

DETERMINATION OF RESIDUAL CONTENTS OF PESTICIDES IN RICE (*ORYZA SATIVA* L.) CROP FROM DIFFERENT REGIONS OF PAKISTAN

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Abstract

The study was conducted to investigate the pesticide residues in unhusked and husked rice (*Oryza sativa* L.) on Basmati-385 and Irri-6 varieties in major rice growing areas of Punjab, Pakistan. The concentration of four pesticides was determined by gas chromatography with flame ionization detection (GC-FID). In all the 400 samples, four pesticides, *i.e.*, Karate, Malathion, Novacran and Padan were found in concentrations ranging from 19 to 148 ppm. The mean levels of pesticides in all the samples were below or just crossed the threshold limiting values (TLV). So presently there is no serious health problem due to pesticide poisoning. The results present important information on the current contamination status of an important agricultural crop in Pakistan and highlight the need for immediate action to manage the use of some excessively applied and potentially persistent pesticides.

Introduction

The primary role of agriculture is to produce a reliable supply of wholesome food to feed the burgeoning world population safely and without adverse effects on environment. The intensified agriculture, in developing countries, has therefore dictated the increasing use of agrochemicals to meet growing food demands. About 30% of the food grown in the world is lost annually because of the effects of weeds, pests and diseases as reported by International Atomic Energy Agency (1987). In spite of the known difficulties caused as a result of pesticide usage, as yet the alternative to practical control measures employing pesticides are still in the developing stage. Crop losses would be doubled, if existing pesticide uses were abandoned. The use of pesticide chemicals has often a dramatic impact on food production. However, negative effects of pesticides on non-target organisms and their effect on the environment must be recognized (Tu & Miles, 1976). Contamination of the environment and food by pesticide residues is a radically current issue in many areas of the world. Any preventive act greatly depends upon international differences, but the common final goal is still to reduce air, water, soil and food contamination, as well as to prevent both acute and chronic adverse effects for manufacturers, consumers and the world community as a whole.

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Rice (*Oryza sativa* L.) is an important cereal and second staple crop of Pakistan after wheat and particularly Basmati-385 variety is known worldwide for its aroma and taste. Rice (*Oryza sativa* L.) production constitutes the major economic activity and a key source of employment for the rural population of Pakistan (Baloch *et al.*, 2006). The area under cultivation for rice (*Oryza sativa* L.) in year 2005-06 was 5,547 thousand tonnes and so was third largest crop grown after wheat and maize (Anon., 2005-06). Punjab is a key area of rice (*Oryza sativa* L.) production of Pakistan. No useful data have been generated so far and investigation reflecting real situation of pesticide contamination have been very scanty.

The purpose of this study was to assess the pesticide residues in unhusked and husked Basmati Pk-385 and Irri-6 varieties in the major rice (*Oryza sativa* L.) growing areas of Punjab, Pakistan. The data collected are to be used as a reference point for future scrutiny as well as for providing basis for developing sustainable natural resource management practices and for taking preventive measures to reduce human health risks.

Materials and Methods

Samples: Pesticides remains were measured quantitatively in 400 (100 from each district) samples of husked and un-husked rice collected from the key rice (*Oryza sativa* L.) growing agricultural farms of Hafizabad, Kasur, Sialkot and Sheikhpura districts of Punjab, Pakistan in 2005. The samples collected belonged to Basmati Pk-385 and Irri-6 varieties (50 of each variety from each area) and random sampling method was used for said purpose (Skoog *et al.*, 2005). All samples were collected in labeled dark glass bottles, transported to the laboratory and stored for a short time at 4°C until they were evaluated for pesticide residues. The husked rice (*Oryza sativa* L.) was unhusked carefully by hands.

Materials and reagents: All organic solvents were product of Merck and redistilled before using. Standard pesticides of purity 99.0-99.9% were obtained and stock standard solutions of each pesticide was prepared in Methylene chloride at 1000mg/ml. An intermediate solution of the mixture of all pesticides was also made up in Methylene chloride.

Extraction and determination of pesticides: Extraction of pesticides was performed by a novel method developed in our lab and acetone and ethyl acetate (1:2) was used for extraction of pesticide residues from unhusked and husked rice (*Oryza sativa* L.) by Soxhelt apparatus. Clean-up and analysis of food were performed according to the Chinese standard method (Wang, 2002). Four pesticides were determined using gas chromatographic method. Three micro liters of extract were injected into a gas chromatograph (Shimadzu-9A) equipped with following instrument parameters and operating conditions; flame ionization detector; columns, capillary 30m×0.53mm packed with a mixture of 200+2.0% OV -17 and 4.5%DC, chromosorb WAW, column temperature, 240°C; detector temperature 275°C. Peak areas and retention times were calculated by comparison of retention time obtained from standard solutions of comparable strength.

Statistics analysis: Data analysis was carried out using the analysis of variance function of the "MSTATC" statistical computer package (Anon., 1991). Differences among the means were determined using the LSD test when more than two means were found to be significant (Steel & Torrie, 1984).

Results and Discussion

Pesticides are used globally in farming sector to control insect and pest population. A study of the possible contamination, of unhusked and husked rice (*Oryza sativa* L.) in four areas of Punjab viz., Kala Shah Kaku, Kasur, Sheikhpura and Batapur of Pakistan was carried out during the crop year 2005. The marked compounds detected were those used more frequently for controlling pest population of rice (*Oryza sativa* L.) crop of Pakistan. The mean levels of four pesticides in unhusked and husked rice (*Oryza sativa* L.) Basmati Pk-385 and Irri-6 varieties samples are presented in Fig. 1 and Table 1.

