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Different Types of Pesticide Residues in foodstuffs

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***Abstract*---**Pesticide have contributed greatly to increase of yield in agriculture by controlling pests. The staggering of agriculture that has has been achieved so far has been driven by pesticide. It has negative impacts for the whole ecosystem by entering food residues. Food products were found to have contaminated 51 percent with pesticide residues were higher than the MRL. The present research was carried out to measure the concentration and awareness of pesticide residues in food stuffs and to quantify the possible health hazards linked with pesticide residue. GC-ECD/NPD was used to estimate the pesticide residues. Analysis of four common organophosphate pesticides chloropyriphos, dimethoate, profenofos, quinalphos and phorate are widely applied on fruits and vegetables was carried out. Along with this residue levels of four pyrethroid and carbamate in fruits and vegetables samples were analysed. In order to analyze the residue levels in major foodstuffs in Kerala, samples of fruits and vegetables have been collected from markets located in Thiruvananthapuram and Kasargod.

***Keywords*---**Pesticide, chloropyriphos, dimethoate, profenofos, quinalphos, phorate, fruits, vegetables, residue.

Introduction

Pesticides have played a major role in increasing agricultural output by pest control. Pesticides are agent that may be used to eliminate undesired plant or animal species during the production, storage and distribution of food. Pesticide

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contamination is becoming a major concern. Exposure to too many pesticides is considered to have harmful health effects and contribute to most of public health diseases. It acts as an endocrine disruptor and various adverse effects connected with hepatotoxicity to reproduction and development. Residue analysis is performed by food and environmental monitoring several multiresidue methods were proposed followed by detection by selective and sensitive detectors in the identification of organophosphates, organochlorine and organo nitrogen pesticides in crop material using gas chromatography. The purpose of current research was to assess the concentration of pesticide residues in food stuffs to raise awareness of their lethal effects on humans.

Organophosphate residual pesticide in fruit & vegetable samples from Trivandrum market areas

Analysis of five common organophosphate pesticides, chlorpyriphos, dimethoate, profenophos, quinalphos, and phorate, which are widely applied on fruits and vegetables, was carried out, and the residue levels are shown in Table 1.1 and Figure 1.1. Among the residues, chlorpyrifos could be detected in orange and mango samples and in three of the vegetable samples, including tomato, bitter-gourd, and carrot, in a considerable range. But the residual level is comparatively lesser than the specified levels in all samples. The samples containing dimethoate residues were found in apple, orange, and grapes in negligible amounts. The quantities were found to be above the permitted level, except in grapes. Dimethoate Residues also detected in all vegetables except that of bitter-gourd and were found to be above MRL in all of the samples. Among fruit samples, profenofos was found to be present not only in grapes in a negligible concentration but also in the samples of tomato and spinach. MRL was exceeded only in the samples of spinach. Quinalphos could be detected in the samples of apple, orange, mango, banana, bitter gourd, carrot, and cabbage. However, the residue levels exceeded the MRL in apple, banana, bitter-gourd, and cabbage samples. The presence of phorate was recorded in the samples of apples, grapes, tomatoes, spinach, and cabbage. The amount varies from 0.084 mg per kg in tomato and 0.004 mg per kg in apple. Still, the concentration exceeded MRL in the samples of grapes, tomatoes, and cabbage.

Among the organophosphate, residual pesticide found in vegetable & fruits, the highest concentration is reported in tomato is 0.084 mg per kg, then quinalphos is 0.08 mg/kg in cabbage, dimethoate is 0.047 mg per kg in spinach, & phorate is 0.035 mg per kg in grape samples. The mean sum values from the table illustrate the occurrence of the highest concentration of phorate in all the tested commodities is 0.028 mg per kg, then quinalphos is 0.024 mg per kg, chlorpyrifos is 0.019 mg/kg & dimethoate is 0.015 mg/kg. However, organophosphates present in nearly every sample are dimethoate and quinalphos.

