Process-specific technical data used in exposure assessment of food enzymes

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Abstract

Technical data for exposure assessment of food enzymes. Dietary exposure is part of the overall assessment of food enzymes. In order to develop food process-based exposure models, a number of different input data are required in tandem with technical conversion factors. This allows for a combination of use levels with food consumption data, which are typically reported as consumed. The use levels are expressed as total organic solids/kg raw materials. For each food process, EFSA identified a list of food groups and collated technical conversion factors. To ensure uniform application of FoodEx food categories and technical conversion factors in the assessment of food enzyme dossiers, stakeholders were consulted via open calls-for-data. Feedback was analysed. This document reports the consolidated input parameters for each food process. Regular updates have been made on a yearly basis since 2018, as further process-specific parameters were generated. The consolidated input data have been used to calculate dietary exposure during the evaluation of food enzyme applications. As well as publishing the input parameters, process-specific calculators of the food enzyme intake models (FEIM) have also been developed on the basis of summary statistics. These calculators have been deposited at https://zenodo.org/ for open access.

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1. Introduction

1.1. Background and Terms of Reference as provided by the requestor

1.1.1. Background as provided by EFSA in 2017

“The CEF Panel has resumed the evaluation of several food enzyme dossiers by implementing the strategy and methodology outlined in the “Statement on exposure assessment of food enzymes” published in November 2016. This methodology follows the best practice in the area of regulated dietary assessment. For dossiers that have been received by EFSA, as individual consumption data in the EFSA Comprehensive Consumption Database are only directly accessible in EFSA, dietary exposure to the food enzyme is being calculated in-house at EFSA.

The recently published Food Additive Intake Model (FAIM) has shown that it is feasible to allow third parties utilising the individual consumption data in the EFSA Comprehensive Consumption Database without infringing confidentiality issues.

With the efforts made in defining food-process relevant food groups and in consolidating technical conversion factors necessary to combine the use levels and consumption data, the CEF Panel is in position to develop an intake model that is specific to food enzymes. Such a model will contribute to speeding up the evaluation of the food enzyme dossiers, as well as enable applicants to prepare future food enzyme dossiers.”

1.1.2. Terms of Reference

In accordance with Article 29(1) of Regulation (EC) No 178/2002, the European Food Safety Authority asks its scientific Panel on Food Contact materials, Enzymes, Flavourings and Processing Aids (CEF) to develop a web-based Food Enzyme Intake Model. The deliverables should include:

- Intermediate output 1: an addendum to the already published Panel statement, entitled ‘Annex B - Process-specific recipe and technical conversion factors’.
- Intermediate output 2: a series of Excel-based tools for calculating exposure to food enzymes used in specific processes.
- Final output: a web-based food enzyme intake model (FEIM).

1.2. Interpretation of the Terms of Reference

The intermediate output 1 was issued for the first time in 2018 as ‘Annex B - Process-specific technical data used in exposure assessment of food enzymes’ to the ‘Statement on exposure assessment of food enzymes’ (EFSA CEF Panel, 2016). This was updated in 2019 and 2020, each time adding more food processes. In 2021, the ‘Statement on exposure assessment of food enzymes’ was incorporated into the revised ‘Scientific Guidance for the submission of dossiers on Food Enzymes’ (EFSA CEP Panel, 2021). The intermediate output 2 consists of a series of Excel-based FEIM calculators that are made from technical data reported in the intermediate output 1.

Applicants now are directed to Annex D of the revised Guidance, and requested to align the uses of the food enzyme under application to the food manufacturing processes described therein. The Annex D of the revised guidance does not provide the source or details of technical conversion factors that underpin the existing FEIM calculators or those to be used in the development of further models. As technical conversion factors are still being developed for additional food processes, it is necessary to continue to document and make available the technical details used for the calculation of exposure. This current document is intended to show how the existing process-specific FEIM calculators were developed and, where FEIM models are not yet available, to illustrate to applicants the data set needed to allow EFSA to complete an exposure assessment. As a result, Annex D of the Guidance will need regular updates as additional food processes are considered.
2. **Data and methodologies**

2.1. **Data**

Process-specific technical conversion factors are derived from several sources, which includes the EFSA Raw Primary Commodity (RPC) Model, publicly available recipe information, food label information, as well as the FAO technical conversion factors.

2.2. **Methodology**

For each food process, EFSA compiled a list of FoodEx categories and derived technical conversion factors. This list is then published as call-for-data on the EFSA website to seek feedback from stakeholders. A full list of call-for-data can be retrieved at https://www.efsa.europa.eu/en/search?=enzyme+calls.

3. **Development of assessment tools**

Food enzymes are used in a variety of food processes to manufacture foods or food ingredients at industrial scale. For the purpose of estimating dietary exposure to food enzymes, food consumption data and food enzyme use levels need to be expressed on the same basis. Typically, food enzyme usage data are expressed on a raw material basis, whereas food consumption data typically refer to food as consumed. Consequently, tools allowing the interconversion of these data sets are needed to facilitate the assessment.

Given the complexity associated with tracing the exposure to food enzymes from physical raw material, across different food manufacturing processes and to foods as consumed, the CEP Panel developed a methodology that takes into account the specific food processes in which food enzymes are used and their fate during food processing (EFSA CEP Panel, 2021). Consequently, each food enzyme application will require assessment of each individual food process for which the food enzyme is intended to be used.

In order to develop food processes-based exposure models, a number of different input data are required in tandem with technical conversion factors to allow for a combination of use levels expressed on raw material with food consumption data, which are typically reported as consumed.

Food consumption data are decoded by FoodEx categories in the EFSA Comprehensive European Food Consumption Database. The assignment of FoodEx categories to a specific food process is guided by the food processes in which food enzymes are intended to be used. In some cases, the selection of food groups to be included is straightforward, e.g. in the case of the processes ‘baking’ and ‘brewing’, the selection of relevant food categories focussed on food products having undergone a baking process (e.g. bread, fine bakery ware) or a brewing process (e.g. beer, malt drinks). In other cases, where the final food product produced with the aid of a food enzyme is an ingredient that can be added to a number of foods, details provided by the applicant, searches in the EFSA RPC model\(^1\) and the Mintel Database,\(^2\) or other relevant sources are used to identify foods which are likely to contain the ingredient. The RPC model does not always capture the level of detail that is required to conduct dietary exposure assessment to food enzymes. Because of this, the Mintel database is consulted.

Technical conversion factors are used to combine the food enzyme use levels and food consumption data. Making use of factors reported in the RPC Model, the FAO technical conversion factors, publicly available recipe information, food label information from the Global New Products Database (GNPD),\(^3\) EFSA derived technical conversion factors specific for each food process.

As technical conversion factors and food categories can vary for different reasons, especially those related to recipes that might be influenced by industrial practices, country to country variability, etc., each specific factor is subject to expert judgement, and consequently is associated with a certain level of uncertainty. To ensure uniform application of FoodEx food categories and technical conversion factors in the assessment of food enzyme dossiers, stakeholders were consulted on the selected food categories and technical conversion factors. Feedback from stakeholders was analysed. This document reports the consolidated input parameters for each food process. Regular updates have been made on a yearly basis since 2018, as further process-specific parameters are generated. The consolidated input

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\(^1\) The model is accessible at [https://doi.org/10.2903/sp.efsa.2019.EN-1532](https://doi.org/10.2903/sp.efsa.2019.EN-1532)

\(^2\) [https://www.mintel.com/global-new-products-database](https://www.mintel.com/global-new-products-database)

\(^3\) The database is accessible at [https://www.mintel.com/global-new-products-database](https://www.mintel.com/global-new-products-database)
data have been used to calculate dietary exposure during the evaluation of food enzyme applications and to develop FEIM models.

The information provided in this document is presented in tables containing the following details:

| FoodEx code | EFSA FoodEx classification food category code |
|-------------|---------------------------------------------|
| FoodEx category | EFSA FoodEx classification food category name – food category relevant to the food process and included in the exposure assessment |
| Technical conversion factor f1 | Conversion factor converting the food or ingredient consumed into the material to which the food enzyme is added |
| Technical conversion factor f2 | Ingredient fraction reflecting the amount of ingredient in the food as consumed in which the food enzyme is present |
| Technical conversion factor f3 | Fraction of the overall food group selected, which is likely to actually contain the food enzyme |

Factor f1 is a technical conversion factor applied to food or food ingredient in order to bring it on par with the raw material to which the food enzyme is added. For example, beer is converted to barley grain, to which the food enzyme is added during the brewing process.

Factor f2 represents the ingredient fraction of interest in a food included in the exposure assessment. For example, bread contains 70% flour; therefore, consumption of bread is corrected by a factor of 0.7 to reflect the flour component only.

Factor f3 is only used in those cases when only a certain percentage of food products within a larger food category are likely to contain the food enzyme.

This factor is derived by using the Mintel GNPD database. This database monitors worldwide product launches of packaged foods. It contains information of over 2 million food and beverage products of which more than 800,000 are or have been available on the EU food market. Mintel started covering the EU food market in 1996, currently covering 20 EU Member States and Norway.

Factor f3 represents the fraction of food items containing the ingredient of interest (as declared on the product label) within the total food category searched. For example, only a certain fraction of biscuits within the overall category of 'biscuits with cream filling' are likely to contain coffee. Factor f3 hence equals the number of biscuits declaring coffee as ingredient divided by the total number of biscuits listed in the food category.

As well as publishing the input parameters, process-specific calculators of the food enzyme intake models (FEIM) have also been developed on the basis of summary statistics. These calculators are deposited at https://zenodo.org/ for open access and can be downloaded at the following links.

- FEIM_baking https://doi.org/10.5281/zenodo.4382037
- FEIM_brewing https://doi.org/10.5281/zenodo.4382046
- FEIM_cereal https://doi.org/10.5281/zenodo.4382057
- FEIM_egg https://doi.org/10.5281/zenodo.4353056
- FEIM_molasses https://doi.org/10.5281/zenodo.4354558
- FEIM_modified fats https://doi.org/10.5281/zenodo.4354782

Yearly updates have been made also to these FEIM calculators. The updates reflect the continuous expansion of consumption data, specifically, dietary surveys in the EFSA Comprehensive Food Consumption Database.

### 3.1. Baking processes

This process is defined according to the ‘EC working document on food processes in which food enzymes are used’ as the following⁴:

*Baking processes are those which rely on flour as the principal raw material and lead to the production of foodstuffs such as, but not limited to, bread, biscuits, cakes, pastries, tortillas and baking specialties. Food enzymes are usually added during the mixing of the dough ingredients.*

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⁴ Unpublished at the time of this publication - Disclaimer: The document has not been officially adopted nor endorsed by the European Commission and it represents the preliminary views of the Commission services.
Following the open call for baking processes, responses were received from the European Association of Manufacturers and Formulators of Enzyme Products (AMFEP), the Federation of European Union Manufacturers and Suppliers of Ingredients to the Bakery, Confectionery and Patisserie Industries and the Association of Chocolate, Biscuits and Confectionery Industries of Europe (CAOBISCO). Feedback from these stakeholders was reviewed by the Enzyme Working Group. Technical conversion factors were further aligned with those used in the EFSA RPC Model. The following input data will be used for estimating dietary intake of food enzyme-total organic solids (TOS) in foods relevant to this intended use.

| FoodEx code | FoodEx category                          | f1 (conversion from material to flour) | f2 (average flour fraction) |
|-------------|------------------------------------------|---------------------------------------|----------------------------|
| A.01        | Grains and grain-based products (unspecified) | 0.8                                   | 1                           |
| A.01.03     | Grain milling products (unspecified)      | 1                                     | 1                           |
| A.01.03.001 | Wheat milling products (unspecified)       | 1                                     | 1                           |
| A.01.03.001.001 | Wheat flour, brown                     | 1                                     | 1                           |
| A.01.03.001.002 | Wheat flour, Durum                     | 1                                     | 1                           |
| A.01.03.001.003 | Wheat flour, white                     | 1                                     | 1                           |
| A.01.03.001.004 | Wheat flour, wholemeal                  | 1                                     | 1                           |
| A.01.03.001.006 | Wheat flour, gluten free                | 1                                     | 1                           |
| A.01.03.001.014 | Wheat starch                           | 1.2                                   | 1                           |
| A.01.03.002 | Rye milling products (unspecified)        | 1                                     | 1                           |
| A.01.03.002.001 | Rye flour, gluten free                 | 1                                     | 1                           |
| A.01.03.002.002 | Rye flour, light                      | 1                                     | 1                           |
| A.01.03.002.003 | Rye flour, medium                     | 1                                     | 1                           |
| A.01.03.002.004 | Rye flour, wholemeal                   | 1                                     | 1                           |
| A.01.03.003 | Buckwheat milling products (unspecified)  | 1                                     | 1                           |
| A.01.03.003.001 | Buckwheat flour                      | 1                                     | 1                           |
| A.01.03.004 | Corn milling products (unspecified)       | 1                                     | 1                           |
| A.01.03.004.001 | Corn flour                            | 1                                     | 1                           |
| A.01.03.004.003 | Corn starch                            | 1.3                                   | 1                           |
| A.01.03.005 | Oat milling products (unspecified)        | 1                                     | 1                           |
| A.01.03.005.002 | Oat flour                             | 1                                     | 1                           |
| A.01.03.005.004 | Oat starch                             | 1.2                                   | 1                           |
| A.01.03.006 | Rice milling products (unspecified)       | 1                                     | 1                           |
| A.01.03.006.001 | Rice flour                             | 1                                     | 1                           |
| A.01.03.006.002 | Rice flour white                      | 1                                     | 1                           |
| A.01.03.006.003 | Rice flour, instant                    | 1                                     | 1                           |
| A.01.03.006.004 | Rice starch                            | 1.2                                   | 1                           |
| A.01.03.007 | Spelt milling products                  | 1                                     | 1                           |
| A.01.03.008 | Other milling products (unspecified)      | 1                                     | 1                           |
| A.01.03.008.001 | Amaranth flour                        | 1                                     | 1                           |
| A.01.03.008.002 | Barley flour                          | 1                                     | 1                           |
| A.01.03.008.003 | Chapatti flour                         | 1                                     | 1                           |
| A.01.03.008.004 | Flour mix, wheat/rye/barley/oats       | 1                                     | 1                           |
| A.01.03.008.005 | Millet flour                           | 1                                     | 1                           |
| A.01.03.008.007 | Sorghum flour                          | 1                                     | 1                           |
| A.01.04 | Bread and rolls (unspecified)             | 1                                     | 0.7                          |
| A.01.04.001 | Wheat bread and rolls                   | 1                                     | 0.7                          |
| A.01.04.002 | Rye bread and rolls                     | 1                                     | 0.7                          |

https://www.efsa.europa.eu/en/data/call/161110
| FoodEx code | FoodEx category | f1 (conversion from material to flour)\(^{(a)}\) | f2 (average flour fraction)\(^{(b)}\) |
|-------------|-----------------|-----------------------------------|-----------------------------------|
| A.01.04.003 | Mixed wheat and rye bread and rolls | 1 | 0.7 |
| A.01.04.004 | Multigrain bread and rolls | 1 | 0.7 |
| A.01.04.005 | Unleavened bread, crisp bread and rusk (unspecified) | 1 | 0.9 |
| A.01.04.005.001 | Crisp bread, rye, wholemeal | 1 | 0.9 |
| A.01.04.005.002 | Crisp bread, rye, light | 1 | 0.9 |
| A.01.04.005.003 | Crisp bread, wheat, wholemeal | 1 | 0.9 |
| A.01.04.005.004 | Crisp bread, wheat, light | 1 | 0.9 |
| A.01.04.005.005 | Rusk, light | 1 | 0.9 |
| A.01.04.005.006 | Rusk, wholemeal | 1 | 0.9 |
| A.01.04.005.007 | Pita bread | 1 | 0.7 |
| A.01.04.005.008 | Matzo | 1 | 0.9 |
| A.01.04.005.009 | Tortilla | 1 | 0.7 |
| A.01.04.006 | Other bread | 1 | 0.7 |
| A.01.04.007 | Bread products | 1 | 0.7 |
| A.01.07 | Fine bakery wares (unspecified) | 1 | 0.32 |
| A.01.07.001 | Pastries and cakes (unspecified) | 1 | 0.22 |
| A.01.07.001.001 | Beignets | 1 | 0.30 |
| A.01.07.001.002 | Buns | 1 | 0.51 |
| A.01.07.001.003 | Cake from batter | 1 | 0.25 |
| A.01.07.001.004 | Cheese cream cake | 1 | 0.20 |
| A.01.07.001.005 | Cheese cream sponge cake | 1 | 0.18 |
| A.01.07.001.006 | Chocolate cake | 1 | 0.24 |
| A.01.07.001.007 | Chocolate cake with fruits | 1 | 0.17 |
| A.01.07.001.008 | Cream cake | 1 | 0.27 |
| A.01.07.001.009 | Cream cheese cake | 1 | 0.20 |
| A.01.07.001.010 | Cream custard cake | 1 | 0.20 |
| A.01.07.001.011 | Cream custard sponge cake | 1 | 0.05 |
| A.01.07.001.012 | Croissant | 1 | 0.52 |
| A.01.07.001.013 | Croissant, filled with chocolate | 1 | 0.33 |
| A.01.07.001.014 | Croissant, filled with cream | 1 | 0.33 |
| A.01.07.001.015 | Croissant, filled with jam | 1 | 0.33 |
| A.01.07.001.016 | Croquembouche | 1 | 0.07 |
| A.01.07.001.017 | Doughnuts | 1 | 0.36 |
| A.01.07.001.018 | Clair | 1 | 0.07 |
| A.01.07.001.020 | Fruit cake | 1 | 0.15 |
| A.01.07.001.021 | Fruit pie | 1 | 0.32 |
| A.01.07.001.022 | Cheese pie | 1 | 0.32 |
| A.01.07.001.023 | Fruit tart | 1 | 0.20 |
| A.01.07.001.024 | Gingerbread | 1 | 0.41 |
| A.01.07.001.025 | Gougere | 1 | 0.18 |
| A.01.07.001.026 | Kringle | 1 | 0.20 |
| A.01.07.001.027 | Nut cream cake | 1 | 0.15 |
| A.01.07.001.028 | Pancakes | 1 | 0.22 |
| A.01.07.001.029 | Profiterole | 1 | 0.07 |
| A.01.07.001.030 | Pyramid cake | 1 | 0.16 |
| A.01.07.001.031 | Rhubarb flan | 1 | 0.15 |
| A.01.07.001.032 | Scone | 1 | 0.43 |
| A.01.07.001.033 | Sponge dough | 1 | 0.25 |
### 3.2. Brewing processes

This process is defined according to the ‘EC working document on food processes in which food enzymes are used’ as the following\(^4\):

Brewing processes are those which rely on cereals as the principal raw material, and following a fermentation, lead to the production of beer or other cereal-based beverages.

