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Food Additives and Contaminants



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Harmonization of food categorization systems for dietary exposure assessments among European children

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26 Abstract

Within the European project called EXPOCHI (Individual food consumption data and exposure assessment studies for children), 14 different European individual food consumption databases of children were used to conduct harmonised dietary exposure assessments for lead, chromium, selenium and food colours. For this, two food categorisation systems were developed to classify the food consumption data in such a way that these could be linked to occurrence data of the considered compounds. One system served for the exposure calculations of lead, chromium and selenium. The second system was developed for the exposure assessment of food colours. The food categories defined for the lead, chromium and selenium exposure calculations were used as a basis for the food colour categorisation, with adaptations to optimize the linkage with the food colour occurrence data. With this work, an initial impetus was given to make user-friendly food categorisation systems for contaminants and food colours applicable on a pan-European level. However, a set of difficulties were encountered in creating a common food categorisation system for 14 individual food consumption databases that differ in type and number of foods coded and in level of detail provided about the consumed foods. The work done and the problems encountered in this project can be of interest for future projects in which food consumption data will be collected on a pan-European level and used for common exposure assessments.

Keywords: exposure assessment; children; Europe; food categorisation; EXPOCHI; food
 colours; lead; selenium; chromium

49 Short title: Harmonized food categorisation systems

52 Introduction

In the area of chemical food safety, food categorisation systems are used to link food consumption data with occurrence data of adverse chemicals present in foods, such as additives and contaminants. Such food categorisation systems are needed since occurrence data and food consumption data are often not available at the same level of detail.

Food consumption data are mostly collected for different purposes (e.g. monitoring population intakes of a range of macro- and micronutrients). Broad food categorizations that are not at a very detailed level of food description may suffice for these purposes. However, in the field of food safety, occurrence data of e.g. additives and contaminants can be collected at a different level of detail (e.g. at food or ingredient level). Use of broad food categories may then hamper the linkage with food consumption data. For example, additives are often analysed or set in specific foods (sometimes at brand level) as described in regulations, whereas trace metals are often analysed in raw foods, such as milk, meat, etc. Linkage of these occurrence data to food consumption data requires a conversion of consumption levels at food level to that at the level of raw ingredient (Boon et al., 2009). In addition are contamination or concentration data (e.g. for food colours) in general over-estimated when they are aggregated at broad food groups because trace elements for instance are in general measured in foods that are supposed to contain the element or to have a high content of this substance. Furthermore, the level of detail present in food consumption surveys may be limited since subjects cannot always provide all the required information of what they have consumed (definitely when retrospective dietary intake assessment methods were used). Obtaining detailed information among children is even harder as they have only a limited capacity to recall their own food intake and parents are often unable to know what their child consumed at school or in the kindergarten. Therefore food consumption data are often available without all the detailed information needed to perform exposure assessments, what will result in an increase of the uncertainty in the resulting exposure outcome.

To link food consumption and occurrence data to assess the exposure to chemicals present in food, often foods consumed and those analysed are categorised in such a way that the most optimal link between both databases is established. Different categorisation systems are available for this, such as the categorisation system described in the SCOOP Tasks Report 3.2.11 (European Commission 2004) used to assess the exposure to different mycotoxins and the Concise European Food Consumption Database developed by the European Food Safety Authority (EFSA) (EFSA 2008), which has been used to assess the exposure to numerous chemicals, such as ochratoxin A (EFSA, 2006), arsenic (EFSA, 2009b), cadmium (EFSA 2009c) and lead (EFSA 2010).

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Food categorisation is a crucial activity to allow for processing of food consumption data, because it is not possible to interpret dietary data without aggregating individual food items into food groups, either before (close-ended survey forms, e.g. food frequency questionnaire) or after (open-ended forms, e.g. diary) the collection of food consumption data. Categorisation of food items implies the identification of foods and their characteristics in order to put the most similar items in the same category of the developed food categorisation system (Turrini 1999; Møller and Ireland 2008). The experience in the food data processing field has shown the necessity of developing different food categorisation systems related to the objectives of the study (Møller and Ireland 2008).

From November, 1st, 2008 until November, 30th, 2009, EFSA funded a research project aiming to create a relational network of different individual European food consumption databases of children (aged 1 to 14 years) and to perform dietary exposure assessment studies. Within this project, called EXPOCHI (Individual food consumption data and exposure assessment studies for children), fourteen individual food consumption databases representative for diverse regions/countries within Europe were harmonized in order to use the consumption data for four specific exposure assessment studies, i.e. for lead, chromium, selenium and a set of food colours. In total, 14 partners covering 13 European countries participated in the project. Food consumption data was derived from 24-h dietary recalls and dietary records. More information about the consortium, rationale, methods and design of this project can be found in a separate paper (Huybrechts et al. 2010).

