The 1st French Total Diet Study

Mycotoxins, minerals and trace elements

Coordinator

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Glossary

ADI: Acceptable Daily Intake (DJA: Dose Journalière Admissible)
AFSSA: French Food Safety Agency (Agence Française de Sécurité Sanitaire des Aliments)
ALARA: As Low As Reasonably Achievable
ASPCC: Sugar/Sugared Products Communication-Consumption Association (Association Sucre/Produits Sucrés, Communication-Consommation)
CAC: Codex Alimentarius Commission (Commission du Codex Alimentarius)
CCFAC: Codex Committee on Food Additives and Contaminants
CIQUAL: Food Quality Computer Centre (Centre Informatique sur la QUalité des ALiments)
CREDOC: Research Centre for the Study and Observation of Living Conditions (Centre de Recherche pour l'Etude et l'Observation des Conditions de Vie)
CSHPF: Upper Council for French Public Health (Conseil Supérieur d'Hygiene Publique de France)
DGAL: General Food Directorate (Direction Générale de l'Alimentation)
DMENO: Minimum Intake Dose Causing Observable Adverse Effect (Dose Minimale Entrainant un Effet Nocif Observable)
EC: European Community (CE: Communauté Européenne)
EFSA: European Food safety Authority (AESA: Autorité Européenne de Sécurité Sanitaire des Aliments)
FAO: Food and Agriculture Organization.
GEMS/Food Euro: Global Environment Monitoring System/ Food Contamination Monitoring and Assessment Program
IARC: International Cancer Research Agency (CIRC: Centre International de Recherche sur le Cancer)
INCA: National Individuals Food Consumption (Individuelles Nationale Consommation Alimentaires)
INRA: National Institute on Agronomic Research (Institut National de la Recherche Agronomique)
IPCS: International Program of Chemical Safety
JECFA: Joint FAO/WHO Expert Committee on Food Additives and Contaminants
LOAEL: Lowest Observed Adverse Effect Level (DMENO: Dose Minimale Entrainant un Effet Nocif Observable)
LOD: Limit of Detection (Limite de détection)
LOQ: Limit of Quantification (Limite de Quantification)
LTI: Lowest Threshold Intake (ANM/BNM: Apport Nutritionnel Minimum/Besoin Nutritionnel Minimum)
LV: Lactovegetarian (Lactovégétarien)
MAAPAR: French Ministry of Agriculture, Food, Fishing and Rural Affairs (Ministére de l'Agriculture, de l'Alimentation, de la Pêche et des Affaires Rurales)
NOAEL (NOEL): No Observed (Adverse) Effect Level (DMSENO: Dose Minimale Sans Effet Nocif Observable (DSE))
OCA: Food Consumption Observatory (Observatoire des Consommations Alimentaires)
OLV: Ovolactovegetarian (Ovolactovégétarien)
PMTDI: Provisional MaximumTolerable Daily Intake (DJTMP: Dose Journaliére Tolérable Maximum Provisoire)
PTWI: Provisional Tolerable Weekly Intake (DHTP: Dose Hebdomadaire Tolérable Provisoire)
RDA: Recommended Daily Allowanced (ANC: Apports Nutritionnels Conseillés)
RHF: Out-of-Home Catering (Restauration Hors Foyer)
SCF: Scientific Committee on Food (CSAH: Comité Scientifique de l'Alimentation Humaine)
SCOOP: Scientific Co-operation task (Tâche de Coopération Scientifique)
TDI: Tolerable Daily Intake (DJT: Dose Journalière Tolérable)
TDS: Total Diet Study (Etude de l'alimentation totale)
TWI: Tolerable Weekly Intake (DHT: Dose Hebdomadaire Tolérable)
UL: Upper Level (LS: Limite de Sécurité)
V/M: Vegan/Macrobiotic (Végétalien/Macrobiote)
VTR: Toxicological Reference Value (Valeur Toxicologique de Référence)
WHO: World Health Organization (OMS: Organisation Mondiale de la Santé)

Preface

Protecting the French population against the risks associated with the presence of contaminants in food is one of the principal responsibilities General Food Directorate (*DGAL: Direction Générale de l'Alimentation*). To fulfil this consumer protection function, the DGAL implements food checking and monitoring plans involving about 70,000 physical and chemical analyses every year, and it regularly finances food quality and safety studies.

One of the three main areas of study chosen by the National Institute on Agronomic Research (*INRA: Institut National de la Recherche Agronomique*) for the years to come is food, whose biological and chemical safety is seen as a major challenge. This research field involves studies to quantify nutritional or health risks, and the development of methodologies to evaluate hazards and risks. This work will be of use to decision-makers responsible for the regulation of chemical products and the safety of food products.

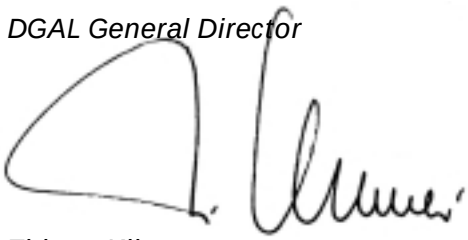
The Total Diet Study (*TDS*) is one of the methods used in many countries to evaluate food safety risks. It has the advantage of providing realistic exposure data since foods are analysed "as-consumed" by the eater.

This technically challenging study has provided not only estimates of consumer exposure to certain trace elements, minerals and mycotoxins, but also new scientific information in terms of methodological comparison of food analysis. It also appeared necessary from a regulatory point of view, in that many member states of the *Codex Alimentarius* defend their consumer protection regulations on the basis of scientific results obtained using this type of methodology. The project was conducted in the INRA's "mét@risk" research unit.

This document presents an evaluation of the levels of consumer exposure to trace elements, minerals and mycotoxins, some naturally present in foods, others potential contaminants. For food safety managers the results obtained will be invaluable when making decisions affecting French consumer health. In addition, they enable France to contribute to ongoing scientific and regulatory studies in this field at national, Community and international level.

In view of the richness of the data obtained and their complementarity to those from existing evaluation systems, it appears desirable and reasonable that this type of nationwide study be performed every five years, for example, like the national survey of individual food consumption (*INCA*).

DGAL General Director



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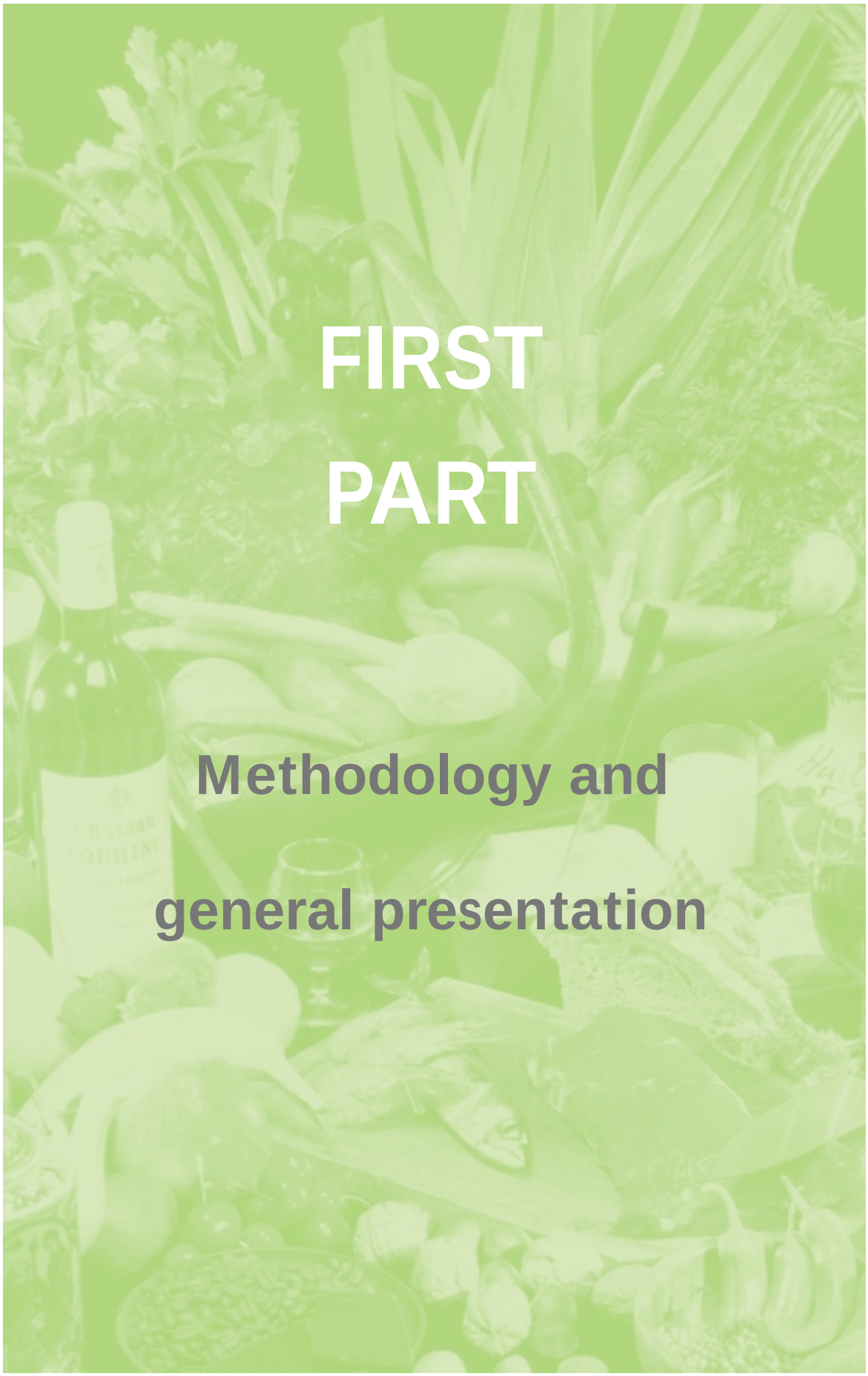


FIRST PART

Methodology and general presentation

Introduction

National authorities carry the responsibility for checking that chemical substances such as additives, residues of phytosanitary product or veterinary medications, environmental contaminants and the natural toxins are not present in food in quantities that might affect public health. While food control and monitoring programmes are essential for surveillance of production practices, governments must also assess the public health risks associated with the presence of such substances in the food consumed in their countries[1]. This assessment is conducted by estimating the quantity of substances actually ingested and comparing this quantity with reference toxicological values (VTR) established for these same substances: Acceptable Daily Intake (ADI), Provisional Tolerable Weekly Intake (PTWI) and Upper Level (UL).

Estimation of food intakes is indispensable for risk evaluation, and possibly to determine relationships between adverse effects observed in humans and exposure to particular substances. These exposure evaluations are also useful when making decisions on the regulation of chemical products and the safety of food products.

The Total Diet Study (TDS) is one method used in many countries[2] to address this issue. It has the advantage of yielding more refined exposure data in that foods are analysed "as-consumed by the consumer", which is a different approach from the current French system based on cross-referencing contamination data for raw food materials obtained from state monitoring plans with national individual food consumption data.

The approach proposed enables evaluation of the exposure to mycotoxins, trace elements and minerals salts of the French population as a whole and of heavy consumers of particular foods. This study applying a standardized methodology will facilitate international comparisons of consumer exposure, since numerous countries (United States, United Kingdom, Czech Republic, Spain, etc.) have already carried out such studies. The existence of data established using the same protocol will probably simplify discussions at Community level, for example in the framework of the *Codex Alimentarius*. Moreover, this type of study illustrates the interest of this method for food monitoring and guiding monitoring and control programmes.

1) Salubrité des aliments et mondialisation du commerce des denrées alimentaires, Accord de l'Organisation Mondiale du Commerce sur l'application des mesures sanitaires et phytosanitaires, Annexe1, p9-23, WHO.

2) Etudes de l'alimentation totale (TDS); consultation US FDA/OMS, Kansas city, juillet/août 1999 et consultation ANFZA/WHO/FAO, Brisbane, janvier 2002.

Study methodology

Defining the list of foods to be sampled

The first stage of this methodology consists in establishing a list of foods to be sampled "as-consumed". This list, based on a food consumption survey – preferably of individual consumers – must be representative of the population's diet.

Two populations of interest were surveyed in this study: the general French population and the vegetarian population which is considered to be exposed to risk as regards certain mycotoxins, its diet being exclusively vegetable-based.

For the French population, the food list is based on the results of the last national survey of individual food consumption ("INCA") in 1998/1999[3], which collected data on individual food consumptions over an entire week. The data were acquired over a period of 11 months from consumption logs filled in by participating consumers over a period of 7 consecutive days; the identification of foods and quantities was simplified by use of a catalogue of photographs[4].

The survey involved 3,003 people, children and adults, representative of the French population. The sample included 1,985 people at least 15 years old and 1,018 younger people (children aged 3 to 8 and young adolescents aged 9 to 14). Good national representativeness of the sample was ensured by stratification (region of residence, town size) and by applying quotas (age, sex, individual professional/cultural category, household size).

- The *adult sample* included 1,985 individuals of 15 years or older. To eliminate bias caused by underestimation of food consumptions by some subjects, the 511 "under-reporting" individuals (for which the calculated ratio between energy consumed and basic metabolism is less than a certain threshold)[5] were excluded from the calculations below. The sample of "normo-reporters" adults therefore includes 1,474 individuals.

- The *child sample* includes 1,018 individuals aged 3 to 14. Unlike the adults, the children were not filtered, since no formula was available enabling under-reporters individuals to be identified.

The choice of the food on the list is based on a hierarchy of food consumptions of adults and children and takes into account the major regional disparities of consumption in French households on the basis of the CREDOC report no.CP004 of February 1996[6].

3) Enquête INCA (2000) CREDOC-AFSSA-DGAL, Enquête nationale sur les consommations alimentaires, Tech & Doc Lavoisier, Coordinateur: J.L Volatier.

4) « Portions alimentaires : manuel photos pour l'estimation des quantités », SUVIMAX, 1994.

5) Goldberg et al. (1991) : critical evaluation of energy intake data using fundamental principles of energy physiology. 1. Dérivation of cut-off values to identify underreporting. Eur. J. Clin. Nutr. 45, 569-581.

6) OCA, (février 1996), Les disparités régionales de la consommation alimentaire des ménages français, Rapport du Crédoc N° CP004.

Three French regions with significantly different eating habits were defined:

- the *southern region* including the south-west; centre-east and Mediterranean, together representing about 34% of the total population,
- the *eastern region* including the eastern Parisian basin, the Parisian region and the northeast, representing about 43% of the population,
- the *western region* including the western Parisian basin and the north-west, representing about 23% of the population.

For the vegetarian population, the defined food list is based on the results of the individual consumption survey of various vegetarian groups in 1998/1999[7] which was carried out using a consumption log over a period of 5 consecutive days. The identification of portions was facilitated by using household units quantified by a dietician. The selection of foods is representative of vegetarian food consumption and takes into account the consumption of the main vegetarian groups characterised in the study.

From this survey, three vegetarian population groups aged 15 or more and having significantly different eating habits were defined. These groups, whose estimated average and 95th percentile food consumption are shown in *Appendix 1*, are:

- *ovolactovegetarian* (n=74) the most common form of vegetarians. This population is characterised by a diet that excludes animals products (meat, fish) but allows all sub- products of animal origin (butter, milk, cheese, eggs, honey, etc.),
- *lactovegatarians* (n=38) corresponding to a vegetarian population whose eating habits forbid consumption of meat, eggs and fish but allows sub-products of animal origin such as butter, milk and cheese,
- *macrobiotics/vegans* (n=26) corresponding to a form of vegetarianism that forbids animal products (meats, eggs and fish[8]) and all sub-products of animal origin.

The literature indicates that vegetarians represent about 2% to 3% of the French population[9]. On this basis, the ovolactovegetarian population represents 1.8%, the lactovegetarians about 1% and the vegans/macrobiotics about 0.2%.

From these two individual food consumption surveys and applying the criteria listed below, a main list of 338 food items for the sampling plan was obtained[10] (see the list in *Appendix 2*):

- Better than 90% coverage of the average total diet for the groups studied,
- Coverage of cereal foods whose consumption is greater than 1 g/day,
- Coverage of specific foods, such as offals or nuts whose consumption is greater than 0.5 g/day (about 29 foods selected).

7) Leblanc, JCh., Yoon, H., Kombadjian A., and Verger Ph. Nutritional intakes of vegetarian populations in France, European journal of clinical nutrition (2000) 54, 1-7.

8) Exclusion de poissons à l'exception de ceux à chaire blanche qu'une partie des macrobiotes s'autorise à consommer.

9) Comité français d'éducation pour la santé : Baromêtre nutrition santé de la population française, 1996.

10) Préparation du plan de sondage d'une étude de l'alimentation totale, note technique du Crédoc pour l'INRA, Novembre 1999.

Sampling and preparing the "as-consumed" food

The experimental kitchen of the *Ecole Superieure de Cuisine Française* (ESCF) in Paris' 6th District and the *Ecole National Superieure des Industries Agricoles et Alimentaires* (ENSIA) in Massy were selected for the study for purposes of food storage and preparation. The "as-consumed" foods were sampled and prepared by an ESCF-qualified cook understanding the rudiments of cooking and the qualitative and quantitative aspects of the purchase and preparation of composed dishes (type and quantities of products, ingredients, etc.).

Two campaigns of purchasing of the foods on the list were programmed to take into account as far as possible of variations due to seasonality, eating behaviour and food contamination. The first one covered the spring/summer 2000 and the second the autumn/winter 2001.

In addition, to attempt to take account of the production and transformation methods, two food groups were defined from the main list:

The first group includes so-called national foods, since these are transformed foods likely to reveal homogeneous contamination levels with respect to their production and/or transformation methods. Generally, this group includes 228 foods produced and commercialised by a limited number of industrial companies, such as biscuits, ready-to-eat cereals, drinks, prepared foods, exotic fruits etc. These foods were therefore bought in one region only (Paris was chosen).

The second group includes so-called regional foods, since these are unprocessed, therefore untransformed and possible containing heterogeneous contamination levels due to production and/or preparation methods specific to the regions previously defined. This group includes 110 foods, such as eggs, meats, charcuterie, some fish, fruits and vegetables, etc. which were bought in each of the selected regions. Three regions were chosen on the basis of the disparity of their consumptions modes: Lorient, Lyon and Paris.

The representativeness of the sampling was ensured by taking into account consumer purchasing and provisioning modes based on a Secodip[11] household purchasing panel. The information obtained cover the places of provisioning (hypermarket, supermarket, hard discounter, retailer, market) and/or the main brands which represent 75% of the market. Moreover, for some so-called regional foods such as soups and composed dishes, a breakdown according to the origin (home-made or not) of the consumed dish was taken into account in the food purchase and preparation sampling[12].

Since the main list also includes vegetarian foods consumed exclusively by this type of population, some basic foods were bought in specialised shops in order to take into account the variability of food purchase, preparation and habits specific to the three vegetarian groups previously defined.

11) Société d'Etudes de la Consommation, de la Distribution et de la Publicité, Panel d'achats des ménages, 1996.

12) CREDOC, Préparation du plan de sondage d'une « Total Diet Study », note technique du Crédoc pour la DGAL et l'INRA, Novembre 1999 et Note technique de l'OCA pour l'INRA, Joëlle Maffre (AFSSA/DERNS/OCA/2000-122), juin 2000.

Each of the 338 sampled foods in the list was obtained from an individual composite sample of 5 sub-samples at most, weighted according to the brand bought and preferred provisioning source used by the consumers in the Secodip panel.

Let us take the example of the sample of chocolate-flavoured breakfast cereals (*Table 1*) where 4 leading brands share the market (X, Y, Z and W, % market share): brand X, box of chocolated puffed wheat flakes (food A, 40% market share); brand Y, box of chocolated puffed rice and corn (food B, 33% share); brand Z, box of chocolated, vitamin-and-iron enriched puffed rice (food C, 20% share); brand W, box of chocolated muesli (food D, 7% share). This type of product is mainly purchased in hypermarkets (50%) and supermarkets (40%).

The food were cooked "as-consumed" when necessary, then mixed, ground and blended to obtain a homogenised composite samples of the national or regional foods for each season. Samples that were bought in different seasons were never mixed.

Table 1 : example of representativeness sampling

Particular name	Food	Secodip name	% market share	Number of purchased units and mixed in the final weighted sample
Chocolate cereals for breakfast	A	Cereals for breakfast, brand X puffed wheat flakes can	40	2
Chocolate cereals for breakfast	B	Cereals for breakfast, brand Y chocolated puffed rice and corn can	33	1.5
Chocolate cereals for breakfast	C	Cereals for breakfast, brand Z chocolated, vitamin-and-iron enriched puffed rice can	20	1
Chocolate cereals for breakfast	D	Cereals for breakfast, brand W, chocolated muesli can	7	0.5

During the preparation or transfer of the prepared "as-consumed" food the use of intermediate recipients and cooking utensils made of aluminium, ceramic or enamel, or of any other packaging material, was excluded. Suitable stainless steel cooking equipment was used to prepare the food. Their use is susceptible to increase the proportion of certain trace elements in food analysed. In accordance with the good laboratory practices and internal quality procedures of the AFSSA Heavy Metals Laboratory, the equipment used for preparing and grinding the composite samples was thoroughly washed between each preparation to avoid risks of cross-contamination prejudicial to the study, notably for analysis of trace elements. Moreover, in compliance with international WHO/GEMS/Food recommendations[13], the food was prepared when necessary using drinking water from the regions where the foods were bought (e.g. pasta, coffee, etc.).

All the sampling brought the number of composite samples to 613 for regional foods and 467 for national foods, or a total of 1,080 composite samples prepared for the study and stored at -20°C in suitable 100 ml containers until their analysis.

13) WHO, Recommendations for study intakes on chemicals in food, 1988.

Analysis of the samples

Mycotoxins

The analysis of mycotoxins concerned only some of the 338 foods on the main list. The mycotoxins sought are fusarium toxins (trichothecenes, zearalenone, nivalenol and fumonisins), aflatoxins B_1, B_2, G_1, G_2 and M_1, ochratoxin A and patulin. Unlike other ubiquitous contaminants such as mineral elements, mycotoxins are present only in certain types of products. This information being largely documented, it is therefore pointless to search for it in all the foods on the list. The selection of the mycotoxin type sought in the foods on the list was based on bibliographic knowledge and on the expertise of analysts specialised in the routine analysis of raw and transformed food products.

This mycotoxin sampling plan involved 176 target foods out of the 338. For the two seasons, 299 composite samples were made for the national foods (150 foods defined per season) and 156 composite samples were made for the regional foods (26 foods defined per region and per season), or a total of 455 composite food samples analysed for one or more mycotoxins, representing 3,676 elementary analyses in all. All the prime vectors for consumer exposure to fusarium toxins, ochratoxin A, aflatoxins and patulin were thereby analysed. The fusarium toxins and Ochratoxin A were sought systematically in all the raw and finished cereal products (bread, rusk, breakfast cereals, biscuits, viennese bread, cake, pasta, rice and semolina, other cereals, etc.), aflatoxin M_1 in milk and dairy products (milk, cheeses, butter and ultra-fresh dairy products), aflatoxins B and G in nuts, eggs and eggs products, and patulin in apple juice and apple-based products.

Table 2 : Limits of quantification (LOQ) for mycotoxins

Mycotoxins	Limit of quantification (LOQ) µg/kg (µg/l) of fresh matter
Aflatoxin B_1	1 (0.1)
Aflatoxin B_2	1 (0.1)
Aflatoxin G_1	1 (0.1)
Aflatoxin G_2	1 (0.1)
Aflatoxin M_1	0.2 (0.02)
Ochratoxin A	1 (0.1)
Diacetoxyscirpenol	60
Monoacetoxyscirpenol	60
Neosolaniol	80
HT2-toxin	80
T-2 toxin	80
T-2 triol	80
3 Acetyldeoxynivalenol	60
15 Acetyldeoxynivalenol	60
Deoxynivalenol	60
Fusarenon X	60
Nivalenol	60
Zearalenone	20
Fumonisin B_1	20
Fumonisin B_2	40
Patulin	60 (10)

The analyses were carried out by the Qualtech Laboratory in Nancy, a laboratory certified by the COFRAC for mycotoxins and a subsidiary of the *Institut Français des Boissons, de la Brasserie et de la Malterie* (IFBM). *Table 2* shows the quantification limits (corresponding to twice the detection limits) obtained for the analysis of mycotoxins by Qualtech according to the type of toxin sought and the type of matrix studied (solid or liquid).

Trace elements and minerals

All the 338 foods on the main list were analysed for trace elements and minerals. All the 1,080 composite food samples were analysed for 20 trace elements and minerals: arsenic, lead, cadmium, aluminium, mercury, antimony, chrome, calcium, tin, iron, manganese, magnesium, nickel, copper, zinc, lithium, sodium, molybdenum, cobalt and selenium. The total content of metalloids and mineral elements in the foods was determined by ICP-MS (Inductively Coupled Plasma-Mass Spectrometry), a sensitive, multi-element detection system after mineralisation of the samples in a pressurised microwave system. However, given the large number of elements of interests, some analytical methodological compromises had to be made.

Table 3 : Limits of quantification (LOQ) for elements

Elements	Limit of Quantification (LOQ) mg/kg of fresh matter
Minerals and essential trace elements	
Calcium (Ca)	15.3
Chromium (Cr)	0.03
Cobalt (Co)	0.002
Copper (Cu)	0.038
Lithium (Li)	0.006
Manganese (Mn)	0.016
Magnesium (Mg)	0.492
Molybdenum (Mo)	0.006
Nickel (Ni)	0.063
Selenium (Se)	0.045
Sodium (Na)	5.83
Zinc (Zn)	0.163
Toxic elements	
Aluminium (Al)	0.218
Antimony (Sb)	0.001
Arsenic (As)	0.009
Cadmium (Cd)	0.001
Lead (Pb)	0.01
Mercury (Hg)	0.011

The elementary analyses (about 19,000 results in all) were carried out by the Heavy Metals and Mineral Elements Unit of the AFSSA-Paris which is the national reference laboratory. The analyses were made using about 0.6 g taken from each composite sample; each sample was analysed twice. Once the method was optimised according to certain criteria[14], the results were validated if they satisfied the defined Internal Quality Controls[15,16]. The results for iron and tin did not satisfy these controls and were therefore eliminated. *Table 3* identifies the detection limits (LOD) of the trace elements and minerals sought, given that the quantification limit (LOQ) corresponds to twice the LOD.

Presentation and interpretation of the results

For reasons of clarity the results are described in two parts. The first part covers mycotoxins, the second part trace elements and minerals. In each part, for each element studied (toxin, element traces or minerals) the results are presented in the form of synthetic sheets following the steps of the risk assessment process. Each sheet contains the following sections:

Hazard evaluation and characterisation

This section gives a brief summary of our toxicological knowledge of the element studied. In general, for an exposure by oral ingestion of a given nutritional element and/or toxic element, a Lowest Threshold Intake or a minimal nutritional requirement (LTI or BNM)[17,18] and/or a reference toxicological value (VTR)[19] is defined. Lowest Threshold Intake is corresponding to the quantity of necessary nutrient to assure maintenance, metabolic and physiological function for an individual in good health. It is defined as being equal to the average requirements – 2 standard deviations. But it must be kept in mind that certain population groups could have superior requirements to this minimal value. It is also important to bear in mind that this document presents VTRs defined for chronic, or subchronic exposure of the general population. The value thus defined corresponds to an estimation of the quantity of the element to which individuals can theoretically be exposed *every day of their lives*, without this ingestion having adverse impact on their health. We speak of Tolerable Daily (or Weekly) Intake (TDI or TWI) for natural toxins and toxic elements and of Upper Levels (UL) for minerals and trace elements.

Risk evaluation and characterisation

This section presents a summary table of the concentrations of element found in the "as-consumed" foods analysed plus a table of the estimated exposure (average and high quantiles) for the population groups studied. The age brackets included are children of 3-14 years and "normo-reporters" adults aged 15 years or more for the general population, and adults aged 15 years or more for the vegetarian population.

14) Noël L., Guérin T., Huet H., Kolf-Clauw M., Frémy J.M., Optimized Simultaneous Determination of Several Elements in Human Intestinal Caco-2 TC7 Cells by ICP-MS after Closed Vessel Microwave Digestion. J. of AOAC International, vol 86, 1225-1231 (2003).

15) Noël L., Leblanc J.C., Guérin T., Determination of several elements in duplicate meals from catering establishment using closed vessel microwave digestion with inductively coupled plasma mass spectrometry detection: estimation of daily dietary intake. Food additives and contaminants, vol. 20, n° 1, 44-56 (2003).

16) Lemahieu N., Guérin T., Rapport complémentaire au rapport final convention DGAL A99/37 AFSSA D2558 (octobre 2003) : Achèvement de l'Etude du Panier de la ménagère ou « Total Diet Study ».

17) SCF, Reports of the scientific committee for food, thirty-first series, food science and techniques, Nutrient and energy intakes for the European community, commission of the European communities, 1993.

18) AFSSA-CNERNA-CNRS, Apports nutritionnels conseillés pour la population française, 3ème édition, Coord. A.Martin, Eds tech et doc, 2001.

19) Valeurs toxicologiques de référence : méthodes d'élaboration, Nathalie Bonvallot et Fréderic Dor, InVS, 2003.

