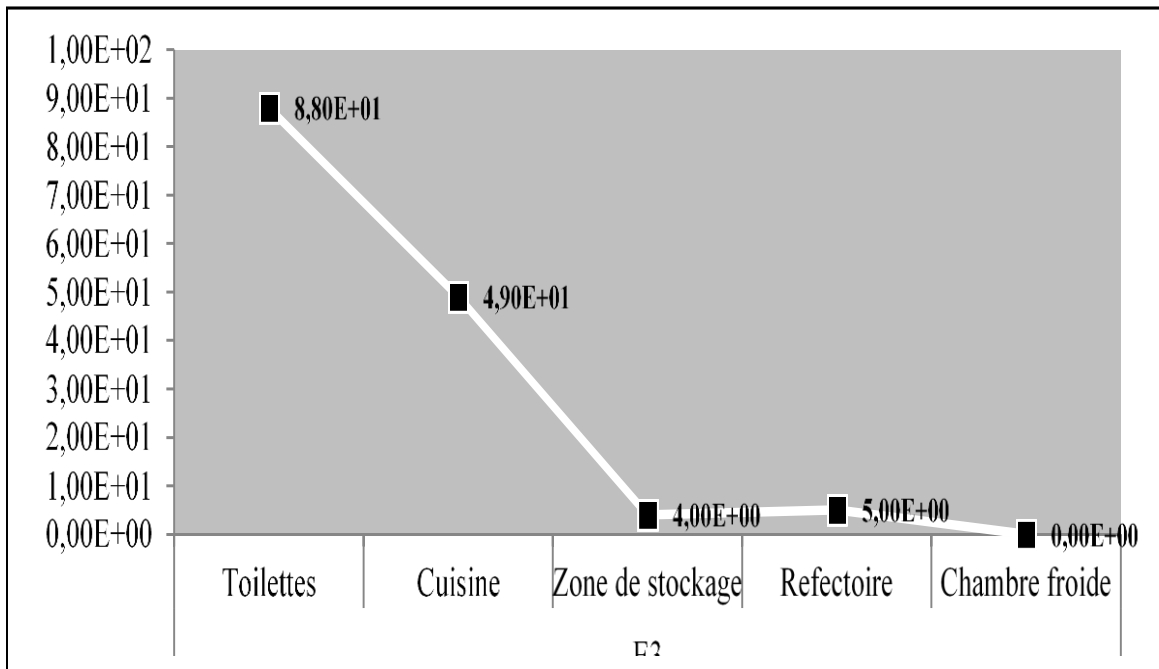


Figure 6: Enumeration of TC (CFU) at establishment No. 3

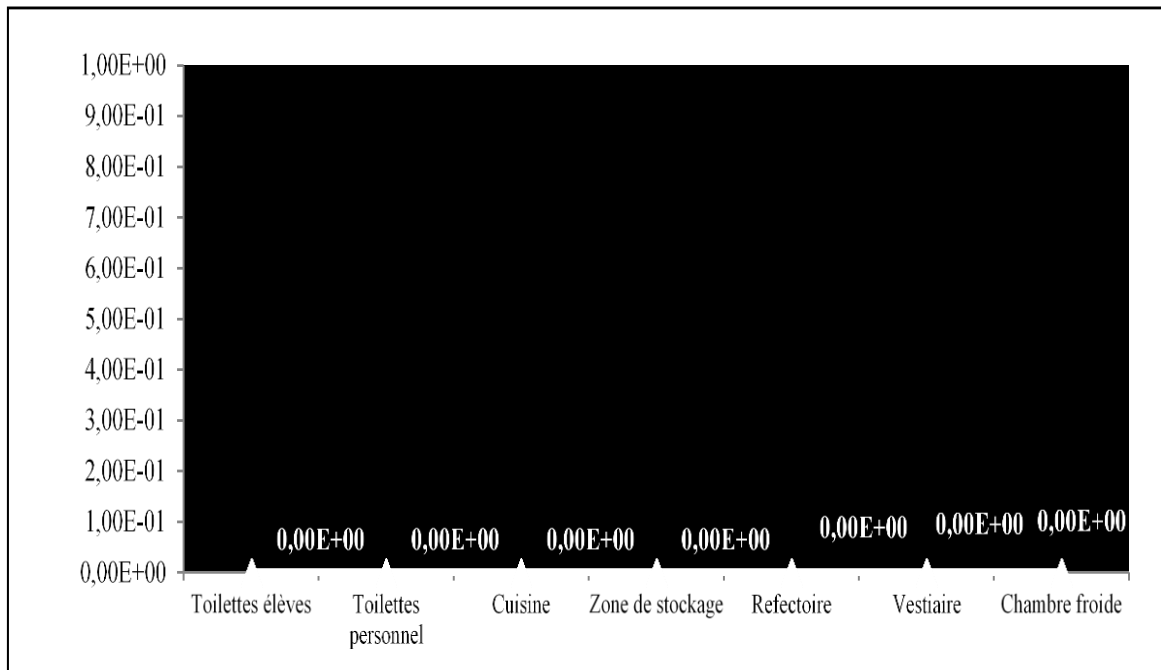


Figure 7: Enumeration of CFU at Establishment No. 1

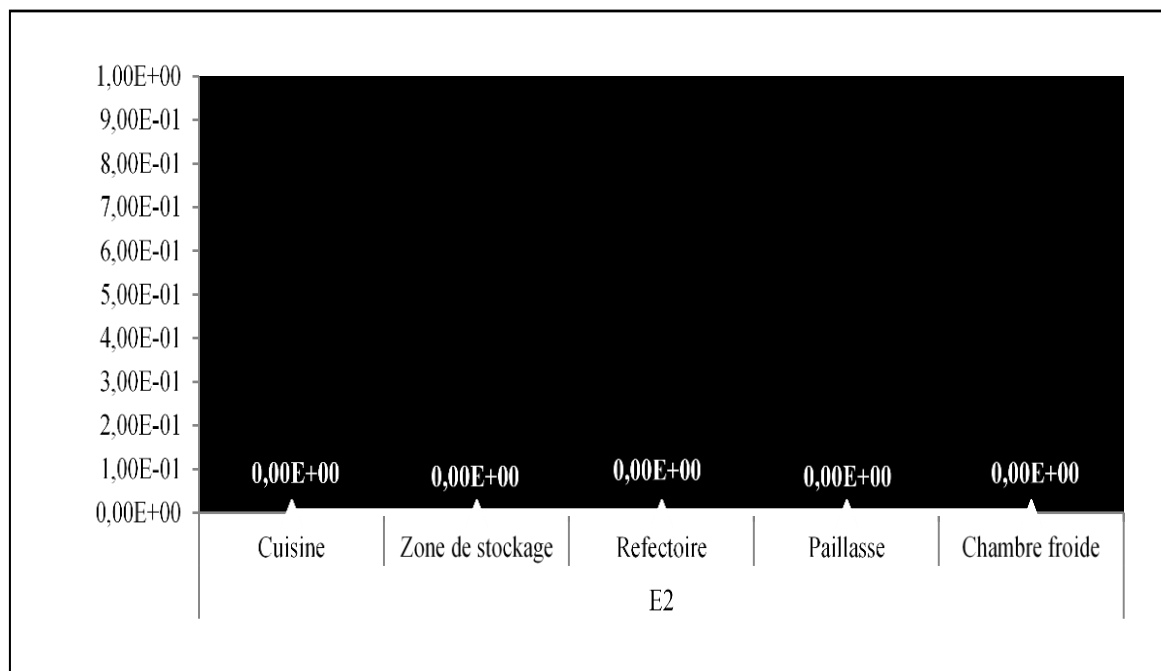


Figure 8: Enumeration of CFU at Establishment No 2

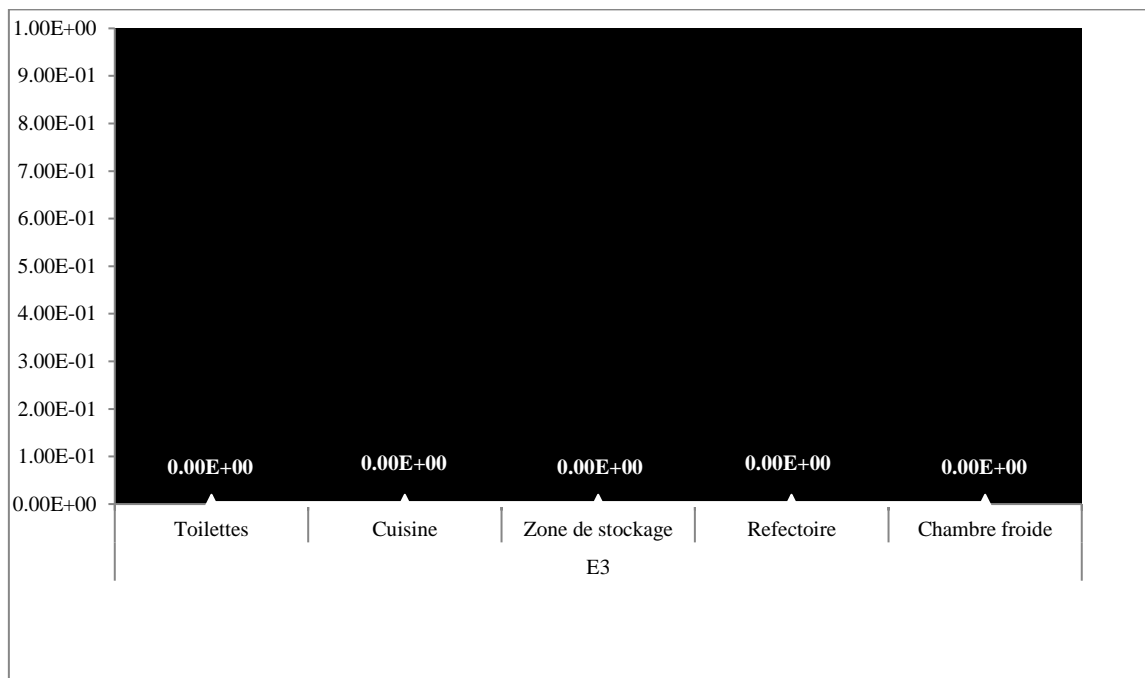


Figure 9: Enumeration of CFU at Establishment No. 3

They are a group of bacteria that are frequently found in the environment, as well as in the intestines of mammals, including humans, which is why they are present on the surfaces of canteen premises. They are often found on poorly cleaned surfaces or equipment, which can contaminate food and the health of students and staff. [19]. They generally do not cause any disease, but their presence indicates that a source of supply may be contaminated [20, 21]. Regarding fecal coliforms, we noticed a total absence of this type of bacteria in the premises of the three establishments. This means the absence of a fecal contamination source for the health of