

Occurrence of Organochlorine Insecticides in Vegetable Oils Produced in Korea

Su-Rae Lee, Soon-Young Kang and Yong-Hwa Kim

Environmental Chemistry Laboratory, Korea Atomic

Energy Research Institute, Seoul

(Received June 29, 1980)

한국산 植物性 기름 중 有機鹽素系 殺虫劑의 殘留量

李 瑞來 · 姜 淳英 · 金 容華

韓國原子力研究所 環境化學研究室

(1980년 6월 29일 수리)

Abstract

The appearance of organochlorine insecticides in 43 samples of refined vegetable oils including rapeseed, rice bran, sesame, perilla and corn oils produced in Korea in 1976 was investigated. Residue levels varied depending on the pesticide, oil source and production area. Gas-liquid chromatographic techniques were used to detect and quantify the presence of heptachlor, its epoxide, BHC, aldrin, endrin and DDT residues.

Introduction

During the last two decades, increasing pesticide residues in food and the environment have caused a worldwide concern⁽¹⁾. Accordingly, the use of so-called persistent pesticides in Korea was legally prohibited or limited by establishing a preharvest interval system in 1971. However, organochlorine pesticides still appear in most foodstuffs because of the previous extensive usage of these chemicals. Survey of pesticide residues in the whole diet consumed by the Korean population has not been made. Most attempts in this country were made to determine residue levels in cereals, fruits, vegetables, seafoods or milk by different investigators⁽²⁻⁶⁾. Data on pesticide residues in vegetable oils are not available at all and it seemed highly desirable to undertake a survey to detect the possible appearance of these chemi-

cals in various oils.

This survey was, therefore, attempted to determine the magnitude of some organochlorine insecticides (if any) in refined vegetable oils consumed in major cities of Korea.

Materials and Methods

Oils: Oil samples from different sources produced in 1976 were collected from the local market in major cities of Korea (Seoul, Chuncheon, Daejeon, Jeonju, Kwangju, Mokpo, Daegu, Busan) and stored at room temperature until analysis.

Analytical methods: The extraction, clean-up and analysis of the pesticides were made according to the standard procedure⁽⁷⁾ using 3 g of oil samples. The alkaline hydrolysis step was adopted for removal of interfering substances. Standard curves were constructed by injecting 3 μ l aliquots of hexane solutions containing 0.015, 0.023, 0.030,

0.150, 0.300, 1.5 and 3.0 μg of individual pesticides into the GLC column and measuring the peak area by the triangle method.

Gas chromatographic determination was made using Varian Aerograph model 2100-40 chromatograph, equipped with 6 mm \times 180 cm stainless steel, U-shaped column packed with 3% DC-200(silicone) /60~100 mesh Chromosorb W, AW and electron capture detector (^{63}Ni). The lowest detection limit by gas chromatography was about $3\times 10^{-12}\text{g}$ of the pesticides; equivalent to 0.001 ppm in oil samples. According to a test using 0.5 and 1.0 μg of each standard pesticide, the recovery ranged between 85 to 125% and reproducibility was fairly satisfactory. No correction for percentage recovery was made.

Results and Discussion

The residue levels of organochlorine insecticides in some representative vegetable oils including rapeseed, rice bran, sesame, perilla and corn are shown in Table 1. The mean levels are generally below the tolerance limits and the range varied depending on oil source and pesticide.

Drin insecticides (aldrin, dieldrin and endrin) were still detected in many of the oil sample, though their usage was banned since 1973, because of their residual toxicity. This is probably related

to their extensive usage over a 10-year period prior to banning, and it is expected that the residue level of these chemicals will continue to decline.

DDT was also detected in most oil samples reaching a maximum of 0.134 ppm in one sesame sample. This represents the highest concentration obtained in this investigation. It is believed, however, that DDT residues will also continue to decline in the coming years. BHC and heptachlor (including its epoxide) were detected to the extent of 0.01 ppm on the average. Both have been used till 1979 on limited scale in crop production. Their residue levels are still below the tolerance values set in other countries.

Mean levels of pesticide residues were 2~10 times higher in sesame and perilla oils than in rapeseed, rice bran and corn oils. Sesame and perilla oils are extracted by mechanical pressing on a small scale whereas the other three oils are processed in modernized oil mills. Different processing conditions may reflect difference in residue levels as suggested by Duggan⁽⁶⁾.

