Improving food composition data by standardizing calculation methods

Improving food composition data by standardizing calculation methods

Veronica Öhrvik, Monica Hauger Carlsen, Anna Källman and Thea Amalie Martinsen

TemaNord 2015:568

Improving food composition data by standardizing calculation methods
Veronica Öhrvik, Monica Hauger Carlsen, Anna Källman and Thea Amalie Martinsen

ISBN 978-92-893-4310-7 (PRINT)
ISBN 978-92-893-4312-1 (PDF)
ISBN 978-92-893-4311-4 (EPUB)

http://dx.doi.org/10.6027/TN2015-568
TemaNord 2015:568
ISSN 0908-6692

Layout: Hanne Lebech
Cover photo: ImageSelect

Print: Rosendahls-Schultz Grafisk
Printed in Denmark

This publication has been published with financial support by the Nordic Council of Ministers. However, the contents of this publication do not necessarily reflect the views, policies or recommendations of the Nordic Council of Ministers.

www.norden.org/nordpub

Nordic co-operation
Nordic co-operation is one of the world's most extensive forms of regional collaboration, involving Denmark, Finland, Iceland, Norway, Sweden, and the Faroe Islands, Greenland, and Åland.

Nordic co-operation has firm traditions in politics, the economy, and culture. It plays an important role in European and international collaboration, and aims at creating a strong Nordic community in a strong Europe.

Nordic co-operation seeks to safeguard Nordic and regional interests and principles in the global community. Common Nordic values help the region solidify its position as one of the world's most innovative and competitive.

Nordic Council of Ministers
Ved Stranden 18
DK-1061 Copenhagen K
Phone (+45) 3396 0200

www.norden.org

Contents

Preface

The project "Improving food composition data" was carried out 2014–2015 with financial support from the Nordic Council of Ministers. The aim of the project was to improve accuracy in food composition data by developing and implementing standardized methods to calculate nutrient content in foods, both industrial made products and homemade dishes.

The projectgroup consisted of members from Norway and Sweden:

Livsmedelsverket, Sweden
- Anna Källman.
- Cecilia Axelsson.
- Marianne Axelsson.
- Veronica Öhrvik (project leader).

Mattillsynet, Norway
- Ellen Kielland.
- Jorån Osterholt Dalane.

Oslo universitet, Norway
- Monica Hauger Carlsen.
- Thea Amalie Martinsen.

The intention is that this report might be used as a guide through recipe calculations. Moreover, the importance of well structured methods for recipe calculations and possible consequences otherwise are discussed.

Summary

Food composition data is important in nutritional policy making. For example food composition data is used for dietary surveys, dietary advice, and epidemiologic research and labelling. To compose a food composition database of analysed values only is not economically justifiable; hence recipe calculations are important for the quality of the food composition database. The project "Improving food composition data" was carried out 2014–2015 with financial support from the Nordic Council of Ministers. The aim was to improve food composition data by standardizing recipe calculations. The project consisted of the following parts:

- *Carefully going-through the different steps of the recipe calculation processes*. Previously used calculation methods are summarized in the project report.
- *Identify equalities and differences as well as advantages and limitations between calculation processes for different partners.* By test calculations the following critical steps were identified:
  - Use of different retention factors.
  - Different corrections for uptake of salt, e.g. during boiling of pasta.
  - Different use of standard ingredients, e.g. choice of fat.
- *Discuss potential improvements using existing literature e.g. those listed in the reference list.* A new general method, including a priority list for yield factors and up-to-date retention factors, for recipe calculations was designed. The method was validated by comparing analysed and calculated content, showing good agreement for macro- and micronutrients. However, for some individual fatty acids large discrepancy were found which must be considered when using data.
- *Implementing improvements to achieve more accurate food composition data.* In total, nutrient content in 953 foods and dishes have been recalculated using the new general method. Foods and dishes will be available for the Nordic public through the national food composition databases. Furthermore, the calculated foods and dishes will be used in national dietary surveys. The method was also used to recalculate the Swedish national dietary survey "Riksmaten

adults 2010–11", showing significantly lower intakes of magnesium, zinc and potassium and higher intakes of vitamin C. Nutritionally relevant but non-significant lower intakes of polyunsaturated fatty acids, vitamin D, iron and selenium were also found.

The results may be used as a guide through recipe calculations. Furthermore, the importance of well structured methods for recipe calculations and potential consequences otherwise are also highlighted.

1. Introduction

Research in nutrition and toxicology using Nordic food composition data has generated hundreds of publications in high impact journals e.g. Lancet (Augustsson *et al*. 1999), JAMA (e.g. Larsson *et al*. 2010) and Journal of the National Cancer Institute (e.g. Menvielle *et al*. 2009). A prerequisite for this is high quality food composition data, preferably analysed data. However, to build a food composition database exclusively upon analysed values is economically not justifiable or fit for purpose. Hence, foods in food composition databases are calculated to various extents. In the latest national dietary surveys in Sweden (Riksmaten Adults 2010–11) and in Norway (Norkost 3 2010–11), more than 50 and 30% respectively, of the foods were calculated, indicating the need of high quality standardized method for calculation procedures.

Nutrient values in foods are calculated using different factors taking into account micronutrient losses and uptake and losses of fat and water. Factors might vary substantially between sources. Hence a standardized method to choose factors, ingredients and recipes is a prerequisite for high quality calculation of nutrients in foods. To improve calculation methods not least for upcoming national dietary surveys and as aid for the work with nutritious meals in schools, it is necessary to assure a high data quality. Food composition data is important for Nordic research, companies e.g. food producers and IT companies, for national and Nordic public health work, for per capita calculation of nutrient intake and so on, as indicated by 1,000,000 searches and 557,000 visits each year in the Swedish and Norwegian food composition databases, respectively. In addition, consumers use data from app's to calculate e.g. energy intake while fasting or for training needs.

The aim of the project was to improve accuracy in food composition data by developing and implementing standardized methods to calculate nutrient content in foods, both industrial made products and homemade dishes. More accurately described food composition data is an advantage internationally, e.g.:

- In research from epidemiology and clinical research to environmental impact of food consumption.

- In policy making by delivering high quality data to EFSA, Codex, OECD and WHO.
- In food export by more accurate nutritional labelling of Nordic foods.
- In dietary surveys and the work to translate Nordic nutrient recommendations into recommendations about food intake.
- When converting foods into raw agricultural commodities (RAC) used for risk evaluations.

2. Methods

To achieve the aim the following parts were carried out within the project:

- Carefully going-through and documenting the different steps of the calculation processes in Sweden and Norway.
- Identify equalities and differences as well as advantages and limitations between calculation processes used by the different partners.
- Discuss potential improvements using existing literature e.g. those listed in the reference list.
- Implementing improvements to achieve more accurate food composition data.

Moreover, in Norway and Sweden calculated foods were recalculated using a standardized method to assure a high quality of the calculated nutrient values in foods.

2.1 Documenting current methods

All written documentation about how recipe calculations were done was gathered by the project group members in Sweden and Norway respectively. General rules for recipe calculations and documentation of yield factors and retention factors used were identified and overviews of the procedures made. The overviews of current methods are presented in the Results part section 3.1 and 3.2.

2.2 Identification of equalities and differences in methods

The documentation of the different methods was compared and discussed in workshops, see overview of current methods in chapter 3.1 and 3.2. To reveal whether the methods or the ingredients contributed the most to the differences in calculated nutrient content test calculations were designed (Figure 1).

Figure 1. Test calculations to identify inequalities

Food items included in the test calculations (Box 1) were chosen to cover different difficulties with the recipe calculations. For example, the milk uptake and water loss is difficult to account for in rice porridge and for fried bacon, fat loss is problematic.

Box 1. Foods and dishes calculated in test calculations

- Pizza Margherita.
- Wheat buns with cinnamon.
- Pancake.
- Blueberry jam.
- Tomato soup.
- Lasagna.
- Bolognese sauce.
- Pasta boiled.
- Béchamel sauce without cheese.
- Béchamel sauce with cheese.
- Ratatouille.
- Bread wholegrain.
- Bacon fried.
- Rice porridge.

Results from recipe calculations were compared by dividing the Swedish method with the Norwegian. To account for the skewed distribution all quotas were log transformed prior to comparison using the Wilcoxon's signed rank test (Minitab version 15.1).

2.3 New general method

Based on the test calculations, discussions in workshops and consulting scientific literature, a new general method for recipe calculations was developed. The new method is summarized and presented in the Results section, table 3.

2.4 Validation of method: comparison between calculated and analysed nutrient content

The most commonly served school meals at 192 different schools in Sweden were identified using dinskolmat.se. School meals, sauces and salad mixtures (n = 34) were analysed using accredited methods at ALS Scandinavia and Eurofins. Energy and content of carbohydrates, water, ash, fat, protein, dietary fiber, fatty acids, trans fatty acids, vitamin C, folate, vitamin D, iron, calcium, phosphorus, selenium, iodine and sodium were determined. Sampling, analysis and calculations have been described in details elsewhere (Rogne 2015).

Recipes for the school meals were collected and the nutrient content calculated using the new method. Calculated nutrient content was compared with analysed nutrient content by dividing the calculated results with the analysed. To account for the skewed distribution all quotas were log transformed prior to comparison using the Wilcoxon's signed rank test (Minitab version 15.1).

