

# THE INTERNATIONAL JOURNAL OF SCIENCE & TECHNOLEDGE

## Evaluation of the Microbiological Quality of the Cheese-based of Cow's Milk Sold in the Markets of Porto-novo (Benin)

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### **Abstract:**

*The present study focuses on the case of the city of Porto Novo, the capital of Benin. The microbiological analyses and the surveys conducted in the markets of this city about cow's milk-based cheese have permitted to appreciate the level of microbiological quality of the cheese-based of cow's milk sold in the markets of Porto-novo (Benin). For the purpose of public health security, the microbiological analyses and surveys on cheese were conducted in four markets of this city and enabled us to appreciate the microbiological quality of the cheese-based of cow's milk sold in the markets of Porto-novo (Benin).*

*We have to look for the pathogenic microorganisms and use different parameters and analysis methods of microbiology.*

*The obtained results show that the concentration of pathogenic microorganisms exceed the regulatory limits set by some international organizations such as the WHO, the codex alimentarius or the European Union. As a result, the city of Porto-Novo is polluted by bacteria.*

*The results raise the issue of public health and illustrate the consequences of anthropic actions likely to affect the quality of foodstuffs exposed to the open air. And since cheese must be delivered in a sane and appropriate condition to consumers, suggestions have been formulated in the present document through a good practice of milk collection, cheese production and conservation, and its sale. We estimate that the implementation of the proposals in an efficient in an efficient way will help reduce the prevalence of contaminants in foodstuffs in general and in cheeses in particular.*

**Keywords:** Cheese, pollution, pathogenic microorganism, Porto-Novo.

### **1. Introduction**

Benin, as well as many African countries, has an economy essentially based on agricultural activities of which, breeding that takes an important place. It contributes in making about 7.5% of the gross domestic product (INSAE, 2003). Among breeding products, cheese obtained by the coagulation of milk is particularly rich in protein and in fats (Egounléty, et al., 1994). Its low content in lactose makes it a food recommended to people suffering from intolerance to lactose (Kora, 2005). It is used by many people in the world for their feeding.

There is a high demand cheese consuming in houses, in general restaurants, in hotels, and in diverse public events (ceremonies, receptions, training workshops). This demand therefore being strong, there is an overproduction of cheeses, especially during periods of rain, which obliges the producers to seek markets to the big cities like Cotonou and Porto-Novo to sell their product. These cities and especially the markets are full of those cheese sellers. However, the environmental problems that these large cities in Benin are facing are becoming increasingly worrisome (Adjakidje, 2009). Numerous colloquiums, conferences, seminars and workshops are organized, aiming to study the strategies of reduction of the air pollution especially in these cities (**Benin, 1992**). Particularly In the city of Porto-Novo, the problem of the environment arises mainly in terms of air pollution, water and soil pollution. In this city, the high activity of the sale of adulterated gasoline called "kpayo", taxis motorcycles, hospitals, chemical and microbiological laboratories are still other sources of pollution for this city according to the Beninese Agency for the Environment (**Benin, 1992**). Indeed, problems of waste management (biomedical and other chemical waste) of any kind now represent a problem. For example, DANA has difficulties in managing its waste and is obliged to discharge it directly into nature (gases and toxic reagents, residues of mycotoxins) or into pits (organic carcinogenic solvents) meanwhile this laboratory is located to only a few meters from the lagoon of Porto-Novo. It is therefore important to look at the quality of the products that are sold in such an environment. The International Commission on Microbiological Specifications for Food recognises that there is little scientific data on the microbiological quality of cheeses (Farkhonde et al., 1974; Ghazvinian et al., 1975; International Commission on Microbiological Specifications for Foods, 1986;

Jacquet et Coiffier, 1972). That is why we were particularly interested in the microbiological quality of cow milk cheeses sold in such an environment.

