Pesticide Burden in Women from Jaipur in Relation to Ethnicity, Religion and Addiction Habit

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***Abstract*—Pesticides, human health and safety of environment is of global concern. Organochlorine pesticides (OCPs) have been used for several decades in development of agriculture and protection of public health. Their low degradation nature, accumulation in living beings, biomagnification and biological effects in natural exposure and animal experimentation led to the legislation of allowable concentrations. This legislation was intended to prevent the exposure of the general population to harmful levels of these xenobiotics. A monitoring study was therefore, conducted in Jaipur (India) in which the circulating blood of pregnant woman subjects was analyzed for pesticide residues viz- aldrin, isomers of HCH, metabolites of heptachlor and DDT by using gas liquid chromatography. Study revealed the effect of religion (dietary habits), ethnicity and addiction habits on the accumulatory pattern of pesticide residues in the blood of pregnant women.**

***Index Terms*—Gas chromatograph, human blood, Jaipur city, organochlorine pesticide residue.**

I. Introduction

Organochlorine pesticides (OCPs) are being used in India mainly because they are cost-effective. But most of these chemicals reported to be carcinogenic [1], [2] mutagenic [2], [3] teratogenic [3], [4] immunosuppressive [5], [6] create endocrine dysfunction such as hypothyroidism or high estrogenic activity [7], [8] disturb reproductive processes [9], [10] growth depressants [11], [12] induces several psychogenic and neurogenic abnormalities in adult stages [13], [14], and are associated with abortions, premature deliveries, still births and infants with low birth weights [15]-[18]. OCPs have been in use in India nearly for a half century now. Even after having clear cut evidence suggesting that these chemicals have the ability to eliminate entire species from the planet, the annual consumption of pesticides in India is about 85,000 tonnes of which organochlorine comprise the bulk [19]. Keeping the cost benefit ratio in mind, we have largely overlooked the darker side of these chemicals i.e. unwanted and unwarranted environment pollution caused by the indiscriminate use of pesticides, secondly their biocidal activity is not only restricted to the target organism but extends to non-target organisms as well. They travel to distant places away from their point of application through the long-distance transport mechanisms and get distributed widely all across the world [20]. Therefore, today the pesticides and in particular insecticides are, perhaps the most ubiquitous of the potentially harmful chemicals encountered in the environment. The problems would further aggravate in the coming year, as many pesticides mainly organochlorines being lipophilic and non-biodegradable due to their great chemical solubility, low aqueous solubility and high fat soluble character [21] became concentrated and magnified as they move up in the food chain. Due to its stability and its capacity to accumulate in adipose tissue, it is found in human tissues, and there is now not a single living organism on the planet that does not contain DDT [22]. Since man in at the top of the food chain he receives and accumulates insecticide residues that vegetables and animals have stored up in various periods of development [23], [24] thus posing a challenge to the ecologists and toxicologists.

Taking above point into consideration, a continued surveillance on the levels of pesticide pollutants in human blood is an important task to ensure the wellbeing of the human pregnancy and health. It was, therefore, planned to conduct a study in Jaipur, the capital of Rajasthan and the pink city of India in which the blood of pregnant women subjects were analyzed for OCPs and were divided into three groups to find out that whether religion (as it effects the food habits in India), ethnicity (rural or urban) and addiction habits (tobacco, betel leaves, areca nut, smoking and others) effects the accumulation of pesticides in the blood. The above study will be of special significance for the Indian population, since, Indians have been reported to possess the highest body burden of pesticides [25].

II. Materials and Methods

The blood samples of 30 pregnant women admitted to Zanana Hospital and Mahila Chikitsalaya, Jaipur (India) attached to the Department of Obstetrics & Gynaecology, S.M.S. Medical Collage, Jaipur were analysed for the pesticide residues. These women were randomly selected and had no history of any occupational or accidental exposure to pesticides. They were grouped into three categories viz: 1) From urban and rural areas 2) Addicted to chewing tobacco, betel leaves, areca nut or smoking etc. and non-addicted ones and 4) Religion-Hindu and Muslim (consuming vegetarian and non-vegetarian diets).