Within the project, the different scientific partners provided the food consumption databases, whereas EFSA was responsible for the occurrence databases of the substances under study. To be able to conduct the requested exposure assessment studies in a standardized way, the 14 different consumption databases were harmonised by categorising all food items in common food groups. To optimize and harmonize the food linking in the EXPOCHI project, a food categorization manual was made. With the use of the manual, a standardised procedure of linking different European consumption databases with one European occurrence database per compound was established. Two food categorisation systems were developed within the project: one for the exposure assessments to lead, chromium and selenium and a second one for the food colours. In this paper, both categorisation systems as well as the difficulties encountered are described and discussed.

56 119

120 Materials and methods

121 Two different food categorisation systems and manuals

Within the EXPOCHI-project, it was the aim to conduct harmonised dietary exposure assessment in children living in different European countries. Therefore, procedures were developed so that all partners categorised their food items in a standardized way. Two food categorisation systems were developed, both described in detail in two extensive manuals: an EXPOCHI-manual on Food Categorisation for (1) Lead, Chromium and Selenium and (2) Food Colours (freely available on request).

To apply the two food categorisation systems, first a list of unique food items as coded in the food consumption databases needed to be generated, containing – if available – details such as preparation, fat content (e.g. for milk), etc. Each food item in this food list was defined by a unique name (preferably in the local language as well as an English translation) and a unique food code. Starting from this food list, food items needed to be categorised in food groups, as defined in the food categorisation system by means of a data entry method described in the manuals. For this it is important that the characteristics of the foods as enclosed in the name of each food item are known in order to be able to categorise the foods correctly. During the categorisation, no difference was made between foods eaten at home or out-of-home, since those details were missing in most food consumption databases.

To develop the categorisation procedure and set up the manuals, preliminary samples of the 14 food lists obtained from the national food consumption databases and received from each partner in the EXPOCHI-project were explored to foresee problems and difficulties that partners would encounter during the categorisation work. These possible problems and difficulties were listed in the manuals and solutions were provided. Moreover, due to these food list samples, examples of food items from all geographical regions under study (e.g. specific local food items) could be included in the manuals. The manuals were continuously updated during the project to address all difficulties experienced during the categorisation work in the participating countries.

To illustrate the results of the food categorisation work, data from four different individual food consumption databases are presented covering a North-European country (Sweden), a West-European country (Belgium), a South-European country (Italy) and an East-European country (Czech Republic). For Sweden, the data were collected in 2003 by a nationwide food consumption survey conducted among children aged 3 to 4 and 7 to 13 years (Enghardt-Barbieri et al. 2006). The Swedish consumption databases consisted in total of 1548 different food items. The Belgian food consumption data used in this project were collected in 2002-2003 from a representative sample of Flemish children aged 2.5 to 6.5 years (Huybrechts et al. 2008) and consisted of 1056 different food items. The Italian food consumption data were collected during the period of 2005-2006 for children aged 1 to 10 years (Leclercq et al.

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2009). The Italian food consumption databases consisted of 1530 different food items. In Czech Republic, a food consumption survey was conducted between November 2003 and 2004 with children aged 4 to 14 years (Ruprich et al. 2006). This database counted 515 different food items, primarily aggregated for the national total diet study focused mainly on contaminants. For more details on the databases see Huybrechts et al. (2010).

1. Lead, chromium and selenium

The food categorisation system for lead, chromium and selenium was based on the food categorisation system described in the SCOOP Tasks report 3.2.11 (European Commission 2004). The groups mentioned in this SCOOP report are based on definitions from the Codex General Standard for Food Additives (GSFA) developed by the Codex Alimentarius Commission (Codex Alimentarius Commission 2009). The document describes the conditions under which permitted food additives may be used in all foods, whether or not they have previously been standardised by Codex. However, for the EXPOCHI-project, those definitions needed to be adjusted since foods in consumption databases are generally mentioned 'as eaten', whereas the definitions found in GSFA are mentioned 'as product in the food manufactory'.

1.1. Main group and subgroups

The lead, chromium and selenium categorisation system consisted of four hierarchical grouping levels: main group (MG), subgroup 1 (SG1), subgroup 2 (SG2) and subgroup 3 (SG3) and one descriptor: special code (SC). This structure is in accordance with Turrini (Turrini 1999), distinguishing two types of food coding variables: hierarchical codes and crosswise codes. Hierarchical codes aim at identifying the type of products (food group, subgroup), while crosswise codes are dedicated to the description of the characteristics (packaged or not, fresh or preserved, etc.).

The hierarchical categorisation process applied in this project was divided into two consecutive steps. Firstly, a main group was defined per food item in the food list. These main food groups and their definitions originated from the GSFA, describing 16 main groups (Codex Alimentarius Commission 2009). Two extra main groups 'Vegetarian meat and fish substitutes (MG17)' and 'Miscellaneous: foods that cannot be placed in categories (MG18)' were added to make it possible to categorise all food items occurring in the national food consumption databases. Table 1 lists all main groups defined in the food categorisation system for the lead, chromium and selenium exposure calculations. In the EXPOCHI manual, the GSFA definitions were reported, including extensions of the definitions to clarify the main

groups more clearly. A short list of food items to be included in a certain food group and of some to be categorised elsewhere illustrated these definitions. The first step was complete when all food items had been assigned to one of the 18 main groups.