Concentration estimates: the contents are expressed in microgram (µg) per kilogram of fresh matter for mycotoxins or in milligrams (mg) per kilogram of fresh weight for trace elements and minerals. The intakes are expressed in the usual measuring unit of the element, in other words in µg or mg per person or per kilogram of body weight per day or per week. The average levels of concentration used in the calculation of intakes correspond to the weighted average of the composite food sample for the two seasons. In order to increase the part of the diet taken into account in the calculation of the mycotoxin intakes, for certain cereal foods not analysed whose average consumption was less than 1g/day, the average contamination value of the food group to which it is attached in the nomenclature was used. This enabled the coverage of cereals and cereal products to be increase by more than 5%. In this calculation, values not detected (nd) were treated as being equal to half the detection limit; values less than the quantification limit were treated as being equal to half this quantification limit (nd values = 1/2 LOD; <LOQ = 1/2 LOQ). The methodology for treating censured data proposed in the ICPS/GEMS/Food[20] recommendations has the advantage of taking into account the effect of censure according to the proportion of quantified results; it thereby bounds the exposure values at a lower lever (lower bound, nd=0 and <LOQ=LOD), an intermediate level (middle bound) and a high level (upper bound, nd=LOD and <LOQ=LOQ). The first and last scenarios were not applied in our study:

1) First because the detection limits obtained for certain mycotoxins were high (e.g. toxin T-2, toxin HT-2),

2) Secondly due to the very large number of non quantified values for several mycotoxins (between 80% and 100%) and,

3) Also the necessity of obtaining a censured value for the other elements analysed in all the foods although they are known to be present only in a limited number of foods (e.g. trace elements).

In this case, the application of the low and high scenarios could well lead to unrealistic exposure values.

Intake estimates : intakes are estimated by multiplying individual food consumption data for the French and/or vegetarian population (see the section on the sampling plan) by the average concentrations of toxins, trace elements or minerals present in the "as-consumed" food. The estimation of the mycotoxin intakes takes into account a coverage of almost all (>99%) individual consumptions of cereals and cereal products declared by the populations studied. For the trace elements and minerals, the coverage of the diet is on average 81% (*Table 15*).

The total food intake and toxin intake shown in the tables is an average and for the high quantiles (95 percentile). Note that the total intake for the high quantiles of consumption and exposure is computed for each individual on basis of actual declared body weight. This value does not correspond to the sum of the high quantiles of consumption or exposure of each food group taken into account in the diet model, since the high consumers characterised for each food group are not the same. The consumption data given in the tables correspond to the consumed quantities only of the products in which the element in question was sought. The average contribution of each product group to the total exposure is expressed here as a percentage. Moreover, when necessary the main vector(s) contributing to this exposure is(are) mentioned in the text, in accordance with the methodological recommendations for fixing food standards in the process of adoption in the *Codex Alimentarius*[21].

20) International Programme on Chemical Safety/Gems/food Euro workshop on reliable evaluation of low level contamination of food, Kulmbach Federal republic of Germany, May 1995.

21) Codex Committee on Foods Additives and Contaminants (CCFAC) (2004), Proposed draft CCFAC policy for exposure assessment of contaminants and toxins in foods or food groups for adoption step 8 to the CAC Through CCGP (36éme session, CDR3, annexe II).

Risk characterisation : the purpose of this final stage of the risk evaluation is to compare the P2.5, the average level, the P95 or even the P97.5, of the exposed population with the reference toxicological values established by the national, European or international scientific expert committees (AFSSA, EFSA and JECFA). The results obtained are expressed as equivalences or as contribution to the VTR or the LTI (e.g. x% of the TDI/UL or x% of the LTI). In this study, the risk was also quantified by estimating empirically for a given population the percentage of individuals exposed to more than the reference toxicological value. This idea appears in the text as a value, also expressed as a percentage, which corresponds simply to the number of individuals exposed to an identified hazard and whose theoretical exposure is under the LTI or exceeds the established VTR corresponding to this hazard.

Although the exercise is difficult in that the consumption and contamination data and the censure scenario used in the exposure model may not always be the same (food consumption survey, population group, real weight of individuals, inclusion (or not) of under-reporters subjects, absence of calculation of global exposure for the high percentiles, no allowance for corrective factors in food composition, contamination data obtained on raw or transformed food, different analytical limits, and so on), a comparative analysis of the average exposure was carried out between the results of this total diet study and those found in published reports on scientific cooperation tasks (SCOOP 3.2.7: ochratoxin[22]; SCOOP 3.2.8: patulin[23]; SCOOP 3.2.10: fusariums[24]; SCOOP 3.2.11: metals[25] or the latest french studies; *see Table 12 for the mycotoxins and the text in the third part for minerals and trace elements).*

Finally, it is necessary here to make five important remarks about the interpretation of the results:

- the use of the average contaminant concentration in the intake calculations provides a realistic and appropriate estimation of the long-term exposure, since these intakes are compared with reference toxicological intakes (Tolerable Daily Intake (TDI), Tolerable Weekly Intake (TWI), Upper Levels (UL), etc.) established over the whole lifetime[26] by European or international scientific bodies;

- toxicologists generally agree that for toxins with chronic effects, exposure exceeding the reference toxicological values at time t and over short periods in the life of an individual do not necessarily induce a significant health risk, due to the fact that the VTR incorporates a safety factor[27],

- nutritionists generally agree that an intake of minerals and trace elements less than the minimum nutritional requirement at any time and during short periods does not necessarily constitute a significant health risk[18],

- it is important to bear in mind that this study is representative of the methodology applied and the "background noise" in the exposure due to food consumption. Consequently, it does not take into account special situations of overexposure relating for example to possible local environmental sources of food contamination (e.g. lead or inorganic arsenic in drinking water) or linked to behavioural practices (e.g. additional food supplements or table salt),

- for some elements, difference may be observed relative to earlier results, which we should seek to explain through further studies or additional methodological work.

22) SCOOP reports on Tasks 3.2.7. Assessment of dietary intake of Ochratoxin A by the population of EU members states, 2000.

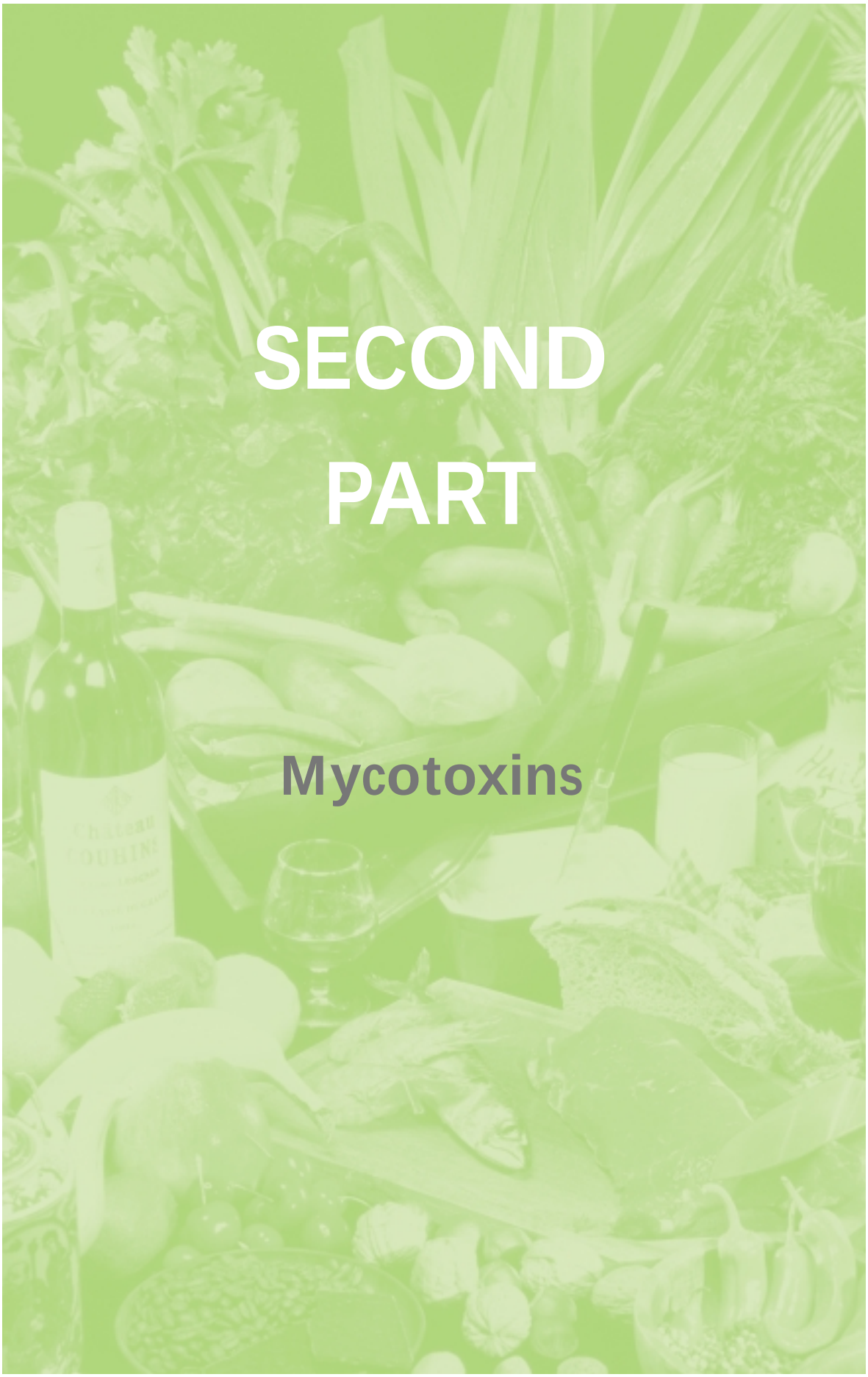
23) SCOOP reports on Tasks 3.2.8. Assessment of dietary intake of Patulin by the population of EU members states, 2002.

24) SCOOP reports on Tasks 3.2.10. Assessment of dietary intake of fusariums by the population of EU members states, 2003.

25) SCOOP reports on Tasks 3.2.11. Assessment of dietary intake of arsenic, cadmium, lead and mercury by the population of EU members states, 2004 à paraître.

26) FAO/WHO, 1985, Guidelines for the study of dietary intakes of chemical contaminants Geneva: WHO, Offset publication n° 87.

27) ILSI Europe, Significance of Excursions of intake above the Acceptable Daily Intake (ADI), Report of a workshop held in April 1998.



SECOND PART

Mycotoxins

Ochratoxin A

Ochratoxin A (OTA) is a mycotoxin produced by several species of fungus, in particular *Aspergillus ochraceus* and *Penicillium viridicatum*, the quantity depending on the temperature and humidity conditions. Contamination by OTA in temperate regions such as Europe and Canada is due to conservation conditions after food harvesting. The OTA is stable in the thermal and chemical conditions normally respected in the transformation of raw materials into human or animal food products.

Hazard evaluation and characterisation

The International Cancer Research Agency (IARC, 1993[28]) classifies OTA in category 2B (possibly carcinogenic to humans) on the basis of clearly carcinogenic effects in animals and possibly in man detected. Similitudes observed between porcine nephropathy and Balkan endemic nephropathy (BEN) suggest that OTA may be one of the agents playing a role in the etiology of this renal disease. The Upper Council for French Public Health (CSHPF,1999[29]) and the Scientific Committee on Food (SCF, 1998[30]) have established a tolerable daily intake (TDI) of 5 ng/kg b.w. (kilograms of body weight) calculated from the nephrocarcinogenic effects observed in the rat (NOEL of 28.8 µg/kg b.w./day). The Joint FAO/WHO Expert Committee on Food Additives and Contaminants (JECFA, 1995[31]) has proposed a TDI of 14.3 ng/kg b.w./day, based on nephrotoxic effects observed in the pig (NOEL of 8 µg/kg b.w./day). The JECFA reconfirmed this value in February 2001.

Risk evaluation and characterisation

Ochratoxin A levels found in the "as-consumed" foods analysed

The results shows that 321 of 343 samples analysed, or more than 93%, have contamination levels below the detection limit. Twenty-one samples, or more than 6% of the products analysed, have contamination levels between the detection limit and 3 µg/kg. These are essentially transformed grape products (grape juice, wine). Only one sample (biscuit), or less than 1% of the products analysed, had a content exceeding 3 µg/kg corresponding to the Community regulatory limit for cereal products destined for human consumption[32]. This was a sample of cake with an ochratoxin A concentration of 6.1 µg/kg. It was not possible to determine precisely if this value is due to the cereal or raisin components (or both) or to another reason.

Estimation of exposure to ochratoxin A of the population groups studied

Table 4 shows that the estimated average ochratoxin intake of the French population is 2.2 ng/kg b.w./day for "normo-reporters" adults aged 15 or more, 4.1 ng/kg b.w./day for children aged 3 to 14. The 95th percentile exposure is 3.6 ng/kg b.w./day (equivalent TDI of 25-72%, JECFA-SCF) for adults and 7.8 ng/kg b.w./day (equivalent TDI of 55-156%, JECFA-SCF) for children. The vectors contributing most (70%) to the exposure for both population groups are cereals and cereal products (bread, rusk, breakfast cereals, pasta, rice and semolina, other cereals, viennese bread, biscuits and cakes); other vectors, mainly grape-based products (dried raisins, eating grapes, grape juice and wine), coffee, nuts and oilseeds contribute less than 5% to the total exposure. If we compare using a similar methodological basis the results

28) IARC, Monographs on evaluation of carcinogenic risks to humans. Some naturally occuring substances, Food items and constituents, heterocyclic aromatic animes and mycotoxins. World health organization, Lyon Vol. 56, pp. 489-521, 1993.

29) Conseil Supérieur d'Hygiène Publique de France (CSHPF), Les mycotoxines dans l'alimentation : évaluation et gestion du risque, éds TEC & DOC, 1999.

30) Scientific Committee for food. European Commission DG XXIV Unit B3. Opinion on Ochratoxin A, September, 1998.

31) JECFA, Evaluation of certain food additives and contaminants. 44éme report. WHO Technical Report Series N°. 859, p35-36, 1995.

32) Règlement (CE) n°466/2001 de la commission du 8 mars 2001 portant fixation de teneurs maximales pour les contaminants dans les denrées alimentaires (JOCE du 16/03/2001).

obtained in this study with those of the last evaluation made in France (SCOOP Task 3.2.7[33]), it is observed that the exposure levels are on average substantially lower, about 10% for young and adult populations (*Table 12*).

For the vegetarian population, the estimated average intake is between 2.2 and 3.7 ng/kg b.w./day depending on the groups studied. The 95th percentile exposure of the OLV and LV groups is 3.7 ng/kg b.w./day (equivalent TDI of 26-74%, JECFA-SCF), while that of the V/M group is 8.5 ng/kg b.w./day (equivalent TDI of 59-170%, JECFA-SCF) (*Table 13*).

The proportion of individuals whose theoretical intake exceeds the JECFA's tolerable daily intake of 14.3 ng/kg b.w. or the SCF's 5 ng/kg b.w. is respectively between 0% and 0.9% for adults aged 15 years or more, between 0% and 25% for children aged 3 to 14 and between 0% and 15% for vegetarians (*Table 13*).

Table 4 : Estimated intakes to Ochratoxin A by French population

Food group	Number of samples	Mean OTA level (µg/kg)	Adults (15 years and more) (n=1474) Consumption (g/day)		Exposure (ng/kg b.w[a]./d)			Children (3 to 14 years) (n=1018) Consumption (g/day)		Exposure (ng/kg b.w[a]./d)		
			Mean	p95	Mean	p95	%	Mean	p95	Mean	p95	%
Vegetarian food	37	0.22	-	[c] -	-	-	-	[c] -	[c] -	-	-	-
Bread, rusk	18	0.43	122.6	280.6	0.706	1.594	32.6	61.5	176.9	0.770	2.108	18.9
Breakfast cereals	12	0.29	4.9	34.3	0.023	0.188	1.1	18.1	64.3	0.210	0.754	5.2
Pasta	4	0.25	36.1	100.0	0.139	0.385	6.4	37.0	100.0	0.325	0.851	8.0
Rice and semolina	8	0.25	20.8	71.4	0.081	0.274	3.7	21.3	64.3	0.187	0.595	4.6
Others cereals	4	0.25	0.9	[c] -	0.004	0.000	0.2	1.3	7.1	0.014	0.073	0.3
Viennese bread and buns	12	0.25	17.3	84.8	0.068	0.316	3.1	24.2	85.7	0.213	0.808	5.2
Biscuits	14	0.69	13.9	57.1	0.141	0.605	6.5	29.3	90.5	0.509	1.825	12.5
Cakes	12	0.29	35.6	121.8	0.166	0.583	7.7	32.1	107.7	0.368	1.376	9.1
Meat	12	0.25	14.9	58.6	0.056	0.207	2.6	9.0	35.7	0.079	0.321	1.9
Poultry and game	18	0.25	26.7	87.8	0.103	0.342	4.7	20.2	60.0	0.178	0.571	4.4
Offals	6	0.25	0.4	[c] -	0.002	0.000	0.1	0.2	[c] -	0.002	0.000	0.0
Delicatessen	20	0.34	17.6	50.7	0.075	0.211	3.5	14.2	42.1	0.137	0.413	3.4
Vegetables (except potatoes)	4	0.25	16.2	52.2	0.063	0.210	2.9	11.2	39.3	0.101	0.345	2.5
Pulses	16	0.25	10.3	42.9	0.039	0.188	1.8	6.7	28.6	0.062	0.285	1.5
Fruits	12	0.25	17.0	121.9	0.029	0.202	1.4	6.9	37.9	0.066	0.394	1.6
Nuts and oilseeds	22	0.25	3.0	17.1	0.011	0.065	0.5	1.7	10.7	0.017	0.088	0.4
Chocolate	4	0.25	2.7	14.3	0.011	0.055	0.5	5.5	22.9	0.049	0.223	1.2
Sugar and confectionery	2	0.25	1.2	4.3	0.005	0.020	0.2	4.4	21.4	0.037	0.184	0.9
Soft drinks[b]	4	0.11	2.3	[c] -	0.004	0.000	0.2	3.6	21.4	0.032	0.164	0.8
Alcoholic beverages	18	0.04	86.6	402.4	0.049	0.218	2.3	0.8	[c] -	0.001	0.000	0.0
Coffee	14	0.04	200.7	600.0	0.076	0.228	3.5	10.5	63.3	0.008	0.048	0.2
Hot beverages	2	0.03	3.7	23.3	0.001	0.009	0.1	11.1	32.9	0.011	0.040	0.3
Pizzas, salt cakes and quiches	6	0.25	21.8	81.7	0.084	0.319	3.9	16.0	60.6	0.134	0.463	3.3
Sandwitches	12	0.25	12.5	66.6	0.047	0.256	2.2	9.5	45.1	0.077	0.353	1.9
Soups	6	0.03	6.3	50.0	0.002	0.020	0.1	3.9	36.8	0.004	0.031	0.1
Prepared dishes	26	0.25	22.7	103.8	0.087	0.416	4.0	20.9	86.1	0.174	0.743	4.3
Salads	4	0.25	4.1	28.6	0.016	0.100	0.7	2.0	14.3	0.016	0.111	0.4
Dessert	14	0.25	19.8	85.7	0.076	0.334	3.5	28.9	107.1	0.284	1.129	7.0
Total	**343**		**742**	**1438**	**2.16**	**3.60**	**100**	**412**	**722**	**4.07**	**7.80**	**100**

[a] b.w. = body weight
[b] Soft drinks (grapes juice and beer without alcohol).
[c] The hyphen means there is less than 5% of consumers for the considered food items and that the P95 value is equal to 0.

33) SCOOP Task 3.2.7, Assessment of dietary intake of Ochratoxin A by the population of EU members states, 1999.

Aflatoxins

Aflatoxins are powerful toxins synthesised by three aspergillus strains (A. *Parasiticus*, A. *Flavus* and A. *Nomius*). The growth of the aspergillus strains and the production of the 5 main forms of aflatoxins (B_1, B_2, G_1, G_2 and M_1) is strongly dependent on environmental factors – humidity, temperature, aeration, nature of the milieu – from the production phase in the field until transformation. The major proliferation risk is related to transport and storage conditions. In France, aflatoxins B and G are found in imported dried fruits, peanuts, pistachios and walnuts, sometimes with very high contamination levels, and cereals. AFM1 metabolite of AFB1 is found in milk.

Hazard evaluation and characterisation

In 1992, the IARC[34] classified the aflatoxins B_1, B_2, G_1, G_2 in group 1 (carcinogenic to humans) and aflatoxin M_1 in group 2B (possibly carcinogenic to humans). In the case of genotoxic carcinogenics, substances without threshold effects, we consider that it is impossible to calculate a tolerable intake and that the only realistic approach is to reduce the exposure as much as possible, the approach adopted by the SCF and the JECFA. However, toxicologists can calculate indicative values by using mathematical extrapolation models to quantify the risk or safety factors from 2000 to 5000. From hepatic carcinogenic studies on rats, we obtain extrapolated intake limits for humans of about 0.15 ng/kg/day for AFB1 and 0.20 ng/kg/day for AFM1 (CSHPF, 1999[35]). The SCF (1994[36]) and the JECFA (1997, 2001[37]) have concluded that even very small levels of exposure to aflatoxins, of 1 ng/kg b.w./day or even less, still contribute to a liver cancer risk.

Risk evaluation and characterisation

Aflatoxins B, G and M_1 levels found in the "as-consumed" foods analysed

The results show that no sample among the 78 analysed for aflatoxins B_1, B_2, G_1 and G_2 and the 70 analysed for aflatoxin M_1 revealed a level higher than the detection limits, nor than those of the current Community regulatory limits[32].

Estimation of exposure to aflatoxins B and G of the population groups studied

Table 5 shows that the estimated average intake of aflatoxins B1, B2, G1 and G2 of the French population is 0.12 ng/kg b.w./day for "normo-reporters" adults aged 15 years or more and 0.32 ng/kg b.w./day for children aged 3 to 14. The 95th percentile exposure is 0.35 ng/kg b.w./day for adults and 0.89 ng/kg b.w./day for children. The last theoretical evaluation made in France in 1998[38] revealed that the average exposure to AFB1 for adults and children was respectively 1.3 and 2.5 ng/day/kg b.w. The calculated theoretical 95th percentile exposure was 2.4 and 4.5 ng/kg b.w./day respectively for adults and children. Compared to this last evaluation, the results indicate a diminution of the exposure by a factor of 5 to 11 depending on the groups studied (*Table 12*). This difference is essentially due to the high levels of contaminants found at the time in cereals and husked fruits, which is not the case in our study.

34) IARC Monographs on the evaluation of carcinogenic risks to humans, vol. 56, some naturally occurring substances, food items and constituents, heterocyclic aromatic amines and mycotoxins, World health organization, Lyon, pp 245-395, 1993.

35) Conseil Supérieur d'Hygiène Publique de France (CSHPF), Les mycotoxines dans l'alimentation : évaluation et gestion du risque, éds TEC & DOC, 1999.

36) Scientific Committee for food. European Commission DG XXIV Unit B3. Thirty-fifth report. Opinion on Aflatoxins B1, B2, G1 et G2 and M1, Expressed on 23 September, 1994.

37) JECFA Evaluation of certain food additives and contaminants. Fourty-nine report. WHO Technical Report Series N°. 884, p69-77, Geneva, 1999

38) Verger Ph., Volatier J.L., et Dufour A., CSHPF, Les mycotoxines dans l'alimentation : évaluation théorique de l'exposition aux aflatoxinese, éds TEC & DOC, 1999.

For the vegetarian population, the estimated average intake is between 0.4 and 0.9 ng/kg b.w./day depending on the groups studied. The 95th percentile exposures are 0.9 ng/kg b.w./day for the LV group, 1.6 ng/kg b.w./day for the OLV group and 2.1 ng/kg b.w./day for the V/M group (*Table 13*).

The proportion of individuals whose intake exceeds the SCF/JECFA recommended "limit" of 1 ng/kg b.w./day is estimated to be 0.01% for adults aged 15 years or more, 3.4% for children of 3 to 14 and between 2.6% and 23% for vegetarians which are the biggest consumers of cereal products and dried fruits in the French population (*Table 13 and appendix 1*).

Table 5 : Estimated intakes to Aflatoxins BG by French population

Food group	Number of samples	Mean AFBG level (µg/kg)	Adults (15 years and more) (n=1474) Consumption (g/day)		Adults (15 years and more) (n=1474) Exposure (ng/kg b.w[a]./d)			Children (3 to 14 years) (n=1018) Consumption (g/day)		Children (3 to 14 years) (n=1018) Exposure (ng/kg b.w[a]./d)		
			Mean	p95	Mean	p95	%	Mean	p95	Mean	p95	%
Vegetarian food	8	0.25	-	[b] -	-	-	-	[b] -	[b] -	-	-	-
Biscuits	2	0.25	2.90	21.43	0.011	0.079	9.7	6.19	34.50	0.056	0.330	17.3
Breakfast cereals	4	0.25	3.55	25.71	0.014	0.106	12.3	8.56	44.39	0.077	0.402	23.9
Chocolate	2	0.25	1.15	7.14	0.005	0.030	3.9	3.43	17.14	0.030	0.163	9.3
Desserts	2	0.25	-	[b] -	-	-	-	-	[b] -	-	-	-
Nuts and oilseeds	22	0.25	2.22	14.29	0.008	0.061	7.2	1.35	7.14	0.014	0.069	4.2
Vegetables (except potatoes)	2	0.25	0.49	[b] -	0.002	0.000	1.8	0.06	[b] -	0.001	0.000	0.2
Pulses	2	0.25	0.32	[b] -	0.001	0.000	1.1	0.08	[b] -	0.001	0.000	0.3
Eggs and egg products	30	0.25	18.3	57.14	0.069	0.209	59.2	11.5	37.14	0.105	0.357	32.5
Sugar and confectionery	2	0.25	1.16	4.29	0.005	0.020	4.1	4.38	21.43	0.037	0.184	11.5
Viennese bread and buns	2	0.25	0.22	[b] -	0.001	0.000	0.7	0.26	[b] -	0.002	0.000	0.7
Total	**78**		**30**	**86**	**0.117**	**0.345**	**100**	**36**	**101**	**0.323**	**0.888**	**100**

[a] b.w. = body weight
[b] The hyphen means there is less than 5% of consumers for the considered food items and that the P95 value is equal to 0

Estimation of exposure to aflatoxin M_1 of the population groups studied

Table 6 shows that the estimated average intake of Aflatoxin M_1 of the French population is 0.09 ng/kg b.w./day for "normo-reporters" adults aged 15 years or more and 0.22 ng/kg b.w./day for children aged 3 to 14. The 95th percentile exposure is 0.21 ng/kg b.w./day for adults and 0.55 ng/kg b.w./day for children. These results are of the same order of magnitude as those estimated during the last French evaluation[38] in which the average aflatoxin M_1 contamination levels were close to the detection limits, which is also the case in our study (*Table 12*).

For the vegetarian population, the estimated average intake is between 0 and 0.1 ng/kg b.w./day depending on the groups studied. The 95th percentile exposure is between 0 and 0.3 ng/kg b.w./day for the OLV and LV groups, whereas the V/M group is not exposed at all to this toxin since is consumes no milk or dairy products (*Table 13)*.

The proportion of individuals whose intake exceeds the SCF/JECFA "limit" of 1 ng/kg b.w./day is estimated to be 0% for adults aged 15 years or more and the vegetarian population and 0.2% for children aged 3 to 14 (*Table 13*).

Tableau 6 : Estimation de l'exposition à l'Aflatoxine M_1 de la population Française

Food group	Number of samples	Mean AF M1 level (µg/kg)	Adults (15 years and more) (n=1474) Consumption (g/day)		Exposure (ng/kg b.w[a]./d)			Children (3 to 14 years) (n=1018) Consumption (g/day)		Exposure (ng/kg b.w[a]./d)		
			Mean	p95	Mean	p95	%	Mean	p95	Mean	p95	%
Butter	2	0.05	13.6	34.1	0.01	0.03	11.0	10.2	24.0	0.02	0.05	8.4
Desserts	4	0.05	0.21	[b] -	0.00	0.00	0.10	0.16	[b] -	0.00	0.00	0.2
Cheeses	20	0.05	25.6	75.0	0.02	0.06	20.6	13.1	45.4	0.02	0.08	10.6
Milk	16	0.005	119	352	0.01	0.03	10.0	219	455	0.04	0.11	20.1
Ultra-fresh dairy products	28	0.047	70.4	214	0.06	0.17	58.3	69.9	180	0.13	0.41	60.7
Total	**70**		**229**	**510**	**0.09**	**0.21**	**100**	**312**	**585**	**0.22**	**0.55**	**100**

[a] b.w. = body weight
[b] The hyphen means there is less than 5% of consumers for the considered food items and that the P95 value is equal to 0

Patulin

Patulin is a mycotoxin produced by a large number of different strains of Aspergillus, Penicillium and Byssochlamys fungi. Patulin, after natural infection by Penicillium is found in numerous whole fruits (pears, peaches, apricots, grapes, bananas, apples, etc.) or transformed fruit (juice, sauce, stewed fruit, jelly), but the most frequent contamination is that caused by Penicillium expansum found in some forms of rot in surface-damaged apples.

Hazard evaluation and characterisation

The IARC (1986[39]) classifies patulin in group 3 (not classifiable as to its carcinogenicity to humans.). The JECFA (1995[40]), the CSHPF (1999[41]) and the SCF (2000[42]) have established a provisional maximum tolerable daily intake (PMTDI) for patulin of 0.4 µg/kg b.w. calculated from combined effects on reproduction of the toxic long-term effects and the carcinogenicity (NOAEL 43 µg/kg b.w./day).

