Appendix AA Calculation of free sugars and AOAC fibre in the NDNS RP

AA.1 The NDNS Nutrient Databank (NDB)

Intakes of nutrients are calculated from the food consumption records using a Nutrient Databank (NDB) that has been specially adapted for the NDNS RP. The NDB was originally developed by the Ministry of Agriculture, Fisheries and Food (MAFF) for the series of NDNS surveys of population age groups carried out from the late 1980s and 1990s, transferring to the Food Standards Agency (FSA) in 2000. The NDB was updated for the start of the NDNS RP in 2007/08 and annually thereafter. Responsibility for the NDB transferred to Public Health England in 2013 alongside responsibility for management of the survey.

Each food on the NDB has values assigned for over 50 nutrients including energy. The nutrient values assigned to the food codes are based on data from PHE's nutrient analysis surveys as well as nutritional information provided on food labels. The vast majority of food codes are generic (covering a range of brands of a single product type) rather than brand-specific. For homemade recipes and some manufactured products, nutrients are calculated from their constituent foods using the automated computer recipe feature of the coding program that allows adjustments to be made for weight and vitamin losses on cooking.

Each year of the NDNS RP is coded separately using a contemporaneous version of the NDB. During each survey year the NDB is updated which includes the addition of new foods as well as revision of the nutrient composition of existing foods based on product label data to take account of reformulation by manufacturers, for example to reduce salt or sugar content, and changes in fortification practices. Foods may also be updated with new analytical data from PHE's nutrient analysis surveys. Therefore the same food codes may have a different composition for some nutrients in one year of the NDNS RP compared to the next. Further details of the NDB can be found in appendix A.

Prior to Year 8 (2015/16) of the NDNS RP, free sugars and AOAC fibre values were not included in the NDB as sugar and fibre were reported as non-milk extrinsic sugars (NMES) and non-starch polysaccharides (NSP) respectively. In 2015 the Scientific Advisory Committee on Nutrition (SACN) published its review of the latest

evidence on carbohydrates and health.[1] As part of this review SACN recommended that free sugars and AOAC fibre, as defined in their report, should be adopted in the UK, replacing NMES and NSP on which previous government recommendations were based. In order to populate the NDB with free sugars and AOAC fibre values for food codes consumed in NDNS RP Years 1 to 8, the following methods were applied.

AA.2 Definition of free sugars

The definition of free sugars as described by SACN includes all monosaccharides and disaccharides added to foods by the manufacturer, cook or consumer, plus sugars naturally present in honey, syrups and unsweetened fruit juices. Under this definition, lactose (milk sugar) when naturally present in milk and milk products and sugars contained within the cellular structure of foods (particularly fruits and vegetables) are excluded. [1,2] Following further advice from SACN on processed fruit and vegetables,[3] PHE expanded the broad definition set by SACN into a set of working principles for estimating the free sugar content of foods in a consistent, transparent way.[4] PHE's definition of free sugars is given in table AA.1.

Table AA.1 Sugar sources included and excluded from the estimation of free sugars for the purposes of estimating intakes in the NDNS RP

Included in the definition of free sugars	**Excluded** from the definition of free sugars
All added sugar in whatever form, including honey, syrups and nectars whether added to products during manufacture or by the consumer during cooking or at the table. This includes ingredients such as malt extract and glucose syrup	Ingredients not included in the definition of sugar as it appears on the nutrition panel, such as maltodextrins, oligofructose and sugar substitutes such as polyols (sorbitol)
Lactose and galactose added as an ingredient to foods or drinks, including lactose in whey powder added as an ingredient	Lactose and galactose when naturally present in milk and dairy products including milk powder
All the sugars naturally present in fruit and vegetable juices, concentrates, smoothies, purees, pastes, powders and extruded fruit	All the sugars naturally present in fresh and most types of processed (dried, stewed, canned, frozen) fruit

and vegetable products This includes pureed legumes (hummus), pureed dried fruits and juice or syrup present in canned fruits/vegetables	and vegetables except for juices, smoothies, purees, pastes and extruded products Fruit and vegetables were defined in line with the definition used for 5 A Day so the sugars in powdered and pureed potatoes and other starchy staples were excluded from free sugars
All sugars in drinks except for milk and other dairy-based drinks. Including: - all sugars in unsweetened fruit and vegetable juices, fruit and vegetable juice concentrates and smoothies - all sugars in alcoholic drinks - all sugars naturally present in dairy-alternative drinks such as soya, rice, oat and nut-based drinks	Lactose and galactose naturally present in milk and other dairy-based drinks
	All sugars naturally present in cereal grains including rice, pasta and flour), regardless of processing (other than cereal-based drinks)
	All sugars naturally present in nuts and seeds regardless of processing (other than nut-based drinks). This includes coconut milk consumed as an ingredient and nut butters

AA.3 Methodology for estimating free sugar values in the NDB

Given the variety of free sugar sources and complexity of their estimation, a recipe approach was used to calculate free sugars values in composite foods containing more than one source of sugars. This approach enabled a more accurate and flexible estimation of free sugars especially for complex foods which include a combination of free and non-free sugars derived from various ingredients. Furthermore, this approach enabled commonly used ingredients containing free sugars (e.g. table sugar) to be assigned only once.