The second step consisted of categorization at subgroup level, which included a refining of the main group categorisation by means of maximum three subgroup levels: SG1, SG2 and SG3. Figure 1 shows an example of subdividing MG 10 (Eggs and egg products) into four different groups on the level of SG1 (10.1, 10.2, 10.3 and 10.4) and two different groups on the level of SG2 when considering SG1 = 10.1 (i.e. fresh eggs): 10.1.1 and 10.1.2.

As is shown in Figure 1, the explanation per main group began with a brief summary based on which it was decided to which subgroup a food item belonged. This was followed by a diagram demonstrating the structure of all subgroups within one main group. Every decision taken during the categorisation work was checked by the given definitions.

It was not always possible to categorise each food item at all three subgroup levels (SG1, 2 and 3), due to two reasons: (1) not all main groups were subdivided into a second and third subgroup level, and (2) not all national food consumption database provided enough detail for each food item to be able to categorise it at a next (or lower), more detailed, subgroup level. An illustration of this can be found in the example given in Figure 1, for SG2 of the group 'fresh eggs' (10.1). Most food consumption databases did not include details on whether eggs originated from indoor or outdoor reared eggs. Therefore, in those cases, the categorisation stopped at the level of SG1.

1.2. Special code

An extra variable 'special code' (SC) was added as a descriptor for five main groups to add relevant information that was not included in the categorisation system based on MG, SG1, SG2 and SG3. This special code indicated the presence of a specific component (e.g. chocolate filling) or a physical state (e.g. powdered form), and was applied within the following five main groups: MG4 (fruits, vegetables, seaweed, nuts and seeds), MG7 (bakery wares), MG9 (fish, fish products, molluscs, cephalopods, crustacean and echinoderms), MG13 (foodstuff intended for particular nutritional use) and MG14 (beverages). If food items contained more than one component/filling a combination of numbers was used by placing the numbers in ascending order. A special code indicating the presence of soy in a food was used for all main groups. Table 2 lists all special codes that were applied in the framework of this project.

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1.3. Link with occurrence data of lead, chromium and selenium

During the project, it emerged that EFSA was not able to provide the occurrence data for the contaminants lead, chromium and selenium categorised according to the food categorisation system described in the SCOOP Tasks report 3.2.11 (European Commission 2004) but only according to the categorisation used in EFSA's Concise Food Consumption Database (EFSA 2008). Due to the huge number of occurrence data resulting from food testing in the different Member States (94,126 for lead, 23,750 for chromium and 47,858 for selenium), EFSA considered it inconvenient to reclassify all food descriptors in the occurrence database according to the SCOOP system. A link was therefore needed between the newly developed food categorisation system and that of EFSA's Concise European Food Consumption Database. Efforts were made to keep the anticipated major food contributors for lead, chromium and selenium in different food categories and, at the same time, to minimise the need for the reclassification of food descriptors. This resulted in a list of 42 communal food groups (Table 3) making it possible to link the food consumption data to the occurrence data. The main group and subgroup together with the special code were subsequently re-organized, as well as certain food items in such a way that the concentration data per communal food group were representative for the food items in those food groups.

2. Food colours

The food categorisation system as specified in the Council Directive 94/36/EC (European Commission 1994) was used to develop a system to classify all food items present in the different national food lists in order to perform dietary exposure assessments for food colours. This food colour classification system was tuned to the Flavourings, Additives and food Contact materials Exposure Task (FACET) project (http://www.ucd.ie/facet/). Occurrence data were provided by EFSA according to this categorization system.

Within the EXPOCHI-project, 41 different food colours were considered for exposure assessment. All, except lycopene, could be approached by one categorisation system based on 84 different food groups (Table 4), partly based on the Council Directive 94/36/EC and partly developed particularly for this project using the information of the FACET project (i.e. to further divide the category 'all other foodstuff' in more detailed categories) (European Commission 1994; Oldring et al. 2009). Of the 84 food groups, 16 were not taken into account within the EXPOCHI-project because the age group addressed in the exposure assessment to food colours was limited to children aged 1 up to 10 years (e.g. food groups like 'spirituous beverages', 'whisky', 'liqueurs' were irrelevant for this age group). The 68 food groups that were considered in the EXPOCHI-project are marked in Table 4.

As stated, a separate food classification system was developed to classify foods for the lycopene exposure assessments. Since naturally occurring lycopene was not considered in the exposure analyses, the system included only food groups in which lycopene could be added as an additive. The food groups differed from those used for the other food colours on the level of aggregation. For example, lycopene is permitted in all types of bread, whereas for the other food colours, only malt bread was considered (see Table 4 and 5). Compared to the general food colour categorisation system, fewer food groups were needed to classify the food items for lycopene, since addition of lycopene is only permitted in a limited number of food groups (in total 33 food groups; see Table 5).