The age group was ranged from 20–40 years and investigation and survey of human health in the study area was carried out by filling a questionnaire according to WHO methodology [26] and interviews of subjects at the time of collection of samples. Five ml of blood was taken by vein puncture in sterilized and heparinized vials. All the blood samples were stored at -10◦C and analysed within 48 hours of

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their storage. Extraction of pesticide residues was done according to the method prescribed by Bush and his co-workers in 1984, [27] with little modifications. Quantitative estimation of pesticide residues in all the extracts was done by HP 5890 series II gas chromatograph (GC) equipped with Ni 63 Electron capture detector (ECD) coupled to HP 3396A integrator. Glass coiled column (1.43 m x 4 mm L x I.D) was packed with Solid Support, Chromosorb 100/120 mesh size along with the Liquid phase: 1.5% OV -14±1.95% OV-210 .Purified nitrogen (IOLAR-1) gas was used as the carrier gas and a known volume of sample was injected in the column with the help of the 10 µl Hamilton syringe. Different peaks of the samples were identified by comparing their retention times with those of standards. Quantitation of the samples were done by the data obtained from the integrator and were based on peak areas. Standards were obtained from Environmental Protection agency (EPA) U.S.A. Recovery of analysis was done by fortification experiments and the percentage recovery was 95–98%. Thin layer Chromatography (TLC) was used for confirming the identity of the OCPs already detected by the GC. The pesticides for which the GC was standardized and were estimated were aldrin, isomers of HCH (α, β & γ), metabolites of heptachlor (Heptachlor & heptachlor epoxide) and DDT (DDE, DDD and DDT).

The calculations are based on biological statistics and values are expressed as mean± standard error (S.E.).The difference in the pesticide residue levels between different groups was analyzed with the help of student t test. Significance between the residue levels of different groups was judged at 5 % and 1% levels.

III. Results and Discussions

The results show in Table I, II, III.

TABLE I: Concentration of OCPs in Maternal Blood of 30 Pregnant Women of Different Area of Residence (PPM)

S. No.	OCPs detected	URBAN No. Of cases - 20 Mean ± S. E.		RURAL No. Of Cases - 10 Mean ± S. E.	
1	α – HCH	0.31 ±0.0078	(n=20)	0.74 ±0.0277*	(n=8)-
2	β- HCH	0.10 ±0.0035	(n=17)	0.041 ±0.0184*	(n=8)
3	γ- HCH	0.044 ±0.0164	(n=11)	0.058 ±0.0195	(n=7)
4	Heptachlor	0.313 ±0.1099	(n=12)	1.468 ±0.2706*#	(n=7)
5	Aldrin	0.093 ±0.0213	(n=18)	0.150 ±0.0429	(n=9)
6	Heptachlor epoxide	0.783 ±0.1849	(n=16)	0.789 ±0.3184	(n=8)
7	DDE	0.096 ±0.0452	(n=18)	0.089 ±0.0241	(n=10)
8	DDD	0.043 ±0.0151	(n=11)	0.019 ±0.0039	(n=3)
9	DDT	0.027 ±0.0074	(n=17)	0.017 ±0.0064	(n=6)
10	Σ HCH	0.062 ±0.0173	(n=20)	0.138 ±0.0291*	(n=10)
11	Σ Heptachlor	0.874 ±0.2272	(n=19)	1.572 ±0.4693	(n=9)
12	Σ DDT	0.141 ±0.0461	(n=19)	0.097 ±0.0294	(n=10)

* Statistically Significant P < .05

\# Statistically Significant P < .01

TABLE II: Concentration of OCPs in Maternal Blood of 30 Pregnant Women of Different Religion (PPM)