3. Results

3.1 Documenting current method – Sweden

3.1.1 Recipes

Cookbooks, internet, in-house recipes and product information were used to identify recipes in the following order: 1. "Rutiga kokboken" (cookbook), 2. "Hemmets kokbok" (cookbook) and 3. internet.

In the absence of quantity one tablespoon per four portions was used for butter or margarine. In cases where the recipes suggest one or more alternative ingredients the quantity was distributed equally between the ingredients.

3.1.2 Ingredients

Missing ingredients were if possible borrowed from other food databases, scientific literature or product information. Standard choices for commonly used ingredients were used for 26 food items.

Fortified products were used in a few cases. For liquid margarine "milda culinesse" fortified with vitamin D was used for cooking but not baking. For pasta a combination of analyzed fortified and non-fortified pasta are used. For semi-skimmed milk with a fat content of 1.5% or below enrichment is required by law and thus used. Fortified wheat flour was used as it is the commonly used flour. Iodine fortified salt was used.

There was no cut of limit when an ingredient was included. There were no different quality demands on different ingredients.

3.1.3 Weight changes

Factors from "Tables on weight yield of food and retention factors of food constituents for the calculation of nutrient composition of cooked foods (dishes)" (Bognar 2002), "Nutrient losses and gains in the preparation of foods" (Bergström 1994) and in-house guidelines were used to calculate the weight changes in fat and water content. Yield factors for cold dishes were set to 1 and soups had the same factor for all ingredients. The following formulas were used to account for water or fat uptake or loss:

$$\text{New water content} = \frac{\text{amount food (g)} * \text{water content (g)}}{100\text{ g}} * \text{yield factor}$$

$$\text{Water change} = \frac{\text{amount food (g)} * \text{water content (g)}}{100\text{ g}} - \text{new water content}$$

New weight = amount food (g) - water change (g)

Example: Boiled jasmine rice
The water content of dry jasmine rice is 13 g/100 g dried rice.

The yield factor for dry jasmine rice to boiled jasmine rice is 17.2.

Thus:

$$\text{New water content} = \frac{100\text{ (g)} * 13\text{ (g)} * 17.2}{100\text{ g}} = 224\text{ (g)}$$

The change in water content of the dish is the water content in the dry jasmine rice minus the water content of the boiled rice, which by definition equals -211g:

$$\text{Water change} = \frac{100\text{ (g)}*13\text{ (g)}}{100\text{ g}} - 224 = -211\text{ (g)}$$

The new weight of the boiled jasmine rice is by definition the old weight minus the new weight, thus:

New weight = 100 (g) – (-) 211 (g) = 311 (g)

Finally, energy content was adjusted as a result of new water or fat content.

3.1.4 Losses of nutrients

Retention factors were used for thiamine, riboflavin, vitamin C, vitamin B6, vitamin B12, folate and potassium. Factors were set by a combination of food group and cooking method (cold dishes, dished cooked with heat (general), boiled, fried, oven-baked and grilled).

Salt uptake was calculated by hand using published factors (Bognar 2002). In cases where factors were absent, e.g. for cooked beans and vegetables, absorption was estimated to 50%.

3.1.5 Sum nutrients of all ingredients

Automatically carried out by the Food Data System.

3.1.6 Sum weights of ingredients and adjust to 100 gram

Automatically carried out by the Food Data System. Digits were rounded up, i.e. 1.5 will be 2.

3.2 Documenting current method – Norway

3.2.1 Recipes

Two different strategies for identifying representative recipes have been used, depending on whether the dish or food item was homemade or industrially made.

Homemade dishes
For traditional Norwegian home cooked dishes the following sources were used, in prioritized order: traditional cookbooks (Den rutete koke-boken, Hovig, version 2010 and 2014) and the internet. In the process of identifying recipes several considerations had to be made. Firstly, if there were reason to believe that people in general cooked the dish in question in the traditional way, then the recipe in the traditional cookbook was used. If there was reason to believe that the general population used one or several different revised versions of an original recipe, revised recipes on the internet were used. When using recipes from the internet the "mean" recipe based on the 3 most popular non-commercial internet recipes found on the web was calculated and used. Visits to restaurants were used one time when reliable information about ingredients and amounts were not found in other ways. Over the last 5 years, procedures have changed gradually due to the fact that the general population is using the internet more frequently as reference and source for recipes.

Industrially prepared food

For industrially prepared dishes and food items recipes procured from the manufacturer were used. If this was not available the recipes were created based on the list of ingredients and the nutrition label on the food items.

3.2.1 Ingredients

For an ingredient to be included in the National Food Composition Database and in the Food and nutrient calculation system KBS, the nutritional data of the ingredient had to include values for all the nutrients currently in the databases. In some specific research studies there may be allowed some exceptions, e.g. if a study only wants so look at the content of choline in food, some foods/ingredients may be entered into KBS without all the other nutrients. These kinds of ingredients will however only be used in the designated research studies and not included for ordinary use.

After identifying the most representative recipe, the ingredients in the recipe must be identified also. If an ingredient was not an item in the database, a so called missing ingredient, data for missing ingredients were borrowed from other food composition databases, scientific literature and/or product information. For some industrially prepared food where recipes were constructed from the list of ingredients and the nutritional label of a food item, the ingredient X was included to make up for ingredients that were not properly listed in the ingredient list. The ingredient X did not contain any other data other than weight and was included in the recipes so that the sum of the weight of the ingredients was totalled to 100%. The ingredient X was often a very small amount of "missing weight" (0.5–1.0 g).

In many recipes standard ingredients were used (Supplement 1b), in an effort to make the recipes as representative for the general population as possible. For example, a homemade dish may include milk as an ingredient. Because people may use different variants of milk with different content of fat in the same recipe, a standard milk ingredient was used, which was composed of different milk variants in correct proportions based on consumption data.

In Norway several food items are fortified. A full list of products may be obtained from the Norwegian Food Safety Authority. In KBS food items fortified with vitamins and minerals are included on the same terms as non fortified food items. Fortified food items often used as ingredients in recipes include whole and semi skimmed milk, margarine, plant oils and salt with iodine,

Fortified food products were used as ingredients in cases where it was thought to reflect the food patterns in the average population. These considerations were based on consumption data from national nutrition surveys.

There was no minimum cut off limit for when an ingredient was not included in a recipe. The quality demands were equal for all ingredients, except for ingredient X as explained earlier.

3.2.2 Weight changes

Loss of weight in recipe calculations was calculated using yield factors in the KBS calculation system, on recipe level. Factors used are presented in Supplement 1c (Norske gamle vektendringsfaktorer). The weight loss calculations included loss of water only.

Gain of weight in recipe calculations was calculated in Excel spreadsheets manually, adding water or fat as ingredient.

3.2.3 Loss of nutrients

Retention factors were used for the following recipes/ ingredients:

- Milk heat treated (retinol, betakaroten, vitamin D, tokoferol, thiamine, riboflavin, niacin, vitamin B6, folate, vitamin B12, vitamin C).
- Bread (thiamine, riboflavin, niacin, vitamin B6, folate, vitamin B12).

Calculation with retention factors were done manually in Excel spreadsheets.

3.2.4 Sum nutrients of all ingredients

Automatically carried out by the KBS data system.

3.2.5 Sum weights of ingredients and adjustments to 100 gram

Automatically carried out by the KBS data system.

3.3 Identification of equalities and differences in methods

The main results from the test calculations were:

- Using different yield factors resulted in non-significant but some large discrepancies in macronutrients content. To address this issue a priority list for identification of yield factors was compiled (supplement 1c).
- Use of different retention factors might significally affect content of vitamins and minerals for which retention factors were used. To address this issue retention factors suggested to be used were compiled in supplement 1d.

The results from the test calculations are presented in Tables 2a–c.

There were no significant differences in nutrient content when using the same recipes, the same ingredients and same yield factors for calculations (table 2a). However, for riboflavin, vitamin B6 and folate a non-significant trend was found ($p = 0.059$), indicating use of different retention factors.

Table 2a. Comparison of different methods using same recipes, ingredients and yield factors

Nutrient/energy	Unit	Number of recipes recalculated[1]	Median ratio (Swedish method /Norweigian method)[2]	p
Macronutrients				
Energy	kJ	5	0.00	0.281
Carbohydrates	G	5	0.00	0.787
Fat	G	5	-0.01	0.418
Protein	G	5	0.00	0.787
Dietary fiber	G	5	-0.01	0.106
Water	G	5	0.00	0.059
Saccharides	G	5	0.00	0.787
Starch	G	3	0.00	0.181
Saturated fatty acids	G	5	0.00	0.590
Monounsaturated fatty acids	G	5	0.00	0.787
Polyunsaturated fatty acids	G	5	0.00	0.590
Trans fatty acids	G	4	-0.02	0.584
Micronutrients				
Retinol equivalents	RE	5	0.00	0.787
Vitamin D	µg	4	0.03	0.361
Vitamin E	Mg	5	-0.01	0.59
Thiamine	Mg	5	-0.08	0.106
Riboflavin	Mg	5	-0.05	0.059
Vitamin C	Mg	3	-0.33	0.181
Niacin equivalents	NE	5	0.00	0.178
Vitamin B6	Mg	5	-0.14	0.059
Vitamin B12	µg	3	-0.12	0.181
Folate	µg	5	-0.08	0.059
P	Mg	5	0.00	0.178
I	µg	5	0.00	0.281
Fe	Mg	5	-0.01	0.787
Ca	mg	5	0.00	1.000
K	mg	5	0.00	0.106
Cu	mg	4	0.00	0.855
Mg	mg	5	0.00	1.000
Na	mg	5	0.00	0.418
Se	µg	3	-0.10	0.181
Zn	mg	5	0.01	0.281

[1] All nutrients were not calculated in all foods, either due to logical zero e.g. vitamin D in blue berry jam or because of lacking value from one of the partners.
[2] Logarithmic values >0 means higher values using the Swedish method, <0 means higher values using the Norweigian method.