The food list including the main groups and subgroups of the food classification system for lead, chromium and selenium formed the starting point for the food colour classification system. Around half of the food items occurring in the food lists from the different EXPOCHI-partners belonged to a MG-SG combination that could be re-coded as a whole in one single food colour group. For example, all food items in the food group 10.1 'Fresh eggs' (see Figure 1) belonged to the food colour group 0 'No food colours'. For the food items belonging to such a MG-SG-combination, the re-coding into the food colour categorisation system could be performed automatically. In contrast, for the other part of the food items, the categorisation into the food colour groups was less straightforward, because food items within a similar MG-SG-combination did not belong to a similar food colour group. For example, the food items classified in 9.4.1 'Fish canned in oil' could belong to different food colour groups (FCG): fish roe belongs to FCG=16; surimi belongs to FCG=15 and fish past belongs to FCG=12. This second step of the classification was performed according to guidelines included in the second categorisation manual.

Results

To illustrate the results of the food categorisation, data are shown for four of the 14 different countries: Belgium, Italy, Sweden and Czech Republic; and for two categorisation systems: the one for lead, chromium and selenium and the one for lycopene. A first important remark is the huge difference in the total number of food items entered in the different food consumption databases. The Czech databases contained the least number of food items (n=515), followed by Belgium with 1056 different food items, Italy with 1530 and Sweden with 1548 food items.

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Table 3 shows the percentage per country of food items classified in each communal food group for the lead, chromium and selenium exposure assessment. These results show first of all that not all 42 communal food groups were needed to classify all food items. For example, the communal groups 9 'Food supplements' and 34 'Other food for special dietary uses' were used by two of the four countries, whereas group 26 'Other seafood' was only used by Italy. Another difference was the percentage of food items in communal food group 2 'Vegetables'. This percentage was low for the Italian database compared to the other countries, whereas the percentage of food items in group 3 'Waters' was high in Italy.

Results are also shown for the lycopene categorisation based on these four national consumption databases (Table 5). Table 5 indicates that some food groups were not needed by any of the four countries, such as groups 31 'Salmon substitutes' and 37 'Edible cheese and edible casings'. The table also indicates that the percentage of food items to which lycopene could be added differed considerably between the different databases, being around 40% in Belgium, 31% in Italy and Sweden, and 22% in Czech Republic.

310 Discussion

In this paper, we described the food categorisation systems that were developed and applied to categorise 14 different food European consumption databases of children in the ages of 1 up to 14 years in order to prepare them for an exposure assessment study of three contaminants (lead, chromium and selenium) and a set of food colours. Although different food categorisation systems already exist (Møller and Ireland 2008), none could be applied without any modification. The work described in this paper illustrates that food categorisation systems can differ substantially depending on the compound under study, as described earlier (Turrini 1999): the food classification system developed for the contaminants differed on many aspects from the one developed for food colours (e.g. number of food groups, composition of food groups, number of food items per food groups).

The unique aspect of the food categorisation work performed in this project is that food items present in 14 different consumption databases for European children were categorised in a uniform way, making it possible to estimate the exposure to the chemicals under study in a uniform way. The food consumption databases used in this study were derived from different studies performed at the national / regional level. These databases differed on many aspects, including dietary assessment methods used and age ranges addressed. Another important difference, which affected the food categorisation (and consequently the resulting exposure calculations), was the way in which the primary dietary information was recorded and aggregated into food items and (sub) food groups. Due to this, the level of detail available of the foods present in the national / regional consumption databases differed greatly. The examples used in this paper to illustrate the approach show that the different food consumption databases differed much in the number of food items entered. For example, the Italian and Swedish databases contained up to three times more food items than the Czech database. The number of food items gives an indication of the level of detail present in the database. For example, in some databases 'milk' can be the only entry, whereas in other databases milk can be entered as 'milk, skimmed', 'milk, semi-skimmed' and 'milk, whole'. Moreover, some food consumption databases contained details as brand names (e.g. of confectionary), additives (e.g. yoghurt with or without sugar), etc. whereas others did not. In fact, the attention paid either to specific food categories (e.g. supplements) or to specific food components could affect the level of food description for the corresponding groups. An additional remark concerns whether the transformation from composite food to ingredients was performed or not. This operation could lead to vary the number of food items. Overall, the more details available, the better and more detailed the categorisation work could be performed.

To address the heterogeneous databases, two detailed manuals were developed, which contain explanations and examples aiming to minimize the chance of misclassifications. Difficulties during the project were discussed, resulting in updated version of the manuals. These manuals address many differences in food items entered in national / regional databases and can be very valuable when developing food categorisation systems to be used in pan-European food consumption surveys. The development of such a food consumption survey is one of EFSA's long-term objectives (EFSA, 2009).

