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PESTICIDE EXPOSURE OF BREAD SELLERS AND MICROBIAL SAFETY OF BREAD SOLD IN BAMENDA, CAMEROON

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Abstract:

Safety of bread sold in Bamenda municipality has been always problematic because of the poor hygienic practices of sellers. This study aimed at assessing the microbial load of bread sold in Bamenda municipality and pesticides exposure of sellers. Ninety samples of bread were randomly collected from standard bakeries, local bakeries and roadside bread vendors; they were analyzed for total viable count, coliforms and yeast and molds (fungi) using the routine analytical method described by the American Public Health Association. The exposure of some bread vendors to pesticide shops was evaluated using questionnaires. As results, the total viable count ranged from 3.09 x 10^3 to 2.57 x 10^5cfu/g, coliform count ranged from 2.27 x 10^1 to 1.18 x 10^3cfu/g, while yeast and molds count ranged from 1.32 x 10^3 to 2.67 x 10^6cfu/g. Bread from roadside vendors was the most contaminated with molds, while the standard bread was the most contaminated with bacteria and coliforms. The local bread was the least contaminated. Sixteen bread sellers counted around pesticides shops presented ailments (Headache, eye irritation, etc.). Bread sold in Bamenda is contaminated by microbes and some vendors are exposed to pesticides.

Key words: *bread, bacteria, coliform, molds, pesticides*

1. Introduction

Bakery products are the most important staple foods in most countries and cultures. These bakery products and cereals are a valuable source of nutrients in our diets **[1]**.

Bread is one of such bakery products, well priced for its taste, aroma, and texture. It is a staple food prepared by baking dough of flour and water [2].

Bread is universally accepted as a very convenient form of food that is important to all populations. It is a good source of nutrients such as macronutrients (carbohydrates, proteins, and fats) and micronutrients (minerals and vitamins) that are essential for human health [3].

The basic criteria for the quality of bread and other bakery products are safe with optimum sensory properties. Bread is one of the most ancient of human foods and it is produced with the help of microorganisms [4].

It is often spoiled within 48 hours of production, causing significant loss to producers and consumers. By its nature, bread is liable to spoilage at several stages of production to just before consumption. Bread spoilage is a metabolic process that causes bread to be undesirable for human

consumption due to changes in sensory characteristics. Contaminated bread may be physically safe, but may cause illness because of the presence of pathogens or toxins while changes in texture, smell, or appearance cause them to be rejected [5]. Bread spoilage can result from physical, chemical or microbial activity.

However, Hocking argues that bread spoilage due to microbial activity, in particular mold growth is of major economic importance. [6]

Microbes including bacteria, mold, yeast and others grow on metabolizing bread to cause severe damage [7].

Microbial species can be controlled by improving sanitary conditions at bakeries and sale points, as well as incorporating different acids and their salts in bread formulations provide the bread protection against rapid growth of mold and bacteria [8].

Contamination is the presence of something harmful in food or drink that creates a risk of illness, injury or discomfort. Bread can be contaminated by chemicals, dirt, pests, pets, waste food or small objects, microbes. Chemicals are used in food production, from the farm where they are grown and during processing or manufacturing. Dirt or small objects can find their way in to food via transportation of the food, handling and in the home [9].

Bread spoilage causes a reduction in the quality of bread. This reduction in the quality is identified by deterioration in the physical, chemical and or sensory properties. Contaminated bread causes poisoning which symptoms are vomiting, diarrhea, nausea and headache [10].

A number of molds produce toxin (mycotoxins) that stay in the food as part of the production process. Some chemicals can even find their way in to food (bread) accidentally. Growth of microorganisms (viruses, bacteria, parasites and molds) causes food spoilage or possible poisoning [7].

At time selling points are closer to agrochemical shops exposing the products and the sellers since various pesticides have high vapor pressure [11].

It has been reported that, the sales conditions by sellers or dealers in pesticides are not adequate to minimize intoxication or poisoning in Bamenda [10].