Following the open call for brewing processes,\(^5\) responses were received from the Brewers of Europe. Feedback from the stakeholder was reviewed by the Enzyme Working group. Technical conversion factors were further aligned with those used in the EFSA RPC Model. The following input data will be used for estimating dietary intake of food enzyme-TOS in foods relevant to this intended use.

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### Table: Technical data for exposure assessment of food enzymes

| FoodEx code      | FoodEx category                             | f1 (conversion from material to flour)\(^{(a)}\) | f2 (average flour fraction)\(^{(b)}\) |
|------------------|---------------------------------------------|-----------------------------------------------|-------------------------------------|
| A.01.07.001.034  | Sponge cake                                 | 1                                             | 0.25                                |
| A.01.07.001.035  | Sponge cake roll                            | 1                                             | 0.18                                |
| A.01.07.001.036  | Muffins                                     | 1                                             | 0.31                                |
| A.01.07.001.037  | Waffles                                     | 1                                             | 0.36                                |
| A.01.07.001.038  | Apple strudel                               | 1                                             | 0.24                                |
| A.01.07.001.039  | Cream-cheese strudel                        | 1                                             | 0.24                                |
| A.01.07.001.040  | Cheese pastry goods from puff pastry        | 1                                             | 0.26                                |
| A.01.07.001.041  | Croissant from puff pastry                  | 1                                             | 0.52                                |
| A.01.07.001.042  | Brioche                                     | 1                                             | 0.48                                |
| A.01.07.001.044  | Lebkuchen                                   | 1                                             | 0.41                                |
| A.01.07.001.045  | Dumpling                                    | 1                                             | 0.45                                |
| A.01.07.001.046  | Cake marbled, with chocolate                | 1                                             | 0.24                                |
| A.01.07.001.047  | Marzipan pie                                | 1                                             | 0.19                                |
| A.01.07.001.048  | Baklava                                     | 1                                             | 0.19                                |
| A.01.07.002     | Biscuits (cookies)                           | 1                                             | 0.60                                |
| A.01.07.002.001  | Biscuits, sweet, plain                      | 1                                             | 0.59                                |
| A.01.07.002.002  | Biscuits, chocolate filling                 | 1                                             | 0.42                                |
| A.01.07.002.003  | Biscuits, cream filling                     | 1                                             | 0.42                                |
| A.01.07.002.004  | Biscuits, fruit filling                     | 1                                             | 0.42                                |
| A.01.07.002.005  | Biscuits, vanilla filling                   | 1                                             | 0.42                                |
| A.01.07.002.006  | Butter biscuits                             | 1                                             | 0.59                                |
| A.01.07.002.007  | Biscuit, iced                               | 1                                             | 0.41                                |
| A.01.07.002.008  | Speculaas                                   | 1                                             | 0.47                                |
| A.01.07.002.009  | Biscuits, sweet, wheat wholemeal            | 1                                             | 0.59                                |
| A.01.07.002.010  | Biscuits, oat meal                          | 1                                             | 0.59                                |
| A.01.07.002.011  | Biscuits, spelt meal                        | 1                                             | 0.59                                |
| A.01.07.002.012  | Biscuits, salty                             | 1                                             | 0.67                                |
| A.01.07.002.013  | Biscuits, salty, with cheese                | 1                                             | 0.60                                |
| A.01.07.002.014  | Sticks, salty                               | 1                                             | 0.79                                |
| A.17.05.003      | Biscuits, rusks and cookies for children    | 1                                             | 0.59                                |
| A.18.04.001      | Fine bakery products for diabetics          | 1                                             | 0.32                                |
| A.19.01.001      | Sandwich and sandwich-like meal             | 1                                             | 0.32                                |
| A.19.01.002      | Pizza and pizza-like pies                  | 1                                             | 0.30                                |

\(^{(a)}\): Conversion factor from the raw material to which the food enzyme is typically added (e.g. starch, flour) to flour. Available at: https://www.fao.org/fileadmin/templates/ess/documents/methodology/tcf.pdf

\(^{(b)}\): Conversion factor accounting for the amount of flour present in the (composite) food. Derived from publically available recipe information and/or food label information (such as Mintel’s Global New Products Database https://www.mintel.com/global-new-products-database), as well as feedback from stakeholders and aligned with factors used in the RPC model.
### 3.3. Distilled alcohol production

This process is defined according to the ‘EC working document on food processes in which food enzymes are used’ as the following:

Distilled alcohol production processes are those which rely on starch or other carbohydrate-rich agricultural commodities as raw material and lead to the production of products such as, but not limited to vodka, gin, and whisky. The carbohydrates contained in raw materials is extracted and/or hydrolysed by enzymes, followed by yeast fermentation. The ethanol produced during fermentation is subsequently recovered by distillation.

Foods/ingredients derived through alcohol (distillation) processes, i.e. spirits, are excluded from the dietary exposure calculation, as the presence of residual amounts of TOS after distillation is negligible.

Food enzyme-TOS is not expected to be carried over into the distillate. This assumption was supported by information submitted by AMFEP, which included a description of the main steps in the manufacturing process of the distilled alcohol production in relation to the addition and inactivation/removal of food enzymes, and analytical data on the final products. When using the total protein as the proxy to consider the residual food enzyme-TOS, it is assumed that the enzymes added to the cereal or potato starch are removed in the final ethyl alcohol.

The Panel considered the evidence as sufficient to conclude that residual amounts of TOS are removed by distillation.

### 3.4. Starch processing for glucose syrups production and other starch hydrolysates

This process has been adapted from to the ‘EC working document on food processes in which food enzymes are used’ as the following:

Starch processing relies on starch from various crops (e.g., cereals and potatoes) as the raw material. The starch fraction obtained from the raw material is transformed enzymatically into starch derivatives such as maltodextrins, maltose and glucose syrups and glucose, which are subsequently used in a variety of food products.

Glucose syrups derived through starch processing are excluded from dietary exposure calculation, as the presence of residual amounts of TOS after filtration and purification during processing is negligible.

Production of carbohydrate-rich syrups for food use typically involves decolourisation with activated charcoal or similar and treatment with ion-exchange resins. These purification processes are expected to remove food enzyme-TOS from the final food product. This assumption was supported by information submitted by AMFEP and Starch Europe, which included a description of the main steps of the manufacturing process of the glucose syrups production in relation to the addition and inactivation/removal of food enzymes, and analytical data on the intermediate products and final ingredients of wheat glucose syrup. When using the total protein and true protein-specific nitrogen as the proxy to consider the residual food enzyme-TOS, it is estimated that 99.35–99.97% of enzymes

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6 Information on ‘Food enzyme removal during the production of cereal-based distilled alcoholic beverages’. February 2017.
7 Information on ‘Food enzyme carry-over in glucose syrups’. February 2017.
added to wheat starch are removed in the commercial syrup. The Panel considered the evidence as sufficient to conclude that residual amounts of TOS are removed by the purification steps applied during the production of glucose syrups (by > 99%), i.e. filtration, ion exchange chromatography, treatment with active carbon and crystallisation.

Depending on the enzymes used to hydrolyse the starch and the extent of the hydrolysis, syrups containing different proportions of mono-, di- and oligosaccharides with varying degree of polymerisation can be obtained. In the food enzyme dossiers received, these products are referred to as starch syrup, glucose syrup, high-maltose glucose syrups, maltodextrin, maltose, etc.

As all these products are obtained from starch and the purification steps applied during their production are virtually the same as for glucose syrup, for which TOS removal has been demonstrated in food enzyme dossiers evaluated, the Panel decided to exclude also these types of starch hydrolysates from the exposure calculation.

### 3.5. Cereal-based processes

This process has been adapted from the ‘EC working document on food processes in which food enzymes are used’ as the following:

*Cereal-based processes rely on flour as the principal raw material and lead to the production of products such as, but not limited to, pasta, noodles, breakfast cereals and snacks (e.g. muesli bars, popcorn, maize and rice crisps), extruded and/or puffed cereals.*

Following the open call for cereal-based processes, no response was received from any stakeholder. Technical conversion factors were aligned with those used in the EFSA RPC Model. The following input data were used to estimate dietary intake of food enzyme-TOS in foods relevant to this intended use.

| FoodEx code | FoodEx category                        | f1 (conversion from material to flour) | f2 (average flour fraction) |
|-------------|----------------------------------------|---------------------------------------|-----------------------------|
| A.01.05     | Pasta (Raw) (unspecifed)               | 1.00                                  | 1.00                        |
| A.01.05.001 | Glass noodle                          | 1.00                                  | 1.00                        |
| A.01.05.002 | Noodle, rice                          | 1.00                                  | 1.00                        |
| A.01.05.003 | Noodle, wheat flour, with eggs         | 1.00                                  | 0.80                        |
| A.01.05.004 | Noodle, wheat flour, without eggs      | 1.00                                  | 1.00                        |
| A.01.05.005 | Pasta, wheat flour, with eggs          | 1.00                                  | 0.80                        |
| A.01.05.006 | Pasta, wheat flour, without eggs       | 1.00                                  | 1.00                        |
| A.01.05.007 | Pasta, wheat flour, filled             | 1.00                                  | 0.60                        |
| A.01.05.008 | Pasta, mixed cereal flour              | 1.00                                  | 1.00                        |
| A.01.05.009 | Pasta, rye flour                       | 1.00                                  | 1.00                        |
| A.01.05.010 | Pasta, soy flour                       | 1.00                                  | 1.00                        |
| A.01.05.011 | Pasta, spelt flour                     | 1.00                                  | 1.00                        |
| A.01.05.012 | Pasta, spelt wholemeal                 | 1.00                                  | 1.00                        |
| A.01.05.013 | Pasta, wheat wholemeal, without eggs   | 1.00                                  | 1.00                        |
| A.01.05.014 | Pasta, wheat wholemeal, with eggs      | 1.00                                  | 0.80                        |
| A.01.05.015 | Pasta, gluten free                     | 1.00                                  | 1.00                        |
| A.01.06     | Breakfast cereals (unspecifed)         | 1.00                                  | 0.65                        |
| A.01.06.001 | Cereal flakes (unspecifed)             | 1.00                                  | 0.65                        |
| A.01.06.005 | Mixed breakfast cereals                | 1.00                                  | 0.65                        |
| A.01.06.005.001 | Breakfast cereals, mixed cereals and fruits | 1.00                                  | 0.60                        |
| A.01.06.005.002 | Breakfast cereals, mixed cereals and honey | 1.00                                  | 0.75                        |
| A.01.06.005.003 | Breakfast cereals, mixed cereals and nuts | 1.00                                  | 0.66                        |
| A.01.06.005.004 | Breakfast cereals, mixed cereals with honey and fruits | 1.00                                  | 0.60                        |
| A.01.06.005.005 | Breakfast cereals, mixed cereals, fruits and chocolate | 1.00                                  | 0.49                        |

8 [https://www.efsa.europa.eu/en/data/call/171130](https://www.efsa.europa.eu/en/data/call/171130)
| FoodEx code | FoodEx category                                                                 | f1 (conversion from material to flour)\(^{(a)}\) | f2 (average flour fraction)\(^{(b)}\) |
|-------------|---------------------------------------------------------------------------------|-----------------------------------------------|--------------------------------------|
| A.01.06.005.006 | Breakfast cereals, mixed cereals, fruits, nuts and chocolate                     | 1.00                                          | 0.43                                 |
| A.17.03.004 | Pasta for children (unspecified)                                                 | 1.00                                          | 1.00                                 |
| A.17.04 | Ready-to-eat meal for infants and young children                                | 1.00                                          | 0.10                                 |
| A.17.04.002 | Ready-to-eat meal for children, cereal-based                                    | 1.00                                          | 0.15                                 |
| A.19.01 | Cereal-based dishes (unspecified)                                               | 1.00                                          | 0.25                                 |
| A.19.01.003 | Pasta, cooked (unspecified)                                                      | 1.00                                          | 0.25                                 |
| A.19.01.003.001 | Pasta, cooked, with vegetables                                                  | 1.00                                          | 0.25                                 |
| A.19.01.003.002 | Pasta, cooked, with cheese/cream                                                 | 1.00                                          | 0.25                                 |
| A.19.01.003.003 | Pasta, cooked, with vegetables and cheese/cream                                 | 1.00                                          | 0.25                                 |
| A.19.01.003.004 | Pasta, cooked, meat filling                                                      | 1.00                                          | 0.25                                 |
| A.19.01.003.005 | Pasta, cooked, vegetable filling                                                | 1.00                                          | 0.25                                 |
| A.19.01.003.006 | Pasta, cooked, meat and vegetable filling                                      | 1.00                                          | 0.25                                 |

\(^{(a)}\): Conversion factor from the raw material to which the food enzyme is typically added (e.g. flour) to flour. Available at see https://www.fao.org/fileadmin/templates/ess/documents/methodology/tcf.pdf

\(^{(b)}\): Conversion factor accounting for the amount of flour present in the (composite) food. Derived from publicly available recipe information and/or food label information (such as Mintel’s Global New Products Database https://www.mintel.com/global-new-products-database), and aligned with factors used in the RAC model.

3.6. Grain treatment for the production of starch and gluten fractions

This process has been adapted from the ‘EC working document on food processes in which food enzymes are used’ as the following\(^9\):

*Grain treatment is the process whereby cereals (grains or grist) are milled and processed in order to be fractioned into starch, gluten and solubles. The separated fractions are then further processed, notably the starch fraction which is either used as a food ingredient (e.g. in baking) or transformed enzymatically into starch derivatives such as maltodextrins, modified starch, glucose syrups and dextrose (glucose) which are themselves used in a number of food products.*

The technical information provided by AMFEP\(^9\) clarified that milled grains are further processed and fractionated into starch, gluten and solubles. Solubles are not used in food production, rather they are generally used in animal feed and as starting material for ethanol production. Therefore, the fraction ‘solubles’ is not further considered.

Starch and gluten fractions obtained following grain treatment are excluded from dietary exposure calculation, as the presence of residual amounts of TOS after repeated washing during production is negligible.

This assumption was supported by information submitted by AMFEP and Starch Europe\(^9,12\), which included (i) a description of the main steps of the production process of the different fractions in relation to the addition and removal of food enzymes, (ii) theoretical calculations based on measured amounts of intermediate and final fractions and (iii) measurement of enzymatic activities for several different food enzymes in the weighed intermediate and final products (e.g. process water, dough, tricanter feed, crude starch, crude and dry gluten). When using both the final calculated residual amount and measured enzyme activity in the final products, respectively, it is estimated that > 99% of enzyme added to the raw material (e.g. grain, flour) are removed during production.

The Panel considered the evidence as sufficient to conclude that residual amounts of TOS are removed by the washing steps applied during the production of the starch and gluten fractions (by > 99%).

3.7. Manufacture of speciality carbohydrates

This process has been adapted from the ‘EC working document on food processes in which food enzymes are used’ as the following\(^4\):

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\(^9\) Information on ‘Grain processing / Fate of the food enzymes’. April 2018 and July 2018.
Carbohydrate processing and conversion rely on disaccharides or oligosaccharides (e.g., sucrose, lactose, inulin) or glucose syrups as the principal raw material and lead to the production of products such as, but not limited to, substitutes for fructo-oligosaccharides, galacto-oligosaccharides and glucose-fructose syrups.