Fig. 1 shows that both major categories of pesticides *i.e.*, carbamate (Karate and Padan) and OP (Malathion and Novacran) residues are present in both varieties of rice (*Oryza sativa* L.) collected from each area. Interestingly the carbamate and OP pesticide residues are present in almost same ratios collected from each of these areas. It clearly indicates that environmental effects *e.g.*, watering at different times by different sources, different climatic conditions, different soil properties and use of different fertilizers has no appreciable effect on pesticide residues. It also clearly indicates that spray of fertilizers by different workers in different manner and different timings also does not affect the residue concentration. The results also demonstrate that rice (*Oryza sativa* L.) samples collected from each area contained relatively greater pesticide residues in unhusked than husked samples from same area. The reason appears that during husking, covers are removed, which leads to reduction in pesticide concentration.

Table 1 show that rice (*Oryza sativa* L.) samples collected from each area contained pesticide residues within concentrations that are equal to or just crossed TLVs set for each pesticide. So till now no serious health issues has arisen but it does not guarantee for same results in future as increasing use of pesticides on rice (*Oryza sativa* L.) may lead to concentrations that are toxic for human health.

The higher concentrations of these pesticides residues above their TLVs may be due to their non-professional use. This observation needs additional study. In order to improve economical development by providing off-season greater amounts to countries, greater volumes of pesticides are used frequently during the growing season in the rice (*Oryza sativa* L.) fields and result in rice contamination. Recent literature reveals that the largest proportion of human acute toxicity data is associated with OP pesticide intoxications (Ecobichon, 2001). The world Health Organization (Anon., 1990) estimated an annual worldwide total of some 3 million cases of acute, severe poisonings matched possibly by a greater number of unreported, with some 220,000 deaths. Additionally, many OP pesticides are considered as environmental endocrine disruptors (Song & Wang, 2001). It is obvious that pesticides should be applied in the approved manner according to their recommended volumes, rather than misused. The results also provide significant information on the current contamination status of a key agriculture crop in Pakistan and point to the need for urgent action to control the use of some excessively applied and potentially persistent pesticides.

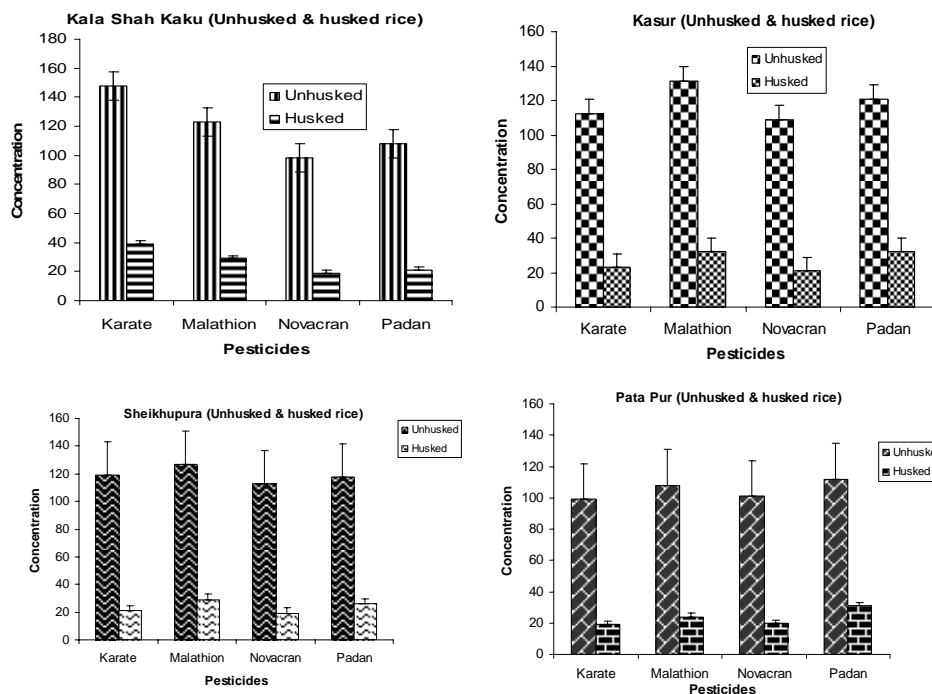


Fig. 1. Mean concentration (ppm) level of four pesticides in unhusked and husked rice (*Oryza sativa* L.) samples from kala Shah Kaku, Kasur, Sheikhupura and Batapur.

Table 1. Mean concentration (ppm) level of four pesticides in unhusked and husked rice (*oryza sativa* L.) samples from each area.

Pesticide name		Mean concentration (ppm) found in each area		Threshold limiting values
Trade	Chemical	a	b	
Karate	Cyhalothrin	90-148	19-39	20
Malathion	-	108-131	24-32	27
Novacran	Monocrotophos	98-113	19-21	24
Padan	Cartap	108-121	21-32	22

a= Un-husked rice

b= Husked rice

The higher concentrations of these pesticides residues above their TLVs may be due to their non-professional use. This observation needs additional study. Although presently there is no serious health problem observed due to pesticide residues in rice (*Oryza sativa* L.) crop. However it does not guarantee for future no health concerns.

Conclusion

The results underline that pesticide residues are present in all samples of un-husked and husked rice (*Oryza sativa* L.) varieties collected from Punjab area. Routine supervision of these pollutants in rice (*Oryza sativa* L.) is required for the prevention, control and reduction of pollution as well as for legal decisions to minimize health risks.

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