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Pesticide Residues in Italian Ready-Meals and dietary intake estimation during 2005.

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ABSTRACT

The investigations carried out by state-run Italian laboratories within the framework of controls seeking pesticide residues monitoring in foodstuffs involve quantifying the levels of such residues in fruit and vegetable produce and their processed products: oil, wine and fruit juices.

The Italian Ready-Meal Residue Project, promoted by the pesticides working group of Italian Environmental Agencies, seeks to asses the quantity of pesticides in pre-prepared (read-to-eat) lunches (comprising a first course, side dish, fruit, bread and wine), and to quantify the amounts consumed and compare with the ADIs.

The data provided by 16 laboratories which analysed 50 complete meals in 2005 (samples taken on 8 February, 26 May, 24 October, 21 December 2005) showed residues in 39 lunches, with an average number of 2.4 pesticides in each meal and a maximum of 10 pesticides.

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The most often found substances were: pirimiphos-methyl (20 times), procymidone (17), pyrimethanil (7), iprodione (7), cyprodinil (7), fenitrothion (6), diphenylamine (6), chlorpyrifos (6), metalaxyl (5) and chlorpyrifos-methyl (5).

The distribution of residues between each dish of the meal was also examined, and the results showed that: 77.3% of the residues were present in the fruit, 14.9 % in the wine, 3.0 % in the main course, 2.8 % in the bread and 2.1 % in the side dish.

Assuming that two meals are consumed per day, the daily intake of pesticide residues was calculated on a daily basis, in relation to normal body weight (60 kg for an adult, 40 kg for a teenager, 20 kg for a child) and compared with the ADI values established by the European Union. In the case of adults, the average daily intake of pesticides in relation to ADI was 2.6 % with a maximum of 73.3 %; for teenagers it was 4.9 % with a maximum of 109 % and for children it was 9.8 % with a peak of 219 %.

Key Words: pesticide residues; daily intake of pesticide residues, dietary exposure to pesticides, dietary intake of pesticide residues.

INTRODUCTION

Monitoring studies have been carried out regularly in Italy with the scope of checking pesticide residue levels in food: fruit, vegetables, cereals, wine and oils. The Decree of the Ministry of 23 December 1992 [1] sets out the minimum number of samples to be analysed annually for the different categories of foodstuff for each region and autonomous province.

According to the Recommendations of the Commission (last Recommendation of 18 January 2006 [2]), the European Union establishes European community monitoring programmes to guarantee that the maximum quantities of pesticide residues in products of vegetable origin are not exceeded. The Recommendations of the Commission establish the number of samples for each member state and the product/pesticide combinations that must be monitored.

Using the data for pesticide residues found in foodstuffs, it is possible to calculate the estimated daily intake (EDI) of pesticides from food, on the basis of knowledge of the diet and factors relating to the processing of the food, bearing in mind preparation (cooking, for example) and the removal of certain parts (for example the skin of bananas and oranges).

In Italy numerous studies [3-5] have been carried out to evaluate EDI and long-term (chronic) hazards resulting from ingestion of levels of pesticide residues in the diet. Total Diet Studies as defined by the WHO [6],consisting of analysis of a representative `market basket' of foods, usually prepared for normal consumption have not been carried in Italy.

The results of Total Diet Studies carried out in the United States [7,8] and in Japan [9] are available. Food and Drug Administration (FDA) [7,8] staff shop in supermarket or grocery stores four times a year, once in each of four geographical regions of the country. Shopping in three cities from each region, they buy the same foods, selected from nationwide dietary survey data, to typify the American diet. Foods from the market baskets are then prepared as the consumer would prepare them. The prepared foods are analysed for pesticide residues.

For estimation of the dietary intake of pesticide residues in France [10] the duplicate diet method was applied, consisting of analysis of exact duplicates of prepared meals eaten and drunk during a period varying from 1 to 7 days,.

The purpose of the Australian Total Diet Survey (ATDS) [11] is to estimate the level of dietary exposure of the Australian population to a range of pesticide residues, contaminants and other substances that can be found in the food supply. This is estimated by determining the mean level of the substance in foods by direct analysis of samples collected for the ATDS. The levels are then multiplied by the amount of food consumed to estimate dietary exposure.

With the New Zealand Total Diet Survey (NZTDS) [12] exposure is estimated by multiplying mean concentration data by the amount of food consumed.

The APAT-ARPA-APPA Pesticides Working Group (abbreviated to AAAF in Italian) devised, planned and performed the “Italian Ready-Meal Residue Project”, which set itself the objective of estimating the intake of pesticide from residues present in the diet. This paper presents the results of pesticide residues in Italian Ready-Meal samples, collected during the year 2005.

Sixteen Italian laboratories were involved in sampling and analysing first courses, side dishes, fruit, bread and wine.

The intake per meal was calculated taking into consideration the concentration of pesticide residues found and the quantities of the first course, side dish, fruit, bread and wine in kg, consumed during a meal. Considering that two meals per day are normally consumed, the daily intake was obtained by multiplying the intake per meal by two.

In order to compare this calculated daily intake with the acceptable daily intake (ADI), we considered an adult weighing 60 kg, a teenager of 40 kg and a child of 20 kg.

The values for the daily intake per kg of body weight calculated were compared with ADI levels established by the European Union doc. 3010 [13] and by the Australian Government in the ADI list [14].

MATERIALS AND METHODS

Laboratories Participating in the Italian Ready-Meal Residue Project

During 2005 the analytical data for the Italian Ready-Meal Residue Project was supplied by the 16 public Italian laboratories as listed in Table 1.

The laboratories analysed products of vegetable origin, seeking pesticide residues within the context of official monitoring of foodstuffs provided for by the Ministerial Decree of 23 December 1992 [1]. To participate in the project, each laboratory had to demonstrate that it had carried out the proficiency tests organised by the European Commission as established by article 28, paragraph 3 of Regulation (EC) No. 396/2005 [15].