Risk evaluation and characterisation

Patulin levels found in the "as-consumed" foods analysed

The results shows that 16 samples, or more than 80% of the products analysed, have contamination levels less than the detection limit. Two samples, or more than 10% of the products analysed, have contamination levels between the detection limit and 50 µg/kg. The first is a sample of concentrate-based apple juice, the second is cider. Two samples, or about 10% of the products analysed, have a content exceeding 50 µg/kg. The first is a sample of apple tart (60 µg/kg); the second is a sample of apple doughnut (100 µg/kg). This type of product containing apple pieces is covered by a Community regulatory limit[43] of 25 µg/kg since 2003.

39) IARC (1986) International Agency for Research on Cancer. Monographs on the evaluation of carcinogenic risk of chemicals to man: Vol. 40 Some naturally occurring and synthetic food components, flurocoumarins and ultraviolet radiation, p83-98
40) Evaluation of certain food additives and contaminants, forty-fourth report of the Joint FAO/WHO Expert Committee on Food Additives (JECFA), 1995.
41) Conseil Supérieur d'Hygiène Publique de France (CSHPF), Les mycotoxines dans l'alimentation : évaluation et gestion du risque, éds TEC & DOC, 1999.
42) Reports of the Scientific Committee for Food (thirty-fifth series), 23 September 1994.
43) Règlement (CE) n°1425/2003 de la commission du 11 août 2003 modifiant le règlement (CE) n°466/2001 en ce qui concerne la patuline (JOCE du 12/08/2003).

Estimation of exposure to patulin of the population groups studied

Table 7 shows that the estimated average patulin intake of the French population is 18 ng/kg b.w./day for "normo-reporters" adults aged 15 years or more and 30 ng/kg b.w./day for children aged 3 to 14. The 95th percentile exposure is 57 ng/kg b.w./day for adults and 110 ng/kg b.w./day for children (equivalent TDI less than 30%). Compare a the last evaluation of the SCOOP Task 3.2.8 conducted in 2002[44], the exposure results are on average higher by a factor of 10 for the adults and by a factor of 5 for the children. This difference is essentially due to the higher detection limits in the study and the taking into account of additional exposure vectors such as fruits (apples) and cakes (apple tart and doughnut) (*Table 12*).

For the vegetarian population, the estimated average intake is between 34 and 50 ng/kg b.w./day depending on the groups studied. The 95th percentile exposure is between 90 and 120 ng/kg b.w./day (equivalent TDI less than or equal to 30%) (*Table 13*).

The proportion of individuals whose theoretical intake exceeds the PMTDI is estimated to be 0% for all the populations studied (*Table 13*).

Table 7 : Estimated intakes to Patulin by French population

Food group	Number of samples	Mean Patulin level (µg/kg)	Adults (15 years and more) (n=1474) Consumption (g/day)		Exposure (ng/kg b.w[a]./d)			Children (3 to 14 years) (n=1018) Consumption (g/day)		Exposure (ng/kg b.w[a]./d)		
			Mean	p95	Mean	p95	%	Mean	p95	Mean	p95	%
Alcoholic beverages[b]	2	19.5	3.54	17.1	1.00	5.18	5.60	0.47	[c] -	0.33	0.00	1.10
Soft drinks[b]	2	20.5	2.25	[c] -	0.78	0.00	4.40	9.02	57.1	7.45	45.2	25.2
Compote and stewed fruit	4	15	6.08	42.9	1.44	9.60	8.10	6.61	42.9	4.17	22.0	14.1
Fruits	6	15	39.7	171	9.16	38.7	51.4	18.7	85.7	10.2	45.0	34.4
Cakes	6	31.7	19.1	77.1	5.45	21.6	30.6	11.6	51.4	7.40	34.7	25.2
Total	**20**		**71**	**233**	**18**	**57**	**100**	**46**	**150**	**30**	**106**	**100**

[a] b.w. = body weight
[b] Soft drinks (grapes juice and beer without alcohol ; Alcoholic beverages (cider dry)
[c] The hyphen means there is less than 5% of consumers for the considered food items and that the P95 value is equal to 0

44) SCOOP reports on Tasks 3.2.8 Assessment of dietary intake of Patulin by the population of EU members states, Mars 2002, directorate general health and consumer protection.

Trichothecenes

Trichothecenes are mycotoxins produced by about 24 strains of fusarium fungi. Among these natural contaminants of cereals currently identified, the most common in agricultural production, we find:

- type A, including the T-2 toxin, HT-2 toxin, T-2 triol, diacetoxyscirpenol (DAS) and monoacetoxyyscirpenol,

- type B, including deoxynivalenol (DON), nivalenol (NIV), 3-acetyldeoxynivalenol, 15-acetyldeoxynivalenol and fusarenone X.

Hazard evaluation and characterisation

The IARC[45] has classified the *T-2 toxin* in category L (Limited evidence of carcinogenicity in animals) and has classified DON in category I (Inadequate evidence of carcinogenicity). In 2001[46], the JECFA established a PMTDI of 60 ng/kg b.w. for T-2 and HT-2 alone or combine based on short-duration studies in the pig (LOAEL = 0.03 mg/kg b.w./day, safety factor = 500). An identical combined value was also confirmed by the SCF in 2002[47]. In 2001[46], the JECFA established for *DON* a TDI of 1 µg/kg b.w. based on a chronic study in the mouse (NOAEL = 0.1 mg/kg b.w./day, retarded growth effects, safety factor = 100). This value was also confirmed by the SCF in 2002[47]. In 2002[47], the SCF established for *NIV* a temporary TDI of 0.7 µg/kg b.w. based on a chronic study in the mouse (LOAEL = 0.7 mg/kg b.w./day, retarded growth effects, safety factor = 1000).

Risk evaluation and characterisation

Trichothecenes levels found in the "as-consumed" foods analysed

The results reveal that on 238 samples only a few trichothecenes (HT-2 toxin. deoxynivalenol. fusarenone X and nivalenol) are sometimes found at levels above the detection limit. The toxins HT-2 and fusarenone X were quantified in 1 sample out of 238 (a walnut sample had respective concentrations of 270 ppb and 60 ppb). Nivalenol was measured in three samples at 60 ppb (walnut, special vegetarian breads, Indian vegetable doughnut). Thirty-one samples, or 13% of the products analysed for deoxynivalenol, had contamination levels above the detection limit. Thirty samples had contents falling between the detection limit and 500 µg/kg; another had a content between 500 and 1000 ppb[48] . These are essentially cereal products including a wholemeal bread sample with 600 ppb.

Estimation of exposure to trichothecenes of the population groups studied

In view of the absence of detection of the majority of tricothecenes in the foods, of the censured data processing scenario uses and of the absence of official toxicological references for these same toxins, it was considered preferable not to calculate estimated intakes for these toxins and to present only the realistic exposure estimations, in other words those concerning deoxynivalenol and nivalenol.

Estimation of exposure to deoxynivalenol

Table 8 shows that the estimated average deoxynivalenol intake of the French population is 281 ng/kg b.w./day for "normo-reporters" adults aged 15 years or more and 451 ng/kg

45) IARC Monographs on the evaluation of carcinogenic risks to humans, vol. 56, some naturally occuring substances, food items and constituents, heterocyclic aromatic amines and mycotoxins. World health organization, Lyon, pp 397-433, 1993.

46) JECFA, Safety evaluation of certain mycotoxins in food..WHO food additives series 47, 2001.

47) SCF, opinion of the scientific committee on food on fusarium toxins, Part 6: group evaluation of T-2 toxin, HT-2 toxin, nivalenol and deoxynivalenol, expressed on 26 february 2002.

48) Proposition par la commission européenne (DG-SANCO) de limite maximale pour le DON variant de 500 à 2000ppb dans les céréales et produits à base de céréales brutes ou transformées destinés à la consommation humaine.

b.w./day for children aged 3 to 14. The 95th percentile exposure is 571 ng/kg b.w./day for adults (equivalent TDI of 57%) and 929 ng/kg b.w./day for children (equivalent TDI of 93%). The vectors contributing most (90% or more) to this exposure for both population groups are cereal-derivative products, in particular the bread/rusk group (between 45% and 70%); other non-cereal vectors contribute less than 2% to the total exposure. These results are on average significantly lower (about 60%) than those estimated during the last evaluation French (SCOOP Task 3.2.10 conducted in 2003[49]) (*Table 12*). The difference is essentially due to the fact that the consumption of the "cereal-based prepared dishes" category taken into account was higher in the calculation of the SCOOP Task and probably also due to the fact that the reduction of DON during cooking was not taken into account in the calculation, whereas this factor is taken into account in this total diet study in which the analyses were made directly on the transformed food.

Table 8 : Estimated intakes to Deoxynivalenol by French population

Food group	Number of samples	Mean DON level (µg/kg	Adults (15 years and more) (n=1474) Consumption (g/day)		Exposure (ng/kg b.w[a]./d)			Children (3 to 14 years) (n=1018) Consumption (g/day)		Exposure (ng/kg b.w[a]./d)		
			Mean	p95	Mean	p95	%	Mean	p95	Mean	p95	%
Vegetarian food	35	16.3	-	[c] -	-	-	-	-	[c] -	-	-	-
Bread, rusk	18	108.9	122.6	280.6	187.8	458.9	66.8	61.5	176.9	201.9	545.1	44.8
Breakfast cereals	12	19.6	4.9	34.3	1.4	9.9	0.5	18.1	64.3	12.7	46.2	2.8
Pasta	4	15.0	36.1	100.0	8.3	23.1	3.0	37.0	100.0	19.5	51.1	4.3
Rice and semolina	8	58.8	20.8	71.4	9.5	40.1	3.4	21.3	64.3	23.7	117.8	5.3
Others cereals	4	15.0	0.9	[c] -	0.2	0.0	0.1	1.3	7.1	0.8	4.4	0.2
Viennese bread and buns	12	57.9	17.3	84.8	18.3	81.8	6.5	24.2	85.7	60.7	222.5	13.5
Biscuits	14	46.4	13.9	57.1	9.5	39.6	3.4	29.3	90.5	57.0	201.2	12.6
Cakes	12	20.4	35.6	121.8	8.8	28.8	3.1	32.1	107.7	18.6	63.2	4.1
Eggs and egg products	30	17.5	18.3	57.1	4.8	14.2	1.7	11.5	37.1	7.2	24.7	1.6
Vegetables (except potatoes)	4	15.0	3.1	26.4	0.4	2.8	0.1	3.0	22.9	0.9	6.5	0.2
Pulses	2	15.0	0.4	[c] -	0.1	0.0	0.0	0.1	[c] -	0.1	0.0	0.0
Fruits	2	15.0	32.5	165.7	3.3	16.1	1.2	29.3	132.4	9.4	41.7	2.1
Nuts and oilseeds	22	16.2	3.0	17.1	0.8	4.5	0.3	1.7	10.7	1.2	6.1	0.3
Sugar and confectionery	2	15.0	1.2	4.3	0.3	1.2	0.1	4.4	21.4	2.2	11.0	0.5
Soft drinks[b]	2	15.0	1.2	[c] -	0.2	0.0	0.1	0.0	[c] -	0.0.	0.0	0.0
Alcoholic beverages[b]	4	15.0	50.1	306.2	6.5	33.5	2.3	0.3	[c] -	0.1	0.0	0.0
Pizzas, salt cakes and quiches	6	22.5	21.8	81.7	9.8	42.3	3.5	16.0	60.6	16.0	55.8	3.5
Sandwitches	12	23.8	12.5	66.6	4.7	25.6	1.7	9.5	45.1	6.9	32.6	1.5
Prepared dishes	24	15.4	22.2	103.8	5.1	25.0	1.8	19.8	86.1	9.7	44.6	2.1
Salads	4	15.0	4.1	28.6	0.9	6.0	0.3	2.0	14.3	1.0	6.6	0.2
Dessert	5	15.0	3.0	20.0	0.4	2.4	0.1	3.9	20.9	1.0	6.1	0.2
Total	**238**		**425**	**837**	**281**	**571**	**100**	**326**	**571**	**451**	**929**	**100**

[a] b.w. = body weight
[b] Soft drinks (beer without alcohol) ; Alcoholic beverages (Shandy and Beer)
[c] The hyphen means there is less than 5% of consumers for the considered food items and that the P95 value is equal to 0

For the vegetarian population, the estimated average deoxynivalenol intake is between 320 and 410 ng/kg b.w./day depending on the groups studied. The 95th percentile exposure is between 720 and 960 ng/kg b.w./day (equivalent TDI of 72-96%) (*Table 13*).

49) SCOOP reports on Tasks 3.2.10. Assessment of dietary intake of fusariums by the population of EU members states, September 2003.

The proportion of individuals whose theoretical intake exceeds the TDI is estimated to be 0.4% for adults, 4% for children and about 4-5% for vegetarians (*Table 13*).

Estimation of exposure to nivalenol

Table 9 shows that the estimated average nivalenol intake of the French population is 90 ng/kg b.w./day for "normo-reporters" adults aged 15 years or more and 160 ng/kg b.w./day for children aged 3 to 14. The 95th percentile exposure is 160 ng/kg b.w./day for adults (equivalent TDI of 23%) and 300 ng/kg b.w./day for children (equivalent TDI of 43%). The vectors contributing most (about 80%) to this exposure for both population groups are cereal-derivative products, in particular the bread/rusk group (between 19% and 32%); other non-cereal vectors contribute less than 4% to the total exposure. Compared to the last evaluation of the SCOOP Task 3.2.10 conducted in 2003[49], the average results are of the same order of magnitude (*Table 12*).

For the vegetarian population, the estimated average nivalenol intake is between 120 and 210 ng/kg b.w./day depending on the groups studied. The 95th percentile exposure is between 190 and 420 ng/kg b.w./day (equivalent TDI of 27-60%) (*Table 13*).

The proportion of individuals whose theoretical intake exceeds the TDI is estimated to be 3.8% for the vegan/macrobiotic group and 0% for all the other groups studied (*Table 13*).

Table 9 : Estimated intakes to Nivalenol by French population

Food group	Number of samples	Mean NIV level (µg/kg)	Adults (15 years and more) (n=1474) Consumption (g/day)		Adults (15 years and more) (n=1474) Exposure (ng/kg b.w[a]./d)			Children (3 to 14 years) (n=1018) Consumption (g/day)		Children (3 to 14 years) (n=1018) Exposure (ng/kg b.w[a]./d)		
			Mean	p95	Mean	p95	%	Mean	p95	Mean	p95	%
Vegetarian food	35	15.4	-	[c] -	-	-	-	-	[c] -	-	-	-
Bread, rusk	18	15.8	122.6	280.6	27.67	62.53	31.56	61.5	176.9	30.6	82.6	18.77
Breakfast cereals	12	15	4.9	34.3	1.19	8.98	1.36	18.1	64.3	10.2	37.1	6.27
Pasta	4	15	36.1	100.0	8.33	23.08	9.50	37.0	100.0	19.5	51.1	11.97
Rice and semolina	8	15	20.8	71.4	4.86	16.45	5.54	21.3	64.3	11.2	35.7	6.89
Others cereals	4	15	0.9	[c] -	0.21	0.00	0.24	1.3	7.1	0.8	4.4	0.51
Viennese bread and buns	12	15	17.3	84.8	4.09	18.98	4.66	24.2	85.7	12.8	48.5	7.85
Biscuits	14	15	13.9	57.1	3.25	13.72	3.71	29.3	90.5	16.9	54.3	10.34
Cakes	12	15	35.6	121.8	8.18	27.05	9.32	32.1	107.7	16.8	57.1	10.29
Eggs and egg products	30	15	18.3	57.1	4.15	12.55	4.74	11.5	37.1	6.3	21.4	3.86
Vegetables (except potatoes)	4	15	3.1	26.4	0.37	2.85	0.42	3.0	22.9	0.9	6.5	0.54
Pulses	2	15	0.4	[c] -	0.08	0.00	0.09	0.1	[c] -	0.1	0.0	0.04
Fruits	2	15	32.5	165.7	3.26	16.07	3.72	29.3	132.4	9.4	41.7	5.76
Nuts and oilseeds	22	16.0	3.0	17.1	0.79	4.46	0.90	1.7	10.7	1.2	6.0	0.72
Sugar and confectionery	2	15	1.2	4.3	0.28	1.18	0.32	4.4	21.4	2.2	11.0	1.36
Soft drinks[b]	2	15	1.2	[c] -	0.21	0.00	0.24	0.0	[c] -	-	-	-
Alcoholic beverages[b]	4	15	50.1	306.2	6.53	33.51	7.44	0.3	[c] -	0.1	0.0	0.08
Pizzas, salt cakes and quiches	6	15	21.8	81.7	5.05	19.13	5.76	16.0	60.6	8.0	27.8	4.92
Sandwitches	12	15	12.5	66.6	2.82	15.33	3.22	9.5	45.1	4.6	21.2	2.84
Prepared dishes	24	15	22.2	103.8	5.03	24.57	5.73	19.8	86.1	9.4	43.7	5.76
Salads	4	15	4.1	28.6	0.95	6.00	1.08	2.0	14.3	1.0	6.6	0.60
Dessert	5	15	3.0	20.0	0.37	2.43	0.43	3.9	20.9	1.0	6.1	0.62
Total	**238**		**425**	**837**	**88**	**157**	**100**	**326**	**571**	**163**	**300**	**100**

[a] b.w. = body weight.
[b] Soft drinks (beer without alcohol) ; Alcoholic beverages (Shandy and Beer).
[c] The hyphen means there is less than 5% of consumers for the considered food items and that the P95 value is equal to 0.

Zearalenone

Zearalenone is a mycotoxin produced by fungi of the *Fusarium* strain, in particular by *F. graminearum*, *F. semitectum*, *F. equiseti*, *F. crookwellense* and *F. culmorum*. This mycotoxin is a natural contaminant of cereals, above all wheat and maize, and of certain fruits and vegetables (bananas, beans, walnuts, etc.). It is also found in animal products such as milk, liver and eggs indirectly through contamination of the animal food. Contamination by zearalenone is a worldwide phenomenon since the originating fungus develops easily in all types of climatic conditions although it prefers low temperatures. Zearalenone is thermostable and can resists a temperature of 120°C for 4 hours.

Hazard evaluation and characterisation

Zearalenone is a molecule of oestrogenic activity classified in the L category (Limited evidence of carcinogenicity in animals) by the IARC[50]. In 2000, the SCF[51] established a temporary tolerable daily intake (t-TDI) of 0.2 µg/kg b.w. based on a short-duration study in the pig (NOAEL= 40 µg/kg b.w./day, hormonal effects, safety factor = 200). In 1999, the JECFA[52] established a PMTDI of 0.5 µg/kg b.w. based on hormonal effects observed in the most sensitive species, the pig (NOAEL= 50 µg/kg b.w./day). In 1999, the CSHPF[53] proposed a TDI of 0.1 µg/kg b.w./day based on effects observed on monkey reproduction.

Risk evaluation and characterisation

Zearalenone levels found in the "as-consumed" foods analysed

The results shows that only 5 out of 245 samples (2%) have levels above the detection limit, including 2 exceeding the 50 ppb limit currently proposed by the European Commission. These are breakfast cereals, two samples of muesli and enriched cornflakes with contents of 200 ppb and 22 ppb; vegetables, one sample of canned soya with a content of 53 ppb; and nuts and oil-seeds, one sample of sesame seed with a content of 18 ppb.

Estimation of exposure to zearalenone of the population groups studied

Table 10 shows that the estimated average zearalenone intake of the French population is 30 ng/kg b.w./day for "normo-reporters" adults aged 15 years or more and 70 ng/kg b.w./day for children aged 3 to 14. The 95th percentile exposure is 70 ng/kg b.w./day for adults (equivalent TDI of 4-35%, JECFA-SCF) and 130 ng/kg b.w./day for children (equivalent TDI of 12-65%, JECFA-SCF). The vectors contributing most (more than 60%) to this exposure for both population groups are cereal-derivative products, in particular the breakfast cereals group (between 12% and 23%). Compared to the last evaluation of the SCOOP Task 3.2.10 conducted in 2003[54], the results are on average of the same order of magnitude (*Table 12*).

50) IARC Monographs on the evaluation of carcinogenic risks to humans, vol. 56, some naturally occuring substances, food items and constituents, heterocyclic aromatic amines and mycotoxins. World health organization, Lyon, pp 397-444, 1993.

51) SCF, opinion of the scientific committee on food on fusarium toxins, Part 2: evaluation of zéaralénone, expressed on 22 june 2000.

52) JECFA, Evaluation of certain food additives and contaminants. Fifty-third report of the joint FAO/WHO expert committee on food additives, WHO technical report series n°896.

53) Conseil Supérieur d'Hygiène Publique de France (CSHPF), Les mycotoxines dans l'alimentation : évaluation et gestion du risque, éds TEC & DOC, 1999.

54) SCOOP reports on Tasks 3.2.10. Assessment of dietary intake of fusariums by the population of EU members states, September 2003.

For the vegetarian population, the estimated average zearalenone intake is between 50 and 200 ng/kg b.w./day depending on the groups studied. The 95th percentile exposure is between 110 and 570 ng/kg b.w./day (equivalent TDI of 22-285%) (*Table 13*).

The proportion of individuals whose theoretical intake exceeds the tolerable daily intake of 500 ng/kg b.w./day established by the JECFA or the 200 ng/kg b.w./day established by the SCF is respectively between 0% and 0.2% for adults aged 15 years or more, between 0.4% and 2.5% for children aged 3 to 14 and between 0% and 31% for the vegetarian population. For the latter, only the vegan/macrobiotic population presents a probability of exposure to the danger of zearalenone which is estimated between 8% and 31% due to a consumption higher than the other groups of cereal products, nuts and soya, the only foods in which we find contamination levels higher than the detection limits (*Table 13 and appendix 1*).

Table 10 : Estimated intakes to Zearalenone by French population

Food group	Number of samples	Mean ZEA level (µg/kg)	Adults (15 years and more) (n=1474) Consumption (g/day)		Adults (15 years and more) (n=1474) Exposure (ng/kg b.w[a]./d)			Children (3 to 14 years) (n=1018) Consumption (g/day)		Children (3 to 14 years) (n=1018) Exposure (ng/kg b.w[a]./d)		
			Mean	p95	Mean	p95	%	Mean	p95	Mean	p95	%
Vegetarian food	35	8.7	-	[c] -	-	-	-	-	[c] -	-	-	-
Bread, rusk	18	5	125.25	283.89	9.39	21.17	28.72	61.5	176.9	10.19	27.20	15.37
Breakfast cereals	12	22.7	4.50	32.14	3.79	13.91	11.59	18.1	64.3	15.33	58.70	23.11
Pasta	4	5	34.75	92.86	2.65	7.29	8.10	37.0	100.0	6.51	17.02	9.81
Rice and semolina	8	5	21.10	74.03	1.63	5.57	4.97	21.3	64.3	3.75	11.90	5.65
Others cereals	4	5	0.94	[c] -	0.07	0.00	0.22	1.3	7.1	0.28	1.45	0.42
Viennese bread and buns	12	5	17.05	80.00	1.33	6.28	4.07	24.2	85.7	4.27	16.16	6.43
Biscuits	14	5	13.41	50.21	1.04	4.31	3.17	29.3	90.5	5.62	18.11	8.48
Cakes	12	5	37.72	128.42	2.88	9.91	8.81	32.1	107.7	5.59	19.04	8.43
Eggs and egg products	30	5	19.32	60.00	1.45	4.32	4.45	11.5	37.1	2.10	7.14	3.17
Offals	6	5	0.45	[c] -	0.03	0.00	0.11	0.2	[c] -	0.04	0.00	0.06
Vegetables (except potatoes)	4	17	2.97	26.43	0.32	0.95	0.96	3.0	22.9	0.36	2.17	0.54
Pulses	2	5	0.20	[c] -	0.02	0.00	0.06	0.1	[c] -	0.02	0.00	0.03
Fruits	2	5	32.56	168.57	1.02	5.11	3.11	29.3	132.4	3.13	13.91	4.72
Nuts and oilseeds	22	5.7	3.28	19.71	0.25	1.38	0.78	1.7	10.7	0.34	1.83	0.52
Sugar and confectionery	2	5	0.98	4.29	0.08	0.39	0.25	4.4	21.4	0.74	3.67	1.12
Soft drinks[b]	2	5	1.56	[c] -	0.10	0.00	0.29	[c] -	[c] -	-	-	-
Alcoholic beverages[b]	4	5	46.72	279.11	2.00	10.73	6.12	0.3	[c] -	0.04	0.00	0.07
Pizzas, salt cakes and quiches	6	5	22.46	87.46	1.74	6.66	5.32	16.0	60.6	2.68	9.26	4.03
Sandwitches	12	5	11.87	72.71	0.89	5.20	2.71	9.5	45.1	1.54	7.05	2.33
Prepared dishes	24	5	21.57	105.93	1.62	8.19	4.95	19.8	86.1	3.13	14.58	4.72
Salads	4	5	3.66	28.57	0.28	1.91	0.87	2.0	14.3	0.33	2.21	0.49
Dessert	6	5	3.03	20.00	0.12	0.80	0.38	3.9	20.9	0.33	2.03	0.50
Total	**245**		**425**	**837**	**33**	**70**	**100**	**326**	**572**	**66**	**132**	**100**

[a] b.w. = body weight.
[b] Soft drinks (beer without alcohol) ; Alcoholic beverages (Shandy and Beer).
[c] The hyphen means there is less than 5% of consumers for the considered food items and that the P95 value is equal to 0.

Fumonisins

The fumonisins are mycotoxins produced by fusarium fungi, in particular *F. moniliform*. These mycotoxins, natural contaminants of maize and maize-based products, are the most common mycotoxins worldwide. There are currently 4 types of fumonisins (FA, FB, FC, FP), the most common being FB_1 and FB_2. They are generally thermostable, which means that contamination of a raw material is generally found in the finished product (possibly at a lower level due to the processing).

Hazard evaluation and characterisation

The IARC[55] has classified fumonisin in category 2B (possibly carcinogenic to humans). In 2000, the SCF[56] established for FB_1 a temporary tolerable daily intake of 2 µg/kg b.w. based on chronic studies in the rat (NOAEL = 0.2 mg/kg b.w./day, renal effects, safety factor = 100). In 2001 the JECFA[57] established for the $FB_1/B_2/B_3$ group, alone or combined, a PMTDI of 2 µg/kg b.w. based on the same NOAEL as the SCF. The CSHPF[53] has calculated for all the fumonisin an indicative toxicological limit for humans of 0.8 µg/kg b.w./day (NOAEL= 4 mg/kg b.w./day) based on studies of liver cancer development in the rat. In its evaluation it proposes a TDI of 5 µg/kg b.w./day based on the effect on pig lungs (LOAEL = 5 mg/kg b.w./day, CSHPF 1999).

Risk evaluation and characterisation

Fumonisins levels found in the "as-consumed" foods analysed

The results shows that 12 out of 34 samples for B_1 fumonisin and 1 sample for B_2 fumonisin (respectively 35% and 3%) reveal levels above the detection limit. Among these we find 5 out of 12 samples of breakfast cereals (42%) with contents between 60 and 120 ppb; 3 out of 6 of poultry liver (50%) with a content between 90 and 120 ppb; 1 sample of canned soya bean sprouts with 100 ppb; 1 sample of canned sweet corn with 80 ppb; 2 samples of ordinary beer with 11-14 ppb.

Estimation of exposure to fumonisins of the population groups studied

Table 11 shows that the estimated average total intake of fumonisins of the French population is 14 ng/kg b.w./day for "normo-reporters" adults aged 15 years or more and 46 ng/kg b.w./day for children of 3 to 14. The 95th percentile exposure is 64 ng/kg b.w./day for adults (equivalent TDI of 3%) and 175 ng/kg b.w./day for children (equivalent TDI of 9%). These results are lower on average by a factor of 10 to 20 than those estimated during the last French evaluation of the SCOOP Task 3.2.10 conducted in 2003[58] (*Table 12*). The difference is essentially due to the fact that in the SCOOP Task calculation the cereal/cereal products category as a vector for exposure to fumonisin was taken into account, whereas in this total diet study it was not.

For the vegetarian population, the estimated average intake of fumonisins is between 40 and 100 ng/kg b.w./day depending on the group studied. The 95th percentile exposure is between 120 and 290 ng/kg b.w./day (equivalent TDI of 1-15%) (*Table 13*).

The proportion of individuals whose theoretical intake exceeds the TDI is estimated to be 0% for all the populations studied (*Table 13*).

55) IARC Monographs on the evaluation of carcinogenic risks to humans, vol. 56, some naturally occuring substances, food items and constituents, heterocyclic aromatic amines and mycotoxins. World health organization, Lyon, pp 444-599, 1993.

56) SCF, Opinion of the scientific committee on food on fusarium toxins, Part 3: evaluation of Fumonisins, adoptée le 17 octobre 2000.

57) JECFA, Safety evaluation of certain mycotoxins in food. WHO food additives series 47

58) SCOOP reports on Tasks 3.2.10. Assessment of dietary intake of fusariums by the population of EU members states, September 2003.