There were no significant differences in nutrient content when using the same recipe and ingredients but different yield factors for calculations (table 2b). However, non-significant but substantially lower content were found for several micronutrients when using the Swedish method. This is most likely due to use of different retention factors (watersoluble vitamins and potassium) and due to different estimations of sodium uptake.

Table 2b. Comparison of different methods using same recipes and ingredients

Nutrient/energy	Unit	Number of recipes recalculated[1]	Median ratio (Swedish method /Norweigian method)[2]	p
Macronutrients				
Energy	kJ	4	-0.03	0.201
Carbohydrates	G	4	-0.03	0.201
Fat	G	4	-0.05	0.100
Protein	G	4	-0.04	0.201
Dietary fiber	G	4	-0.02	0.100
Water	G	4	0.02	0.100
Saccharides	G	4	-0.03	0.100
Starch	G	3	-0.06	0.423
Saturated fatty acids	G	4	-0.03	0.584
Monounsaturated fatty acids	G	4	-0.03	0.361
Polyunsaturated fatty acids	G	4	-0.04	0.100
Trans fatty acids	G	3	-0.04	0.423
Micronutrients				
Retinol equivalents	RE	4	-0.03	0.201
Vitamin D	µg	3	-0.05	0.423
Vitamin E	mg	4	-0.03	0.100
Thiamine	mg	4	-0.13	0.100
Riboflavin	mg	4	-0.10	0.100
Vitamin C	mg	3	-0.33	0.181
Niacin equivalents	NE	4	-0.04	0.201
Vitamin B6	mg	4	-0.19	0.100
Vitamin B12	µg	3	-0.12	0.181
Folate	µg	4	-0.13	0.100
P	mg	4	-0.03	0.201
I	µg	4	-0.03	0.201
Fe	mg	4	-0.02	0.361
Ca	mg	4	-0.03	0.201
K	mg	4	-0.05	0.201
Cu	mg	4	-0.04	0.201
Mg	mg	4	-0.02	0.584
Na	mg	4	-0.06	0.201
Se	µg	3	-0.04	0.789
Zn	mg	4	-0.02	1.000

[1] All nutrients were not calculated in all foods, either due to logical zero e.g. vitamin D in blue berry jam or because of lacking value from one of the partners.
[2] Logarithmic values >0 means higher values using the Swedish method, <0 means higher values using the Norweigian method.

Using the same recipe and yield factors but different ingredients resulted in significantly higher content of polyunsaturated fatty acids using the Swedish method and significantly higher content of niacin equivalents and folate using the Norwegian method (table 2c). Further, large but non-significant differences were found for vitamin B6 and potassium. For the watersoluble vitamins and potassium this is most likely due to use of different retentionfactors. The difference in polyunsaturated fatty acid content is probably a result of the standard ingredient rich in polyunsaturated fatty acids used in Sweden.

Table 2c. Comparison of different methods using same recipes and yield factors, and different ingredients

Nutrient/energy	Unit	Number of recipes recalculated[1]	Median ratio (Swedish method /Norweigian method)[2]	p
Macronutrients				
Energy	kJ	9	0.01	0.813
Carbohydrates	G	9	0.00	0.722
Fat	g	9	0.02	0.906
Protein	g	9	-0.01	0.906
Dietary fiber	g	9	0.00	1.000
Water	g	9	-0.01	0.554
Starch	g	9	-0.01	0.124
Saturated fatty acids	g	9	0.01	0.722
Monounsaturated fatty acids	g	9	-0.02	0.141
Polyunsaturated fatty acids	g	8	0.10	*0.035*
Trans fatty acids	g	5	-0.04	1.000
Micronutrients				
Retinol equivalents	RE	7	-0.01	0.834
Thiamine	mg	9	0.00	0.800
Riboflavin	mg	9	0.02	0.944
Vitamin C	mg	4	0.03	0.636
Niacin equivalents	NE	9	-0.05	*0.009*
Vitamin B6	mg	9	-0.29	0.181
Vitamin B12	µg	5	-0.02	0.407
Folate	µg	9	-0.03	*0.024*
P	mg	9	-0.09	0.059
Fe	mg	9	0.00	0.636
Ca	mg	9	0.01	0.477
K	mg	9	0.03	0.529
Cu	mg	9	-0.02	0.155
Mg	mg	9	-0.02	0.124
Na	mg	9	0.00	0.906
Se	µg	8	-0.01	0.407
Zn	mg	9	-0.01	0.193

[1] All nutrients were not calculated in all foods, either due to logical zero e.g. vitamin B_{12} in blue berry jam or because of lacking value from one of the partners.

[2]Logarithmic values >0 means higher values using the Swedish method, <0 means higher values using the Norweigian method.

For fatty acids large discrepancies between methods was partly explained by foods having a low fat content, i.e. cerealbased foods: “Bread wholewheat 50%”, “Bread rich in fiber industrially produced” and “Pasta boiled”. For example “Bread wholewheat 50%” contained 0.02 and 0.00 g/100 g of mono- and polyunsaturated fatty acids respectively using the Norwegian method and 0.23 and 0.66 g/100 g of mono- and polyunsaturated fatty acids respectively using the Swedish method. When excluding the cerealbased products agreement between the methods was substantially improved: -0.00 for monounsaturated fatty acids (p = 1.000) and 0.10 for polyunsaturated fatty acids (p = 0.106). However, since cerealbased foods are important in the Nordic diet this is troublesome and was considered during the work with the general method (3.4).

3.4 New general method

A new general method was developed and is summarized in table 3. Due to differences between countries regarding different sources of recipes, different common ingredients (i.e. standard ingredients), different food management systems and so on parts of the method must be adapted to the own country.

New retention factors were compiled by a literature search using the following search terms: retention, cooking, frying, boiling, food and the different nutrients. If no scientific articles were found, retention factors from Bognar were used. If several articles were found, the mean was calculated (supplement 1d).

Table 3. New general method for nutrient calculations

Step	Procedure
Identify recipe	
Which sources are used? Is there a priority list for choice of recipes?	Recipes used for calculating nutrient content in foods are selected in the following priority order: 1. Cookbooks – Recipes are used from cookbooks in a defined order. 2. Internet sources – Recipes from the top three to five noncommercial search results are pooled. 3. Product information from the manufacturer or package information. 4. In-house guidelines – When recipes are not applicable e.g. boiled carrots and fried sausage.
Are there guidelines for quantities unless stated in the recipe?	Yes, within the project a list of standard quantities was compiled (Supplement 1a)
Identify ingredients	
Is there a minimum level of quality demands on ingredients?	Yes, the ingredients included in a recipe must be of at least equal quality of that of the calculated food. If possible, analyzed ingredients of good quality should be used.
Are there standard ingredients for commonly used ingredients such as fat?	Yes, standard ingredients with high analytical quality were defined. Ingredients were pooled according to sales data when appropriate (Supplement 1b).
How are missing ingredients handled?	Data for missing ingredients are if possible borrowed from other food databases, scientific literature and/or product information or estimations from best matching food items.
Is there a cut-off (minimum quantity) for when an ingredient is included?	No
Are there different quality demands for different ingredients?	No

Step	Procedure
Are fortified ingredients used?	Unfortified ingredients are used in calculations except for particular cases when fortified products better reflect the food patterns of the population. Norway: whole and semi-skimmed milk, margarine, plant oils and salt with iodine. Sweden: For semi-skimmed milk with a fat content of or below 1.5% enrichment is required by law and is thus used. Fortified wheat flour is used as it is the most common one. Salt fortified with iodine is used.
Adjust for uptake and losses	
What formulae are used?	Norway: loss of water is calculated using an appropriate yield factor. Uptake of water or fat is added as ingredients. Sweden: Water factors were calculated from analytical data or yield factors using the following formulae: Water factor = (Amount water in ingredient (g) + Yield factor * Weight ingredient (g) – Weight ingredient (g)) / Amount water in ingredient (g)
Which level for rounding off?	No rounding off at this stage.
Which weight changes are corrected for?	Fat and water.
Are factors used in combination?	Yes, if both uptake or loss of water and fat occur, both are corrected for.
Should more or less factors be used?	No
Are there guidelines for choosing factors (literature sources etc)?	Yes within the project a priority list over references for different weight changes were compiled (Supplement 1d).
Factors for uptake of salt?	Norway: Salt is added as an ingredient in recipes. Sweden: Salt uptake during cooking are corrected for by factors in Bognar (2002).
Adjust for nutrient losses	
What formulae are used?	If available, true retention as defined in Bergström (1994) was used: $TR = \frac{\text{content per gram cooked food} * \text{g cooked food}}{\text{contentper gram raw food} * \text{g raw food}}$
Which level for rounding off?	No rounding off at this stage.
For which nutrients are retention factors used?	Norway: in heat treated milk: retinol, betakaroten, vitamin D, tokoferol, thiamine, riboflavin, niacin, vitamin B6, folate, vitamin B12, vitamin C; in bread recipes: thiamine, riboflavin, niacin, vitamin B6, folate, vitamin B12. In other recipes retention factors are not used. Sweden: thiamine, riboflavin, vitamin C, vitamin B6, vitamin B12, folate, vitamin D, potassium and alcohol.
Are there guidelines for choosing factors (literature sources etc)?	An updated list with appropriate retention factors for various food groups was compiled within the project (Supplement 1e).

