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HEALTH RISK ASSESSMENT OF WATER IN PLASTIC BAG SOLD IN THE CITY OF ABIDJAN *(CÔTE D'IVOIRE, WEST AFRICA)*

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ABSTRACT

Water is essential for life because of the role that it plays in our daily life. For that reason we decided to assess the risk of sanitary water in bags, sold in Abidjan. The study is kind of a cross that had been realized to Côte d'Ivoire Pasteur Institute at Cocody. It's based on a sample of 450 bags of craft type and 450 semi-industrial bags. At the end of the study, the following results have been obtained: At the epidemiologic level, the samples not precise sites represented 82.2% of the samples, 89.6% of sellers were carrying out their activities for more than six months whom we have 69.8% of women. Besides, 79.3% had a primary level education. The factor of risk associated revealed by our study is the mode of conditioning in individual bags hygiene mainly that of the place of production. At the physico-chemical level, 32.3% of the samples did not comply with standard pH values higher that the average (> 8.5) versus 67.3% that were acceptable. The non conformity of the bags of semi-industrial type bags for 26% of the craft types. At the level the bacteriologic contamination rate by pathogen germs responsible for the sanitary risk was 5.4% for bags of the craft type with 3.3% for those of semi-industrial type. They are *Enterococcus faecalis* of 91.6% (76 cases), *Escherichia coli* of 7.2% (06 cases), Salmonella sp of 1.2% (01 case). These kinds of water in bags, semi-industrial or craft type have not heathly quality drinkable water, with a rate of infection of 79.4%.

Keywords : *Bags dinking water, Craft and semi-industrial type, Waterborne diseases, Health risk, Abidjan, Côte d'Ivoire.*

RÉSUMÉ

Évaluation du risque sanitaire des eaux en sachet plastique vendues à Abidjan, Côte d'Ivoire (Afrique de l'Ouest)

L'eau est source de vie de par son caractère indispensable et surtout pour la place qu'elle occupe dans notre vie de tous les jours. On se propose alors d'évaluer le risque sanitaire des eaux en sachet plastiques vendues à Abidjan. Il s'agit d'une étude de type transversale qui a été réalisée a l'Institut Pasteur de Cote d'Ivoire. Elle a concerne 450 sachets de type artisanal et 450 sachets de type semi industriel. Au terme de l'étude, les résultats suivants ont été obtenus : Au niveau épidémiologique, les échantillons provenant des sites non systématisés représentent 82,2 % de la population d'étude. 89,6 % des vendeurs exercent plus de 6 mois dont 69,8 % de femmes. En outre, 79,3 % ont un niveau faible d'instruction. Les facteurs de risques associés, révélés par l'étude sont le mode d'ensachage, l'hygiène corporelle et environnementale. Au plan physico-chimique, 32,3 % des échantillons sont non conformes aux normes en vigueur avec un pH supérieur a la normale (> 8,5) contre 67,3 % qui sont acceptables. La non conformité des sachets de type semi industriel est de 21,3 % contre 26 % pour les sachets de type artisanal. Concernant l'aspect bactériologique, le taux de contamination par les germes pathogènes responsables de risque sanitaire est de 5.4 % pour les sachets de type artisanal contre 3.3 % pour les sachets de type semi industriel. Il s'agit : *Enterococcus faecalis* a 91,6 % soit 76 souches ; *Escherichia coli* a 7,2 % soit 06 souches ; *Salmonella* sp a 1,2 % soit 01 souche.

Ces eaux vendues en sachet plastique, quel soit le type semi industriel ou artisanal sont impropres a la consommation, conformément au critère de qualité des eaux de consommation, avec un taux de contamination de 79,4 %.

Mots-clés *:* *Eaux en sachet plastique, Type artisanal et semi-industriel, Maladies hydriques, Risque sanitaire, Abidjan, Côte d'Ivoire.*

I - INTRODUCTION

The importance of water is dominant, like other elements in human life, both for food and for its physiological needs. The quality of this water has a direct or indirect impact on consumer health by the many diseases it might carry. Thus, 80% of diseases in the environment are water-borne and water consumption is often blamed [1]. However, the water packed in bags, have proved successful, as they are practical, refreshing and affordable for people on low incomes. Facing this situation, studies have been conducted to assess the health risk, quality and

potability of the water and distributed in major cities in general [2,3]. Given the recurrence of these diseases and health risk is that food, it seems imperative, despite the studies through some African cities, the Institute Pasteur de Cote d'Ivoire is to study the health quality sachet water sold in a Abidjan. Thus, the main objective of this study is to assess the health risk associated with the consumption of water packed in plastic bag using biological indicators. For specific objectives, it is to identify these pathogens in drinking water, to determine some physico-chemical parameters and to assess the hygiene of the vendors.