Table 11 : Estimated intakes to Fumonisins by French population

Food group	Number of samples	Mean FB_1 Level (µg/kg)	Mean FB_2 Level (µg/kg)	Adults (15 years and more) (n=1474) Consumption (g/day)		Adults (15 years and more) (n=1474) Exposure (ng/kg b.w[a]./d)			Children (3 to 14 years) (n=1018) Consumption (g/day)		Children (3 to 14 years) (n=1018) Exposure (ng/kg b.w[a]./d)		
				Mean	p95	Mean	p95	%Mean	p95		Mean	p95	%
Vegetarian food	2	5.0	10.0	[c] -	[c] -	-	-	-	[c] -	[c] -	-	-	-
Offals	6	52.5	10.0	0.42	[c] -	0.41	0.00	2.8	0.21	[c] -	0.48	0.00	1.03
Alcoholic beverages[b]	4	7.4	10.0	50.1	306	8.46	44.0	58.8	0.28	[c] -	0.13	0.00	0.29
Soft drinks[b]	2	8.2	10.0	1.17	[c] -	0.26	0.00	1.8	[c] -	[c] -	-	-	-
Breakfast cereals	12	41.3	11.7	4.88	34.29	3.80	28.6	26.4	18.15	64.29	42.53	161	91.8
Vegetables (except potatoes)	4	47.5	10.0	3.11	26.43	1.38	10.1	9.6	2.95	22.94	3.12	22.8	6.73
Pulses	4	5.0	10.0	0.35	[c] -	0.08	0.00	0.6	0.08	[c] -	0.06	0.00	0.13
Total	**34**			**60**	**316**	**14**	**64**	**100**	**22**	**73**	**46**	**175**	**100**

[a] b.w. = body weight.
[b] Soft drinks (beer without alcohol) ; Alcoholic beverages (Shandy and Beer).
[c] The hyphen means there is less than 5% of consumers for the considered food items and that the P95 value is equal to 0.

Table 12 : Comparative analysis of the mean exposure to mycotoxins of the French population with two different methodologies

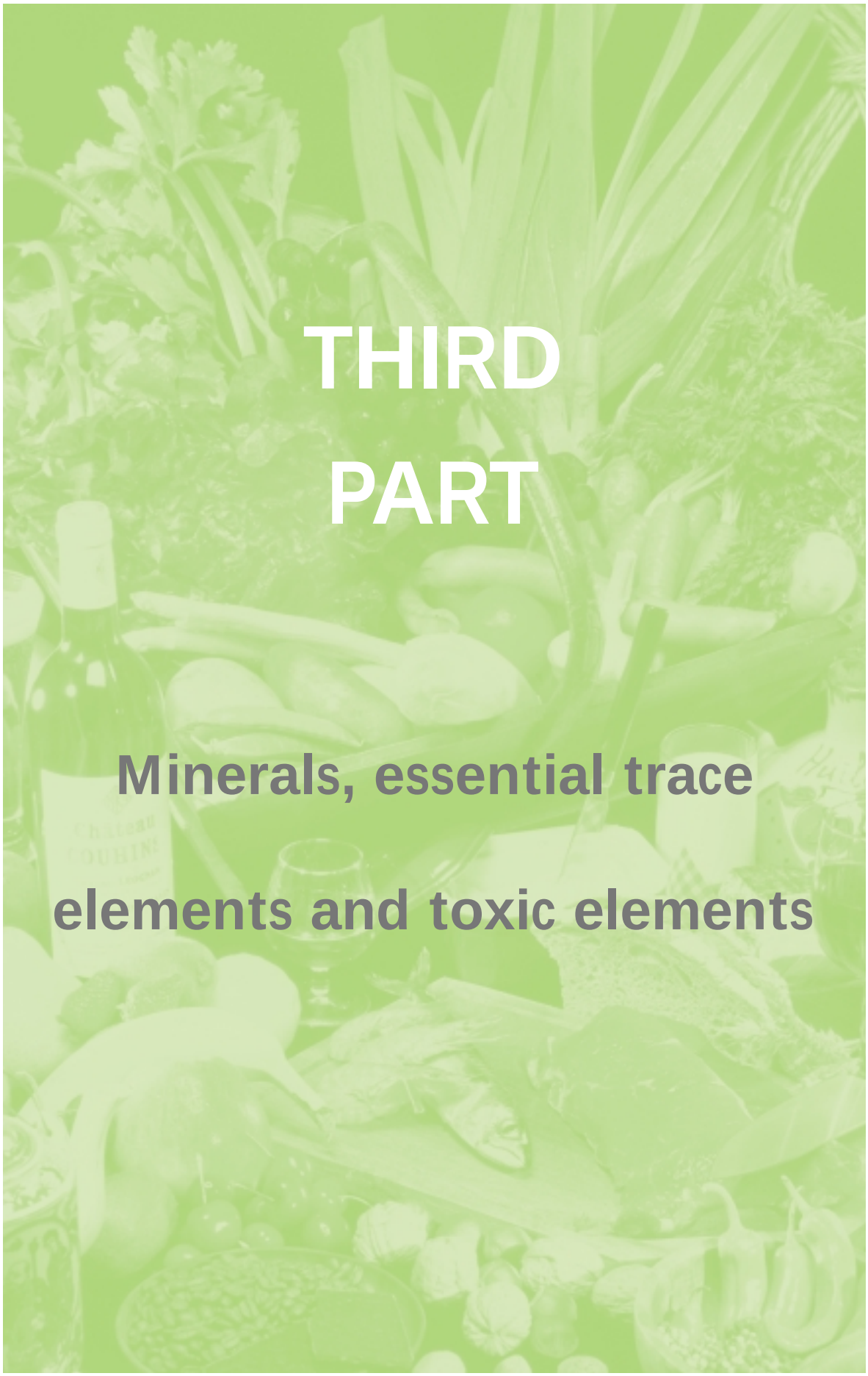
Survey source	Toxicological Reference Value SCF / JECFA (µg/kg b.w.[a]./d)	Adults "normo-reporters" (over 15 years and more, n=1474) Exposure[a] (ng/kg b.w./d)		Children (3 to 14 years, n=1018) Exposure[a] (ng/kg b.w./d)	
		Mean	Comparison of the mean vs TDI JECFA / SCF (%)	Mean	Comparison of the mean vs TDI JECFA / SCF (%)
Ochratoxin A SCOOP 3.2.7, 1999	0.005 / 0.0143	1.9	13 / 40	3.2	22 / 64
Ochratoxin A TDS, 2002		1.7	12 / 34	3.0	21 / 60
Deoxynivalenol SCOOP 3.2.10, 2003	1	460	46	730	73
Deoxynivalenol TDS. 2002		281	28	451	45
Nivalenol SCOOP 3.2.10, 2003	0.7	0.06	9	0.09	13
Nivalenol TDS, 2002		0.09	13	0.16	23
Zearalenone SCOOP 3.2.10, 2003	0.2 / 0.5	0.03	6 / 15	0.04	8 / 20
Zearalenone TDS, 2002		0.03	6 / 15	0.07	14 / 35
Fumonisins SCOOP 3.2.10, 2003	2	0.26	13	0.44	22
Fumonisins TDS, 2002		0.014	0.7	0.046	2
Patulin SCOOP 3.2.8, 2002	0.4	1.2	0.3	4.8	1.2
Patulin TDS, 2002		18	4.5	30	7.5

[a] b.w. = body weight The exposure level are expressed in mean. The mean concentration levels used in calculus are corresponding to the following censored data scenario middle bound: nd=1/2 LOD and <LOQ=1/2 LOQ. The body weights used are corresponding to the real individual body weight obtained in the food consumption survey. The risk characterisation to mycotoxins is expressed in % of the contribution to the toxicological reference value established by the European (SCF) or international (JECFA) scientific committee. At least, intakes for mycotoxins obtained for the two surveys have all been calculated from the INCA 1999 food consumption survey, Adults "normo-reporters" (over 15 years and more, n=1474) and Children (3 to 14 years, n=1018) except those from the SCOOP task ochratoxin A 3.2.7. 1999 who were obtained from the ASPCC 1994 food consumption survey, Adults "normo-reporters" (over 15 years and more, n=929) and Children (3 to 14 years, n=232).

Table 13 : Risk characterisation to mycotoxins for population groups studied

Mycotoxin	Toxicological reference value SCF / JECFA (µg/kg b.w[a]./d)	General population (3 to 65 years and more) (n=2492)						Vegetarian population (over 15 years and more) (n=138)								
		Adults "normo-reporters" (over 15 years and more, n=1474)			Children (3 to 14 years, n=1018)			Ovolactovegetarian (n=74)			Lactovegetarian (n=38)			Vegan/Macrobiotic (n=26)		
		Exposure (µg/kg b.w[a]./d)			Exposure (µg/kg b.w[a]./d)			Exposure (µg/kg b.w[a]./d)			Exposure (µg/kg b.w[a]./d)			Exposure (µg/kg b.w[a]./d)		
		Mean	p95	% PDI SCF / JECFA[b]	Mean	p95	% PDI SCF / JECFA[b]	Mean	p95	% PDI SCF / JECFA[b]	Mean	p95	% PDI SCF / JECFA[b]	Mean	p95	% PDI SCF / JECFA[b]
Aflatoxins B_1	0.001	0.0001	0.00035	0.01	0.0003	0.0009	3.4	0.0006	0.0016	16.2	0.0004	0.0009	2.6	0.0009	0.0021	23
Aflatoxins M_1	0.001	0.00001	0.0002	0	0.0002	0.0006	0.2	0.0001	0.0002	0	0.0001	0.0003	0	Nc[c]	Nc[c]	0
Ochratoxin A	0.005 / 0.0143	0.0022	0.0036	1 / 0	0.0041	0.0078	25 / 0	0.0022	0.0037	1.4 / 0	0.0024	0.0037	0 / 0	0.0037	0.0085	15 / 0
Deoxynivalenol	1	0.28	0.57	0.4	0.45	0.93	4	0.36	0.72	4	0.32	0.83	5.3	0.41	0.96	3.8
Nivalenol	0.7	0.09	0.16	0	0.16	0.3	0	0.12	0.23	0	0.12	0.19	0	0.21	0.42	3.8
Zearalenone	0.2 / 0.5	0.03	0.07	0.2 / 0	0.07	0.13	2.5 / 0.4	0.05	0.11	0 / 0	0.06	0.12	0 / 0	0.20	0.57	31 / 8
Fumonisins	2	0.014	0.064	0	0.046	0.175	0	0.04	0.13	0	0.05	0.12	0	0.10	0.29	0
Patulin	0.4	0.018	0.057	0	0.03	0.11	0	0.044	0.10	0	0.05	0.12	0	0.034	0.09	0

[a] b.w. = body weight.
[b] The percentage represents the estimation of the probabilities that individual exposure may be over the toxicological reference value (s).
[c] Nc The Vegan/Macrobiotic group is a non consumer group for milk and milk products.



THIRD PART

Minerals, essential trace elements and toxic elements

Minerals and essential trace elements

Calcium

Calcium (Ca) is a metal belonging to the alkaline earths and chemically similar to magnesium. The human body contains 1 to 1.2 kg of calcium of which about 99% is in the bones. Blood calcium regulation is ensured by the parathyroid hormone (parathormone - PTH), vitamin D and calcitonin. These hormones ensuring calcium homeostasis act on the intestinal absorption of calcium in food, on the degradation of the bone structure, on the re-absorption of urinary calcium and on taste sensitivity to calcium in order to maintain a constant calcemia.

Hazard evaluation and characterisation

Calcium is a major element of bone mineralization and contributes to growth, in particular in children up to the age of 18. The medium- and long-term symptoms of calcium deficiency are bone problems associated with insufficient bone tissue mineralization, rickets in children and osteomalacia in adults, or excessive loss of bone matter (osteoporosis). Very high calcium intakes can, in sensitive subjects, lead to hypercalciuria and nephrocalcinosis, this risk being aggravate in cases of hypervitaminosis. The Scientific Committee on Food (SCF)[59] has established a lowest threshold intake (LTI) and an upper level (UL) between 0.4 and 2.5 g/day in adults and between 0.2-0.3 and 2.5 g/day in children. The French Food Safety Agency (AFSSA)[60] has established a UL of 2 g/day.

Risk evaluation and characterisation

Calcium levels found in the "as-consumed" foods analysed

Table 14 shows that 970 out of 998 samples (97.3%) display calcium levels above the detection limit of 7.65 mg/kg of fresh weight. Calcium is found at average levels between 1.0 and 6.7 g/kg in the following food groups, in decreasing order of content: cheeses, breakfast cereals, Nuts and oilseeds, pizzas, quiches and salt cake, milk, chocolate, substitute meals, ultra-fresh dairy products and salads ; the majority of other food groups contain less than 0.8 g/kg.

Estimation of exposure to calcium of the French population

Tables 15 and 16 show that the estimated average daily intake of the French population is 721 mg for "normo-reporters" adults aged 15 years or more and 729 mg for children aged 3 to 14. The 2.5th and 97.5th percentile daily exposures for adults are 300 mg (equivalent LTI of 75%) and 1312 mg (equivalent UL of 66%). For children, the exposures are 274 mg (equivalent LTI of 90-140%) and 1324 mg (equivalent UL of 66%) (*Table 19*). Compared to existing French data, the results are lower on average and for the median by about 100 mg (INCA[61]) or higher by about 100 mg (Noël et *al.*[62], 642 mg). The milk/dairy products group is the vector contributing most (49-54%) to the exposure of the populations. The proportion of individuals whose theoretical intake is less than the lowest threshold intake is estimated to be 8.6% of adults aged 15 years or more and 4.3% of children aged 3 to 14. The proportion exceeding the upper level is estimated to be 0.01% for both groups.

59) SCF, Opinion of the scientific committee on food on the tolerable upper intake level of calcium, EC, 2003.

60) AFSSA-CNERNA-CNRS, Apports nutritionnels conseillés pour la population française, 3ème édition, Coord. A.Martin, Eds tech et doc, 2001.

61) Enquête INCA (2000) CREDOC-AFSSA-DGAL, Enquête nationale sur les consommations alimentaires, Tech & Doc Lavoisier, Coordinateur: J.L Volatier.

62) Noël L., Leblanc J.C., Guérin T., Determination of several elements in duplicate meals from catering establishment using closed vessel microwave digestion with inductively coupled plasma mass spectrometry detection: estimation of daily dietary intake. Food additives and contaminants, vol. 20, n° 1, 44-56 (2003).

Chromium

Most of the chromium (Cr) present in food is in the form of trivalent chromium (CrIII), an essential trace element, and in hexavalent form (CrVI), more toxic but which is not normally found in food. Chromium (CrIII) is a trace element necessary for the glucidic, lipidic and nucleic acid metabolisms. It is above all known for its important role in glucidic homeostasis via its potentialising effect of insulin. The main food sources containing chromium are spices, yeast, liver and egg-yolk[60,63].

Hazard evaluation and characterisation

The toxicity of chromium in humans is usually the result of accidental ingestion of hexavalent chromiumcompounds which can result in damage of the digestive tract, the liver, the kidneys and nervous system. Chromium (CrVI) is classified in category 1 (carcinogenic to humans) by the International Cancer Research Agency (IARC, 1990[64]). To date no reference toxicological value has been established internationally by the JECFA for hexavalent chromium. On the other hand, in 2003 the SCF established an upper level (UL) of 1000 µg/day for trivalent chromium[65].

Risk evaluation and characterisation

Chromium levels found in the "as-consumed" foods analysed

Table 14 shows that 813 out of 998 samples (81.5%) display chromium levels above the detection limit of 15 µg/kg of fresh weight. Chromium is found in the majority of foods at average levels between 0.10 and 0.34 mg/kg in the following food groups, in decreasing order of content: chocolate, cereals and cereal products, cheeses, offals and delicatessen, sugars and confectionery, salads and condiments and sauces; the majority of other groups contain less than 90 µg/kg.

Estimation of exposure to chromium of the French population

Tables 15 and 16 show that the estimated average daily intake of the French population is 77 µg for "normo-reporters" adults aged 15 years or more and 68 µg for children aged 3 to 14. The daily 97.5th percentile exposure for adults is 126 µg (equivalent UL of 13%) and 124 µg for children (equivalent UL of 12%) (*Table 19*). Compared to existing French data, the results are on average of the same order of magnitude (Biego et *al.*[66]) or lower by a factor of about 2 (Noël et *al.*[62]). This difference is probably explained by the fact that the LOQ in this study (30 µg/kg) has been estimated to be about 2.5 times less that during the previous study (82 µg/kg). The food groups including bread, rusk, non-alcoholic beverages and prepared dishes are the vectors contributing most (7-17%) to the exposure of the populations; other vectors contribute less than 5% of the total food exposure. The proportion of individuals whose theoretical intake exceeds the upper level is estimated to be 0% of adults aged 15 years or more and of children aged 3 to 14.

63) Risk evaluation of essential trace elements, essential versus toxic levels of intake, report of a Nordic project group, 1995.

64) IARC, Monographs on evaluation of carcinogenic risks to humans. World health organization, Lyon Vol. 49, p.90, 1990.

65) SCF, Opinion of the scientific committee on food on the tolerable upper intake level of trivalent chromium, European commission, 2003.

66) Biego, G. H., Joyeux, M., Hartemann, P., and Debry, G., Daily intake of essential minerals and metallic micropollutants from foods in France. Science of the total environment, 217, 227-232.

Cobalt

Cobalt (Co) is an essential trace element as the central bonding atom of vitamin B_{12}(cobalamins). It therefore plays an important physiological role, since vitamin B_{12}intervenes as coenzymes in the enzymatic reactions of methyl grouping transfer in the metabolism of amino acids, in particular in the synthesis of methionine from homocysteine. Vitamin B_{12} is exclusively synthesised by bacteria and, being linked to proteins, is present in food of animal origin. The main foods containing B_{12} are animal products such as meat, fish, poultry, seafood, milk, cheese and eggs[60].

Hazard evaluation and characterisation

Vitamin B_{12} deficiency, although rare in the general population due to the existence of the body's usual reserves, generally results in macrocythaemia. In the absence of undesirable effects at high dose and although no upper level has been proposed internationally, the SCF in its scientific opinion on vitamin B_{12} established in 1992[67] recommends that daily intakes do not exceed 200 µg/day. This committee also recommends a lowest threshold intake (LTI) of 0.6 µg/day for adults or 0.3 to 0.5 µg/day for children.

Risk evaluation and characterisation

Cobalt levels found in the "as-consumed" foods analysed

Table 14 shows that 469 out of 998 samples (47%) display cobalt levels above the detection limit of 1 µg/kg of fresh weight. Cobalt is found in the majority of foods at average levels between 25 and 50 µg/kg in the following food groups, in decreasing order of content: chocolate, shellfish, nuts and oilseed, pasta and salads ; the majority of other food groups contain less than 20 µg/kg.

Estimation of exposure to cobalt of the French population

Tables 15 and 16 show that the estimated average daily intake of the French population is 7.5 µg for "normo-reporters" adults aged 15 years or more and 7.3 µg for children aged 3 to 14. The 2.5th and 97.5th percentile daily exposures for adults are 3.5 µg and 14 µg. For children, these exposures are 3.0 µg and of 15 µg (*Table 19*). To be able to compare the exposure to cobalt with reference nutritional or toxicological values, it is necessary to know the proportion of foods containing cobalt in the form of vitamin B_{12}, information that we do not have. Compared to existing French data, the results are on average lower by a factor of 4 (Biego et *al.*[66]) or higher by a factor of 2 (Noël et *al.*[62]). The food groups including cereals and cereal products, fruits, sugars and confectionery, salads and prepared dishes are the vectors contributing most (7-12%) to the exposure of the populations; other vectors contribute less than 5% of the total food exposure.

67) SCF, Reports of the scientific committee for food, thirty-first series, food science and techniques, Nutrient and energy intakes for the European community, commission of the European communities, 1993.

Copper

Copper (Cu) is an essential trace element that plays a vital role in various metabolisms. It is known to play a role notably in the quality of cartilage, bone mineralization, synthesis and the regulation of peptide neurotransmitters, immunity and iron metabolism. Copper also plays an important role in the oxidative metabolism of glucose and is therefore essential for operation of the myocardium.

Hazard evaluation and characterisation

Copper intoxications are rare but can follow accidental ingestion of copper salts or accidental contamination of beverages. Excess copper can lead to hepatitis and serious hemolytic disease. Copper 8-hydroxyquinoline is classified in category 3 (not classifiable as to its carcinogenicity to humans) by the International Cancer Research Agency (IARC, 1987[68]). The SCF in its scientific opinion on copper established in 1992[69] recommends a lowest threshold intake of 0.6 mg/day for adults and 0.2 to 0.3 mg/day for children, and an upper level (UL) of 10 mg/day. In 1982 the JECFA established a PMTDI for copper having concluded that effects in humans can occur above 0.5 mg/kg/day (>35 mg/day in adults)[70].

Risk evaluation and characterisation

Copper levels found in the "as-consumed" foods analysed

Table 14 shows that 977 out of 998 samples (97.9%) display an average copper content above the detection limit of 19 µg/kg of fresh weight. The main food groups containing copper are shellfish, nuts and oilseed and offals at respective levels of 7.0; 7.15 and 13.5 mg/kg; other food groups contain less than 3 mg/kg.

Estimation of exposure to copper of the French population

Tables 15 and 16 show that the estimated average daily intake of the French population is 0.98 mg for "normo-reporters" adults aged 15 years or more and 0.81 mg for children aged 3 to 14. The 2.5th and 97.5th percentile daily exposures for adults are 0.5 mg (equivalent LTI of 83%) and 1.7 mg (equivalent UL of 17%). For children, these exposures are 0.4 mg (equivalent LTI of 130-200%) and 1.6 mg (equivalent UL of 16%) (*Table 19*). Compared to existing French data, the results are on average equivalent (Noël et *al.*[62], 0.93 mg) or lower by a factor of 1.5-2 (Biego et *al.*[66] and Martin et *al.*[71]). The food groups including bread, rusks, biscuits, vegetables, starchy vegetables and fruits are the vectors contributing most (5-16%) to the exposure of the populations; other vectors contribute less than 5% of the total food exposure. The proportion of individuals whose theoretical intake is less than the lowest threshold intake is estimated to be 7.3% of adults aged 15 years or more and 0.01% of children aged 3 to 14. The proportion exceeding the upper level is estimated to be 0% for both groups.

68) IARC, Monographs on evaluation of carcinogenic risks to humans. World health organization, Lyon Suppl. 7, p.61, 1987.

69) SCF, Reports of the scientific committee for food, thirty-first series, food science and techniques, Nutrient and energy intakes for the European community, commission of the european communities, 1993.

70) Joint Expert Committee mixt FAO/OMS food additives and contaminants : Evaluation de certains additifs alimentaires et contaminants. Trente sixiéme session du comité mixte FAO/OMS d'experts, Technical reports series n°683, WHO, 1982.

71) AFSSA-CNERNA-CNRS, Apports nutritionnels conseillés pour la population française, 3ème édition, Coord. A.Martin, Eds tech et doc, 2001.

Lithium

Lithium (Li) is a trace element that plays an important role in the central nervous system. There is evidence that lithium affects the transport of the sodium ion and interferes with the ion exchange mechanism, which affects nerve conduction. Lithium acts on the capture of neurotransmitters, serotonin and norepinephrine in the synapses, thereby reducing their action. It acts on the synaptic vesicles by reducing the liberation of norepinephrine and on the cellular membranes by inhibiting the production of cyclic AMP which is a second cellular messenger.

Hazard evaluation and characterisation

The most frequent adverse effects include gastro-intestinal disorders, nausea and vertigo. The most common and most persistent adverse effects are trembling of the hands, chronic fatigue, thirst, polyuria and nephrogenic diabetes insipidus. To date no official minimum or maximum recommendations for lithium have been made by national, European or international scientific bodies.

Risk evaluation and characterisation

Lithium levels found in the "as-consumed" foods analysed

Table 14 shows that 679 out of 998 samples (68%) display an average lithium content above the detection limit of 3 µg/kg of fresh weight. The main food groups containing lithium are shellfish (123 µg/kg) and drinking water (100 µg/l); other food groups contain less than 40 µg/kg.

Estimation of exposure to lithium of the French population

Tables 15 and 16 show that the estimated average daily intake of the French population is 28.5 µg for "normo-reporters" adults aged 15 years or more and 14.5 µg for children aged 3 to 14. The daily 97.5th percentile exposure is 144 µg for adults and 38 µg for children (*Table 19*). Compared to existing French data, the results are on average higher by a factor of 3 (Noël et *al.*[72]). The food groups including drinking waters and soups are the vectors contributing most (respectively 25-41% and 14-15%) to the exposure of the populations; other vectors contribute less than 10% of the total food exposure.

72) Noël L., Leblanc J.C., Guérin T. Determination of several elements in duplicate meals from catering establishment using closed vessel microwave digestion with inductively coupled plasma mass spectrometry detection: estimation of daily dietary intake. Food additives and contaminants, vol. 20, n° 1, 44-56 (2003).

Magnesium

Magnesium (Mg) is an essential trace element present as the fourth most abundant cation in the body of mammals and the second most abundant cation in extracellular fluids. Magnesium plays an important role as cofactor in numerous enzymatic reactions, in the synthesis of proteins and nucleic acids and it has a protective and stabilising effect on membranes. It is also considered to have an essential role in the homeostasis of calcium, potassium and sodium ions[73].

Hazard evaluation and characterisation

Magnesium deficiency results in alterations of the metabolism of calcium, sodium and potassium and induces muscular tetany. When absorbed in excessive quantity, magnesium induced intestinal secretions and diarrhoea without causing major systemic effects, with the exception of the individuals suffering renal insufficiency. In 2001, the SCF and the AFSSA[73,74], in their scientific opinion on magnesium, recommended a lowest threshold intake (LTI) of 150 mg in adults and 34-110 mg/day in children, and an upper level (UL) of 750 mg/day.

Risk evaluation and characterisation

Magnesium levels found in the "as-consumed" foods analysed

Table 14 shows that 996 out of 998 samples (99.8%) display magnesium levels above the detection limit of 0.25 mg/kg of fresh weight. The main food groups containing magnesium are shellfish, cereals, and nuts and oilseed groups at respective average levels of 510, 896 and 1150 mg/kg; other food groups contain less than 500 mg/kg.

Estimation of exposure to magnesium of the French population

Tables 15 and 16 show that the estimated average daily intake of the French population is 224 mg for "normo-reporters" adults aged 15 years or more and 197 mg for children aged 3 to 14. The 2.5th and 97.5th percentile daily exposures of adults are 130 mg (equivalent LTI of 87%) and 359 mg (equivalent UL of 48%). For children, these exposures are 105 mg (equivalent LTI of 95-310%) and 334 mg (equivalent UL of 45%) (*Table 19*). Compared to existing French data, the results are on average of the same order of magnitude (INCA[75] and Noel et *al.*[72]). The food groups including bread, rusks, milk, vegetables, meat, fruits and coffee are the vectors contributing most (6-13%) to the exposure of the populations; other vectors contribute less than 5% of the total food exposure. The proportion of individuals whose theoretical intake is less than the lowest threshold intake is estimated to be 7.2% of adults aged 15 years or more and 1.3% of children aged 3 to 14. The proportion exceeding the upper level is estimated to be 0% for both groups.

73) SCF, Opinion of the scientific committee on food on the tolerable upper intake level of magnesium, European commission, 2001.

74) AFSSA-CNERNA-CNRS, Apports nutritionnels conseillés pour la population française, 3émé édition, Coord. A.Martin, Eds tech et doc, 2001.

75) Enquête INCA (2000) CREDOC-AFSSA-DGAL, Enquête nationale sur les consommations alimentaires, Tech & Doc Lavoisier, Coordinateur: J.L Volatier.

Manganese

Manganese (Mn) is a trace element that can exist in numerous states of oxidation, of which Mn (II) is the predominant form in biological systems. Its main functions concern glucidic metabolisms (synthesis and secretion of insulin), lipidic metabolisms and metabolic detoxification of free radicals of oxygen. Exposure to manganese of the general population comes mainly from foods such as tea, grain, rice and dried fruit[77].

Hazard evaluation and characterisation

Exposure to manganese by inhalation is neurotoxic. Intake by ingestion, despite the low absorption by the digestive tract, has led to observed neurotoxic effects. Insufficient intake can cause bone problems and can reduce the cholesterolemia. The SCF, in its scientific opinion on manganese established in 2000[76], and the AFSSA in 2001[77], recommend a lowest threshold intake (LTI) of 0.75 mg/day and an upper level (UL) of 10 mg/day.

Risk evaluation and characterisation

Manganese levels found in the "as-consumed" foods analysed

Table 14 shows that 976 out of 998 samples (97.8%) display manganese levels above the detection limit of 8 µg/kg of fresh weight. The main food groups containing manganese are breakfast cereals, nuts and oilseed, and other cereals at respective average levels of 10.8, 10.9 and 19.6 mg/kg; other food groups contain less than 5 mg/kg.

Estimation of exposure to manganese of the French population

Tables 15 and 16 show that the estimated average daily intake of the French population is 2.3 mg for "normo-reporters" adults aged 15 years or more and 1.9 mg for children aged 3 to 14. The 2.5th and 97.5th percentile daily exposures for adults are 1.0 mg (equivalent LTI of 133%) and 4.8 mg (equivalent UL of 48%). For children, these exposures are 0.6 mg (equivalent LTI of 80%) and 4.2 mg (equivalent UL of 42%) (*Table 19*). Compared to existing French data, the results are on average of the same order of magnitude (Biego et *al.*[66], Noël et *al.*[72]). The food groups including bread, rusk and fruits are the vectors contributing most (respectively 20-30% and 15-17%) to the exposure of the populations; other vectors contribute less than 8% of the total food exposure. The proportion of individuals whose theoretical intake is less than the MNI is estimated to be 0.4% of adults aged 15 years or more and 0.8% of children aged 3 to 14. The proportion exceeding the upper level is estimated to be 0% in adults and 0.01% in children.

76) SCF, Opinion of the scientific committee on food on the tolerable upper intake level of manganese, European commission, 2000.