Pesticides are handled carelessly with bare hands which can lead to poisoning through the mouth (when hands are used for eating). Retailing and mixing are done with no personal protective equipment and outside where bread vendors stand. Rooms are not properly ventilated, chemicals may be inhaled and this can cause building effects leading to long term chronic diseases for sellers and for people around. .

The aim of this study was to assess the microbiological load of bread produced and distributed in Bamenda municipality, and to estimate, according to the proximity of selling site to pesticides shops, the exposure of sellers to pesticides.

2. Materials and method

2.1 Sample collection

A total of ninety bread samples, three from each sampling site were collected from ten standard bakeries, ten local bakeries and ten roadside vendors in the Bamenda city area. The maximum number of samples collected in each session was ten for duration of three months (one sampling per month).

The bread samples were each put in a sterile stomacher bag, labeled with the names of the bakeries from which they were collected and placed in an airtight cooler (flask) to prevent cross contamination and contamination in the cause of transportation in view of stopping microorganism's multiplications. Immediately after collection, the bread samples were transported to the microbiology unit of the food technology

and post-harvest laboratory (FTPHL) of the institute of agricultural research for development (IRAD) Bambui for microbiological analysis.

2.2 Preparation of sample

Upon arrival at the laboratory, the bread samples were removed from the cooler (flask) but still kept in the stomacher bags and stored in a refrigerator for one night. Ten grams of each bread sample was cut with knives (Stainless Steel) and weighed on a top loader electric balance (METTLER AE-200), and placed in sterile stomacher-blending bags labelled with codes. The knives used had been swabbed with 70% alcohol. Ninety milliliter (90ml) of 0.1% peptone solution (diluents) was added to the bread sample in each stomacher-blending bag and blended for fifteen (15) minutes in a stomacher (Stomacher Model 400 Circulator®, Seward-England) rotating at three hundred and sixty revolutions per minute.

2.3 Microbiological analysis

Microbiological analyses were carried out following routine analytical method described by the American Public Health Association [12].

2.3.1 Preparation and plating of samples

Peptone was supplied in powder form. 0.1 % of peptone solution was prepared and dispensed in 90 mL and 9 mL amounts respectively, in to universal dilution bottles and sterilized in an autoclave (Dixon's Surgical Instrument® Ltd U.K), for 15 minutes at a temperature of 121^0C.

The work bench was swabbed with 70% ethyl alcohol and Bunsen burners were lit to provide a sterile working environment. Small glassware was autoclaved (Dixon Surgical Instrument Ltd U.K), at a temperature of 121^0C for 20 minutes before use. Previously washed petri dishes were sterilized by heating in a vacuum oven at 120^0C for three hours and allowed to cool still wrapped or in their canisters to be removed just before use. Without opening the Petri dishes, they were labelled externally using a permanent marker, with the sample code number, dilution factor and the plating date. The 0.1% peptone solution already distributed into universal dilution bottles were arranged according to the number of dilutions to be made.

2.3.2 Preparation of serial dilution

Ten folds dilutions of bread samples were made by aseptically transferring 1 mL of the blended bread sample in to 9 mL of the sterile 0.1% peptone solution in universal dilution bottles to give a 10^{-2} dilution [13]. Further ten folds dilutions of up to 10^{-4} were made by transferring 1 mL of successive dilutions into 9 mL of 0.1% peptone solution. All work was done close to the flame of a Bunsen burner to avoid eventual contamination.

2.3.3 Enumeration of total viable bacteria

The enumeration of total viable bacteria was done using Nutrient Agar (NA). This culture medium was prepared and sterilized in an autoclave (Dixon's Surgical Instrument Ltd. U.K.) according to the manufacturer's instruction. It was prevented from solidifying by placing it in a water bath (HAAKE WB 20) at a temperature of 45^0C.