Table 1.1 Organophosphate pesticide residues analyzed from the fruits and vegetable samples (mg/kg) collected from Trivandrum market areas

Fruit/Vegetable	Chlorpyrifos	Dimethoate	Profenphos	Quinalphos	Phorate
Apple	0	0.017*±0.05	0	0.016±0.03	0.004±0.03
Orange	0.012±0.003	0.021*±0.04	0	0.009±0.04	0
Grapes	0	0.008±0.025	0.003±0.002	0	0.035*±0.28
Banana	0	0	0	0.018±0.03	0
Mango	0.06±0.031	0	0	0.012±0.05	0
Tomato	0.029±0.002	0.018*±0.04	0.008±0.003	0	0.084*±0.006
Bittergourd	0.013±0.004	0	0	0.026*±0.07	0
Spinach	0	0.047*±0.05	0.028*±0.014	0	0.015*±0.04
Cabbage	0	0.013*±0.09	0	0.08*±0.07	0.042*±0.028
Carrot	0.008±0.06	0	0	0.004±0.08	0

N.B Values are the mean of three samples analyzed in duplicate collected from each locations. *values above corresponding MRL. The MRLs (mg/kg) for chlorpyrifos: 0.5, dimethoate: 0.02, quinalphos: 0.05, profenophos: 0.02, phorate: 0.02.

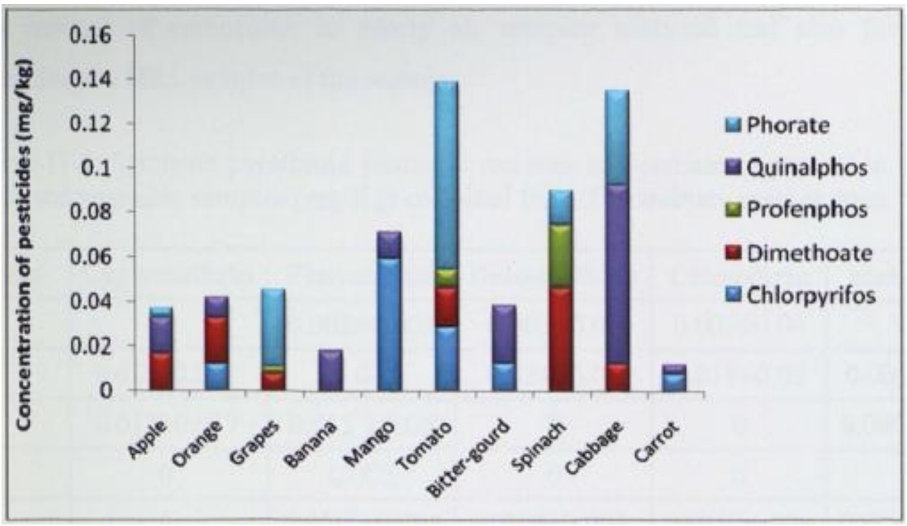

Figure 1.1: Organophosphate pesticide residues obtained from the fruits and vegetable samples (mg/kg) collected from Trivandrum market areas

Synthetic pyrethroid residual pesticide present in fruit & vegetable samples from Trivandrum market areas:

The levels of four pyrethroid residues and carbofuran in fruit and vegetable samples are illustrated in Table 1.2 and Figure 1.2. The table shows that, cypermethrin could be detected in samples of orange and grapes but was found undetected in the vegetable samples except in tomato. Still, the values never exceeded the MRL in any of the samples. The residual levels of fenvalerate were detected in more or less every sample tested except for orange, bitter gourd, and cabbage. Furthermore, the concentration exceeded the MRL in grapes, mango, and tomato and carrot samples. Deltamethrin was found in nearly all the samples, including apple, orange, mango, tomato, spinach, and carrot. Nevertheless, the concentrations were negligible and were found exceeding the permissible limit only in carrot samples. Another pyrethroid pesticide, cismethrin, was seen in three of the fruit samples, including apple, orange, and mango, and among the vegetable samples tested, only the cabbage showed the presence of the residue. However, the quantities of all the commodities were well below the MRL. The mean sum values illustrate the occurrence of the highest concentration of fenvalerate in all the tested commodities is 0.018 mg per kg, then deltamethrin is 0.016 mg per kg, cypermethrin is 0.014 mg per kg and cismethrin is 0.008 mg per kg. Table also shows the presence of carbofuran in nearly all the samples analysed and also exceeds the MRL in most of the samples.