The food enzyme maybe be used in free form or as an immobilised preparation. When immobilised, the carry-over of TOS into the speciality carbohydrates is likely to be reduced. Independent of the methods of application, the final products undergo extensive purification.

Nonetheless, as different approaches to immobilising food enzymes are in use, and are often specific to the individual application, the Panel decided to request the relevant technical information and/or experimental data on a case-by-case basis.

3.8. Coffee bean demuciliation

This process has been adapted from the ‘EC working document on food processes in which food enzymes are used’ as the following:

Coffee processing relies on raw coffee cherries as the principal raw material. Demucilation is the removal of the mucilage coat surrounding the coffee cherries in the fermentation step which may be accelerated by the enzymatic treatment.

The resulting product, i.e., green coffee beans, is excluded from the dietary exposure calculation, as the presence of residual TOS after demucilation is negligible.

This assumption was supported by information submitted by AMFEP, which included (i) a description of the main steps employed in coffee processing from the harvested coffee cherries to soluble ground coffee, and (ii) in relation to the addition and inactivation/removal of food enzymes, measurement of enzymatic activity for two different food enzymes on the surface of the harvested coffee cherries, intermediate coffee bean under fermentation and final green coffee beans.

Although it was not possible to quantify the extent of TOS removal based on the residual enzyme activity measured, the Panel considered the fact that the food enzyme is used only on the coat of the raw coffee cherries to aid removal of same and followed by washing steps as sufficient to conclude that enzymes are removed during mucilation of coffee beans.

3.9. Coffee processing

This process has been adapted from the ‘EC working document on food processes in which food enzymes are used’ as the following:

Coffee processing relies on demucilaged coffee beans as the principal raw material and covers any aspect of coffee processing after the fermentation step.

Following the open call for coffee processing, feedback was received from the European Coffee Federation. The following input data were used to estimate dietary exposure to food enzyme-TOS in foods relevant to this intended use.

| FoodEx hierarchical code | FoodEx matrix description | f1 (Conversion from roasted coffee bean to raw material (coffee bean, green)) | f2 (Average fraction of roasted coffee bean in respective FoodEx category) | f3 (Percentage of FoodEx category containing coffee as ingredient) |
|--------------------------|---------------------------|-------------------------------------------------|-------------------------------------------------|-------------------------------------------------|
| A.01.06                  | Breakfast cereals (unspeci | 4                                               | 1.19                                            | 0.020                                           | 0.01                                           |
|                          | fied)                     |                                                 |                                                 |                                                 |                                                 |
| A.01.06.002              | Muesli (unspecied)        | 4                                               | 1.19                                            | 0.020                                           | 0.01                                           |
| A.01.06.002.001          | Muesli bars               | 4                                               | 1.19                                            | 0.023                                           | 0.01                                           |

10 Information on ‘Transfer of enzymes into food, for refined sugar production and processing’, provided by AMFEP. October 2017.
11 Information on ‘Coffee processing/demucilation’. September 2019.
12 https://www.efsa.europa.eu/en/consultations/call/190617
| FoodEx hierarchical code | FoodEx matrix description | FoodEx hierarchical level | f1 (Conversion from roasted coffee bean to raw material (coffee bean, green)) | f2 (Average fraction of roasted coffee bean in respective FoodEx category) | f3 (Percentage of FoodEx category containing coffee as ingredient) |
|--------------------------|---------------------------|--------------------------|-----------------------------------------------------------------------|------------------------------------------------------------------------|------------------------------------------------------------------|
| A.01.06.002.002          | Muesli with added sugar   | 4                        | 1.19                                                                  | 0.023                                                                   | 0.01                                                             |
| A.01.06.002.003          | Muesli with chocolate     | 4                        | 1.19                                                                  | 0.023                                                                   | 0.01                                                             |
| A.01.06.002.004          | Muesli with fruits        | 4                        | 1.19                                                                  | 0.023                                                                   | 0.01                                                             |
| A.01.06.002.005          | Muesli with fruits and chocolate | 4 | 1.19 | 0.023 | 0.01 |
| A.01.06.002.006          | Muesli with fruits and nuts | 4 | 1.19 | 0.023 | 0.01 |
| A.01.06.002.007          | Muesli with fruits, nuts and chocolate | 4 | 1.19 | 0.023 | 0.01 |
| A.01.06.002.008          | Muesli, mixed             | 4                        | 1.19                                                                  | 0.023                                                                   | 0.01                                                             |
| A.01.06.002.009          | Muesli, no added sugar    | 4                        | 1.19                                                                  | 0.023                                                                   | 0.01                                                             |
| A.01.06.003              | Cereal bars (unspecified) | 4                        | 1.19                                                                  | 0.020                                                                   | 0.01                                                             |
| A.01.06.003.001          | Cereal bar with fruits    | 4                        | 1.19                                                                  | 0.021                                                                   | 0.01                                                             |
| A.01.06.003.002          | Cereal bar with added sugar | 4 | 1.19 | 0.021 | 0.01 |
| A.01.06.003.003          | Cereal bar with chocolate | 4                        | 1.19                                                                  | 0.021                                                                   | 0.01                                                             |
| A.01.06.003.004          | Cereal bar, with no added sugar | 4 | 1.19 | 0.021 | 0.01 |
| A.01.07                 | Fine bakery wares (unspecified) | 4 | 1.19 | 0.001 | 0.01 |
| A.01.07.001              | Pastries and cakes (unspecified) | 4 | 1.19 | 0.001 | 0.01 |
| A.01.07.001.004          | Cheese cream cake         | 4                        | 1.19                                                                  | 0.005                                                                   | 0.01                                                             |
| A.01.07.001.005          | Cheese cream sponge cake  | 4                        | 1.19                                                                  | 0.005                                                                   | 0.01                                                             |
| A.01.07.001.008          | Cream cake                | 4                        | 1.19                                                                  | 0.001                                                                   | 0.01                                                             |
| A.01.07.001.010          | Cream custard cake        | 4                        | 1.19                                                                  | 0.001                                                                   | 0.01                                                             |
| A.01.07.001.011          | Cream custard sponge cake | 4                        | 1.19                                                                  | 0.001                                                                   | 0.01                                                             |
| A.01.07.001.014          | Croissant, filled with cream | 4 | 1.19 | 0.001 | 0.01 |
| A.01.07.001.016          | Croquembouche             | 4                        | 1.19                                                                  | 0.001                                                                   | 0.01                                                             |
| A.01.07.001.018          | Éclair                    | 4                        | 1.19                                                                  | 0.001                                                                   | 0.01                                                             |
| A.01.07.001.019          | Flan                      | 4                        | 1.19                                                                  | 0.007                                                                   | 0.01                                                             |
| A.01.07.001.027          | Nut cream cake            | 4                        | 1.19                                                                  | 0.001                                                                   | 0.01                                                             |
| A.01.07.001.029          | Profiterole               | 4                        | 1.19                                                                  | 0.001                                                                   | 0.01                                                             |
| A.01.07.001.035          | Sponge cake roll          | 4                        | 1.19                                                                  | 0.001                                                                   | 0.01                                                             |
| A.01.07.001.037          | Waffles                   | 4                        | 1.19                                                                  | 0.010                                                                   | 0.01                                                             |
| A.01.07.001.043          | Macaroons                 | 4                        | 1.19                                                                  | 0.0002                                                                  | 0.01                                                             |
| A.01.07.002              | Biscuits (cookies) (unspecified) | 4 | 1.19 | 0.001 | 0.01 |
| FoodEx hierarchical code | FoodEx matrix description | FoodEx hierarchical level | f1 (Conversion from roasted coffee bean to raw material (coffee bean, green)) | f2 (Average fraction of roasted coffee bean in respective FoodEx category) | f3 (Percentage of FoodEx category containing coffee as ingredient) |
|--------------------------|----------------------------|----------------------------|-------------------------------------------------|-------------------------------------------------|-------------------------------------------------|
| A.01.07.002.002          | Biscuits, chocolate filling | 4                          | 1.19                                            | 0.001                                           | 0.01                                            |
| A.01.07.002.003          | Biscuits, cream filling    | 4                          | 1.19                                            | 0.001                                           | 0.01                                            |
| A.01.07.002.005          | Biscuits, vanilla filling  | 4                          | 1.19                                            | 0.001                                           | 0.01                                            |
| A.02.12                  | Coffee beans and coffee products (Solid) (unspecified) | 4                          | 1.19                                            | 1.000                                           | 1                                               |
| A.02.12.001              | Coffee beans               | 4                          | 1.19                                            | 1.000                                           | 1                                               |
| A.02.12.002              | Coffee beans, roasted      | 4                          | 1.19                                            | 1.000                                           | 1                                               |
| A.02.12.003              | Coffee beans, roasted, decaffeinated | 4                            | 1.19                                            | 1.05                                            | 1                                               |
| A.02.12.004              | Coffee beans, roasted and ground | 4                                | 1.19                                            | 1.000                                           | 1                                               |
| A.02.12.005              | Coffee beans, roasted and ground, decaffeinated | 4                                      | 1.19                                            | 1.05                                            | 1                                               |
| A.02.12.006              | Instant coffee, powder     | 4                          | 1.19                                            | 2.6                                             | 1                                               |
| A.02.12.007              | Instant coffee, powder, decaffeinated | 4                                | 1.19                                            | 2.73                                            | 1                                               |
| A.08.02.001              | Flavoured milk (unspecified) | 4                              | 1.19                                            | 0.007                                           | 0.01                                            |
| A.08.02.001.002          | Chocolate and fruit-flavoured milk | 4                                    | 1.19                                            | 0.007                                           | 0.01                                            |
| A.08.02.002              | Milkshakes (unspecified)   | 4                          | 1.19                                            | 0.007                                           | 0.01                                            |
| A.08.02.002.001          | Chocolate milkshake        | 4                          | 1.19                                            | 0.007                                           | 0.01                                            |
| A.08.06.002              | Yoghurt, cow milk, with fruit (unspecified) | 4                                | 1.19                                            | 0.007                                           | 0.01                                            |
| A.08.06.002.001          | Yoghurt, cow milk, with fruit, > 3% fat | 4                                     | 1.19                                            | 0.007                                           | 0.01                                            |
| A.08.06.002.002          | Yoghurt cow milk, with fruit, 1–3% fat | 4                                      | 1.19                                            | 0.007                                           | 0.01                                            |
| A.08.06.002.003          | Yoghurt, cow milk, with fruit, < 1% fat | 4                                      | 1.19                                            | 0.007                                           | 0.01                                            |
| A.10.03                  | Chocolate (Cocoa) products (unspecified) | 4                                | 1.19                                            | 0.030                                           | 0.01                                            |
| A.10.03.001              | Bitter chocolate           | 4                          | 1.19                                            | 0.035                                           | 0.01                                            |
| A.10.03.002              | Bitter-sweet chocolate     | 4                          | 1.19                                            | 0.035                                           | 0.01                                            |
| FoodEx hierarchical code | FoodEx matrix description | FoodEx hierarchical level | f1 (Conversion from roasted coffee bean to raw material (coffee bean, green)) | f2 (Average fraction of roasted coffee bean in respective FoodEx category) | f3 (Percentage of FoodEx category containing coffee as ingredient) |
|--------------------------|---------------------------|--------------------------|--------------------------------------------------------------------------------|--------------------------------------------------------------------------------|------------------------------------------------------------------|
| A.10.03.003              | Chocolate bar             | 4                        | 1.19                                                                            | 0.035                                                                          | 0.01                                                             |
| A.10.03.004              | Chocolate, cream          | 4                        | 1.19                                                                            | 0.035                                                                          | 0.01                                                             |
| A.10.03.005              | Chocolate with nuts or fruits | 4                    | 1.19                                                                            | 0.035                                                                          | 0.01                                                             |
| A.10.03.006              | Chocolate-coated confectionery | 4                   | 1.19                                                                            | 0.035                                                                          | 0.01                                                             |
| A.10.03.007              | Filled chocolate          | 4                        | 1.19                                                                            | 0.035                                                                          | 0.01                                                             |
| A.10.03.008              | Milk chocolate            | 4                        | 1.19                                                                            | 0.035                                                                          | 0.01                                                             |
| A.10.03.009              | White chocolate           | 4                        | 1.19                                                                            | 0.035                                                                          | 0.01                                                             |
| A.10.03.010              | Pralines                  | 4                        | 1.19                                                                            | 0.035                                                                          | 0.01                                                             |
| A.10.03.011              | Cooking chocolate         | 4                        | 1.19                                                                            | 0.035                                                                          | 0.01                                                             |
| A.10.03.012              | Cooking chocolate, white  | 4                        | 1.19                                                                            | 0.035                                                                          | 0.01                                                             |
| A.10.03.013              | Dietetic chocolate        | 4                        | 1.19                                                                            | 0.035                                                                          | 0.01                                                             |
| A.10.03.014              | Chocolate substitutes      | 4                        | 1.19                                                                            | 0.035                                                                          | 0.01                                                             |
| A.10.04                  | Confectionery (non-chocolate) (unspecified) | 4                   | 1.19                                                                            | 0.030                                                                          | 0.01                                                             |
| A.10.04.001              | Candies, with sugar       | 4                        | 1.19                                                                            | 0.032                                                                          | 0.01                                                             |
| A.10.04.002              | Candies, sugar free       | 4                        | 1.19                                                                            | 0.032                                                                          | 0.01                                                             |
| A.10.04.003              | Marzipan                  | 4                        | 1.19                                                                            | 0.032                                                                          | 0.01                                                             |
| A.10.04.004              | Caramel, hard             | 4                        | 1.19                                                                            | 0.032                                                                          | 0.01                                                             |
| A.10.04.005              | Caramel, soft             | 4                        | 1.19                                                                            | 0.032                                                                          | 0.01                                                             |
| A.10.04.006              | Toffee                    | 4                        | 1.19                                                                            | 0.032                                                                          | 0.01                                                             |
| A.10.04.007              | Fudge                     | 4                        | 1.19                                                                            | 0.032                                                                          | 0.01                                                             |
| A.10.04.008              | Dragée, sugar coated      | 4                        | 1.19                                                                            | 0.032                                                                          | 0.01                                                             |
| A.10.04.011              | Liquorice candies         | 4                        | 1.19                                                                            | 0.032                                                                          | 0.01                                                             |
| A.10.04.012              | Gum drops                 | 4                        | 1.19                                                                            | 0.032                                                                          | 0.01                                                             |
| A.10.04.014              | Nougat                    | 4                        | 1.19                                                                            | 0.032                                                                          | 0.01                                                             |
| A.13.03                  | Coffee (Beverage) (unspecified) | 4                   | 1.19                                                                            | 0.050                                                                          | 1                                                                |
| A.13.03.001              | Coffee drink, espresso    | 4                        | 1.19                                                                            | 0.143                                                                          | 1                                                                |
| A.13.03.002              | Coffee drink, café amérícano | 4                    | 1.19                                                                            | 0.056                                                                          | 1                                                                |
| A.13.03.003              | Coffee drink, cappuccino  | 4                        | 1.19                                                                            | 0.056                                                                          | 1                                                                |
| A.13.03.004              | Coffee drink, café macchiato | 4                   | 1.19                                                                            | 0.143                                                                          | 1                                                                |
| A.13.03.005              | Iced coffee               | 4                        | 1.19                                                                            | 0.056                                                                          | 1                                                                |
| A.13.03.006              | Coffee with milk (café latte, café au lait) | 4                   | 1.19                                                                            | 0.056                                                                          | 1                                                                |
| A.13.03.007              | Instant coffee, liquid    | 4                        | 1.19                                                                            | 0.042                                                                          | 1                                                                |
### 3.10. Wine and wine vinegar production

This process has been adapted from the ‘EC working document on food processes in which food enzymes are used’ as the following:\(^1\):

Wine making processes rely on grapes as the main raw material in the production of wine and wine vinegar. The process involves fermentation of grapes or grape musts with yeast, optionally followed by a malolactic fermentation with bacteria.

