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EVALUATION OF THE TOXICOLOGICAL QUALITY OF CHICKEN'S DROPPINGS USED FOR THE CULTURE OF *SOLANUM MACROCARPUM L.* IN COTONOU (REPUBLIC OF BENIN)

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ABSTRACT
The study evaluated the toxicological quality of the chicken's droppings used for the amendment of the seedlings of *Solanum macrocarpum L*. in Cotonou. A pilot site with Glo, the market-gardening sites of Houéyiho, Fidjrossè and Agongbomey were included in the study. The lead contents sought in eight samples of droppings at a rate of two per site are as follows: Glo-Djigbé (3.618 Mg/kg± 0.051); Houéyiho (0.887 mg/kg ± 0.017); Agongbomey (1.921 mg/kg ±0.079) Fidjrossè (0.696 mg/kg ± 0.048) ($p< 0.05$). Cadmium is present in the samples at the following rates: Glo-Djigbé (0.08±0.02 mg/kg); Houeyiho (0.04±0.01); Fidjrosse (0.05±0.01 mg/kg), Agongbomey (0.07±0.01). These results have shown the chicken's droppings used in Cotonou are contaminated by lead and cadmium; which could contribute to the contamination of *Solanum macrocarpum L*. leaves and other vegetable plants. The populations which consume these vegetables are exposed to diseases related to the intoxication by lead and cadmium.

KEYWORDS: Lead,cadmium, chicken's droppings, *Solanum macrocarpum* L.

INTRODUCTION

Urban agriculture became throughout the whole world and specifically in the developing countries, one of the activities necessary to ensure the food safety of the townsmen and to get financial resources with the unemployed persons of the cities. Its contribution with the food production on a world level which was at 15 % in 1993 can have exceeded 33 % as from the year 2005 (Niang, 1996). Smit *et al*. (1996) revealed that agriculture is practised in at least 90 towns of 31 countries of the Southeast Asia, Middle East, Europe, Subsaharian Africa, America and Antilles. In addition, 800 million people practise this activity on a worldwide scale (Koc *et al*. 2000). The problems of urban agriculture in West Africa were the subject of several publications which show well its importance in cities (Akinbamijo *et al*. 2002). Urban agriculture is thus socially significant. The activities of production, transformation and marketing offer employment opportunities for a mass of the urban population in situation of unemployment and the rural ones in seasonal migration. Benin, following the example of many african countries, experienced these last years a development of urban agriculture (Dougnon *et al*., 2012).

In the town of Cotonou, the market-gardening production and more precisely of the vegetable-sheets is a reality. It contributes to the provisioning of the markets of the city of food products (Afrique Conseil, 2006). The systems of production are much diversified in terms of speculations (vegetables, fruits, flowers, meat, eggs, etc.) and of economic profile of the owners (young people, little qualified populations, contractors). The modernization and the intensification of the systems of production induce a stronger use of agricultural inputs. The producers answer this request by the recycling of various types of waste (Akinbamijo *et al,*. 2002). Thus, inside the city, the population developed a local strategy of market-gardening production which resulted in the use of the chicken's droppings to amend the market-gardening products. These poultry's droppings, as many waste used in agriculture, contains organic matter and biogenic salts which constitute a contribution interesting for the grounds of culture (Legret *et al*., 1988). But the presence of elements traces in the droppings represents a major constraint with its use in agriculture because these elements can be brought in unstable and potentially biodisponibles forms (Legret, 1984). Indeed, in the event of use of waste of animals on the market gardenings (whose sheets are consumed), certain metals, like lead, accumulate preferentially in the foliar parts (Niang, 1996); which could be at the origin of food poisonings on the level of the fresh vegetable consumers. For that, we chose to study the lead which is one of the most toxic metals for the man. It involves more or less serious lesions and diseases (Testud, 2005).

Having thus noticed that an increasing number of market-gardeners prefer to use the chicken's droppings to amend their cultures, this study evaluated the toxicological

quality of these inputs which are used to amend different vegetables.

MATERIALS AND METHODS

Localization of the sites of study

Our survey took in account a witness site at Glo (6° 56 ' Northern latitude and 2°30' Eastern longitude) and market-gardening sites of Houeyiho (6° 21' 20" Northern latitude and 2° 21' 35" Eastern longitude), of Fidjrosse (6° 22' Northern latitude and 2° 24' Eastern longitude); of Agongbomey (6° 21' Northern latitude and 2° 24' 45" Eastern longitude) (Figure 1).

FIGURE 1: Localization of sites included in the survey

Sampling

It has been used among others of the white sachets labeled to collect samples, of the sterile gloves for withdrawals, an icebox for the transportation of samples. For exams to the laboratory, a balance of high degree of accuracy, a Spectrophotometer of Atomic Absorption (SAA) equipped with a system of correction of the background noise, with a burner air - acetylene and a gas supply adapted, a lamp with hollow cathode specific to the lead, a thermostated hotplate, a programmable furnace, quartz crucibles and glassmaking of laboratory (flasks, erlenmeyers).