To be able to link the categorised food consumption data with the lead, chromium and selenium occurrence data received from EFSA, foods categorised according to the hierarchical food categorisation system were generalised to 42 communal groups. During this process, certain details on the foods entered in the different regional/national food consumption databases were inevitably lost. Due to this, the link between the foods consumed and those analysed will not be optimal, affecting negatively the representativity of the ensuing exposure results. It is therefore important, for an optimal exposure result, that both the food consumption and occurrence data are categorised at the highest level of detail possible. In practice however, often either the consumption data or occurrence data are categorised at a level that makes an optimal link not feasible. During the interpretation of the exposure results obtained with such data, this should be taken into account. If for instance the level of coding is too low there is a danger of assuming that all foods within that category contain the highest level. Alternatively it could be assumed that all foods contain average levels and so missing the true high-level individual.

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> Also the food categorisation system developed for the exposure assessments to food colours, started from the detailed, hierarchical system developed based on the food categorisation system described in the SCOOP Tasks report 3.2.11 (European Commission 2004). However, the food groups needed to be recoded to the groups specified in the Council Directive 94/36/EC (European Commission 1994). In the first step, scripts could be used to reclassify automatically about half of the food items in the food lists from the hierarchical system to the groups of the food colour system. This was a time-saving procedure and it reduced the chance of mistakes (like typing errors).

Next, it should be noted that the precision of matching occurrence and consumption categories can have a major impact on the uncertainties introduced into the model. For the food colour exposure assessment, the most important source of uncertainty was the use of 'maximum permitted level' data in the worst case scenario, resulting in an overestimation of the exposure, also due to the use of very broad food groups. Also for the other components (lead, chromium and selenium), it is very likely that the exposure was overestimated due to the use of broad food groups. How large this overestimation is, is difficult to predict, since no information on the specific foods that were analysed was available. However, the approach used in this project is the best approach presently possible and is a major step forward compared to national risk assessments performed in the past.

This issue needs to be taken into consideration when making national comparisons since the level of detail in food description will vary between surveys. Therefore, compromises are needed to be made between loss of precision caused by including as many countries as possible or improved accuracy but only within those countries that have highly detailed food descriptions. Additionally, future exposure assessment studies should focus on the development of a total diet study based on the core foods method which allows to get contamination data more in line with food really consumed.

Overall, the authors believe that they have a positive bias in the calculation method, that is a conservative bias. The reason for this is that the occurrence values are often based on targeted sampling of problem products that will influence the overall mean upwards. As described in the manuscript, the authors also did some considerable adjustment to exclude typical adult products rarely consumed by children.

Although the limitations mentioned above should always be considered when interpreting results derived from the EXPOCHI project, this project delivered important data for analyses in the field of exposure assessments in children in Europe, and was a first and valuable step that needed to be done to proceed from a country specific view to a European view. Acknowledging the shortcomings of the current system, EFSA has three main activities under way to address this: (1) the development of a harmonised food description and categorisation system that at least should be able to translate different approaches into a 404 common output; (2) the dissemination of guidelines developed on how to harmonise food
405 consumption data collection; (3) and finally the development of a guideline for a total diet
406 study approach to get baseline occurrence data. However, these steps are part of a long407 term strategy that will not happen overnight.

408 Conclusion

In this paper we describe two food categorisation methodologies, one for contaminants and one for food colours. The difficulties associated with the creation of a single food categorisation system for several heterogeneous food consumption databases, and possible solutions, were highlighted. The work performed illustrates that food categorisation systems differ depending on the compound under study and that the categorisation work is influenced by the level of detail present in the food consumption databases. Without good planning of objectives for food consumption studies and effort devoted to concerted food categorisation activities in places where occurrence data are produced or collected, the considerable lose of information and higher uncertainty of exposure assessment have to be expected. Nevertheless, the developed systems are an important step forward to reach the goal of a pan-European food categorisation system to perform harmonised exposure assessments at a European level. The best way forward will be by means of a common categorization system based on hierarchical systems for both, food consumption and also concentration data.

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500	Figure Caption:
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502	Figure 1. Example of the layout of the main food group 'eggs and egg products, including
503	four subgroups on the level of SG1 and two subgroups on the level of SG2 when
504	considering SG1 = 10.1 (i.e. 'fresh eggs')
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	499 500 501 502 504 505 506

Chapter 10

Eggs and egg products

If more details are available for the food items in MG = 10: eggs and egg products, go further with this chapter.

If more	details are available for food items with a "MG" = 10, they should be c	hecked for the following characteristics:
•	Fresh eggs	→ 10.1
٠	Egg products produced from fresh eggs: liquid, frozen or dried	→ 10.2
•	Preserved eggs e.g. salt-cured, alkaline treated	→ 10.3
•	Egg-based dessert	→ 10.4
If no mo	ore details are available: the final code is MG = 10	
! If not l	nown fresh eggs or egg product = MG = 10 and SG1 = 1 (fresh) see pa	age 108



10.1 Fresh eggs:

 \rightarrow Fresh in-shell eggs are not expected to contain additives. However, colours may be used for decorating, dyeing or stamping the exterior surfaces of shell eggs.