1 mL of the 10^{-3} and10^{-4} dilutions of each sample was aseptically plated in sterile Petri dishes initially labeled with the sample code, culture medium, and plating date. The plating was done using the pour plate technique. About 20 mL of NA was added, allowed to cool and solidify before incubating at 37^0C for two days. The Petri dishes were placed up-side-down in an incubator (HEARSON®) to enable the viable bacteria to grow to the bottom of the Petri dish to ease counting since the viable bacteria are aerobic. At the end of the second day, the total colonies of viable bacteria were counted.

2.3.4 Enumeration of coliforms

The enumeration of coliforms was done using MacConkey Agar (MCA). This culture medium was prepared and sterilized in an autoclave (Dixon's Surgical Instrument Ltd. U.K.) according to the manufacturer's instruction. It was prevented from solidifying by placing it in a water bath (HAAKE WB® 20) at a temperature of 45^0C. 1 mL of the 10^{-1} and 10^{-2} dilutions of each sample was aseptically plated in sterile Petri dishes initially labelled with the sample code, culture medium, and plating date. The plating was done using the pour plate technique. About 20 mL of MCA was added, allowed to cool and solidify before incubating at 37^0C for two days. The Petri dishes were placed up-side-down in an incubator (HEARSON®) to enable the coliforms to grow to the bottom of the Petri dish to ease counting since coliforms are aerobic. At the end of the second day, the total colonies of coliforms were counted.

2.3.5 Enumeration of Yeasts and Molds

The enumeration of yeast and molds was done using Sabouraud Dextrose Agar (SDA). This culture medium was prepared and sterilized in an autoclave (Dixon's Surgical Instrument Ltd. U.K.) according to the manufacturer's instruction. It was prevented from solidifying by placing it in a water bath (HAAKE WB20) at a temperature of 45^0C.
1 mL of the 10^{-3} and 10^{-4} dilutions of each sample was aseptically plated in sterile Petri dishes initially labeled with the sample code, culture medium, and plating date. The plating was done using the pour plate technique. About 20 mL of SDA was added, allowed to cool and solidify before incubating at 28^0C for three days. The Petri dishes were placed upright in an incubator (HEARSON®) to enable the yeast and molds to grow to the bottom of the Petri dish to ease counting since yeast and molds are anaerobic. At the end of the third day, the total colonies of yeasts and molds were counted.
In all cases colonies were counted manually on an electric lit background of a Gallenkamp Colony Counter. The positions of colonies counted were marked externally on the Petri dish with a permanent marker to avoid re-counting. Only plates containing between 30-300 colony forming units were considered during counting. Plates having 30-300 colony forming units were chosen because this range is considered statistically significant. If there are less than 30 colonies on the plate, small errors in dilution technique or the presence of a few contaminants will have a drastic effect on the final count. Likewise, if there are more than 300 colonies on the plate, there will be poor isolation and colonies will have grown together.

2.4. Exposure of bread sellers to pesticides

A list of agro-chemical shops in Bamenda municipality was gotten from the regional phytosanitary intervention brigade. Since the population of this study was not vast, a systematic sampling method was used in which all the 16 shops agro-chemical shops were investigated, surveyed and questionnaires were administered to 16 bread sellers whose selling points were closer (less than 5 (five) meters distant) from the pesticides shops.

2.5 Data analysis

The microbial counts observed on bread samples were transformed using $\log_{10}$ transformation. The transformed data was subjected to analysis of variance (ANOVA) to determine if there were significant differences between mean counts in colony forming unit per gram (cfu/g) for the different bread samples. Significantly different means were separated by the Duncan's Multiple Range Test (DMRT) at a probability level of 95%. All analyses were

done with the help of Statistical Package for Social Sciences (SPSS) version 16. The results from exposure will be expressed in terms of percentages and frequency.

3. Results and discussion

3.1. Microbial counts on bread samples from standard bakeries

3.1.1 Total colony count of bacteria

The minimum total colony count of bacteria (Table 1) was 3.09 x 10^3 cfu/g of bread while the maximum was 3.46 x 10^4 cfu/g of bread. The total colony count of bacteria in the bread from standard bakeries were not significantly different

3.2 Microbial counts on bread samples from local bakeries

3.2.1 Total colony count of bacteria

There was no significantly different (P>0.05) in the total colony count of bacteria in bread samples from local bakeries (P>0.05). The minimum total colony count of bacteria was observed in bread samples from bakery BS20 (8.91 x 10^3cfu/g) whereas the maximum total colony count of bacteria was observed in bread samples from bakeries BS12 and BS14 (1.99 x 10^4cfu/g) (Table 2).

