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AVERAGE DAILY INTAKE OF PESTICIDE RESIDUES THROUGH MILK FOR EGYPTIANS

BY

A.A. Abdel- Gawaad; A. El. Mousallamy**; M.A. Fatah;*** N.A. Labib;*** Z.M. Seleim**** and A.EZZ.****

* Faculty of agriculture, Moshtohor, Zagazig Univ.,;** Faculty of science, Zagazig Univ.; ;*** Faculty of Medicine, Cairo Univ.,; **** Faculty of agriculture, Minia Univ.

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ABSTRACT

The average daily intake of some pesticide residues for the Egyptian persons and for infants during his first year of life (6 Kg) was estimated based on the average daily intake of milk.

The estimated daily intake of aldrin and dieldrin; chlordane. ΣDDT, endrin, heptachlor, lindane and dimethoate in all milk samples for Egyptians were 0.000041; 0.000032; 0.001079; 0.000023; 0.000660; 0.000006 and 0.000016 mg/kg b.w. respectively. Also, the estimated daily intake of the same residues in milk for Egyptian infants were 0.000601 mg/kg for aldrin and dieldrin; 0.000474 mg/kg for chlordane; 0.016031 mg/kg for ΣDDT; 0.000345 mg/kg for endrin; 0.009803 mg/kg for heptachlor; 0.000096 mg/kg for lindane and 0.000243 mg/kg for dimethoate. While the acceptable daily intake for that pesticides are 0.0001; 0.0005; 0.02; 0.0002; 0.0001; 0.0080 and 0.01mg/kg respectively.

INTRODUCTION

During the present century, especially during the last three decades, it has become increasingly evident that certain chemical contaminants can produce diseases after a latent period of months or years. Thus, it is no longer sufficient to ensure that food does not contain contaminants at such levels that lead to acute intoxication, but it is also necessary to guard against the possibility of effects appearing after along latent periods. (GEMS 1991).

Milk contains the highest residue levels compared to any other food group. Residues of aldrin and dieldrin heptachlor, lindane, endrin, HCB and HCH (BHC), are generally below MRL's with a few exceptions and are slowly declining in most developed countries such as USA, Canada and Netherlands as well as some developing countries. There is no evidence of changes in these levels with time as the general trend is maintained save for Germany, Japan and some developing countries, where the level is increasing at a high rate. Whereas for DDT, its continued use in public health in some countries as India leads to the increased residue levels in these countries only. However, most of these countries did not submit data for DDT. Other countries follow the common trend for organochlorine pesticides in general. (GEMS, 1991).

Organophosphorus pesticide residues in milk, if any are almost always below detection level, no countries reported to GEMS/ food any such residues. (GEMS, 1991).

High daily intakes of PCB's in New Zealand from dairy products were reported by Pickston et al., (1985). Median levels of PCB's in 14 countries as reported in GEMS/food were below 20 ug/kg in dairy milk and were substantially higher in human milk. A general decreasing trend is seen in several countries except for Germany and Sweden where it is increasing. (GEMS, 1991).

EZZ et al., 1991 reported the average daily intake of some pesticide residues for the Egyptian infants in the first year of old based on the infants average daily intake of different food as assessed in previous survay. Results indicated that estimated daily intake (EDI) for dieldrin and endrin were 0.002187 and 0.000626 mg/kg b.w. Which exceeded the acceptable daily intake (ADI) established by the FAO/WHO.

The EDI for ΣDDT and lindane residues were below the ADI being 0.02 and 0.008 mg/kg b.w. respectively. Further more the main bulk of pesticide residues intake is obtained from the different types of milk.

Yoshida et al., 1986 studied the daily intake of pesticides in infants (0 - 3 years old). They found that HCH was detected in 100% of samples collected. DDT, dieldrin were found in 92% and 89% of samples respectively.

The average daily intake of HCH, DDT, dieldrin were 1.00, 0.45 and 0.17 mg/kg respectively.

MATERIALS AND METHODS

Milk Samples:

A total of 390 samples of fresh cow and buffalo milk and 135 packed ultra-high treated milk samples were collected from great Cairo. Only 44 of the packed samples contained powder milk which imported from other countries.