77) AFSSA-CNERNA-CNRS, Apports nutritionnels conseillés pour la population française, 3ème édition, Coord. A.Martin, Eds tech et doc, 2001.

Molybdenum

Molybdenum (Mo) is an essential trace element widely found in nature. It plays a role in the metabolism of sulphur amino acids and purins. Molybdenite (MoS2) is the main source of industrial production of molybdenum compounds which are used in the production of steel, electrical equipment and also in agriculture in the formulation of fertilisers and seed treatments. The main foods containing molybdenum are sorghum, leaf vegetables, pulses, cereal grains, milk, eggs and offal[78].

Hazard evaluation and characterisation

The main signs of toxicity observed in man are characterised by diarrhoea, anaemia, erythrocytic immaturity and uricemia. A deficiency in cofactor Mo enzymes is associated with neurological problems. The insoluble compounds MoS2, Mo and MoO2 are less toxic than the more soluble molybdates. The SCF and the AFSSA, in their scientific opinions on molybdenum established in 2000[78] and 2001[77], recommend a lowest threshold intake of 17.5 µg/day for the general population and an upper level (UL) of 600 µg/day for adults and 200 to 400 µg/day for children.

Risk evaluation and characterisation

Molybdenum levels found in the "as-consumed" foods analysed

Table 14 shows that 848 out of 998 samples (85%) display molybdenum levels above the detection limit of 3 µg/kg of fresh weight. The main food groups containing molybdenum are nuts and oilseed, offals, pulses and other cereals at respective average levels of 1.3, 0.8 and 0.7 mg/kg; other food groups contain less than 0.5 mg/kg.

Estimation of exposure to molybdenum of the French population

Tables 15 and 16 show that the estimated average daily intake of the French population is 138 µg for "normo-reporters" adults aged 15 years or more and 114 µg for children aged 3 to 14. The 2.5th and 97.5th percentile daily exposures for adults are 65 µg (equivalent LTI of 370%) and 270 µg (equivalent UL of 45%). For children, these exposures are 48 µg (equivalent LTI of 274%) and 216 µg (equivalent UL of 54-108%) (*Table 19*). Compared to existing French data, the results are on average lower by a factor of 2 (Biego et *al.*[66]) or of the same order of magnitude (Noël et *al.*[72]). The food groups including bread, rusk, starchy vegetables, vegetables and pulses are the vectors contributing most (respectively 13-22%, 16-18%, 9-13% and 7%) to the exposure of the populations; other vectors contribute less than 5% of the total food exposure. The proportion of individuals whose theoretical intake is less than the lowest threshold intake is estimated to be 0% of adults aged 15 years or more and children aged 3 to 14. The proportion exceeding the upper level is estimated to be 0% of adults and 0.5% of children.

78) SCF, Opinion of the scientific committee on food on the tolerable upper intake level of molybdene, European commission, 2000.

Nickel

Nickel (Ni) is a trace element existing in different forms, the most common form in biology being divalent nickel. It plays a role in the metabolism of methionine. Nickel is a compound that has been long and widely used above all in the fabrication of hard, malleable and corrosion-resistant alloys, coatings, currency coins, catalysts, chemistry laboratories devices and instruments, thermopiles, Ni-Cd accumulators and magnetic materials[79]. The main foods containing nickel are chocolate, dried fruits and legumes.

Hazard evaluation and characterisation

Nickel metal and its inorganic compounds are considered to be not highly toxic. On the other hand, certain organic compounds such as tetracarbonyl nickel are extremely toxic and can be highly allergenic and mutagenic. Nickel is carcinogenic essentially when inhaled. Nickel compounds are classified in category 1 (carcinogenic to humans) and metallic nickel in category 2B (possibly carcinogenic to humans) by the International Cancer Research Agency (IARC, 1990[80]). The JECFA makes no Provisional Tolerable Weekly Intake (PTWI) recommendation for nickel. On the other hand, in 2001 the AFSSA[77] recommended an upper level (UL) of 600 µg/day which corresponds to the threshold of appearance of nickel toxicity.

Risk evaluation and characterisation

Nickel levels found in the "as-consumed" foods analysed

Table 14 shows that 599 out of 998 samples (60%) display nickel levels above the detection limit of 32 µg/kg of fresh weight. The main food groups containing nickel are nuts and oilseed, chocolate and breakfast cereals at respective average levels of 1.15, 0.63 and 0.55 mg/kg; other food groups contain less than 0.5 mg/kg.

Estimation of exposure to nickel of the French population

Tables 15 and 16 show that the estimated average daily intake of the French population is 94 µg for "normo-reporters" adults aged 15 years or more and 92 µg for children aged 3 to 14. The daily 97.5th percentile exposure for adults is 166 µg (equivalent UL of 28%) and for children 174 µg (equivalent UL of 29%) (*Table 19*). Compared to existing French data, the results are on average lower by a factor of 2.5 (Biego et *al.*[66]) or of the same order of magnitude (Noël et *al.*[72]). The food groups including vegetables, drinking water, breakfast cereals, biscuits, bread, rusk, milk, cheeses, non-alcoholic beverages and prepared dishes are the vectors contributing most (respectively 5% and 10%) to the exposure of the populations; other vectors contribute less than 5% of the total food exposure. The proportion of individuals whose theoretical intake exceeds the upper level is estimated to be 0% of adults aged 15 years or more and 0% of children aged 3 to 14.

79) Ministère fédéral allemand de la Coopération économique et du Développement, Documentation pour l'étude et l'évaluation des effets sur l'environnement, 1995.

80) IARC, Monographs on evaluation of carcinogenic risks to humans. World health organization, Lyon Vol. 49, p.257, 1990.

Selenium

Selenium (Se) is a metalloid whose physical and chemical properties are similar to those of sulphur. The selenomethionines are the predominant forms of selenium in food. Most of selenium's biological functions involve the action of selenoproteins such as the peroxidase glutations which are antioxidant enzymes constituting one of the body's main lines of defence. It plays also a role in inflammatory and immunitary responses[81].

Hazard evaluation and characterisation

Selenium and its compounds are classified in category 3 (not classifiable as to its carcinogenicity to humans) by the International Cancer Research Agency (IARC, 1987[82]). Insufficient intake of selenium can cause dystrophy of the skeletal muscle, retarded neurological development and increased frequency of infections. The SCF in its scientific opinion on selenium established in 2000[83] recommends a lowest threshold intake of 20 µg/day for adults and 4 to 10 µg/day for children, and an upper level (UL) of 300 µg/day for adults and 90 to 250 µg/day for children. In 1996 the CSHPF[84] recommended an upper level (UL) of 150 µg/day.

Risk evaluation and characterisation

Selenium levels found in the "as-consumed" foods analysed

Table 14 shows that 369 out of 998 samples (37%) display selenium levels above the detection limit of 22 µg/kg of fresh weight. The main food groups containing selenium are poultry and game, fish, delicatessen and meat at average levels between 95 and 170 µg/kg; other food groups contain less than 50 µg/kg.

Estimation of exposure to selenium of the French population

Tables 15 and 16 show that the estimated average daily intake of the French population is 42 µg for "normo-reporters" adults aged 15 years or more and 31 µg for children aged 3 to 14. The 2.5th and 97.5th percentile daily exposures for adults are 22 µg (equivalent LTI of 110%) and 70 µg (equivalent UL of 23%). For children, these exposures are 15 µg (equivalent LTI of 150-375%) and 55 µg (equivalent UL of 22-61%) (*Table 19*). Compared to existing French data, the results are on average lower by a factor of 1.5 (Noël et *al.*[72]) or of the same order of magnitude (AFSSA, 2001[81]). The food groups including vegetables, drinking water, breakfast cereals, biscuits, bread, rusk, milk, cheeses, non-alcoholic beverages and prepared dishes are the vectors contributing most (respectively 5 and 10%) to the exposure of the populations; other vectors contribute less than 5% of the total food exposure. The proportion of individuals whose theoretical intake is less than the lowest threshold intake is estimated to be 1.5% of adults aged 15 years or more and 0.2% of children aged 3 to 14. The proportion exceeding the upper level is estimated to be 0% for both groups.

81) AFSSA-CNERNA-CNRS, Apports nutritionnels conseillés pour la population française, 3ème édition, Coord. A.Martin, Eds Tech et doc, 2001.

82) IARC, Monographs on evaluation of carcinogenic risks to humans. World health organization, Lyon Suppl. 7, p.71, 1987.

83) SCF, Opinion of the scientific committee on food on the tolerable upper intake level of sélénium, European commission, 2000.

84) Conseil supérieur d'hygiène publique de France, Martin, A., Les limites de sécurité dans les consommations alimentaires des vitamines et minéraux. Tech et doc Lavoisier, Paris, p 35-36, 199685) AFSSA, Rapport sel, Evaluation et recommandations, Août 2002.

Sodium

Sodium (Na) is in general associated with chlorine (Cl) in the form of common salt (sodium chloride). Sodium is the most abundant ion in extracellular liquid, which constitutes about 90% of extracellular cations. It plays an important role in the transmission of the nerve and muscular impulses and an essential role in the hydromineral balance. The balance of extracellular fluids is therefore strongly dependent on its ingestion. The homeostasis of blood sodium is mainly under the control of two fundamental "natriogenic" hormones, aldosterone and angiotensin II, mineralocorticoids playing a direct role in the innate ingestive behaviour of the natriophilia.

Hazard evaluation and characterisation

The SCF in its scientific opinion on sodium in 1992[69] established a lowest threshold intake (LTI) of 0.57 g/day and an upper level (UL) of 3.5 g/day for the general population. The AFSSA in its opinion of June 2002[85] recommends a maximum daily intake of 8 g of common salt (NaCl), equivalent to a maximum daily limit of 3.15 g of sodium.

Risk evaluation and characterisation

Sodium levels found in the "as-consumed" foods analysed

Table 14 shows that 959 out of 998 samples (96.1%) display sodium levels above the detection limit of 2.92 mg/kg of fresh weight. The main food groups containing sodium are cereal products (1.7 to 6.8 g/kg), meat products (1.2 to 6.9 g/kg), fishing products (2.1 to 5.4 g/kg), cheeses (5.6 g/kg) and composed products such as pizzas, salt cakes, quiches, sandwiches, prepared dishes, soups and salads (1.5 to 6.0 g/kg).

Estimation of exposure to sodium of the French population

Tables 15 and 16 show that the estimated average daily intake of the French population is 2.3 g for "normo-reporters" adults aged 15 years or more and 1.8 g for children aged 3 to 14. The 2.5th and 97.5th percentile daily exposures for adults are 1.1 g (equivalent LTI of 193%) and 4.3 g (equivalent UL of 90-122%). For children, these exposures are 0.8 g (equivalent LTI of 140%) and 3.8 g (equivalent UL of 81-108%) (*Table 19*). The results compared to existing French data are on average and at the 95th percentile lower by about 20-25% (INCA[86] and Noel et *al.*[72]). The food groups including bread, rusk, and prepared dishes are the vectors contributing most (respectively 20-40% and 10%) to the exposure of the populations; other vectors contribute less than 6% of the total food exposure. The proportion of individuals whose theoretical intake is less than the lowest threshold intake is estimated to be 0.07% of adults aged 15 years or more and 0.3% of children aged 3 to 14. The proportion of individuals exceeding the upper level is estimated to be between 8% and 13% of adults aged 15 years or more and between 3.5% and 5% of children aged 3 to 14. This frequency is higher if food table salt is included.

85) AFSSA, Rapport sel, Evaluation et recommandations, Août 2002.

86) Enquête INCA (2000) CREDOC-AFSSA-DGAL, Enquête nationale sur les consommations alimentaires, Tech & Doc Lavoisier, Coordinateur: J.L Volatier.

Zinc

Zinc (Zn) is an essential element in human, animal and vegetal nutrition. It plays a major role in growth and development, in testicular maturation, in neurological functions and in immunocompetence. It is involved in the activity of numerous enzymes. Its greatest physiological impact is in all the stages of protein synthesis, in the activity of RNA and ADN polymerases and in the triggering of the reading of the genome via "zinc finger" proteins.

Hazard evaluation and characterisation

Zinc deficiency is rare. In man, the most pronounced effect is acute toxicity of zinc which results in gastro-intestinal problems. The chronic toxic effect of zinc associated with copper deficiency causes adverse effects such as anaemia, neutropenia and reduced immunitary response. In 1982 the JECFA[87] established a PMTDI for zinc of 1 mg/kg b.w./day (equivalent to 60 mg/day for adults of 60 kg, and 30 mg/day for children of 30 kg). The SCF in its scientific opinion on zinc established in 2003[88] recommends a lowest threshold intake (LTI) of 4-5 mg/day for adults and 1.6-3.6 mg/day for children, and an upper level (UL) of 25 mg/day for adults and between 10 and 22 mg/day for children. In 1996 the CSHPF[84] recommended an upper level of 15 mg/day.

Risk evaluation and characterisation

Zinc levels found in the "as-consumed" foods analysed

Table 14 shows that 988 out of 998 samples (99%) have an average zinc content above the detection limit of 81 µg/kg of fresh weight. The main food groups containing zinc are shellfish (66 mg/kg), meat (37 mg/kg), cheese and offal (31 mg/kg), other cereals and nuts and oilseed (19-26 mg/kg); other food groups contain less than 17 mg/kg.

Estimation of exposure to zinc of the French population

Tables 15 and 16 show that the estimated average daily intake of the French population is 8.7 mg for "normo-reporters" adults aged 15 years or more and 7.6 mg for children aged 3 to 14. The 2.5th and 97.5th percentile daily exposures for adults are 4.6 mg (equivalent LTI of 92-115%) and 15 mg (equivalent UL of 25-100%). For children, these exposures are 3.6 mg (equivalent LTI of 100-225%) and 14 mg (equivalent UL of 47-140%) (*Table 19*). Compared to existing French data, the results are on average lower by a factor of 1.5 (Biego et *al.*[66]) or of the same order of magnitude (Noël et *al.*[72]). The food groups including meat, milk, cheeses, bread and rusk are the vectors contributing most (respectively 22-23%, 8-17% and 6-11%) to the exposure of the populations; other vectors contribute less than 5% of the total food exposure. The proportion of individuals whose theoretical intake is less than the lowest threshold intake is estimated to be 2.6% of adults aged 15 years or more and 0.9% of children aged 3 to 14. The proportion of individuals exceeding the upper level is estimated to be between 0 and 2.0% of adults and between 0 and 2.1% of children.

87) Joint Expert Committee mixt FAO/OMS food additives and contaminants : Evaluation de certains additifs alimentaires et contaminants. Trente sixième session du comité mixte FAO/OMS d'experts, Technical reports series n°683, WHO, 1982.

88) SCF, Opinion of the scientific committee on food on the tolerable upper intake level of zinc, European commission, 2003.

Toxic elements

Aluminium

Aluminium (Al) is one of the most common elements in the Earth's crust (8.8% of the total mass, and the third most common element in nature). It is a ubiquist metal found in soils, clays, minerals, rocks and even in water.

Hazard evaluation and characterisation

Acquired knowledge and notably the results of the most recent studies has led the World Health Organisation (WHO) as part of its International Program of Chemical Safety (IPCS) to publish the following conclusions (WHO, 1996[89]): "There is no evidence that aluminium causes Alzheimer's disease. Aluminium has induced no pathology of Alzheimer type in vivo in any species, including the human species. The hypothesis that exposure to high levels of aluminium through the drinking water of elderly people can accelerate or aggravate Alzheimer's disease is not confirmed by any scientific data". The JECFA in 1989[90] and the SCF in 2000[91] fixed a PTWI of 7 mg/kg b.w. for the total intake, including the use of the aluminium salts as food additives.

Risk evaluation and characterisation

Aluminium levels found in the "as-consumed" foods analysed

Table 14 shows that 848 out of 998 samples (85%) display average aluminium levels above the detection limit of 109 µg/kg of fresh weight. Aluminium is found at a level exceeding 3 mg/kg only in the following food groups: bread, rusk, breakfast cereals, biscuits, vegetables, nuts and oilseed, ice-cream, chocolate, salads and shellfish.

Estimation of the level of exposure to aluminium of the French population

Tables 17 and 18 show that the estimated average daily intake of the French population is 1.6 mg for "normo-reporters" adults aged 15 years or more and 1.3 mg for children aged 3 to 14. The 97.5th percentile exposure for adults is 0.4 mg/kg b.w./week (equivalent PTWI of 6% - JECFA-SCF) and for children 0.7 mg/kg b.w./week (equivalent PTWI of 10% - JECFA-SCF) (*Table 20*). Compared to existing French data, the results are of the same order of magnitude (Noël et *al.*[72]) or lower by a factor of 1.75 (InVS-AFSSA-AFSSAPS[92]) or 2.5 (Biego et *al.*[66]). The food groups including vegetables, bread and rusk are the vectors contributing the most (15-20%) to the exposure of the populations; other vectors contribute less than 10% of the total food exposure. The proportion of individuals whose theoretical intake exceeds the tolerable weekly dose of 7 mg/kg b.w./week is estimated to be 0% of adults aged 15 years or more and 0% of children aged 3 to 14.

89) IPCS-WHO Monographie n°194, Environmental health criteria 1997.

90) Joint Expert Committee mixt FAO/OMS food additives and contaminants : Evaluation de certains additifs alimentaires et contaminants. Trente-troisième rapport du comité mixte FAO/OMS d'experts. Genève, Organisation Mondiale de la santé, 1989, Série de rapports techniques N° 776.

91) SCF, Rapport 25ème séries, First of food additives of various technological functions : 18-5-199092) InVS-AFSSA-AFSSAPS :Evaluation des risques sanitaires lies à l'exposition de la population française à l'aluminium, Novembre 2003.

92) InVS-AFSSA-AFSSAPS :Evaluation des risques sanitaires lies à l'exposition de la population française à l'aluminium, Novembre 2003.

Antimony

Antimony (Sb) is a toxic compound relatively rare in the Earth's crust (0.2 ppm). Its main industrial use is the fabrication of batteries (lead-antimony alloy). Antimony is also one of the main constituents of lead and tin alloys. Antimony trioxide, the most toxic form, is mainly used as a fire retardant in the formulation of plastics, rubbers, textiles, papers and paints. It is also used as an additive in the glass and ceramics industry and as a catalyst in the chemical industry.

Hazard evaluation and characterisation

Antimony trioxide is classified in category 2B (possibly carcinogenic to humans) by the International Cancer Research Agency (IARC, 1989[93]). The toxicity of antimony and its compounds varies with the chemical state of the element. In its metallic form, antimony is relatively inert, whereas stibium proves to be highly toxic for humans. Other compounds are serious irritants and cause several forms of dermatitis. To date no reference toxicological value for antimony has been established at national or European level. Who[93a] in 2003 has established TDI of 60 µg/kg b.w. for antimony (360 µg/day for an adult of 60 kg).

Risk evaluation and characterisation

Antimony levels found in the "as-consumed" foods analysed

Table 14 shows that 170 out of 998 samples (17%) display antimony levels above the detection limit of 0.6 µg/kg of fresh weight. Antimony is found at an average level between 1.7 and 2.4 µg/kg in the food groups including meats, delicatessen, shellfish, vegetables and starchy vegetables, fruits and nuts and oilseed; the majority of other groups contain less than 0.6 µg/kg.

Estimation of the level of exposure to antimony of the French population

Tables 17 and 18 show that the estimated average daily intake of the French population is 1.0 µg for "normo-reporters" adults aged 15 years or more and 0.8 µg for children aged 3 to 14. The daily 97.5th percentile exposure is 2 µg for adults and 1.6 µg for children (*Table 20*). The results compared to existing French data are lower by a factor of 3 (Noël *et al.*[72]). This is explained notably by the fact that the LOQ estimated to be 1.2 µg/kg in this study is about 2 times smaller than in the previous one (2 µg/kg), while 83% of the samples display antimony levels less than the detection limit. The food groups including meats, vegetables and starchy vegetables, fruits and drinking water are the vectors contributing most (10-15%) to the exposure of the populations; other vectors contribute less than 10% of the total food exposure. The proportion of individuals whose theoretical intake exceeds the TDI established for antimony estimated to be 0% of adults aged 15 years or more and 0% of children aged 3 to 14.

93) IARC, Monographs on evaluation of carcinogenic risks to humans. Vol47, p. 291, 1989.
93a) WHO, revision of recommendations for drinking water quality, 2003.

Arsenic

Arsenic (As) is present in the soil and is of generally geogenic and anthropogenic origin. Releases into the atmosphere by incineration installations and foundries and other industrial activities are the main sources soil contamination[94]. In food matrices, the predominant forms of arsenic are organic (arsenobetaine, arsenocholine, monomethylarsinic acid, dimethylarsinic acid, arsenosugars, etc.) which are the less toxic forms.

Hazard evaluation and characterisation

Arsenic is classified in category 1 (carcinogenic to humans) by the International Cancer Research Agency (IARC, 1987[95]). Inorganic arsenic compounds are much more toxic for humans than are the organic forms. In 1967 the WHO established a Maximum Tolerable Daily Intake (TDMI) of 50 µg/kg b.w. for total arsenic (organic and inorganic forms) and in 1989[96] a PTWI of 15 µg/kg b.w. for inorganic arsenic (130 µg/day for an adult of 60 kg).

Risk evaluation and characterisation

Arsenic levels found in the "as-consumed" foods analysed

Table 14 shows that 469 out of 998 samples (47%) display arsenic levels above the detection limit of 5 µg/kg of fresh weight. Arsenic is found at an average level of 2 mg/kg in the fish and shellfish food group; the majority of other groups contain less than 50 µg/kg. The scientific literature reports that 0.4-5.3% of arsenic present in products from the sea are in the form of inorganic arsenic[97].

Estimation of the level of exposure to arsenic of the French population

Tables 17 and 18 show that the estimated average daily intake of the French population is 62 µg for "normo-reporters" adults aged 15 years or more and 43 µg for children aged 3 to 14. The 97.5th percentile exposure is 31 µg/kg b.w./week for adults (equivalent PTWI of inorganic arsenic[98] of 3.1%) and 42 µg/kg b.w./week for children (equivalent PTWI of inorganic arsenic[98] of 4.2%) (*Table 20*). Compared to existing French data, the results are lower by a factor of 1.8 to 2.4 (Noël et *al.*[72], Leblanc et al.[99] et SCOOP 3.2.11[102]). The food group including fish, shellfish and fruits are the vectors contributing most (respectively 49-50%, 8-13% and 15-17%) to the exposure of the populations; other vectors contribute less than 5% of the total food exposure. The proportion of individuals whose theoretical intake exceeds the PTWI established for inorganic arsenic is estimated to be 0% of adults aged 15 years or more and 0% of children aged 3 to 14.

94) INERIS, Rapport toxicologique et environnemental sur l'arsenic, juillet 2000.

95) IARC, Monographs on evaluation of carcinogenic risks to humans. Suppl. 7 p. 100, 1987.

96) WHO, Evaluation toxicologique de certains additifs alimentaires et contaminants. Trente-troisième rapport du comité mixte FAO/OMS d'experts. Genève, Organisation Mondiale de la santé, 1989, Série de rapports techniques N° 776.

97) Schoof, R. A., Yost, L. J., Eickhoff, J., Crecelius, E. A., Cragin, D. W., Meacher, D. M., and Menzel, D. B., 1999, A market basket survey of inorganic arsenic food. Food and Chemical Toxicology, 37, 839-846.

98) To permit a comparison of the exposure versus PTWI based on toxicity of inorganic arsenic, it is estimated that around 10% of the arsenic found in foods are inorganic forms.

99) Leblanc J-Ch., L., Malmauret, T., Guérin, F., Bordet, B., Boursier, Ph., Verger, Estimation of the dietary intakes of pesticides residues, lead, cadmium, arsenic and radionucleides in France, Food Additives and Contaminants, Vol. 17, pp. 925-932 (2000).

Cadmium

Cadmium (Cd) is a contaminant found in various compartments of the environment in general and the soil in particular due to erosion, human industrial activities and agricultural practices (phosphate fertilisers, sewage sludge spreading) contributing widely to the enrichment of cadmium in the soil and therefore to the contamination of agricultural land (2 to 6 g/Ha). The real problem lies in the fact that part of cadmium is easily extracted from the soil thereby facilitating transfer of cadmium from the soil to plants, whose roots assimilate cadmium without any threshold effect. This can lead to long-term accumulation of the toxic which can then enter the food chain.

Hazard evaluation and characterisation

Cadmium is classified in category 1 (carcinogenic to humans) by the International Cancer Research Agency (IARC, 1993[100]). Cadmium is a cumulative toxin whose biological half-life has been estimated to be 20-30 years in humans. The main toxic effects are, in animals and in humans, problems of the renal function which is characterised by degeneration of the proximal tubules and proteinuria. In 2003 the JECFA[101] confirmed the Provisional Tolerable Weekly Intake of 7 µg/kg b.w.

Risk evaluation and characterisation

Cadmium levels found in the "as-consumed" foods analysed

Table 14 shows that 309 out of 998 samples (31%) display cadmium levels above the detection limit of 0.7 µg/kg of fresh weight. Cadmium is found at an average level between 0.05 and 0.1 mg/kg in offals and shellfish ; the majority of other food groups contain less than 0.02 mg/kg.

Estimation of exposure to cadmium of the French population

Tables 17 and 18 show that the estimated average daily intake of the French population is 2.7 µg for "normo-reporters" adults aged 15 years or more and 2.0 µg for children aged 3 to 14. The 97.5th percentile exposure for adults is 0.7 µg/kg b.w./week (equivalent PTWI of 10%) and for children 1.2 µg/kg b.w./week (equivalent PTWI of 17%) children (*Table 20*). Compared to existing French data, the results are on average comparable (Noël et *al.*[72]) or lower by a factor 4 to 10 (SCOOP 3.2.11[102], Leblanc et *al.*[99], Decloitre[103] and Biego et *al.*[66]). The food group including vegetables and starchy vegetables are the vectors contributing most (respectively 21-23% and 21-27%) to the exposure of the populations; other vectors contribute less than 5% of the total food exposure. The proportion of individuals whose theoretical intake exceeds the PTWI established for cadmium is estimated to be 0% of adults aged 15 years or more and 0% of children aged 3 to 14.

100) IARC, Monographs on evaluation of carcinogenic risks to humans. World health organization, Lyon Vol. 58, p.119, 1993.

101) Joint Expert Committee mixt FAO/OMS food additives and contaminants : Evaluation de certains additifs alimentaires et contaminants. Soixante et uniéme rapport du comité mixte FAO/WHO d'experts. Rome, WHO, june 2003.

102) SCOOP reports on Tasks 3.2.11. Assessment of dietary intake of arsenic, cadmium, lead and mercury by the population of EU members states, 2004 in press.

103) Decloitre , La part des différents aliments dans l'exposition au plomb, au cadmium et au mercure en france, Cah. Nutr. Diet., 33, 3, 1998.

Lead

Lead (Pb) is an environmental pollutant found above all in the soil and atmosphere in the vicinity of industrial sites (foundries, fabrication and recycling installations handling products containing lead, etc.), in zones of heavy automobile traffic, in the fabrication of the solders for food cans and in wine vinification and corking processes. Following the application of the regulation on the lead-free gasoline and an improvement of good practices of food production and transformation, exposure levels have fallen. On the other hand, due to its ubiquitousness and persistent character, lead is found in many food products and in dusts and water.

Hazard evaluation and characterisation

Lead is a cumulative metabolic poison which targets the hematopoietic system, the nervous system, the kidneys and the male reproductive system. Several studies have confirmed the serious toxic effect of lead during the foetal development that leads to a durable neurobehavioral deficit during childhood. In 2000 the JECFA[104] confirmed the provisional tolerable weekly intake (PTWI) of 25 µg/kg b.w.

Risk evaluation and characterisation

Lead levels found in the "as-consumed" foods analysed

Table 14 shows that 749 out of 998 samples (75%) display lead levels above the detection limit of 5 µg/kg of fresh weight. Lead is found at an average level between 0.05 and 0.1 mg/kg in offals and shellfish; the majority of other food groups contain less than 0.04 mg/kg.

Estimation of exposure to lead of the French population

Tables 17 and 18 show that the estimated average daily intake of the French population is 18 µg for "normo-reporters" adults aged 15 years or more and 13 µg for children aged 3 to 14. The 97.5th percentile exposure for adults is 3.6 µg/kg b.w./week (equivalent PTWI of 14%) and for children 6.4 µg/kg b.w./week (equivalent PTWI of 26%) (*Table 20*). Compared to existing French data, the results are lower by a factor of 3 on average (Noël et *al.*[72], SCOOP 3.2.11[102], Leblanc et *al.*[99] and Decloitre[103]). To within the differences of the analytical methodology used, this exposure estimation difference is explained to a large degree by the estimation made in this study of a LOQ 2.5 times lower than in the previous one (Noël et *al.*[72]). The following food groups are the vectors contributing most (5-11%) to the exposure of the populations: bread, rusk, soups, vegetables, fruits, drinking water, non-alcoholic beverages, alcoholic beverages and sugars and confectionery; other vectors contribute less than 5% of the total food exposure. The proportion of individuals whose theoretical intake exceeds the PTWI established for lead is estimated to be 0% of adults aged 15 years or more and 0% for children aged 3 to 14.

104) Joint Expert Committee mixt FAO/WHO food additives and contaminants, Cinquante cinquième rapport du comité mixte FAO/WHO d'experts. Genève, WHO, rapport technique séries 901, 2000.