Two analytical methods were adopted: with the first method [16], used by 14 laboratories, the sample mixed with diatomaceous earth is extracted with dichloromethane or ethyl acetate; the second method [16] provides for SPE purification with con C-18 after extraction with acetone/methanol.

Sampling

In planning the Italian Ready-Meal Residue Project the AAAF group chose to analyse the meals prepared and supplied by company cafeterias and by schools, hospitals and rest homes. Cafeterias, particularly school cafeterias, which declared that they obtained products from organic farms were excluded from the survey.

A typical Italian meal is made up of a first course (pasta, risotto or soup), a second course (meat, fish, cheese or cured meats), a vegetable side dish (raw or cooked), bread, fruit and wine.

The second course was not analysed as products of animal origin are less likely to contain pesticide residues.

The samples were collected at four different times during the year: in February, May, October and December, and on different days of the week. Sampling of the meals took place as follows: 1st sample on Tuesday 8 February 2005; 2nd sample on Thursday 26 May 2005; 3rd sample on Monday 24 October; 4th sample on Wednesday 21 December 2005.

In many of the cafeterias where sampling was carried out wine was not available; in these cases the sample of wine analysed was purchased at a supermarket.

Sample Preparation and Analysis

The AAAF group supplied all the laboratories participating in the Italian Ready-Meal Residue Project with a procedure for the preparation of samples to be analysed and for data reporting .

The procedure involved the laboratory weighing and recording the weight of the first course, the side dish, fruit and bread. The quantity of wine used for the calculation of the intake of pesticide residues was 0.250 kg per meal.

It was also necessary to check and record the composition of each dish; for example, mixed salad made up of carrot, lettuce and tomato.

In order to be able to calculate the real intake, it is necessary to analyse the part of the food which is actually consumed and thus the inedible parts were eliminated: for example, bananas and oranges were peeled and weighed, recording the weight of the fruit without the skin.

After preparation the sample was homogenised using a laboratory cutting chopper; in many cases the food was first roughly chopped with a knife.

The homogenised sample was stored in the freezer (-20 °C) up to the time of analysis.

The procedure established that each laboratory determines the amount of pesticide residues using the method used in the proficiency tests organised by the European Commission, with a detection limit equal to, or less, than 0.01 mg/kg and confirmation with mass spectrometry.

Pesticides found in products of vegetable origin in italian monitoring carried out in previous years were sought: azinphos-methyl , bromopropylate, bupirimate, buprofezin, captan, carbaryl, chlorothalonil, chlorpropham, chlorpyrifos, chlorpyrifos-methyl, cyprodinil, DDD, DDE, DDT, diazinon, dichlofluanid, dicloran, dimethoate, diphenylamine, ensodulfan (alpha, beta, sulfate), ethoxyquin, fenhexamid, fenitrothion, fludioxonil, imazalil, iprodione, kresoxim methyl, malathion, metalaxyl, methidathion, metoxychlor, myclobutanil, nuarimol, penconazole, pendimethalin, 2-phenylphenol, phosalone, piperonyl butoxide, pirimicarb, pirimiphos-methyl , procymidone, prometryn, pyrimethanil, tetrachlorvinphos, thiabendazole, tolclofos-methyl, tolylfluanid.

Calculation of the Daily Intake of Pesticide Residues.

The laboratory participating in the Italian Ready-Meal Residue Project determined the concentration (in mg/kg) of pesticides in the first course, side dish, fruit, bread and wine.

The quantity of pesticides (in mg) present in the first course, side dish, fruit, bread and wine was calculated by multiplying the concentration found (in mg/kg) by the weight (in kg) recorded in the prepared sample.

If the pesticide was present in two or more dishes of the meal, the overall quantity was equivalent to the sum of the quantities present in the individual dishes.

The quantity found in wine was not considered in calculations for the teenagers and children, as it was assumed (or rather hoped) that wine is not consumed by these categories.

In order to calculate the daily intake of pesticide residues, the AAAF group considered an average of two complete meals a day, ignoring breakfast and any snacks consumed in the morning or afternoon.

The daily intake per kg of body weight (in mg/ kg bw) was calculated by dividing the data for the daily intake by the average weight of an adult (60 kg), teenager (40 kg) and child (20 kg).

The calculation was performed for each pesticide found in the meal.

Calculation of the Ratio between the Daily Intake of Pesticide Residues and ADI.

The values for the estimated daily intake per kg of body weight (in mg/ kg bw) for each pesticide was compared with the ADI levels established by the European Union in document 3010[13].

The comparison was undertaken by dividing the figures for the daily intake by the kg of body weight, and comparing this result with the ADI levels for each of the pesticides found.

A comparison was also made with the ADI levels established by the Australian Government[14].

RESULTS AND DISCUSSION

Pesticides in Meals

In 2005 the 16 laboratories participating in the Italian Ready-Meal Residue Project analysed 50 meals, determining pesticide residues in the first course, side dish, fruit, bread and wine.

In the first group of samples collected in February, pesticide residues were found in 13 meals, whereas no residues were found in 2 meals; in the second sampling 10 meals with pesticide residues and 3 without pesticide residues were found; in the third sampling 8 meals with pesticide residues and 3 without pesticide residues were found; in the fourth sampling 8 meals with pesticide residues and 3 without pesticide residues were found.

Overall pesticide residues were measured in 39 out of 50 meals, with a maximum of 10 different pesticides (Laboratory Code 13) and a minimum of 1 (Laboratory Codes 5, 6, 8, 10, 12, 16) pesticide per meal with an average number of 2.4 pesticide found for each meal.

In Table 2 the number of pesticides detected in total and separately for each dish are given.

Pirimiphos-methyl is the pesticide most frequently found in the meal as a whole (20 times), in bread (14 times) and in the first course (4 times). The pesticide most frequently found in wine is procymidone (11 times), which was also found most frequently in fruit (6 times), together with diphenylamine. In the side dish the pesticides most frequently found were diphenylamine and chlorpropham, on 2 occasions.

By multiplying the concentration of pesticide residues by the weight of the food, the quantity of pesticides in the first course, side dish, fruit, bread and wine was obtained: the data obtained was used to calculate the arithmetic mean.