In conclusion, the levels of organochlorine insecticides found in vegetable oil samples produced in Korea are below the tolerance limits set for farm products in foreign countries. Unless a total diet survey is undertaken, the toxicological aspects of the present residue levels in vegetable oils can not be assessed appropriately.

Table 1. Residue levels of organochlorine pesticides in refined vegetable oils produced in Korea
(Unit : ppm)

Oil	No. of samples		Total BHC	Heptachlor	Heptachlor epoxide	Aldrin	Dieldrin	Endrin	DDT
Rapeseed	5	Range Mean	0.002~0.006 0.003	TR~0.002 0.001	TR~0.008 0.002	ND~0.001 0.001	ND~0.002 0.001	ND~0.002 0.001	0.006~0.053 0.019
Rice bran	7	Range Mean	0.001~0.007 0.003	ND~TR TR	TR~0.005 0.002	ND~0.001 0.001	TR~0.002 0.001	ND~0.003 0.001	0.002~0.009 0.006
Sesame	15	Range Mean	0.003~0.021 0.010	0.00~20.052 0.029	ND~0.019 0.005	ND~TR TR	TR~0.017 0.008	ND~0.088 0.013	0.024~0.134 0.048
Perilla	14	Range Mean	0.007~0.075 0.031	TR~0.011 0.006	TR~0.033 0.011	ND ND	0.002~0.057 0.017	ND~0.112 0.026	ND~0.104 0.054
Corn	2	Range Mean	0.003~0.004 0.004	TR TR	TR~0.001 0.001	ND ND	0.001 0.001	0.001 0.001	0.008~0.009 0.009
Groupwise	5(43)	Range Mean	0.001~0.075 0.010	ND~0.052 0.008	ND~0.019 0.004	ND~0.001 0.001	ND~0.057 0.006	ND~0.112 0.008	ND~0.134 0.028

TR: trace (<0.001) (Half-value of the quantitation limit was used to calculate the mean values)
ND: non-detectable

요 약

국내산 植物性 기름 중 유기염소계 殺虫劑의 殘留量을 평가하기 위하여 국내 주요도시에서 판매되는 1976년산 평지씨기름, 쌀겨기름, 참기름, 들기름 및 옥수수기름 43개 시료를 수집하여 기체크로마토그래피에 의하여 분석한 결과는 다음과 같다.

殘留水準은 농약의 성분, 기름의 종류 및 생산지역에 따라 달리 나타났다. 각 殘留成分의 전체기름에 대한 평균치는 total BHC 0.010 ppm, heptachlor 0.008 ppm, heptachlor epoxide 0.004 ppm, aldrin <0.001 ppm, dieldrin 0.006 ppm, endrin 0.008 ppm, DDT 0.028 ppm이었다.

Acknowledgement

This work was undertaken by the Joint Research Project between International Atomic Energy Agency and Korea Atomic Energy Research Institute under the Contract Numbers 1656/RB and 1656/RI/RB. Authors wish to express their thanks to Professor A. Hassan, Scientific Secretary of Chemical Residues and Pollution Section, IAEA, for his technical advice and comments.

References

1. Matsumura, F., Bousch, G. M. and Misato, T. (ed.): *Environmental Toxicology of Pesticides*, Academic Press, New York, p.637 (1972)
2. Kwon, T. W. (ed.): *Cumulative Review of the Literature on Korean Foods(II)* (1969~76), Korean Soc. Food Sci. Technol., Seoul, p.410 (1977)
3. Lee, S. R. and Kang, S. Y.: *Korean J. Food Sci. Technol.*, **8**, 219 (1979)
4. Kim, M. H., Kwon, S. P., Kwak, H. M., Yim, C. K. and Kim, C. J.: *New Medical J. (Korea)*, **17**, 1705 (1974)
5. Kim, Y. H., Song, K. J. and Lee, S. R.: *Korean J. Food Sci. Technol.*, **10**, 306 (1978)
6. Kim, Y. H. and Lee, S. R.: *Korean J. Food Sci. Technol.*, **12**, 141 (1980)
7. McMahon, B. M. and Sawyer, L. C. (ed.): *Pesticide Analytical Manual*, Food and Drug Admin., US Dept. Health, Educ. and Welfare, vol. I, section 211.14 (1977)
8. Duggan, R. E.: *Pest. Monit. J.*, **1**(4), 2(1968)