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EMERGING INTERNATIONAL STANDARDS IN COCOA TRADE: RECENT TREATISE ON MRL

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ABSTRACT

Contracts for the sale of cocoa beans basically require that the beans should be well fermented, dry, free from smoky and other abnormal odours. The cocoa beans should also be reasonably free from flat beans, germinated beans, fragments and pieces of shell. It should be reasonably free from insect, rodent and any other type of infestation. The cocoa beans should be reasonably uniform in size and virtually free from foreign matter and adulteration. Additionally the contracts require that good fermented beans should not be more than 4% visibly mouldy or 6% insect damaged and not have more than 8% slaty beans. This however, constitutes the basic requirement for trading on the international market. In recent time, the use of agro-chemicals to curb the population of insect pests and diseases has ushered in a new requirement. The Japanese published a “Positive List System for Agro-chemical residues” on cocoa which requires that cocoa beans with pesticide residue above prescribed limit (MRL) would not be accepted for processing. This was followed by EU with the introduction of pesticide residue legislation (EC No. 396/2005). To enforce and promote compliance to these requirements or emerging international standards, cocoa beans are routinely monitored and screened for pesticides residue in Ghana before export. Not with standing, the cocoa sector faces a lot of challenges and require arduous task to confront them. Some of these challenges emanate from methodology differentials and equipment use. Hence, this paper is an attempt to alleviate the bottomless in MRL analysis of cocoa beans.

Key words: cocoa beans, Agro-chemical, pesticides residue, MRL, international standards

INTRODUCTION

Cocoa, like other tropical crops, is often ravaged by insects, diseases and other pests that must be controlled effectively as well as safely. Pesticides can provide useful control solutions, but must be approved for use on the basis of Good Agricultural Practices (GAP).

In recent times, the extent of the use of pesticides and their mode of application including their abuse, especially in agriculture, has been of much concern to environmental scientists. Alongside their uses are also the residual effect of these pesticides and particularly their replicating effect on human health.

When a pesticide product is applied on the field, the chemical is gradually lost as a result of breakdown, leaching and evaporation and the residue is the amount that remains after application (Cox, 1995). Some pesticides have long residual activity and therefore persist in the environment whereas others have short residual activity and therefore disappear from the environment or produce low residue concentration. It is therefore not surprising to find or detect residues of pesticides in the environment. Pesticide residues on crops are monitored with reference to Maximum Residue Level (MRL) which are based on analysis of quantity of a given active ingredient remaining on food product samples (Bateman, 2008) and it is the maximum concentration of pesticide residue likely to occur in or on food and feedstuff after the use of pesticide according to GAP and will not cause any health effect or hazard (Cabtas and Martin, 1992). In International circles food crops with pesticide residue level above the stipulated MRL are likely to be rejected.

Pesticide residues determination in food crop allows us to know the quality of the food in terms of pesticide contamination. Chromatographic techniques such as Gas Chromatography (GC), High Performance Liquid Chromatography (HPLC) and Thin Layer Chromatography (TLC) have been recommended for the determination of pesticides residues. Spectrophotometry could also be used for many pesticides, and colorimetric kits are available for cholinesterase inhibiting insecticides and fungicides (Afful, 2002; Lowor, 1999). Nowadays, techniques such as Gas Chromatography-Mass Spectrometry (GC-MS), Liquid Chromatography-Mass Spectrometry (LC-MS) is becoming popular and fast gaining grounds for pesticide residues analysis (Balinova and Balinova, 2006). Gas Chromatography has traditionally, however, been used widely for analysis of pesticide residues in plants tissues, soils and water samples (Yeboah *et al.*, 2003; Roseboom and Herbold, 1980).

Pesticide residue monitoring programmes are the only tool to control the quantity of pesticides on food and to enforce tolerances. In view of increasing consumer awareness of food safety issues, traceability is becoming an important agenda for the global cocoa market. Markets now require MRLs of pesticides as an additional standard in cocoa beans.

The European Parliament amended Regulation (EC) No 396/2005 and replaced it with (EC) No 149/2008 of 29 January 2008 which set maximum levels on the amount of pesticides permitted on imported foods including cocoa beans. Consequently, all cocoa beans imported into the EU from September 2008 must conform to the new Regulation. Also, the Food Quality Protection Act (FQPA) in the U.S.A was passed and was signed into law on August 3, 1996 (WWW – 1), empowering the Environmental Protection Agency (EPA) with an enormous challenge of implementing the Nation's pesticide and food safety laws. The FQPA amended the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) and the Federal Food Drug, and Cosmetic Act (FFDCA) by fundamentally changing the way EPA regulates pesticides (WWW – 2) and the amount of pesticide residues permitted on food for consumption.