Table 3 gives the average figures of pesticides found in the first course, side dish, fruit, bread and wine; as such these quantities have no toxicological meaning, as the residues of the individual pesticide must be compared with ADI levels, but they are useful for highlighting the contribution of the different dishes.

The data shows that 77.3% of the total quantity of pesticides found was consumed from the fruit, followed by wine (14.9 %), the first course (3.0 %), bread (2.8 %) and the side dish (2.1 %).

To calculate the intake of pesticides for a teenager and child the contribution from wine consumption was not considered. The average number of pesticide residues thus reduced from 2.4 to 1.7. For a teenager and the child 90.8 % of pesticides were consumed from the fruit, 3.6 % from the first course, 3.2% from the bread and 2.4% from the side dish.

Comparison of the Daily Intake of Pesticide Residues with ADI

The daily intake per kg of body weight for each individual pesticide must be compared with the ADI for that pesticide.

The result obtained, expressed as a percentage of ADI,. Values greater than 100% indicate that the ADI has been exceeded, whereas values lower than 100 %, indicate that the daily intake per kg of body weight is less than the ADI.

The results of the analysis carried out in 2005 allowed comparison between the daily intake per kg of body weight and the ADI, 121 times in the case of the adult and 84 times for a teenager and a child. The difference in the number of comparisons depends on the fact that the contribution of wine was not considered for a teenager and a child.

The data comparing the daily intake per kg of body weight and the ADI established by the European Union in document 3010 [13] gives a maximum figure of 73.3% for the adult, an average figure of 2.6% and a median level of 0.4 %. In the teenager the maximum figure was 109 %, the average figure 4.9 % and the median level 0.6 %. In the child the maximum figure was 219 %, the average 9.8 % and the median level 1.2 %.

The data is presented in Table 4, whereas Table 5 shows the ratio between the estimated daily intake per kg of body weight and the ADI established by the Australian Government [14].

The data presented in Tables 3 and 4 shows that the maximum figures do not change, whereas the average and median figures are higher when comparison between the daily intake per kg of body weight is done with the ADI levels established by the Australian Government.

The number of figures exceeding 100%, 50%, 10% and l.1% (Tables 4 and 5, columns 5-8), is higher as compared to the ADI levels established by the Australian Government than as compared to ADI levels established by the European Union.

The three cases in which the ADI was exceeded in the child are as follows:

A – 1st sample – sample of apple (weight of peeled apple 0.180 g) containing 0.130 mg/kg of pirimicarb – daily intake per kg of body weight 0.00234 mg/kg bw – ADI 0.002 mg/kg bw – relationship 117%;

B – 2nd sample – sample of peach (weight of peeled peach 0.246 g) containing 0.715 mg/kg of carbaryl – daily intake per kg of body weight 0.0175 mg/kg bw – ADI 0.008 mg/kg bw – relationship 219%;

C – 3rd sample– sample of grapes (weight of grapes 0.290 g) containing 0.810 mg/kg of cyprodinil –

daily intake per kg of body weight 0.02349 mg/kg bw – ADI 0.02 mg/kg bw – relationship 117%;

Table 6 gives the 2005 Italian Ready-Meal Residue Project results, with comparison (as a percentage of ADI) between the daily intake per kg of body weight for an adult of 60 kg and the ADI levels established by the European Union, whereas Table 7 shows the comparison between the daily intake per kg of body weight for a child of 20 kg and was performed using the ADI levels established by the Australian Government.

Comparison of the results of the Italian Ready-Meals Residue Project with the results of studies to calculate the National Estimated Daily Intake (NEDI) of Total Diet Studies and Total Diet Surveys is very difficult because different calculation systems have been used. It is possible to compare the average daily intake as a percentage of ADI estimated by the Italian Ready-Meals Residue Project and the maximum figure, as a percentage of ADI, estimated by other studies.

The average daily intake for man (as a percentage of ADI) established for 2005 in Italy (Table 4, column 3) is very similar to the NEDI/ADI ratio figures calculated by Camoni et. al [3,4] from 1993 to 1997. The maximum figures for NEDIs, as a percentage of ADIs relative to pesticide residues for official monitoring studies, has been estimated at 4.8 % in 1995, whereas the other NEDI/ADI ratio figures are almost always less than 1%.

Similar considerations can be made as regards comparison of the figures for the NEDI/ADI ratio estimated by Gaidano and Fabbrini [5] with pesticide residues from private organisations, which obtain data comparable with the data of Camoni et. al [3,4].

In the study (duplicate diet method) carried out in France [10] for 10 pesticides in 1998-1999, the daily intake estimates are generally low, representing a maximum of only 4% of the ADI for pesticide residues. The maximum figure is very similar to the average daily intake as a percentage of ADI for man estimated in Italy (2.6 % -Table 4, column 3).

In Japan [9], the Total Diet Study for 14 pesticides from 1977 to 2002, highlighted average levels of daily intake as a percentage of ADI in 2002 which are much lower than the average figure established for 2005 with the Italian Ready-Meals Residue Project.

FDA Total Diet Studies [17,18] have estimated the mean daily intake for eight age-sex groups from 1984 to 1991. In the first study (1984-1986) the maximum figure for the mean daily intake estimated for the male, aged 14-16 group (body weight 60 kg) was 5.8 % as a percentage of ADI, whereas in the second study (1986-1991) the maximum figure was 3 % as a percentage of ADI. These levels are very similar to the average figure (2.6 %) estimated for man in 2005 in Italy.

The Australian Total Diet Survey [11] carried out in 2000-2001, estimated maximum levels of mean estimated daily dietary exposure to pesticide residues as a percentage of the ADI based on mean analytical results, as between 5 % -15 % depending on the six age-sex groups.

Maximum figures closer to the average figure established for 2005 with the Italian Ready-Meals Residue Project (Table 4, column 3) have been estimated in New Zealand. The New Zealand Total

Diet Survey [12] carried out in 2003-2004, estimates maximum levels of mean estimated daily dietary exposure to pesticide residues as a percentage of the ADI (excluding dithiocarbamates), as between 2 % - 4 % depending on the six age-sex groups.