S. No.	OCPs detected	HINDU No. of cases - 15 Mean ± S. E.		MUSLIM No. of Cases - 15 Mean ± S. E.	
1	α – HCH	0.020 ±0.0044	(n=15)	0.76 ±0.0258*	(n=14)
2	β- HCH	0.009 ±0.0040	(n=14)	0.060 ±0.0363	(n=13)
3	γ- HCH	0.034 ±0.0212	(n=8)	0.039 ±0.0107	(n=7)
4	Heptachlor	0.391 ±0.1319	(n=11)	1.420 ±0.5127*	(n=10)
5	Aldrin	0.092±0.0254	(n=14)	0.087 ±0.0231	(n=13)
6	Heptachlor epoxide	0.839 ±0.2424	(n=11)	0.247 ±0.3653	(n=10)
7	DDE	0.121 ±0.0618	(n=13)	0.037 ±0.0090	(n=14)
8	DDD	0.018 ±0.0081	(n=7)	0.349 ±0.2840	(n=5)
9	DDT	0.018 ±0.0052	(n=11)	0.349 ±0.0103	(n=10)
10	Σ HCH	0.048 ±0.0181	(n=15)	0.137 ±0.0544	(n=15)
11	Σ Heptachlor	0.920 ±0.2669	(n=14)	1.151 ±0.7555	(n=12)
12	Σ DDT	0.139 ±0.0618	(n=14)	0.179 ±0.1070	(n=14)

* Statistically Significant P < .05

TABLE III: CONCENTRATION OF OCPS IN MATERNAL BLOOD 0F 30 PREGNANT WOMEN OF DIFFERENT ADDICTION HABITS (PPM)

S. No.	OCPs detected	Non Addicted women		Addicted women	
		No. of cases - 15		No. of Cases - 15	
		Mean ± S. E.		Mean ± S. E.	
1	α – HCH	0.25 ± 0.0064	(n=15)	046 ± 0.0096*	(n=15)
2	β- HCH	0.14 ± 0.0045	(n=14)	0.014 ± 0.0045	(n=12)
3	γ- HCH	0.041 ± 0.0225	(n=8)	0.044 ± 0.0150	(n=10)
4	Heptachlor	0.458 ± 0.0417	(n=12)	1.886 ± 0.2420	(n=10)
5	Aldrin	0.100 ± 0.0258	(n=14)	0.080 ± 0.0202	(n=14)
6	Heptachlor epoxide	1.015 ± 0.2428	(n=10)	0.704 ± 0.2397	(n=11)
7	DDE	0.0116 ± 0.0575	(n=14)	0.044 ± 0.0126	(n=12)
8	DDD	0.045 ± 0.0189	(n=7)	0.054 ± 0.0216	(n=7)
9	DDT	0.017 ± 0.0037	(n=10)	0.045 ± 0.0202	(n=20)
10	Σ HCH	0.058 ± 0.0190	(n=15)	0.058 ± 0.0190	(n=15)
11	Σ Heptachlor	1.150 ± 0.3088	(n=13)	1.040 ± 0.2966	(n=15)
12	Σ DDT	0.154 ± 0.0617	(n=14)	0.097 ± 0.0210	(n=15)

* Statistically Significant P < .05

Abbreviations used in the tables

- n: number of positive samples
- ∑HCH: Total HCH equivalent which is a sum alpha HCH, gamma HCH and beta HCH.
- ∑Heptachlor: Total Heptachlor equivalent which is a sum of Heptachlor and Heptachlor epoxide.
- ∑DDT: Total DDT equivalent which is a sum of DDD, DDE and DDT.
- ppm=parts per million=mg per liter = mg/Liter

IV. DISCUSSION

In the present study, blood of pregnant women was used for biological monitoring of pesticides which besides indicating quantitative and qualitative trends in residue deposits and distribution in pregnant women of the general population, also gives an assessment of the vulnerability of the progeny to these environmental toxins. The Concentration of OCPs estimated in the blood of pregnant women with respect to ethnicity, religion and addiction habits of the mothers are given in Table I to Table III.

Analysis of the blood specimen shows the presence of isomers of HCH, metabolites of heptachlor and DDT and aldrin. A number of OCPs used in different national programmes seem to be accessible to humans through different routes of exposure, digestive tract being the main. After the absorption, organochlorine pesticides are circulated in the blood and then distributed to different organs and tissues where they get accumulated in accordance with fat content of the tissues.