Following the open call for wine production,\(^12\) no response was received from any stakeholder. The following input data were used to estimate dietary intake of food enzyme-TOS in foods relevant to this intended use.

| FoodEx hierarchical code | FoodEx matrix description | FoodEx hierarchical level | \(f_1\) (Conversion from wine or wine vinegar to raw material (grape)) | \(f_2\) (Average fraction of wine or wine vinegar in respective FoodEx category) | \(f_3\) (Percentage of FoodEx category containing wine or wine vinegar) |
|--------------------------|----------------------------|--------------------------|------------------------------------------------|-------------------------------------------------|-------------------------------------------------|
| A.05.04.002              | Wine grapes                | 4                        | 1                                               | 1.000                                           | 1                                               |
| A.05.09.009              | Fruit in vinegar, oil, or brine | 4                       | 1                                               | 0.138                                           | 1                                               |
| A.06.09.001              | Fresh and lightly cooked sausage (unspecified) | 4                       | 1.43                                           | 0.010                                           | 0.2                                             |
| A.06.09.001.001          | Salsiccia                  | 4                        | 1.43                                           | 0.010                                           | 1                                               |
| A.06.09.006              | Dry sausage (unspecified)  | 4                        | 1.43                                           | 0.014                                           | 0.08                                            |
| A.06.09.006.009          | Hungarian-type salami      | 4                        | 1.43                                           | 0.014                                           | 1                                               |
| A.06.11.001              | Meat paste (unspecified)   | 4                        | 1                                               | 0.002                                           | 1                                               |
| I.06.11.001.001          | Meat paste, Poultry        | 4                        | 1                                               | 0.002                                           | 1                                               |
| A.07.02.005              | Fish pâté (unspecified)    | 4                        | 1                                               | 0.006                                           | 0.25                                            |
### Technical data for exposure assessment of food enzymes

| FoodEx hierarchical code | FoodEx matrix description | FoodEx hierarchical level | f1 (Conversion from wine or wine vinegar to raw material (grape)) | f2 (Average fraction of wine or wine vinegar in respective FoodEx category) | f3 (Percentage of FoodEx category containing wine or wine vinegar) |
|--------------------------|----------------------------|---------------------------|---------------------------------------------------------------|-------------------------------------------------|-------------------------------------------------------------|
| I.07.02.005.001          | Fish pâté, Mackerel        | 4                         | 1                                                             | 0.024                                           | 1                                                           |
| I.07.02.005.004          | Fish pâté, Tuna            | 4                         | 1                                                             | 0.006                                           | 1                                                           |
| A.10.05                  | Dessert sauces (unspecified) | 4                      | 1.43                                                          | 0.410                                           | 0.25                                                        |
| A.10.05.004              | Alcoholic sweet sauce      | 4                         | 1.43                                                          | 0.410                                           | 1                                                           |
| A.14.02                  | Wine (unspecified)         | 4                         | 1.43                                                          | 1.000                                           | 1                                                           |
| A.14.02.001              | Wine, white                | 4                         | 1.43                                                          | 1.000                                           | 1                                                           |
| A.14.02.002              | Wine, white, sparkling     | 4                         | 1.43                                                          | 1.000                                           | 1                                                           |
| A.14.02.003              | Wine, red                  | 4                         | 1.43                                                          | 1.000                                           | 1                                                           |
| A.14.02.004              | Wine, red, sparkling       | 4                         | 1.43                                                          | 1.000                                           | 1                                                           |
| A.14.03                  | Fortified and liqueur wines (e.g. Vermouth, Sherry, Madeira) (unspecified) | 4          | 1.43                                                          | 0.800                                           | 1                                                           |
| A.14.03.001              | Vermouth                   | 4                         | 1.43                                                          | 0.906                                           | 1                                                           |
| A.14.03.002              | Sherry                     | 4                         | 1.43                                                          | 0.800                                           | 1                                                           |
| A.14.07.001              | Cocktail drink (unspecified) | 4                      | 1.43                                                          | 0.700                                           | 1                                                           |
| I.14.07.001.001          | Kir                        | 4                         | 1.43                                                          | 0.900                                           | 1                                                           |
| I.14.07.001.003          | Sangria                    | 4                         | 1.43                                                          | 0.671                                           | 1                                                           |
| A.16.05                  | Condiment (unspecified)    | 4                         | 1                                                             | 0.030                                           | 1                                                           |
| A.16.05.001              | Mustard, sweet             | 4                         | 1                                                             | 0.180                                           | 1                                                           |
| A.16.05.002              | Mustard, mild              | 4                         | 1                                                             | 0.150                                           | 1                                                           |
| A.16.05.003              | Mustard, hot               | 4                         | 1                                                             | 0.270                                           | 1                                                           |
| A.16.05.004              | Vinegar, wine              | 4                         | 1                                                             | 1.000                                           | 1                                                           |
| A.16.05.006              | Tomato ketchup             | 4                         | 1                                                             | 0.120                                           | 1                                                           |
| A.16.05.007              | Barbecue sauce            | 4                         | 1                                                             | 0.059                                           | 1                                                           |
| A.16.05.008              | Tabasco sauce              | 4                         | 1                                                             | 0.480                                           | 1                                                           |
| A.16.05.009              | Horseradish sauce          | 4                         | 1                                                             | 0.034                                           | 1                                                           |
| A.16.05.010              | Mint sauce                 | 4                         | 1                                                             | 0.800                                           | 1                                                           |
| A.16.05.012              | Curry sauce                | 4                         | 1                                                             | 0.061                                           | 1                                                           |
| A.16.05.014              | Tartar sauce               | 4                         | 1                                                             | 0.033                                           | 1                                                           |
| A.16.05.015              | Mixed condiment            | 4                         | 1                                                             | 0.060                                           | 1                                                           |
| A.16.06                  | Dressing (unspecified)     | 4                         | 1                                                             | 0.030                                           | 1                                                           |
| A.16.06.001              | Salad dressing, > 50% oil   | 4                         | 1                                                             | 0.210                                           | 1                                                           |
| A.16.06.002              | Salad dressing, 25-50% oil  | 4                         | 1                                                             | 0.524                                           | 1                                                           |
| A.16.06.003              | Salad dressing, < 25% oil   | 4                         | 1                                                             | 0.630                                           | 1                                                           |
| A.16.06.004              | Mayonnaise, > 50% oil       | 4                         | 1                                                             | 0.041                                           | 1                                                           |
| FoodEx hierarchical code | FoodEx matrix description | FoodEx hierarchical level | f1 (Conversion from wine or wine vinegar to raw material (grape)) | f2 (Average fraction of wine or wine vinegar in respective FoodEx category) | f3 (Percentage of FoodEx category containing wine or wine vinegar) |
|--------------------------|--------------------------|--------------------------|---------------------------------------------------------------|---------------------------------------------------------------|---------------------------------------------------------------|
| A.16.06.005              | Mayonnaise, 25-50% oil   | 4                        | 1                                                             | 0.033                                                         | 1                                                             |
| A.16.06.006              | Mayonnaise, < 25% oil    | 4                        | 1                                                             | 0.049                                                         | 1                                                             |
| I.16.06.007              | Salad dressing (unspecified) | 4                        | 1                                                             | 0.305                                                         | 1                                                             |
| I.16.06.008              | Yogonaise                | 4                        | 1                                                             | 0.028                                                         | 1                                                             |
| I.16.06.009              | Thousand Islands sauce   | 4                        | 1                                                             | 0.130                                                         | 1                                                             |
| A.16.07                  | Chutney and pickles (unspecified) | 4                        | 1                                                             | 0.001                                                         | 1                                                             |
| A.16.07.001              | Tomato chutney           | 4                        | 1                                                             | 0.100                                                         | 1                                                             |
| A.16.07.002              | Apple chutney            | 4                        | 1                                                             | 0.100                                                         | 1                                                             |
| A.16.07.003              | Cucumber chutney         | 4                        | 1                                                             | 0.100                                                         | 1                                                             |
| A.16.07.004              | Mango chutney            | 4                        | 1                                                             | 0.100                                                         | 1                                                             |
| A.16.07.005              | Mixed chutney            | 4                        | 1.43                                                          | 0.320                                                         | 1                                                             |
| A.16.07.006              | Piccalilli                | 4                        | 1                                                             | 0.001                                                         | 1                                                             |
| A.16.07.007              | Chilli pickle            | 4                        | 1                                                             | 0.023                                                         | 1                                                             |
| A.16.07.008              | Lime pickle              | 4                        | 1                                                             | 0.100                                                         | 1                                                             |
| A.16.07.009              | Mango pickle             | 4                        | 1                                                             | 0.006                                                         | 1                                                             |
| A.16.07.010              | Mixed pickle             | 4                        | 1                                                             | 0.060                                                         | 1                                                             |
| A.16.07.011              | Relish                   | 4                        | 1                                                             | 0.107                                                         | 1                                                             |
| A.16.08                  | Savoury sauces (unspecified) | 4                        | 1.43                                                          | 0.202                                                         | 1                                                             |
| A.16.08.003              | Cream sauce (unspecified) | 4                        | 1.43                                                          | 0.180                                                         | 1                                                             |
| I.16.08.003.005          | Dill sauce               | 4                        | 1.43                                                          | 0.179                                                         | 1                                                             |
| A.16.08.005              | Emulsion sauce (Hollandaise sauce) (unspecified) | 4                        | 1                                                             | 0.003                                                         | 1                                                             |
| I.16.08.005.001          | Sauce béarnaise          | 4                        | 1                                                             | 0.109                                                         | 1                                                             |
| I.16.08.005.002          | Sauce hollandaise        | 4                        | 1                                                             | 0.003                                                         | 1                                                             |
| A.16.08.006              | Oil-based sauce (Pesto, Aioli sauce) (unspecified) | 4                        | 1                                                             | 0.031                                                         | 0.25                                                          |
| I.16.08.006.001          | Aioli                    | 4                        | 1                                                             | 0.031                                                         | 1                                                             |
| A.16.08.007              | Alcoholic sauce (unspecified) | 4                        | 1.43                                                          | 0.100                                                         | 1                                                             |
| I.16.08.007.002          | Red wine sauce           | 4                        | 1.43                                                          | 0.521                                                         | 1                                                             |
| I.16.08.007.003          | White wine sauce         | 4                        | 1.43                                                          | 0.180                                                         | 1                                                             |
| A.16.08.008              | Meat sauce (unspecified) | 4                        | 1.43                                                          | 0.050                                                         | 0.5                                                           |
| I.16.08.008.001          | Bolognese sauce          | 4                        | 1.43                                                          | 0.050                                                         | 1                                                             |
| I.16.08.008.004          | Meat sauce, with sausage | 4                        | 1.43                                                          | 0.060                                                         | 1                                                             |
| A.16.08.010              | Vegetable sauce (unspecified) | 4                        | 1                                                             | 0.003                                                         | 0.1                                                           |
| FoodEx hierarchical code | FoodEx matrix description                  | FoodEx hierarchical level | f1 (Conversion from wine or wine vinegar to raw material (grape)) | f2 (Average fraction of wine or wine vinegar in respective FoodEx category) | f3 (Percentage of FoodEx category containing wine or wine vinegar) |
|-------------------------|--------------------------------------------|--------------------------|-----------------------------------------------------------------|---------------------------------------------------------------------------|-----------------------------------------------------------------|
| I.16.08.010.001         | Bean sauce                                 | 4                        | 1                                                               | 0.050                                                                     | 1                                                               |
| I.16.08.010.002         | Mushroom sauce                             | 4                        | 1.43                                                            | 0.020                                                                     | 1                                                               |
| I.16.08.010.003         | Mustard sauce                              | 4                        | 1                                                               | 0.215                                                                     | 1                                                               |
| I.16.08.010.005         | Peanut sauce                               | 4                        | 1                                                               | 0.003                                                                     | 1                                                               |
| I.16.08.010.006         | Pepper sauce                              | 4                        | 1.43                                                            | 0.120                                                                     | 1                                                               |
| I.16.08.010.007         | Sweet and sour sauce                       | 4                        | 1                                                               | 0.118                                                                     | 1                                                               |
| A.19.01.001             | Sandwich and sandwich-like meal (unspecified) | 4                        | 1                                                               | 0.004                                                                     | 1                                                               |
| A.19.01.001.002         | Sandwich, meat filling (unspecified)       | 4                        | 1                                                               | 0.004                                                                     | 1                                                               |
| I.19.01.001.009         | Cheeseburger                               | 4                        | 1                                                               | 0.008                                                                     | 1                                                               |
| I.19.01.001.011         | Hamburger                                  | 4                        | 1                                                               | 0.004                                                                     | 1                                                               |
| I.19.01.001.012         | Doner kebab                                | 4                        | 1                                                               | 0.008                                                                     | 1                                                               |
| I.19.01.001.014         | Sausage roll                               | 4                        | 1.43                                                            | 0.005                                                                     | 1                                                               |
| I.19.01.001.014         | Sausage roll                               | 4                        | 1                                                               | 0.009                                                                     | 1                                                               |
| A.19.01.001.003         | Sandwich, fish filling                     | 4                        | 1                                                               | 0.005                                                                     | 1                                                               |
| A.19.01.001.007         | Sandwich, meat and vegetable filling       | 4                        | 1.43                                                            | 0.020                                                                     | 1                                                               |
| A.19.01.001.008         | Sandwich, fish and vegetable filling       | 4                        | 1                                                               | 0.004                                                                     | 1                                                               |
| I.19.01.001.010         | Double burger                              | 4                        | 1                                                               | 0.006                                                                     | 1                                                               |
| I.19.01.001.013         | Hot dog                                    | 4                        | 1                                                               | 0.017                                                                     | 1                                                               |
| I.19.01.001.016         | Fish burger                                | 4                        | 1                                                               | 0.015                                                                     | 1                                                               |
| A.19.01.003             | Pasta, cooked (unspecified)                | 4                        | 1.43                                                            | 0.020                                                                     | 0.2                                                             |
| A.19.01.003.004         | Pasta, cooked, meat filling                | 4                        | 1.43                                                            | 0.020                                                                     | 0.05                                                            |
| A.19.01.003.006         | Pasta, cooked, meat and vegetable filling  | 4                        | 1.43                                                            | 0.020                                                                     | 1                                                               |
| I.19.01.003.007         | Pasta, cooked, with bolognese sauce        | 4                        | 1.43                                                            | 0.029                                                                     | 1                                                               |
| I.19.01.003.017         | Lasagna/Canelloni, with meat               | 4                        | 1.43                                                            | 0.025                                                                     | 1                                                               |
| A.19.02.003             | Rice, meat and vegetables                  | 4                        | 1                                                               | 0.013                                                                     | 1                                                               |
| A.19.03.002             | Potatoes and meat meal (unspecified)       | 4                        | 1.43                                                            | 0.019                                                                     | 0.17                                                            |
| I.19.03.002.004         | Potato sausage meal                        | 4                        | 1.43                                                            | 0.019                                                                     | 1                                                               |
| A.19.03.003             | Potatoes, meat and vegetable meal (unspecified) | 4                        | 1.43                                                            | 0.016                                                                     | 0.33                                                            |
| I.19.03.003.001         | Moussaka                                   | 4                        | 1.43                                                            | 0.016                                                                     | 1                                                               |
| A.19.06.002             | Fish and rice meal                         | 4                        | 1.43                                                            | 0.027                                                                     | 1                                                               |
### 3.11. Egg processing

This process has been adapted from the ‘EC working document on food processes in which food enzymes are used’ as the following:

_Egg processing relies on raw eggs (without shell) and/or components of egg (yolk or egg white) as raw materials and leads to the production of products such as dried or pasteurised egg products._

Following the open call for egg processing, no response was received from any stakeholder. The following input data were used to estimate dietary intake of food enzyme-TOS in foods relevant to this intended use.