CONCLUSIONS

The Italian Ready-Meal Residue Project devised and planned by the AAAF group allows the intake of pesticide residues through diet to be estimated, by analysing the first course, side dish, fruit, bread and wine.

In 2005 50 meals were analysed by 16 laboratories and the data shows an average presence of 2.4 pesticide residues per meal.

Comparison between the estimated daily intake and the ADI shows a level higher than the ADI only in the case of a teenager and a child. The average value, considering the ADI levels established by the European Union, was 2.6%, 4.9% and 9.8 % respectively for the adult, teenager and child.

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Table 1. List of the laboratories participating in the Italian Ready-Meal Residue Project – 2005.

Number	Laboratory
1	ARPA Sicily Ragusa
2	ARPA Sicily Palermo
3	ARPA Sicily Catania
4	ARPA Puglia Bari
5	ARPA Campania Napoli
6	ARPA Sardinia Cagliari
7	ARPA Marche Macerata
8	ARPA Tuscany Arezzo
9	ARPA Emilia Romagna Ferrara
10	ARPA Liguria La Spezia
11	ARPA Piemonte Turin
12	ASL Lombardia Bergamo
13	ARPA Veneto Verona
14	ARPA Friuli Venezia Giulia Pordenone
15	ARPA Friuli Venezia Giulia Gorizia
16	APPA Trento

Table 2. The number of pesticides detected in total and separately for each dish.

pesticide	first course	side dish	fruit	bread	wine	total
pirimiphos-methyl	6			14		20
procymidone			6		11	17
cyprodinil	1		2		4	7
iprodione			1		6	7
pyrimethanil			1		6	7
chlorpyrifos	2		4			6
diphenylamine			6			6
diphenylamine		2	3	1		6
chlorpyrifos-methyl	1		3		1	5
metalaxyl		1			4	5
chlorpropham	2	2				4
dichlofluanid			2	1	1	4
bromopropylate	1		2			3
azinphos-methyl	1	1				2
captan	1		1			2
carbaryl			1		1	2
ensodulfan		1			1	2
fludioxonil			1		1	2
imazalil	1		1			2
penconazole		1	1			2
thiabendazole			2			2
chlorothalonil			1			1
diazinon			1			1
dicloran	1					1
dimethoate					1	1
fenhexamide					1	1
phosalone	1					1
kresoxim-methyl					1	1
malathion				1		1
methoxychlor		1				1
myclobutanil					1	1
nuarimol		1				1
2-phenylphenol	1					1
pendimethalin	1					1
piperonyl butoxide				1		1
pirimicarb			1			1
pp-DDD		1				1
prometryn	1					1
tetrachlorvinphos	1					1
tolylfluanid			1			1

Table 3. Average quantity of pesticides found in the meal.

First Course (µg)	Side dish (µg)	Fruit (µg)	Bread (µg)	Wine (µg)	Complete Meal (µg)
0.89 (3.0 %)	0.63 (2.1 %)	23.37 (77.3 %)	0.83 (2.8 %)	4.49 (14.9 %)	30.22 (100 %)

* The figure in brackets is the quantity of pesticides as a percentage of the quantity found in the complete meal.

Table 4. Ratio of the daily intake per kg of body weight and ADI levels established by the European Union in document 3010 [13].

	Maximum (%)	Average (%)	Median (%)	Number of values over 100 %	Number of values over 50 %	Number of values over 10 %	Number of values over 1 %
Adult* (60 kg)	73.3	2.6	0.4	0	2	6	37
Teenager** (40 kg)	109.9	4.9	0.6	1	2	7	34
Child** (20 kg)	219.9	9.8	1.2	2	5	14	46

* Comparison between the daily intake per kg of body weight and the ADI was carried out 121 times for an adult.

** Comparison between the daily intake per kg of body weight and the ADI was carried out 84 times (wine was not considered) for a teenager and a child.

Table 5. Ratio of daily intake per kg of body weight and ADI levels established by the Australian Government [14].

	Maximum (%)	Average (%)	Median (%)	Number of values over 100 %	Number of values over 50 %	Number of values over 10 %	Number of values over 1 %
Adult* (60 kg)	73.3	3.6	0.6	0	1	11	48
Teenager** (40 kg)	109.9	6.9	0.8	1	3	12	36
Child** (20 kg)	219.9	13.8	1.5	3	8	17	48

* Comparison between the daily intake per kg of body weight and the ADI was carried out 121 times for an adult.

** Comparison between the daily intake per kg of body weight and the ADI was carried out 84 times (wine was not considered) for a teenager and a child.

Table 6. Results for the Italian Ready-Meal Residue Project with calculation of the daily intake for an adult of 60 kg and ADI levels established by the European Union.

