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PURITY LEVEL OF DIFFERENT BRANDS OF MARKETED PESTICIDES

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Abstract

The study was undertaken to determine the purity level of eleven selected pesticides collected from different locations of Bangladesh. In this study, Gas Chromatography coupled with Flame Ionization Detector (FID) and Electron Captured Detector (ECD) was used to determine the purity of acephate, diazinon, dimethoate, chlorpyrifos, quinalphos, malathion, fenitrothion cypermethrin, fenvalerate. High Performance Liquid Chromatography (HPLC 20A Prominence) coupled with Photo Diode Array (PDA) detector was used to determine the purity of carbofuran and carbosulfan. Results indicated that 40% of the tested pesticides have lower active ingredient (ai) than stated on the label of container. A total of 11 pesticides were tested. The purity of all tested brands of fenvalerate and fenitrothion were 100%. The purity of cypermethrin ranged from 72-100%. The purity of organocarbamate pesticide carbofuran and carbosulfan ranged from 70-100% and 95-100%, respectively. The purity of dimethoate, chlorpyrifos, malathion, quinalphos, diazinon and acephate ranged from 63-100%, 67-100%, 79-100%, 83-100% and 68-100%, respectively.

Keywords: Pesticides, purity, active ingredient.

Introduction

Pesticides are used worldwide to manage agricultural pests. Farmers use pesticides for the better production of crop. However, due to the lack of knowledge and non-availability of sustainable alternatives to pesticides farmers of Bangladesh become dependent on pesticide for crop production. The negative impact of excessive and non-judicious use of pesticide can be reflected an environment and social issues can disrupt our agricultural ecosystem.

(Handa and Walia, 1996). Over the year pesticide consumption in Bangladesh increased manifold. The Pesticide consumption in 2018 was 38691.86 metric tons (Anonymous, 2019). It is assumed that adulteration of pesticide is one of the major causes of such extensive use of pesticides Kabir *et al.* (2008) & Begum *et al.* (2016).

Due to absence or little amount of active material in the formulated pesticides, they do not work properly against targeted insect pests and diseases and thus the farmers are using more pesticides for better result. In this perspective it has become imperative to analyze the available brands of pesticides in the market for

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their purity determination and to assure the effective, safer and non-hazardous for better protection of crops.

Materials and Methods

The percentage of active ingredient remain in acephate, carbofuran, diazinon, dimethoate, chlorpyrifos, quinalphos, malathion, carbosulfan, cypermethrin, fenvalerate and fenitrothion were tested in the Pesticide Analytical Laboratory, Entomology Division, BARI, Gazipur, Bangladesh. Sample of pesticides were collected from dealers of Rangpur, Jamalpur, Bogura, Cumilla, Gazipur, Jashore and Rajshahi where extensive usage of pesticides was recorded. Each formulated product either of granular or liquid was being dissolved in the respective solvent. described by Lehotay and Mastovska (2004).

In case of granular pesticides, the solid inert materials were removed by filtration. In case of liquid pesticides, the known concentration of the solutions was prepared directly. Methods for testing different brands with GC-FID, GC-ECD and HPLC-PDA were developed by setting the instrument parameters suitable for analyzing concerned pesticides selected on the basis of peak sharpness of the chromatogram and retention time for respective compound.

The amount of the active material present in each brand was determined by comparing with standard solution of concerned group of pesticide with the help of built-in software of GC (GC solution) and HPLC (LC solution). Percent purity was calculated from the actual amount of ai present in different marketed brands, the amount of ai actually required in the concerned group of pesticide.

Results and Discussion

Purity of Synthetic Pyrethroid Pesticides

The percentage of active ingredient presents in cypermethrin 10EC and fenvalarate 20EC are shown in Table 1. Thirteen popular marketed brands of cypermethrin were analyzed using GC-ECD. The purity of the selected tested brands of cypermethrin was ranged from 72% to 100%. Among thirteen tested brands, seven were 100% pure in terms of ai, four brands contained above 90% ai and two brands contained below 80% ai and the lowest one (RacyBk) contained only 72% ai. Four different popular marketed brands of fenvalerate were analyzed with GC-ECD. All the selected tested brands of fenvalerate were 100% pure in terms of ai presence (Table 1).