Step	Procedure
Sum nutrients for all ingredients	
Level of rounding off	No rounding off at this stage.
Sum weights of ingredients and adjust to 100 gram	
Level for rounding off	The conventional rounding rules are used (Bankers rounding), with even values ending in the digit 5 being rounded down (e.g. 0.25 becomes 0.2) and uneven numbers rounded up (e.g. 0.55 becomes 0.6) to avoid significant bias.

3.5 Validation of method: comparison between calculated and analysed nutrient content

To validate the general method calculated nutrient content was compared with analysed nutrient content (table 4a and 4b). Method performance was overall good. However, a low concentration is often associated with higher variance and thereby more uncertain results. Significant correlations between actual concentration and agreement between analysed and calculated values were found for:

- Folate, pearsons correlation -0.384, p <0.05.
- Selenium, pearsons correlation -0.478, p <0.001.
- Sodium, pearsons correlation -0.489, p <0.005.
- Water, pearsons correlation -0.541, p <0.05.
- Protein, pearsons correlation -0.421, p <0.05.
- C15:0, pearsons correlation -0.849, p <0.001.
- C17:0, pearsons correlation -0.757, p <0.001.
- C14:1, pearsons correlation -0.826, p <0.001.
- C18:1, pearsons correlation -0.364, p <0.05.
- C18:2n-6, pearsons correlation -0.602, p <0.05.
- C18:3n-3, pearsons correlation -0.440, p <0.05.
- C18:1trans, pearsons correlation -0.810, p <0.001.
- C18:2trans, pearsons correlation -0.763, p <0.001.
- C18:3trans, pearsons correlation -0.858, p <0.001.

From a quality perspective this is less problematic since low concentrations are of less importance when estimating nutrient intakes.

Larger discrepancies between calculated and analysed content of macronutrients was mainly found in foods with low energy content and thereby low content of e.g. fat, protein and carbohydrates. When excluding foods with an energy content below 250 kJ/100 g, that is cabbagesoup (energycontent 110 kJ/100 g at school 1 and 240 kJ/100 g at school 2) and salad at school 2 (energycontent 187 kJ/100 g), agreement was improved for fat 0.07 ($p = 0.144$); protein 0.03 ($p = 0.439$); ash -0.03 ($p = 0.352$), for other macronutrients there were no changes. However, since the contribution to intake of macronutrients from low energy foods is limited this was considered a minor issue.

Nutritionally and statistically significant discrepancies were found for folate, iron and selenium, all present in minor amounts (micrograms, table 4a) except for iron. For folate, the difference between analysed and calculated content was mainly due to underestimation of folate content in dishes with fish (food ID 1202, 4586) or minced meat (food ID 1143, 1149, 5052). When excluding these dishes agreement for folate improved (-0.23, $p = 0.098$). In minced meat dishes, selenium content was also underestimated using the recipe calculation and by excluding minced meat dishes agreement was improved to -0.17.

Iron was overestimated using the calculation method. A possible explanation might be higher iron content in ingredients used for calculations, for example analysed meatproducts might have a lower meatcontent due to costs.

Agreement for vitamin C and vitamin D appears to be good, but more analyses are required to confirm the results since concentrations of both vitamin C and vitamin D were below quantification level in many of the samples.

Table 4a. Calculated nutrient content – comparison with analysed values

Nutrient	N1	Median ratio (calculated/analysed)2	P
Macronutrients			
Energy (kJ)	34	0.02	0.381
Carbohydrates (g)	34	-0.00	0.889
Fat (g)	33	0.08	0.068
Protein (g)	34	0.04	0.314
Fibre (g)	25	-0.06	0.095
Water (g)	34	-0.00	0.712
Ash (g)	34	-0.04	0.314
Micronutrients			
Vitamin D (µg)	29	0.00	1.000
Vitamin C (mg)	29	0.00	0.723
Folate (µg)	31	-0.41	0.000
Ca (mg)	34	0.04	0.177
Fe (mg)	32	0.09	0.011
I (µg)	18	-0.13	0.276
Na (mg)	34	-0.03	0.182
P (mg)	34	-0.39	0.000
Se (µg)	33	-0.41	0.000

[1] All nutrients were not calculated or analysed in all foods, either due to logical zero e.g. vitamin D in vegetarian stew or because of lacking value(s) from ingredient(s) during calculation.
[2] Logarithmic values >0 means higher values using the new general method, <0 means higher values using the analytical method.

For fatty acids, agreement was good to satisfactory except for C15:0, C17:0, C14:1, C18:1trans, C18:2n-6, C18:2trans, C18:3n-3, C18:3trans and sum of polyunsaturated fatty acids. The significant differences for the essential fatty acid alfa linolenic acid (C18:3n-3) and sum of polyunsaturated are of special nutritional concern but not suprising. That content of the polyunsaturated fatty acids, 18:2n-6, 18:3n-3 and 20:4n-6 is difficult to estimate has been shown using biomarkers. Lemming *et al.* (2015) found no significant correlation between estimated intakes of any of 18:2n-6, 18:3n-3 and 20:4n-6 and the concentrations in plasma phospholipids. Hopefully this has been improved by introducing new more realistic standard ingredients (supplement 1b).

The discrepancy might be explained by mismatch of ingredients when interpreting the school meals e.g. different types of added fat during preparation. It might also be because the chef might have used another but similar ingredient, for example one fish was listed in the recipe but a similar was used for the analysed dish due to costs. Another explanation might be inclusion of different fatty acid isomers in the method. In this case, the analytical method did not detect C16:3, C16:4, C18:4, C20:4, C22:4 and C21:5, which might explain why the calculation method including these isomers, overestimated content of polyunsaturated fatty acids compared to the analytical method. To limit this problematic it is strongly recommended to consistently use the same method including the same isomers for fatty acid analyses.

Table 4b. Calculated fatty acid content – comparison with analysed values

Fatty acids	N[1]	Median (calculated/analysed)[2]	P
Saturated fatty acids (g)	33	0.10	0.192
Monounsaturated fatty acids (g)	33	0.06	0.604
Polyunsaturated fatty acids (g)	33	0.23	0.003
Trans fatty acids (g)	28	0.00	0.763
C4:0-C10:0	19	0.20	0.360
C4:0	17	0.31	0.074
C6:0	15	0.13	0.572
C8:0	15	0.09	0.727
C10:0	15	0.06	0.660
C12:0	22	0.08	0.581
C14:0	28	-0.03	0.601
C15:0	19	*-0.54*	*0.014*
C16:0	33	0.08	0.805
C17:0	22	*-0.71*	*0.001*
C18:0	33	0.02	0.436
C20:0	30	0.12	0.160
C22:0	15	-0.03	0.538
C14:1	19	*-0.80*	*0.005*
C16:1	31	-0.10	0.399
C18:1	33	0.08	0.268
C20:1	19	-0.09	0.083
C22:1	5	-0.11	0.262
C18:2CN6	16	*-1.57*	*0.006*
C18:2	33	0.10	0.494
C18:3N3	21	*-0.70*	*0.004*
C18:3	32	-0.03	0.574
C20:4N6	6	-0.05	0.327
C20:4	11	-0.47	0.107
C18:1T	22	*-0.83*	*0.002*
C18:3T	15	*-1.00*	*0.014*
C18:2T	21	*-0.78*	*0.003*

[1] All isomers were not calculated in all foods due to lacking value(s) from ingredient(s) during calculation.

[2] Logarithmic values >0 means higher values using the new general method, <0 means higher values using the analytical method.

3.6 Evaluation and implementation of the new method

The new method was implemented using different channels:

- Nutrients values produced within the project (Table 5a–c) were partly published in Matvaretabellen (http://www.matvaretabellen.no/) and entirely in the Swedish National Food Agency's food database (http://www7.slv.se/Naringssok/soklivsmedel.aspx).
- Results from the dietary survey "Riksmaten adults 2010–11" were partly recalculated using the new nutrients values for calculated foods.

In Sweden the national food database contained 560 calculated foods. However, 53 of those were foods and dishes no longer available or consumed and were thereby excluded from the database. Thus, in total 507 foods were recalculated (Table 5a–c). In Norway 446 recipes were recalculated.