## 2. Material and Methods

### 2.1. Study Area

The research was carried out in the capital city of Porto Novo located in the south east of Bénin Republic. The cheeses' samples were collected from four selected markets of Porto Novo city which are Ouando, Gbégo, Ahouangbo and Grand marché.

### 2.2. Cheese's Sampling

The cheeses were sampled randomly in each of the selected market from different sellers. Composite samples were made with three replicates from each cheese's seller and a total of 22 samples of cheese were collected. The samples were put in zip bags that were stored in carried refrigerator and took to the Laboratory for diverse analysis.

### 2.3. Microbiological Analysis

The following table show us the different parameters that we are looking for and the used methods

Counted microorganisms	Culture medium	Inoculation techniques	Incubation conditions	
			Temperature (°C)	Time(H)
GAM	PCA	In the mass	30°C	72hrs
Total coliforms	VRBA	In the mass	30°C	24hrs
Faecal coliforms	VRBA	In the mass	44°C	24hrs
<i>S. aureus</i>	BP	In surface	37°C	24hrs to 48hrs
Salmonella	SS	Par stries	37°C	5 days
ASR	BSA	In the mass	37°C	48hrs
Yeast and moist	OGA	In surface	25°C	5 days

Table 1: Different parameters and analysis methods in microbiology

### 2.4. Statistical Analysis

The average and standard deviation of data were computed with Microsoft Excel 2010 software. For the multiple comparison of average, the test of student p (T>t) = 0.05 was used through the statistical package of Social Sciences (SPSS) Version 17.

## 3. Results and Discussion

### 3.1. Microbiological Analysis of Cheeses of Different Markets

#### 3.1.1. Ouando Market

Code of cheeses	Total flore at 30°C per g	Total coliforms per g	Fecal coliforms per g	E. coli per g	Salmonella per 25 g	Sulphite reducing anaerobes per	Yeast per g	Moist
F1	$7.36.10^7$	$9.8.10^3$	$4.5.10^3$	$5.1.10^2$	Abs	Abs	$>1.5.10^4$	$2.7.10^3$
F2	$4.76.10^7$	$3.2.10^4$	$1.84.10^4$	< 1	Abs	Abs	$>1.5.10^4$	$8.3.10^3$
F3	$1.75.10^5$	< 1	< 1	< 1	Abs	Abs	$>1.5.10^4$	<1
F4	$3.4.10^5$	< 1	< 1	< 1	Abs	Abs	$>1.5.10^4$	<1
F5	$1.63.10^7$	< 1	< 1	< 1	Abs	Abs	$>1.5.10^4$	<1
F6	$8.9.10^6$	$5.9.10^4$	$4.1.10^4$	< 1	Abs	Abs	$>1.5.10^4$	<1
F7	$4.1.10^6$	< 1	< 1	< 1	Abs	Abs	$>1.5.10^4$	<1
F8	$4.04.10^7$	$1.39.10^4$	$7.63.10^3$	$2.80.10^2$	Abs	Abs	$>1.5.10^4$	<1

Table 2: Results of microbiological analysis of Ouando market cheeses

Pertaining to the microbiological results, we have noticed that all the cheeses that have been analysed are contaminated with microorganisms. Three cheese samples are highly contaminated with faecal coliforms and *E. coli* (table 2). Of all the cheeses, two contain enough moist. However, no cheese is contaminated with salmonella that are very dangerous in food poisoning. Faecal coliforms found in those cheeses confirm the lack of hygiene noticed in most of the sellers encountered. This is as well justified because the cheeses are left without any protection. And when we compare the final results with the biological regulation, we notice that all these cheeses are not accepted, meaning not suitable for immediate consumption as some consumers do. These results are even with those (Keke et al., 2008) in the markets of Cotonou and Abomey-Calavi. And they can be explained by the traffic and the crowd

that characterize this market. To that, should be added the preservation time. The presence of moist should make us think of other contaminant in cheeses. They are mycotoxins, particularly aflatoxins M that are found in milk and its derivate products.