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
1	2	chlorpyrifos	0	0	13.5	0	0	0.0135	0.027	0.00045	0.01	4.50
1	2	dimethoate	0	0	0	0	4.75	0.00475	0.0095	0.0001583	0.002	7.92
1	2	fenitrothion	0	0.666	12.42	0	0	0.013086	0.026172	0.0004362	0.005	8.72
1	2	pirimiphos-methyl	0	0	0	1	0	0.001	0.002	3.333E-05	0.03	0.11
1	2	procymidone	0	0	20.25	0	0	0.02025	0.0405	0.000675	0.1	0.68
1	3	chlorpyrifos	0.5	0	0	0	0	0.0005	0.001	1.667E-05	0.01	0.17
1	3	diphenylamine	0	0	0.23	0	0	0.00023	0.00046	7.667E-06	0.08	0.01
1	3	procymidone	0	0	0.345	0	0	0.000345	0.00069	0.0000115	0.1	0.01
1	4	chlorpyrifos	0	0	14	0	0	0.014	0.028	0.0004667	0.01	4.67
1	4	chlorpyrifos-methyl	0	0	1.4	0	0	0.0014	0.0028	4.667E-05	0.01	0.47
1	4	diphenylamine	0	0	1.4	0	0	0.0014	0.0028	4.667E-05	0.08	0.06
1	4	metalaxyl	0	2.2	0	0	0	0.0022	0.0044	7.333E-05	0.08	0.09
1	5	azinphos-methyl	2	0	0	0	0	0.002	0.004	6.667E-05	0.005	1.33
1	6	pirimiphos-methyl	0.19265	0	0	0.2181	0	0.0004108	0.000822	1.369E-05	0.03	0.05
1	8	chlorpropham	16.9	0	0	0	0	0.0169	0.0338	0.0005633	0.05	1.13
1	9	azinphos-methyl	0	1.16	0	0	0	0.00116	0.00232	3.867E-05	0.005	0.77
1	9	chlorpyrifos-methyl	0	0	2.7	0	0	0.0027	0.0054	0.00009	0.01	0.90
1	9	chlorpropham	0	52.2	0	0	0	0.0522	0.1044	0.00174	0.05	3.48
1	9	cyprodinil	0	0	0	0	4	0.004	0.008	0.0001333	0.03	0.44
1	9	endosulfan	0	0.58	0	0	11.25	0.01183	0.02366	0.0003943	0.006	6.57
1	9	fenitrothion	0	0	0	2.25	0	0.00225	0.0045	0.000075	0.005	1.50
1	9	fludioxonil	0	0	0	0	8.75	0.00875	0.0175	0.0002917	0.033	0.88
1	9	iprodione	0	0	0	0	75	0.075	0.15	0.0025	0.06	4.17
1	9	pirimicarb	0	0	23.4	0	0	0.0234	0.0468	0.00078	0.02	3.90
1	9	pirimiphos-methyl	0	0	0	7.8	0	0.0078	0.0156	0.00026	0.03	0.87
1	10	carbaryl	0	0	0	0	10	0.01	0.02	0.0003333	0.008	4.17
1	11	captan	2.6274	0	0	0	0	0.0026274	0.005255	8.758E-05	0.1	0.09

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
1	11	chlorpropham	0	0.4716	0	0	0	0.0004716	0.000943	1.572E-05	0.05	0.03
1	11	dichlofluanid	0	0	0	1.032	3.25	0.004282	0.008564	0.0001427	0.3	0.05
1	11	diphenylamine	0	0	3.9405	0	0	0.0039405	0.007881	0.0001314	0.08	0.16
1	12	bromopropylate	14.8	0	2.21	0	0	0.01701	0.03402	0.000567	0.03	1.89
1	13	chlorothalonil	0	0	3.4496	0	0	0.0034496	0.006899	0.000115	0.03	0.38
1	13	dichlofluanid	0	0	2.2176	0	0	0.0022176	0.004435	7.392E-05	0.3	0.02
1	13	dicloran	4.2	0	0	0	0	0.0042	0.0084	0.00014	0.01	1.40
1	13	fenitrothion	0	0	5.544	0	0	0.005544	0.011088	0.0001848	0.005	3.70
1	13	iprodione	0	0	0	0	10	0.01	0.02	0.0003333	0.06	0.56
1	13	kresoxim-methyl	0	0	0	0	6.25	0.00625	0.0125	0.0002083	0.4	0.05
1	13	pendimethalin	3.08	0	0	0	0	0.00308	0.00616	0.0001027	0.125	0.08
1	13	pirimiphos-methyl	0	0	0	1.9602	0	0.0019602	0.00392	6.534E-05	0.03	0.22
1	13	procymidone	0	0	0	0	4.5	0.0045	0.009	0.00015	0.1	0.15
1	13	prometryn	4.48	0	0	0	0	0.00448	0.00896	0.0001493	0.01	1.49
1	15	cyprodinil	0.05465	0	0	0	0.325	0.0003796	0.000759	1.265E-05	0.03	0.04
1	15	diphenylamine	0	0	0.0484	0	0	4.838E-05	9.68E-05	1.613E-06	0.08	0.00
1	15	pyrimethanil	0	0	0	0	1.775	0.001775	0.00355	5.917E-05	0.17	0.03
1	16	procymidone	0	0	0	0	2.025	0.002025	0.00405	0.0000675	0.1	0.07
2	1	diphenylamine	0	0	132.5	0	0	0.132495	0.26499	0.0044165	0.08	5.52
2	1	imazalil	0	0	169.73	0	0	0.169725	0.33945	0.0056575	0.03	18.86
2	1	thiabendazole	0	0	1505.3	0	0	1.50526	3.01052	0.0501753	0.1	50.18
2	2	pirimiphos-methyl	0	0	0	0.9	0	0.0009	0.0018	0.00003	0.03	0.10
2	2	procymidone	0	0	2.09	0	0	0.00209	0.00418	6.967E-05	0.1	0.07
2	3	carbaryl	0	0	175.89	0	0	0.17589	0.35178	0.005863	0.008	73.29
2	3	chlorpyrifos-methyl	9.96	0	0	0	0	0.00996	0.01992	0.000332	0.01	3.32
2	3	procymidone	0	0	0	0	28.75	0.02875	0.0575	0.0009583	0.1	0.96
2	4	captan	0	0	12	0	0	0.012	0.024	0.0004	0.1	0.40
2	4	chlorpropham	21.56	0	0	0	0	0.02156	0.04312	0.0007187	0.05	1.44
2	4	pirimiphos-methyl	0	0	0	14.7	0	0.0147	0.0294	0.00049	0.03	1.63