Table 5a. Recalculated foods

Food group	No of recalculated foods Sweden	No of recalculated foods Norway
Bread and cereals	24	59
Fruits and berries	4	1
Vegetables and leguminous plants	24	0
Meat fish shellfish egg	91	67
Cheese and milk products	1	8

Table 5b. Recalculated dishes

Food group	No of recalculated foods Sweden	No of recalculated foods Norway
Bloodproducts and dishes	3	0
Fish and shellfish dishes	37	49
Poultry products and dishes	1	9
Vegetables root vegetables leguminous plants products and dishes	36	24
Porridge	13	10
Hamburgers	3	2
Offals products and dishes	6	0
Sausage dishes	7	15
Meat products meatdishes	47	35
Cheese dishes	3	0
Pancake, waffles, crêpes	7	13
Pasta dishes	4	11
Pizza pie pirog sandwich	15	5
Potatoes products and dishes	17	6
Rice dishes	1	7
Gruel	3	0
Soya products dishes	2	0
Sweet soup sauce	15	0
Soup	20	7
Sauce dressing mayonnaise	45	24
Mixed salad	7	1
Mayonnaise salad	3	0
Egg products and dishes	5	11

Table 5c. Recalculated sweet foods and cooking ingredients

Food group	No of recalculated foods Sweden	No of recalculated foods Norway
Buns cakes pastries etc.	29	50
Dessert	24	17
Beverages	6	12
Ice cream	1	1
Broth cooking ingredients etc.	2	0
Jam, marmelade, jelly, apple sauce	1	2

3.7 Case study: Replacing calculated foods in Riksmaten 2010–11

Replacing calculated foods in Riksmaten 2010–11 with foods calculated according to the new method resulted in significantly lower intakes of potassium, magnesium and zink, and significantly higher intakes of vitamin C (table 6a, 6b and 6c). For magnesium and zink intake was about 5 percent lower, which is probably explained by a standardized way to identify recipes which resulted in many new recipes. For potassium and vitamin C the results are probably explained by new retention factors. New retention factors for potassium are lower resulting in a 15% lower intake from recalculated foods. The intake of vitamin C from the recalculated foods increased with 40% which is probably explained by the new retention factors being higher, especially for cold dishes. However, this must be considered to be of less nutritional relevance.

Of greater nutritional relevance were the non-significant but nearly 25% lower intake of vitamin D, 20% lower intakes of polyunsaturated fatty acids, the 10% lower intake of vitamin A, 10% higher intake of vitamin E and 6 percent lower intakes of iron and selenium found when using the new recipe calculations. The change in intake of vitamin D, polyunsaturated fatty acids, vitamin A and vitamin E is most likely explained by the previous Swedish method using a liquid margarine in all recipes whereas the new method uses a mixture of vegetable and animal fats, pooled according to salesdata. This results in a lower intake of rapeseed oil (being the main ingredient in liquid margarine) and thereby a lower intake of polyunsaturated fatty acids as well as lower intake of vitamin D and vitamin A since the margarine was fortified making the content substantially higher than in for example animal fat such as butter.

Those results, although non-significant, are of great importance since less than half of the Swedish population meet the average requirement of 7.5 µg vitamin D per day and the intakes of polyunsaturated fatty acids, iron and selenium are also low in some population groups.

Table 6a. Change in macronutrient intake in Riksmaten 2010–11 with the new general method for recipe calculations (using old retention factors). Logarithmic values >0 means higher intake

Food group	N	Energy	Carbohy-drates	Fat	Protein	Dietary fiber	Water	Ash	Mono-sacc-harides	Disaccha-rides	Saccha-rose	Saturated fatty acids	Unsatura-ted fatty acids	Polyun-saturated fatty acids	Fatty acid 18:3	Chole-sterol
Vegetables and leguminous plants	15	-0.06	-0.04	-0.23	-0.03	-0.09	0.00	-0.05	-0.01	-0.15	-0.15	-0.17	-0.50	-0.17	-0.20	N/A
Fruits and berries	1	-0.18	-0.11	-0.88	-0.23	-0.07	0.03	-0.10	-0.15	0.08	0.08	-0.50	-1.63	-0.43	0.03	N/A
Bread and cereals	13	0.00	0.00	0.03	-0.01	-0.02	0.00	-0.14	0.00	0.12	0.14	0.21	-0.03	-0.05	-0.20	0.08
Gruel and porridge	10	-0.02	-0.01	-0.07	-0.01	-0.02	0.00	0.03	0.03	-0.01	-0.02	-0.09	-0.08	-0.04	-0.11	-0.13
Meat fish shellfish	47	-0.03	0.00	-0.03	-0.02	-0.10	0.01	-0.03	0.08	0.28	-0.18	-0.04	-0.04	-0.04	-0.03	-0.02
Quorn and soy	1	0.08	0.16	0.07	0.01	-0.03	-0.04	0.10	-0.12	-0.13	-0.14	0.10	0.09	-0.01	0.01	N/A
Egg and egg products and dishes	7	0.03	-0.06	0.09	-0.04	0.06	0.00	-0.02	-0.06	-0.08	-0.16	0.02	0.11	0.12	0.18	0.01
Poultry and meat products and dishes	19	-0.04	-0.01	-0.07	0.00	0.06	0.01	0.03	0.08	-0.08	0.15	-0.05	-0.07	-0.13	-0.25	0.01
Fish and shellfish dishes	21	-0.10	-0.22	0.01	-0.03	-0.13	0.07	0.00	0.07	0.38	0.42	-0.03	0.01	0.01	-0.02	-0.03
Blood and offals products and dishes	7	-0.01	-0.02	-0.01	0.00	-0.01	0.01	-0.01	-0.02	-0.02	-0.02	-0.01	-0.01	-0.01	-0.01	0.00
Pasta and rice dishes	4	-0.06	-0.08	-0.02	-0.09	0.19	0.03	-0.03	0.28	-0.10	0.09	-0.06	0.02	0.17	0.00	-0.09
Potatoes products and dishes	6	0.08	0.03	0.17	0.03	0.03	-0.02	0.02	0.18	0.05	-0.07	0.28	0.24	-0.15	0.03	0.12
Vegetables root vegetables leguminous plants products and dishes	13	-0.07	-0.11	-0.05	-0.06	0.02	0.02	-0.12	0.00	-0.14	-0.16	0.22	-0.10	-0.18	-0.21	0.31
Cheese dishes	2	0.00	0.14	-0.03	-0.03	0.23	-0.01	-0.01	0.24	0.12	0.25	-0.05	-0.02	0.02	0.00	-0.05
Hamburgers and sausage dishes	3	0.04	-0.09	0.13	0.13	-0.07	-0.02	0.00	-0.09	-0.29	-0.41	0.16	0.21	-0.16	-0.07	0.22
Pizza pie pirog sandwich	8	-0.01	-0.07	0.05	-0.07	0.07	0.02	0.03	0.21	0.04	0.17	0.12	0.09	-0.16	-0.12	-0.03
Soup sauce and mixed salads	43	0.02	0.05	0.01	0.04	0.04	-0.01	0.12	0.14	0.06	-0.06	0.01	0.08	-0.16	-0.08	0.01
Beverages	6	-0.07	-0.09	-0.08	0.05	-0.06	0.01	-0.02	-0.30	0.02	-0.01	-0.09	-0.06	0.10	-0.09	-0.04
Jam, marmelade, jelly, apple sauce	1	0.03	0.03	0.01	-0.05	-0.10	-0.03	-0.02	0.04	0.04	0.04	-0.03	0.04	0.01	0.02	N/A
Ice cream	1	-0.02	-0.20	0.06	0.06	-0.01	0.03	0.05	-0.14	-0.24	-0.29	0.05	0.08	0.15	0.07	0.06
Sweet soup sauce	7	0.21	-0.02	0.69	-0.09	0.09	-0.03	0.01	0.01	-0.03	-0.02	0.75	0.65	0.36	0.32	0.41
Buns cakes pastries desserts	28	-0.01	0.00	-0.03	-0.01	-0.07	0.01	-0.01	-0.35	0.01	0.01	0.08	-0.12	-0.15	-0.25	0.08
All food groups	263	-0.01	-0.03	0.00	-0.02	-0.01	0.01	-0.01	-0.02	0.00	0.00	0.02	0.00	-0.08	-0.09	0.00
P all food groups	22	0.38	0.06	0.97	0.11	0.60	0.46	0.58	0.75	0.77	0.60	0.50.	0.75	0.17	0.09	0.36

Table 6b. Change in micronutrient intake in Riksmaten 2010–11 with the new general method for recipe calculations (using old retention factors). Logarithmic values >0 means higher intake

