International Journal of Science and Research (IJSR)
ISSN: 2319-7064
Impact Factor (2018): 7.426

Contamination of Raw Cow Milk by Residues of Organochlorine Pesticides and Veterinary Products: Case of Daloa (Côte d'Ivoire)

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Abstract: ***This study was undertaken to examine the dietary risks that can result from human exposure to organochlorine pesticide residues and veterinary products through the consumption of fresh cow's milk. The various chromatographic analyzes carried out on the various samples taken revealed a contamination of this foodstuff rather popular with the population of Daloa. Quantified levels range from 0.004 to 0.048 mg.kg-1 per organochlorine pesticide residue with an overall mean loading of 0.083 mg.kg-1. At the level of veterinary products, the result indicates average concentrations ranging from 1.085 to 3.125 µg.kg-1 with an overall average load of 1.698µg.kg-1.***

Keywords: Fresh cow milk, organochlorine pesticide residues, residues of veterinary products, Daloa (Côte d'Ivoire)

1. Introduction

Milk is a food of high nutritional value; it represents a nutritional complex necessary for the needs of the organism [1]. But today the consumer does not expect only a food that contains an untold number of nutrients but rather that it is good for health [2]. Faced with this situation, food security has become in recent years the main concern of the agri-food industry and health professions. [3]. It has become the leitmotif of the media, politics, societies and even families. Foods that are consumed should meet quality criteria for diets that support good nutritional and health status [4], [5]. Unfortunately, large-scale nutritional problems, whether persistent or emerging, do not spare any continent despite the efforts made.

Among this panoply of difficulties facing the quality of the foods we consume, the presence of chemicals in our food is an important factor. It is even shown through various studies that the average diet is composed of many chemicals [6], [7]. Chemicals (pesticides, veterinary products) used for the protection of plants, animals and food and against pests and diseases are found in the form of residues in our food [8]; Thus, foods formerly considered as a source of energy are transformed over the years into a vector of toxic. This sad fact worries consumers today.

Milk and dairy products are perishable foods. High qualitystandards must be maintained across all production lines to maintain consumer confidence. This trust is essential to promote the consumption of dairy products. The milk that leaves the farm must be of irreproachable quality. The aim of this study is to evaluate the level of contamination of raw cow's milk, a high-consumption food in Daloa (west-central Côte d'Ivoire) with organochlorine pesticide residues and veterinary products.

2. Material and Methods

2.1. Sampling of the biological material

The biological material that is the subject of this study is fresh cow's milk from "Abattoir 2", district of the city of Daloa (west-central Côte d'Ivoire). This district is presented as an area for cattle breeding and cow's milk production. Milk sampling was conducted at ten different breeders. 2 L of milk were collected from each farmer. (1L for the detection of organochlorine pesticide residues and 1L for the determination of veterinary products). A total of 20 L of milk was used for analysis. The milk collected is put into sterile glasses, covered with aluminum foil and sealed to limit the oxidation phenomena. The samples were conveyed the same day of the sampling in a cooler containing ice in Abidjan at the National Laboratory for Agricultural Development Support (LANADA) where the analyzes were carried out the next day.

a)Collection of the milk b)conservation of the milk collected

Figure 1: Collection and conservation of cow's milk

2.2. Chromatographic analysis of pesticide residues and veterinary products

The location of organochloric pesticides residues and veterinary products is made through residual method in order to determine all the residues of these products [9]. These different residues were measured from cow's milk fat. To extract these residues, the samples were deposited at

room temperature for six days in order to allow the milk to settle at room temperature.After decantation, two phases were obtained: a hydrophilic phase (containing water) and a lipophilic phase (which contains fat). After removing the water, 10 g of fat from each sample were dried in an oven at a temperature of 55 ° C for 24 hours.

