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Pesticide Residues in Marketed Sesame

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Pesticides are chemicals used to enhance food production. While this factor remains important in the food industry, pesticides are also known to induce toxic effects in humans and animals. This, in part, is due to their stability in food processing (Dewailly et al. 1993; Gunn and Stevens 1976). Pesticide residues have been identified in air, water, foods, and the tissues of unborn children (Dikshith, 1991). As a result, there has been increased public awareness and concern for pesticide use among the public.

Sesamum indicum L. (Pedaliaceae) is widely used for food ingredients, topping, and edible oil in Asian countries including Korea where a large amount of sesame is consumed. However, there are few studies on pesticide residues in sesame.

The purpose of this study was to investigate the contamination by pesticide residues in seven varieties of both domestic and imported sesame purchased from sesame marketed in Seoul, Korea. This data obtained may provide basal information about reevaluation and establishment of the level of pesticide residues for public health interest.

MATERIALS AND METHODS

Seven varieties of sesame, both local and imported, were collected in different markets in Seoul, Korea: ground sesame [A], imported sesame [B], Heukimja meal [C], ground black sesame [D], Joseon sesame [E], Yechon sesame [F], and Yechon black sesame [G]. The pesticide residues were examined on the basis of the pesticide allowances, which are regulated by the Ministry of Agriculture and Fisheries in Korea (1991). Three pesticides, Benomyl, Mancozeb,

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and Metalaxyl, known as major fungicides for cultivation in sesames were analyzed by following methods:

Benomyl is a systemic fungicide belonging to the benzimidazole family. It is rapidly converted to carbendazim (MBC) during extraction. The amount of benomyl was determined by analysis of MBC (Pyysalo 1977). Sample was extracted with acetone, 2*N* HCI and dichloromethane and the upper layer collected, followed by pH adjustment to 8.5-9.0 with 0.1*M* potassium phosphate and separation by dichloromethane. The lower layer was collected for benomyl detection. HPLC analysis was done on a Waters HPLC system with two 510 pumps, 721 programmer, equipped with absorbance detector 490. The column was Bondapak C18 radial-pak (10 cm, 8 mm i.d x 10 cm). The operating conditions were: detection: UV 285 nm, 0.5 AFS; Mobil phase: 50% acetonitrile + 50% phosphate buffer (2 mL / min) and sample volume 20 µL. Limit of detection: 0.05 ppm of MBC and recovery: 92.30 %.

Mancozeb was extracted and analyzed by Keppel and Gotdon method (1971): sample was added conc. HCl and $SnC1_2$ and heated for 30 min, followed by disconnecting vacuum line and trapping CS_2. The contents of CS_2 trapped were washed with ethanol and detected at 435 nm by spectrophotometer (Gilford 260). Limit of detection: 0.1 ppm of MBC and recovery: 90 %.

To detect Metalaxyl, the finely ground sample was extracted with acetone and concentrated through celite with acetone and coagulating solution, NH_4Cl and H_3PO_4. Separation was with dichloromethane, dehydrated with anhydrous Na_2SO_4 and the residue reconstituted with acetone and hexane (15:85 v/v). The operating conditions of gas chromatography (Varian Vista 6000 Capillary GC) were: column: SGE BP-1 (0.33 mm i.d x 25 m) Film thickness 0.5pm; Injector temperature: 230 °C, detector temperature 250 °C; Split ratio: 1:30; Carrier gas: H_2, and Make-up gas: He. Limit of detection: 0.04 ppm of MBC and recovery: 90.01 %.

RESULTS AND DISCUSSION

Seven sesame samples were examined for pesticide residues. The findings are presented in Table 1. Metalaxyl residues were detected in sample B (imported sesame) and F (Yecheon sesame), 0.014 ppm and 0.04 ppm, respectively. These chromatograms are shown in Fig. 1, 2 and 3. Metalaxyl belongs to acylalanine family and is commercially named as Ridomil or Metasyl. FAO/WHO (1987) reported the maximum residue limit (MRL) of Metalaxyl in soy bean (0.1 ppm), cotton seed oil (0.05 ppm), peanuts (0.1 ppm) whereas Pesticide chemical news guide determined cotton seed oil (0.1 ppm) and peanuts (0.2 ppm). However, MRL of Metalaxyl in sesames was not established due to low consumption of sesames in western countries. Considering these MRL, the metalaxyl residues of imported and Yecheon sesames from this study were not a significant amount.

Table 1. Pesticide residues in sesames (n = 7).