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
2	4	procymidone	0	0	0	0	6.5	0.0065	0.013	0.0002167	0.1	0.22
2	6	procymidone	0	0	1.8	0	0	0.0018	0.0036	0.00006	0.1	0.06
2	8	2-phenylphenol	1.50232	0	0	0	0	0.0015023	0.003005	5.008E-05	0.4	0.01
2	9	diazinon	0	0	1.73	0	0	0.00173	0.00346	5.767E-05	0.002	2.88
2	9	fenitrothion	0	0.92	0	0	0	0.00092	0.00184	3.067E-05	0.005	0.61
2	9	pirimiphos-methyl	0	0	0	1.76	0	0.00176	0.00352	5.867E-05	0.03	0.20
2	13	iprodione	0	0	0	0	12.5	0.0125	0.025	0.0004167	0.06	0.69
2	13	penconazole	0	0	3.7376	0	0	0.0037376	0.007475	0.0001246	0.03	0.42
2	15	myclobutanil	0	0	0	0	2.5	0.0025	0.005	8.333E-05	0.03	0.28
2	15	pirimiphos-methyl	2.296	0	0	0.8565	0	0.0031525	0.006305	0.0001051	0.03	0.35
2	15	pyrimethanil	0	0	0	0	5	0.005	0.01	0.0001667	0.17	0.10
2	16	chlorpyrifos-methyl	0	0	6	0	0	0.006	0.012	0.0002	0.01	2.00
2	16	procymidone	0	0	6	0	0	0.006	0.012	0.0002	0.1	0.20
3	2	cyprodinil	0	0	234.9	0	0	0.2349	0.4698	0.00783	0.03	26.10
3	2	pirimiphos-methyl	0	0	0	7.7	0	0.0077	0.0154	0.0002567	0.03	0.86
3	2	tolylfluanid	0	0	411.8	0	0	0.4118	0.8236	0.0137267	0.08	17.16
3	4	metalaxyl	0	0	0	0	2	0.002	0.004	6.667E-05	0.08	0.08
3	4	pirimiphos-methyl	0.5	0	0	2.76	0	0.00326	0.00652	0.0001087	0.03	0.36
3	4	procymidone	0	0	0	0	1	0.001	0.002	3.333E-05	0.1	0.03
3	4	pyrimethanil	0	0	0	0	1	0.001	0.002	3.333E-05	0.17	0.02
3	9	cyprodinil	0	0	8.36	0	0	0.00836	0.01672	0.0002787	0.03	0.93
3	9	fludioxonil	0	0	13.2	0	0	0.0132	0.0264	0.00044	0.033	1.33
3	9	iprodione	0	0	0	0	65	0.065	0.13	0.0021667	0.06	3.61
3	9	pirimiphos-methyl	12.285	0	0	4.2	0	0.016485	0.03297	0.0005495	0.03	1.83
3	10	chlorpyrifos	1.104	0	0	0	0	0.001104	0.002208	0.0000368	0.01	0.37
3	10	dichlofluanid	0	0	0.966	0	0	0.000966	0.001932	0.0000322	0.0125	0.26
3	10	phosalone	0.828	0	0	0	0	0.000828	0.001656	0.0000276	0.02	0.14
3	10	nuarimol	0	0.2754	0	0	0	0.0002754	0.000551	9.18E-06	0.021	0.04
3	10	pp-DDD	0	0.1836	0	0	0	0.0001836	0.000367	6.12E-06	0.01	0.06

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
3	10	procymidone	0	0	0	0	75	0.075	0.15	0.0025	0.1	2.50
3	10	tetrachlorvinphos	1.38	0	0	0	0	0.00138	0.00276	0.000046	0.05	0.09
3	12	metalaxyl	0	0	0	0	7.5	0.0075	0.015	0.00025	0.08	0.31
3	12	methoxychlor	0	13.68	0	0	0	0.01368	0.02736	0.000456	0.1	0.46
3	13	chlorpyrifos-methyl	0	0	0	0	8	0.008	0.016	0.0002667	0.01	2.67
3	13	iprodione	0	0	0	0	9.5	0.0095	0.019	0.0003167	0.06	0.53
3	14	fenhexamide	0	0	0	0	62.5	0.0625	0.125	0.0020833	0.2	1.04
3	14	procymidone	0	0	0	0	2.5	0.0025	0.005	8.333E-05	0.1	0.08
3	14	pyrimethanil	0	0	0	0	22.5	0.0225	0.045	0.00075	0.17	0.44
3	15	cyprodinil	0	0	0	0	1.5	0.0015	0.003	0.00005	0.03	0.17
3	15	metalaxyl	0	0	0	0	9.25	0.00925	0.0185	0.0003083	0.08	0.39
3	15	pyrimethanil	0	0	0	0	2.25	0.00225	0.0045	0.000075	0.17	0.04
4	1	chlorpyrifos	0	0	4.94	0	0	0.00494	0.00988	0.0001647	0.01	1.65
4	1	fenitrothion	0	0	19.76	0	0	0.01976	0.03952	0.0006587	0.005	13.17
4	3	procymidone	0	0	0	0	5	0.005	0.01	0.0001667	0.1	0.17
4	4	chlorpyrifos	0	0	1.71	0	0	0.00171	0.00342	0.000057	0.01	0.57
4	4	diphenylamine	0	0	2.052	0	0	0.002052	0.004104	0.0000684	0.08	0.09
4	4	malathion	0	0	0	16.016	0	0.016016	0.032032	0.0005339	0.3	0.18
4	4	piperonyl butoxide	0	0	0	6.776	0	0.006776	0.013552	0.0002259	0.2	0.11
4	4	pirimiphos-methyl	1.446	0	0	29.26	0	0.030706	0.061412	0.0010235	0.03	3.41
4	4	procymidone	0	0	0	0	1.25	0.00125	0.0025	4.167E-05	0.1	0.04
4	4	pyrimethanil	0	0	0.342	0	0	0.000342	0.000684	0.0000114	0.17	0.01
4	6	iprodione	0	0	0.744	0	0	0.000744	0.001488	0.0000248	0.06	0.04
4	6	pirimiphos-methyl	0.6468	0	0	0.7	0	0.0013468	0.002694	4.489E-05	0.03	0.15
4	6	procymidone	0	0	1.736	0	0	0.001736	0.003472	5.787E-05	0.1	0.06
4	10	imazalil	5.625	0	0	0	0	0.005625	0.01125	0.0001875	0.03	0.63
4	13	penconazole	0	4.128	0	0	0	0.004128	0.008256	0.0001376	0.03	0.46
4	13	thiabendazole	0	0	3.309	0	0	0.003309	0.006618	0.0001103	0.1	0.11
4	14	iprodione	0	0	0	0	22.5	0.0225	0.045	0.00075	0.06	1.25