Table 1.2: Synthetic pyrethroid residual pesticides and carbamate present in vegetable & fruit samples (mg/kg) collected from Trivandrum market areas

Pesticides	**Cypermethrin**	**Fenvalerate**	**Deltamethrin**	**Cismethrin**	**Carbofuran**
Apple	0	0.002±0.003	0.003±0.07	0.005±0.04	0
Orange	0.015±0.021	0	0.024±0.08	0.018±0.08	0.005±0.034
Grapes	0.012±0.037	0.015*±0.06	0	0	0.063*±0.028
Banana	0	0.005	0	0	0
Mango	0	0.025*±0.002	0.009±0.003	0.018±0.028	0.014*±0.004
Tomato	0.023±0.025	0.057*±0.004	0.023±0.06	0	0.018*±0.003
Bittergourd	0	0	0	0	0.013±0.009
Spinach	0.038±0.02	0.009±0.004	0.034±0.004	0	0.018*±0.015
Cabbage	0	0	0	0.012±0.019	0
Carrot	0.029±0.031	0.021*±0.003	0.046±0.005	0	0.018*±0.013

N.B: Values are the mean of three samples analyzed in duplicate collected from each locations. *values above corresponding MRL. The MRLs (mg/kg) for 0.02, cypermethrin: 0.5, fenvalerate 0.02, deltamethrin 0.05 cismethrin: 0.05 and carbofuran: 0.02.

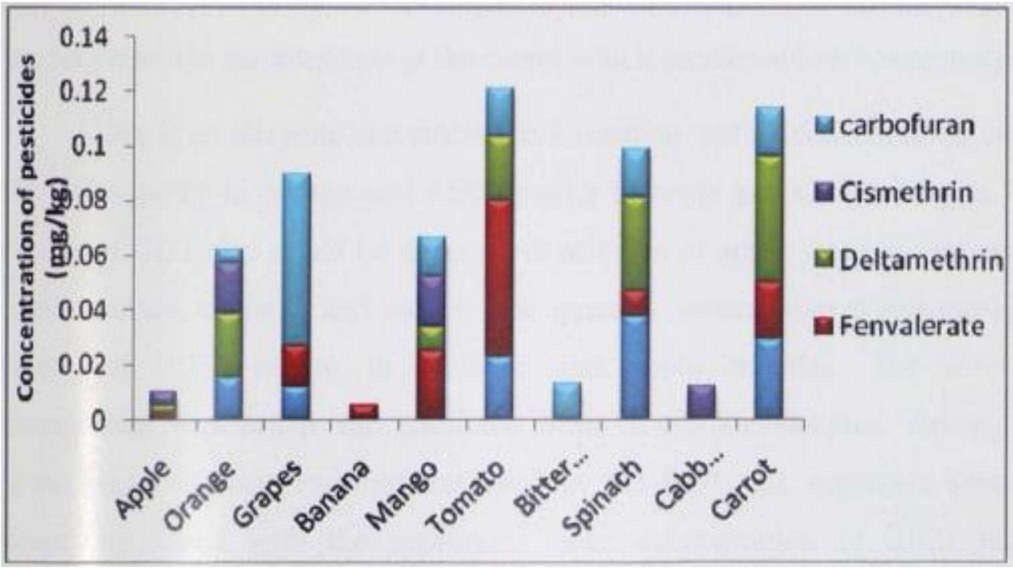

Figure 1.2: Synthetic pyrethroid residual pesticides obtained in vegetable & fruit samples collected from Trivandrum (mg/kg)

Residual Pesticides in vegetables and fruits collected from Kasargod:

Tables 1.3 and 1.4 and Figures 1.3 and 1.4 depicts the residual pesticide range and mean concentrations of organochlorine and pyrethroid pesticides present in vegetable and fruit samples collected from Kasargod's local market, Kerala.