### 3.1.2. Gbègo Market

Code of cheeses	Total flore at 30°C per g	Total coliforms per g	Fecal coliforms per g	E. coli per g	Salmonella per 25 g	Sulphite reducing anaerobes per g	Yeast per g	Moist
F9	$4.11.10^7$	3900	3900	390	Abs	Abs	$>1.5.10^4$	<1
F10	$3.7.10^7$	3700	3700	3700	Ab	Ab	$>1.5.10^4$	<1
F11	$3.905.10^7$	3800	3800	3800	Abs	Abs	$>1.5.10^4$	<1

Table 3: Results of microbiological analysis of Gbègo cheeses

The microbiological results (table 3) show that the cheeses that have been analysed are very contaminated by microorganisms. However, no cheese is contaminated by staphylococcus, salmonella and moist. The fecal coliforms found on those cheeses are a result of bad hygiene. The very high microbial charge confirms once again the effect of air pollution on unprotected foods. These results are once again even with those of Adjakidjè (2009) carried out on food exposed to the air in the city of Cotonou. When we as well compare the obtained results with the microbiological regulation, we notice that all these cheeses are not suitable for direct human consumption, meaning, without heating at a suitable temperature.

### 3.1.3. Ahouangbo Market

Code of cheeses	Total flore at 30°C per g	Total coliforms per g	Fecal coliforms per g	E. coli per g	Salmonella per 25 g	Sulphite reducing anaerobes per g	Yeast per g	Moist
F12	$7.3.10^7$	430	430	190	Abs	Abs	$>1.5.10^4$	<1
F13	$4.60.10^7$	$2.13.10^4$	$1.03.10^4$	$1.00.10^2$	Abs	Abs	$>1.5.10^4$	<1
F14	$6.48.10^7$	$5.6.10^4$	$3.2.10^4$	<1	Abs	Abs	$>1.5.10^4$	<1
F15	$4.10^5$	$7.5.10^3$	$1.2.10^3$	$1.1.10^2$	Abs	Abs	$>1.5.10^4$	<1
F16	$4.63.10^7$	$2.16.10^4$	$1.11.10^4$	$1.03.10^2$	Abs	Abs	$>1.5.10^4$	<1

Table 4: Results of the microbiological analysis of Ahouangbo cheeses

Pertaining to the microbiological results, we not noticed that all the cheeses all the cheeses that have been analysed are contaminated by microorganisms. We have five cheese samples that contain a lot of fecal coliforms f which especially *E. coli* (table 4). On the other hand, no cheese is contaminated by salmonellas, or moist. However, these cheeses are rejected pertaining to the microbiological regulation considering the pathogenic germs found such as *E. coli*

### 3.1.4. Grand Marché

Code of the cheeses	Total flore at 30°C per g	Total coliforms per g	Fecal coliforms per g	E. coli per g	Salmonella per 25 g	Sulphite reducing anaerobes per g	Yeast per g	Moist
F17	$5.8.10^7$	$1.5.10^3$	$1.5.10^3$	$1.5.10^3$	Abs	Abs	$>1.5.10^4$	<1
F18	$4.56.10^7$	<1	<1	<1	Abs	Abs	$>1.5.10^4$	<1
F19	$5.18.10^7$	750.5	750.5	750.5	Abs	Abs	$>1.5.10^4$	<1
F20	$5.5.10^7$	$1.2.10^3$	$1.2.10^3$	$1.2.10^3$	Abs	Abs	$>1.5.10^4$	<1
F21	$4.60.10^7$	<1	<1	<1	Abs	Abs	$>1.5.10^4$	<1
F22	$5.20.10^7$	752.5	752.5	752.5	Abs	Abs	$>1.5.10^4$	<1

Table 5: Results of the microbiological analysis of the cheeses of the Grand marché

The microbiological results (Table 5) show that the cheeses that have been analysed are very contaminated by microorganisms. So, we notice a heavy microbial charge with total, fecal coliforms and *E. coli* compared to the regulation except for two cheese samples. However, no cheese is contaminated by staphylococcus, salmonella and the moist. The very high, microbial charge confirms once again the effect of air pollution on non-protected foods. These results are the match again with those of Adjakidjè (2009) and of Keke (2009).