3.2.2 Coliforms

The values for the coliform counts in the bread samples from local bakeries were significantly difference (P<0.05). The minimum coliform count was recorded by bread samples from bakery BS19 (2.86 x 10^1cfu/g) while the maximum coliform count was recorded by bread samples from bakery BS15 (1.18 x 10^3cfu/g) (Table 2). Coliform counts on bread samples from bakeries BS11, BS12, BS14, BS16, BS17, and BS20 were not significantly different. (P>0.05). However the minimum colony count of bacteria was recorded by bakery BS4 (3.09 x 10^3cfu/g) while the maximum colony count of bacteria was recorded by bakery BS2 (3.46 x 10^4cfu/g).

3.1.2 Coliforms

There were significant differences in the coliform count. The lowest coliform count (Table 1) was observed on bread samples from bakery BS5 (2.27 x 10^1cfu/g) while the highest coliform count was observed on bread samples from bakery BS8 (3.46 x 10^2cfu/g). Coliform counts on bread samples from bakeries BS1, BS2, BS3, BS5, BS7, and BS9 had no significant difference. But amongst them BS5 had the least coliform count (2.27 x 10^1cfu/g) and BS2 had the highest coliform count (5.79 x 10^1cfu/g). Coliform counts of bread samples from bakeries BS4, BS6, BS8, and BS10 equally had no significantly different (P>0.05).

3.1.3 Yeast and molds

The yeast and molds counts were significantly different (P>0.05) (Table 1).
The minimum yeast and count was recorded in the samples from bakery BS5 (1.32 X 10^3cfu/g) while the maximum yeast and mold count was recorded by samples from bakery BS9 (2.69 X 10^4cfu/g). Yeast and molds counts recorded in bread samples from bakeries BS1, BS2, BS3, BS4, BS6, BS7, BS8, and BS10 had no significantly different (P>0.05). However, amongst them bakery BS7 had the least yeast and mold count (1.63 x 10^3cfu/g) while bakery BS10 had the highest count (1.22 x 10^4cfu/g).
However samples from bakery BS16 recorded the minimum coliform count (3.16 x 10^2cfu/g) amongst them while samples from bakery BS12 recorded the maximum coliform count (4.26 x 10^2cfu/g). The samples from bakeries BS13, BS18, and BS19 did not have any significant difference (P>0.05) in their coliform count.

Table 1

Total colony count of microorganisms on bread from standard bakeries

Roadside vendor	Bacteria (Maximum Limit: 10^5 cfu/g)	Coliforms (Maximum Limit: 10^2 cfu/g)	Yeast and molds (Maximum Limit: 10^4 cfu/g)
BS1	$2.39 \times 10^4 \pm 9.46^a$	$4.78 \times 10^1 \pm 3.29^a$	$5.79 \times 10^3 \pm 9.46^{ab}$
BS2	$3.46 \times 10^4 \pm 3.04^a$	$5.79 \times 10^1 \pm 1.62^a$	$6.45 \times 10^3 \pm 7.38^{ab}$
BS3	$4.36 \times 10^3 \pm 1.37^a$	$5.01 \times 10^1 \pm 2.22^a$	$1.99 \times 10^3 \pm 3.36^{ab}$
BS4	$3.09 \times 10^3 \pm 4.64^a$	$3.33 \times 10^2 \pm 1.13^b$	$2.99 \times 10^3 \pm 4.36^{ab}$
BS5	$5.01 \times 10^3 \pm 1.35^a$	$2.27 \times 10^1 \pm 2.44^a$	$1.32 \times 10^3 \pm 3.56^a$
BS6	$1.25 \times 10^4 \pm 2.02^a$	$2.83 \times 10^2 \pm 1.13^b$	$1.01 \times 10^4 \pm 1.43^{ab}$
BS7	$3.46 \times 10^3 \pm 14.55^a$	$2.43 \times 10^1 \pm 2.25^a$	$1.63 \times 10^3 \pm 5.87^{ab}$
BS8	$6.16 \times 10^3 \pm 1.27^a$	$3.46 \times 10^2 \pm 1.15^b$	$1.16 \times 10^4 \pm 3.12^{ab}$
BS9	$1.28 \times 10^4 \pm 3.22^a$	$3.60 \times 10^1 \pm 1.72^a$	$2.69 \times 10^4 \pm 4.98^b$
BS10	$2.63 \times 10^4 \pm 3.22^a$	$3.16 \times 10^2 \pm 1.25^b$	$1.22 \times 10^4 \pm 1.33^{ab}$