Food group	N	Vitamin A	Vitamin D	Vitamin E	Thia-mine	Ribo-flavin	Vitamin C	Niacin	Niacin equiva-lents	Vitamin B6	Vitamin B12	Folate	P	I	Fe	Ca	K	Mg	Na	Se	Zn
Vegetables and leguminous plants	15	-0.01	-0.88	0.13	-0.03	-0.37	0.17	-0.01	-0.02	0.08	N/A	0.00	-0.02	-0.08	0.00	-0.03	0.00	-0.03	-0.09	-0.61	-0.14
Fruits and berries	1	-0.07	N/A	-0.42	-0.21	-0.04	0.30	0.01	-0.06	-0.11	N/A	0.17	-0.18	-0.05	-0.23	-0.07	-0.07	-0.05	-0.01	0.01	-0.22
Bread and cereals	13	0.07	-0.09	-0.12	0.00	-0.02	0.00	-0.01	-0.01	0.00	0.06	-0.06	-0.01	-0.20	-0.02	-0.02	-0.01	-0.02	-0.19	0.00	-0.01
Gruel and porridge	10	-0.18	0.54	-0.06	-0.01	-0.01	1.19	-0.02	-0.01	-0.01	0.14	0.02	-0.01	0.04	-0.02	0.00	-0.02	-0.02	0.05	-0.04	-0.02
Meat fish shellfish	47	-0.02	-0.06	0.01	-0.03	-0.02	0.00	-0.01	-0.01	-0.07	-0.02	-0.02	-0.02	-0.05	-0.03	-0.02	-0.02	-0.02	-0.04	-0.04	-0.03
Quorn and soy	1	0.05	-0.03	0.29	-0.06	0.25	0.21	0.09	0.07	0.00	N/A	0.04	0.00	0.20	-0.04	-0.02	-0.01	-0.06	0.18	0.62	-0.02
Egg and egg products and dishes	7	-0.03	-0.05	0.11	-0.03	0.00	0.34	-0.09	-0.05	0.00	0.02	0.04	-0.02	0.04	0.01	-0.03	-0.03	-0.02	-0.03	0.00	-0.04
Poultry and meat products and dishes	19	-0.13	-0.34	-0.01	0.07	-0.06	-0.06	-0.04	-0.03	-0.12	0.02	-0.18	-0.02	0.07	-0.05	-0.07	-0.03	-0.04	0.08	-0.11	-0.04
Fish and shellfish dishes	21	-0.07	0.01	0.09	-0.10	-0.03	0.11	-0.02	-0.02	-0.02	0.01	-0.02	-0.04	0.02	0.00	0.00	-0.02	-0.06	0.01	0.00	-0.09
Blood and offals products and dishes	7	0.00	-0.02	0.02	-0.01	0.00	-0.02	0.00	0.00	-0.01	0.02	-0.01	-0.01	-0.14	-0.02	-0.01	-0.01	-0.01	0.00	-0.01	0.00
Pasta and rice dishes	4	0.03	0.04	0.04	-0.05	0.02	-0.21	-0.14	-0.10	-0.04	-0.06	0.06	-0.09	0.02	-0.05	-0.12	-0.11	-0.10	0.06	-0.16	-0.11
Potatoes products and dishes	6	0.12	0.22	0.27	0.06	0.07	0.06	0.02	0.02	0.02	-0.09	0.05	0.06	0.12	0.39	0.10	0.03	0.02	0.03	-0.06	0.01
Vegetables root vegetables leguminous plants products and dishes	13	0.03	0.62	-0.18	-0.11	-0.23	-0.05	-0.12	-0.10	-0.05	0.08	-0.12	-0.07	-0.17	-0.11	-0.08	-0.08	-0.15	-0.15	-0.33	-0.05
Cheese dishes	2	0.06	-0.01	0.02	0.09	-0.02	0.08	0.00	-0.03	0.02	-0.04	0.03	-0.03	0.09	0.04	-0.05	0.03	0.04	0.02	-0.03	-0.03
Hamburgers and sausage dishes	3	0.08	-0.31	0.23	-0.01	0.07	0.14	0.01	0.07	-0.06	0.19	-0.01	0.13	0.00	0.03	0.27	0.06	0.02	-0.08	-0.01	0.11
Pizza pie pirog sandwich	8	-0.44	-0.06	0.11	-0.10	-0.11	-0.16	-0.09	-0.08	-0.07	-0.14	-0.01	-0.01	0.23	-0.12	0.03	0.05	0.02	0.02	0.03	-0.11
Soup sauce and mixed salads	43	-0.04	-0.13	0.14	0.01	0.05	0.09	-0.07	-0.01	0.07	0.10	0.10	0.07	0.26	-0.05	0.10	0.07	0.05	0.18	0.05	0.03
Beverages	6	-0.28	0.00	-0.14	0.06	0.00	-0.27	-0.02	0.04	-0.01	0.16	0.20	0.07	-0.07	-0.15	0.07	-0.01	-0.08	0.02	-0.01	0.02
Jam, marmelade, jelly, apple sauce	1	-0.06	N/A	0.04	-0.10	-0.06	-0.11	-0.08	-0.07	-0.12	N/A	-0.08	0.00	0.39	0.02	-0.06	-0.02	-0.01	0.03	-0.07	0.04
Ice cream	1	0.08	-0.05	0.07	0.07	0.07	0.13	0.08	0.05	0.06	0.11	0.10	0.07	0.02	0.06	0.06	0.01	0.02	0.05	0.05	0.05
Sweet soup sauce	7	0.66	0.20	0.25	0.04	-0.10	0.00	0.05	-0.07	-0.01	0.05	0.04	-0.01	-0.10	0.02	0.00	0.00	-0.01	-0.15	0.03	-0.01
Buns cakes pastries desserts	28	0.00	-0.09	-0.12	0.11	0.00	-0.03	0.01	0.01	0.16	0.10	0.11	0.02	0.23	0.02	-0.10	-0.02	-0.07	0.00	0.08	-0.02
All food groups	263	-0.05	-0.06	0.05	-0.02	-0.03	0.13	-0.02	-0.02	-0.03	-0.01	0.00	-0.01	0.01	-0.03	0.00	-0.01	-0.02	0.01	-0.03	-0.03
P all food groups	22	0.75	0.26	0.21	0.46	0.36	0.21	0.09	0.06	0.23	0.08	0.24	0.42	0.35	0.19	0.44	0.23	0.03	0.75	0.30	0.05

Table 6c. Change in micronutrient intake in Riksmaten 2010–11 with the new general method for recipe calculations (using new retention factors). Logarithmic values >0 means higher intake

Grupp	Vitamin D	Thiamine	Riboflavin	Vitamin C	Vitamin B6	Vitamin B12	Folate	K
Vegetables and leguminous plants	-0.98	-0.03	-0.36	0.18	0.09	n/a	-0.01	-0.01
Fruits and berries	n/a	-0.21	-0.04	0.30	-0.11	n/a	0.17	-0.07
Bread and cereals	-0.32	-0.11	-0.14	0.04	0.00	0.07	-0.12	-0.14
Gruel and porridge	0.53	-0.13	-0.07	1.47	-0.01	0.16	-0.03	-0.11
Meat fish shellfish	-0.13	-0.06	-0.05	0.09	-0.14	-0.13	0.06	-0.12
Quorn and soy	-0.12	0.04	0.32	0.34	0.17	n/a	0.04	-0.01
Egg and egg products and dishes	-0.15	-0.05	-0.01	0.37	0.00	0.06	0.02	-0.04
Poultry and meat products and dishes	-0.42	0.07	-0.06	0.06	-0.19	0.00	-0.21	-0.14
Fish and shellfish dishes	-0.03	-0.13	-0.02	0.11	-0.03	-0.10	-0.01	-0.05
Blood and offals products and dishes	-0.12	-0.02	0.00	0.08	-0.19	-0.03	-0.01	-0.16
Pasta and rice dishes	-0.04	-0.07	0.04	-0.05	-0.02	-0.04	0.04	-0.11
Potatoes products and dishes	0.17	0.11	0.11	0.16	0.12	-0.17	0.02	0.03
Vegetables root vegetables leguminous plants products and dishes	0.58	-0.15	-0.18	-0.03	-0.01	0.10	-0.18	-0.13
Cheese dishes	-0.11	0.08	-0.02	0.20	0.02	-0.02	0.02	0.03
Hamburgers and sausage dishes	-0.35	-0.01	0.07	0.15	-0.16	0.17	-0.01	-0.03
Pizza pie pirog sandwich	-0.21	-0.09	-0.08	-0.05	-0.04	-0.15	-0.04	0.02
Soup sauce and mixed salads	-0.16	-0.02	0.06	0.13	0.09	0.10	0.09	0.04
Beverages	0.00	0.02	0.02	-0.25	-0.01	0.18	0.25	-0.01
Jam, marmelade, jelly, apple sauce	n/a	-0.10	-0.06	-0.11	-0.12	n/a	-0.08	-0.02
Ice cream	-0.05	0.07	0.07	0.13	0.06	0.11	0.10	0.01
Sweet soup sauce	0.17	-0.01	-0.08	-0.08	0.01	0.05	0.06	-0.03
Buns cakes pastries desserts	-0.28	0.10	0.01	0.16	0.17	0.12	0.11	-0.02
All food groups	-0.13	-0.05	-0.04	0.15	-0.07	-0.09	0.01	-0.06
P all food groups	0.10	0.14	0.35	0.01	0.52	0.30	0.42	0.01

4. Discussion

The current method is overall in line with other recommendations regarding recipe calculations (Norfoods 2000, 2002: Greenfield and Southgate, 2003; Reinivou *et al*. 2009) except for how to handle yield factors. In the methods suggested by Greenfield and Southgate (2003) and by Reinivou *et al*. (2009) yield factors should be applied at recipe level because it is most common approach. However, due to last years progress of softwares for food composition data, application of yield factors on recipe level due to convenience is no longer necessary in many countries. In the current method we thereby applied yield factors at the ingredient level since different ingredients, e.g. tomato and fish, will not loose the same amount of water during preparation.

During 1998–2001 the "Norfoods 2000" project, aiming to identify differences in food composition data and intake caculations, was carried out. The authors concluded that Nordic food composition and consumption data was not directly comparable as a result of different definitions for nutrients, different retention factors and different energy calculation factors (Norfoods 2000, 2002). Since that Nordic efforts to use common definitions and energy calculation factors have been successful as indicated by the results in the current Nordic project showing that:

- Content of energy and macronutrients were comparable between Norway and Sweden.
- Content of micronutrients appears to be comparable. However, it is recommended that similar retentionfactors are used for comparison.

In this project, polyunsaturated fatty acids were identified as problematic and a comparison might be misleading. This might have been due to the Swedish old method, estimating the content 20% higher than the Norwegian method (table 2c). The estimated intake of polyunsaturated fatty acids using the the old Swedish method was also about 20% higher compared to estimations with the new method.

Recipe calculations are cost efficient and flexible methods. However, despite efforts by compilers to obtain the highest quality recipe calculations will be associated with some uncertainties that should be addressed when interpreting results from for example dietary surveys and epidemiological studies.