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13 [https://www.efsa.europa.eu/en/consultations/call/call-input-data-exposure-assessment-food-enzymes-6th-call](https://www.efsa.europa.eu/en/consultations/call/call-input-data-exposure-assessment-food-enzymes-6th-call)
| FoodEx hierarchical code | FoodEx matrix description                          | FoodEx hierarchical level | f1 (converting treated egg component to whole liquid egg) | f2 (average fraction of egg component in respective FoodEx category) |
|--------------------------|---------------------------------------------------|--------------------------|----------------------------------------------------------|-----------------------------------------------------------------|
| A.01.05                   | Pasta (Raw) (unspecified)                         | 4                        | 1                                                        | 0.20                                                            |
| A.01.05.003               | Noodle, wheat flour, with eggs                    | 4                        | 1                                                        | 0.14                                                            |
| A.01.05.005               | Pasta, wheat flour, with eggs                     | 4                        | 1                                                        | 0.20                                                            |
| A.01.05.007               | Pasta, wheat flour, filled                        | 4                        | 1                                                        | 0.20                                                            |
| A.01.05.014               | Pasta, wheat wholemeal, with eggs                 | 4                        | 1                                                        | 0.20                                                            |
| A.01.07                   | Fine bakery wares (unspecified)                   | 4                        | 1                                                        | 0.13                                                            |
| A.01.07.001               | Pastries and cakes (unspecified)                  | 4                        | 1                                                        | 0.13                                                            |
| A.01.07.001.001           | Beignets                                          | 4                        | 1                                                        | 0.05                                                            |
| A.01.07.001.002           | Buns                                              | 4                        | 1                                                        | 0.12                                                            |
| A.01.07.001.003           | Cake from batter                                 | 4                        | 1                                                        | 0.17                                                            |
| A.01.07.001.004           | Cheese cream cake                                | 4                        | 1                                                        | 0.18                                                            |
| A.01.07.001.005           | Cheese cream sponge cake                          | 4                        | 1                                                        | 0.32                                                            |
| A.01.07.001.006           | Chocolate cake                                   | 4                        | 1                                                        | 0.10                                                            |
| A.01.07.001.007           | Chocolate cake with fruits                        | 4                        | 1                                                        | 0.15                                                            |
| A.01.07.001.008           | Cream cake                                       | 4                        | 1                                                        | 0.15                                                            |
| A.01.07.001.009           | Cream cheese cake                                | 4                        | 1                                                        | 0.18                                                            |
| A.01.07.001.010           | Cream custard cake                               | 4                        | 1                                                        | 0.17                                                            |
| A.01.07.001.011           | Cream custard sponge cake                         | 4                        | 1                                                        | 0.35                                                            |
| A.01.07.001.012           | Croissant                                        | 4                        | 1                                                        | 0.13                                                            |
| A.01.07.001.013           | Croissant, filled with chocolate                  | 4                        | 1                                                        | 0.08                                                            |
| A.01.07.001.014           | Croissant, filled with cream                      | 4                        | 1                                                        | 0.08                                                            |
| A.01.07.001.015           | Croissant, filled with jam                        | 4                        | 1                                                        | 0.08                                                            |
| A.01.07.001.016           | Croquembouche                                    | 4                        | 1                                                        | 0.17                                                            |
| A.01.07.001.017           | Doughnuts                                         | 4                        | 1                                                        | 0.03                                                            |
| A.01.07.001.018           | Éclair                                           | 4                        | 1                                                        | 0.20                                                            |
| A.01.07.001.019           | Flan                                              | 4                        | 1                                                        | 0.19                                                            |
| A.01.07.001.020           | Fruit cake                                       | 4                        | 1                                                        | 0.13                                                            |
| A.01.07.001.021           | Fruit pie                                        | 4                        | 1                                                        | 0.10                                                            |
| A.01.07.001.022           | Cheese pie                                       | 4                        | 1                                                        | 0.10                                                            |
| A.01.07.001.023           | Fruit tart                                       | 4                        | 1                                                        | 0.08                                                            |
| A.01.07.001.024           | Gingerbread                                      | 4                        | 1                                                        | 0.07                                                            |
| A.01.07.001.025           | Gougere                                          | 4                        | 1                                                        | 0.29                                                            |
| A.01.07.001.026           | Kringles                                         | 4                        | 1                                                        | 0.04                                                            |
| A.01.07.001.027           | Nut cream cake                                   | 4                        | 1                                                        | 0.12                                                            |
| A.01.07.001.028           | Pancakes                                         | 4                        | 1                                                        | 0.12                                                            |
| A.01.07.001.029           | Profiterole                                      | 4                        | 1                                                        | 0.17                                                            |
| A.01.07.001.030           | Pyramid cake                                     | 4                        | 1                                                        | 0.18                                                            |
| A.01.07.001.031           | Rhubarb flan                                     | 4                        | 3                                                        | 0.06                                                            |
| A.01.07.001.032           | Scone                                            | 4                        | 1                                                        | 0.06                                                            |
| A.01.07.001.033           | Sponge dough                                     | 4                        | 1                                                        | 0.26                                                            |
| A.01.07.001.034           | Sponge cake                                      | 4                        | 1                                                        | 0.26                                                            |
| A.01.07.001.035           | Sponge cake roll                                 | 4                        | 1                                                        | 0.23                                                            |
| A.01.07.001.036           | Muffins                                          | 4                        | 1                                                        | 0.16                                                            |
| A.01.07.001.037           | Waffles                                          | 4                        | 1                                                        | 0.14                                                            |
| A.01.07.001.038           | Apple strudel                                    | 4                        | 1                                                        | 0.04                                                            |
| FoodEx hierarchical code | FoodEx matrix description | FoodEx hierarchical level | f1 (converting treated egg component to whole liquid egg) | f2 (average fraction of egg component in respective FoodEx category) |
|-------------------------|--------------------------|--------------------------|--------------------------------------------------------|----------------------------------------------------------|
| A.01.07.001.039         | Cream-cheese strudel     | 4                        | 1                                                     | 0.01                                                     |
| A.01.07.001.040         | Cheese pastry goods from puff pastry | 4                     | 1                                                     | 0.02                                                     |
| A.01.07.001.041         | Croissant from puff pastry | 4                      | 1                                                     | 0.13                                                     |
| A.01.07.001.042         | Brioche                  | 4                        | 1                                                     | 0.14                                                     |
| A.01.07.001.043         | Macaroons                | 4                        | 1.5                                                   | 0.11                                                     |
| A.01.07.001.044         | Lebkuchen                | 4                        | 1                                                     | 0.08                                                     |
| A.01.07.001.045         | Dumpling                 | 4                        | 1                                                     | 0.18                                                     |
| A.01.07.001.046         | Cake marbled, with chocolate | 4                     | 1                                                     | 0.17                                                     |
| A.01.07.001.047         | Marzipan pie             | 4                        | 1                                                     | 0.12                                                     |
| A.01.07.002             | Biscuits (cookies) (unspecified) | 4                     | 1                                                     | 0.05                                                     |
| A.01.07.002.001         | Biscuits, sweet, plain   | 4                        | 1                                                     | 0.05                                                     |
| A.01.07.002.002         | Biscuits, chocolate filling | 4                     | 1                                                     | 0.05                                                     |
| A.01.07.002.003         | Biscuits, cream filling  | 4                        | 1                                                     | 0.05                                                     |
| A.01.07.002.004         | Biscuits, fruit filling  | 4                        | 1                                                     | 0.05                                                     |
| A.01.07.002.005         | Biscuits, vanilla filling | 4                        | 1                                                     | 0.05                                                     |
| A.01.07.002.006         | Butter biscuits          | 4                        | 1                                                     | 0.04                                                     |
| A.01.07.002.007         | Biscuit, iced            | 4                        | 1                                                     | 0.08                                                     |
| A.01.07.002.008         | Speculaas                | 4                        | 1                                                     | 0.08                                                     |
| A.01.07.002.009         | Biscuits, sweet, wheat wholemeal | 4                     | 1                                                     | 0.03                                                     |
| A.06.09.001.002         | Bratwurst                | 1.5                      | 0.052                                                 |                                                           |
| A.06.09.001.004         | Weisswurst               | 4                        | 1.5                                                   | 0.052                                                    |
| A.06.09.001.005         | Bockwurst                | 4                        | 1.5                                                   | 0.052                                                    |
| A.07.02.002             | Fishcakes                | 4                        | 1                                                     | 0.067                                                    |
| A.07.02.003             | Fish fingers             | 4                        | 1                                                     | 0.067                                                    |
| A.10.05.004             | Alcoholic sweet sauce    | 4                        | 1                                                     | 0.30                                                     |
| A.16.06                 | Dressing (unspecific)    | 4                        | 3                                                     | 0.02                                                     |
| A.16.06.001             | Salad dressing, > 50% oil | 4                      | 3                                                     | 0.05                                                     |
| A.16.06.002             | Salad dressing, 25–50% oil | 4                     | 3                                                     | 0.03                                                     |
| A.16.06.003             | Salad dressing, < 25% oil | 4                      | 3                                                     | 0.03                                                     |
| A.16.06.004             | Mayonnaise, > 50% oil    | 4                        | 3                                                     | 0.06                                                     |
| A.16.06.005             | Mayonnaise, 25–50% oil   | 4                        | 3                                                     | 0.06                                                     |
| A.16.06.006             | Mayonnaise, < 25% oil    | 4                        | 3                                                     | 0.06                                                     |
| A.19.01.003             | Pasta, cooked (unspecified) | 4                     | 1                                                     | 0.12                                                     |
| A.19.01.003.001         | Pasta, cooked, with vegetables | 4                     | 1                                                     | 0.12                                                     |
| A.19.01.003.002         | Pasta, cooked, with cheese/cream | 4                     | 1                                                     | 0.12                                                     |
| A.19.01.003.003         | Pasta, cooked, with vegetables and cheese/cream | 4                     | 1                                                     | 0.12                                                     |
| A.19.01.003.004         | Pasta, cooked, meat filling | 4                      | 1                                                     | 0.12                                                     |
| A.19.01.003.005         | Pasta, cooked, vegetable filling | 4                     | 1                                                     | 0.12                                                     |
| A.19.01.003.006         | Pasta, cooked, meat and vegetable filling | 4                     | 1                                                     | 0.12                                                     |
| A.19.05                 | Meat-based meals (unspecified) | 4                     | 1                                                     | 0.07                                                     |
| A.19.05.001             | Meat burger              | 4                        | 1                                                     | 0.07                                                     |
| A.19.05.002             | Meat balls               | 4                        | 1                                                     | 0.07                                                     |
| A.19.07.006             | Vegetable soufflé        | 4                        | 1                                                     | 0.29                                                     |
| A.19.11.003             | Prepared potato salad    | 4                        | 3                                                     | 0.006                                                    |
### 3.12. Modified lecithin production from egg

This process is not listed in the ‘EC working document on food processes in which food enzymes are used’; however, applications for this intended use were received by EFSA. For the purpose of this work, the EFSA CEP Panel considers that

> *This food manufacturing process covers any modification to lecithin designed to improve functionality.*

Lecithins (E 322) is an authorised food additive in the EU according to Annex II and Annex III to Regulation (EC) No 1333/2008 on food additives.

In the framework of Regulation (EC) No 1333/2008 on food additives and of Commission Regulation (EU) No 257/2010 regarding the re-evaluation of approved food additives, the ANS panel, in 2017, re-evaluated lecithin used as food additive and in support of this opinion issued public calls for occurrence data (usage level and/or concentration data) on lecithins (E 322). In response to this public call, updated information on the actual use levels of lecithins (E 322) in foods was made available to EFSA by industry.

Since an exposure assessment to lecithins (E 322) was carried out by the EFSA ANS panel as part of the re-evaluation programme and published in 2017, the already derived exposure estimates were combined with the food enzyme use levels in the assessment of exposure to food enzymes used in the production of lecithin.

### 3.13. Refined and unrefined sugar production

This process has been adapted from the ‘EC working document on food processes in which food enzymes are used’ as follows:

> *Sugar production relies on sugar cane and sugar beet as raw material and leads to the production of products such as, but not limited to refined sugar, sugar syrups and molasses.*

The resulting food products, refined white beet/cane sugar, are excluded from the dietary exposure calculation, as the presence of residual TOS in the refined sucrose is negligible.

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14 Available at [https://efsa.onlinelibrary.wiley.com/doi/full/10.2903/j.efsa.2017.4742](https://efsa.onlinelibrary.wiley.com/doi/full/10.2903/j.efsa.2017.4742)
This assumption was supported by information submitted by AMFEP, which included a description of the main steps employed in the sugar production from sugar beet. In case of microbial spoilage of beets, dextranase can be added to the beet juice during the diffusion step to breakdown the mucous polymers (dextrans) formed by lactic acid bacteria. During diffusion, sucrose and other beet constituents are extracted from the beet slices. The raw beet juice then undergoes liming and carbonation with carbon dioxide, during the ‘juice purification’ step. In this step, the precipitating solubles (proteins, beet minerals, amino acids, etc.) are removed from the beet juice by decantation or centrifugation. Sucrose is further purified by discoloration and crystallisation. It is assumed that at least 99% of the enzyme TOS is eliminated during the beet sugar production process.

Similarly, dextranase is used in the production of cane sugar to degrade dextran resulting from microbial spoilage. In addition, alpha-amylase is used to break down starch, present in the cane and carried over into the cane juice. The elimination of the food enzyme-TOS during the cane sugar-making process is also estimated to be at least 99%, according to the European Association of Sugar Manufacturers (CEFS). This assumption was supported by information submitted by CEFS which included a description of the main steps of the manufacturing process of both beet and cane sugar production in relation to the addition and inactivation/removal of food enzymes, and analytical data on the intermediate products and final purified white sugar. When using sucrose content as the proxy to consider the residual food enzyme-TOS, it is estimated that 98.2–99.9% (beet) and 98.7–99.8% (cane) of enzymes added to the raw material are removed in the commercial sugar. The Panel considered the evidence as sufficient to conclude that residual amounts of TOS are removed by the purification steps applied during the production of sugar (by > 98%), i.e. decantation, centrifugation, discoloration and crystallisation.

This consideration, however, is not applicable to unrefined beet/cane sugar products, including unrefined sugar, beet molasses and cane syrups. Molasses (also referred to as black treacle) is a by-product of the refined beet sugar production in the form of an uncrystallised syrup. In the EU, molasses is mainly used as animal feed and in biofuels production. However, due to its nutritional value and flavour characteristics, it has also emerged as alternative to sweeten and flavour foods, e.g. breakfast cereals, sauces, bread. Certain products, e.g. Speculaas and Lebkuchen, have traditionally been produced with molasses. Data from the CEFS on the raw beet juice suggest that the beet molasses for human consumption are at least 90% pure. No data was provided to establish the purity of cane syrups.

As the Comprehensive Database does generally not provide information on the raw material used (i.e. cane, beet) to produce the unrefined sugar products, consumption of such products could not be separated into the different categories according to plant source. While it is acknowledged that use of such products may not be equal to each other, in the absence of being able to distinguish products coming from the two different sources, dietary exposure assessment of these products was combined, and which was reflected in the undifferentiated inclusion of both the beet molasses and the unrefined cane syrup in the open call.

Following the open call, which focused on the possible intake of food enzyme-TOS via consuming unrefined beet/cane sugar products, a response was received from CEFS.

CEFS further clarified that ‘brown sugar’, which is currently not legally defined at EU level, covers a broad range of different sugars with brown colour, and which do not all correspond to raw cane sugar. According to CEFS’ members, brown sugars containing cane molasses or caramelised sugar syrup are considered to be niche products in the EU and only make up a small fraction. Such sugars were therefore excluded from the exposure assessment.

The following input data were used to estimate dietary intake of food enzyme-TOS in foods relevant to this intended use.

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15 Information on the transfer of enzymes into foods for refined sugar production and processing. October 2017.
16 Information on the transfer of enzymes into foods for refined sugar production and processing. October 2020.
17 Information on EFSA call for input data for the exposure assessment of food enzymes: refined sugar production (molasses as a by-product) CEFS comment. July 2020.
| FoodEx hierarchical code | FoodEx matrix description                  | FoodEx hierarchical level | f1 (Converting unrefined sugar product* to sugar beet or cane) | f2 (Average fraction of unrefined sugar product* in respective FoodEx category) | f3 (Percentage of FoodEx category containing unrefined sugar product*) |
|--------------------------|-------------------------------------------|---------------------------|---------------------------------------------------------------|---------------------------------------------------------------------------------|--------------------------------------------------------------------------------|
| A.01.04.001.004          | Wheat bread, brown                         | 4                         | 35                                                            | 0.01                                                                              | 0.1                                                                              |
| A.01.04.001.005          | Wheat bread, brown, gluten free            | 4                         | 35                                                            | 0.01                                                                              | 0.1                                                                              |
| A.01.04.001.006          | Wheat bread, brown, with oil seeds         | 4                         | 35                                                            | 0.01                                                                              | 0.1                                                                              |
| A.01.04.001.007          | Wheat bread, with bran                     | 4                         | 35                                                            | 0.01                                                                              | 0.1                                                                              |
| A.01.04.001.008          | Wheat bread, with oil seeds                | 4                         | 35                                                            | 0.01                                                                              | 0.1                                                                              |
| A.01.04.001.009          | Wheat germ bread                           | 4                         | 35                                                            | 0.01                                                                              | 0.1                                                                              |
| A.01.04.001.013          | Wheat rolls, brown                         | 4                         | 35                                                            | 0.01                                                                              | 0.1                                                                              |
| A.01.04.001.014          | Wheat rolls, brown and oil seeds           | 4                         | 35                                                            | 0.01                                                                              | 0.1                                                                              |
| A.01.04.001.015          | Wheat rolls, with oil seeds                | 4                         | 35                                                            | 0.01                                                                              | 0.1                                                                              |
| A.01.04.001.017          | Wheat toast bread, brown                   | 4                         | 35                                                            | 0.01                                                                              | 0.1                                                                              |
| A.01.04.002              | Rye bread and rolls                        | 3                         | 35                                                            | 0.01                                                                              | 0.1                                                                              |
| A.01.04.003              | Mixed wheat/rye bread and rolls            | 3                         | 35                                                            | 0.01                                                                              | 0.1                                                                              |
| A.01.04.004              | Multigrain bread and rolls                 | 3                         | 35                                                            | 0.01                                                                              | 0.1                                                                              |
| A.01.04.006.004          | Muesli bread                               | 4                         | 35                                                            | 0.01                                                                              | 0.1                                                                              |
| A.01.04.006.005          | Oat bread                                  | 4                         | 35                                                            | 0.01                                                                              | 0.1                                                                              |
| A.01.06.001              | Cereal flakes                              | 3                         | 35                                                            | 0.04                                                                              | 0.03                                                                             |
| A.01.06.002              | Muesli                                     | 3                         | 35                                                            | 0.001                                                                             | 0.03                                                                             |
| A.01.06.003              | Cereal bars                                | 3                         | 35                                                            | 0.001                                                                             | 0.01                                                                             |
| A.01.07.001.020          | Fruit cake                                 | 4                         | 35                                                            | 0.01                                                                              | 0.25                                                                             |
| A.01.07.001.024          | Gingerbread                                | 4                         | 35                                                            | 0.1                                                                               | 1                                                                                |
| A.01.07.001.044          | Lebkuchen                                  | 4                         | 35                                                            | 0.1                                                                               | 1                                                                                |
| A.01.07.002.008          | Speculaas                                  | 4                         | 35                                                            | 0.1                                                                               | 1                                                                                |
| A.10.04.001              | Candies, with sugar                        | 3                         | 35                                                            | 0.001                                                                             | 0.01                                                                             |
| A.10.04.011              | Liquorice candies                          | 3                         | 35                                                            | 0.001                                                                             | 0.13                                                                             |
| A.10.04.012              | Gum drops                                  | 3                         | 35                                                            | 0.001                                                                             | 0.01                                                                             |
| A.10.04.013              | Jelly candies                              | 3                         | 35                                                            | 0.001                                                                             | 0.01                                                                             |
| A.10.06.001              | Molasses                                   | 4                         | 35                                                            | 1                                                                                 | 1                                                                                |
| A.10.06.005              | Sugar beet syrup                           | 4                         | 35                                                            | 1                                                                                 | 1                                                                                |
| A.10.06.006              | Treacle                                    | 4                         | 35                                                            | 1                                                                                 | 1                                                                                |
| A.16.05.001              | Mustard, sweet                             | 3                         | 35                                                            | 0.035                                                                             | 1                                                                                |
| A.16.05.007              | Barbecue sauce                            | 3                         | 35                                                            | 0.05                                                                              | 1                                                                                |
| A.16.05.015              | Mixed condiment                            | 3                         | 35                                                            | 0.05                                                                              | 0.25                                                                             |
| A.16.08.002              | Brown sauce                                | 3                         | 35                                                            | 0.05                                                                              | 1                                                                                |
| A.19.02.002              | Rice and meat meal                         | 3                         | 35                                                            | 0.01                                                                              | 0.1                                                                              |
| A.19.02.003              | Rice, meat and vegetables meal             | 3                         | 35                                                            | 0.01                                                                              | 0.1                                                                              |
### 3.14. Hydrolysis of whey proteins for use in infant formula, follow-on formulae and food for special medical purposes

This process is included in the 'EC working document on food processes in which food enzymes are used' as part of protein processing, however, because the intended use concerns vulnerable population groups, a separate process for this intended use was established. It deals exclusively with enzymes that are used to produce whey protein hydrolysates for use in infant formula (IF), follow-on formulae (FOF) and food for special medical purposes (FSMP).