Means along the same column with different superscripts are significantly different ($P < 0.05$).

3.2.3 Yeast and molds

There was no significant difference in the yeast and mold counts of bread samples from local bakeries P>0.05). The minimum yeast and molds count was 2.45×10^3cfu/g recorded by bread samples from bakery BS15 while the maximum yeast and molds count was 1.98×10^4cfu/g recorded by bread samples from bakery BS14

Table 2

Total colony count of microorganisms on bread from local bakeries

Roadside vendor	Bacteria (Maximum Limit: 10^5 cfu/g)	Coliforms (Maximum Limit: 10^2 cfu/g)	Yeast and molds (Maximum Limit: 10^4 cfu/g)
BS11	$1.25 \times 10^4 \pm 1.15^a$	$3.83 \times 10^2 \pm 1.16^b$	$7.13 \times 10^3 \pm 1.51^a$
BS12	$1.99 \times 10^4 \pm 1.25^a$	$4.26 \times 10^2 \pm 1.25^b$	$1.12 \times 10^4 \pm 2.10^a$
BS13	$1.31 \times 10^4 \pm 1.74^a$	$3.26 \times 10^1 \pm 2.78^a$	$6.23 \times 10^3 \pm 1.94^a$
BS14	$1.99 \times 10^4 \pm 1.55^a$	$3.38 \times 10^2 \pm 1.15^b$	$1.98 \times 10^4 \pm 5.56^a$
BS15	$1.09 \times 10^4 \pm 1.67^a$	$1.18 \times 10^3 \pm 1.18^c$	$2.45 \times 10^3 \pm 5.97^a$
BS16	$1.69 \times 10^4 \pm 1.35^a$	$3.16 \times 10^2 \pm 1.25^b$	$4.82 \times 10^3 \pm 10.6^a$
BS17	$1.58 \times 10^4 \pm 1.21^a$	$3.36 \times 10^2 \pm 1.03^b$	$9.69 \times 10^3 \pm 1.39^a$
BS18	$1.23 \times 10^4 \pm 1.97^a$	$4.39 \times 10^1 \pm 1.43^a$	$4.78 \times 10^3 \pm 1.62^a$
BS19	$9.33 \times 10^3 \pm 1.60^a$	$2.86 \times 10^1 \pm 1.4^a$	$7.85 \times 10^3 \pm 3.28^a$
BS20	$8.91 \times 10^3 \pm 1.60^a$	$3.80 \times 10^2 \pm 3.89^b$	$5.79 \times 10^3 \pm 10.28^a$

Means along the same column with different superscripts are significantly different ($P < 0.05$).

3.3 Microbial counts on bread samples from roadside vendors

3.3.1 Bacteria

The bacterial counts were significantly different (P<0.05). The highest bacteria count was observed from bread samples from vendor BS22 (2.57×10^5cfu/g) and the lowest bacterial count was observed on bread samples from vendor BS23 (3.16×10^4cfu/g) (Table 3). The bacteria count of bread samples from vendors BS21 and BS24 were not significantly different (P>0.05).