Purity of Organocarbamate Pesticides

The percentage of active ingredient presents in carbufuran 5G and carbosulfan 20EC are shown in Table 1. Sixteen brands of carbofuran were tested with HPLC

and the purity of the tested brands of carbofuran ranged from 70% to 100%. Among sixteen brands, ten contained 100% AI, four contained above 90% ai while two brands contained below 90% and the lowest AI (70%) present in GcfBf. The purity of all the selected tested brands of carbosulfan analyzed by HPLC was ranged from 95% to 100%. Among seven tested brands, six were 100% pure in terms of ai, while only one brand (RaCSAt) contained 95% ai of carbosulfan.

Purity of Organophosphorus Pesticides:

Eight different popular marketed brands of chlorpyrifos were analyzed by GC-ECD. The purity of the selected tested brands of chlorpyrifos was ranged from 67% to 100%. Among eight tested brands, five were 100% pure in terms of ai, two brands contained above 90% ai and one brand (Bochsf) contained 67% ai. Ten different popular marketed brands of diazinon were analyzed with GC-FID. The purity of the tested brands of diazinon ranged from 68% to 100%. Among ten tested brands, four contained 100% ai, another four brands contained above 90% ai while two brands contained below 90% ai. and the lowest one (GcfBf) contained 68% ai.

Ten different popular marketed brands of malathion were analyzed with GC-FID. The purity of the selected tested brands of malathion ranged from 79% to 100%. Among ten tested brands, five were 100% pure in terms of ai, three brands contained above 90% ai and two brands contained below 90% ai and one brand (ComGt) contained 79% ai of malathion. The purity of the selected tested brands of dimethoate analyzed with GC-FID ranged from 63% to 100%. Among thirteen tested brands, six were 100% pure in terms of ai, four brands contained above 90% ai and three brands contained below 90% ai and only one brand (CoDtTt) had 63% ai (Table 2.)

The percentage of active ingredient presents in the acephate 75SP, quinalphos 25 EC and fenitrothion 50EC are shown in Table 3. Five different popular marketed brands of acephate were tested with GC-FID. The purity of the selected tested brands of acephate was ranged from 93% to 100%. Among five tested brands, one was 100% pure in terms of ai, and four brands contained above 90% a.i. one brand (RaApLa) contained 93% ai. Six different popular marketed brands of quinalphos were analyzed with GC-FID. The purity of the selected tested brands of quinalphos was ranged from 83% to 100%. Among six tested brands, five were 100% pure in terms of ai while only one brand (JsQGl) contained 83% ai. Three different popular marketed brands of fenitrothion were tested with GC-FID. The purity of all the selected tested brands of fenitrothion was 100% in terms of ai presence.

Table 1. Percentage of active ingredient presents in synthetic pyrethroid & organocarmate pesticides

Cypermethrin 10EC		Fenvalerate 20EC		Carbofuran 5G		Carbosulfan 20 EC	
Brand	Purity (%)	Brand	Purity (%)	Brand	Purity (%)	Brand	Purity (%)
JacyCt	100 ± (0.012)	RjFvsd	100±(0.094)	JaCSM	100±(0.235)	JaCSM	100±(0.235)
RjcyRt	100 ± (0.051)	RjFvRf	100±(0.014)	RjCSm	100±(0.015)	RjCSm	100±(0.015)
RjcyFR	92 ±(0.816)	JeFvs	100±(0.015)	RjCSRf	100±(0.010)	RjCSRf	100±(0.010)
RjcyKt	100 ± (0.010)	RaFvs	100±(0.456)	RaCSAt	95±(0.0496)	RaCSAt	95±(0.0496)
JecyO	100 ± (0.006)			CoCSm	100±(0.834)	CoCSm	100±(0.834)
JecyJt	100 ± (0.000)			GCSM	100 (0.005)	GCSM	100 (0.005)
RacyBk	72± (0.572)			BoCSM	100±(0.161)	BoCSM	100±(0.161)
RacyRt	100± (0.010)			RacfBf	100±(0.001)		
BocyJt	75± (0.816)			Racffn	90± (1.634)		
CocyCt	96± (1.632)			CocfB	98± (0.311)		
GcyKt	95.5± (0.849)			CocFd	100± (0.012)		
GcySp	98± (0.626)			BocfK	97± (0.685)		
GcyCnt	100± (0.073)			BocfS	80± (1.06)		
				GcfKa	100± (0.00)		
				GcfBf	70± (0.188)		
				GcfRd	100± (0.015)		