Variable MG = 10 Variable SG1 = 1

If more details are available for food items that meet the definition of "10.1", they should be checked for the following characteristics:

- If known from indoor reared hens: \rightarrow 10.1.1
- If known from outdoor reared hens:





10.1.1 Eggs from indoor reared hens

ightarrow Hens reared in battery cages

Variable MG = 10

Variable SG1 = 1 Variable SG2 = 1

http://mc.manuscriptcentral.com/tfac_Email: fac@tandf.co.uk

Table 1. Food groups used for the classification of food items to assess the exposure to lead, chromium and selenium

MG	Main group
1	Dairy products and analogues (incl. dairy based ices), excluding products of food
	category "2. Fats and oils, and fat emulsions" e.g. butter
2	Fats, oils and fat emulsions (incl. imitation milks)
3	Edible ices (excl. dairy based ices)
4	Fruits and vegetables (including mushrooms and fungi, roots and tubers, pulses
	and legumes, and aloe vera), seaweeds, and nuts and seeds
5	Confectionary
6	Cereals and cereal products (cereal grains, tubers, roots, pulses and legumes)
	(no bakery wares)
7	Bakery wares
8	Meat, meat products, poultry and game
9	Fish, fish products, molluscs, cephalopods, crustaceans and echinoderms
	(MCCE)
10	Eggs and egg products
11	Sweeteners (incl. honey)
12	Salt, spices, soups, sauces, salads and protein products
13	Foodstuff intended for particular nutritional uses
14	Beverages (excl. dairy products, imitation milks)
15	Ready-to-eat savouries
16	Composite foods
17	Vegetarian meat and fish substitutes
18	Miscellaneous – foods that cannot be placed in categories

Table 2. The special codes used for the classification of food items to assess the exposure to lead, chromium and selenium

Special code	Component or physical state
1	Fruit (filling)
2	Nuts/seeds (filling) (incl. coconut)
3	Vegetables (incl. olives)
4	Pulses/legumes
5	Chocolate (filling)
6	Dairy (filling)
71	Powdered form
72	Concentrated form
73	Dissolved from powder or concentrate / Original form
8	No filling / no pieces
91	Fish
92	Molluscs
93	Crustaceans
94	Cephalopods
95	Echinoderm
96	Reptiles: e.g. crocodile, snake
97	Amphibian: e.g. frog
900	Soy
999	Not known

 6 Table 3. The communal food groups used in the food categorisation system for lead, chromium and selenium to link food consumption data to occurrence

7 data of these chemicals combined with the percentage of food items per food group for four different countries

Communal food group	Name	Belgium (%); n=1056	ltaly (%); n=1530	Sweden (%); n=1548	Czech Republic (%); n=515
1	Composed foods: Cereal based mixed dishes and cereal-based desserts	4.64	0.33	5.56	1.55
2	Vegetables excl. dried vegetables	11.46	4.31	11.95	10.29
3	Nuts and seeds	1.61	1.50	1.03	2.33
4	Coffee and tea in concentrated and in powdered form	0.00	0.39	0.00	1.55
5	Chocolate and chocolate products	3.50	1.44	1.29	2.14
6	Fruit excl. dried fruit	4.92	2.88	6.85	7.38
7	Dried fruit	0.38	0.39	0.39	0.78
8	Fresh and dried herbs, spices, seasonings and condiments	0.00	0.92	0.58	4.47
9	Food supplements	0.00	10.65	4.07	0.00
10	Waters	2.27	9.93	0.32	0.58
11	Sugar, sweeteners and sugar products (e.g. sugar based confectionery, chewing gum and decorations)	1.89	8.04	1.81	2.33
12	Fats, oils and fat emulsions (also e.g. rice milk (no soy milk))	4.92	2.29	2.20	2.52
13	Composed foods: Meat based mixed dishes	0.85	0.13	4.01	0.97
14	Composed foods: Fish based mixed dishes	0.47	0.00	1.29	0.19

15	Dried vegetables	0.00	0.13	0.00	0.39
16	Pulses and legumes	0.76	0.85	1.29	0.78
17	Soy milk and soy based dessert	1.80	0.52	0.13	0.00
18	Milk and dairy drinks	3.69	1.70	1.36	1.36
19	Cheese	3.98	4.58	2.39	3.30
20	Dairy based products	4.64	4.38	4.52	2.33
21	Salt	0.09	0.00	0.06	0.19
22	Fish	2.27	3.40	3.94	5.24
23	Molluscs	0.28	0.26	0.19	0.19
24	Cephalopods	0.00	0.20	0.13	0.00
25	Crustaceans	0.09	0.26	0.78	0.39
26	Other seafood (echinoderms)	0.00	0.07	0.00	0.00
27	Beer and malt beverages	0.38	0.13	0.13	0.39
28	Wine and substitutes	0.19	0.52	0.06	0.78
29	Other alcoholic beverages	0.00	0.26	0.06	1.94
30	Fruit juices and nectars.	1.61	3.99	1.29	0.19
31	Vegetable juices and nectars	0.09	0.00	0.06	0.19
32	Soft drinks and edible ices	3.79	1.76	2.91	1.17