The herds produced the bulk milk samples can be devided into 19% of herds consumed concentrates and feed which produced 14% of all samples. Only 9% of herds consumed greens and produced 7% of the samples. The remaining herds (72%) which produced bulk milk constituting 53% of samples were unspecified. All of herds that produced packed samples constituting 26% of the samples were unspecified.

Extraction, clean up and determination:

The same methods conducted before by Abdel Fatah et al., 1992 were conducted.

Daily intakes:

Estimated Daily Intakes (EDIs) from milk alone, for the detected pesticide residues were calculated according to the data regarding the consumption of milk by the population at large that was obtained from FAO (1991) and from CAPMAS 1991 and 1992). The average weight for the Egyptian population used was 70 kg as was employed by Abdel Gawaad and Shams El Dine (1989) and GEMS (1991); and the data regarding the consumption of milk by infants (first year of life) and their averge weight 6 kg that was obtained from the Nutrition Institute of the Ministry of Health (Galal 1989).

EDIs for different pesticides were tabulated and compared to the established Acceptable Daily Intakes (ADIs).

RESULTS

Table (1) shows the Average Daily Consumption (ADC) of milk in Egypt according to FAO (1991) and according to CAPMAS (1991) and (1992); and the Average Daily Consumption (ADC) of milk for Egyptian infants (first year of life) according to Galal (1989).

Table (1): Average Daily Consumption [ADC] of Milk Egypt.

Group	ADC kg/person	ADC kg/kg b.wt.
Average for Egyptians*	0.1134	0.0016
Average for Egyptians**	0.0949	0.0014
Average for Egyptians infants***	0.1250	0.0208

* Calculated from PAO (1991)
** Calculated from CAPMAS (1991) and CAPMAS (1992)
*** Calculated from Galal (1989)

The Average Daily Consumption (ADC) in kilogram milk per kilogram body weight (kg/kg bw) has been calculated using an average weight for Egyptians at large of 70 kg.

The Average Daily Consumption (ADC) in kilogram milk per kilogram body weight (kg/kg bw) has been calculated using the average weight of 6 kg for Egyptian infants during the first year of life according to Galal (1989).

Data in table (2) show the Estimated Daily Intake (EDI), of the detected pesticide residues, for Egyptians (through the Consumption of milk only) in mg/kg bw according to the Average Detected Residues (ADRs) listed in table (3) and the Average Daily Consumptions (ADCs) listed in table (1). The difference between both intake levels was insignificant. The Acceptable Daily Intakes (ADIs) established by FAO/ WHO for such residues are listed for comparison.

Table (2): Estimated Daily Intake (EDI) of pestitides detected in all milk samples for Egyptians in mg/kg b.wt. compared to the established Acceptable Daily Intake (ADI).

Pesticide	EDI (FAO)	EDI (CAPMAS)	ADI
Aldrin & Dieldrin	0.000046	0.000041	0.0001
chlorodane	0.000037	0.000032	0.0005
Summation DDT	0.001233	0.001079	0.0200
Endrin	0.000026	0.000023	0.0002
Heptachlor	0.000754	0.000660	0.0001
Lindane	0.000007	0.000006	0.0080
Dimethoate	0.000019	0.000016	0.0100

Table (3): Average Detected Residues (ADR) of Pesticides or Pollutants in all milk samples.

Pesticide or Pollutant	Average Detected [ADR] mg/kg	Maximum Residue Level [MRL] mg/kg
Aldrin	0.0267	0.0060
Dieldrin	0.0022	0.0060
Aldrin and Dieldrin	0.0289	0.0060
BHC	ND	*
Chlorodane	0.0228	0.0020
Summation DDT	0.7707	0.0500
Endrin	0.0166	0.0008
Heptachlor	0.4713	0.0060
Lindane	0.0046	0.0100
Dimethoate	0.0117	*
Malathion	ND	*
Archlor 1016	ND	0.0200
Archlor 1221	ND	0.0200
Archlor 1242	ND	0.0200
Archlor 1248	ND	0.0200
Archlor 1254	ND	0.0200

* No MRL as no residue should be present in milk.