In 2014, the EFSA Scientific Committee (SC) prepared a guidance for the risk assessment of substances in food intended for infants below 16 weeks of age. This guidance was followed for the assessment of exposure to the food enzymes used in the hydrolysis of whey proteins. The Scientific Committee derived a formula consumption value of 260 mL/kg body weight (bw) per day, derived from 95th percentile consumption during the period of 14–27 days of life. This time reflects the highest relative consumption on a body weight basis and also covers the potential high consumption rates of preterm infants on enteral (formula) feeding.

The value of 260 mL/kg bw per day therefore is used to calculate exposure to food enzyme-TOS through consumption IF/FOF or FSMP, respectively.

Based on maximum energy and maximum protein content provided for IF and FOF in Regulation (EU) 2016/127, the maximum protein content per 100 ml prepared formula equates to 1.96g protein/100 ml formula. The recommended consumption value by the Scientific Committee of 260 ml/kg bw per day therefore may contain up to 5.1 g of protein.

The maximum use level expressed as mg TOS/g protein therefore allows for calculation of the exposure of an infant from consumption of 260ml formula/kg bw per day (containing 5.1 g protein).

### 3.15. Degumming of fats and oils

This process has been adapted from the 'EC working document on food processes in which food enzymes are used' as the following:

*Crude oil extracted from different plant sources (e.g. oilseeds, fruit pulps) is the principal raw material. Water refining, usually called degumming, is the treatment of crude oils and fats with a small amount of water repeatedly to remove water-soluble impurities, followed by centrifugal separation to produce refined oils. The process is applied to many oils that contain phospholipids in significant amounts.*

Vegetable oils derived through degumming are excluded from dietary exposure calculation, as the degummed oil is further washed with water and centrifuged to remove the water/gum phase. The

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18 Available at [https://efsa.onlinelibrary.wiley.com/doi/epdf/10.2903/j.efsa.2017.4849](https://efsa.onlinelibrary.wiley.com/doi/epdf/10.2903/j.efsa.2017.4849)
enzyme is retained in the water/gum phase. Repeated refining to remove impurities after degumming, filtration and purification steps also removes any residual TOS to a negligible amount.

This assumption was supported by information submitted by AMFEP together with the Federation representing the European Vegetable Oil and Protein Meal Industry in Europe,\(^\text{19}\) which included a description of the main steps of the refined vegetable oil production through enzymatic degumming in relation to the addition and inactivation/removal of food enzymes, and analytical data on the intermediate products and final ingredients. When using the total protein and true protein-specific nitrogen as the proxy to consider the residual food enzyme-TOS, it is estimated that > 99% of enzymes added to the raw material are removed during the process. The Panel considered the evidence as sufficient to conclude that residual amounts of TOS are removed by the purification steps applied during the production of vegetable fats and oils (by > 99%), i.e. repeated washing and centrifugation.

### 3.16. Modification of fats and oils by interesterification

This process has been adapted from the 'EC working document on food processes in which food enzymes are used' as the following\(^\text{20}\):

*This food manufacturing process covers any modification of oils and fats designed to improve functionality through interesterification.*

Concerning the interesterification of fats and oils, AMFEP, in October 2017, provided technical information, which indicated that (i) immobilised lipases are used for enzymatic interesterification of oil/fat, (ii) interesterification is operated as a ‘continuous’ process and (iii) 1 kg enzyme TOS is used for the production of at least 20–100 tons refined oil. Assuming that all TOS would leach into the final oil product, AMFEP estimated that 1 kg enzyme TOS/100,000 kg oil would correspond to 0.001% TOS in final oil products.\(^\text{20}\)

This information was not considered sufficient to waive the need for calculating exposure. In particular, since different approaches to immobilising food enzymes are in use, and are often specific to the individual application, the Panel decided to request the relevant technical information and/or experimental data on a case-by-case basis.

In February 2020, EFSA launched a call-for-data on interesterified fats. The input data contained a list of FoodEx categories and respective technical conversion factors. Due to the difficulty of distinguishing enzymatically interesterified fats from chemically modified vegetable fats, EFSA decided to use all vegetable fats (except fats and oils consumed as such or used as ingredient in chocolate\(^\text{21}\)) as a proxy for enzymatically interesterified fats. Consequently, the FoodEx categories cover foods that contain processed vegetable fats, such as margarine and shortening.

Following this call,\(^\text{22}\) a response was received from the EU vegetable oil and protein meal industry association (FEDIOL) with input from FoodDrinkEurope, CAOBISCO, Federation of Associations and Enterprises of Industrial Culinary Product Producers in Europe, European Snack Association, European Ice Cream Association, European Margarine Association. It is clarified that butter biscuits contain only butter as the fat component. These associations also specified the amount of enzymatically interesterified fats in margarine.\(^\text{23}\)

The following input data were used to estimate dietary exposure to food enzyme-TOS in foods relevant to this intended use.

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\(^{19}\) Information on 'Transfer of enzymes into food, for fat and oil processing'. October 2017 and February 2019.

\(^{20}\) AMFEP answer to EFSA's request for additional information on the transfer of enzymes into food, for fat and oil processing. October 2017.

\(^{21}\) Directive 2000/36/EC of the European Parliament and of the Council of 23 June 2000 relating to cocoa and chocolate products intended for human consumption (OJ L 197, 3.8.2000, p. 19) specifies that vegetable fats used in chocolate are to be obtained only by the processes of refining and/or fractionation, which excludes enzymatic modification of the triglyceride structure.

\(^{22}\) https://www.efsa.europa.eu/en/consultations/call/call-input-data-exposure-assessment-food-enzymes-5th-call

\(^{23}\) Feedback regarding FEDIOL input into the 5th EFSA call for input data for the Exposure Assessment of Food Enzymes related to fats and oils processing for interesterification. October 2020 & May 2021.
| FoodEx hierarchical code | FoodEx matrix description | FoodEx hierarchical level | f1 (Conversion from IE fats to vegetable oils) | f2 (Average fraction of vegetable fats in respective FoodEx category) |
|--------------------------|---------------------------|---------------------------|-----------------------------------------------|---------------------------------------------------|
| A.01.04                  | Bread and rolls (unspecified) | 4                         | 1                                             | 0.03                                             |
| A.01.04.001              | Wheat bread and rolls     | 3                         | 1                                             | 0.03                                             |
| A.01.04.002              | Rye bread and rolls       | 3                         | 1                                             | 0.03                                             |
| A.01.04.003              | Mixed wheat and rye bread and rolls | 3       | 1                                             | 0.03                                             |
| A.01.04.004              | Multigrain bread and rolls | 3                         | 1                                             | 0.03                                             |
| A.01.04.005              | Unleavened bread, crisp bread and rusk (unspecified) | 4       | 1                                             | 0.07                                             |
| A.01.04.005.005           | Rusk, light               | 4                         | 1                                             | 0.07                                             |
| A.01.04.005.006           | Rusk, wholemeal           | 4                         | 1                                             | 0.07                                             |
| A.01.04.005.009           | Tortilla                  | 4                         | 1                                             | 0.07                                             |
| A.01.04.006              | Other bread               | 3                         | 1                                             | 0.03                                             |
| A.01.04.007              | Bread products            | 3                         | 1                                             | 0.03                                             |
| A.01.06.002.001           | Muesli bars               | 4                         | 1                                             | 0.13                                             |
| A.01.06.003              | Cereal bars               | 3                         | 1                                             | 0.13                                             |
| A.01.07                  | Fine bakery wares (unspecified) | 4       | 1                                             | 0.10                                             |
| A.01.07.001              | Pastries and cakes (unspecified) | 4       | 1                                             | 0.10                                             |
| A.01.07.001.001           | Beignets                  | 4                         | 1                                             | 0.14                                             |
| A.01.07.001.002           | Buns                      | 4                         | 1                                             | 0.29                                             |
| A.01.07.001.003           | Cake from batter          | 4                         | 1                                             | 0.25                                             |
| A.01.07.001.004           | Cheese cream cake         | 4                         | 1                                             | 0.04                                             |
| A.01.07.001.005           | Cheese cream sponge cake  | 4                         | 1                                             | 0.15                                             |
| A.01.07.001.006           | Chocolate cake            | 4                         | 1                                             | 0.09                                             |
| A.01.07.001.007           | Chocolate cake with fruits| 4                         | 1                                             | 0.06                                             |
| A.01.07.001.009           | Cream cheese cake         | 4                         | 1                                             | 0.02                                             |
| A.01.07.001.010           | Cream custard cake        | 4                         | 1                                             | 0.19                                             |
| A.01.07.001.011           | Cream custard sponge cake | 4                         | 1                                             | 0.01                                             |
| A.01.07.001.012           | Croissant                 | 4                         | 1                                             | 0.19                                             |
| A.01.07.001.013           | Croissant, filled with chocolate | 4       | 1                                             | 0.14                                             |
| A.01.07.001.014           | Croissant, filled with cream | 4     | 1                                             | 0.14                                             |
| A.01.07.001.015           | Croissant, filled with jam | 4                         | 1                                             | 0.14                                             |
| A.01.07.001.016           | Croquembouche             | 4                         | 1                                             | 0.06                                             |
| A.01.07.001.017           | Doughnuts                 | 4                         | 1                                             | 0.06                                             |
| A.01.07.001.018           | Éclair                    | 4                         | 1                                             | 0.11                                             |
| A.01.07.001.020           | Fruit cake                | 4                         | 1                                             | 0.14                                             |
| A.01.07.001.021           | Fruit pie                 | 4                         | 1                                             | 0.17                                             |
| A.01.07.001.022           | Cheese pie                | 4                         | 1                                             | 0.18                                             |
| A.01.07.001.023           | Fruit tart                | 4                         | 1                                             | 0.10                                             |
| A.01.07.001.024           | Gingerbread               | 4                         | 1                                             | 0.19                                             |
| A.01.07.001.025           | Gougere                   | 4                         | 1                                             | 0.12                                             |
| A.01.07.001.026           | Kringles                  | 4                         | 1                                             | 0.18                                             |
| A.01.07.001.027           | Nut cream cake            | 4                         | 1                                             | 0.17                                             |
| A.01.07.001.028           | Pancakes                  | 4                         | 1                                             | 0.05                                             |
| A.01.07.001.029           | Profiterole               | 4                         | 1                                             | 0.09                                             |
| A.01.07.001.030           | Pyramid cake              | 4                         | 1                                             | 0.15                                             |
| A.01.07.001.031           | Rhubarb flan              | 4                         | 1                                             | 0.08                                             |
| A.01.07.001.032           | Scone                     | 4                         | 1                                             | 0.18                                             |
| FoodEx hierarchical code | FoodEx matrix description | FoodEx hierarchical level | f1 (Conversion from IE fats to vegetable oils) | f2 (Average fraction of vegetable fats in respective FoodEx category) |
|--------------------------|---------------------------|--------------------------|-----------------------------------------------|---------------------------------------------------------------|
| A.01.07.001.033          | Sponge dough              | 4                        | 1                                             | 0.25                                                          |
| A.01.07.001.034          | Sponge cake               | 4                        | 1                                             | 0.25                                                          |
| A.01.07.001.035          | Sponge cake roll          | 4                        | 1                                             | 0.18                                                          |
| A.01.07.001.037          | Waffles                   | 4                        | 1                                             | 0.11                                                          |
| A.01.07.001.038          | Apple strudel             | 4                        | 1                                             | 0.14                                                          |
| A.01.07.001.039          | Cream-cheese strudel      | 4                        | 1                                             | 0.17                                                          |
| A.01.07.001.040          | Cheese pastry goods from puff pastry | 4 | 1 | 0.19 |
| A.01.07.001.041          | Croissant from puff pastry | 4 | 1 | 0.19 |
| A.01.07.001.042          | Brioche                   | 4                        | 1                                             | 0.12                                                          |
| A.01.07.001.044          | Lebkuchen                 | 4                        | 1                                             | 0.19                                                          |
| A.01.07.001.045          | Dumpling                  | 4                        | 1                                             | 0.05                                                          |
| A.01.07.001.046          | Cake marbled, with chocolate | 4 | 1 | 0.18 |
| A.01.07.001.047          | Marzipan pie              | 4                        | 1                                             | 0.17                                                          |
| A.01.07.001.048          | Baklava                   | 4                        | 1                                             | 0.13                                                          |
| A.01.07.002              | Biscuits (cooking) (unspecified) | 4 | 1 | 0.20 |
| A.01.07.002.001          | Biscuits, sweet, plain    | 4                        | 1                                             | 0.20                                                          |
| A.01.07.002.002          | Biscuits, chocolate filling | 4 | 1 | 0.12 |
| A.01.07.002.003          | Biscuits, cream filling   | 4                        | 1                                             | 0.09                                                          |
| A.01.07.002.004          | Biscuits, fruit filling   | 4                        | 1                                             | 0.18                                                          |
| A.01.07.002.005          | Biscuits, vanilla filling | 4                        | 1                                             | 0.09                                                          |
| A.01.07.002.007          | Biscuit, iced             | 4                        | 1                                             | 0.17                                                          |
| A.01.07.002.008          | Speculaas                 | 4                        | 1                                             | 0.20                                                          |
| A.01.07.002.009          | Biscuits, sweet, wheat wholemeal | 4 | 1 | 0.21 |
| A.01.07.002.010          | Biscuits, oat meal        | 4                        | 1                                             | 0.21                                                          |
| A.01.07.002.011          | Biscuits, spelt meal      | 4                        | 1                                             | 0.21                                                          |
| A.01.07.002.012          | Biscuits, salty           | 4                        | 1                                             | 0.23                                                          |
| A.01.07.002.013          | Biscuits, salty, with cheese | 4 | 1 | 0.21 |
| A.01.07.002.014          | Sticks, salty             | 4                        | 1                                             | 0.07                                                          |
| A.08.09                  | Milk and milk product imitates (unspecified) | 4 | 1 | 0.01 |
| A.08.09.002              | Imitation cream           | 4                        | 1                                             | 0.29                                                          |
| A.10.03.004              | Chocolate, cream          | 3                        | 1                                             | 0.08                                                          |
| A.10.03.006              | Chocolate coated confectionery | 3 | 1 | 0.09 |
| A.10.03.007              | Filled chocolate         | 3                        | 1                                             | 0.08                                                          |
| A.10.03.010              | Pralines                  | 4                        | 1                                             | 0.10                                                          |
| A.10.03.014              | Chocolate substitutes     | 4                        | 1                                             | 0.56                                                          |
| A.10.04                  | Confectionery (non-chocolate) | 4 | 1 | 0.04 |
| A.10.04.004              | Caramel, hard             | 4                        | 1                                             | 0.04                                                          |
| A.10.04.006              | Toffee                    | 4                        | 1                                             | 0.05                                                          |
| A.10.04.007              | Fudge                     | 4                        | 1                                             | 0.05                                                          |
| A.10.04.012              | Gum drops                 | 4                        | 1                                             | 0.06                                                          |
| A.10.04.013              | Jelly candies             | 4                        | 1                                             | 0.06                                                          |
| A.10.04.014              | Nougat                    | 4                        | 1                                             | 0.02                                                          |
| A.10.04.015              | Halva                     | 3                        | 1                                             | 0.02                                                          |
| A.10.05.003              | Fudge sauce               | 4                        | 1                                             | 0.19                                                          |
| A.11.03.001              | Peanuts butter            | 4                        | 1                                             | 0.11                                                          |
| FoodEx hierarchical code | FoodEx matrix description | FoodEx hierarchical level | f1 (Conversion from IE fats to vegetable oils) | f2 (Average fraction of vegetable fats in respective FoodEx category) |
|--------------------------|--------------------------|--------------------------|---------------------------------------------|--------------------------------------------------|
| A.11.05                  | Fats of mixed origin     | 4                        | 1                                           | 0.83                                             |
| A.11.06                  | Margarine and similar products | 2                      | 1                                           | 0.06                                             |
| A.16.04.008              | Stock cubes (bouillon cube) | 4                      | 1                                           | 0.17                                             |
| A.16.08.001              | White sauce              | 3                        | 1                                           | 0.38                                             |
| A.16.08.010              | Vegetable sauce          | 3                        | 1                                           | 0.06                                             |
| A.19.01.001              | Sandwich and sandwich-like meal | 3                      | 1                                           | 0.02                                             |
| A.19.01.002              | Pizza and pizza-like pies | 3                       | 1                                           | 0.01                                             |
| A.19.03.002              | Potatoes and meat meal   | 3                        | 1                                           | 0.01                                             |
| A.19.10                  | Ready to eat soups       | 2                        | 1                                           | 0.01                                             |
| A.20.02                  | Ices and desserts (unspecified) | 4                      | 1                                           | 0.02                                             |
| A.20.02.001              | Ice cream, milk-based    | 3                        | 1                                           | 0.005                                            |
| A.20.02.002              | Ice cream, not milk-based | 3                       | 1                                           | 0.005                                            |
| A.20.02.003              | Starchy pudding          | 3                        | 1                                           | 0.06                                             |