Residual pesticides of Organochlorine in fruits & vegetables samples of Kasargod

Tables 1.3 & figure 1.3 depicts the residual pesticide range and mean concentrations of organochlorine pesticide present in vegetable & fruit samples. The residues of endosulfan could be detected in grapes, mango, and all the vegetable samples. The range was found to be 0.006 mg per kg in spinach and 0.022 mg per kg in tomato samples. All the results of tested samples reveals were found within the permitted limits. Lindane residues are found in the samples in a range of 0.058 mg per kg in tomato and 0.003 mg per kg in cabbage. The quantity exceeded MRL in samples are apple, orange, tomato, and carrot. The concentration of Dieldrin in vegetable & fruit samples was bit more, varying between 0.014 mg per kg in apples and 0.005 mg per kg in oranges. Except grapes and bananas, all the fruit varieties found residues. Also, the level of contamination was above the limit in all fruits detected except that in orange. The dieldrin residues were not present in samples except the carrot, which contained a low concentration. Aldrin is an alicyclic chlorinated hydrocarbon, and its concentration is 0.004 mg per kg in orange and 0.008 mg per kg in apple & carrot samples. DDT residues were also detected in samples of apples, oranges, grapes, tomatoes, spinach, cabbage, and carrots. The concentration range varies from 0.008 mg per kg in tomato and 0.032 mg per kg in cabbage & apple samples. The contamination level was below the Permissible limit in all the samples. Number of fruit samples and vegetable samples were analzed to check the presence of organochlorine pesticides, the maximum concentration of lindane was 0.021 mg per kg, followed by p,p[1]DDT was 0.012 mg per kg. The outcome clearly indicates that each of the varities analysed was polluted with a minimum of two pesticide residues.

Table 1.3: Organochlorine residual pesticide present in fruit & vegetable samples from Kasargod

Pesticides	**Endosulfan**	**Lindane**	**Dieldrin**	**aldrin**	**p,p'-DDT**
Apple	0	0.017*±0.02	0.014*±0.01	0.008±0.04	0.032±0.04
Orange	0	0.04*±0.03	0.005±0.03	0.004±0.0	0.021±0.02
Grapes	0.018*±0.04	0	0	0	0.017±0.06
Banana	0	0	0	0	0
Mango	0.013±0.01	0.004±0.02	0.013*±0.04	0	0
Tomato	0.022*±0.02	0.058*±0.04	0.009±0.02	0	0.008±0.01
Bittergourd	0	0	0	0	0
Spinach	0.006±0.07	0	0	0.003±0.0	0.009±0.03
Cabbage	0.009±0.03	0.003±0.06	0	0	0.032*±0.05
Carrot	0	0.028*±0.07	0.008±0.01	0.008±0.0	0.012±0.03
∑Mean level	0.008	0.021	0.006	0.003	0.012

N,B Values are the mean of three samples analyzed in duplicate collected from each locations. *values above corresponding MRL. The MRLs (mg/kg) for endosulfan: 0.02, lindane: 0.02, dieldrin; 0.01, aldrin: 0.01 and DDT: 0.05.