In Japan, the Ministry of Health, Labour and Welfare (MHLW) established a new legislation that came into effect from May 2006, setting new MRLs for food products. Codex, European Union, Japan, Canada, New Zealand, South Africa Malaysia, Hong Kong, Korea, India, Israel, Russian Federation and Singapore set default pesticides MRLs for cocoa beans to be 0.01mg/kg if no MRL exist (Azhar & Rahmat, 2011).

MATERIALS AND METHODS

Problems however arise from the fact that cocoa importing countries use different methodologies to establish MRLs and different analytical methods to determine pesticide residues in cocoa beans. Different MRL levels in different countries and different measurement technologies constitute complications for international trade in cocoa (ICCO, 2011). These issues call for harmonization in legislation and its implementation. Examples of some of the different methodologies applied in pesticide residues analysis are the Classical

Multi Residue Method (Luke *et al*., 1999; Anastassiades *et al.,* 2003), the Japanese MHLW Method and the QuEChERS Method (Anastassiades *et al.,* 2003).

The Japanese MHLW method is adapted by the Ghana Standards Authority and Ghana Cocoa Board for the analysis of organochlorines and organophosphates for the cocoa beans from Ghana.

Currently, Ghana is complying with the Japanese legislation – which is more stringent than the others, since it requires the use of whole cocoa beans (beans with both nib and shell) in analysis, which is more likely to result in residue violations, whereas in the EU and USA, samples of cocoa beans are first de-shelled before residue analysis takes place. A comparison study of the two methods carried out by Azhar and Rahmat (2011) in Malaysia revealed that the QuEChERS method is more effective, less time and chemical consumption, simple, safe and more environmental friendly than the Japanese MHLW method.

Since 2008, the Ghana Cocoa Board has been determining the MRLs of the cocoa beans shipped to the international (Japanese) markets**.** The Japanese pesticides of interest were: Chlorpyrifos, Fenvalerate, Pirimiphos-Methyl, Endosulfan, Promecarb and Fenitrothion. These pesticides according to the new EU legislation on pesticide residues in foodstuffs of vegetable and animal origin imported into the European Union are not to be used on cocoa. Imidacloprid and Thiametoxam active ingredient in insecticides were recently added to the Japanese list for MRL analysis.

PESTICIDE RESIDUE ANALYSIS OF COCOA BEANS FROM GHANA

The annual production of cocoa beans in Ghana between 2008 and 2010 was around 750,000 metric tons. About 40% of the cocoa beans produced were analysed for pesticide residue and only those whose residue were within the Japanese MRL were shipped. All cocoa beans are re-analysed for pesticide residue on arrival at Japan. Any pesticide residue that is above the MRL is recorded as violation. This study examined the violations in the MRL of pesticide residues in cocoa beans.

RESULTS AND DISCUSSION

The MRLs of Chlorpyrifos, Fenvalerate, Pirimiphos-Methyl, Endosulfan, Promecarb, Fenitrothion, Imidacloprid and Thiametoxam in cocoa beans set by the Ministry of Health, Labour and Welfare (MHLW) in Japan are shown on Fig. 1- . The Japanese MRLs are very stringent and any pesticide residue in cocoa beans within the MRL certifies also the European and America market.

In total, one hundred and thirteen (113) violations of MRL were recorded in Japan between 2008 and 2010 (Figure 2). High violations were recorded in 2009 with Endosulfan leading followed by Pirimiphos-Methyl and then Fenvalerate. The least violations were recorded in 2008 with Chlorpyrifos leading followed by Pirimiphos-Methyl and then Endosulfan. In 2010, Fenvalerate recorded the highest violation followed by Imidacloprid and then permethrin.

Mean concentration of Endosulfan residue in cocoa beans was far higher than the MRL in 2008. May recorded the highest followed by April and December (Figure 3). Profenofos and Fenvalerate recorded the lowest concentration in December. In all violations occurred in seven out of the twelve months of shipment of cocoa beans.