On each site, we carried out in two different market-gardeners, some samples of droppings. 500 grams of chicken's droppings were collected on the sites and introduced into hermetically tied plastic sachets. All the samples were transported in a refrigerator towards the laboratory in a one hour interval after the taking away where they were preserved at once at a temperature of 4° C. The toxicological analyses were carried out in the 200 hours following the test sample selections.

Methods of analysis

Toxicological analyses

They were made at the Laboratory for Sciences Ground, Water and Environment of the National Institute of the Agronomic Research of Benin (INRAB) in Republic of the Benin. Lead and cadmium were required in the samples by reading with the Spectrophotometer of Atomic absorption (SAA) 110 with flame in accordance.

Droppings are incinerated with a muffle furnace with 550°C during 24 hours. Ash obtained is dissolved in 2 mL of hydrochloric acid (HCl) 6N which is evaporated on hotplate with 125°C. The viscous remainder obtained is again dissolves and recovered using nitric acid (HNO3) 0,1M in a flask of 100 mL. The solution obtained is used for lead and cadmium dosage by AAS.

With a specific wavelength, part of the luminous energy emitted by the lamp with hollow cathode is absorbed by the solution of the sample. This quantity of energy is used by the element to pass from its "fundamental" state to a metastable "excited" state: it is the energy of excitation. It is proportional to the concentration in suggestion for the solution. Thus knowing the quantity of energy absorptive by a solution sample, the concentration is deduced.

With this intention, it resorts each time at standard solutions (solutions prepared or acquired in the trade) of concentration known with precision. For a range of standards, the optical device of the apparatus calculates a parameter (absorbance) for each standard. It then carries out a parametric regression which enables it to determine the concentration of each sample starting from this same given parameter and of a curve of regression for the sample.

To make possible the uniformly exposition of element's atoms with the source of light, the solution of proportioning is aspired through a very fine capillary then

pulverized in the flame supplied with a mixture of air and acetylene. The atoms released can then absorb part of the energy emitted by the lamp with hollow cathode and make it possible to determine absorption.

To ensure the handling of the signals, the optical system is equipped with detectors and amplifying precise and powerful. For the system flame used, the limit of detection of the instrument for lead and cadmium are respectively of 0.0100 and 0.0200 ppm.

Statistical analyses

It was calculated the averages and the standard deviations. Multiple comparisons consisting in comparing the averages using the test of Student p (T>t) = 0.05 were made. The softwares used are Microsoft Excel 2010 and XL Stat 2011.

RESULTS AND DISCUSSION

With regard to the lead content in the droppings used for the amendment of the sites, the averages obtained are as follow: Glo-Djigbé (3.618 ± 0.051); Houeyiho (0.887 ± 0.017); Agongbomey (1.921±0.079) Fidjrosse (0.696 ± 0.048) ($p< 0.05$) (Figure 2).

The averages of cadmium contamination are as follow: Glo-Djigbé (0.08±0.02 mg/kg); Houeyiho (0.04±0.01); Fidjrosse (0.05±0.01 mg/kg), Agongbomey (0.07±0.01) (Figure 3)

The droppings used for the amendment of the various sites of study are all contaminated by lead. These results are confirmed by work of Gupta *et al*. (1999) which found values lower than 35 mg/kg in samples of droppings. In the same way, Kouassi *et al*. (2008) found that the droppings used on the market-gardening grounds of Abidjan are rich in lead. These droppings are also contaminated by cadmium. Lead's averages are more important than cadmium's one (figure 4). That difference could be explained by the fact that cadmium is an industrial heavy metal. It more concentrated around industrial installations (Dougnon *et al*., 2012).