3.3.2 Coliforms

The coliform counts of bread samples from roadside vendors were significantly different (P>0.05). The highest count was recorded by bread samples from vendors BS30 (8.31 x 10^2cfu/g) and the lowest coliform count was recorded by bread samples from vendors BS23 (8.44 x10^1cfu/g) (Table 3).

3.4 Total colony count of microorganisms on different categories of bread

Comparing the general total count of microorganisms in the different categories, it was observed that the bacteria count in the standard bakery category was significantly different (P>0.05) from those of local bakeries and roadside vendors

3.3.3 Yeast and molds

The yeast and molds count were significantly different (P>0.05). The highest yeast and molds count was observed on bread samples from vendor BS29 (2.67 x 10^6cfu/g) while the lowest count was recorded by bread samples from vendor BS25 (3.16 X10^3cfu/g) as showed in table 3.

(Table 4).The lowest bacteria count of 9.36 x10^3cfu/g was recorded by standard bakery while the highest bacteria count was recorded by roadside vendors (8.02 x 10^4cfu/g).

Coliform counts were significantly different (P>0.05). Standard bakeries had the coliform count (8.83 x 10^1cfu/g) while roadside vendors recorded the highest coliform count (3.64 x 10^2cfu/g).

Table 3

Total colony count of microorganisms on bread from roadside vendors

Roadside vendor	Bacteria (Maximum Limit: 10^5 cfu/g)	Coliforms (Maximum Limit: 10^2 cfu/g)	Yeast and molds (Maximum Limit: 10^4 cfu/g)
BS21	$1.73 \times 10^5 \pm 1.01^e$	$4.33 \times 10^2 \pm 1.04^c$	$5.79 \times 10^4 \pm 1.03^d$
BS22	$2.57 \times 10^5 \pm 1.06^g$	$4.43 \times 10^2 \pm 1.04^c$	$2.34 \times 10^5 \pm 1.00^h$
BS23	$3.16 \times 10^4 \pm 1.08^a$	$8.44 \times 10^1 \pm 1.26^a$	$6.21 \times 10^3 \pm 1.03^b$
BS24	$1.81 \times 10^5 \pm 1.00^e$	$3.28 \times 10^2 \pm 1.04^b$	$1.41 \times 10^5 \pm 1.02^f$
BS25	$3.23 \times 10^4 \pm 1.07^a$	$3.38 \times 10^2 \pm 1.07^b$	$3.16 \times 10^3 \pm 1.08^a$
BS26	$1.20 \times 10^5 \pm 1.01^d$	$3.18 \times 10^2 \pm 1.08^b$	$1.41 \times 10^5 \pm 1.02^f$
BS27	$4.07 \times 10^4 \pm 1.05^b$	$3.68 \times 10^2 \pm 1.04^{bc}$	$6.86 \times 10^4 \pm 1.02^e$
BS28	$2.18 \times 10^5 \pm 1.01^f$	$3.54 \times 10^2 \pm 1.02^{bc}$	$1.53 \times 10^5 \pm 1.01^g$
BS29	$5.88 \times 10^4 \pm 1.03^c$	$6.65 \times 10^2 \pm 1.33^d$	$2.67 \times 10^6 \pm 1.07^i$
BS30	$2.04 \times 10^5 \pm 1.01^f$	$8.31 \times 10^2 \pm 1.04^e$	$4.97 \times 10^4 \pm 1.04^c$

Means along the same column with different superscripts are significantly different (P < 0.05).

Table 4

General total colony count of microorganisms on bread from the different categories of bread distributors

Category	Bacteria (Maximum Limit: 10^5 cfu/g)	Coliforms (Maximum Limit 10^2 cfu/g)	Yeast and molds (Maximum Limit 10^4 cfu/g)
Standard Bakeries	$9.36 \times 10^3 \pm 2.44^a$	$8.83 \times 10^1 \pm 3.41^a$	$3.03 \times 10^3 \pm 4.79^a$
Local Bakeries	$1.35 \times 10^4 \pm 1.33^b$	$2.01 \times 10^2 \pm 3.75^b$	$3.83 \times 10^3 \pm 3.89^a$
Roadside Vendors	$8.02 \times 10^4 \pm 2.51^b$	$3.64 \times 10^2 \pm 1.80^c$	$7.71 \times 10^4 \pm 6.56^b$

Means along the same column with different superscripts are significantly different (P < 0.05).