References

Amcoff, E, Edberg, A, Enghardt Barbieri, H, Lindroos, AK, Nälsén, C & Warensjö Lemming, E (2012). *Riksmaten-vuxna 2010-11. Livsmedels-och näringsintag bland vuxna i Sverige. Diet and nutrient intake among adults*. National Food Agency: Uppsala, Sweden.

Augustsson, K, Skog, K, Jägerstad, M *et al*. (1999). Dietary heterocyclic amines and cancer of the colon, rectum, bladder, and kidney: a population-based study. *Lancet* Vol 353, pp 703–7. http://dx.doi.org/10.1016/s0140-6736(98)06099-1

Bell, S (2006). *Report on Nutrient Losses and Gains Factors used in European Food Composition Databases* (WP 1.5) EuroFIR

Bergström, L. (1994). *Nutrient losses and gains in the preparation of foods*. Rapport-Livsmedelsverket (Sweden).

Bognár, A. & Piekarski, J. (2000). Guidelines for recipe information and calculation of nutrient composition of prepared foods (dishes). *Journal of food composition and analysis*, Vol 13 No 4, pp. 391–410. http://dx.doi.org/10.1006/jfca.2000.0922

Bognár, A. (2002). *Tables on weight yield of food and retention factors of food constituents for the calcluation of nutrient composition of cooked foods (dishes)*. Bundesforschungsanstalt für Ernährung: Karlsruhe, Germany.

EuroFIR (2015). *EuroFIR recipe guidelines: How to calculate nutrient content of foods*. www.euroFIR.org Accessed 2015-03-23

Greenfield and Southgate (2003). *Food Composition data.* 2nd Edition FAO: Rome, Italy.

Larsson, SC, Orsini, N & Wolk, A. (2010). Vitamin B6 and risk of colorectal cancer: a meta-analysis of prospective studies. *JAMA* Vol 303, pp. 1077–83. http://dx.doi.org/10.1001/jama.2010.263

Lemming Warensjö, E, Nälsen, C, Becker, W, Ridefelt, P, Mattisson, I & Lindroos, AK (2015). Relative validation of the dietary intake of fatty acids among adults in the Swedish National Dietary Survey using plasma phospholipid fatty acid composition. *JNS* Vol 4, pp.1–9.

Menvielle, G, Boshuizen, H, Kunst, AE *et al.* (2009). The role of smoking and diet in explaining educational inequalities in lung cancer incidence. *J Natl Cancer Inst*. Vol 101, pp. 321–30. http://dx.doi.org/10.1093/jnci/djn513

Norfoods 2000. (2002). *Intagsberäkningar av kosdata i Norden. En jämförelse av näringsdata, beräkningsfaktorer och beräkningsmetoder*. TemaNord. Nr 522. Nordiska ministerrådet; Köpenhamn, Denmark.

Reinivuo, H, Bell, S & Ovaskainen, M.L. (2009). Harmonisation of recipe calculation procedures in European food composition databases. *J food comp anal*. Vol 22, No 5 pp. 410–13. http://dx.doi.org/10.1016/j.jfca.2009.04.003

Rogne, I (2015). *Näringsinnehåll i skolmat.* Swedish University of Agricultural Sciences: Uppsala, Sweden.

Showell, A, Williams, J, Duvall, M, Howe, J, Pattersom, K, Roseland, J & Holden, J (2012). *USDA Table of Cooking Yields for Meat and Poultry*. Nutrient Data Laboratory: Beltsville, USA

Totland, TH, Melnæs, BK, Lundberg-Hallén, N, Helland-Kigen, KM, Lund-Blix, NA, Myhre, JB, Johansen, AMW, Løken, EB & Andersen, LF (2012). *Norkost 3 En lands-omfattende kostholdsundersøkelse blant men og kvinner i Norge i aldermen 18 – 70 år, 2010-11*. Helsedirektoratet, Oslo, Norway.

Vásquez-Caicedo, AL, Bell, S & Hartmann B (2008). *Report on collection of rules on use of recipe calculation procedures including the use of yield and retention factors for imputing nutrient values for composite foods*. (D2.2.9) EuroFIR

Sammanfattning

Livsmedelsdata ligger till grund för många underlag som används för nutritionspolitiska åtgärder. Till exempel används livsmedelsdata för matvaneundersökningar, kostråd, epidemiologisk forskning och märkning av förpackningar. Av resursskäl är det inte möjligt att basera en livsmedelsdatabas på bara analyserade värden utan dessa kompletteras med beräknade recept. Projektet ”Improving food composition data” genomfördes under 2014–2015 med medel från Nordiska Ministerrådets livsmedelssamarbete. Syftet var att förbättra livsmedelsdata genom att strukturera upp receptberäkningar. Projektet bestod av 4 delar:

- *Noggrann genomgång av de olika steg som ingår i recepberäkning idag.* De olika metoderna finns sammanfattade i denna rapport.
- *Identifiera likheter och skillnader såväl som fördelar och nackdelar mellan recpetberäkningar av olika partners.* I testberäkningar identifierades följande steg i beräkningsprocessen som kritiska:
    - Användning av olika retentionsfaktorer för mikronäringsämnen.
    - Olika korrigering för saltupptag, till exempel vid kokning av pasta.
    - Olika val av standardingredienser, till exempel val av fett.
- *Diskutera potentiella förbättringar med stöd från aktuell litteratur.* En ny generell metod, inklusive prioriteringsordning för val av faktorer och en tabell över uppdaterade retentionsfaktorer, sammanställdes. Metoden validerades genom att jämföra beräknat och analyserat näringsinnehåll. Resultaten visade på bra överensstämmelse för makro- och mikronäringsämnen. För enskilda fettsyror avvek beräknat värde vilket bör beaktas när data används.
- *Använda förbättringar för att få mer korrekt livsmedelsdata.* Totalt 953 livsmedel har räknats om med den nya generella metoden. En stor del av dessa tillgängliggörs gratis via de Norska och Svenska livsmedelsdatabaserna. Beräknade recept kommer användas till exempel i kommande nationella matvaneundersökningar och för märkning av livsmedel. Delar av matvaneundersökningen ”Riksmaten vuxna 2010–11” räknades om enligt den nya metoden vilket visade att den tidigare icke-validerade metoden signifikant

överskattat intaget av magnesium, zink och kalium och underskattat intaget av vitamin C. Av nutritionell relevans är att intagen av fleromättade fettsyror, vitamin D, järn och selen kan ha överskattats med den tidigare metoden.

Resultaten från detta projekt ger vägledning i receptberäkning men visar även på behovet av väl strukturerade metoder för receptberäkning och vilka konsekvenserna annars kan bli.

Sammendrag

Matvaredata ligger til grunn for mange ernæringspolitiske tiltak. Matvaredata brukes i kostholdsundersøkelser, for å lage kostråd, i epidemiologisk forskning og for merking av matvarer. Av ressursmessige hensyn er det vanskelig å basere en matvaredatabase bare på analyserte verdier, derfor inneholder matvaredatabaser også verdier fra beregnete oppskrifter. Prosjektet "Improving food composition data" ble gjennomført i 2014–2015 med midler fra Nordisk Ministerråds næringsmiddelssamarbeid. Hensikten var å forbedre matvaredata gjennom strukturering av oppskriftsberegninger. Prosjektet besto av 4 deler:

- *Gjennomgang av de ulike trinnene som inngikk i metodene for oppskriftsberegning i de 2 landene.* De ulike metodene er sammenfattet i denne rapporten.
- *Identifisere likheter og forskjeller så vel som fordeler og ulemper ved de ulike landenes beregning av oppskrifter.* Gjennom test-beregninger ble følgende punkter i beregningsprosessene identifisert som kritiske:
  - Bruk av ulike retensjonsfaktorer for mikronæringsstoffer.
  - Korrigering av saltopptak, for eksempel ved koking av pasta.
  - Valg av standardingredienser, for eksempel valg av fett.
- *Diskutere potensielle forbedringer i lys av aktuell litteratur.* En ny generell metode for oppskriftsberegning ble laget. Prosjektet inkluderer en prioriteringsrekkefølge for valg av faktorer og en tabell med oppdaterte retensjonsfaktorer. Metoden ble validert ved å sammenligne beregnet mot analysert næringsstoffinnhold. Resultatene viste bra overensstemmelse for makro- og mikronæringsstoffer. For enkeltfettsyrer ble det påvist avvik mellom beregnete og analyserte verdier, noe som bør tas med i betraktning når data brukes.
- *Bruke forbedringene til å få mer korrekte matvaredata.* Totalt 953 matvarer ble re-beregnet med den nye generelle metoden. En stor del av disse gjøres tilgjengelige gratis via den norske og den svenske matvaredatabasen. Beregnede oppskrifter vil bli brukt for eksempel i kommende nasjonale kostholdsundersøkelser og ved merking av matvarer. Gjennom å beregne deler av den svenske kostholdsundersøkelsen "Riksmaten vuxna 2010–11" i følge den nye metoden ble det

vist at den tidligere ikke-validerte metoden signifikant overrapporterte inntaket av magnesium, sink og kalium, og underrapporterte inntaket av vitamin C. Av ernæringsmessig relevans viser de nye beregningene at inntaket av flerumettede fettsyrer, vitamin D, jern og selen kan ha vært overrapportert med den tidligere metoden.

