

Health risk assessment of pesticides residues in maize and cowpea from Ejura, Ghana

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Introduction

Exposure of the general populace to pesticides could be high in Ghana where staple foods such as maize and cowpea are regularly sprayed to protect them against insect pests. Significant contamination of maize and cowpea has been reported in some neighbouring countries (Gwary et al. 2011; Ogah et al. 2011). However, there is no quantitative information on the levels of pesticide residues and associated health risks based on the exposure of the population through maize and cowpea consumption. This work provides baseline information on contamination levels of pesticides in maize and cowpea from Ejura, the largest maize production district in Ghana. It assesses the human health risk through estimated average daily intakes (EADIs) as compared with acceptable daily intakes (ADIs) set by FAO/WHO (2010).

Material and methods

Samples were collected from 10 maize and 10 cowpea farms during harvest from Ejura in the Ashanti Region of Ghana in December 2012. Analytes were extracted using an acetone: methanol mixture (1:1 v/v) and then partitioned with dichloromethane followed by clean up on an alumina-activated charcoal (12:1) packed column. Separation and analyses were carried out on GC-ECD (for organochlorines) and GC- PFPD (for organophosphorus).

Results

Table 1. Concentration of organochlorine pesticide residues detected in maize and cowpea and EU MRL

Pesticide	Maize		Cowpea	
	Mean \pm SD (mg/kg)	EU MRL (mg/kg)	Mean \pm SD (mg/kg)	EU MRL (mg/kg)
β -HCH	0.045 \pm 0.018	0.020	0.025 \pm 0.014	0.010
γ -HCH	0.001 \pm 0.000	0.010	0.002 \pm 0.001	0.010
δ -HCH	0.002 \pm 0.001	0.020	0.003 \pm 0.001	0.010
Heptachlor	0.005 \pm 0.005	0.010	0.010 \pm 0.002	0.010
Aldrin	0.003 \pm 0.000	0.010	0.003 \pm 0.001	0.010
γ -chlordane	0.005 \pm 0.001	NA	0.002 \pm 0.001	0.010
α -endosulfan	0.001 \pm 0.001	0.050	0.001 \pm 0.001	0.050
β -endosulfan	0.103 \pm 0.101	0.050	0.081 \pm 0.045	0.050
Endosulfan sulphate	0.009 \pm 0.002	0.050	0.006 \pm 0.003	0.050
<i>p,p'</i> -DDE	0.064 \pm 0.033	0.050	0.053 \pm 0.018	0.050
<i>p,p'</i> -DDD	0.102 \pm 0.029	0.050	0.118 \pm 0.006	0.050
<i>p,p'</i> -DDT	0.002 \pm 0.001	0.050	0.003 \pm 0.001	0.050
Methoxychlor	0.002 \pm 0.002	0.010	0.003 \pm 0.001	0.010
Endrin	0.002 \pm 0.001	0.010	0.002 \pm 0.001	0.010
Dieldrin	0.002 \pm 0.000	0.010	0.003 \pm 0.002	0.010

Table 2. Concentration of organophosphorus pesticide residues detected in maize and cowpea compared with EU MRL

Pesticide	Maize		Cowpea	
	Mean \pm SD (mg/kg)	MRL (mg/kg)	Mean \pm SD (mg/kg)	MRL (mg/kg)
Dimethoate	0.004 \pm 0.001	0.020	0.008 \pm 0.003	0.020
Methamidophos	0.003 \pm 0.000	0.010	0.005 \pm 0.003	0.010
Ethoprophos	ND	0.020	ND	0.020
Phorate	ND	0.050	ND	0.050
Diazinon	0.002 \pm .001	0.010	ND	0.010
Pirimiphos-methyl	0.002 \pm 0.001	5.000	ND	0.050
Chlorpyrifos	0.013 \pm 0.004	0.050	0.015 \pm 0.007	0.050
Malathion	0.019 \pm 0.021	8.000	0.014 \pm 0.011	0.020
Fenitrothion	0.006 \pm 0.004	0.050	0.003 \pm 0.004	0.010
Parathion-methyl	0.002 \pm 0.001	0.020	0.002 \pm 0.000	0.020
Chlorfenvinphos	0.019 \pm 0.011	0.020	0.009 \pm 0.008	0.020
Profenofos	0.005 \pm 0.000	0.050	0.011 \pm 0.006	0.050
Fonofos	0.001 \pm 0.001	NA	ND	NA

*SD = standard deviation.

*NA = MRL not available for commodity analysed.

*ND = not detected

This study found various levels of pesticide contamination in maize and cowpea samples. The levels of β -HCH, β -endosulfan, p,p' -DDE, p,p' -DDD, fenpropathrin and λ -cyhalothrin in maize and β -HCH, β -endosulfan, p,p' -DDE and p,p' -DDD in cowpea were found to exceed their respective European Union MRLs. Analysis of health risks revealed that heptachlor, aldrin, dieldrin, endrin, γ -chlordane and chlorfenvinphos in maize and heptachlor and p,p' -DDD in cowpea had great potential for systemic toxicity to the consumers. The research has provided important information on pesticide residue contamination in maize and cowpea from Ghana.

References

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