Yeast and molds counts for standard and local bakeries were significantly different (P>0.05) from that of roadside vendors. The lowest yeast and molds count was recorded by standard bakery (3.03 x 10^3cfu/g) while the highest was recorded by roadside vendors (7.71 x 10^4cfu/g).

3.5 Ailment and poisoning cases among bread's sellers closest to pesticide shops

The breads sellers presented varied ailments including headaches, weakness, skin irritation, eye irritation, nose irritation, throat irritation and difficulty in breathing (table 5).

The range of symptoms presented by the sellers was 1-6 per seller; so one seller may present only one ailment and another up to six ailments. Eye and nose irritations are the most frequent ailments: 53% and 66% respectively while difficulty in breathing is the least.

Many cases of poisoning have been reported by breads sellers themselves during the investigation. These cases were experienced by themselves or by a colleague. These include skin irritation, death and others, as illustrated in table 4. Out of the sampled population, only 37.5% of sellers have actually witnessed cases of poisoning in terms of skin burns, death, food poisoning, collapse, and respiratory problems among themselves or among neighboring pesticides sellers. Death was the most prevalent case as a result of suicide or through accidental inhalation.

Table 5

Ailments among bread sellers working nearest pesticides shops

Ailments	Number of sellers (N)	Number of sellers with ailment (%)	Number of poisoning found (%)
Headache	16	7 (28.1)	-
Weakness	16	4(21.8)	-
Skin irritation	16	5(28.1)	-
Eye irritation	16	9(53.1)	-
Nose irritation	16	11(65.6)	-
Throat irritation	16	6(37.5)	-
Difficulty in breathing	16	1(6.3)	-
Skin burn	16	-	9(12.5)
Death	16	-	7(18.8)
Others	16	-	9(6.2)

3.6 Discussion

Viable bacteria, coliforms and fungi (yeast and molds) were detected in all the samples. The high level of total viable bacterial count observed on bread samples from roadside vendors could be associated to poor hygienic standards often characterizing roadside vendors and poor storage conditions. In a related research conducted by Isong et al. in Abak local government area in Nigeria, ready- to-eat breads from hawkers were evaluated for similar microbiological quality [13]. Their report was in line with that of Bryan et al. who concluded that the general state of inadequate hygiene and sanitation could account for organisms in ready-to-eat food [14].

Although the bacteria count observed in bread samples from roadside vendors was high, it did not exceed the standard recommended limits of bacterial contamination for ready- to- eat foods set by the International Commission on Microbiological Specification for food

which is x 10^5cfu/g of food for total bacteria plate count [15].

Thus all the bread samples in this study could be termed safe because the bacterial count for all the samples were less than x10^5cfu/g [16]. According to Hocking, depending on the product, a high standard plate count indicates that the product might have been prepared under poor hygienic conditions or stored inappropriately [6].

Thus when assessing foods for standard plate count, the processing and / or ingredients present in the foods need to be considered. Though the results did not reveal the different types of bacteria associated with the bread samples, it was clear that the bacteria colony count was a mixed flora since the counts were less than 10^5cfu/g. Any count above this level implies there is usually a predominant organism [17].

The coliform counts were significantly different ($P<0.05$) for the bread samples from standard bakeries, local bakeries, and roadside vendors in the Bamenda city area. Found values of coliform counts fall within the range of international microbiological standard units of coliforms in foods (10^2 cfu/g). In a related study conducted in Nigeria, a similar coliform count was recorded in the cooling step in bakery production [18].

Majority of food contamination involving coliforms are due to improper handling arising from contact with handlers, their feces or objects contaminated with feces which is a very common occurrence amongst local baked food handlers and retailers [19, 20].