II - MATERIALS AND METHODS

II-1. Study area

The various analysis and tests were conducted at the Clinical Bacteriology Unit of the Institute Pasteur de Cote d'Ivoire. The study of transversal type, ran from October 2003 to May 2004. The city of Abidjan has ten which are common: Abobo, Adjamé, Attécoubé, Cocody, Koumassi, Marcory, Plateau, Port-Bouet, Treichville and Yopougon. A socio-medical investigation is being conducted from vendors during the study period. The water bags are craft and semi industrial collected and sold in these municipalities.

The sampling does not cover water packet with the following symbols: bag of water damage, sachet water in the sun sets, bags of water in coolers or containers Couvert. Moreover, water in bags in a good state of conservation cool and dark have been the subject of the samples. 450 bags of craft for 45 pouches per common and 450 bags of semi-industrial type were collected, total 900 bags of water. A stratified sampling was carried out at two levels the first of which is represented by the ten Commons. Thirty sites were selected for three sales by municipality, representing the second degree, with a power of stratified 15% threshold of significance alpha (λ) of 5%.

These vendors were selected following a study made at the preliminary study. Sampling was done using the simple random sampling, we formed into a customer to buy these waters. Finally when sampling the files of health surveys have been completed. Samples are sent to the Clinical Bacteriology Unit of the Pasteur Institute of Ivory Coast in coolers within three hours after collection.

II-2. Methodology

II-2-1. Bacteriological study

Salmonella detection in the water follows a standardized technique protocol, as well as *Enterococcus faecalis*, *Escherichia coli* [4-6]. The following analysis of three stages: Enrichment, Isolation, Identification.

II-2-2. Physico-chemical determination

The pH is determined by specific electrode, based on the difference in potential between the electrodes, a glass electrode and a reference using a pH meter mark KNICK Digital pH meter 646 mV / pH electrodes whose are combined into one. The results are expressed in pH units with two decimal places.

II-3. Statistical analysis

The data collected for bacteriological and epidemiological were processed with the software Epi Info *version 6*.

III - RESULTS

III-1. Epidemiological data

III-1-1. Features sellers

Places to purchase non-systematized improvises including spaces in shopping centers, shops, restaurants are the most representative number of 740 is 82.2% of the sites selected for purchase. Vendors are divided between 272 men and 628 women representing their respective proportions of 30.2% and 69.8% with a sex ratio of 2.3 for women.
These vendors were classified according to whether or not an activity and their health. Among them, 87.8% have activities, 2.7% have questionable hygiene through observation, only 0.2% has garbage.

III-1-2. Drinking water in bag characteristics

Table 1 shows that 415 bags were placed in a bag from a container as against 35% directly from the tap or the proportions of 46.1% against 3.9%, however the 450 packets whose mode is unknown bagging is the packet type semiconductor industry. Furthermore, 12.1% of sellers-manufacturers had any activity during bagging against 37.9%. 50% of bags are typically semi industry. 625 samples and tests have been preserved in coolers against 245 in freezers (20°C).

Table 1 : *Distribution of contamination by bagging mode types of drinking-water in bag*

Packet type/mode bagging d'ensachage		Contaminated N=79		Not contaminted N=79		Pourcentage (%) N=900 (Sellers)
		Number	%	Number	%	
Semi-industrial (N=450)		30	38	420	51,2	50
Craft (N=450)	Type (n=35)	5	6,3	30	3,7	3,9
	valvet (n=415)	44	55,7	37,1	45,2	46,1

III-2. Physico-chemical data

The pH values show in ***Table 2*** that 72% of craft bags have a pH between [6.5-8.5] and 26% higher than a 8.5 against 78.7% of the semi industry.

Table 2: *Values of pH for different type drinking water in bags*

Type of packet	pH	Number (N)	Pourcentage (%)
Artisanal (N=450)	< 6,5	9	2
	[6,5 - 8,5]	324	72
	> 8,5	117	26
Semi-industrial (N=450)	< 6,5	0	0
	[6,5 - 8,5]	354	78,7
	> 8,5	96	21,3

III-3. Bacteriological data

III-3-1. Contamination by type of packet.

The plastic bags were distributed according to the contamination and type of packet. 5.4% of packet type craft have been contaminated by microbes searches against 44.6% which the contamination is negative (***Table 3***) .3.3% of bags are also semi industrial infected against 46.7% which the contamination is negative. This type of contamination is significant because packet P = 0.03 is below 0.05.

Furthermore, Cocody is the most represented with 11 strains of *Enterococcus faecalis* and 3 strains of *E. coli*. Of all the germs insulated bags plastic craft.