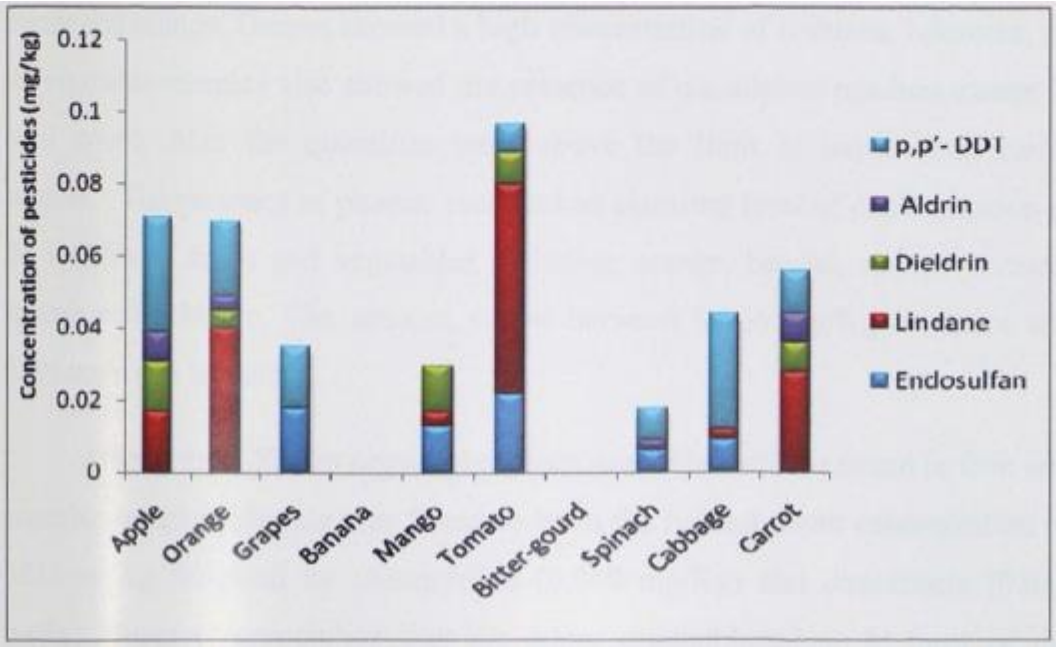

Fig. 1.3: Organochlorine pesticide residues (mg/kg) obtained from the fruits and vegetable samples collected from Kasargod

Synthetic pyrethroid residual pesticide present in fruit & vegetable samples from Kasargod:

The residue levels of four pyrethroid and carbamate in fruit & vegetable samples are illustrated in Table 1.4 and Figure 1.4. The data reveals, cypermethrin detected in all samples having 0.007 mg per kg in grapes and 0.028 mg per kg in bananas. Still, the values never exceeded the MRL in any samples. The residual level of fenvalerate was detected in more or less every sample except for banana, bitter gourd, and carrot. Furthermore, the concentration exceeded the MRL in apple, grapes, mangoes, and tomato and spinach samples. The residues of deltamethrin could not be detected in any of the samples except in tomato and carrot. Also, the residual concentration was comparatively low. Another pyrethroid, cismethrin, was also present in negligible concentrations in the samples of mango and cabbage. The carbamate pesticide carbofuran could be detected in nearly all samples except grapes, cabbage, and carrots. The level of contamination was also found to be high in all fruit samples. The range varies from 0.003 mg per kg in spinach and 0.037 mg per kg in mango samples. The values were above MRL in banana and mango samples. The results illustrated that among the various pyrethroids analyzed; the maximum mean concentration (0.022 mg per kg) was shown by fenvalerate, followed by cypermethrin (0.012 mg/kg). Among the fruit and vegetable samples, mango and tomato showed the presence of the maximum number of residues.

Table 1.4: Synthetic pyrethroid and carbamate pesticide residues obtained from the fruits and vegetable samples (mg/kg) collected from Kasargod

Pesticides	**Cypermethrin**	**Fenvalerate**	**Deltamethrin**	**Cismethrin**	**Carbofuran**
Apple	0	0.029*±0.004	0	0	0.005±0.01
Orange	0	0.003±0.013	0	0	0.012±0.018
Grapes	0.007±0.16	0.053*±0.016	0	0	0
Banana	0.028±0.002	0	0	0	0.018*±0.003
Mango	0.021±0.006	0.057*±0.018	0	0.005±0.03	0.037*±0.004
Tomato	0.024±0.005	0.028*±0.006	0.003±0.04	0	0.004±0.006
Bittergourd	0	0	0	0	0.008±0.018
Spinach	0	0.026*3±0.004	0	0	0.003±0.015
Cabbage	0.024±0.02	0.009±0.008	0	0.006±0.022	0
Carrot	0.014±0.06	0	0.013±0.0	0	0
∑Mean level	0.012	0.022	0.004	0.002	0.011