Page	23	of	28
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33	mixed dishes)	18.84	18.37	15.63	11.07
34	Other food for special dietary uses	0.00	0.26	0.00	0.19
35	Infant formulae, follow up formulae, food for young children and infant formulae and follow up formulae for medical purposes	0.85	3.59	0.90	0.58
37	Miscellaneous foods/products	6.63	2.09	9.17	6.99
38	Liver and kidney	0.47	0.59	0.58	1.94
39	Offals except liver and kidney	0.09	1.44	0.84	2.33
40	Types of vegetarian substitutes for meat and fish	0.66	0.33	0.26	0.19
41	Fresh meat	7.39	2.94	5.49	5.83
42	Processed meat	2.56	2.55	5.68	14.76
44	Coffee and tea in liquid form	1.33	1.11	0.13	0.00
45	Eggs	0.57	0.52	0.65	0.19
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9 Table 4. Food groups used for the classification of food items to assess the exposure to food colours

10 (exc. lycopene)

Code	Food group name	EXPOCHI*
0	No food colour allowed	X
1	Non-alcoholic flavoured drinks	X
2	Candied fruits & vegetables, Fruit Mustard	X
3	Preserves of red fruits	X
4	Confectionery	X
5	Decorations & coatings	X
6	Fine bakery wares (e.g. viennoiserie, biscuits, cakes, wafers)	X
7	Edible ices	X
8	Flavoured processed cheese	X
9	Desserts inc. flavoured milk products	X
10	Sauces, seasonings (e.g. curry powder, tandoori), pickles, relishes, chutney, piccalilli	X
11	Mustard	X
12	Fish paste and crustacean paste	X
13	Pre-cooked crustaceans	X
14	Salmon substitutes	X
15	Surimi	X
16	Fish roe	X
17	Smoked fish	X
181	Other savoury snack products and savoury peanuts, nuts or hazelnuts	X
182	Snacks: dry, savoury potato, cereal or starch-based snack products: extruded or expanded savoury snack products	X
19	Edible cheese rind and edible casings	X
20	Complete formulae for weight control intended to replace total daily food intake or an	

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		EXPOCHI
	individual meal	
21	Complete formulae and nutritional supplements for use under medical supervision	
22	Liquid food supplements/dietary integrators	
23	Solid food supplements/dietary integrators	
24	Soups	X
25	Meat and fish analogues based on vegetable proteins	X
26	Spirituous beverages (inc. products less than 15% alcohol by volume), except any mentioned in Schedule 2 or 3	
	Aromatized wines, aromatized wine-based drinks and aromatized wine-product	
27	cocktails as mentioned in Reg 1601/91, except any mentioned in Schedule 2 or 3	
	Fruit wines (still or sparkling), Cider (except cider bouche) and perry and aromatized	
28	fruit wines	
29	Malt bread	X
30	Beer, Cider bouche	
31	Butter (including reduced-fat butter and concentrated butter)	X
32	Margarine, minarine, other fat emulsions, and fats essentially free from water	X
33	Sage Derby cheese	X
34	Ripened Orange, Yellow and broken-white cheese; unflavoured processed cheese	X
35	Red Leicester cheese; Mimolette cheese	X
36	Morbier cheese	X
37	Red marbled cheese	X
38	Vinegar	X
	Whisky, Whiskey, grain spirit (other than), wine spirit, rum, Brandy, Weinbrand,	
	grape marc, grape marc spirit (other than) Grappa invecchiata, Bazaceira velha as	
39	mentioned in Reg (EEC) No. 1601/91	
	Aromatized wine-based drinks (except bitter soda) and aromatized wines as mentioned	
40	in Reg (EEC) No. 1601/91	
41	Americano	

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Code	Food group name	EXPOCHI*		
42	Bitter soda, bitter wine as mentioned in Reg (EEC) No. 1601/91			
43	Liqueur wines and quality liqueur wines produced in specified regions			
44	Vegetables in vinegar, brine or oil (excluding olives)	Х		
45	Extruded, puffed and/or fruit-flavoured breakfast cereals	х		
46	Fruit-flavoured breakfast cereals	Х		
	Jams, jellies, and marmalades as mentioned in Directive 79/693/EEC and other similar	Х		
47	fruit preparations including low-calorie products			
48	Sausages, pates and terrines	Х		
49	Luncheon meat	Х		
	Breakfast sausages with a minimum cereal content of 6%; Burger meat with a minimum	Х		
50	vegetable and/or cereal content of 4%			
51	Chorizo sausage; Salchichon	Х		
52	Sobrasada	Х		
53	Pasturmas (edible external coating)	Х		
54	Dried potato granules and flakes	х		
55	Processed mushy and garden peas (canned)	Х		
56	Aperitif wines, spirit drinks including products with less than 15% alcohol by volume			
57	Cocktail cherries and candied cherries	Х		
58	Bigarreaux cherries in syrup and in cocktails	х		
59	Kippers	х		
60	External coating of sugar confectionery for the decoration of cakes and pastries	Х		
61	External coating of confectionery	Х		
62	Decoration of chocolates	X		
63	Liqueurs			
64	Liqueurs, including fortified beverages with less than 15% alcohol by volume			
65	Edible cheese rind	Х		