In the present finding area of residence seems to influence the accumulation of organochlorine pesticides in the maternal blood. On comparing the two groups significantly high concentration of α-HCH, γ-HCH, heptachlor and total HCH were found in the blood of pregnant women living in rural areas in comparison of women living in urban areas. The difference is statistically significant at .05 for all the above mentioned pesticides but for heptachlor difference is significant at 0.1 level too. A possible cause for this difference may be that those living in rural areas are more exposed to a polluted ecology than those living in urban areas, because agricultural fields are the main site of application of pesticides. This might have resulted in the more exposure and more accumulation of pesticides in women living in rural areas in comparison of women living in urban areas. The results of the above findings are in accordance with the results reported by Siddiqui in 1982 from Lucknow, India [28], Kumar and co-workers in 2006 from Anupgarh, India [29], Subramaniam and Soloman from Madurai, India [30] and Varona and co-workers from Colombia [31] and Zumbado and co-workers from Canary Island (Spain) [32] who reported higher levels of pesticides in the blood of the women residing in the rural areas in comparison to the women who were living in urban areas.

A general trend of high residue accumulation of pesticides was found in the blood of women of Muslims religion when compared with that of Hindu women. Residue level of α-HCH and heptachlor were significantly higher in the maternal blood of pregnant women of Muslim religion in comparison of women of Hindu religion. The difference between two groups for α- HCH and heptachlor in significant at 0.5 level. These results are in concurrence with the studies of Siddiqui (1982) from Lucknow, India [28], Kumar and his co-workers in 2006 from Anupgarh, India [29], A possible explanation for the above findings is that living and dietary habits of the Muslims are totally different from that of Hindus. A Muslim mother consumes more of the non-vegetarian dishes in comparison of Hindu mothers which is a part of their culture. The organochlorine pesticides being lipophilic tend to accumulate in the lipids and fat rich tissues and being non-biodegradable becomes persistent in the environment hence do not get metabolized or excreted. These pesticides then reach to animals and human beings through the food chain. Since, non-vegetarian dishes have animal tissues therefore; tend to be

more contaminated with OCPs. Reference [33]-[38] reports the high levels of pesticides in eggs, meat fishes, chicken and dairy products. Even the vegetable oils of corn, soybean, sunflower and mixtures of oils which are the most popular sources of cooking worldwide are reported to be contaminated with OCPs [39]. The above result clearly reflects the role of dietary habits in the body burden of OCPs in pregnant mothers.

Subject were also divided on the basis of their addiction habits and an attempt has also been made to find out whether the addiction habits towards eating or chewing supari (areca nut), tobacco or paan (betel leaves) or paan masala, or smoking plays any role in the accumulation of OCPs in the maternal blood. A general trend of high residue accumulation of OCPs was observed in blood of addicted women but significantly higher accumulation could be observed only in the case of α-HCH. The difference is significant at 0.5 levels. Probable reason for the above findings may be that, for the cultivation of tobacco, areca nut and betel (a climber), a large amount of pesticides such as DDT and DDD are widely used and are reported to be present in the significant amount as they are persistent compounds [40], [41]. Presence of endosulfan and lindane was reported by Mourkidou and Milothridou in 1990 in dry tobacco leaves and cigarettes [42]. OCPs when applied in the fields tend to get adsorbed to the betel leaf, areca nut and tobacco leaves and becomes an integral part of it. Regular chewing of these might have resulted in higher accumulation of pesticides in the body of addicted subjects as this pesticide burden is in addition to what they accumulate from their diet.

The present study reflects the national scene of magnitude of pesticide pollution and also signifies the distribution and accumulation of non-biodegradable lipophilic OCPs in pregnant women on one side and subsequently the vulnerability of the successive generations from its very inception in womb of the mother on other side. Despite the fact that the consumption of pesticides in India is still very low, which is about 0.5 kg/ha of pesticides in comparison to 6.60 and 12.0 kg/ha in Korea and Japan, respectively, there has been a widespread contamination of food commodities with pesticide residues, mainly because of non-judicious use of pesticides. 51% of the food commodities in India are contaminated with pesticide residues and out of these, 20% have pesticides residues which are above the maximum residue level values on a worldwide basis [43].