Table 2. Percentage of active ingredient presents in organophosphate pesticides

Chloropyrifos 20EC		Diazinon 60 EC/10G		Malathion 57 EC		Dimethoate 40 EC	
Brand	Purity (%)	Brand	Purity (%)	Brand	Purity (%)	Brand	Purity (%)
RjchD	100± (0.00)	RjDiH	82 ± (0.005)	RjmFf	100±(0.056)	JaDtTh	95.5±(0.235)
RjchMt	100± (0.012)	JeDiDg	94.6±(0.019)	RjmKl	100±(0.841)	JaDtSt	100± (0.006)
JechHx	100± (0.235)	RaDiBg	68± (0.030)	JemDt	84± (1.632)	RjDtDt	100±(0.010)
Jechcb	100± (0.208)	RaDiDz	100± (0.177)	JemGt	98.2 (0.249)	RjDtTf	100± (0.015)
RachPf	94± (0.141)	CoDiDg	92.5±(0.335)	RamSl	100±(0.466)	RjDtSg	100± (0.008)
RachD	100± (0.094)	GDiH	100± (0.062)	GmDt	100±(0.231)	JeDtTf	93±(0.059)
BochMt	95± (0.471)	GDiBg	96± (0.816)	ComGt	79± (0.864)	JeDtSn	99± (0.086)
Bochsf	67± (0.15)	BoDiTr	100± (0.536)	ComRn	96±(0.816)	RaDtSn	86± (0.417)
		BoDimg	100± 0.0145)	BomFf	100±(0.010)	BoDtDm	100± (0.015)
		CoDiDn	98.3±(0.567)	BomRn	94±(0.0196)	BoDtsg	100± (0.471)
						CoDtTt	63± (0.817)
						CoDtDk	88± (0.435)
						GDTJy	97.5± (0.35)

The farmers of Bangladesh are using pesticides extensively to prevent the crop loss caused by insect pests infestation, Pesticide adulteration is one of the major reasons for the excessive and indiscriminate use of pesticides. Due to the adulteration, the effectiveness of pesticides is reduced and that is why, the farmers are spraying pesticides too often to control the insect-pests. As a result of frequent application of pesticides, their residues are remaining of different agricultural commodities reported by several researchers in Bangladesh (Islam *et al.,* 2019; Islam *et al.,* 2019a; Islam *et al.,* 2019b; Rahman *et al.,* 2019; Prodhan *et al.,* 2018; Prodhan *et al.,* 2018a; Prodhan *et al.,* 2018b; Hasan *et al.,* 2017; Aktar *et. al.,* 2017; Islam *et. al.,* 2014; Hossain *et al.,* 2014; Prodhan *et al.,* 2010; Prodhan *et al.*2009; Kabir *et. al.,* 2008a; Kabir *et. al.,* 2007), the insect-pests are developing resistance and due to the excessive use of pesticide insect pollinator also declined day by day (Amin *et al*., 2014). Besides, a lot of money also spends for buying pesticides. On the other hand, extensive use of pesticides disrupts the agro eco-system and also creates several adverse effects on human health and the environment.

Table 3. Percentage of active ingredient presents organophosphate pesticides

Acephate75SP		Quinalphos 25 EC		Fenitrothion 50EC	
Brand	Purity (%)	Brand	Purity (%)	Brand	Purity (%)
JaApLa	96±(1.685)	JsQGl	83±(0.235)	RjFtsm	100± (0.010)
JeApAt	100±(0.467)	RjQKls	100±(0.816)	JeFtSm	100± (0.358)
RaAppt	99± (0.010)	RjQqu	100±(0.012)	RaFtsm	100± (0.014)
RaApLa	93± (0.45)	RaQKls	100±(0.006)		
BoApAt	100±(0.012)	CoQKls	100±(0.235)		
		GQKrl	100±(0.009)		

Conclusion

The present result indicates that, around 40% marketed brands of tested pesticides contained lower active ingredient than that stated on the label of container and this results support the overusing of pesticides due to impurities. From the present study, it is recommended that the Government of Bangladesh should take necessary steps to prevent this adulteration of pesticides.

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