### 3.2. Statistical Analysis

The statistical results of microbiological analysis of the whole of the markets are presented in the table 6:

Puncture site	Total flore at 30°C/g	Total coliforms per g	Fecal coliforms per g	E. coli /g	S.aureus/g	Salmoella/25 g	Sulphite reducing anaerobes per g	Yeast/g	Moist/g
Ouando	2.39.10 <sup>7</sup> ± 2.69.10 <sup>7</sup> a	1.44.10 <sup>4</sup> ± 1.01.10 <sup>2</sup> a	8.99.10 <sup>3</sup> ± 1.44.10 <sup>4</sup> a	1.99.10 <sup>2</sup> ± 1.68.10 <sup>2</sup> a	Abs	Abs	Abs	>1.5.10 <sup>4</sup>	1.38.10 <sup>3</sup> a
Ahouangbo	4.61.10 <sup>7</sup> ± 2.81.10 <sup>7</sup> a	2.14.10 <sup>4</sup> ± 4.30.10 <sup>2</sup> a	1.1.10 <sup>4</sup> ± 1.27.10 <sup>4</sup> a	1.21.10 <sup>2</sup> ± 3.9.10 <sup>1</sup> a	Abs	Abs	Abs	>1.5.10 <sup>4</sup>	<1b
Grand marché	5.14.10 <sup>7</sup> ± 4.89.10 <sup>6</sup> a	7.35.10 <sup>2</sup> ± 1.02.10 <sup>2</sup> a	7.35.10 <sup>2</sup> ± 5.66.10 <sup>2</sup> a	7.35.10 <sup>2</sup> ± 5.66.10 <sup>2</sup> a	Abs	Abs	Abs	>1.5.10 <sup>4</sup>	<1b
Gbègo	3.9.10 <sup>7</sup> ± 2.05.10 <sup>6</sup> a	3.8.10 <sup>3</sup> ± 3.7.10 <sup>3</sup> a	3.8.10 <sup>3</sup> ± 10 <sup>2</sup> a	2.63.10 <sup>3</sup> ± 1.94.10 <sup>3</sup> b	Abs	Abs	Abs	>1.5.10 <sup>4</sup>	<1b

Table 6: Measured microbiological parameters of cheeses

This study helped to notice that the urban environment of Porto-Novo is really contaminated. It is mainly pathogenic microorganisms (*E. coli*) found in different markets (Ouando, Ahouangbo, Gbègo and “Grand marché”). These results helped us to measure the level of contamination in our capital city.

In fact, the different content in microorganism found in the cheeses of those markets are over the normal limits fixed by the international organisations such as the European Union, FAO and WHO.

So, there is a threat, not only for the health of the populations consuming the cheeses but also for other food products sold in the same conditions.

We previously showed that scientific studies increasingly confirm that the cow milk cheese is an excellent food product. These studied substances can cause toxic effects on the consumers sooner or later.

Even if these preliminary results are only based on a little part of our environment (Country), they are nevertheless disturbing and must call out to the government and all the consumers on this food, so loved by many people.

Unfortunately, however, Bénin does not have extensive statistics which allow a better appreciation of the national situation. It is important to extend the study to several areas of our country and to follow up for several years in order to carry out a comparative analysis in order to appreciate better this pollution.

#### 4. Acknowledgements

We thank the cheese's sellers for their participation in the study. A sincere thanks goes out to team of Laboratory of Quality Control of Water and Food (LCQEA) of the Direction of the Hygiene and the Basic Purification (DHAB).

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