students and staff. The degree of contamination is generally estimated by the enumeration of fecal contamination indicators, the main ones being total coliforms, fecal or thermotolerant coliforms [22], *Escherichia coli* [23, 24]. The presence of fecal coliforms is a reliable indicator of fecal contamination. The source of contamination of surfaces, work plans, utensils, as well as food could be animal excreta, sewage, sludge, and also the lack of hand hygiene after each visit to the toilet by the handler, which constitutes the main source of infection [25, 26]. In humans, *Pseudomonas aeruginosa* is found in the nasal mucosa flora and as a contamination flora on the skin. It can also be found in the intestinal flora [27, 28]. The contamination of kitchen equipment and objects is done through contact with contaminated water, which allows it to survive and multiply in very poor environments and also on moist surfaces [29, 30]. The colonization of surfaces by *Pseudomonas aeruginosa* is related to its ability to form biofilms, communities of

microorganisms fixed to surfaces. It is a model microorganism for biofilm studies, as it can colonize tissues (lungs) or abiotic surfaces, such as water pipes [31].

4. Conclusions

The evaluation of the bacterial load, specifically the total aerobic mesophilic flora, total coliforms, and fecal coliforms, in the 17 premises of school canteens in three institutions has highlighted the degree of adherence to good hygiene and cleaning practices in these locations. The need to control hygiene problems involves taking into account the risk factors of contamination and infections by pathogenic microorganisms. Hygiene in these premises is a normative dimension that must comply with international norms and standards to prevent food poisoning of students in school canteens. The food offered to children in school canteens could be considered, a priori, as a probable source of health risks for children, which should be further investigated through additional research.

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