Mercury

Mercury (Hg) is a chemical compound extracted from an ore called cinnabar. It is used in various activities industrial (batteries, electrical and measuring equipment, chemicals, paints and dental fillings). The main sources of environmental exposure are degassing of the Earth's crust and volcanic activity. Anthropogenic releases are essentially due to exploitation of ores (lead and zinc mines), combustion of fossil fuels (coal, fuel oil), industrial waste (chlorine and soda industry, etc.) and waste incineration[105]. In food matrices, the organic forms of mercury, notably methylmercury (MeHg) are more toxic than the inorganic ones. Absorption of mercury through food, in particular its methylated form, methylmercury, is essentially due to consumption of fishing products which are the main source of food exposure.

Hazard evaluation and characterisation

Mercury is a ubiquist element whose toxicity to humans has been known since antiquity. Current epidemiological data strongly suggest that methylmercury is a neurotoxic substance that causes retarded psychomotor development in children. Wishing to take additional precautions regarding the potential impact of methylmercury on the neurological development of the foetus, in 2003 the JECFA[106] re-evaluated the PTWI, and lowered it to 1.6 µg/kg b.w.. The PTWI of total mercury, which has not been re-examined, is still 5 µg/kg b.w.[107].

Risk evaluation and characterisation

Mercury levels found in the "as-consumed" foods analysed

Table 14 shows that 379 out of 998 samples (38%) display mercury levels above the detection limit of 6 µg/kg of fresh weight. Mercury is found at an average level of 62 µg/kg in the fish food group and 42 µg/kg in chocolate group; other food groups contain less than 17 µg/kg.

Estimation of exposure to mercury of the French population

Tables 17 and 18 show that the estimated average daily intake of the French population is 9.7 µg for "normo-reporters" adults aged 15 years or more and 7.9 µg for children aged 3 to 14. The 97.5th percentile exposure for adults is 1.8 µg/kg b.w./week for mercury and an estimated 0.7 µg/kg b.w./week for methylmercury[108] (equivalent PTWI of 44% for adult consuming fishing products), and for children 4.1 µg/kg b.w./week for mercury and an estimated 1.0 µg/kg b.w./week for methylmercury[108] (equivalent PTWI of 63% for children consuming fishing products) (*Table 20*). Compared to existing French data, the results are on average comparable (Noël et *al.*[72], SCOOP 3.2.11[102]) or lightly lower by a factor of 1.5 (Decloitre[103]). The proportion of individuals whose theoretical intake exceeds the PTWI established for methylmercury is estimated to be 0% of adults aged 15 years or more and 1% of children aged 3 to 14.

105) INERIS, Rapport toxicologique et environnemental sur le mercure et les dérivés du mercure, juillet 2000.

106) Joint Expert Committee mixt FAO/WHO food additives and contaminants : Evaluation de certains additifs alimentaires et contaminants. Soixante et unième rapport du comité mixte FAO/WHO d'experts. Rome, WHO, june 2003.

107) Joint Expert Committee mixt FAO/WHO food additives and contaminants : 53ème rapport du comité mixte FAO/WHO d'experts, june 1999.

108) To permit a comparison of the exposure versus PTWI based on toxicity of methylmercury, it is estimated that around 100% of the mercury found in fish and shellfish are methylmercury forms.

Table 14: Mean concentrations of minerals, essential trace elements and toxic elements in “as-consumed” foods

Food group	% diéte	Nb samples	Mean concentration (mg/kg fresh matter)																
			Minerals and essential trace elements											Toxic elements					
			Li	Cr	Mn	Co	Ni	Cu	Zn	Se	Mo	Na	Mg	Ca	Al	As	Cd	Pb	Hg	Sb
Bread, rusk	98.6	12	0.027	0.16	7.75	0.006	0.07	1.62	9.21	0.016	0.255	6820	341	627	4.06	0.004	0.0048	0.026	0.013	0.0003
Breakfast cereals	93.0	10	0.009	0.13	10.88	0.008	0.55	2.45	11.89	0.025	0.374	3248	484	1815	3.00	0.004	0.0017	0.015	0.010	0.0003
Pasta	99.2	2	0.002	0.04	2.54	0.025	0.02	1.08	3.77	0.011	0.034	2544	122	204	0.39	0.003	0.0022	0.012	0.003	0.0003
Rice and semolina	100	6	0.004	0.06	4.41	0.010	0.02	1.15	4.71	0.011	0.110	3364	226	216	0.42	0.016	0.0032	0.005	0.005	0.0003
Miscellaneous cereals	88.4	4	0.020	0.01	19.63	0.001	0.47	3.74	25.70	0.014	0.689	690	896	514	0.84	0.004	0.0075	0.018	0.013	0.0003
Viennese bread, buns	99.7	12	0.037	0.16	4.39	0.014	0.11	1.36	7.28	0.017	0.172	4417	221	564	2.89	0.003	0.0004	0.028	0.016	0.0003
Biscuits	81.6	14	0.005	0.14	3.51	0.018	0.28	1.82	5.94	0.011	0.113	2744	232	471	5.29	0.003	0.0012	0.019	0.009	0.0003
Cakes	75.4	12	0.012	0.07	1.99	0.001	0.06	0.71	3.98	0.011	0.085	1699	119	548	1.40	0.003	0.0004	0.008	0.004	0.0003
Milk	99.6	16	0.006	0.02	0.09	0.001	0.07	0.12	5.06	0.015	0.039	449	141	1371	0.19	0.003	0.0004	0.003	0.003	0.0003
Ultra-fresh dairy products	51.1	30	0.004	0.03	0.16	0.003	0.06	0.12	4.20	0.020	0.043	410	111	1184	0.33	0.003	0.0004	0.004	0.003	0.0003
Cheeses	61.6	16	0.010	0.14	0.25	0.018	0.26	0.97	30.67	0.060	0.075	5611	281	6741	0.44	0.003	0.0004	0.016	0.003	0.0003
Eggs and egg products	98.4	30	0.014	0.05	0.28	0.005	0.03	0.59	10.07	0.040	0.067	1237	108	711	0.10	0.008	0.0004	0.011	0.004	0.0003
Butter	51.5	2	0.002	0.07	0.03	0.018	0.02	0.07	0.58	0.011	0.031	120	60	145	0.08	0.051	0.0004	0.007	0.003	0.0003
Oils	12.9	2	0.002	0.04	0.06	0.017	0.02	0.05	0.19	0.011	0.011	60	45	19	0.05	0.045	0.0004	0.005	0.003	0.0003
Margarin	10.5	2	0.002	0.06	0.04	0.018	0.02	0.06	0.40	0.011	0.022	1735	42	111	0.05	0.060	0.0004	0.004	0.003	0.0003
Meat	82.6	44	0.002	0.05	0.13	0.008	0.02	0.78	36.76	0.095	0.141	1292	286	153	0.21	0.009	0.0010	0.004	0.003	0.0017
Poultry and game	84.2	24	0.006	0.03	0.13	0.002	0.02	0.60	16.23	0.184	0.166	1266	305	169	0.26	0.022	0.0019	0.015	0.005	0.0005
Offals	60.5	18	0.041	0.10	2.14	0.033	0.04	13.46	31.12	0.011	0.777	2459	151	92	0.52	0.003	0.0516	0.055	0.019	0.0003
Delicatessen	60.7	32	0.007	0.17	0.57	0.010	0.04	1.61	23.69	0.118	0.096	6885	257	257	2.23	0.032	0.0063	0.014	0.004	0.0024
Fish	57.1	62	0.030	0.08	0.30	0.007	0.05	0.41	5.51	0.170	0.065	2117	262	346	0.51	2.237	0.0016	0.023	0.062	0.0003
Shellfish	66.3	18	0.123	0.09	2.68	0.046	0.23	7.05	65.93	0.011	0.129	5422	509	753	17.1	1.926	0.0827	0.098	0.017	0.0018
Vegetables (except potatoes)	86.1	198	0.014	0.05	1.83	0.006	0.08	0.89	2.46	0.017	0.165	811	165	448	3.22	0.012	0.0108	0.015	0.005	0.0018
Starchy vegetables	98.6	26	0.002	0.05	1.43	0.001	0.07	0.94	2.80	0.011	0.418	800	208	156	0.59	0.017	0.0109	0.005	0.007	0.0021
Pulses	95.4	16	0.016	0.08	4.20	0.008	0.33	2.06	6.99	0.060	0.727	1848	269	595	1.08	0.005	0.0012	0.012	0.016	0.0003
Fruits	99.1	79	0.007	0.01	2.05	0.009	0.03	0.65	0.73	0.016	0.010	12	103	99	0.41	0.076	0.0018	0.010	0.003	0.0024
Nuts and oilseeds	75.2	22	0.022	0.06	10.81	0.041	1.15	7.15	18.77	0.048	1.301	477	1146	1593	4.10	0.169	0.0187	0.022	0.005	0.0018
Ices cream	85.7	2	0.002	0.10	1.44	0.003	0.37	1.28	3.68	0.011	0.466	517	287	859	3.91	0.061	0.0004	0.005	0.006	0.0003
Chocolate	72.3	4	0.021	0.34	2.38	0.050	0.63	2.39	8.57	0.011	0.167	976	368	1361	3.69	0.007	0.0004	0.028	0.042	0.0003
Sugars, confectionery	100	18	0.002	0.12	2.31	0.021	0.04	0.86	1.65	0.011	0.024	108	118	193	1.51	0.018	0.0004	0.036	0.008	0.0003
Drinking waters	63.0	12	0.100	0.01	0.19	0.001	0.03	0.05	0.05	0.011	0.002	38	27	120	0.05	0.003	0.0004	0.003	0.003	0.0003
Non-alcoholic beverages	95.9	46	0.004	0.05	0.82	0.002	0.03	0.24	0.44	0.011	0.007	76	60	143	0.45	0.017	0.0004	0.008	0.004	0.0003
Alcoholic beverages	60.8	22	0.003	0.02	0.55	0.001	0.02	0.07	0.64	0.011	0.002	19	48	49	0.52	0.003	0.0004	0.015	0.003	0.0003
Coffee	100	12	0.006	0.01	0.30	0.001	0.02	0.10	0.47	0.011	0.002	34	64	64	0.24	0.005	0.0004	0.004	0.003	0.0003
Hot beverages	99.7	4	0.002	0.02	0.58	0.002	0.09	0.50	4.20	0.011	0.016	237	113	632	1.03	0.003	0.0004	0.004	0.003	0.0003
Pizzas, salt cakes, quiches	33.6	6	0.006	0.07	1.62	0.001	0.02	0.69	10.06	0.040	0.057	4118	171	1428	2.24	0.023	0.0004	0.004	0.003	0.0003
Sandwitches	48.1	12	0.008	0.08	3.84	0.005	0.05	0.99	16.76	0.023	0.113	6020	285	701	1.38	0.003	0.0004	0.009	0.003	0.0003
Soups	97.9	38	0.038	0.05	0.97	0.006	0.14	0.70	2.39	0.038	0.194	1507	107	213	1.09	0.004	0.0004	0.019	0.003	0.0003
Mixed dishes	82.9	75	0.018	0.09	1.18	0.008	0.06	0.68	9.96	0.019	0.062	3307	141	433	1.28	0.030	0.0007	0.012	0.011	0.0003
Salads	40.8	4	0.010	0.14	2.20	0.033	0.07	0.96	4.97	0.030	0.105	2618	162	294	4.93	0.013	0.0004	0.022	0.003	0.0003
Dessert	77.3	12	0.012	0.09	0.75	0.011	0.23	0.84	4.60	0.014	0.120	497	172	1079	1.65	0.003	0.0004	0.010	0.009	0.0003
Stewed fruit, compote	97.6	8	0.003	0.03	3.06	0.001	0.03	0.37	0.45	0.011	0.013	6	53	67	0.39	0.003	0.0004	0.017	0.005	0.0004
Condiments, sauces	68.9	12	0.024	0.12	0.46	0.001	0.07	0.71	2.15	0.029	0.050	5086	191	387	1.13	0.003	0.0014	0.011	0.003	0.0004
Substitute meals	76.6	2	0.002	0.06	0.57	0.001	0.10	0.63	7.52	0.011	0.002	953	142	1330	1.41	0.003	0.0004	0.003	0.003	0.0003

Table 15: Estimation of daily intakes of minerals and essential trace elements of children from 3 to 14 years (n=1018)

Food group	Li (µg)		Cr (µg)		Mn (mg)		Co (µg)		Ni (µg)		Cu (mg)		Zn (mg)		Se (µg)		Mo (µg)		Na (g)		Mg (mg)		Ca (mg)	
	Mean	P95	Mean	P95	Mean	P95	Mean	P95	Mean	P95	Mean	P95	Mean	P95	Mean	P95	Mean	P95	Mean	P95	Mean	P95	Mean	P95
Bread, rusk	1.31	3.85	6.24	19.4	0.35	1.02	0.22	0.69	2.49	7.84	0.08	0.23	0.48	1.40	1.86	5.75	15.3	44.6	0.41	1.19	14.5	44.2	28.3	82.5
Breakfast cereals	0.15	0.60	2.11	8.00	0.18	0.74	0.13	0.56	8.52	34.8	0.04	0.15	0.19	0.79	0.34	1.57	6.00	25.0	0.06	0.26	7.9	31.9	36.4	158
Pasta	0.06	0.15	1.38	3.75	0.09	0.25	0.90	2.45	0.87	2.38	0.04	0.11	0.14	0.38	0.40	1.10	1.23	3.35	0.09	0.25	4.5	12.2	7.5	20.4
Rice and semolina	0.06	0.23	1.06	3.18	0.04	0.11	0.27	0.80	0.34	1.03	0.02	0.06	0.06	0.19	0.23	0.71	1.52	5.10	0.07	0.20	1.3	5.2	4.0	12.5
Others cereals	0.04	0.20	0.02	0.11	0.03	0.09	0.00	0.00	0.43	0.74	0.01	0.03	0.04	0.18	0.02	0.08	0.79	2.25	0.00	0.01	1.3	5.1	0.8	2.9
Viennese and buns	0.84	2.92	3.33	12.2	0.11	0.40	0.35	1.41	2.51	10.4	0.03	0.12	0.18	0.66	0.61	2.27	3.86	13.4	0.11	0.38	5.6	19.1	12.1	41.6
Biscuits	0.07	0.27	3.94	16.3	0.09	0.32	0.58	2.66	8.39	37.4	0.05	0.19	0.16	0.52	0.27	0.90	2.81	9.39	0.07	0.22	6.3	23.1	11.5	38.1
Cakes	0.30	1.43	1.40	6.57	0.05	0.22	0.02	0.07	1.15	5.53	0.02	0.07	0.08	0.40	0.25	1.04	1.99	9.29	0.05	0.28	2.7	12.4	12.4	58.9
Milk	0.67	1.39	2.53	5.38	0.01	0.01	0.12	0.24	7.26	15.7	0.01	0.01	1.34	2.79	2.42	5.06	7.11	14.8	0.10	0.20	33.0	68.2	257	533
Ultra-fresh dairy products	0.13	0.46	1.13	3.79	0.01	0.04	0.09	0.43	2.54	9.21	0.00	0.01	0.16	0.53	0.78	2.56	1.51	4.85	0.02	0.05	4.4	14.0	45.9	151
Cheeses	0.12	0.41	1.49	5.24	0.00	0.01	0.20	0.74	3.12	10.7	0.02	0.08	0.40	1.43	0.58	2.01	0.91	3.17	0.06	0.23	3.5	12.3	89.0	322
Eggs, egg products	0.16	0.53	0.77	2.41	0.00	0.01	0.05	0.19	0.43	1.54	0.01	0.02	0.11	0.36	0.39	1.69	0.75	2.49	0.02	0.05	1.2	3.8	8.1	25.9
Butter	0.01	0.03	0.35	1.33	0.00	0.00	0.08	0.31	0.08	0.29	0.00	0.00	0.00	0.01	0.05	0.20	0.15	0.56	0.00	0.00	0.3	1.1	0.7	2.6
Vegetal oils	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0
Meat	0.12	0.32	2.43	5.91	0.01	0.03	0.20	0.75	0.91	2.17	0.03	0.07	1.73	4.24	2.88	8.28	6.58	16.0	0.06	0.16	11.6	28.5	5.8	14.7
Poultry and game	0.19	0.70	0.76	2.35	0.00	0.01	0.05	0.18	0.38	1.10	0.01	0.04	0.34	1.06	3.82	11.6	3.73	11.0	0.03	0.09	6.6	19.7	3.1	10.5
Offals	0.04	0.34	0.09	0.86	0.00	0.01	0.04	0.14	0.03	0.30	0.02	0.02	0.03	0.24	0.01	0.09	0.85	1.68	0.00	0.01	0.1	1.0	0.1	0.7
Delicatessen	0.09	0.32	2.48	8.04	0.01	0.02	0.14	0.46	0.52	1.74	0.02	0.07	0.36	1.10	1.94	5.66	1.24	4.86	0.09	0.29	4.4	12.2	3.8	12.6
Fish	0.40	1.38	0.94	3.09	0.01	0.03	0.06	0.29	0.73	2.57	0.01	0.02	0.07	0.23	2.09	7.62	1.19	4.36	0.05	0.16	3.5	11.5	3.5	13.3
Shellfish	0.13	0.91	0.10	0.79	0.00	0.02	0.06	0.43	0.33	2.49	0.01	0.03	0.04	0.13	0.01	0.11	0.16	1.16	0.01	0.05	0.5	3.0	0.9	6.5
Vegetables (except potatoes)	0.69	2.13	3.72	9.68	0.12	0.29	0.25	0.85	5.76	14.7	0.05	0.13	0.18	0.43	0.89	2.02	9.99	29.6	0.09	0.23	11.2	33.4	25.8	72.5
Starchy vegetables	0.17	0.41	3.46	8.41	0.07	0.15	0.06	0.16	4.20	9.70	0.05	0.11	0.16	0.36	0.66	1.50	20.1	49.1	0.05	0.14	10.1	22.8	14.8	37.7
Pulses	0.09	0.49	0.67	3.66	0.02	0.10	0.05	0.24	1.76	9.21	0.01	0.06	0.04	0.21	0.55	3.73	7.48	43.9	0.02	0.09	1.2	6.2	2.4	11.8
Fruits	0.29	0.99	0.63	1.83	0.32	1.16	0.55	2.36	1.68	5.56	0.05	0.17	0.06	0.24	1.38	4.97	0.72	2.36	0.00	0.01	10.5	32.8	5.8	20.9
Nuts and oilseeds	0.02	0.09	0.03	0.22	0.01	0.07	0.03	0.11	1.25	3.15	0.01	0.03	0.02	0.08	0.04	0.16	1.53	11.2	0.00	0.00	0.9	4.8	0.5	2.7
Ices cream	0.01	0.05	0.74	3.51	0.01	0.05	0.02	0.09	2.67	12.7	0.01	0.04	0.03	0.13	0.08	0.38	3.35	16.0	0.00	0.02	2.1	9.8	6.2	29.5
Chocolate	0.09	0.39	1.50	6.56	0.01	0.05	0.22	0.97	2.73	11.7	0.01	0.05	0.04	0.16	0.05	0.20	0.72	3.27	0.00	0.02	1.6	7.0	5.9	26.7
Sugars and confectionery	0.04	0.10	3.23	10.2	0.07	0.31	0.75	3.46	1.01	3.37	0.03	0.12	0.05	0.19	0.22	0.60	0.84	3.08	0.00	0.01	4.1	17.5	6.5	26
Drinking waters	3.62	12.1	2.20	5.79	0.01	0.02	0.15	0.38	7.69	19.9	0.02	0.07	0.02	0.04	3.29	8.45	0.45	1.15	0.01	0.02	3.7	11.5	24.0	67.9
Non-alcoholic beverages	0.83	2.71	7.97	24.7	0.05	0.14	0.34	0.95	5.30	15.0	0.04	0.11	0.07	0.19	2.10	5.78	0.74	2.43	0.01	0.02	13.7	38.8	13.5	37.9
Alcoholic beverages	0.01	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0
Coffee	0.08	0.56	0.13	0.86	0.00	0.02	0.00	0.03	0.20	1.32	0.00	0.01	0.00	0.02	0.10	0.69	0.02	0.13	0.00	0.00	0.6	4.2	0.5	3.4
Hot beverages	0.04	0.12	0.51	1.58	0.01	0.04	0.04	0.11	1.92	5.44	0.01	0.03	0.09	0.26	0.22	0.76	0.36	1.02	0.01	0.01	2.5	7.0	13.8	39.8
Pizzas, salt cakes, quiches	0.02	0.10	0.31	1.58	0.01	0.03	0.00	0.01	0.09	0.48	0.00	0.02	0.05	0.25	0.31	1.83	0.33	1.91	0.02	0.11	0.8	4.4	5.3	25.7
Sandwitches	0.04	0.21	0.65	3.19	0.01	0.07	0.05	0.25	0.35	1.68	0.01	0.03	0.13	0.62	0.08	0.39	0.60	2.77	0.03	0.15	1.4	6.5	5.1	25.0
Soups	2.07	9.26	1.28	5.49	0.03	0.13	0.20	0.90	2.16	9.31	0.02	0.08	0.08	0.33	0.60	2.54	0.66	2.73	0.04	0.18	3.9	16.3	8.3	35.3
Mixed dishes	1.12	3.51	5.42	16.3	0.09	0.27	0.54	1.83	4.78	17.2	0.04	0.14	0.55	1.89	1.09	3.76	4.40	15.0	0.21	0.61	9.3	26.9	27.5	98.1
Salads	0.02	0.16	0.29	2.06	0.00	0.03	0.07	0.47	0.14	0.86	0.00	0.01	0.01	0.06	0.06	0.39	0.21	1.49	0.01	0.04	0.3	2.6	0.6	3.6
Dessert	0.31	1.20	2.51	11.1	0.02	0.11	0.39	1.87	7.26	33.7	0.03	0.12	0.14	0.52	0.33	1.26	3.19	12.0	0.01	0.06	5.2	21.4	30.1	109
Stewed fruit	0.02	0.10	0.21	1.00	0.01	0.04	0.01	0.02	0.20	0.91	0.00	0.02	0.00	0.02	0.12	0.50	0.13	0.63	0.00	0.00	0.3	1.4	0.6	3.3
Condiments, sauces	0.05	0.22	0.35	1.49	0.00	0.01	0.00	0.01	0.20	0.94	0.00	0.01	0.01	0.04	0.08	0.33	0.16	0.73	0.01	0.06	0.4	1.7	1.0	4.4
Total	**14.5**	**28.1**	**68.4**	**110**	**1.88**	**3.51**	**7.26**	**12.8**	**92.4**	**157**	**0.81**	**1.36**	**7.63**	**12.0**	**31.2**	**49.4**	**114**	**196**	**1.81**	**3.15**	**197**	**307**	**729**	**1180**

Table 16: Estimation of daily intakes of minerals and essential trace elements of Adults “normo-reporters”, 15 years and more (n=1474)

Food group	Li (µg)		Cr (µg)		Mn (mg)		Co (µg)		Ni (µg)		Cu (mg)		Zn (mg)		Se (µg)		Mo (µg)		Na (g)		Mg (mg)		Ca (mg)	
	Mean	P95	Mean	P95	Mean	P95	Mean	P95	Mean	P95	Mean	P95	Mean	P95	Mean	P95	Mean	P95	Mean	P95	Mean	P95	Mean	P95
Bread, rusk	2.69	6.31	12.9	33.7	0.72	1.72	0.47	1.20	5.18	14.07	0.16	0.38	0.98	2.28	3.56	8.94	30.7	72.2	0.83	1.95	30.4	73.6	54.5	127
Breakfast cereals	0.06	0.34	0.51	4.00	0.06	0.39	0.03	0.17	2.48	14.7	0.01	0.08	0.07	0.40	0.20	1.06	2.16	13.1	0.01	0.08	2.7	16.4	9.8	74.6
Pasta	0.05	0.15	1.34	3.75	0.09	0.25	0.88	2.45	0.85	2.38	0.04	0.11	0.13	0.38	0.39	1.10	1.20	3.35	0.09	0.25	4.4	12.2	7.3	20.4
Rice and semolina	0.06	0.21	1.03	3.56	0.03	0.12	0.26	0.89	0.33	1.14	0.02	0.07	0.06	0.22	0.23	0.79	1.46	5.36	0.06	0.23	1.3	4.6	3.9	14.3
Others cereals	0.03	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.19	0.00	0.00	0.00	0.03	0.00	0.01	0.00	0.41	0.00	0.00	0.00	0.8	0.0	0.4	0.0
Viennese and buns	0.59	2.84	2.04	10.9	0.08	0.38	0.20	1.09	1.34	7.20	0.02	0.10	0.13	0.60	0.42	1.97	2.83	13.3	0.08	0.39	3.8	16.9	8.5	40.3
Biscuits	0.05	0.22	1.25	6.34	0.04	0.16	0.19	1.07	2.84	16.0	0.02	0.09	0.06	0.30	0.12	0.52	1.17	5.29	0.03	0.14	2.4	11.5	5.1	23.6
Cakes	0.34	1.38	1.53	5.94	0.06	0.22	0.02	0.08	1.22	4.88	0.02	0.07	0.09	0.35	0.31	1.16	2.22	8.85	0.04	0.22	3.0	11.9	13.8	54.9
Milk	0.36	1.07	1.37	4.15	0.00	0.01	0.06	0.18	3.85	11.7	0.00	0.01	0.73	2.17	1.35	4.14	3.87	11.6	0.05	0.15	17.9	53.2	140	416
Ultra-fresh dairy products	0.15	0.64	1.18	5.00	0.01	0.05	0.08	0.39	2.80	12.8	0.00	0.02	0.16	0.67	0.73	3.11	1.48	5.88	0.02	0.07	4.4	18.5	45.6	189
Cheeses	0.24	0.71	3.05	9.32	0.00	0.01	0.38	1.21	6.07	18.2	0.03	0.13	0.74	2.35	1.14	3.46	1.77	5.22	0.13	0.42	6.7	20.2	169	530
Eggs and egg products	0.26	0.84	1.23	3.98	0.00	0.02	0.07	0.26	0.70	2.31	0.01	0.03	0.18	0.56	0.60	2.38	1.22	3.83	0.03	0.08	1.9	6.1	13.1	41.2
Butter	0.01	0.04	0.54	2.01	0.00	0.00	0.13	0.48	0.12	0.43	0.00	0.00	0.00	0.02	0.08	0.30	0.23	0.84	0.00	0.00	0.4	1.6	1.1	3.9
Vegetal oils	0.00	0.00	0.05	0.16	0.00	0.00	0.01	0.05	0.01	0.05	0.00	0.00	0.00	0.00	0.01	0.03	0.02	0.05	0.00	0.00	0.04	0.13	0.07	0.20
Meat	0.12	0.30	2.60	6.44	0.01	0.03	0.25	0.93	1.00	2.49	0.04	0.09	1.97	4.80	4.23	11.9	7.74	19.4	0.07	0.17	14.0	34.4	7.1	19.2
Poultry and game	0.28	1.08	1.08	3.65	0.00	0.01	0.07	0.27	0.52	1.68	0.02	0.06	0.48	1.64	5.09	16.1	5.00	16.1	0.04	0.14	8.9	28.4	4.5	16.4
Offals	0.08	0.67	0.19	1.52	0.00	0.04	0.08	0.52	0.08	0.61	0.03	0.10	0.06	0.47	0.02	0.18	1.61	16.21	0.00	0.04	0.3	2.6	0.2	1.1
Delicatessen	0.12	0.42	3.04	9.66	0.01	0.03	0.18	0.64	0.65	2.09	0.02	0.09	0.45	1.38	2.43	6.97	1.64	6.83	0.11	0.37	5.6	16.0	4.6	14.8
Fish	0.49	1.93	1.04	3.75	0.01	0.03	0.10	0.52	0.77	2.96	0.01	0.02	0.08	0.33	2.73	11.5	1.13	4.45	0.04	0.16	4.2	16.2	4.9	25.1
Shellfish	0.29	2.11	0.23	1.55	0.01	0.03	0.12	1.01	0.76	4.43	0.02	0.07	0.11	0.31	0.03	0.19	0.33	2.70	0.02	0.09	1.2	6.8	2.2	12.8
Vegetables (except potatoes)	1.08	3.07	6.13	15.5	0.18	0.43	0.42	1.30	9.33	23.8	0.08	0.20	0.26	0.61	1.39	3.14	18.1	65.4	0.13	0.31	16.8	46.2	40.5	109
Starchy vegetables	0.17	0.43	3.38	8.34	0.07	0.16	0.07	0.19	4.16	9.84	0.05	0.12	0.15	0.36	0.68	1.65	21.5	55.1	0.05	0.13	10.1	24.1	12.6	35.7
Pulses	0.14	0.73	0.95	5.47	0.03	0.15	0.09	0.47	2.62	13.8	0.02	0.10	0.06	0.32	0.73	4.72	10.4	57.8	0.03	0.13	1.9	9.2	3.9	17.7
Fruits	0.46	1.59	1.03	3.09	0.35	1.43	0.92	3.68	2.82	8.98	0.08	0.23	0.09	0.37	2.19	7.46	1.29	4.51	0.00	0.01	14.8	44.1	9.3	30.9
Nuts and oilseeds	0.03	0.15	0.08	0.51	0.03	0.14	0.07	0.29	2.76	12.6	0.01	0.08	0.04	0.25	0.06	0.30	3.13	22.4	0.00	0.01	2.2	13.3	1.2	5.5
Ices cream	0.01	0.04	0.52	2.64	0.01	0.04	0.01	0.07	1.90	9.57	0.01	0.03	0.02	0.09	0.06	0.28	2.37	12.0	0.00	0.01	1.5	7.4	4.4	22.1
Chocolate	0.05	0.30	0.80	4.60	0.01	0.03	0.13	0.76	1.57	8.54	0.01	0.04	0.02	0.13	0.03	0.16	0.44	2.51	0.00	0.01	1.0	5.6	3.6	19.7
Sugars and confectionery	0.07	0.17	3.04	8.00	0.04	0.14	0.29	0.84	1.23	3.83	0.02	0.07	0.03	0.10	0.36	0.89	0.67	2.06	0.00	0.01	2.2	6.7	3.6	11.7
Drinking waters	11.6	42.9	2.69	7.93	0.02	0.08	0.18	0.53	9.05	26.6	0.02	0.08	0.02	0.06	3.87	11.6	0.54	1.59	0.01	0.03	5.5	23.7	31.0	100
Non-alcoholic beverages	0.41	1.91	3.98	17.8	0.02	0.08	0.17	0.65	2.67	11.1	0.02	0.08	0.03	0.14	1.05	4.37	0.37	1.69	0.00	0.02	6.8	26.8	7.2	28.4
Alcoholic beverages	0.30	1.31	1.86	8.75	0.05	0.27	0.05	0.22	1.58	7.19	0.01	0.04	0.07	0.35	1.07	4.92	0.15	0.67	0.00	0.01	5.6	26.1	4.1	19.5
Coffee	1.79	5.35	2.76	8.23	0.08	0.23	0.10	0.30	4.25	12.7	0.02	0.07	0.07	0.22	2.22	6.60	0.40	1.20	0.01	0.01	13.5	40.1	11.1	33.0
Hot beverages	0.11	0.60	0.91	4.65	0.05	0.30	0.05	0.21	2.21	10.2	0.02	0.12	0.12	0.60	0.80	4.40	0.22	0.93	0.00	0.01	1.8	7.4	11.4	48.3
Pizzas, salt cakes, quiches	0.04	0.18	0.49	2.34	0.01	0.05	0.00	0.02	0.14	0.64	0.00	0.02	0.07	0.33	0.48	2.07	0.53	2.44	0.03	0.14	1.3	5.7	8.4	39.2
Sandwitches	0.04	0.31	0.58	3.59	0.02	0.10	0.04	0.25	0.32	2.14	0.01	0.04	0.11	0.71	0.09	0.63	0.60	4.30	0.03	0.24	1.4	10.1	4.6	30.9
Soups	4.35	17.0	2.58	10.2	0.06	0.24	0.42	1.65	4.61	17.7	0.04	0.15	0.16	0.62	1.28	4.87	1.53	5.10	0.08	0.32	8.0	30.8	17.3	66.0
Mixed dishes	1.30	4.40	5.87	20.3	0.09	0.30	0.53	1.93	5.16	18.7	0.05	0.16	0.66	2.63	1.22	4.65	4.75	17.29	0.21	0.69	10.0	32.1	27.6	99.9
Salads	0.04	0.30	0.59	4.13	0.01	0.06	0.13	0.94	0.27	1.72	0.00	0.03	0.02	0.12	0.11	0.68	0.43	2.99	0.01	0.07	0.7	4.4	1.2	7.2
Dessert	0.21	0.98	1.67	8.84	0.01	0.08	0.26	1.49	4.76	24.6	0.02	0.09	0.09	0.41	0.21	0.94	2.14	9.78	0.01	0.05	3.4	15.5	19.4	91.0
Stewed fruit	0.02	0.11	0.22	1.32	0.01	0.04	0.01	0.03	0.20	1.14	0.00	0.02	0.00	0.02	0.11	0.63	0.13	0.75	0.00	0.00	0.3	1.6	0.6	3.8
Condiments,sauces	0.07	0.31	0.44	1.95	0.00	0.01	0.00	0.01	0.25	1.22	0.00	0.01	0.01	0.04	0.11	0.47	0.18	0.80	0.02	0.08	0.5	2.5	1.2	5.5
Total	**28.5**	**59.8**	**76.9**	**117**	**2.31**	**4.26**	**7.53**	**12.5**	**93.7**	**149**	**0.98**	**1.55**	**8,66**	**13,5**	**41,8**	**64,4**	**138**	**235**	**2.30**	**3.87**	**224**	**331**	**721**	**1189**