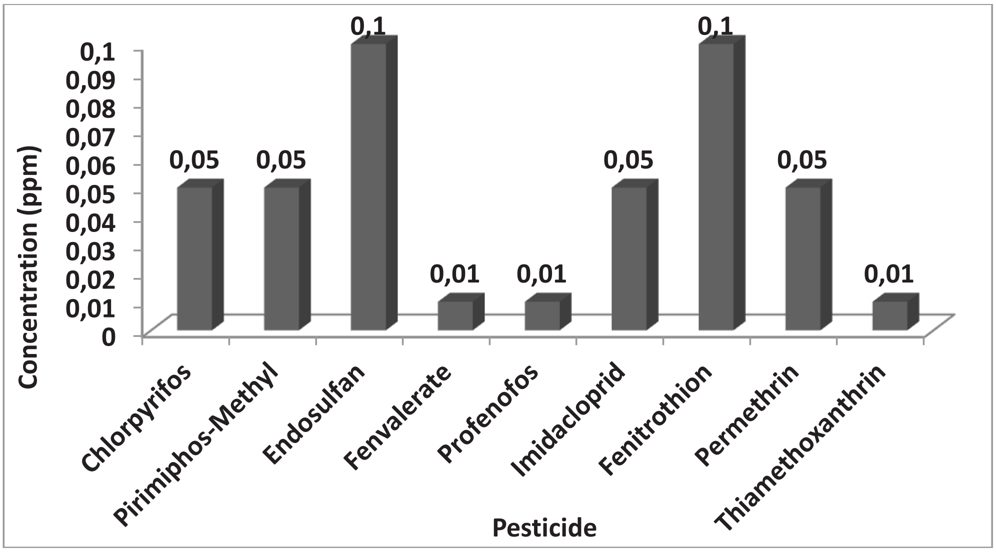

Fig. 1- MRL set by the Ministry of Health, Labour and Welfare of Japan.

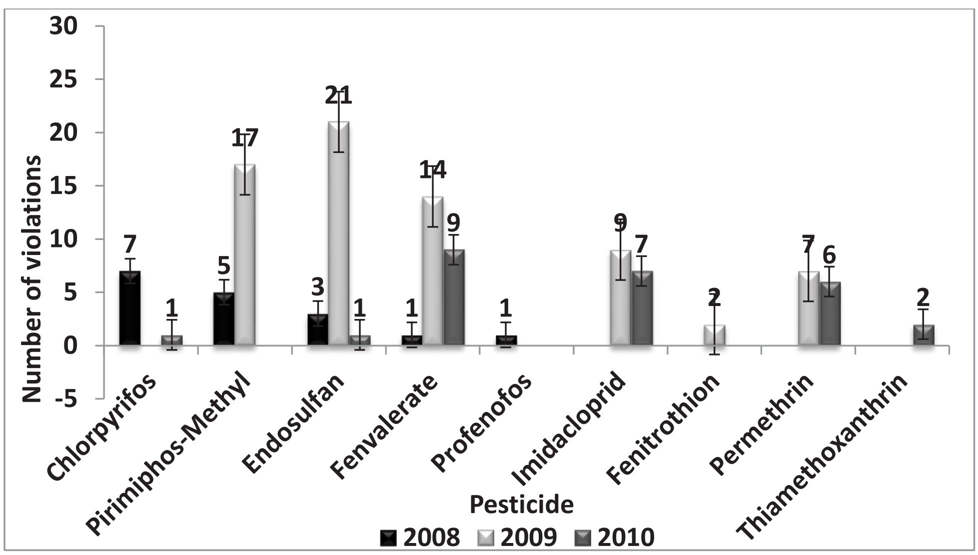

Fig. 2- Number of MRL violations of pesticide residues in cocoa beans shipped to Japan between 2008 and 2010.