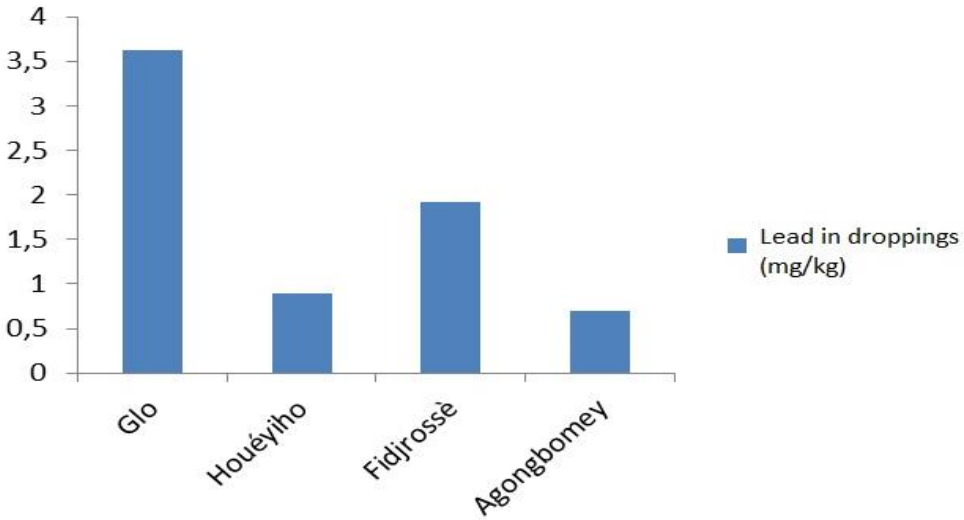

FIGURE 2: Contamination of chicken's droppings by lead

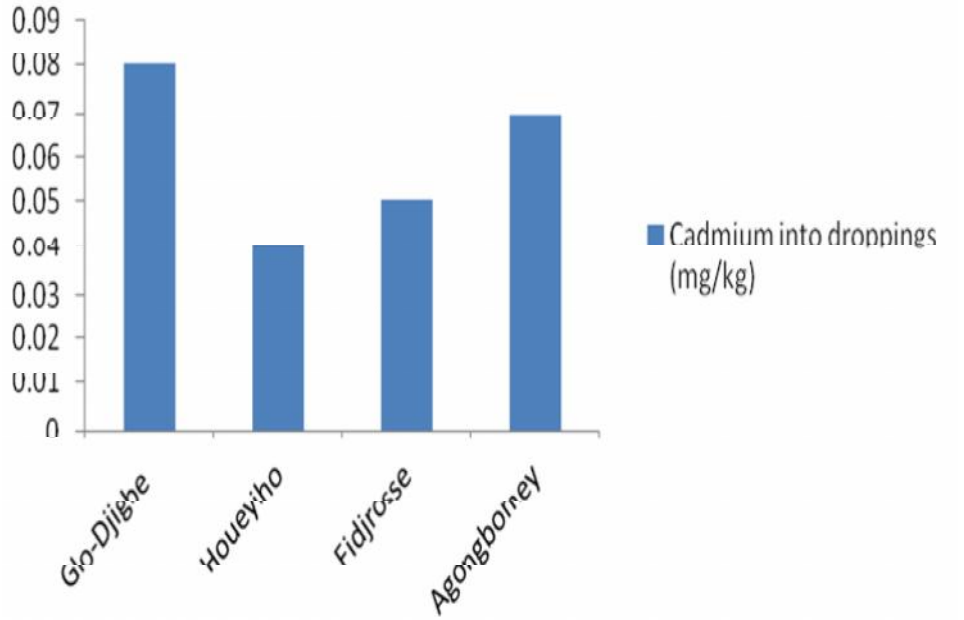

FIGURE 3: Contamination of chicken's droppings by cadmium

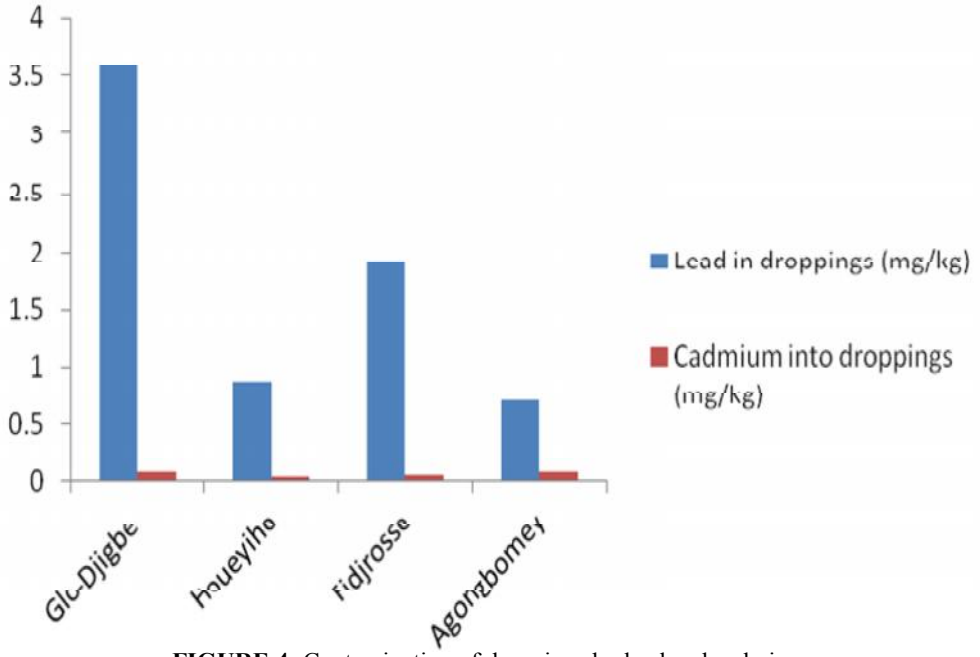

FIGURE 4: Contamination of droppings by lead and cadmium

However, it remain weak compared to the value threshold AFNOR (180 mg/kg) for lead and 3mg/kg for cadmium (Kouassi *et al*, 2008). These rates of contamination are significantly different on the level from the site of Glo compared with the other sites. That would be certainly due to the fact that the chicken's droppings used to amend these sites come from various hen houses. However, the presence of a strong lead concentration in the droppings of the pilot site of Glo (which not having known any composting) could mean that composting plays a rather significant role in the heavy metal holding capacity of the droppings. Indeed, it seems the wet and compact droppings would retain lead better than dry droppings as same manner that the heavy grounds retain some of it. (Chidikofan, 2010).

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