Table 17: Estimation of daily intakes of toxic elements of children from 3 to 14 years (n=1018)

Food group	Al (mg)			As (µg)			Cd (µg)			Pb (µg)			Hg (µg)			Sb (µg)		
	Mean	P95	%	Mean	P95	%	Mean	P95	%	Mean	P95	%	Mean	P95	%	Mean	P95	%
Bread, rusk	0.19	0.58	14.89	0.42	1.27	0.98	0.06	0.24	2.98	0.87	2.79	6.82	0.55	1.61	6.95	0.02	0.05	2.35
Breakfast cereals	0.06	0.22	4.44	0.06	0.21	0.13	0.02	0.10	1.05	0.27	1.03	2.13	0.17	0.65	2.17	0.00	0.02	0.64
Pasta	0.01	0.04	1.15	0.09	0.25	0.21	0.08	0.22	3.91	0.44	1.20	3.45	0.11	0.30	1.39	0.01	0.03	1.42
Rice and semolina	0.01	0.02	0.55	0.07	0.23	0.18	0.02	0.13	0.95	0.10	0.31	0.82	0.09	0.28	1.18	0.01	0.02	0.83
Miscellaneous cereals	0.00	0.01	0.16	0.01	0.03	0.01	0.01	0.04	0.53	0.03	0.11	0.21	0.02	0.07	0.24	0.00	0.00	0.06
Viennese bread and buns	0.07	0.28	5.70	0.07	0.23	0.15	0.01	0.03	0.43	0.72	2.52	5.66	0.40	1.43	5.08	0.01	0.03	0.94
Biscuits	0.12	0.45	9.41	0.06	0.20	0.14	0.04	0.17	1.73	0.39	1.46	3.07	0.21	0.74	2.63	0.01	0.02	0.94
Cakes	0.04	0.15	2.79	0.06	0.24	0.13	0.01	0.03	0.39	0.16	0.66	1.23	0.09	0.37	1.11	0.01	0.03	0.87
Milk	0.01	0.03	1.08	0.55	1.13	1.28	0.08	0.16	3.74	0.55	1.14	4.30	0.65	1.35	8.28	0.07	0.14	8.44
Ultra-fresh dairy products	0.02	0.07	1.38	0.10	0.33	0.24	0.01	0.05	0.68	0.13	0.43	1.03	0.13	0.44	1.66	0.01	0.04	1.54
Cheeses	0.00	0.01	0.34	0.03	0.11	0.07	0.00	0.02	0.22	0.18	0.64	1.40	0.04	0.13	0.48	0.00	0.01	0.49
Eggs and egg products	0.00	0.00	0.08	0.09	0.36	0.20	0.00	0.01	0.20	0.11	0.37	0.89	0.04	0.12	0.46	0.00	0.01	0.43
Butter	0.00	0.00	0.03	0.24	0.91	0.56	0.00	0.01	0.08	0.03	0.12	0.25	0.01	0.05	0.18	0.00	0.01	0.18
Vegetal oils	0.00	0.00	0.00	0.01	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.01
Meat	0.01	0.03	0.82	0.32	0.92	0.74	0.03	0.10	1.60	0.15	0.37	1.17	0.12	0.30	1.57	0.08	0.22	10.8
Poultry and game	0.01	0.02	0.44	0.46	1.46	1.08	0.07	0.28	3.65	0.57	2.11	4.49	0.14	0.47	1.83	0.01	0.03	1.38
Offals	0.00	0.00	0.04	0.00	0.02	0.01	0.06	0.22	2.80	0.05	0.43	0.41	0.02	0.16	0.23	0.00	0.00	0.04
Delicatessen	0.03	0.11	2.05	0.61	1.73	1.43	0.08	0.31	3.82	0.22	0.67	1.70	0.06	0.19	0.78	0.04	0.17	5.34
Fish	0.01	0.04	0.84	21.6	73.7	50.6	0.02	0.10	0.94	0.23	0.79	1.82	0.66	2.28	8.38	0.00	0.01	0.51
Shellfish	0.02	0.19	1.91	3.34	23.7	7.81	0.07	0.48	3.66	0.12	0.83	0.96	0.02	0.19	0.31	0.00	0.02	0.29
Vegetables (except potatoes)	0.23	1.27	17.9	0.51	1.38	1.19	0.43	2.11	21.2	0.76	2.20	6.00	0.45	1.06	5.73	0.08	0.27	10.4
Starchy vegetables	0.04	0.09	2.78	0.86	2.11	2.01	0.55	1.35	26.9	0.34	0.80	2.65	0.47	1.05	5.89	0.11	0.28	13.7
Pulses	0.01	0.05	0.62	0.03	0.15	0.06	0.02	0.16	1.16	0.15	0.99	1.21	0.12	0.57	1.53	0.00	0.01	0.25
Fruits	0.02	0.09	1.90	6.33	19.9	14.8	0.08	0.34	3.67	0.82	3.03	6.42	0.26	0.82	3.31	0.08	0.39	10.4
Nuts and oilseeds	0.00	0.01	0.22	0.22	1.19	0.51	0.01	0.03	0.68	0.02	0.11	0.16	0.01	0.03	0.10	0.00	0.01	0.31
Ices cream	0.03	0.13	2.22	0.44	2.09	1.03	0.00	0.01	0.12	0.04	0.17	0.28	0.04	0.19	0.50	0.00	0.01	0.28
Chocolate	0.02	0.07	1.28	0.03	0.16	0.07	0.00	0.01	0.08	0.12	0.57	0.97	0.18	0.76	2.30	0.00	0.01	0.17
Sugars and confectionery	0.05	0.19	4.03	0.45	1.65	1.04	0.01	0.02	0.35	0.65	1.92	5.10	0.10	0.23	1.21	0.01	0.02	0.79
Drinking waters	0.02	0.04	1.29	0.75	1.92	1.75	0.10	0.27	5.12	0.75	1.92	5.86	0.90	2.30	11.4	0.09	0.23	11.6
Non-alcoholic beverages	0.05	0.17	3.89	3.06	8.29	7.15	0.07	0.18	3.27	1.40	4.25	11.0	0.62	1.74	7.88	0.06	0.16	7.39
Alcoholic beverages	0.00	0.00	0.03	0.00	0.00	0.01	0.00	0.00	0.02	0.01	0.00	0.08	0.00	0.00	0.03	0.00	0.00	0.04
Coffee	0.00	0.02	0.19	0.05	0.31	0.11	0.00	0.02	0.16	0.04	0.23	0.28	0.03	0.19	0.36	0.00	0.02	0.36
Hot beverages	0.02	0.07	1.57	0.05	0.17	0.11	0.01	0.02	0.34	0.07	0.26	0.58	0.06	0.21	0.74	0.01	0.02	0.76
Pizzas, salt cakes and quiches	0.01	0.03	0.48	0.10	0.55	0.24	0.00	0.01	0.09	0.02	0.08	0.12	0.02	0.09	0.20	0.00	0.01	0.20
Sandwitches	0.01	0.04	0.71	0.02	0.07	0.04	0.00	0.01	0.10	0.05	0.26	0.43	0.02	0.09	0.23	0.00	0.01	0.24
Soups	0.02	0.09	1.57	0.18	0.76	0.42	0.01	0.06	0.70	1.00	4.43	7.83	0.12	0.51	1.55	0.01	0.05	1.58
Mixed dishes	0.07	0.26	5.89	1.35	8.84	3.15	0.04	0.17	1.84	0.64	2.02	5.03	0.65	2.05	8.23	0.02	0.05	2.28
Salads	0.01	0.06	0.79	0.03	0.07	0.06	0.00	0.01	0.03	0.04	0.14	0.35	0.01	0.04	0.08	0.00	0.00	0.08
Dessert	0.05	0.23	4.02	0.07	0.27	0.16	0.01	0.04	0.46	0.26	1.02	2.02	0.24	0.91	2.99	0.01	0.03	1.03
Stewed fruit, compote	0.00	0.02	0.22	0.03	0.11	0.06	0.00	0.02	0.18	0.21	1.37	1.64	0.06	0.30	0.73	0.00	0.02	0.49
Condiments and sauces	0.00	0.02	0.32	0.01	0.04	0.02	0.00	0.02	0.24	0.03	0.12	0.23	0.01	0.04	0.12	0.00	0.00	0.13
Total	**1.26**	**2.53**		**42.7**	**103**		**2.04**	**4.24**		**12.8**	**20.8**		**7.90**	**12.4**		**0.78**	**1.35**	

Table 18: Estimation of daily Intakes of toxic elements of Adults “normo-reporters” over 15 years and more (n=1474)

Food group	Al (mg)			As (µg)			Cd (µg)			Pb (µg)			Hg (µg)			Sb (µg)		
	Mean	P95	%	Mean	P95	%	Mean	P95	%	Mean	P95	%	Mean	P95	%	Mean	P95	%
Bread, rusk	0.40	1.02	24.6	0.80	1.99	1.28	0.16	0.59	5.78	1.96	5.35	10.6	1.13	2.67	11.7	0.04	0.08	3.61
Breakfast cereals	0.02	0.12	0.99	0.01	0.11	0.02	0.02	0.07	0.64	0.07	0.49	0.36	0.06	0.37	0.57	0.00	0.01	0.27
Pasta	0.01	0.04	0.87	0.09	0.25	0.14	0.08	0.22	2.85	0.43	1.20	2.33	0.11	0.30	1.11	0.01	0.03	1.07
Rice and semolina	0.01	0.02	0.41	0.08	0.26	0.12	0.02	0.09	0.64	0.10	0.36	0.55	0.09	0.32	0.94	0.01	0.02	0.62
Miscellaneous cereals	0.00	0.00	0.08	0.00	0.00	0.01	0.01	0.00	0.23	0.02	0.00	0.09	0.01	0.00	0.11	0.00	0.00	0.03
Viennese bread and buns	0.04	0.21	2.67	0.05	0.22	0.08	0.01	0.03	0.23	0.51	2.37	2.76	0.28	1.34	2.93	0.01	0.03	0.52
Biscuits	0.05	0.25	3.21	0.03	0.12	0.04	0.01	0.03	0.29	0.20	0.92	1.10	0.10	0.47	1.05	0.00	0.01	0.33
Cakes	0.04	0.16	2.62	0.07	0.26	0.11	0.01	0.04	0.37	0.20	0.73	1.06	0.11	0.41	1.11	0.01	0.03	0.85
Milk	0.01	0.02	0.41	0.30	0.88	0.48	0.04	0.12	1.52	0.30	0.92	1.64	0.36	1.06	3.70	0.04	0.11	3.55
Ultra-fresh dairy products	0.01	0.05	0.69	0.10	0.40	0.16	0.01	0.06	0.49	0.14	0.60	0.78	0.12	0.48	1.24	0.01	0.05	1.14
Cheeses	0.01	0.03	0.53	0.06	0.19	0.10	0.01	0.03	0.33	0.37	1.10	1.99	0.07	0.22	0.77	0.01	0.02	0.74
Eggs and egg products	0.00	0.00	0.10	0.13	0.52	0.21	0.01	0.02	0.24	0.18	0.59	0.99	0.06	0.18	0.61	0.01	0.02	0.54
Butter	0.00	0.00	0.04	0.37	1.37	0.60	0.00	0.01	0.09	0.05	0.18	0.27	0.02	0.08	0.23	0.00	0.01	0.22
Vegetal oils	0.00	0.00	0.00	0.05	0.16	0.08	0.00	0.00	0.01	0.00	0.01	0.02	0.00	0.01	0.03	0.00	0.00	0.03
Meat	0.01	0.03	0.67	0.45	1.29	0.73	0.04	0.12	1.63	0.18	0.45	0.97	0.15	0.37	1.56	0.09	0.25	8.94
Poultry and game	0.01	0.03	0.49	0.58	1.90	0.94	0.11	0.43	4.01	0.84	3.27	4.55	0.21	0.71	2.16	0.02	0.05	1.51
Offals	0.00	0.01	0.07	0.00	0.04	0.01	0.11	0.93	4.04	0.12	1.12	0.64	0.04	0.33	0.39	0.00	0.01	0.06
Delicatessen	0.03	0.15	2.07	0.76	2.14	1.22	0.09	0.38	3.43	0.27	0.85	1.48	0.08	0.25	0.83	0.04	0.18	4.37
Fish	0.01	0.03	0.55	30.6	110	49.2	0.03	0.13	0.95	0.28	0.96	1.49	0.89	3.84	9.19	0.00	0.02	0.47
Shellfish	0.05	0.32	3.37	7.99	53.2	12.9	0.18	1.18	6.41	0.26	1.94	1.40	0.06	0.37	0.63	0.01	0.03	0.54
Vegetables (except potatoes)	0.32	1.69	19.6	0.85	2.29	1.37	0.65	2.74	23.7	1.18	3.18	6.39	0.73	1.67	7.60	0.15	0.50	14.7
Starchy vegetables	0.03	0.08	2.00	0.85	2.21	1.37	0.58	1.42	21.2	0.35	0.85	1.91	0.45	1.05	4.62	0.13	0.33	12.5
Pulses	0.01	0.06	0.65	0.04	0.21	0.07	0.03	0.18	1.11	0.20	1.17	1.11	0.18	0.86	1.88	0.00	0.01	0.29
Fruits	0.04	0.15	2.63	10.4	33.7	16.7	0.10	0.39	3.81	1.36	4.77	7.36	0.43	1.31	4.45	0.11	0.40	10.9
Nuts and oilseeds	0.00	0.02	0.28	0.38	2.56	0.61	0.04	0.21	1.32	0.03	0.20	0.17	0.01	0.09	0.13	0.00	0.03	0.43
Ices cream	0.02	0.10	1.23	0.31	1.57	0.50	0.00	0.01	0.07	0.03	0.13	0.14	0.03	0.14	0.29	0.00	0.01	0.15
Chocolate	0.01	0.05	0.56	0.01	0.08	0.02	0.00	0.01	0.03	0.06	0.32	0.32	0.10	0.58	1.04	0.00	0.00	0.07
Sugars and confectionery	0.04	0.15	2.72	0.33	1.02	0.53	0.01	0.03	0.42	1.39	3.67	7.56	0.13	0.33	1.33	0.01	0.02	0.97
Drinking waters	0.02	0.06	1.18	0.88	2.63	1.42	0.12	0.37	4.51	0.88	2.63	4.77	1.06	3.15	10.9	0.11	0.32	10.5
Non-alcoholic beverages	0.02	0.08	1.17	1.50	6.13	2.42	0.03	0.14	1.22	0.65	2.85	3.52	0.31	1.31	3.25	0.03	0.12	2.86
Alcoholic beverages	0.04	0.21	2.66	0.26	1.23	0.42	0.03	0.16	1.25	1.39	6.69	7.52	0.29	1.34	3.03	0.03	0.13	2.91
Coffee	0.05	0.16	3.24	0.99	2.95	1.60	0.07	0.21	2.58	0.75	2.25	4.09	0.60	1.80	6.26	0.06	0.18	6.02
Hot beverages	0.08	0.46	5.10	0.18	1.00	0.29	0.03	0.14	0.94	0.27	1.50	1.49	0.22	1.20	2.27	0.02	0.12	2.18
Pizzas, salt cakes and quiches	0.01	0.04	0.59	0.17	0.86	0.28	0.00	0.01	0.11	0.02	0.11	0.13	0.03	0.12	0.26	0.00	0.01	0.25
Sandwitches	0.01	0.05	0.51	0.01	0.10	0.02	0.00	0.01	0.07	0.05	0.34	0.28	0.02	0.12	0.18	0.00	0.01	0.17
Soups	0.04	0.18	2.59	0.37	1.47	0.60	0.03	0.11	1.09	2.10	8.17	11.4	0.25	0.98	2.63	0.03	0.10	2.53
Mixed dishes	0.08	0.30	5.12	1.93	15.3	3.11	0.05	0.23	1.72	0.73	2.52	3.94	0.63	1.95	6.49	0.02	0.06	1.96
Salads	0.02	0.13	1.21	0.05	0.23	0.07	0.00	0.01	0.05	0.08	0.39	0.43	0.01	0.09	0.13	0.00	0.01	0.12
Dessert	0.03	0.18	2.06	0.05	0.21	0.07	0.01	0.03	0.23	0.17	0.86	0.93	0.16	0.75	1.64	0.01	0.03	0.53
Stewed fruit, compote	0.00	0.02	0.17	0.03	0.14	0.04	0.00	0.02	0.13	0.22	1.44	1.22	0.06	0.30	0.58	0.00	0.02	0.37
Condiments and sauces	0.00	0.02	0.27	0.01	0.05	0.02	0.01	0.03	0.20	0.04	0.16	0.22	0.01	0.05	0.13	0.00	0.01	0.13
Total	**1.62**	**3.21**		**62.1**	**163**		**2.73**	**5.48**		**18.4**	**30.0**		**9.65**	**14.7**		**1.00**	**1.72**	

Table 19 : Intakes distribution and quantification of the probabilities for general population to be under or over toxicological or nutritional references values established for minerals and essential trace elements

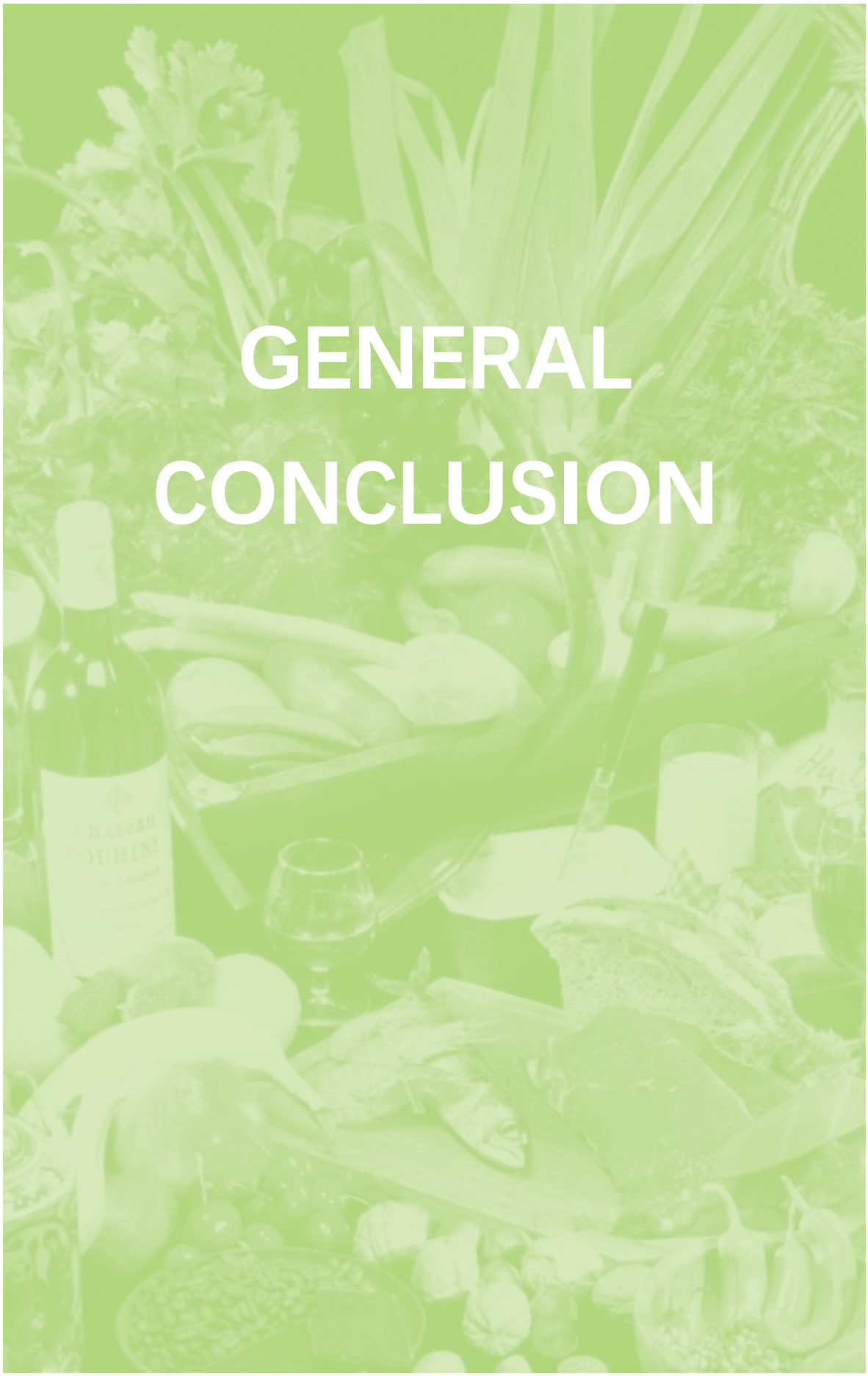
Minerals and essential trace elements	Nutritionnal reference value LTI [a]	Toxicological reference value UL [b]	Adults "normo-reporters" (15 years and more, n=1474)					Children (3 to 14 years, n=1018)				
			P2.5	P50	P97.5	%<LTI[a]	%>UL[b]	P2.5	P50	P97.5	%<LTI[a]	%>UL[b]
Calcium (mg/d)	200 - 300 (children) 400 (adults)	2000 – 2500	300	696	1312	8.6	0.01	274	701	1324	4.3	0.01
	AFSSA, 2001; SCF, 2003											
Chromium (µg/d)	No recommendation	1000	43	74	126	-	0	34	65	124	-	0
	SCF, 2003											
Cobalt (µg/d)	No recommendation		3.5	7,1	14	-	-	3.0	6.8	15	-	-
Copper (mg/d)	0,2 - 0,3 (children) 0,6 (adults)	10 - >35	0.5	0.9	1.7	7.3	0	0.4	0.8	1.6	0.01	0
	SCF, 1993; JECFA, 1982											
Lithium (µg/d)	No recommendation		7.8	18	144	-	-	4.6	11	38	-	-
Magnesium (mg/d)	34 - 110 (children) 150 (adults)	750	130	215	359	7.2	0	105	191	334	1.3	0
	AFSSA, 2001; SCF, 2001											
Manganese (mg/d)	0.75	10	1.0	2.2	4.8	0.4	0	0.6	1.7	4.2	0.8	0.01
	AFSSA, 2001; SCF, 2000											
Molybdenum (µg/d)	17.5	200 - 400 (children) 600 (adults)	65	128	270	0	0	48	106	216	0	0.5
	SCF, 2000; AFSSA, 2001											
Nickel (µg/d)	No recommendation	600	47	90	166	-	0	42	87	174	-	0
	AFSSA, 2001											
Selenium (µg/d)	4 - 10 (children) 20 (adults)	90 – 250 (children) 150-300 (adults)	22	40	70	1.5	0	15	30	55	0.2	0
	CSHPF, 1996; SCF, 2000											
Sodium (g/d)	0.57	3.15 – 3.5	1.1	2.2	4.3	0.07	8 - 13	0.8	1.7	3.8	0.3	3.5 – 5
	SCF, 1993; AFSSA, 2002											
Zinc (mg/d)	1.6 - 3.6 (children) 4 - 5 (adults)	10 – 30 (children) 25 - 60 (adults)	4.6	8.3	15	2.6	0 - 2.0	3.6	7.3	14	0.9	0 - 2.1
	JECFA, 1982; CSHPF, 1996; SCF, 2003											

[a] Lowest Threshold Intake
b Upper Level

Table 20 : Intakes distribution and quantification of the probabilities for general population to be under or over toxicological reference value established for toxic elements

Toxic elements	Toxicological reference value PTWI [c]	Adults "normo-reporters" (15 years and more n=1474)				Children (3 to 14 years, n=1018)			
		P2.5	P50	P97.5	% > PTWI [c]	P2.5	P50	P97.5	% > PTWI [c]
Aluminium (mg/kg b.w./w)	7 JECFA, 1988	0.1	0.15	0.4	0	0.1	0.3	0.7	0
Antimony (µg/d)	360[d] WHO, 2003	0.5	0.9	2.0	0	0.3	0.7	1.6	0
Arsenic (µg/ kg b.w./w)	350 (15)[b] WHO, 1967 (JECFA, 1989)[b]	1.0 (0.1)[b]	4.3 (0.4)[b]	31 (3.1)[b]	0 (0)[b]	1.3 (0.1)[b]	7.6 (0.8)[b]	42 (4.2)[b]	0 (0)[b]
Cadmium (µg/ kg b.w./w)	7 JECFA, 2003	0.1	0.3	0.7	0	0.1	0.4	1.2	0
Lead (µg/ kg b.w./w)	25 JECFA, 1999	1.0	1.9	3.6	0	1.1	2.9	6.4	0
Mercury (µg/ kg b.w./w)	5 JECFA, 1988	0.5	1.0	1.8	0	0.7	1.9	4.1	0.5
Methylmercury (µg/ kg b.w./w)[a]	1,6 JECFA, 2003	0.01	0.1	0.7	0	0.02	0.2	1.0	1

[a] Intakes estimation for methylmercury have been calculated only from fish and shellfish consumption for adults and children consumers, which food sources are knew to be the main exposure sources to methylmercury.
[b] The PTWI of 15µg/kg b.w. for arsenic inorganic have been established by JECFA in 1989.
[c] Provisional Tolerable Weekly Intake.
[d] Tolerable Daly Intake.