V. Conclusion

It can be concluded that the magnitude of pollution is quantitatively enough to contaminate the food and environment and the pesticide reach the human body through various sources mainly by absorption from the gastrointestinal tract through contaminated food chain, are circulated in the maternal blood, leading to their transfer to the developing foetus during gestation. Since, the pesticides are reported to be carcinogenic, mutagenic, teratogenic, immunosuppressive, induces endocrine dysfunction and high estrogenic activity, disturb the reproductive processes, growth depressants, induces several psychogenic and neurogenic abnormalities in adult stages and are also reported to be associated with abortions, premature deliveries, still births, low birth weight consequences are obvious on the mother and on the developing baby. This poses various problems of management of nutrition and health of pregnant women and calls for suggestion like special care in nutrition and in the environment of the women throughout the life especially during the pregnancy. It also reflects that there is an urgent need to develop less/non persistent and more/total biodegradable pesticides and other means by which we can to reduce the environmental pollution by the pesticides which is not only posing risk to human health but also jeopardising our future generations .

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References

[1] V. Mathur, P. Bhatnagar, R. G. Sharma, V. Acharya, and R. Sexana, "Breast cancer incidence and exposure to pesticides among women originating from Jaipur," *Environment International.*, vol. 28, no. 5, pp. 331–336, November 2002.

[1] S. Z. Ingber, M. C. Buser, H. R. Pohl, H. G. Abadin, H. E. Murray, and F. Scinicariello, "DDT/DDE and breast cancer: a meta-analysis," *Regul Toxicol Pharmacol.*, vol. 67, no. 3, pp. 421-33, 2013.

[2] S. K. Yaduvanshi, N. Srivastava, F. Marotta, S. Jain, and H. Yadav, "Evaluation of micronuclei induction capacity and mutagenicity of organochlorine and organophosphate pesticides," *Drug Metab Lett.*, vol. 6, no. 3, pp. 187-97, September 2012.

[3] Agency for Toxic Substances and Diseases Registry (ATSDR)/US Public Health Service, Toxicological Profile for 4,4'-DDT, 4,4'-DDE, 4, 4'-DDD (Update), ATSDR, Atlanta, GA.1994.

[4] R. Repetto and S. S. Baliga, "Pesticides and immunosuppression: The risks to public health," *Health Policy Plan*, vol. 12, no. 2, pp. 97-106, 1997.

[5] E. Corsinia, M. Sokootib, C. L. Gallia, A. Morettoc, and C. Colosiob, "Pesticide induced immunotoxicity in humans: A comprehensive review of the existing evidence," *Toxicology*, vol. 307, pp. 123–135, May 2013.

[6] E. Dewailly, P. Ayotte, S. Bruneau, S. Gingras, M. Belles-Isles, and R. Roy, "Susceptibility to infections and immune status in Inuit infants exposed to organochlorines," *Environ Health Perspect.*, vol. 108, no. 3, pp. 205–211, March 2000.

[7] M. Rathore, P. Bhatnagar, D. Mathur, and G. N Saxena, "Burden of organochlorine pesticides in blood and its effect on thyroid hormones in women," *Sci Total Environ.*, vol. 295, no. 1–3, pp. 207–215, August 2002.

[8] N. Pant, R. Kumar, N. Mathur, S. P. Srivastava, D. K. Saxena, and V. R. Gujrati, "Chlorinated pesticide concentration in semen of fertile and infertile men and correlation with sperm quality," *Environ Toxicol and Pharmacol.*, vol. 23, no. 2, pp. 135–139, March 2007

[9] U. Tiemann, "In vivo and in vitro effects of the organochlorine pesticides DDT, TCPM, methoxychlor, and lindane on the female reproductive tract of mammals: A review," *Reproductive Toxicology*, vol. 25, no. 3, pp. 316–326, April 2008.

[10] T. Colborn, F. S. vom Saal, and A. M. Soto, "Developmental Effects of Endocrine-Disrupting Chemicals in Wildlife and Human," *Environ. Health. Perspect*, vol. 101, no. 5, pp. 378-384, October 1993.