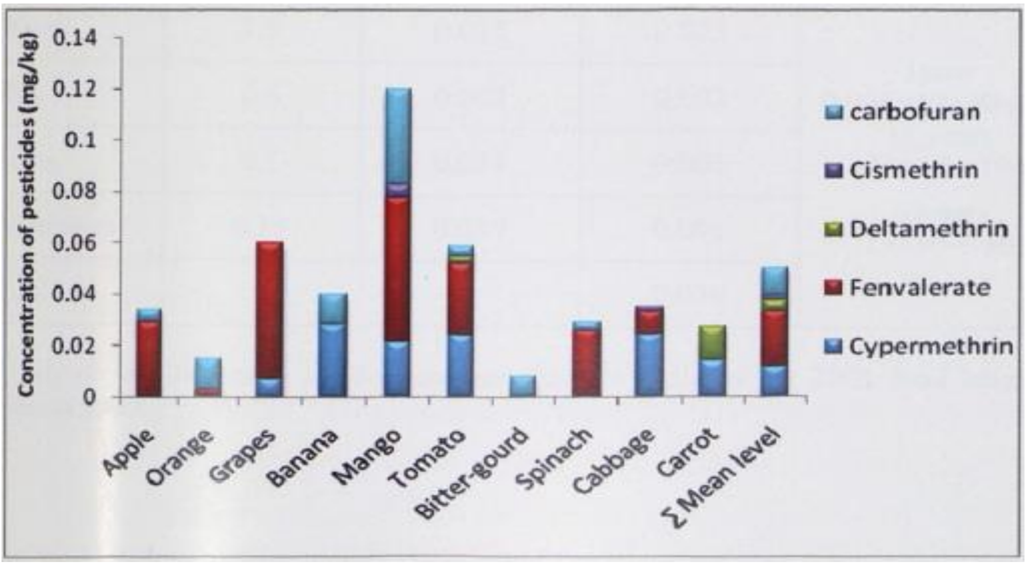

Figure 1.4: Synthetic pyrethroid residual pesticides obtained from vegetable & fruit samples (mg/kg) collected from Kasargod

Table 1.5: Estimation of phorate concentration that can be accumulated in humans after consumption of the food types analyzed

Food Item	**Daily Consumption*(X) L or kg/day**	**Concentration of residue (Y) mg/kg or L**	**Concentration of residue per day (X x Y) mg/kg or L**	**Concentration of residue accumalted (mg/kg)**
Water	1.5	0.035	0.053	1 year 0.088x12x30=31.7 15 years 31.7x15=475.5 30 years 31.7x30=951
Rice	0.6	0.015	0.009	
Fruits	0.1	0.061	0.006	
Vegetables	0.15	0.132	0.02	
Total			0.088	

Table 1.6: Estimation of fenvalerate concentration that can be accumulated in humans after consumption of the food types analyzed

Food Item	**Daily Consumption*(X) L or kg/day**	**Concentration of residue (Y) mg/kg or L**	**Concentration of residue per day (X x Y) mg/kg or L**	**Concentration of residue accumalted (mg/kg)**
Water	1.5	0.114	0.171	1 year 0.4x12x30=144 15 years 144x15=2160 30 years 144x30=4320
Rice	0.6	0.119	0.077	
Fruits	0.1	0.142	0.014	
Vegetables	0.15	0.087	0.131	
Total			0.393	

Conclusion

The present work provides information on residual pesticides in ground water, rice, fruits & vegetables, collected from different locations in Trivandrum and Kasargod, which are the southern and northern most districts of Kerala. While pesticide usage has undoubtedly enhanced agricultural productivity in general, persistent pesticide residues have a tremendous negative effect on environment & on human health.The analytical technique for pesticide residues should be sufficiently sensitive that at the very least the lowest allowable limit is quantified (Khan et al. 2007b). Current findings is entirely consistent with this advice.

Pesticide residues of Organochlorine was noticed in 30.2 percent of vegetables & fruits, pesticide residues of organophosphate were noticed in 24.7 percent, and pesticide residues of synthetic pyrethroid are noticed in 41.1 percent samples. Dieldrin quickly converts aldrin to its epoxide (GESAMP, 1993). The presence of an average of 0.004 mg/kg aldrin in orange and 0.014 mg/kg dieldrin in tomato in the analysed samples indicates that aldrin may be converted to dieldrin in biological systems via epoxidation (Rumsey and Bond, 1974), and thus dieldrin is expected to be found at relatively higher concentrations than aldrin. Lindane is a relatively stable chemical that decomposes only under alkaline circumstances to form trichlorobenzene. This result is consistent with the reported mean concentration levels of 0.002 mg per kg and 0.004 mg per kg in the Nigerian and Indian markets, respectively (Bhanti and Taneja, 2007; Adeyeye and Osibanjo, 1999). This further indicates that lindane is widely utilised in the agricultural sector for the cultivation of fruits and vegetables.

Additionally, 61% of fruits and vegetables samples tested positive for contamination, with 18.7% of samples testing positive for pesticide residues above the MRL and 42.3 percent testing positive for pesticide residues below the MRL.Only 39% of samples evaluated did not contain detectable levels of the pesticides being monitored. A comparable investigation was conducted in the Danish market, which revealed pyrethroid pesticide residues in 54% of fruit samples and 13% of vegetable samples (Andersen and Paulsen, 2001). The results of this analysis corroborate those of Kumar et al. (2006), found cypermethrin and fenvalerate residues in grapes varies from 0.045 to 0.064 mg per kg and 0.046 to 0.067 mg per kg.