Table (4) and figure (1) show the Estimated Daily Intake (EDI), of the detected pesticide residues, for Egyptian infants during their first year of life (through the consumption of milk only) in mg/kg b.w. according to the Average Detected Residues (ADRS) listed in table (3) and the Average Daily consumptions (ADCs) listed in table (1). The Acceptable Daily Intakes (ADIS) established by FAO/WHO for such residues are listed for comparison.

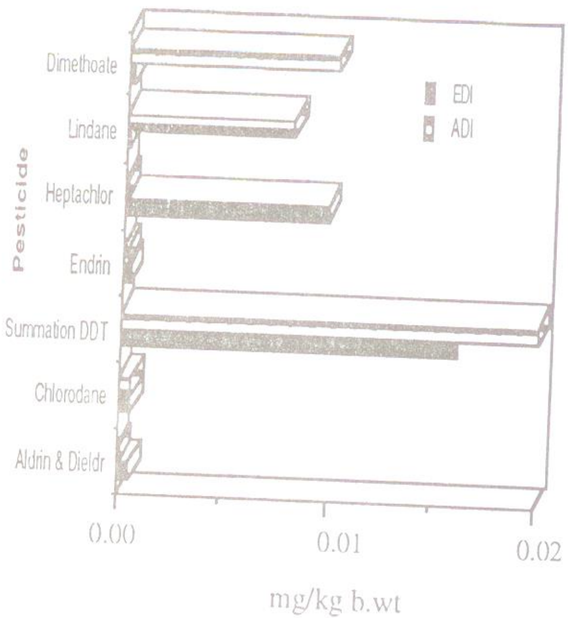

Fig. (1): Estimated and Accepted Daily Intake of pesticide residues for Egyptian infants.

Table (4): Estimated Daily Intake (EDI) from pesticides detected in all milk samples for Egyptian infants in mg/kg bw compared to the established Acceptable Daily Intake (ADI).

Pesticide	EDI	ADI
Aldrin & Dieldrin	0.000601	0.0001
chlorodane	0.000474	0.0005
Summation DDT	0.016031	0.0200
Endrin	0.000345	0.0002
Heptachlor	0.009803	0.0001
Lindane	0.000096	0.0080
Dimethoate	0.000243	0.0100

Discussion

The Estimated Daily Intake (EDI) of Aldrin and Dieldrin residues for Egyptians from milk was less than 46% of the established Acceptable Daily Intake (ADI) being 0.000046 mg/kg bw and 0.000041 mg/kg bw, based on both FAO and CAPMAS estimates.

Whereas, the Estimated Daily Intake (EDI) of Aldrin and Dieldrin residues for Egyptian infants from milk was 13 times that of the general population, and it was 6 folds the established Acceptable Daily Intake (ADI) being 0.000601 mg/kg bw.

The estimated Daily Intake (EDI) of chlordane residues for Egyptians from milk was less than 10% of the established Acceptable Daily Intake (ADI) being 0.000037 mg/kg bw and 0.000032 mg/kg bw.

Whereas, the Estimated Daily Intake (EDI) of chlordane residues for Egyptian infants from milk was 15 times that of the general population, yet it was less than 95% of the established Acceptable Daily Intake (ADI) being 0.000474 mg/kg bw.

The Estimated Daily Intake (EDI) of ΣDDT residues for Egyptians from milk was less than 6% of the established Acceptable Daily Intake (ADI) being 0.001233 mg/kg bw and 0.001079 mg/kg bw.

Whereas, the Estimated Daily Intake (EDI) of summation DDT residues for Egyptian infants from milk was 15 times that of the general population, yet it was less than 81% of the established Acceptable Daily Intake (ADI) being 0.016031 mg/kg bw.

The Estimated Daily Intake (EDI) of Endrin residues for Egyptians from milk was less than 15% of the established Acceptable Daily Intake (ADI) being 0.000026 mg/kg bw and 0.000023 mg/kg bw.

Whereas, the Estimated Daily Intake (EDI) of Endrin residues for Egyptian infants from milk was 15 times that of the general population, and it was more than 1.7 folds the established Acceptable Daily Intake (ADI) being 0.000345 mg/kg bw.

The Estimated Daily Intake (EDI) of Heptachlor residues for Egyptians was 6.6 times the established Acceptable Daily Intake (ADI) from milk alone being 0.000754 mg/kg bw and 0.000660 mg/kg bw.