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
4	14	metalaxyl	0	0	0	0	20	0.02	0.04	0.0006667	0.08	0.83
4	14	procymidone	0	0	0	0	20	0.02	0.04	0.0006667	0.1	0.67
4	15	bromopropylate	0	0	0.0485	0	0	4.851E-05	9.7E-05	1.617E-06	0.03	0.01
4	15	cyprodinil	0	0	0	0	0.175	0.000175	0.00035	5.833E-06	0.03	0.02
4	15	pirimiphos-methyl	0	0	0	0.7315	0	0.0007315	0.001463	2.438E-05	0.03	0.08
4	15	procymidone	0	0	0	0	7.5	0.0075	0.015	0.00025	0.1	0.25
4	15	pyrimethanil	0	0	0	0	0.275	0.000275	0.00055	9.167E-06	0.17	0.01

(1) Sample; (2) Laboratory code; (3) Pesticide; (4) Quantity of pesticide in first course in µg; (5) Quantity of pesticide in side dish in µg; (6) Quantity of pesticide in fruit in µg; (7) Quantity of pesticide in bread in µg; (8) Quantity of pesticide in wine in µg; (9) Quantity of pesticide in meal in mg; (10) Daily quantity (two meals) of pesticide in mg; (11) Daily intake per kg of body weight in mg/kg bw; (12) ADI in mg/kg bw; (13) Relationship between daily intake per kg of body weight and ADI in %.

Table 7. Results for the Italian Ready-Meal Residue Project with calculation of the daily intake for a child of 20 kg and ADI levels established by the Australian Government.

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1	2	chlorpyrifos	0	0	13.5	0	0.0135	0.027	0.00135	0.003	45
1	2	fenitrothion	0	0.666	12.42	0	0.013086	0.026172	0.001309	0.002	65.43
1	2	pirimiphos-methyl	0	0	0	1	0.001	0.002	0.0001	0.02	0.5
1	2	procymidone	0	0	20.25	0	0.02025	0.0405	0.002025	0.03	6.75
1	3	chlorpyrifos	0.5	0	0	0	0.0005	0.001	0.00005	0.003	1.66667
1	3	diphenylamine	0	0	0.23	0	0.00023	0.00046	0.000023	0.02	0.115
1	3	procymidone	0	0	0.345	0	0.000345	0.00069	3.45E-05	0.03	0.115
1	4	chlorpyrifos	0	0	14	0	0.014	0.028	0.0014	0.003	46.6667
1	4	chlorpyrifos-methyl	0	0	1.4	0	0.0014	0.0028	0.00014	0.01	1.4
1	4	diphenylamine	0	0	1.4	0	0.0014	0.0028	0.00014	0.02	0.7
1	4	metalaxyl	0	2.2	0	0	0.0022	0.0044	0.00022	0.03	0.73333
1	5	azinphos-methyl	2	0	0	0	0.002	0.004	0.0002	0.025	0.8
1	6	pirimiphos-methyl	0.19265	0	0	0.21811	0.00041076	0.000822	4.11E-05	0.02	0.20538
1	8	chlorpropham	16.9	0	0	0	0.0169	0.0338	0.00169	0.05	3.38
1	9	azinphos-methyl	0	1.16	0	0	0.00116	0.00232	0.000116	0.025	0.464
1	9	chlorpyrifos-methyl	0	0	2.7	0	0.0027	0.0054	0.00027	0.01	2.7
1	9	chlorpropham	0	52.2	0	0	0.0522	0.1044	0.00522	0.05	10.44
1	9	endosulfan	0	0.58	0	0	0.00058	0.00116	0.000058	0.006	0.96667
1	9	fenitrothion	0	0	0	2.25	0.00225	0.0045	0.000225	0.002	11.25
1	9	pirimicarb	0	0	23.4	0	0.0234	0.0468	0.00234	0.002	117
1	9	pirimiphos-methyl	0	0	0	7.8	0.0078	0.0156	0.00078	0.02	3.9
1	11	captan	2.6274	0	0	0	0.0026274	0.005255	0.000263	0.1	0.26274
1	11	chlorpropham	0	0.4716	0	0	0.0004716	0.000943	4.72E-05	0.05	0.09432
1	11	dichlofluanid	0	0	0	1.032	0.001032	0.002064	0.000103	0.03	0.344
1	11	diphenylamine	0	0	3.9405	0	0.0039405	0.007881	0.000394	0.02	1.97025
1	12	bromopropylate	14.8	0	2.21	0	0.01701	0.03402	0.001701	0.03	5.67