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Code	Food group name	EXPOCHI*
66	Saucisses de Strasbourg	X
67	All other foodstuffs	X
68	Meat and fish products	X
69	Canned meat products	X
70	Liver pate	X
71	Roast beef	X
72	Meat products (including roast beef, cutlet, ready meals)	x
73	Liquid egg products	x
74	Milk and dairy based drinks	X
75	Fruit and vegetables canned, frozen, etc	X
76	Dairy products	X
77	Noodles	X
78	Ready meals	X
79	Delicatessen salads	X
80	Processed potato products	X
81	Liquid dough	X
82	Milk and cream analogues	X

59 60 *Food groups that were considered within the EXPOCHI project are marked with the sign "X".

Table 5.Food groups used for the classification of food items to assess the exposure tolycopene

Code	Food group name	Belgium (%);	Italy (%); n=1530	Sweden (%);	Czech Republic
		n=1056		n=1548	(%); n=515
0	No lycopene	60.61	69.54	68.73	77.48
19	Non-alcoholic flavoured drinks	3.60	1.70	2.33	1.17
20	Candied fruits and vegetables, Fruit Mustard	0.19	0.20	1.23	0.58
21	Confectionery	0.95	5.88	1.29	1.36
22	Decorations and coatings	0.00	0.00	0.06	0.00
23	Fine bakery wares (e.g. viennoiserie, biscuits, cakes and wafers)	9.19	5.95	6.40	4.47
24	Edible ices	0.19	0.07	0.58	0.00
25	Flavoured processed cheese	0.57	0.52	0.39	0.78
26	Desserts including flavoured milk products	6.34	3.59	5.94	2.33
27	Sauces, seasonings (for example, curry powder, tandoori), pickles, relishes, chutney and picalilli	2.37	0.52	3.75	3.30
28	Jams jellies and marmalades as mentioned in directive 79/693/EC and similar fruit preps	1.42	0.65	1.16	0.78
29	Fish paste and crustacean paste	0.00	0.00	0.06	0.39
30	Pre-cooked crustaceans	0.09	0.07	0.13	0.00
31	Salmon substitutes	0.00	0.00	0.00	0.00
32	Surimi	0.00	0.00	0.00	0.00
33	Fish roe	0.00	0.00	0.13	0.19
34	Smoked fish	0.38	0.07	0.39	0.39
35	Snacks: extruded or expanded savoury snack products	1.33	0.13	0.90	0.97
36	Snacks: other savoury snack products and savoury coated nuts	0.38	0.65	0.26	0.39
37	Edible cheese and edible casings	0.00	0.00	0.00	0.00
38	Complete formulae for weight control intended to replace total daily intake or an	0.00	0.00	0.00	0.00

Food Additives and Contaminants

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	individual meal				
	Complete formulae and nutritional				
	supplements for use under medical				
39	supervision	0.00	0.00	0.00	0.00
40	Liquid food supplements / dietary integrators	0.00	0.00	0.00	0.00
41	Solid food supplements / dietary integrators	0.00	0.00	0.00	0.00
	Meat and fish analogues based on vegetable				
42	proteins	0.47	0.33	0.19	0.19
	Spirituous beverages (excluding products				
	<15% alcohol by volume) except those				
43	mentioned in Annex II or III	0.00	0.00	0.00	0.00
	Aromatized wines, aromatized wine based				
	drinks and aromatized wine product cocktails				
11	as mentioned in Regulation (EEC) No 160	0.00	0.00	0.00	0.00
44	except those mentioned in Annex if or in	0.00	0.00	0.00	0.00
	Fruit wine (still or sparkling); Cider (except				
45	cidre bouche) and perry; Aromatized fruit	0.00	0.00	0.00	0.00
45	wines	0.00	0.00	0.00	0.00
	Fruit/vegetable juice-based drinks (including				
46	concentrates)	1.61	3.46	1.10	0.39
	Drinks intended to meet the expenditure of				
	intense muscular effort especially for				
47	sportsmen	0.00	0.00	0.00	0.00
49	Breakfast cereals	4.36	2.94	1.42	0.97
50	Fats and dressings	4.83	1.96	1.94	2.52
51	Bread (including crispy breads)	1.14	1.76	1.61	1.36
		<u> </u>			