Whereas, the Estimated Daily Intake (EDI) of Heptachlor residues for Egyptian infants from milk was 15 times that of the general population, and it was more than 98 folds the established Acceptable Daily Inake (ADI) being 0.009803 mg/kg bw.

The Estimated Daily Intake (EDI) of Lindane residues for Egyptians from milk was less than 0.1% of the established Acceptable Daily Intake (ADI) being 0.000007 mg/kg bw and 0.000006 mg/kg bw based on both FAO and CAPMAS estimates.

Whereas, the Estimated Daily Intake (EDI) of Lindane residues for Egyptian infants from milk was 15 times that of the general population, yet it was less than 1.2% of the established Acceptable Daily Intake (ADI) being 0.000096 mg/kg bw.

The Estimated Daily Intake (EDI) of Dimethoate residues for Egyptians from milk was less than 0.2% of the established Acceptable Daily Intake (ADI) being 0.000019 mg/kg bw and 0.000016 mg/kg bw based on both FAO and CAPMAS estimates.

Whereas, the estimated Daily Intake (EDI) of Dimethoate residues for Egyptian infants from milk was 15 times that of the general population, yet it was less than 3% of the established Acceptable Daily Intake (ADI) being 0.000243 mg/kg bw.

As there were no residues of PCB's and Malathion in milk samples, the EDI's were not estimated.

Pesticide residues and nutrition interact in a variety of ways. Optimal nutrition is mandatory of avoid the dermatological or other nutritional pathologies as malnutrition may render the body more accessible to pesticides by weakening natural barriers such as skin, respiratory epithelium and GIT mucosa. Hence pesticides enter the blood stream more quickly and in larger quantities enhancing their toxicity. Vitamin A and C deficiencies affect the integrity of the skin and its vascular system (Chadwick et al., 1971). Proteins, niacin and linoleic acid deficiencies cause skin lesions; deficiency in B group of vitamins affects the skin, mucous membranes and mucocutaneous junctions of eyes, nose and mouth; vitamin A deficiency makes the epithelial linning of the respiratory tract more permeable; chronic malnutrition affects the GIT in general and especially its absorptive function, leading to uninhibited and unconjugated absorption of pesticides directly into the blood stream "Calabrese 1980". Pesticides may influence the dietary and nutritional status by the decrease of appetite; induction of weight loss; alteration of nutrient requirements; and affect micro and macro nutrient storage sites such as the liver. Furthermore, they may affect specific metabolic pathways; increase excretion of nutrients or their metabolites; compete for a specific blood-binding site of a micro nutrient (a pesticide may require a protein fraction such as albumin as a carrier and displace vitamin A); bind with any moiety of nutritional significance (dieldrin binds with hemoglobin and albumin); trigger a metabolic effect which increases the risk of disease (DDT induces hyperlipoproteinemia, as it is transported in low density lipoproteins); may injure the microsomal fractions necessary for enzyme induction, which in turn are required for metabolic and detoxifying processes; and be distributed in organ systems which have nutrient digestive, utilization, absorption and excretion function (eg. dieldrin is excreted into bile and pancreatic juice, which may then influence dietary nutrient absorptions (Davies et al., 1986). Increased protein intake reduces the effect of pesticides, exposure alters plasma aminoacid concentrations, (Lee et al., 1964, Boyd et al., 1968, Boyd and Chen 1986, Boyd and De Costra 1968, Weatherholtz 1968, and Shakman 1974).

Organochlorine pesticides being soluble in adipose tissue are mobilized during weight loss and starvation leading to elevated plasma, renal and hepatic levels as well as human milk levels. (Dale et al., 1962, and Keane et al., 1969). The potential of metabolic hazards induced by pesticides periodically leaking into the circulation during weight loss are to be considered, especially with starvation in developing countries, preoccupation of weight loss in developed countries, and significantly during pregnancy and lactation with the risk of cross contamination to progeny. (Davison et al., 1970 and Ezz et al., 1991).