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1	13	chlorothalonil	0	0	3.4496	0	0.0034496	0.006899	0.000345	0.01	3.4496
1	13	dichlofluanid	0	0	2.2176	0	0.0022176	0.004435	0.000222	0.03	0.7392
1	13	dicloran	4.2	0	0	0	0.0042	0.0084	0.00042	0.07	0.6
1	13	fenitrothion	0	0	5.544	0	0.005544	0.011088	0.000554	0.002	27.72
1	13	pendimethalin	3.08	0	0	0	0.00308	0.00616	0.000308	0.1	0.308
1	13	pirimiphos-methyl	0	0	0	1.9602	0.0019602	0.00392	0.000196	0.02	0.9801
1	13	prometryn	4.48	0	0	0	0.00448	0.00896	0.000448	0.03	1.49333
1	15	cyprodinil	0.05465	0	0	0	5.4646E-05	0.000109	5.46E-06	0.02	0.02732
1	15	diphenylamine	0	0	0.04838	0	4.8384E-05	9.68E-05	4.84E-06	0.02	0.02419
2	1	diphenylamine	0	0	132.495	0	0.132495	0.26499	0.01325	0.02	66.2475
2	1	imazalil	0	0	169.725	0	0.169725	0.33945	0.016973	0.03	56.575
2	1	thiabendazole	0	0	1505.26	0	1.50526	3.01052	0.150526	0.3	50.1753
2	2	pirimiphos-methyl	0	0	0	0.9	0.0009	0.0018	0.00009	0.02	0.45
2	2	procymidone	0	0	2.09	0	0.00209	0.00418	0.000209	0.03	0.69667
2	3	carbaryl	0	0	175.89	0	0.17589	0.35178	0.017589	0.008	219.863
2	3	chlorpyrifos-methyl	9.96	0	0	0	0.00996	0.01992	0.000996	0.01	9.96
2	4	captan	0	0	12	0	0.012	0.024	0.0012	0.1	1.2
2	4	chlorpropham	21.56	0	0	0	0.02156	0.04312	0.002156	0.05	4.312
2	4	pirimiphos-methyl	0	0	0	14.7	0.0147	0.0294	0.00147	0.02	7.35
2	6	procymidone	0	0	1.8	0	0.0018	0.0036	0.00018	0.03	0.6
2	8	2-phenylphenol	1.50232	0	0	0	0.00150232	0.003005	0.00015	0.4	0.03756
2	9	diazinon	0	0	1.73	0	0.00173	0.00346	0.000173	0.001	17.3
2	9	fenitrothion	0	0.92	0	0	0.00092	0.00184	0.000092	0.002	4.6
2	9	pirimiphos-methyl	0	0	0	1.76	0.00176	0.00352	0.000176	0.02	0.88
2	13	penconazole	0	0	3.7376	0	0.0037376	0.007475	0.000374	0.007	5.33943
2	15	pirimiphos-methyl	2.296	0	0	0.8565	0.0031525	0.006305	0.000315	0.02	1.57625
2	16	chlorpyrifos-methyl	0	0	6	0	0.006	0.012	0.0006	0.01	6
2	16	procymidone	0	0	6	0	0.006	0.012	0.0006	0.03	2
3	2	cyprodinil	0	0	234.9	0	0.2349	0.4698	0.02349	0.02	117.45

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
3	2	pirimiphos-methyl	0	0	0	7.7	0.0077	0.0154	0.00077	0.02	3.85
3	2	tolylfluanid	0	0	411.8	0	0.4118	0.8236	0.04118	0.1	41.18
3	4	pirimiphos-methyl	0.5	0	0	2.76	0.00326	0.00652	0.000326	0.02	1.63
3	9	cyprodinil	0	0	8.36	0	0.00836	0.01672	0.000836	0.02	4.18
3	9	fludioxonil	0	0	13.2	0	0.0132	0.0264	0.00132	0.03	4.4
3	9	pirimiphos-methyl	12.285	0	0	4.2	0.016485	0.03297	0.001649	0.02	8.2425
3	10	chlorpyrifos	1.104	0	0	0	0.001104	0.002208	0.00011	0.003	3.68
3	10	dichlofluanid	0	0	0.966	0	0.000966	0.001932	9.66E-05	0.03	0.322
3	10	phosalone	0.828	0	0	0	0.000828	0.001656	8.28E-05	0.006	1.38
3	10	nuarimol	0	0.2754	0	0	0.0002754	0.000551	2.75E-05	0.021	0.13114
3	10	pp-DDD	0	0.1836	0	0	0.0001836	0.000367	1.84E-05	0.002	0.918
3	10	tetrachlorvinphos	1.38	0	0	0	0.00138	0.00276	0.000138	0.05	0.276
3	12	methoxychlor	0	13.68	0	0	0.01368	0.02736	0.001368	0.1	1.368
4	1	chlorpyrifos	0	0	4.94	0	0.00494	0.00988	0.000494	0.003	16.4667
4	1	fenitrothion	0	0	19.76	0	0.01976	0.03952	0.001976	0.002	98.8
4	4	chlorpyrifos	0	0	1.71	0	0.00171	0.00342	0.000171	0.003	5.7
4	4	diphenylamine	0	0	2.052	0	0.002052	0.004104	0.000205	0.02	1.026
4	4	malathion	0	0	0	16.016	0.016016	0.032032	0.001602	0.3	0.53387
4	4	piperonyl butoxide	0	0	0	6.776	0.006776	0.013552	0.000678	0.1	0.6776
4	4	pirimiphos-methyl	1.446	0	0	29.26	0.030706	0.061412	0.003071	0.02	15.353
4	4	pyrimethanil	0	0	0.342	0	0.000342	0.000684	3.42E-05	0.2	0.0171
4	6	iprodione	0	0	0.744	0	0.000744	0.001488	7.44E-05	0.04	0.186
4	6	pirimiphos-methyl	0.6468	0	0	0.7	0.0013468	0.002694	0.000135	0.02	0.6734
4	6	procymidone	0	0	1.736	0	0.001736	0.003472	0.000174	0.03	0.57867
4	10	imazalil	5.625	0	0	0	0.005625	0.01125	0.000563	0.03	1.875
4	13	penconazole	0	4.128	0	0	0.004128	0.008256	0.000413	0.007	5.89714
4	13	thiabendazole	0	0	3.309	0	0.003309	0.006618	0.000331	0.3	0.1103
4	15	bromopropylate	0	0	0.04851	0	0.00004851	9.7E-05	4.85E-06	0.03	0.01617
4	15	pirimiphos-methyl	0	0	0	0.7315	0.0007315	0.001463	7.32E-05	0.02	0.36575

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)

(1) Sample; (2) Laboratory code; (3) Pesticide; (4) Quantity of pesticide in first course in µg; (5) Quantity of pesticide in side dish in µg; (6) Quantity of pesticide in fruit in µg; (7) Quantity of pesticide in bread in µg; (8) Quantity of pesticide in meal in mg; (9) Daily quantity (two meals) of pesticide in mg; (10) Daily intake per kg of body weight in mg/kg bw; (11) ADI in mg/kg bw; (12) Relationship between daily intake per kg of body weight and ADI in %.