Overall, almost 70% of samples tested positive for contamination, with around 25% of samples testing positive for pesticide residues above the MRL. Based on the findings of these investigations, it is suggested that a more comprehensive research encompassing all food and water in all of Kerala's districts be conducted to ascertain the precise degree of pesticide contamination.

References

[1] Agrawal GD Diffuse agricultural water pollution in India, Water Sci. Technol. 39; (1999) 33-47.

[2] Devi, Pesticides in Agriculture-A Boon or a Curse? A Case Study of Kerala, Vol. 45, No. 26/27 (JUNE 26-JULY 9, 2010), pp. 199-207 (9 pages)

[3] Agnihotri NP, Vijay P, Kumar T, Mohapatra M, Salja P Organochlorine insecticide residue in Ganga River, water near Farrukhabad, Environmental monitoring and assessment, 30(2); (1994)12-105.

[4] Ahmad S, Zia-Ul-~aq M, Imran M, Iqbal S, Iqbal JM, Ahmad Determination of residual contents of pesticides in rice (Oriza sativa L.) Crop from different regions of Pakistan Pak. J. Bot., 40(3); (2008)1253-1257.

[5] Amaraneni SR Distribution of pesticides, PAHs and heavy metals in prawn ponds near Kolleru lake wetland, India, Environ. Int. 32 (2006) 294-302.

[6] Yogeesh N, Dr. P.K. Chenniappan, "Illustrative study on intuitionistic fuzzy hyper-graphs and dual-intuitionistic fuzzy hyper-graphs", International Journal of Engineering, Science and Mathematics, 2(1), 2013, 255-264.

[7] Anonymous Joint FAO/WHO Food Standards Programme Codex Alimentarious Commission Codex Alimentarius. Section 2, Pesticide Residues in Food. Section 3, Recommended Methods of Sampling for the Determination of Pesticide Residues (1993).

[8] Anonymous Pesticides in Bottled Water, The Times of India, New Delhi, 16 October (2003). Anonymous Public health-impact of pesticides used in agriculture. World Health Organization, Geneva, (1990) pp. 47-49.

[9] Ahmad I "Pesticide Residues in Fortified Water, Soil, Food, Fruits and Vegetable Samples in Pakistan," Journal of Experimental Zoology India. 7(1); (2004) 67-72.

[10] Ahamad S, Ajmal M, Nomani AA Organochlorines and polycyclic aromatic hydrocarbons in the sediments of Ganges River (India). Bull. Environ Contamn Toxicol. 57: (1996) 794-802.

[11] Bouwer H Agriculture and Ground water quality. Civil Engg 59: (1989) 60-63.

[12] Yogeesh N, "Mathematical maxima program to show Corona (COVID-19) disease spread over a period.", TUMBE Group of International Journals, 3(1), 2020, 14 -16

[13] Cbiron S, Valverde A Fernandez-Alba A, Barcelo D. Automated sample preparation for monitoring ground water pollution by carbamate-insecticides and their transformation products. J AOAC. 78: (1995) 1346-1352.

[14] Chaturvedi, Kumari R, Murthy Re, Patel DK Analysis of pesticide residues in drinking water samples using solid-phase micro-extraction (SPME) coupled to a gas chromatography-electron-capture detector (GC-ECD). Water Science & Technology: Water Supply 11 (6); (2011) 754-764.

[15] Anwar A, Ahad I, Tahir S Determination of pesticide residues in fruits of Nawabshah District, Sindh, Pakistan. Pale J. Bot., 43(2): (2011) 1133-1139.

[16] Yogeesh N, Dr. P.K. Chenniappan, "STUDY ON HYPER-GRAPHS AND DIRECTED HYPER-GRAPHS", Journal of Advances and Scholarly Researches in Allied Education, 5(10), 2013, 1-5.

[17] Khan et al. 2007b Multi-residue Determination of Synthetic Pyrethroids and Organophosphorus Pesticides in Whole Wheat Flour using Gas Chromatography Bulletin of Environmental Contamination and Toxicology volume 79, pages 454–458 (2007).