The large number of pesticides with residues exceeding the MRL being six pesticides, surpasses the number of those exceeding the ADI for the population at large being only one pesticide . This is attributed to the relatively low consumption of milk in Egypt compared to that in developed countries (FAO 1991), as the MRL for each commodity is basically inversely proportionate to the consumption of such a commodity . This relation is observed eminently in the number of those exceeding the ADI for infants being three {plus one borderline} pesticides, this is attributed to the relative high consumption of milk for the body weight of this age group which is fifteen folds that of the population at large. Hence we could reduce that MRLs for different foods are not absolute, and they should be modified from one country to another based on the local feeding pattern and habits, as observed in milk.

On the other hand, the ADI should not be calculated based on one food, but should be based on residues in all foods, (ie. total diet, or meal basket) (GEMS, 1991). However, if the EDI from one food exceeds the ADI, it is highly significant and such an estimation would be of value. Moreover, as milk constitutes only 6% of the Egyptian diet (FAO, 1991), the EDI/ADI ratio for organochlorine residues in milk, of less than 6% should suggest that the EDI from all foods should be less than the ADI as most pesticide residues are at a higher level in milk than in any other food group, (GEMS, 1991). However, this is not absolute, but could insinuate the situation. Moreover, this is not applicable to other groups such as organophosphates and carbamates as they are at a lesser level in milk than in other foods if present.

The ERLs for detected organochlorine pesticides that have been used in Egypt for the past decades are relatively high, as observed in several countries (GEMS, 1991). However, such levels are expected to remain for generations to come, or decline slowly over several decades subject to the restriction or banning of their further use (Matsumura, 1976) and (GEMS, 1991), which is the present situation as the organophosphates and carbamates have almost replaced the organochlorines in Egypt in general (CAPMES, 1990 and CAPMES, 1992) and specifically in most aspects of agriculture (MALR, 1992). Furthermore, the gradual removal of subsidies for agricultural pesticides that started in 1989 and is expected to be completed by 1993, (Malr, 1992), is anticipated to have a significant impact on reducing the abuse of pesticides as well as rendering other means of pest control more economic (Davies et al., 1986; MALR, 1992). If such a trend continues as observed in the quantities used annually over the past 3 years, the level of residues in foods in the coming decades is expected to decline (Matsumora, 1976).

Morgan (1980) summarized a variety of different types of epidemiologic studies that have looked into the association of some chronic diseases with chronic pesticide exposure. Chronic adverse effects such as peripheral neuropathy; effects on reproduction; sensitization; suspected, but unconfirmed effects including, effects on the brain, heart, liver, kidney, lung, blood, and reproductive organs, accelerated atherosclerosis, and hypertension, carcinogenesis, teratogenesis, and impaired immunity and immunopathies. These effects were of a delayed onset, protracted, recurrent, or irreversible course.

The effect of pesticides involves different organs, and no organ seems to be exempted. Examples of such effects are aplastic anemia, neurological and behavioral effects, delayed neurotoxicity, soft tissue sarcomas, and lung cancer, (Davies et al., 1986); renal tubular abnormalities, (Mann, et al. 1967); impaired male fertility, (Whorton et al., 1977); male reproductive disorders, sterility, oligospermia and hypomotility, (Cohn et al., 1978); hemorrahagic cystitis, (Folland et al., 1978); hypertension and hyperlipoproteinemia, (Morgan, 1980); hepatic disorders ranging from liver microsomal changes to angiosarcoma of the liver, (IARC Monograph, 1973); lung cancer, (Mabuchi et al., 1980); posibility of a positive relation in inducing the increasing mortality rate due to cancer (Ezz and Abdel Gawaad, 1985).

Most of such conditions are present in Egypt at an increasing rate, especially malignancies, cardiovascular system disorders and hepatic and renal failure, (Ministry of Health data Bank 1992), however, as in most developing countries, such an increase could be attributed to an improve in the surveillance and reporting systems. Furthermore, such conditions are predisposed by a variety of environmental and epidemiological conditions, of which several are endemic in Egypt such as bilharziasis, chemical pollution, .. etc.

The role of variable levels of differnt pesticide residues in food, in the induction of such maladies is significant, yet it is still ambiguous. As they could be causative factors, predisposing factors, or act as cofactors executing a further insult to the already offended organs and systems such as the liver and kidneys.

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