Table 3 : *Distribution of contaminated bags depending on the type of drinking water bag*

Type of manufacturing	Contamination	Number (N)	Pourcentage (%)
Craft (N=450)	yes	49	5,4
	no	401	44,6
Semi-industrial (N=450)	yes	30	3,3
	no	420	46,7
Total		**900**	**100**

III-3-2. Contamination of various types of plastic bag by bagging mode.

Contamination of samples analyzed was divided according to the method of packaging of different types of packet. Setting plastic bag containers represents 55.7% of 6.3% against contamination from the tap for plastic bags craft, however, that plastic bags semi - industrial remains unknown with 38% contamination ***(Table 4).*** The risk of contamination of plastic bags as the method of bagging is not significant for P = 0.06, with a chi = 5.46 and a degree of freedom equal to 2.

Table 4 : *Enumeration of bacteria in bags of water analyzed*

Macroorganism	**Craft type**		**Industrial type**		**Total number**	**Pour-centage**
	Number (N)	(%)	Number (N)	(%)	(N)	(%)
Bacillus sp	4	0,9	2	0,4	6	0,7
Coliformes	50	11,1	34	7,6	84	9,3
Coliformes-Bacillus	32	7,1	6	1,3	38	4,2
Coliformes-*Bacillus sp*	19	4,2	8	1,8	27	3
Pseudomonas sp						
Coliformes-*Pseudomonas sp*	8	1,8	0	0	8	0,9
Coliformes-*Staphylocoques sp*	91	20,2	178	39,6	269	9,9
Coliformes-*Staphylocoques sp*	83	18,4	63	14	146	16,2
Bacillus sp						
Coliformes-*Staphylocoques sp*	79	17,6	64	14,2	143	15,9
Bacillus sp-Pseudomonas sp						
Coliformes-*Staphylocoques sp*	17	3,8	13	2,9	30	3,3
Pseudomonas sp						
Staphylocoques	36	8	42	9,3	78	8,7
Staphylocoques sp-Bacillus sp	13	2,9	17	3,8	30	3,3

IV - DISCUSSION

Analysis of pH levels depending on the type of packet has revealed relatively high pH, above a 8.5 fixed by the [1] and legislation ie 26% for packets of craft and 21.3% for semi industrial types. This may be explained by exposure to sunlight and then delivered to the freezer. Note that high pH causes a reduction in the concentration of hypochlorous acid [1], thus promoting colonization of the water by micro-organisms. 740 plastic bags of water or 82.2% came from sites not systematized compounds improvised space in shopping mall or coexist informal economic activities. These activities attract a relative affluence and consumption of these waters, thus justifying the activities of vendors has 87.8% of our study population. In all sellers women are most represented with 69.8% of the study population with a sex ratio of 2.3. Indeed, women hold a majority of small businesses. 79.3% of sellers have a low level of education. They are often unaware of the health risks present in these waters plastic bag offered to consumers.

This observation emphasizes that the environmental health of the 24 vendors was 2.7% have questionable hygiene and only 2 have trash. This situation would promote circulation and proliferation of certain bacteria. Furthermore 87.8% of sellers have a core activity of an economic order to increase their revenue by selling more water. The method of packaging water in plastic bags semiconductor industry remains unknown sellers interviewed in these waters because they are delivered only to the sale. By the way against bagging plastic bags craft is known, or indirectly from containers or water is collected. has 46.1% of sales against the direct method of making the bags directly from the tap was 3.9% of these sellers. These results are consistent with those of [7] 73.3% for the indirect method. However, they are higher than those of [8] with 27% for the indirect method from the pans. With regard to plastic bags 37.9% craft vendors / manufacturers interviewed did not show activity in the bag against 12.1% who had other tasks involved either selling or plastic bags or household activities.

These movements are probably responsible for exogenous contamination of water samples in bags. 69.5% of the water sachets are kept in coolers against 27.2% directly in the freezer and 3.3% presented to consumers in containers.

The bacteriological analysis identified 83 strains of pathogenic micro-organisms isolated from samples. These include *Enterococcus faecalis* (91.6%) are 76 strains of Escherichia coli (7.2%) were 6 strains and *Salmonella enterica serovar Typhimurium* (1.8%) are 1 strain. Their presence is evidence of faecal contamination of water in bags. This could be explained by the lack of basic environmental health by the sellers [9]

Indeed, the contaminated water samples represent 8.8% are 79 bags of waters against 821 bags of water. 5.4% of water sachets craft would infect against 3.3% of semi industry. 79.4% of samples analyzed do not conform to standards [1,10,11].

V - CONCLUSION

Water sold in plastic bag is a vital need, and still quite convenient for people. The analysis revealed that the water bag is not satisfactory bacteriological quality. *Enterococcus faecalis*, *Escherichia coli*, *Pseumonas sp*, *Staphylococcus sp Salmonella enterica serovar typhimurium* have been isolated in samples. The risk factors related to health bagging mode water, education sellers may pose a public health problem.

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