3.17. Treatment of plant and algae for edible oil production

This process is not listed in the ‘EC working document on food processes in which food enzymes are used’, however, applications for this intended use were received by EFSA. On the basis of similarity with the fruit and vegetable processing described in the ‘EC working document on food processes in which food enzymes are used’, a definition is given as follows:

*This food process relies on oil-rich plant parts (pulp and seeds) or microalgae as the raw material and leads to the production of plant or algal oils for human consumption.*

This process allows the aqueous extraction of crude vegetable oils. The food enzyme-TOS is predominantly separated from the oil phase and stays within the aqueous phase. Residual amounts of TOS may remain in the crude oils. For crude oils that are degummed and further refined, these steps are expected to remove any residual TOS in edible vegetable oils to a negligible amount.

This assumption was supported by information submitted by AMFEP, which included (i) a process diagram showing steps from treating fruit and vegetable material with cell-wall degrading enzymes to the first extraction of crude oils; (ii) a process diagram showing steps for treating microalgae with cell-wall degrading enzymes for the extraction of crude oils; (iii) proximate analysis on the intermediate products and final algal oils; (iv) a theoretical calculation. Using the hydrophilic properties of enzymes and the residual moisture of algal oil as the proxy, it is estimated that the amount of TOS in refined edible oils would not exceed 0.0001%.

The Panel considered the evidence provided by AMFEP as sufficient to support the exclusion of refined final oil products derived from enzymatically treated plants and algae from dietary exposure calculation. However, for non-refined oils intended for human consumption, minor amounts of TOS are expected to remain in the final oil. To exclude such non-refined edible oils from exposure estimation, the applicant should provide analytical data to substantiate TOS removal of at least 99%.

3.18. Lactose hydrolysis in dairy processing

This process has been adapted from the ‘EC working document on food processes in which food enzymes are used’ as follows:

*This food process relies on milk, components of milk and processed dairy products as the principle raw material and leads to the production of dairy products with reduced lactose content.*

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24 Information on ‘Transfer of enzymes into food, as consumed in fruit and vegetable processing for vegetable oil production’. February and July 2021.
The Comprehensive Food Consumption Database currently does not provide sufficient details to identify consumers for dairy products with reduced lactose content. Nowadays, lactose-reduced products are widely available in the market. The selection of food categories was therefore based on the assumption that consumption of lactose-reduced products is similar to dairy products in general. An exception, however, was made for cheese and yoghurts, which are often naturally lactose-reduced or even lactose-free. Therefore, factor f3 has been assigned to these groups to reflect the proportion of foods within these two food categories that are likely to have been treated with a food enzyme to degrade lactose.

Feedback was also sought on which type of food categories containing whey produced from lactose-reduced milk and lactose-reduced milk powder, and in particular to specify whether lactose-reduced whey and/or lactose-reduced milk is used in the production of infant formulae and follow-on formulae.

An open call-for-data is ongoing.25

3.19. Cheese production in dairy processing

This process has been adapted from the ‘EC working document on food processes in which food enzymes are used’ as follows4:

This food process relies on milk as the principle raw material and leads to the production of cheese with whey as a by-product.

This call considers milk coagulation by enzymes and takes account of differential partition of enzymes in curd and whey. After the milk coagulation, the cheese curd is separated from the whey. Retention factors were provided by the Specialised Nutrition Europe to account for the partition of enzyme residues after the separation: 20% in curd and 80% in whey.26,27

Cheeses and food products that contain cheeses can be clearly identified in the EFSA Raw RPC model. However, this is not the case for food products containing whey as an ingredient. The selection of these food categories was aided by information available in recipes and in databases such as Mintel’s Global New Products Database. Feedback is sought, therefore, particularly on what type of food categories containing whey as an ingredient.

An open call-for-data is ongoing.28

3.20. Fruit and vegetable processing for juice production

This process has been adapted from the ‘EC working document on food processes in which food enzymes are used’ as follows4:

This food process relies on fruit and vegetable raw materials and leads to the production of juices.

Following the open call for fruit and vegetable juice production,29 feedback was received from the European Fruit Juice Association (AIJN). The following input data were used to estimate dietary exposure to food enzyme-TOS in foods relevant to this intended use.

| FoodEx hierarchical code | FoodEx matrix description                  | FoodEx hierarchical level | f1 (Converting juice ingredients to fruit or vegetable) | f2 (Average fraction of juice ingredients in respective FoodEx category) |
|--------------------------|--------------------------------------------|--------------------------|-------------------------------------------------------|------------------------------------------------------------------------|
| A.01.06.003.004          | Cereal bar, with no added sugar            | 4           | 4.50                                                   | 0.02                                                                   |
| A.01.07.001.023          | Fruit tart                                | 4           | 1.80                                                   | 0.07                                                                   |
| I.05.08.003.001          | Fruit spreads, Sirop de Liège              | 4           | 3.90                                                   | 0.55                                                                   |