Coliform bacteria will not likely cause an illness. However, their presence indicates that disease-causing organisms (pathogens) could be in the system [21].

Thus, it could be concluded that the presence of the coliform bacteria on bread in the Bamenda city area is a consequence of contamination which occurred after the baking process because coliform germ being asporulated and acapsulated, they do not resist high temperatures and are entirely destroyed in the baking process [22].

Since coliform presence on food sample is a serious quality concern as most of the bread sold in Bamenda city is consumed unsterilized, producers need to handle their products under suitable hygienic conditions to avoid high levels of microbial contamination and possible health risks.

The analysis revealed that the yeast and molds counts were significantly different ($P<0.05$) for the bread samples from standard bakeries, local bakeries, and roadside vendors in Bamenda city area. The yeast and molds count on bread from roadside vendors was higher than that on bread from local bakeries and standard bakeries). This is on line with the work done by Isong et al. in a similar research conducted in Nigeria [13].

The acceptable limit of yeast and molds in ready-to- eat food is $<10^4$cfu/g [23].

Thus bread samples from standard and local bakeries had yeast and molds count that were within the acceptable limits in ready-to-eat food. However, the yeast and molds count in bread sample from roadside vendors (hawkers) was higher and out of the acceptable limit of yeast and molds for ready-to-eat food. Such high levels of yeast and molds on bread should be worrying because several food borne molds and possibly yeast may be a potential hazard to human or animal health because of their ability to produce toxic metabolites known as mycotoxins. Certain food borne molds and yeast may also be a hazard because of their ability to elicit allergic reactions and even cause infections. Although most food borne fungi are not infectious, some species can cause infections, especially to vulnerable population groups like the aged, individuals receiving chemotherapy or antibiotic treatment [24].

The pesticides sold are mostly liquid. According to their properties they are colorless or colored (yellow). Globally, they have a strong odor, are flammable and

volatile. Consequently they are able to affect respiratory, cardiac, central nervous, liver, kidney, and reproductive systems. Their main routes of entering the body are through inhalation, ingestion, skin penetration or eyes irritation. The effects on the respiratory system are very obvious since most of them are fumigants [25].

The symptoms evaluated in this study were only mild symptoms, as mentioned by Beti, which may make a worker feel uncomfortable: eyes can water and get red, and itchy; skin can get red burns and itchy; dizziness, faintness, blurry vision, vomiting; coughing , fainting ,very bad headaches ; wheezing or trouble ; drooling; small pupils of the eyes[26].

All of these symptoms where found amongst sellers interviewed. Subsequently, they witness the effect of those chemicals on their health. Severe symptoms which may be cold, flu, or heat exhaustion where not evaluated. However, very severe pesticides poisonings cases leading to death were testified by respondents. These accidents generally happened when opening containers, handling or mixing chemicals and when gases leak from containers [27].

Increasing distances, prevention and prompt cleaning of spills and suitable emergency procedures which are important control measures were poorly respected. Henry's law constant, vapor pressure, and volatilization are all properties responsible for the movement of chemicals from the surface into the atmosphere. At room temperature, PvP values can range from 10-s to 300 mm of Hg (mercury). Consequently, symptoms observed reflect characteristics of some of those products with high vapor pressure such as Glyphosate which releases carbon monoxide, toxic gas, after combustion [28].

4. Conclusions

The aim of this study was to evaluate the prevalence of microbes on bread produced and marketed in the Bamenda city area of the North West Region of Cameroon. The results revealed the prevalence of bacteria, coliform, and yeast and molds on bread samples from standard bakeries, local bakeries and roadside vendors. Thus, regular checks by sanitary inspectors are encouraged to check the microbial quality of most of the bread in the Bamenda city area. The ailments presented by bread sellers whose selling points are nearest to pesticide shops are nose irritation, throat irritation, headaches, weakness, skin irritation, eye irritation, and difficulty caused by pesticide breathing.

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6.References

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