[11] M. Mercier, "Criteria (dose effect relationships) for organochlorine pesticides report," The Committee of the European Communities by Pergamon Press, 1981.

[12] C. F. Mactutus and H. A. Tilson, "Psychogenic and neurogenic abnormalities after perinatal insecticide exposure," Hand Book of Behavioral Teratology, Plenum Press, NY, 1986,pp. 335-391.

[13] B. Joode, C. Wesseling, H. Kromhout, P. Monge, M. Garc á, and D. Mergler, "Chronic nervous-system effects of long-term occupational exposure to DDT," *Lancet.*, vol. 357, no. 9261, pp. 1014–1016, March 2001.

[14] M. Sharma and P. Bhatnagar, "Organochlorine pesticides and preterm labour in human beings," *Current Sci.*, vol. 71, no. 8, pp. 628-630, Oct 1996.
[15] M. Sharma, "Transplacental movements of pesticides in women from Jaipur," Ph.D. thesis, University of Rajasthan, Jaipur, 1995.
[16] V. Tyagi, N. Garg, M. D. Mustafa, B. D. Banerjee, and K. Guleria, "Organochlorine pesticide levels in maternal blood and placental tissue with reference to preterm birth: A recent trend in North Indian population," *Environ Monit Assess.*, vol. 187, no. 7, pp. 471, July 2015.
[17] Q. Chen, T. Zheng, B. Bassig, Y. Cheng, B .Leaderer, S. Lin, T. Holford, J. Qiu, Y. Zhang, K. Shi, Y. Zhu, J. Niu, Y. Li, Y, H. Guo, X. Huand, and Y. Jin, "Prenatal exposure to polycyclic aromatic hydrocarbons and birth weight in China," *Open Journal of Air Pollution*, vol. 3, pp. 100-110, 2014.
[18] *India Environment Portal Knowledge for Change*, 1998.
[19] A. Kanazawa, C. Miyasita, E. Okada, S.Kobayashi, N. Washino, M. Yuasa, S. Sasaki, E. Yoshioka, F. Mizutani, Y. Chisaki, and R. Kishi, "Concentrations of persistent organochlorine pesticides in whole blood of pregnant women in Hokkaido study on environment and children's health," *Nihon Eiseigaku Zasshi.*, vol. 66, no. 1, pp. 95-107, January 2011.
[20] R. Cremlyn, *Pesticides, Preparation and Mode of Action*, Chichester Jhon Wiely and Sons,1980
[21] V. Turusov, V. Rakitsky, and L. Tomatis, "Dichlorodiphenyltrichloroethane (DDT): Ubiquity, persistence, and risks," *Environ Health Perspect*., vol. 110, no. 2, pp. 125–128, Feb. 2002.
[22] R. W. Hornabrook, P. G. Dyment, E. D. Gomes, and J. S. Wiseman, "DDT residues in human milk from new Guinea natives," *Med. J. Aust.*, vol. 1, pp. 1297-1300, 1972.
[23] W. H. Lara and H. H. C. Barreto, "Residues de pesticidas organochlorados en leite humano Sao Paulo Brasil 1979-81," *Rev. Inst. Adolfo. Lutz.*, vol. 42, pp. 45-52, 1982.
[24] W. E. Dale, M. F. Copeland, and W. I. J. Hays "Chlorinated insecticides in body fat of people in India," *Bull. World. Hlth. Orgn.*, vol. 33, pp. 471-7, 1965.
[25] WHO/EURO, "WHO protocol for second round of exposure studies: Levels of PCBs and PCDFs in human milk," 1991.
[26] B. Bush, J. Snow, and R. Kolblintz, "Polychlorobiphenyl (PCB) congeners, p,p-DDE and hexachlorobenzene in maternal and foetal cord blood from mothers in upstate, New York," *Arch. Environ. Contm. Toxicol.*, vol. 13, pp. 517-527, 1984.
[27] M. K. J. Siddiqui, "Biochemical studies on tissues accumulating pesticides," Ph.D. Thesis submitted to the University of Lucknow, India, 1982.