GENERAL CONCLUSION

General conclusion

The implementation of this type of method for risk managers involved in food safety offers three advantages:

- It allows a more realistic estimation of the mean exposure levels and of the high quantiles of the populations by taking exhaustive account of the real "as-consumed " diet.
- It provides a good tool for:
  - identifying the population or age groups most exposed (children, vegans, etc.),
  - identifying the main food groups contributing to the exposure,
  - monitoring food and identifying useful trends for guiding and orienting monitoring and control programmes.
- It facilitates usable for international comparisons, since the study applies a methodological approach similar to that already used in other countries (USA, Australia, New Zealand, China, Canada, England, Ireland, Netherlands, Spain, Czech Republic, etc.).

This study enabled us to highlight the following points:

- the contamination level observed in the "as-consumed" food products is globally satisfactory with respect to current regulations;
- concerning mycotoxins: it appears necessary that particular attention be paid to the exposure of specific population groups, such as children and vegans/macrobiotics, which could potentially absorb certain mycotoxins in quantities exceeding the reference toxicological values;
- concerning minerals, essential trace elements and toxic elements: the study shows that for the populations studied the probability of exposure to nutritional and/or health risks from such elements is globally small. Nevertheless, certain consumers are exposed to a non-negligible risk of an intake that is below the lowest threshold intake or above the reference toxicological values.

APPENDIX

Appendix 1 :

Estimation of the food consumption of vegetarians population groups

Food group	Vegetarian population (over 15 years and more) (n=138)					
	Ovolactovegetarian (n=74)		Lactovegetarian (n=38))		Vegan/Macrobiocs (n=26)	
	Consumption (g/day)		Consumption (g/day)		Consumption (g/day)	
	Mean	p95	Mean	p95	Mean	p95
Vegetarian food	48.8	249.9	89.7	278.0	182.0	436.2
Other cereals	2.2	9.7	5.8	34.7	6.5	37.5
Butter	6.1	18.4	9.2	23.1	nc[a]	nc[a]
Biscuits	13.4	45.2	11.7	55.1	4.5	20.0
Alcoholic beverages	61.8	268.3	17.7	40.4	34.7	177.5
Hot beverages	1.0	6.0	4.4	21.5	0.9	8.0
Non-alcoholic beverages	25.8	174.0	71.8	233.2	25.2	157.5
Coffee	92.8	389.6	35.7	241.9	45.0	187.3
Breakfast cereals	11.3	44.8	12.6	53.4	33.9	81.9
Chocolate	6.7	26.1	2.7	18.1	3.6	23.3
Stewed fruit, compote	15.9	73.5	9.7	57.9	12.8	67.5
Salads	5.3	44.2	nc[a]	nc[a]	1.9	[b] -
Desserts	20.4	75.0	22.0	75.8	29.3	125.0
Cheeses	57.2	151.5	66.1	147.8	nc[a]	nc[a]
Fruits	109.8	330.0	100.8	249.0	112.5	487.5
Nuts and oilseeds	32.4	101.4	21.7	83.6	43.3	174.0
Milk	72.8	286.1	164.4	574.9	nca	nc[a]
Vegetables (except potatoes)	20.5	80.5	31.9	114.1	25.1	92.9
Pulses	28.7	95.7	39.4	125.2	85.8	194.3
Margarine	0.7	5.0	1.2	6.3	nc[a]	nc[a]
Eggs and eggs products	27.1	72.8	nc[a]	nc[a]	3.3	25.0
Bread, rusk	90.9	218.7	67.5	214.7	64.2	227.5
Pasta	21.1	76.1	34.4	103.8	42.8	142.0
Cakes	38.3	140.4	26.1	100.6	9.3	32.8
Pizzas, salt cake and quiches	21.4	92.2	16.2	76.9	1.6	15.0
Mixed dishes	3.3	21.8	8.6	83.3	nc[a]	nc[a]
Rice and semolina	28.3	90.0	75.2	214.1	104.5	310.0
Ultra-fresh dairy products	54.9	211.1	59.0	221.7	nc[a]	nc[a]
Viennese bread and buns	8.5	38.2	9.3	46.3	2.0	10.0
Total	**929**	**1602**	**1015**	**1416**	**874**	**1322**

[a] nc : The Vegan/Macrobiotic group is a non consumer group for milk and milk products.
[b] The hyphen means there is less than 5% of consumers for the considered food items and that the P95 value is equal to 0.

Appendix 2:

Principal list of the 338 foods items of the French Total Diet Study

INCA code group	Product group	INCA code product	Food name	Type of product
1	Bread, rusk	6	Wheat, whole	N
1	Bread, rusk	7	Wheat, durum, preboiled	N
1	Bread, rusk	8	Bread, french, multicereal	N
1	Bread, rusk	7001	Bread, French	N
1	Bread, rusk	7004	Toast	N
1	Bread, rusk	7100	Bread, French, country style	N
1	Bread, rusk	7200	Bread, sandwich loaf	N
1	Bread, rusk	7300	Crispbread	N
2	Breakfast cereals	9	Breakfast cereal, mix	N
2	Breakfast cereals	32000	Puffed wheat cereal	N
2	Breakfast cereals	32001	Breakfast cereal, chocolate	N
2	Breakfast cereals	32003	Breakfast cereal, sweet	N
2	Breakfast cereals	32004	Muesli	N
2	Breakfast cereals	32005	Corn flakes, enriched	N
3	Pasta	10	Pasta, wheat, preboiled	N
3	Pasta	9811	Pasta, boiled	N
4	Rice and semolina	11	Rice, brown, preboiled	N
4	Rice and semolina	9103	Rice, brown, boiled	N
4	Rice and semolina	9104	Rice, white, boiled	N
4	Rice and semolina	90005	Semolina, boiled	N
5	Others cereals	9313	Porridge, made with water	N
5	Others cereals	9660	Wheat germ	N
6	Viennese bread and buns	7110	Bread, wholemeal	N
6	Viennese bread and buns	7601	Croissant	N
6	Viennese bread and buns	7710	Roll, milk	N
6	Viennese bread and buns	7720	Roll, raisin	N
6	Viennese bread and buns	7730	Roll, chocolate-filled	N
6	Viennese bread and buns	7741	Brioche	N
6	Viennese bread and buns	90006	Croissant with butter	N
7	Biscuits	23032	Chocolate-nut brownies	N
7	Biscuits	23909	Fruit cake	N
7	Biscuits	24000	Biscuit or cracker	N
7	Biscuits	24036	Biscuit (cookie), chocolat	N
7	Biscuits	24630	Madeleine biscuit	N
7	Biscuits	90022	Chocolate cake	N
7	Biscuits	90026	Cake	N
8	Cakes	702	Pancake with sugar, filled	N
8	Cakes	23477	Eclair	N
8	Cakes	23490	Tart, apple	N
8	Cakes	23499	Pie, fruit	N
8	Cakes	23881	Doughnut, jam filled	N
8	Cakes	90031	Cake, cream	N
9	Milk	19023	Milk, whole, UHT	N
9	Milk	19024	Milk, whole, pasteurized	N
9	Milk	19027	Milk, whole, condensed sweetened	N
9	Milk	19041	Milk, semi-skimmed, UHT	N

9	Milk	19042	Milk, semi-skimmed, pasteurized	N
9	Milk	19050	Milk, skimmed, UHT	N
9	Milk	19800	Yoghurt, Bifidus, plain	N
9	Milk	90036	Milk, aromatised, UHT	N
10	Ultra-fresh dairy products	583	Yoghurt, wholemilk, with fruit and sweeteners	N
10	Ultra-fresh dairy products	19510	Uncured cheese 20% fidm	N
10	Ultra-fresh dairy products	19522	Uncured cheese 40% fidm	N
10	Ultra-fresh dairy products	19565	Petit-Suisse 4O% fidm	N
10	Ultra-fresh dairy products	19600	Yoghurt, plain	N
10	Ultra-fresh dairy products	19601	Yoghurt, wholemilk, plain	N
10	Ultra-fresh dairy products	19606	Yoghurt, nonfat, plain	N
10	Ultra-fresh dairy products	19609	Yoghurt, sweetened	N
10	Ultra-fresh dairy products	19610	Yoghurt, flavored	N
10	Ultra-fresh dairy products	19611	Yoghurt, wholemilk, flavoured	N
10	Ultra-fresh dairy products	19700	Yoghurt, wholemilk, with fruit	N
10	Ultra-fresh dairy products	19771	Drinking yoghurt, flavored	N
10	Ultra-fresh dairy products	90039	Milk, cream without any precision	N
10	Ultra-fresh dairy products	90046	Petit-Suisse 4O% fidm, flavored	N
11	Cheeses	12008	Camembert-type cheese 60% fidm	N
11	Cheeses	12009	Camembert-type cheese 20-30% fidm	N
11	Cheeses	12115	Emmental cheese	N
11	Cheeses	12500	Roquefort cheese	N
11	Cheeses	12758	Tome cheese	N
11	Cheeses	12815	Goat cheese, dry	N
11	Cheeses	19505	Uncured cheese 0% fidm	N
11	Cheeses	19851	Uncured cheese with fruit	N
11	Cheeses	90068	Camembert-type cheese without any precision	N
11	Cheeses	90082	Gruyere cheese	N
12	Eggs and egg products	22000	Egg, whole, raw	Rlo/Rly/Rrp
12	Eggs and egg products	22010	Egg, hard-boiled	Rlo/Rly/Rrp
12	Eggs and egg products	22011	Egg, poached	Rlo/Rly/Rrp
12	Eggs and egg products	22500	Omelet, plain	Rlo/Rly/Rrp
12	Eggs and egg products	22501	Egg, fried	Rlo/Rly/Rrp
13	Butter	16400	Butter	N
14	Oils	17270	Olive oil	N
14	Oils	80004	Oil, cook, added	N
15	Margarin	700	Chocolate paste	N
15	Margarin	16615	Margarine	N
17	Meat	6200	Beef, rump steak, broiled	Rlo/Rly/Rrp
17	Meat	6210	Roast beef, roasted	Rlo/Rly/Rrp
17	Meat	6255	Ground beef 15% fat, cooked	N
17	Meat	6520	Veal round, cooked	Rlo/Rly/Rrp
17	Meat	21501	Lamb cutlet, grilled	Rlo/Rly/Rrp
17	Meat	21503	Lamb leg, roasted	Rlo/Rly/Rrp
17	Meat	28101	Pork chop, grilled	Rlo/Rly/Rrp
17	Meat	28301	Pork roast, lean & fat, cooked	Rlo/Rly/Rrp
18	Poultry and game	36004	Chicken, leg, meat & skin, roasted	Rlo/Rly/Rrp
18	Poultry and game	36005	Chicken, meat & skin, roasted	Rlo/Rly/Rrp
18	Poultry and game	36306	Turkey, breast, meat only, sauteed	Rlo/Rly/Rrp
18	Poultry and game	90044	Rabbit without any precision	Rlo/Rly/Rrp
19	Offals	40105	Liver, beef, cooked	Rlo/Rly/Rrp
19	Offals	40109	Liver, poultry, fried	Rlo/Rly/Rrp

19	Offals	40203	Tongue, beef, boiled	Rlo/Rly/Rrp
20	Delicatessen	8211	Pâté de campagne	Rlo/Rly/Rrp
20	Delicatessen	28800	Ham, Bayonne style	Rlo/Rly/Rrp
20	Delicatessen	28916	Ham, cooked	N
20	Delicatessen	30110	Toulouse sausage	Rlo/Rly/Rrp
20	Delicatessen	30150	Merguez sausage	Rlo/Rly/Rrp
20	Delicatessen	30300	Dry sausage	Rlo/Rly/Rrp
21	Fish	26006	Hake (Alaska), raw	N
21	Fish	26015	Saithe (Pollock), cooked	Rlo/Rly/Rrp
21	Fish	26021	Whiting, fried	Rlo/Rly/Rrp
21	Fish	26023	Cod, oven cooked	Rlo/Rly/Rrp
21	Fish	26024	Cod, salted, poached	Rlo/Rly/Rrp
21	Fish	26028	Fish nuggets, fried	N
21	Fish	26030	Fish cakes, fried	N
21	Fish	26034	Sardine, in oil, canned, drained solids	N
21	Fish	26037	Salmon, smoked	N
21	Fish	26038	Salmon, steamed	Rlo/Rly/Rrp
21	Fish	26039	Tuna, canned in brine, drained	N
21	Fish	26046	Surimi	N
21	Fish	26054	Fish in sauce, frozen	N
21	Fish	26060	Sole, cooked in oven	Rlo/Rly/Rrp
21	Fish	26071	Tuna, canned in oil, drained solids	N
21	Fish	27014	Trout, rainbow, cooked, dry heat	Rlo/Rly/Rrp
21	Fish	90122	Fish, nugget, fried	N
22	Shellfish	10007	Shrimp or prawn, boiled	Rlo/Rly/Rrp
22	Shellfish	10009	Lobster, boiled	N
22	Shellfish	10011	Oyster, raw	Rlo/Rly/Rrp
22	Shellfish	10013	Mussel, boiled	Rlo/Rly/Rrp
23	Vegetables (excluding potatoes)	3	Vegetal mix salad, canned	N
23	Vegetables (excluding potatoes)	13004	Avocado, pulp, raw	Rlo/Rly/Rrp
23	Vegetables (excluding potatoes)	20000	Artichoke, globe, boiled	Rlo/Rly/Rrp
23	Vegetables (excluding potatoes)	20001	Asparagus, boiled	N
23	Vegetables (excluding potatoes)	20002	Eggplant, cooked	Rlo/Rly/Rrp
23	Vegetables (excluding potatoes)	20003	Beetroot, boiled	Rlo/Rly/Rrp
23	Vegetables (excluding potatoes)	20005	Swiss chard, cooked	Rlo/Rly/Rrp
23	Vegetables (excluding potatoes)	20005	Swiss chard, cooked	Rlo/Rly/Rrp
23	Vegetables (excluding potatoes)	20006	Broccoli, boiled	Rlo/Rly/Rrp
23	Vegetables (excluding potatoes)	20008	Carrot, boiled	Rlo/Rly/Rrp
23	Vegetables (excluding potatoes)	20009	Carrot, raw	Rlo/Rly/Rrp
23	Vegetables (excluding potatoes)	20010	Mushroom, raw	Rlo/Rly/Rrp
23	Vegetables (excluding potatoes)	20011	Mushroom, canned	N
23	Vegetables (excluding potatoes)	20014	Cabbage, red, raw	Rlo/Rly/Rrp
23	Vegetables (excluding potatoes)	20015	Cabbage, green, boiled	Rlo/Rly/Rrp
23	Vegetables (excluding potatoes)	20016	Cauliflower, raw	Rlo/Rly/Rrp
23	Vegetables (excluding potatoes)	20017	Cauliflower, boiled	Rlo/Rly/Rrp
23	Vegetables (excluding potatoes)	20019	Cucumber, raw	Rlo/Rly/Rrp
23	Vegetables (excluding potatoes)	20021	Courgette (zucchini), boiled	Rlo/Rly/Rrp
23	Vegetables (excluding potatoes)	20024	Celery stalk, boiled	Rlo/Rly/Rrp
23	Vegetables (excluding potatoes)	20026	Chicory (Belgian endive), raw	Rlo/Rly/Rrp
23	Vegetables (excluding potatoes)	20027	Spinach, steamed	Rlo/Rly/Rrp
23	Vegetables (excluding potatoes)	20028	Fennel, boiled	Rlo/Rly/Rrp
23	Vegetables (excluding potatoes)	20029	Bean sprout, canned	N

23	Vegetables (excluding potatoes)	20031	Lettuce, raw	Rlo/Rly/Rrp
23	Vegetables (excluding potatoes)	20033	Turnip, boiled	Rlo/Rly/Rrp
23	Vegetables (excluding potatoes)	20034	Onion, raw	Rlo/Rly/Rrp
23	Vegetables (excluding potatoes)	20036	Pea, canned	N
23	Vegetables (excluding potatoes)	20037	Pea, boiled	Rlo/Rly/Rrp
23	Vegetables (excluding potatoes)	20038	Dandelion leaves, raw	N
23	Vegetables (excluding potatoes)	20040	Leek, boiled	Rlo/Rly/Rrp
23	Vegetables (excluding potatoes)	20045	Radish, raw	Rlo/Rly/Rrp
23	Vegetables (excluding potatoes)	20047	Tomato, raw	Rlo/Rly/Rrp
23	Vegetables (excluding potatoes)	20048	Tomato, peeled, canned	N
23	Vegetables (excluding potatoes)	20051	Vegetable mix, canned	N
23	Vegetables (excluding potatoes)	20066	Sweet corn, canned	N
23	Vegetables (excluding potatoes)	20085	Pepper, sweet, green, raw	Rlo/Rly/Rrp
23	Vegetables (excluding potatoes)	20089	Radish, black, raw	Rlo/Rly/Rrp
23	Vegetables (excluding potatoes)	20095	Cabbage, red, cooked	Rlo/Rly/Rrp
23	Vegetables (excluding potatoes)	20098	Chicory (Belgian endive), cooked	Rlo/Rly/Rrp
23	Vegetables (excluding potatoes)	20099	Corn salad, raw	Rlo/Rly/Rrp
23	Vegetables (excluding potatoes)	20132	Potimarron, peeled, raw	N
24	Starchy vegetables	4002	Potato, baked	Rlo/Rly/Rrp
24	Starchy vegetables	4003	Potato, boiled	Rlo/Rly/Rrp
24	Starchy vegetables	4004	Potato crisp (US=chip), salted	N
24	Starchy vegetables	4005	Potato chip (US=French-fry), no salt	N
24	Starchy vegetables	4013	Potato ball, precooked, frozen	N
24	Starchy vegetables	4018	Mashed potato	N
24	Starchy vegetables	90129	Potato, toasted	Rlo/Rly/Rrp
25	Pulses	20030	Green bean, boiled	N
25	Pulses	20502	Haricot bean, boiled	N
25	Pulses	20503	Red kidney bean, boiled	N
25	Pulses	20505	Lentil, boiled	N
25	Pulses	20506	Split pea, boiled	N
25	Pulses	20507	Chick pea, boiled	N
25	Pulses	20508	Dwarf kidney bean, canned	N
25	Pulses	20904	Tofu	N
26	Fruits	1	Fruit, salad, raw	N
26	Fruits	13000	Apricot, raw	Rlo/Rly/Rrp
26	Fruits	13002	Pineapple, pulp, raw	N
26	Fruits	13005	Banana, pulp, raw	N
26	Fruits	13008	Cherry, raw	Rlo/Rly/Rrp
26	Fruits	13009	Lemon, pulp, raw	N
26	Fruits	13014	Strawberry, raw	Rlo/Rly/Rrp
26	Fruits	13021	Kiwi fruit, pulp and seeds, raw	Rlo/Rly/Rrp
26	Fruits	13024	Clementine or Mandarin orange, pulp, raw	N
26	Fruits	13026	Melon, raw	Rlo/Rly/Rrp
26	Fruits	13030	Nectarine, flesh and skin, raw	Rlo/Rly/Rrp
26	Fruits	13034	Orange, sweet, pulp, raw	N
26	Fruits	13036	Watermelon, pulp, raw	Rlo/Rly/Rrp
26	Fruits	13037	Pear, flesh and skin, raw	Rlo/Rly/Rrp
26	Fruits	13039	Apple, with skin, raw	Rlo/Rly/Rrp
26	Fruits	13040	Grapefruit, pulp, raw	N
26	Fruits	13041	Greengage plum, raw	Rlo/Rly/Rrp
26	Fruits	13043	Peach, flesh and skin, raw	Rlo/Rly/Rrp
26	Fruits	13044	Grape, white, raw	Rlo/Rly/Rrp

26	Fruits	13045	Grape, black, raw	Rlo/Rly/Rrp
27	Nuts and oilseeds	13011	Date, pulp and skin, dried	N
27	Nuts and oilseeds	13013	Fig, dried	N
27	Nuts and oilseeds	13046	Raisin	N
27	Nuts and oilseeds	15000	Almond	N
27	Nuts and oilseeds	15001	Peanut, in shell	N
27	Nuts and oilseeds	15003	Chestnut	N
27	Nuts and oilseeds	15005	Walnut	Rlo/Rly/Rrp
27	Nuts and oilseeds	15010	Sesame seed	N
27	Nuts and oilseeds	15015	Chestnut puree, canned	N
28	Ices cream	39500	Ice cream	N
29	Chocolate	31001	Chocolate bar, type Mars ®	N
29	Chocolate	31005	Chocolate, dark-	N
30	Sugar and confectionery	31003	Sweets (Candy)	N
30	Sugar and confectionery	31006	Jam or Marmalade	N
30	Sugar and confectionery	31008	Honey	Rlo/Rly/Rrp
30	Sugar and confectionery	31016	Sugar, white	N
30	Sugar and confectionery	80005	Sugar, milk product, added	N
30	Sugar and confectionery	80006	Suggar, coffee, added	N
31	Drinking water	90137	Water, natural	N
31	Drinking water	90138	Water, town (more quantity for prepared dishes)	Rlo/Rly/Rrp
31	Drinking water	90139	Water, mineral, frizente	N
31	Drinking water	90140	Water, mineral, plate	N
32	Soft drinks	577	Beer, without alcohol	N
32	Soft drinks	18000	Pineapple juice, reconst., pasteurized	N
32	Soft drinks	18006	Carrot juice, pasteurized	N
32	Soft drinks	18007	Lemon, juice, fresh	N
32	Soft drinks	18010	Lemonade	N
32	Soft drinks	18012	Orange juice, from concentrate, pasteur.	N
32	Soft drinks	18013	Orange juice, fresh	N
32	Soft drinks	18014	Apple juice, reconstituted, pasteurized	N
32	Soft drinks	18015	Grapefruit juice, reconst., pasteurized	N
32	Soft drinks	18016	Grape juice, pasteurized	N
32	Soft drinks	18017	Fruit syrup	N
32	Soft drinks	18018	Cola drink	N
32	Soft drinks	18019	Fruit soft-drink	N
32	Soft drinks	18043	Apricot nectar, pasteurized	N
32	Soft drinks	18060	Cola beverage, light	N
32	Soft drinks	18220	Lemon beverage base	N
32	Soft drinks	18330	Tropical fruit drink	N
32	Soft drinks	18370	Mango nectar, pasteurized	N
32	Soft drinks	18375	Orange nectar, pasteurized	N
32	Soft drinks	18900	Soy drink	N
32	Soft drinks	90146	Orange, soda	N
32	Soft drinks	90147	Perrier, frizente water	N
32	Soft drinks	90148	Schweppes	N
33	Alcoholic beverages	590	Panach	N
33	Alcoholic beverages	1010	Anis spirit, diluted (1+5)	N
33	Alcoholic beverages	5001	Beer, ordinary	N
33	Alcoholic beverages	5006	Cider, dry	N
33	Alcoholic beverages	5200	Wine, white dry 11°	N
33	Alcoholic beverages	5201	Wine, white sparkling	N

33	Alcoholic beverages	5203	Wine, red 10°	N
33	Alcoholic beverages	5204	Wine, red 11°	N
33	Alcoholic beverages	5205	Wine, red 12°	N
33	Alcoholic beverages	90149	Champagne	N
33	Alcoholic beverages	90151	Champagne, with blackcurrant liqueur	N
34	Coffee	4	Chicore, instant	N
34	Coffee	18004	Coffee, black	Rlo/Rly/Rrp
34	Coffee	18005	Coffee, instant	Rlo/Rly/Rrp
35	Hot beverages	18020	Tea, infusion	N
35	Hot beverages	18101	Instant cocoa powder, sweetened	N
36	Pizzas, salt cakes and quiches	25404	Pizza, tomato and cheese	N
36	Pizzas, salt cakes and quiches	25405	Quiche Lorraine	N
36	Pizzas, salt cakes and quiches	25417	Quiche, vegetable	N
37	Sandwiches	25413	Hamburger	Rlo/Rly/Rrp
37	Sandwiches	90175	Sandwitch, with ham	Rlo/Rly/Rrp
38	Soups	25900	Lentil soup	Rlo/Rly/Rrp
38	Soups	25902	Vegetable soup	Rlo/Rly/Rrp
38	Soups	25907	Leek and potato soup, canned	Rlo/Rly/Rrp
38	Soups	25908	Chicken noodle soup	Rlo/Rly/Rrp
38	Soups	25910	Onion soup	Rlo/Rly/Rrp
38	Soups	25914	Tomato soup, cream of	Rlo/Rly/Rrp
38	Soups	25916	Minestrone	N
39	Prepared dishes	25002	Cassoulet, canned	N
39	Prepared dishes	25003	Sauerkraut with meat, canned	N
39	Prepared dishes	25004	Sauerkraut, drained	Rlo/Rly/Rrp
39	Prepared dishes	25009	Shepherd's pie	Rlo/Rly/Rrp
39	Prepared dishes	25013	Beef stew	Rlo/Rly/Rrp
39	Prepared dishes	25018	Ratatouille	Rlo/Rly/Rrp
39	Prepared dishes	25019	Ravioli in tomato sauce	N
39	Prepared dishes	25029	Couscous with mutton	Rlo/Rly/Rrp
39	Prepared dishes	25031	Paëlla	Rlo/Rly/Rrp
39	Prepared dishes	25033	Boeuf bourguignon	Rlo/Rly/Rrp
39	Prepared dishes	25081	Lasagne	Rlo/Rly/Rrp
39	Prepared dishes	25103	Stuffed tomatoes	Rlo/Rly/Rrp
39	Prepared dishes	25109	Spaghetti, in tomato sauce	N
39	Prepared dishes	25400	Grilled cheese & ham sandwich	N
39	Prepared dishes	90203	Pancake, with salt, filled	N
39	Prepared dishes	90209	Potato, baked, with gruyere cheese	Rlo/Rly/Rrp
39	Prepared dishes	90216	Chicken, nugget, fried	N
40	Salads	25420	Egg roll	N
40	Salads	25604	Green salad, without seasoning	Rlo/Rly/Rrp
40	Salads	25608	Taboule, canned	N
41	Dessert	20905	Soy yoghurt	N
41	Dessert	39200	Chocolate custard, commercial	N
41	Dessert	90223	Cake, with rice or semolina	N
41	Dessert	90231	Dessert	N
41	Dessert	90232	Dessert, with caramel	N
41	Dessert	90236	Cream, whipped	N
41	Dessert	90237	Mousse, chocolate	N
41	Dessert	90245	Milk, semolina	N
42	Compote and stewed fruit	591	Apple raspberry sauce, canned, sweetened	N
42	Compote and stewed fruit	13003	Pineapple, canned	N

42	Compote and stewed fruit	13038	Applesauce, canned, sweetened	N
42	Compote and stewed fruit	13049	Fruit cocktail, canned	N
43	Condiments and sauces	11011	Mayonnaise, soy oil	N
43	Condiments and sauces	11101	White sauce	N
43	Condiments and sauces	11107	Tomato sauce without meat	N
43	Condiments and sauces	11108	Salad dressing, olive oil & vinegar	N
43	Condiments and sauces	11114	Tomato sauce with meat	N
43	Condiments and sauces	13032	Olive, ripe, in brine	N
44	Substitute meals	578	Vegetal, protein	N
99	Vegetarian food	0	Vegetal, steack	N
99	Vegetarian food	2	Cream, cereal, vegan	N
99	Vegetarian food	5	Milk, soy	N
99	Vegetarian food	12	Algae	N
99	Vegetarian food	13	Doughnut, vegetables	N
99	Vegetarian food	14	Vegetables, puff	N
99	Vegetarian food	15	Cake, semolina	N
99	Vegetarian food	16	Pancake, whole wheat, preboiled	N
99	Vegetarian food	17	Milk, cereal, vegan	N
99	Vegetarian food	18	Pancake, cereal	N
99	Vegetarian food	19	Pate, vegetal	N
99	Vegetarian food	20	Potato, peeled, raw	N
99	Vegetarian food	21	Soy, fermented	N
99	Vegetarian food	22	Rice and barley soup	N
99	Vegetarian food	23	Pancake, wheat, fried	N
99	Vegetarian food	24	Stuffed cabbage	N
99	Vegetarian food	25	Doughnut, with butter and chick pea	N
99	Vegetarian food	26	Chutney, Pineapple	N
99	Vegetarian food	27	Cake, cereal, vegan	N
99	Vegetarian food	28	Dessert, vegan	N
99	Vegetarian food	29	coffee, succedane	N
99	Vegetarian food	30	Soup, power	N
99	Vegetarian food	31	Cake, semolina, vegan	N
99	Vegetarian food	32	Cereal croquette, vegan	N
99	Vegetarian food	33	The, green	N

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Performed at the initiative of France's General Food Directorate (*DGAL*), attached to the Ministry of Agriculture, Food, Fishing and Rural Affairs, and the National Institute on Agronomic Research (*INRA*) and with the collaboration of the French Food Safety Agency (*AFSSA*), this Total Diet Study of French consumers is the first major study covering exposure to mycotoxins, trace elements and minerals present in "as-consumed" foods. It provides a first panorama of intakes and exposure to these food components for the French population.

Total Diet Studies (*TDS*) consist in combining individual quantitative consumption data with the measured contamination levels of foods as they are actually eaten. Compared to exposure studies based on the contamination of raw materials, the TDS yields more realistic data and avoids overestimating risks.

This study reveals that, for the French population, the observed levels of the mycotoxins, minerals and trace elements studied in representative diets is globally satisfactory with respect to current regulations. It also confirms, for the populations concerned, the low probability of nutritional or health risks due to food consumption. However, certain consumer groups are subject to a non-negligible risk of nutrient intake below the lowest threshold intake or to exposure to contaminants exceeding the reference toxicological values.