Firstly, a free sugars database was created whereby every food code in the NDB was assigned a recipe giving a breakdown of ingredients and proportions as well as a set of nutrients, including total sugar. The proportions of ingredients were based on the FSA recipes database which includes recipes derived from foods consumed for all UK nutrition surveys from 1992.[5]

The nutrition information and the ingredient list taken from food packaging was used to guide the estimation of the proportion of ingredients for manufactured foods.[5]

Secondly, for each ingredient it was decided whether the total sugar should be assigned to free sugars based on the definition of free sugars (see table AA.1). If the ingredient fell within the definition of free sugars, the total sugar was assigned to the relevant free sugar components listed below:

- free sugars from added sugar (table sugar)
- free sugars from other added sugars (e.g. sugar based sweeteners such as fructose, lactose, maltodextrin, syrups)
- free sugars from honey
- free sugars in fruit juice
- free sugars in fruit puree
- free sugars in vegetable puree and juice

For example, a sugar sweetened yogurt with strawberry has the ingredients “yogurt” (85%), “strawberry puree” (10%) and “table sugar” (5%). Strawberry puree has a total sugars content of 9.7g/100g, so 9.7g/100g was assigned to the “free sugars in fruit puree” component. Table sugar has a total sugars content of 100g/100g, so all of the sugar was assigned to the “free sugars from added sugar” component. Plain yogurt has no free sugars.

Thirdly, a calculation programme was run to generate the value of each free sugar component in the whole recipe based on the proportion of each ingredient. So for the strawberry fruit yogurt, if 10% of the product is strawberry puree, then 0.97g is “free sugars in fruit puree” in the recipe. If 5% of the product is table sugar, then 5g is “free sugars from added sugar” in the recipe. Ultimately, the individual free sugar components (0.97g and 5g) were summated to give an estimated overall free sugars content of 5.97g in 100g of sugar sweetened yogurt with strawberry. This calculation was applied to all recipes in the free sugars database and values were sense checked.

Once a review of all codes had been completed, the free sugars value for each recipe in the free sugars database was transferred to the NDNS RP Year 8 NDB by a proportioning approach. For example, in the free sugars database if “yogurt with fruit” has a total sugar value of 10g/100g and a free sugar value of 5g/100g, 50% of the total sugar is free sugar (the other 50% is naturally occurring lactose and galactose). If the same code in the NDB has 15g/100g of total sugar, then 50% of this is assigned as free sugar.

It was not practical in the time available to undertake separate calculations for the free sugar content of food codes for each previous year of the RP. Therefore the assumption was made that the free sugars content as a proportion of total sugars in any food code in Years 1 to 7 (2008/09- 2014/15) was the same as in Year 8. The free sugars content of foods consumed in Years 1 to 7 were calculated from total sugar using the same proportion of free sugar as in the Year 8 code. This means that the free sugar values assigned for Years 1 to 8 do not reflect changes in the proportion of free sugar in products which may have changed over time due to reformulation. For Year 9 onwards, free sugars have been incorporated into the regular programme of updates as described in appendix A.

AA.4 Assumptions made to estimate free sugars in the NDNS RP

When using the methodology described above (section AA.3) to estimate free sugar values, a number of assumptions were made to keep the process manageable.

- All sugars in jams, marmalades and fruit spreads have been included in the estimation of free sugars on the basis that the cellular structure of the fruit in such products is predominantly broken down and the proportion of sugars naturally present from the fruit is small in comparison to the amount of added sugar.

- Minor ingredients (less than 0.5% of the product) considered to have a low free sugar content, were excluded from the calculation, for example a ready-to-eat beef stew containing 0.2g of garlic puree.
- Sugars in herbs and spices were generally excluded from the free sugar calculation as their contribution would be negligible. In products where herbs were present in larger quantities such as pesto they were taken into account.
- For soups containing vegetables it was assumed that all the vegetables were pureed or blended (as in a smooth soup) unless it was feasible to estimate the proportion of intact vegetables based on knowledge of the range of products available. The same approach was used for fruit yogurts and similar products.

AA.5 Definition of AOAC fibre

The definition of AOAC fibre is dietary fibre which is measured by analytical AOAC methods.[6] AOAC methods capture resistant starch and lignin in the estimation of total fibre, as well as non-starch polysaccharides (NSP). PHE's nutrient analysis projects since 2007 have used method AOAC 985.29/45.4.07. More recent AOAC methods measure all resistant starches and low molecular weight dietary fibres such as non-digestible oligosaccharides and inulin.

AA.6 Methodology for estimating AOAC fibre values in the NDB

As the first step, analytical data for AOAC fibre from UK nutrient analysis projects were assigned to food codes where available. This included data available from 2 recent nutrient analysis projects on fruit and vegetables, analytical projects carried out since 2008 on processed foods, biscuits, buns, cakes and pastries and fish and fish products and earlier analytical projects including those on bread and morning goods, pasta and pasta sauces and flour, rice and other grains, carried out since the late 1990s.[7] AOAC fibre data for foods that were similar to those derived from these analyses were extrapolated using the NSP ratios of the food code to be updated and the analysed food.

To populate the food codes which had no analytical values, data was compiled by using a food group approach as described below.

- Food groups containing no NSP, such as fat spreads and soft drinks, were assumed to contain no AOAC fibre.
- In addition to the analytical data described above, a limited number of other AOAC fibre values were published in McCance and Widdowson's composition of foods integrated dataset (CoFID)[8] and these were used as appropriate. Values were also derived from non-UK food composition databases such as the USDA database.[9]

- AOAC fibre values from food labels were used for packaged foods where available.
- For the remaining food codes where neither analytical values nor nutrition label values were available, AOAC values were calculated either from recipes in the FSA recipe database or using the standard conversion factor 1.33 to convert NSP to AOAC fibre.[10]

The values derived from this process were used to calculate AOAC fibre values for complex foods (recipes) in the NDNS RP Year 8 NDB. The new AOAC fibre values were sense checked against a range of other data sources. The same AOAC fibre values were used in each survey year (NDNS RP Years 1 to 7 (2008/09- 2014/15)) of the NDB, so this does not take into account any changes in fibre content of foods over time due to reformulation. For Year 9 onwards, free sugars have been incorporated into the regular programme of updates as described in appendix A.

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