25 https://www.efsa.europa.eu/en/call/call-input-data-exposure-assessment-food-enzymes-7th-call
26 Feedback from the SNE to the call for input data for the Exposure Assessment of Food Enzymes related to Protein components in infant formulae and follow-on formulae. April 2019.
27 https://www.efsa.europa.eu/en/consultations/call/call-input-data-exposure-assessment-food-enzymes-3rd-call
28 https://www.efsa.europa.eu/en/call/call-input-data-exposure-assessment-food-enzymes-8th-call
29 https://www.efsa.europa.eu/en/call/call-input-data-exposure-assessment-food-enzymes-9th-call
| FoodEx hierarchical code | FoodEx matrix description                          | FoodEx hierarchical level | f₁ (Converting juice ingredients to fruit or vegetable) | f₂ (Average fraction of juice ingredients in respective FoodEx category) |
|--------------------------|----------------------------------------------------|--------------------------|--------------------------------------------------------|-----------------------------------------------------------------------|
| I.05.08.003.004          | Fruit spreads, Jelly                               | 4                        | 1.30                                                   | 0.40                                                                   |
| A.05.09.006.001          | Canned fruit, Mandarin (Citrus reticulata)         | 4                        | 2.60                                                   | 0.01                                                                  |
| A.05.09.006.002          | Canned fruit, Apple (Malus domestica)              | 4                        | 2.60                                                   | 0.01                                                                  |
| A.05.09.006.003          | Canned fruit, Pear (Pyrus communis)                | 4                        | 2.60                                                   | 0.01                                                                  |
| A.05.09.006.004          | Canned fruit, Apricot (Prunus armeniaca)           | 4                        | 3.90                                                   | 0.10                                                                  |
| A.05.09.006.005          | Canned fruit, Plum (Prunus domestica)              | 4                        | 2.60                                                   | 0.01                                                                  |
| A.05.09.006.006          | Canned fruit, Sweet cherry (Prunus avium)          | 4                        | 2.60                                                   | 0.01                                                                  |
| A.05.09.006.007          | Canned fruit, Sour cherry (Prunus cerasus)         | 4                        | 2.60                                                   | 0.01                                                                  |
| A.05.09.006.008          | Canned fruit, Peach (Prunus persica)               | 4                        | 3.90                                                   | 0.10                                                                  |
| A.05.09.006.010          | Canned fruit, Cranberry (Vaccinium macrocarpon)    | 4                        | 2.60                                                   | 0.01                                                                  |
| A.05.09.006.011          | Canned fruit, Pineapple (Ananas comosus)           | 4                        | 5.00                                                   | 0.38                                                                  |
| A.05.09.006.012          | Canned fruit, Mixed fruit                          | 4                        | 2.60                                                   | 0.01                                                                  |
| A.05.09.009              | Fruit in vinegar, oil, or brine                    | 3                        | 3.90                                                   | 0.83                                                                  |
| I.07.02.004.003          | Fish paste, Salmon                                 | 4                        | 2.60                                                   | 0.01                                                                  |
| I.07.02.005.002          | Fish pâté, Salmon                                  | 4                        | 2.60                                                   | 0.03                                                                  |
| A.08.02.001.001          | Fruit-flavoured milk                               | 4                        | 1.30                                                   | 0.04                                                                  |
| A.08.02.002.002          | Fruit milkshake                                    | 4                        | 1.00                                                   | 0.20                                                                  |
| I.10.03.006.009          | Chocolate coated biscuit, fruit filling            | 4                        | 3.90                                                   | 0.01                                                                  |
| I.10.03.007.004          | Filled chocolate, flavoured cream                  | 4                        | 3.90                                                   | 0.01                                                                  |
| A.10.04.014              | Nougat                                             | 3                        | 8.30                                                   | 0.01                                                                  |
| I.10.05.001.002          | Fruit sauce, Lemon                                 | 4                        | 8.30                                                   | 0.02                                                                  |
| I.10.05.001.003          | Fruit sauce, Raspberry                             | 4                        | 3.90                                                   | 0.02                                                                  |
| A.10.05.004              | Alcoholic sweet sauce                              | 4                        | 2.60                                                   | 0.05                                                                  |
| A.12.01                 | Fruit juice                                        | 4                        | 1.30                                                   | 1.00                                                                  |
| A.12.01.001              | Juice, Apple                                       | 4                        | 1.31                                                   | 1.00                                                                  |
| A.12.01.002              | Juice, Orange                                      | 4                        | 1.80                                                   | 1.00                                                                  |
| A.12.01.003              | Juice, Grapefruit                                  | 4                        | 2.10                                                   | 1.00                                                                  |
| A.12.01.004              | Juice, Pineapple                                   | 4                        | 5.00                                                   | 1.00                                                                  |
| A.12.01.005              | Juice, Mango                                       | 4                        | 10.00                                                  | 1.00                                                                  |
| A.12.01.006              | Juice, Grape                                       | 4                        | 1.30                                                   | 1.00                                                                  |
| A.12.01.007              | Juice, Cranberry                                   | 4                        | 1.46                                                   | 1.00                                                                  |
| A.12.01.008              | Juice, Pomegranate                                 | 4                        | 1.30                                                   | 1.00                                                                  |
| A.12.01.009              | Juice, Peach                                       | 4                        | 1.49                                                   | 1.00                                                                  |
| A.12.01.010              | Juice, Lemon                                       | 4                        | 2.60                                                   | 1.00                                                                  |
| A.12.01.011              | Juice, Lime                                        | 4                        | 2.60                                                   | 1.00                                                                  |
| A.12.01.012              | Juice, Pear                                        | 4                        | 1.30                                                   | 1.00                                                                  |
| A.12.01.013              | Juice, Apricot                                     | 4                        | 1.49                                                   | 1.00                                                                  |
| A.12.01.014              | Juice, Nectarine                                   | 4                        | 1.30                                                   | 1.00                                                                  |
| A.12.01.015              | Juice, Blackberry                                  | 4                        | 1.30                                                   | 1.00                                                                  |
| FoodEx hierarchical code | FoodEx matrix description | FoodEx hierarchical level | f1 (Converting juice ingredients to fruit or vegetable) | f2 (Average fraction of juice ingredients in respective FoodEx category) |
|-------------------------|--------------------------|--------------------------|------------------------------------------------------|---------------------------------------------------------------|
| A.12.01.016             | Juice, Blackcurrant      | 4                        | 1.30                                                 | 1.00                                                          |
| A.12.01.017             | Juice, Prune             | 4                        | 1.30                                                 | 1.00                                                          |
| A.12.01.018             | Juice, Redcurrant        | 4                        | 1.30                                                 | 1.00                                                          |
| A.12.01.019             | Juice, Elderberry        | 4                        | 1.49                                                 | 1.00                                                          |
| A.12.01.020             | Juice, Passion fruit     | 4                        | 1.30                                                 | 1.00                                                          |
| A.12.01.021             | Juice, Guava             | 4                        | 1.30                                                 | 1.00                                                          |
| I.12.01.022             | Juice, Raspberry         | 4                        | 1.28                                                 | 1.00                                                          |
| I.12.01.023             | Juice, Cherry            | 4                        | 1.30                                                 | 1.00                                                          |
| I.12.01.024             | Juice, Strawberry        | 4                        | 1.28                                                 | 1.00                                                          |
| I.12.01.025             | Juice, Mandarin          | 4                        | 2.20                                                 | 1.00                                                          |
| I.12.01.026             | Juice, kiwi              | 4                        | 1.30                                                 | 1.00                                                          |
| I.12.01.027             | Juice, Blueberry         | 4                        | 1.30                                                 | 1.00                                                          |
| A.12.02                 | Concentrated fruit juice (unspecified) | 4                  | 3.90                                                 | 1.00                                                          |
| A.12.02.001             | Juice concentrate, Strawberries | 4          | 3.90                                                 | 1.00                                                          |
| A.12.02.002             | Juice concentrate, Raspberries | 4                   | 3.90                                                 | 1.00                                                          |
| A.12.02.003             | Juice concentrate, Blackberries | 4             | 3.90                                                 | 1.00                                                          |
| A.12.02.004             | Juice concentrate, Currants (red) | 4          | 3.90                                                 | 1.00                                                          |
| A.12.02.005             | Juice concentrate, Currants (black) | 4           | 3.90                                                 | 1.00                                                          |
| A.12.02.006             | Juice concentrate, Gooseberries | 4           | 3.90                                                 | 1.00                                                          |
| A.12.02.007             | Juice concentrate, Cranberries | 4            | 3.90                                                 | 1.00                                                          |
| A.12.02.008             | Juice concentrate, Blueberries | 4          | 3.90                                                 | 1.00                                                          |
| A.12.02.009             | Juice concentrate, Apricots | 4             | 3.90                                                 | 1.00                                                          |
| A.12.02.010             | Juice concentrate, Plums  | 4                        | 3.90                                                 | 1.00                                                          |
| A.12.02.011             | Juice concentrate, Peaches | 4             | 3.90                                                 | 1.00                                                          |
| A.12.02.012             | Juice concentrate, Sweet cherry | 4         | 3.90                                                 | 1.00                                                          |
| A.12.02.013             | Juice concentrate, Oranges | 4              | 10.00                                                | 1.00                                                          |
| A.12.02.014             | Juice concentrate, Mandarins | 4            | 6.60                                                 | 1.00                                                          |
| I.12.02.015             | Juice concentrate, Rosehip | 4             | 3.90                                                 | 1.00                                                          |
| I.12.02.016             | Juice concentrate, Apple  | 4                        | 4.50                                                 | 1.00                                                          |
| I.12.02.017             | Juice concentrate, Lemon  | 4                        | 8.30                                                 | 1.00                                                          |
| I.12.02.018             | Juice concentrate, Pear   | 4                        | 3.90                                                 | 1.00                                                          |
| I.12.02.019             | Juice concentrate, Quince  | 4                         | 3.90                                                  | 1.00                                                          |
| I.12.02.020             | Juice concentrate, Lime   | 4                        | 8.30                                                 | 1.00                                                          |
| I.12.02.021             | Juice concentrate, Passion fruit | 4          | 3.90                                                 | 1.00                                                          |
| I.12.02.022             | Juice concentrate, Mango  | 4                        | 30.00                                                | 1.00                                                          |
| I.12.02.023             | Juice concentrate, Papaya  | 4                      | 3.90                                                 | 1.00                                                          |
| I.12.02.024             | Juice concentrate, Mixed fruit | 4         | 3.90                                                 | 1.00                                                          |
| A.12.03                 | Fruit nectar (unspecified) | 4             | 1.30                                                 | 0.25                                                          |
| A.12.03.001             | Nectar, Mango             | 4                        | 10.00                                                | 0.25                                                          |
| A.12.03.002             | Nectar, Peach             | 4                        | 1.30                                                 | 0.50                                                          |
| A.12.03.003             | Nectar, Pear              | 4                        | 1.30                                                 | 0.50                                                          |
| A.12.03.004             | Nectar, Orange            | 4                        | 1.80                                                 | 0.50                                                          |
| A.12.03.005             | Nectar, Pineapple         | 4                        | 5.00                                                 | 0.50                                                          |
| A.12.03.006             | Nectar, Banana            | 4                        | 1.30                                                 | 0.25                                                          |
| A.12.03.007             | Nectar, Apple             | 4                        | 1.50                                                 | 0.50                                                          |
| FoodEx hierarchical code | FoodEx matrix description | FoodEx hierarchical level | f1 (Converting juice ingredients to fruit or vegetable) | f2 (Average fraction of juice ingredients in respective FoodEx category) |
|--------------------------|---------------------------|---------------------------|--------------------------------------------------------|-------------------------------------------------|
| I.12.03.008              | Nectar, Apricot           | 4                         | 1.30                                                   | 0.40                                            |
| I.12.03.009              | Nectar, Blackcurrant      | 4                         | 1.30                                                   | 0.25                                            |
| I.12.03.010              | Nectar, Cherry            | 4                         | 1.30                                                   | 0.40                                            |
| I.12.03.011              | Nectar, Cranberry         | 4                         | 1.30                                                   | 0.30                                            |
| I.12.03.012              | Nectar, Grape             | 4                         | 1.30                                                   | 0.25                                            |
| I.12.03.013              | Nectar, Lemon             | 4                         | 2.60                                                   | 0.25                                            |
| I.12.03.014              | Nectar, Redcurrant        | 4                         | 1.30                                                   | 0.25                                            |
| I.12.03.015              | Nectar, Mixed fruit       | 4                         | 1.30                                                   | 0.25                                            |
| I.12.03.015.001          | Nectar, Berries           | 4                         | 1.30                                                   | 0.25                                            |
| I.12.03.015.002          | Nectar, Carrot–orange–lemon | 4                    | 1.30                                                   | 0.25                                            |
| I.12.03.015.003          | Nectar, Apricot–orange    | 4                         | 1.30                                                   | 0.25                                            |
| I.12.03.016              | Nectar, other             | 3                         | 1.30                                                   | 0.25                                            |
| A.12.04                  | Mixed fruit juice         | 2                         | 1.30                                                   | 1.00                                            |
| A.12.05                  | Dehydrated/powdered fruit juice | 2                      | 10.00                                                  | 1.00                                            |
| A.12.06                  | Vegetable juice           | 2                         | 1.30                                                   | 1.00                                            |
| A.12.07                  | Mixed vegetable juice     | 2                         | 1.30                                                   | 1.00                                            |
| A.12.08                  | Mixed fruit and vegetable juice | 2                    | 1.30                                                   | 1.00                                            |
| A.13.01.001.001          | Fruit soft drink, Currant red | 4                      | 1.30                                                   | 0.10                                            |
| A.13.01.001.002          | Fruit soft drink, Currant white | 4                       | 1.30                                                   | 0.10                                            |
| A.13.01.001.003          | Fruit soft drink, Gooseberry | 4                 | 1.50                                                   | 0.10                                            |
| A.13.01.001.004          | Fruit soft drink, Grape red | 4                        | 1.30                                                   | 0.10                                            |
| A.13.01.001.005          | Fruit soft drink, Grape white | 4                  | 1.30                                                   | 0.10                                            |
| A.13.01.001.006          | Fruit soft drink, Grapefruit | 4                        | 2.10                                                   | 0.10                                            |
| A.13.01.001.007          | Fruit soft drink, Mango   | 4                         | 10.00                                                  | 0.10                                            |
| A.13.01.001.010          | Fruit soft drink, Orange  | 4                         | 1.80                                                   | 0.10                                            |
| A.13.01.001.011          | Fruit soft drink, Papaya  | 4                         | 1.30                                                   | 0.10                                            |
| A.13.01.001.012          | Fruit soft drink, Peach   | 4                         | 1.30                                                   | 0.10                                            |
| A.13.01.001.013          | Fruit soft drink, Pear    | 4                         | 1.30                                                   | 0.10                                            |
| A.13.01.001.014          | Fruit soft drink, Pineapple | 4                       | 5.00                                                   | 0.10                                            |
| A.13.01.001.015          | Fruit soft drink, Plum/prune | 4                    | 1.30                                                   | 0.10                                            |
| A.13.01.001.016          | Fruit soft drink, Pomegranate | 4                       | 1.30                                                   | 0.10                                            |
| A.13.01.001.017          | Fruit soft drink, Rasperry | 4                       | 1.30                                                   | 0.10                                            |
| A.13.01.001.020          | Fruit soft drink, mixed fruit | 4                  | 1.30                                                   | 0.10                                            |
| A.13.01.001.021          | Fruit soft drink, mixed fruit, with sweetener | 4           | 1.30                                                   | 0.10                                            |
| I.13.01.001.022          | Fruit soft drink, Apple   | 4                         | 1.50                                                   | 0.10                                            |
| I.13.01.001.023          | Fruit soft drink, Lemon   | 4                         | 2.60                                                   | 0.10                                            |
| I.13.01.001.024          | Fruit soft drink, Blackcurrant | 4                   | 1.30                                                   | 0.10                                            |
| I.13.01.001.025          | Cordial, Mixed fruit      | 4                         | 1.30                                                   | 0.10                                            |
| A.13.01.002              | Soft drink, flavoured     | 4                         | 1.30                                                   | 0.01                                            |
| A.13.01.002.001          | Soft drink with bitter principle | 4                 | 2.60                                                   | 0.01                                            |
| A.13.01.002.002          | Soft drink, apple flavour | 4                         | 1.50                                                   | 0.01                                            |
| A.13.01.002.003          | Soft drink, apricot flavour | 4                      | 1.30                                                   | 0.01                                            |
| A.13.01.002.004          | Soft drink, banana flavour | 4                       | 1.30                                                   | 0.01                                            |
| A.13.01.002.005          | Soft drink, cherry flavour | 4                       | 1.30                                                   | 0.01                                            |
| A.13.01.002.006          | Soft drink, flavoured with herbs | 4            | 1.30                                                   | 0.01                                            |
| FoodEx hierarchical code | FoodEx matrix description                      | FoodEx hierarchical level | \( f_1 \) (Converting juice ingredients to fruit or vegetable) | \( f_2 \) (Average fraction of juice ingredients in respective FoodEx category) |
|-------------------------|------------------------------------------------|--------------------------|---------------------------------------------------------------|--------------------------------------------------------------------------------|
| A.13.01.002.007         | Soft drink, grapefruit flavour                 | 4                        | 2.10                                                          | 0.01                                                                          |
| A.13.01.002.008         | Soft drink, lemon flavour                     | 4                        | 2.60                                                          | 0.01                                                                          |
| A.13.01.002.009         | Soft drink, lime flavour                      | 4                        | 2.60                                                          | 0.01                                                                          |
| A.13.01.002.010         | Soft drink, mixed flavours                    | 4                        | 1.30                                                          | 0.01                                                                          |
| A.13.01.002.011         | Soft drink, orange flavour                    | 4                        | 1.80                                                          | 0.01                                                                          |
| A.13.01.002.012         | Soft drink, pear flavour                      | 4                        | 1.30                                                          | 0.01                                                                          |
| A.13.01.002.013         | Soft drink, pineapple flavour                 | 4                        | 5.00                                                          | 0.01                                                                          |
| A.13.01.002.014         | Soft drink, raspberry flavour                 | 4                        | 1.30                                                          | 0.01                                                                          |
| A.13.01.002.015         | Soft drink, mango flavour                     | 4                        | 10.00                                                         | 0.01                                                                          |
| A.13.01.007             | Cola Mix                                       | 4                        | 1.30                                                          | 0.02                                                                          |
| I.14.01.006             | Beer with limonade 1/1                        | 3                        | 2.60                                                          | 0.05                                                                          |
| I.14.07.001.002         | Pina colada                                    | 4                        | 5.00                                                          | 0.59                                                                          |
| A.14.07.002             | Punch                                          | 3                        | 1.30                                                          | 0.03                                                                          |
| A.14.07.003             | Alcopop                                        | 3                        | 1.30                                                          | 0.03                                                                          |
| A.16.05.013             | Salsa                                          | 3                        | 1.30                                                          | 0.03                                                                          |
| A.16.05.014             | Tartar sauce                                   | 3                        | 8.30                                                          | 0.01                                                                          |
| A.16.06                 | Dressing                                       | 2                        | 8.30                                                          | 0.01                                                                          |
| A.16.07.006             | Piccalilli                                     | 3                        | 8.30                                                          | 0.05                                                                          |
| I.16.08.003.009         | Cream sauce, tzatziki                          | 4                        | 8.30                                                          | 0.01                                                                          |
| A.16.08.004             | Butter sauce                                   | 3                        | 8.30                                                          | 0.01                                                                          |
| I.16.08.005.001         | Sauce béarnaise                                | 4                        | 8.30                                                          | 0.01                                                                          |
| I.16.08.005.002         | Sauce hollandaise                              | 4                        | 8.30                                                          | 0.01                                                                          |
| I.16.08.006.001         | Aioli/Garlic sauce                             | 4                        | 8.30                                                          | 0.01                                                                          |
| I.16.08.009.003         | Tuna sauce                                     | 4                        | 8.30                                                          | 0.01                                                                          |
| I.16.08.010.009         | Tomato sauce                                   | 4                        | 8.30                                                          | 0.01                                                                          |
| I.16.08.010.010         | Guacamole sauce                                | 4                        | 8.30                                                          | 0.01                                                                          |
| A.17.08.001             | Fruit juice for infants and young children     | 3                        | 1.30                                                          | 1.00                                                                          |
| A.17.08.002             | Fruit nectar for infants and young children    | 3                        | 1.30                                                          | 0.25                                                                          |
| A.17.08.004             | Tee and juice mixture for infants and young children | 3                | 1.30                                                          | 0.50                                                                          |
| A.18.04.005             | Fruit-based beverages for diabetics            | 3                        | 1.30                                                          | 1.00                                                                          |
| A.19.06.002             | Fish and rice meal                             | 3                        | 2.60                                                          | 0.01                                                                          |
| I.19.06.003.001         | Fish and vegetable gratin                      | 4                        | 2.60                                                          | 0.01                                                                          |
| I.19.06.006             | Salmon en croute                               | 3                        | 2.60                                                          | 0.01                                                                          |
| I.19.06.007             | Fish gratin                                    | 3                        | 2.60                                                          | 0.01                                                                          |
| A.19.10.001             | Vegetable/herb soup                            | 3                        | 3.90                                                          | 0.01                                                                          |
| A.19.10.005             | Fish soup                                      | 3                        | 2.60                                                          | 0.01                                                                          |
| I.19.10.011             | Vegetable broth                                | 3                        | 3.90                                                          | 0.01                                                                          |
| A.19.11.009             | Prepared fish salad                            | 3                        | 2.60                                                          | 0.01                                                                          |
| A.20.02.005             | Sorbet                                         | 3                        | 2.60                                                          | 0.34                                                                          |
| I.20.02.006.001         | Jelly dessert                                  | 4                        | 1.30                                                          | 0.02                                                                          |
| I.20.02.006.002         | Rote grütze                                    | 4                        | 2.60                                                          | 0.09                                                                          |
| A.20.02.007             | Granita                                        | 3                        | 1.30                                                          | 0.41                                                                          |
3.21. **Fruit and vegetable processing for products other than juices**

This process has been adapted from the ‘EC working document on food processes in which food enzymes are used’ as follows:

*This food process relies on fruit and vegetable raw materials and leads to the production of products such as but not limited to purées, compotes, jams, jellies and marmalades, canned fruits and vegetables, and other fruit and vegetable preparations.*

An open call-for-data is ongoing.\(^{30}\)

3.22. **Alcoholic beverages derived from fruit other than grapes**

This process is defined according to the ‘EC working document on food processes in which food enzymes are used’ as the following:

*Fruit derived alcoholic beverages processing relies on fruit raw materials other than grapes and leads to the production of an alcoholic beverage obtained by the complete or partial fermentation of the juice, the pulp of fresh fruits, or reconstituted concentrated fruit juice.*\(^{31}\)

An open call-for-data is ongoing.\(^{30}\)

3.23. **Processing of tea, herbal and fruit infusions**

This process is described in the ‘EC working document on food processes in which food enzymes are used’ as follows:

*Tea processing relies on leaves and tender shoots of varieties of the species *Camellia sinensis* (L.) O. Kuntze as the raw material for manufacture of leaf tea and aqueous extracts of tea (including dried extracts).*

*Herbal and fruit infusions processing rely on plants or parts of plants that do not originate from the tea plant (*Camellia sinensis* (L.) O. Kuntze) as the raw material for manufacture of herbal and fruit infusions including dried extracts.*

An open call-for-data is ongoing.\(^{32}\)

3.24. **Fermented dairy products**

This process has been adapted from the ‘EC working document on food processes in which food enzymes are used’ as follows:

*This food process relies on milk as the principle raw material and leads to the production of fermented products such as, but not limited to, yoghurt, sour cream and buttermilk.*

An open call-for-data is ongoing.\(^{33}\)

3.25. **Manufacture of enzyme-modified dairy ingredients**

This process has been adapted from the ‘EC working document on food processes in which food enzymes are used’ as follows:

*This food process relies on dairy products to which enzymes are added with the intention of modifying sensory properties.*

This process considers the production of Enzyme Modified Dairy Ingredients (EMDI). EMDI are flavoured ingredients derived by enzymatic processes from dairy ingredients such as cheese, butter, cream. The selection of food groups that contain EMDI as an ingredient could not be clearly identified in the EFSA RPC model. Therefore, the selection of these food categories was aided by information

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\(^{30}\) [https://www.efsa.europa.eu/en/call/call-input-data-exposure-assessment-food-enzymes-10th-call](https://www.efsa.europa.eu/en/call/call-input-data-exposure-assessment-food-enzymes-10th-call)

\(^{31}\) The term 'fruit derived alcoholic beverages' is defined in the European Cider and Fruit Wine Association (AICV) voluntary ingredient listing & nutrition information: production process for cider and fruit wine (available online: [https://ec.europa.eu/food/system/files/2018-03/fs_labeling-nutrition_legis_alcohol-self-regulatory-proposal_cider_en.pdf](https://ec.europa.eu/food/system/files/2018-03/fs_labeling-nutrition_legis_alcohol-self-regulatory-proposal_cider_en.pdf)).

\(^{32}\) [https://www.efsa.europa.eu/en/call/call-input-data-exposure-assessment-food-enzymes-11th-call](https://www.efsa.europa.eu/en/call/call-input-data-exposure-assessment-food-enzymes-11th-call)

\(^{33}\) [https://www.efsa.europa.eu/en/call/call-input-data-exposure-assessment-food-enzymes-12th-call](https://www.efsa.europa.eu/en/call/call-input-data-exposure-assessment-food-enzymes-12th-call)
from literatures and in the GNPD database. The keywords ‘flavour’, ‘natural flavour’ and their variants were used in the search.

An open call-for-data is ongoing.34

References

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Abbreviations

AICV European Cider and Fruit Wine Association
ADJN European Fruit Juice Association
AMFEP European Association of Manufacturers and Formulators of Enzyme Products
ANS EFSA Panel Food Additives and Nutrient Sources Added to Food
CAOBISCO Association of Chocolate, Biscuits and Confectionery Industries of Europe
CEF EFSA Panel on Food Contact Materials, Enzymes, Flavourings and Processing Aids
CEFS European Association of Sugar Manufacturers
CEP EFSA Panel on Food Contact Materials, Enzymes and Processing Aids
EMDI Enzyme Modified Dairy Ingredients
FAIM Food Additive Intake Model
FAO Food and Agricultural Organization of the United Nations
FEDIOL EU vegetable oil and protein meal industry association
FEIM Food Enzyme Intake Models
FOF Follow-on Formulae
FSMP Food for Special Medical Purposes
GNPD Global New Products Database
IF Infant Formula
RPC Raw primary commodity
SC EFSA Scientific Committee
TOS Total organic solids

34 https://www.efsa.europa.eu/en/call/call-input-data-exposure-assessment-food-enzymes-13th-call