Then the dry samples were made into powder using a mortar and then dehydrated with 10 g of anhydrous sodium sulphate. After the extraction of the various residues, the homogenate obtained was purified from cartridge C18. 3µL of this purified solution was injected with a gas chromatograph (SHIMMADZU GC-14A split splitless) equipped with a 63Ni electron capture detector and a SHIMADZU C-R6A CHROMATOPAC integrator.

c) Decanted milk d) fat of the milk

Figure 2: Method of extracting fat from cow's milk

3. Results and Discussion

Instrumental analysis identified and quantified several pesticide and veterinary product residues in cow's milk sample

3.1 Residue content of pesticides in milk

The organochlorine pesticide(PO) residue levels are reported in Table I. This result shows that most samples contain pesticide residues. These residues are grouped into three (03) major groups of pesticides: isomers of lindane (α HCH, βHCH and γHCH), metabolites of DDT (4.4 DDE and 4.4 DDD) and Endosulfan.

Of the residues sought (Table I), DDT and its metabolite 2,4-DDD were undetectable in cow's milk. The contents in the table represent the average concentrations of the ten (10) milk samples taken.Quantified levels range from 0.004 to 0.048 $mg.Kg^{-1}$ per PO residue. These organochlorine pesticide residues in cow's milk would come from the diet of these animals grazing in the fields treated with plant protection products. These products will therefore end up in the milk produced by these infected animals. Indeed, Daloa is a large agricultural production area [10] and farmers use a lot of pesticides (insecticides, herbicides) to treat their orchard.

Table I: Content (mg / kg) of organochlorine pesticide residues in cow's milk

Residues of OP	α-HCH	β-HCH	γ HCH	4,4-DDE	4,4-DDD	2,4-DDE	4,4-DDT	Endosulfan
Concentration by residues (µg/Kg)	0.028	0.007	0.004	0.018	0.021	nd	nd	0.048
Average concentration by group of pesticide (µg/Kg)	0016			0.018				0.048
global average load (µg/Kg)	0.083							

OP: organochlorine pesticide. **nd**: not detected

3.2 Pollutant load provided per group of organochlorine pesticides

Figure 3 below shows that cow's milk is more contaminated by pesticides in the DDT group (46%). This dominance by the metabolites of DDT is worrying because this group of pesticide is not registered in Ivory Coast. Their presence in a foodstuff intended for human consumption is a problem for the health of the consumer with regard to the harmful effects that the molecules of this group cause in humans. The presence of these molecules in the environment could be explained by the ignorance or neglect of good agricultural practices on the one hand, and the lack of control over the distribution of these products by the competent authorities.

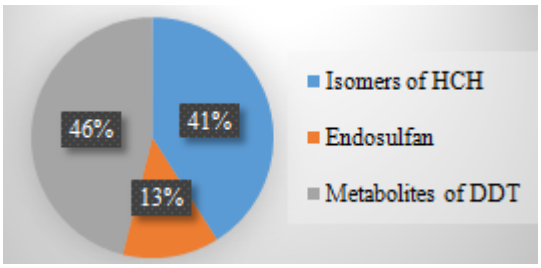

Figure 3: Proportion of different organochlorine pesticides found in the cow's milk

3.3 Comparative study of the level of pesticides present in milk with standards (MRLs)

The average concentrations of the different organochlorine pesticide residues quantified in the cow's milk samples were compared to the European Union (EU) standards for pesticide residues in foodstuffs. This comparison shows that the levels of organochlorine pesticide residues are unevenly distributed in raw cow's milk. The levels of HCH (αHCH and βHCH) are well above the limit set by the EU (Figure 4). For all samples, the concentration of detected PO residues remains below the maximum residual limit (MRL). But this situationis still problematic because the European regulation provides for the prohibition of DDT and its metabolites in foodstuffsintended for human consumption [11]. Thismolecule is cumulative; it can lead to diseases: neurological deficits, reproductive disorders, long-term cancer [6].