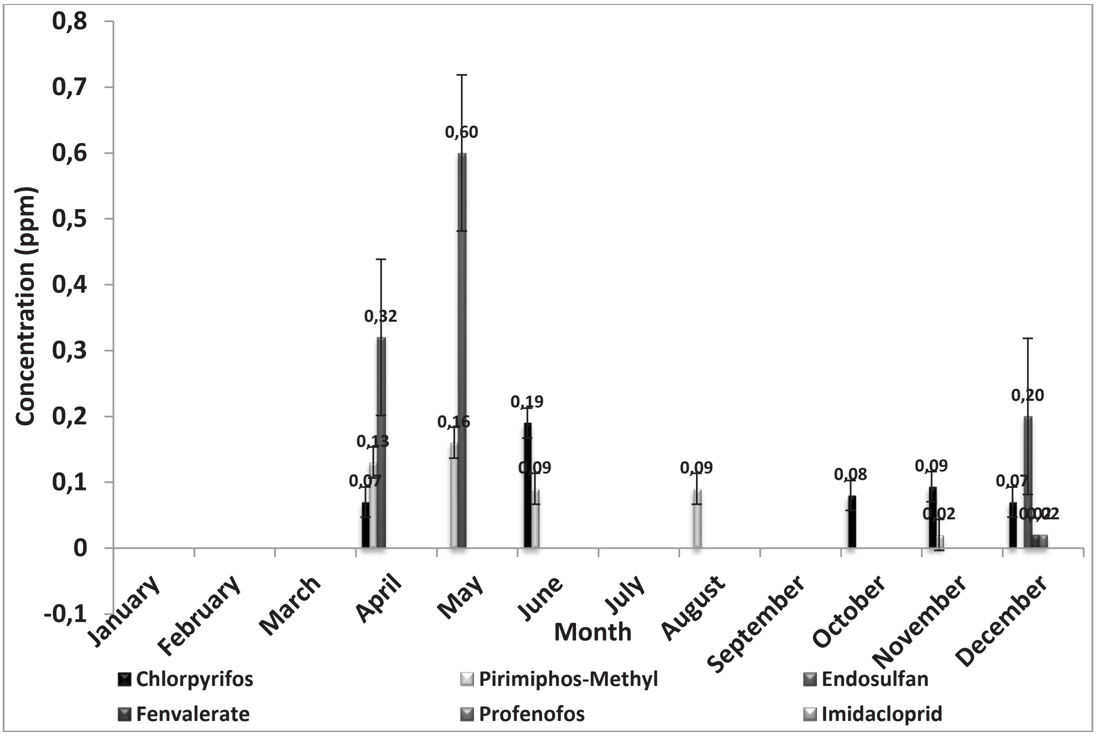

Fig. 3- Mean concentration of pesticide residue in cocoa beans shipped to Japan in 2008 in violation of MRL.

The trend was different in 2009 and the occurrence of violations was higher in this year. With the exception April, all the other eleven months in 2009 recorded violations (Fig. 4).

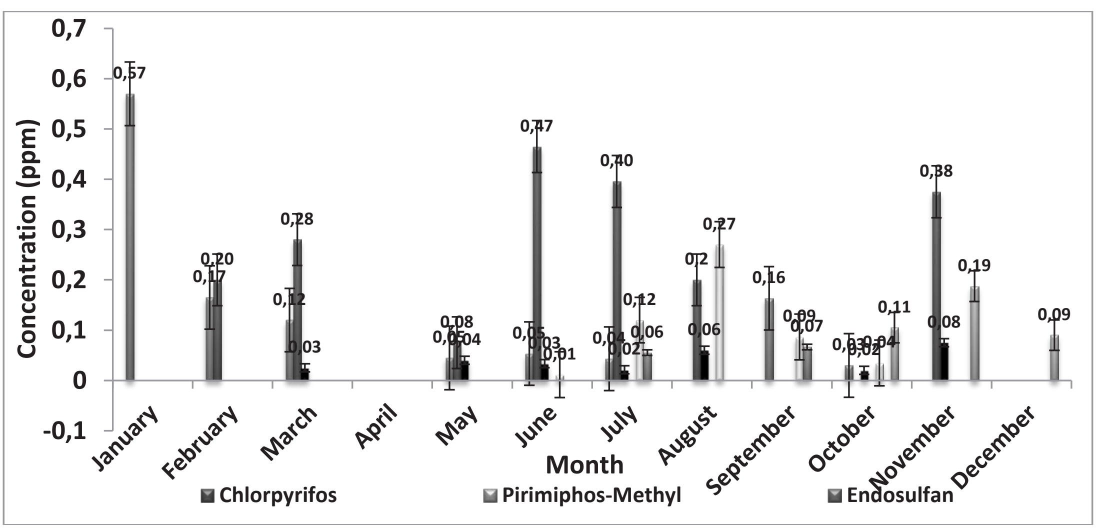

Fig. 4- Mean concentration of pesticide residue in cocoa beans shipped to Japan in 2009 in violation of MRL.

Pirimiphos-Methyl and Endosulfan had the highest frequency in violation of MRL but Pirimiphos-Methyl had the highest concentration of residues in the cocoa beans though Endosulfan generally had high concentration of residues. In 2010, violation occurred only in half of the year, thus from January to May and in July but no violation in MRL occurred in the cocoa beans at all in June and from August to December (Fig. 5).