[28] A. Kumar, A. Baroth, I. Soni, P. Bhatnagar, and P. J. John, "Organochlorine pesticide residues in milk and blood of women from Anupgarh, Rajasthan, India," *Environ Monit Assess.*, vol. 116, no.1, pp 1-7, May 2006.
[29] K. Subramaniam and J. K. Solomon, "Organochlorine pesticides BHC and DDE in human blood in and around Madurai, India," *Indian J Clin Biochem.*, vol. 212, pp.169–172, September 2006.
[30] M. E. Varona, S. M. Díaz-Criollo, A. R. Lancheros-Bernal, A. M. Murcia-Orjuela, G. L. Henao-Londoño, and A. J. Idrovo," Organochlorine pesticide exposure among agricultural workers in Colombian regions with illegal crops: An exploration in a hidden and dangerous world," *Int. J. Environ Health Res*., vol. 20, no. 6, pp. 407-14, Decemeber 2010.
[31] M. Zumbado, M. Goethals, E. E. Alvarez-León, O. P. Luzardo, F. Cabrera, L. Serra-Majem, and L. Domínguez-Boada," Inadvertent exposure to organochlorine pesticides DDT and derivatives in people from the Canary Islands (Spain)," *Sci Total Environ.*, vol. 339, no. 1-3, pp. 49-62, March 2005.
[32] R. Ahmad, N. M. Salem, and H. Estaitieh, "Occurrence of organochlorine pesticide residues in eggs, chicken and meat in Jordan," *Chemosphere.*, vol. 78, no. 6, pp. 667-71, February 2010.
[33] E. Kampire, B. T. Kiremire, S. A. Nyanzi, and M. Kishimba, "Organochlorine pesticide in fresh and pasteurized cow's milk from Kampala markets," *Chemosphere.*, vol. 84, no. 7, pp. 923-7, August 2011.
[34] A. K. Chopra, M. K. Sharma and S. Chamoli, "Bioaccumulation of organochlorine pesticides in aquatic system — An overview," *Environ Monit Assess.*, vol. 173, no. 1-4, pp. 905-16, Febrauray 2011.
[35] P. J. John, N. Bakore, and P. Bhatnagar, "Assessment of organochlorine pesticide residue levels in dairy milk and buffalo milk from Jaipur city, Rajasthan, India," *Environ. Intern.*, vol. 26, pp. 231–236, 2001.
[36] U. K. Sarkar, V. S. Basheer, A. K. Singh, and S. M. Srivastava, "Organochlorine pesticide residues in water and fish samples: First report from rivers and streams of Kumaon Himalayan region, India," *Bull Environ. Contam. & Toxicol.*, vol. 70, no. 3, pp. 0485-0493, March 2003.
[37] R. M. Avancinia, I. S. Silvaa, A. C. Simões Rosab, P. de Novaes Sarcinellib, and S. Alexandra de Mesquitab, "Organochlorine compounds in bovine milk from the state of Mato Grosso do Sul – Brazil," *Chemosphere.*, vol. 90, no. 9, pp. 2408–2413, March 2013.
[38] M. P. González, P. I. Córser, M. A. Cagnasso, and A. G. Urdaneta, "Organochlorine pesticide residues in 4 types of vegetable oils," *Arch Latinoam Nutr.*, vol. 57, no. 4, pp. 397-401, December 2007.
[39] N. Rosa and H. H. Cheng, "Distribution of DDT 14C in Nicotiana Tabacum," *Can. J. Plant. Sci.*, vol. 54, pp. 403-407, 1974.
[40] J. J. Domanski and F. E. Guthrie, "Pesticide residues in 1972 cigars," *Bull Environ Contam Toxicol.*, vol. 11, no. 4, pp. 312-4, April 1974.
[41] E. P. Mourkidou and A. Milothridou, "Residues of endosulfan in dry tobacco leaves and cigarettes," *Bull. Environ. Contam. Toxicol.*, vol. 44, pp. 394–400, 1990.
[42] P. K. Gupta, "Pesticide exposure — Indian scene" *Toxicology.*, vol. 198, no.1–3, pp. 83–90, May 2004.

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