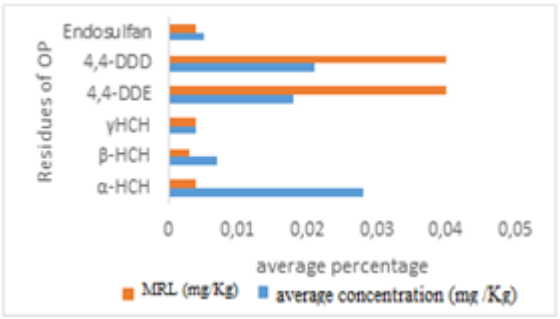

Figure 4: Comparison of average concentrations of pesticide residues in cow'smilk with the standards(MRL).

3.4 Contamination of cow's milk with medicinal residues

The different residue levels of veterinary products are mentioned in Table II. These various products detected are divided into three categories: antibiotics (Tylosin 20% and Sulfadoxine), tranquilizers (Xylazine) and antiparasitics (Tripamidim-Samorin and Benzimidazole). The overall average load is 1.698 µg / kg for all veterinary residues, ie 44% for antibiotics, 21% for tranquillizers and 35% for antiparasitic agents (Figure 5). Antibiotics have the highest frequency of occurrence in cow's milk. This abundance of antibiotics could be explained on the one hand by the fact that antibiotics are used in animals for the treatment and prevention of bacterial diseases as well as a growth factor and on the other hand by metabolism slow antibiotics by cows [12-13]. Antibiotics used in animals leave residues in foods of animal origin such as milk, resulting in the introduction of mandatory waiting periods [13 -14]. Overuse of antibiotics in animals will cause resistance to these products [14-15]. In some countries, 80% of antibiotics are consumed by animals. However, this overconsumption contributes to the rise of antimicrobial resistance in veterinary and human medicine. Hence the proscription of these antibiotics in breeding by WHO [15 -16]. Antibiotics given to animals being close to those used in humans, resistant bacteria can pass from animals to humans through the consumption of uncooked meat, by close contact between humans and animals or by contaminated water. Faced with this threat, the European Commission (EC) has totally banned the use of antibiotics as growth factors in animal feed [16-17]. Indeed, even with antibiotic residue levels below the maximum residual limit (MRL), this is in the long run problematic for the consumer.

Table II: Percentages of veterinary product residues in cow'smilk (µg/Kg)

Residues of veterinary products	Antibiotics		Tranquillizer	Antiparasits	
	Tylosine 20%	Sulfadin	Xylazine	Trpamidim	Benzimidazole
average concentration (µg/kg)	3,125	1,296	1,085	2,005	1,598
average concentration by category (µg/kg)	2,21		1,085	1,801	
global average charge (µg/Kg)	1698				

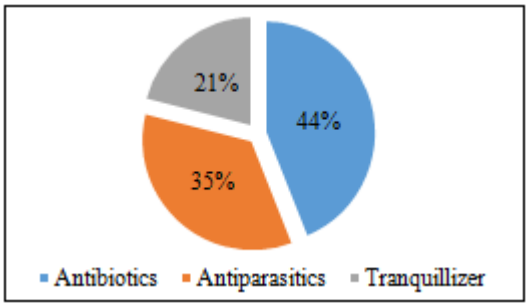

Figure 5: Frequency of categories of veterinary products in cow's milk

4. Conclusion

Chromatographic analysis performed on cow's milk from Daloa (west-central Côte d'Ivoire) determined the level of contamination of this foodstuff by organochlorine pesticide residues and veterinary drugs. The results of this study show that the raw cow's milk of the Department of Daloa certainly contains residues of phytosanitary products (organochlorine pesticides) and veterinary drug residues but these residues have lower concentrations than the standards of food safety provided by the European Commission. (EC). However, veterinary products used for the care of animals have environmental and human consequences especially as they are biologically active molecules.

In order to guarantee food safety for cow's milk consumers, the establishment of biological elimination processes for the content of these chemical pollutants in animals is necessary.

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