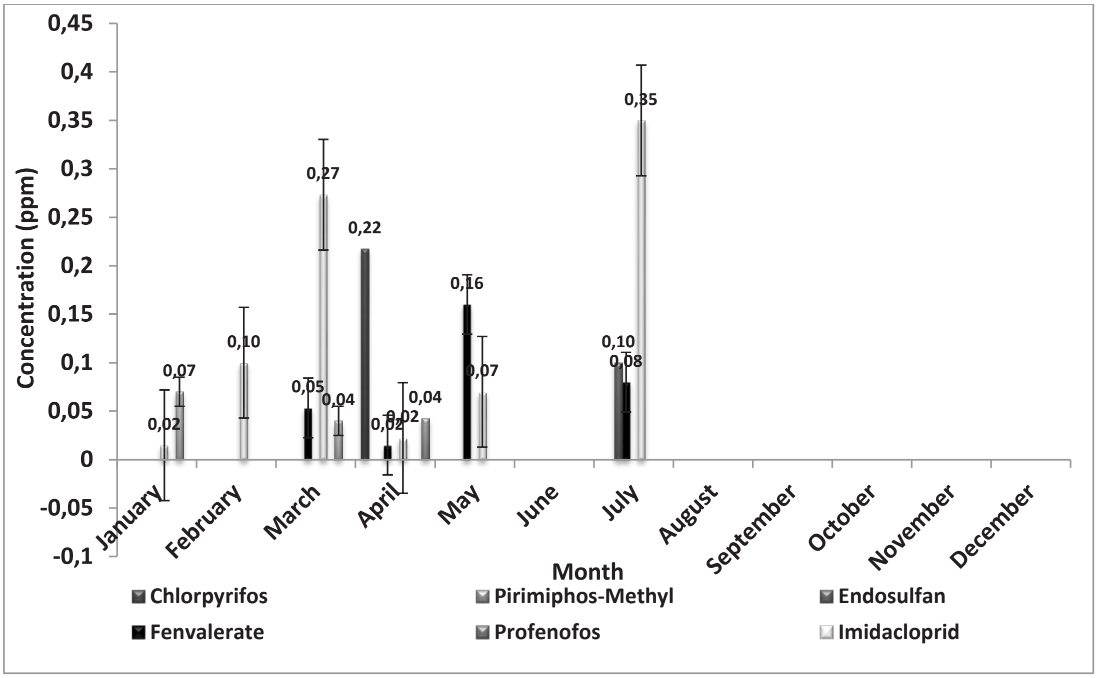

Fig. 5- Mean concentration of pesticide residue in cocoa beans shipped to Japan in 2010 in violation of MRL.

Imidacloprid recorded the highest concentration and high frequency with residue above the MRL in all the cocoa beans shipped every month. The frequency of residue above the MRL in cocoa beans was followed by Fenvalerate.

It was observed that the violation in MRL of Fenvalerate occurred frequently in cocoa beans obtained from Enchi, Dadieso, Wassa Akropong and Ashanti Bekwai Sefwi Wiawso Districts whereas that of Imidacloprid occurred frequently in cocoa beans obtained from Wassa Akropong, Sefwi Wiawso and Takoradi Districts. There was no trend in violations in MRL of other pesticides.

One major pitfall in the MRL was the frequency of violations in cocoa beans analyzed outside Ghana whilst only cocoa beans with low pesticide residue below the MRL were shipped. During the study, it was observed that the Japanese MHLW method adapted by the Ghana Standards Authority and Ghana Cocoa Board for the pesticide residue analysis was not exactly the same method that was used. The method used had gone through slight modification. The Japanese has kept on up-grading their methodology and also their instrumentation in terms of pesticide residue analysis. Currently GC-MS and HPLC recommended by the Japanese for the pesticide residue analyses are being used in Ghana. However Japan is not using GC-MS and HPLC for confirmatory pesticide residue analysis.

They are using GC-MS/MS and LC-MS/MS which have relatively lower detection limit for the confirmatory pesticide residue analysis performed in Japan. This implied that pesticide residues that were not detectable with the GC-MS and HPLC in Ghana were detected by the GC-MS/MS and LC-MS/MS in Japan. Thus rendering the MRL of pesticide residues in cocoa beans, which is an emerging international standard endless. This therefore explains why violations in the MRL of pesticide residues in cocoa beans occur frequently.

The rising cost of both instrumentation and chemicals is also a major factor to be looked at critically if MRL of pesticide residues in cocoa beans should be considered as international standard. All the various regulations notably, EU Council Directive 91/414/EEC, EU Regulation (EC) NO 396/2005, EU Commission Regulation (EC) No 149/2008, USA Food Quality Protection Act (FQPA), or H.R.1627, USA Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) and the USA Federal Food Drug, and Cosmetic Act (FFDCA) and the Japanese MHLW has an inherent mandatory force for pesticide residue to be conducted without recourse to cost implication.

CONCLUSIONS

To alleviate the bottomless in MRL of pesticide residues in cocoa beans with all the pitfalls, all methodologies must be harmonized. The methodologies developed in Japan, EU and USA must be harmonized into one standardized method. Such a method should be used for all confirmatory pesticide residue analysis on cocoa beans.

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