Name of Sample	Pesticide Residue (ppm)		
	Metalaxyl	Mancozeb (EBDC)[a]	Benomyl (MBC)[b]
Detection Limit	0.04	0.1	0.05
A*	ND[c]	Bdl[d] 0.05	ND
B	ND	Bdl 0.07	ND
C	ND	Bdl 0.02	ND
D	ND	Bdl 0.04	ND
E	ND	Bdl 0.04	ND
F	0.04	Bdl 0.04	ND
G	ND	Bdl 0.04	ND

[a]Total EBDC calculated by CS_2 [b]MBC as carbendazim [c]ND=not detectable [d]Bdl=below detection limit (<0.1 ppm) * Sample names: A: Ground sesame B: imported sesame C: Heukimja D: Ground black sesame E: Joseon sesame F: Yechon sesame G: Yechon black sesame

Mancozeb (dithane M-45) is a complex of zinc and maneb containing 20 % manganese and 2,5-zinc. Mancozeb is known to be a safe pesticide but mancozeb or EBDC family can act as a precursor of cancer induced material, ethylenethiourea (ETU) (Ott and Gunther 1982). In this study, a trace amount of mancozeb was detected below detection limit, <0.1 ppm (Table 1). The allowance of mancozeb residue is registered in bean family (0.1 ppm), soybean (0.2 ppm), soybean oil (0.1 ppm), and peanuts (0.5 ppm) except sesames.

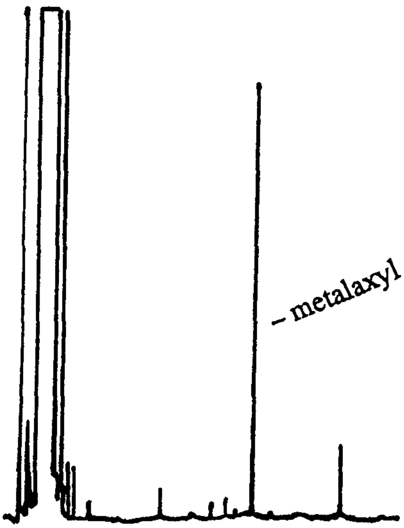

Figure 1. Standard gas chromatogram of metalaxyl.

Figure 2. Gas chromatogram of metalaxyl in imported sesame (sample B).

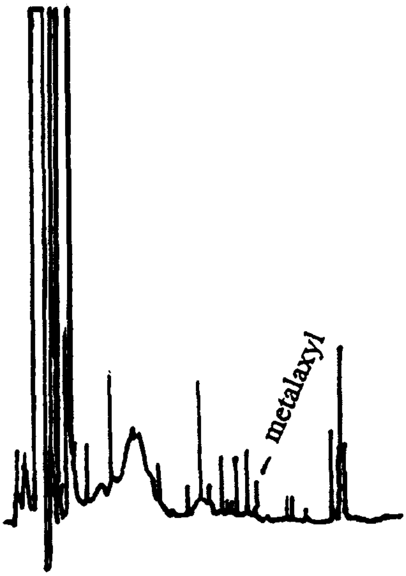

Figure 3. Gas chromatogram of metalaxyl in Yechon sesame (sample F).

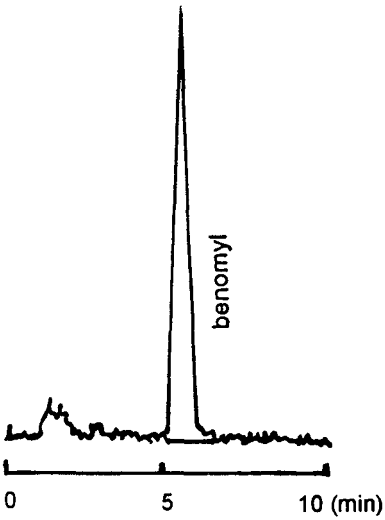

Figure 4. Standard HPLC chromatogram of benomyl.

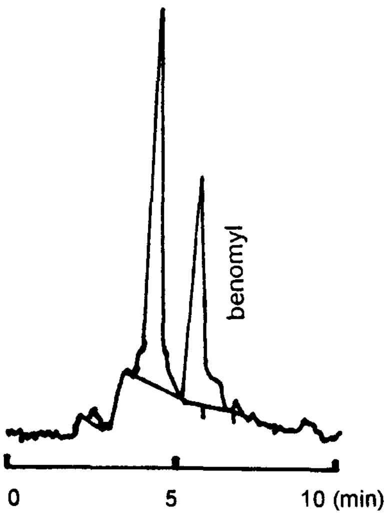

Figure 5. HPLC chromatogram of benomyl in Yechon black sesame (sample G).

Benomyl is rapidly converted to carbendazim in the environment and carbendazim is mainly decomposed by microorganisms, producing 2-aminobenzimidazole (2-AB) (WHO 1993). Therefore, benomyl and carbendazim are relevant for the evaluation of environmental effects. Benomyl may cause contact dermatitis and dermal sensitization in animals (Kuehne et al. 1985; Lisi et al. 1986) but no other effects have been repotted in humans thus far. The data obtained from HPLC are shown in Fig. 5 and 6, and carbendazim was not detected.

Residues of pesticides in food, raw agricultural commodities, humans, and environment, have not been studied extensively in most developing countries. Basic pesticide legislation and official control procedures at the national level are essential first steps in promoting the safe and effective use of pesticides (Gunn and Stevens 1976). On the basis of this study, which detected metalaxyl residue in sesame, the Korean Ministry of Health & Social Affairs should determine and establish the allowance limit of metalaxyl residue for food safety and public health.

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