Resultatene fra dette prosjektet gir veiledning i beregning av oppskrifter men viser også behovet for godt strukturerte metoder for oppskriftsberegning, samt hvilke konsekvenser det kan få hvis man ikke har gode metoder.

Supplements

Supplement 1a. Standard quantities

Table S1a. Swedish standard quantities

Ingredient	Measure	Reference
Lemon zest	0.5 teaspoon/lemon	
Lime zest	0.25 teaspoon/lime	
Orange zest	1 teaspoon/orange	
Soy sauce	1 tablespoon/4 portions	2 tablespoons contain the same amount of salt as 0.75 teaspoon salt
Amount of water for boiling	1 litre for 700 g of product	Öhrvik, V., Mattisson, I., Wretling, S. & Åstrand, C. (2010) Potato – analysis of nutrients. Livsmedelsverkets rapportserie nr 19/2010.Swedish National Food Agency: Uppsala.
Ketchup	1 tablespoon/portions	
Preserving	75% of the salt is taken up by the food	As calculated from the content of salt in no 1273 Salted herring (14.75 g/100 g) and amount of salt in the recipe for salted herring, Vår kokbok 2013 page 231. 14.75/(amount of salt in recipe/amount of fish in recipe * 100) = 0,75)
Lemon juice, freshly squeezed	1 teaspoon/portions	1/6 of a lemon contains 7,5 g saft
Mustard	0.5 tablespoon/portions	
Salt added for flavour in recipes	0.75 teaspoon/4 portions	
Salt for frying	1.3 gram/600 g meat (pork, lamb, game)	
Margarine/butter	1 tablespoon/4 portions	
Margarine/butter for frying	1 tablespoon/4 portions	
Herbs	1 tablespoon/4 portions	

Supplement 1b. Standard ingredients

Table S1b. Standard ingredients

Standard ingredients		
Swedish standard ingredients		
Ingredient in recipe	**Standard ingredient no name**	**Kommentarer**
Fish, high fat	5335 Fish, high fat	Pooled using salesdata GfK, 2014
Fish, low fat	5334 Fish, low fat	Pooled using salesdata GfK, 2014
Pork	5447 Pork meat	Pooled using salesdata GfK, 2014
Pork minced	979 Pork minced fat 15%	
Pork pieces for stew	5449 Pork meat stew	
Ham smoked	1006 Pork smoked	
Sausage	5301 Sausage fat 22%	
Wild boar	5060 Wild boar meat	Öhrvik V, Engman J, von Malmborg A & Wretling S (2013) Kött – analys av näringsämnen. Livsmedelsver-kets rapportserie nr 24/2013.Swedish National Food Agency: Uppsala.
Wine for sauce	1907 Red wine vol. 12% 1908 White wine medium dry or semi-sweet vol. 12.5%	Is comibned with a retention factor for alcohol and thus the alcohol vol % is reduced in the ready food.
Lamb cuts for stew	5068	
Lamb	5067	
Beef minced	951 Beef minced fat 10%	Öhrvik V, Engman J, von Malmborg A & Wretling S (2013) Kött – analys av näringsämnen. Livsmedelsver-kets rapportserie nr 24/2013.Swedish National Food Agency: Uppsala.
Beef meat	5066 Beef meat	
Beef cuts for stew	961 Beef	
Egg boiled	3515 Egg conventional boiled	Gard C, Mattisson I, Staffas A & Åstrand C (2010) Fullkorn, bönor och ägg – analys av näringsämnen. Livsmedelsverkets rapportserie nr. Livsmedelsverkets rapportserie nr 2/2010.Swedish National Food Agency: Uppsala.
Egg raw	1225 Egg conventional raw	
Milk	5297 Milk fat 1.7% fortified	Pooled using salesdata Arla, 2014.
Cheese	5310 Cheese fat 27%	Pooled using salesdata Arla, 2014.
Cream	5306 Cream fat 33%	Pooled using salesdata Arla, 2014.
Cream, low fat	1717	
Coconut milk	3849	

Standard ingredients		
Margarine	5303 Oil and margarine fat 89% fortified	Used for frying unless otherwise stated in the recipe. Pooled using salesdata GfK, 2014 and SCB statistical database 2014.
Margarine for pies etc.	5304 Butter and margarine fat 81% fortified	Pooled using salesdata GfK, 2014 and SCB statistical database 2014.
Butter or margarine for baking	5304 Butter and margarine fat 81% fortified	Pooled using salesdata GfK, 2014 and SCB statistical database 2014.
Butter, margarine or oil	5307 Butter, margarineand oil fat 85% fortified	Used if it is not stated in the recipe whether the fat should be hard or soft/liquid.
Oil	2189 Rapeseed oil	
Oil for deep-frying	4131 Palmoil	Commonly used for frying.
Potato boiled	231 Autumnpotato boiled w salt	Öhrvik, V., Mattisson, I., Wretling, S., & Åstrand, C. (2010) Potato – analysis of nutrients. Livsmedelsverkets rapportserie nr 19/2010.Swedish National Food Agency: Uppsala.
Potato raw	230 Autumnpotato raw	
Flour, wheat	1939 Flour, wheat	
Pasta for lasagna	3756 Pasta boiled w salt	
Pasta boiled	3756 Pasta boiled w salt	Gard C, Mattisson I, Staffas A & Åstrand C (2010) Fullkorn, bönor och ägg – analys av näringsämnen. Livsmedelsverkets rapportserie nr. Livsmedelsverkets rapportserie nr 2/2010.Swedish National Food Agency: Uppsala.
Rice boiled	2515 Rice long-grain boiled w salt 4591 Rice round-grain boiled w salt	Motivation parboiled rice more expensive.
Rice boiled wholegrain or rice brow	2517 Brown rice wholegrain boiled w salt	
Rice dry wholegrain or rice brow	2478 Brown rice wholegrain boiled w salt	
Rice boiled Sushi	5339 Rice sushi boiled w salt	
Rice dry	2481 Rice long-grain dry 2485 Rice short-grain dry	
Rice dry risotto	2057 Risotto rice dry	
Salt	1975 Salt w iodine	
Stock concentrate	535 1210 1212 1214 1216 1419	Different taste and salt content.

Standard ingredients		
Norwegian standard ingredients		
Ingredient in recipe	**Standard ingredient no name**	**Comments**
Milk		
Milk heat treated		
Whole fat milk	01.236 Whole fat milk, unspecified	Pooled using sales data 2014
Whole fat milk, heat treated		
Semi skimmed milk	01.229 Semi skimmed milk unspecified	Pooled using saled data 2014
Semi skimmed milk, heat treated		
Skimmed milk		
Skimmed milk, heat treated		
Powdered milk		
Unspedified fat in indus-trial recipes		
Margarine		
Margarine/butter		
Butter		
Oil for cooking		
Unspecified flour, sifted (wheat)		
Unspecified flour, whole grain (wheat)		
Unspecified spices		

Supplement 1c. Priority list factors to correct for weight changes

Table S1c. Priority list: factors to correct for weight changes

Food group	Recommended reference
Cereals	Martinsen Bergvatn, T. & Østerholt Dalane, J. (2014). *Vektendringsfaktorer for kjøtt og fisk, fersk pasta og noen grønnsaker*. Mattilsynet: Oslo, Norway. Öhrvik, V. & Mattisson, I. (2015). *Swedish table of ccoking yields*. National Food Agency: Uppsala, Sweden. Industry bread: 0.88.
Dairy products	Bognár, A. (2002). *Tables on weight yield of food and retention factors of food constituents for the calcluation of nutrient composition of cooked foods (dishes)*. Bergström, L. (1994). *Nutrient losses and gains in the preparation of foods*. Rapport-Livsmedelsverket (Sweden). (For eggs in dishes.)
Egg	Bognár, A. (2002). *Tables on weight yield of food and retention factors of food constituents for the calcluation of nutrient composition of cooked foods (dishes)*. Bergström, L. (1994). *Nutrient losses and gains in the preparation of foods*. Rapport-Livsmedelsverket (Sweden). (For eggs in dishes.).
Fish	Martinsen Bergvatn, T. & Østerholt Dalane, J. (2014). *Vektendringsfaktorer for kjøtt og fisk, fersk pasta og noen grønnsaker*. Mattilsynet: Oslo, Norway. Öhrvik, V. & Mattisson, I. (2015). *Swedish table of ccoking yields*. National Food Agency: Uppsala, Sweden.
Legumes	Martinsen Bergvatn, T. & Østerholt Dalane, J. (2014). *Vektendringsfaktorer for kjøtt og fisk, fersk pasta og noen grønnsaker*. Mattilsynet: Oslo, Norway. Öhrvik, V. & Mattisson, I. (2015). *Swedish table of ccoking yields.* National Food Agency: Uppsala, Sweden.
Meat	Showell, A., Williams, J., Duvall, M., Howe, J., Pattersom, K., Roseland, J. & Holden, J. (2012). *USDA Table of Cooking Yields for Meat and Poultry*. Nutrient Data Laboratoru: Beltsville, USA. Martinsen Bergvatn, T. & Østerholt Dalane, J. (2014). *Vektendringsfaktorer for kjøtt og fisk, fersk pasta og noen grønnsaker*. Mattilsynet: Oslo, Norway. Öhrvik, V. & Mattisson, I. (2015). *Swedish table of ccoking yields*. National Food Agency: Uppsala, Sweden. Hess Ygil, K. (2013). *Mål, vaegt og portionsstørrelser på fødevarer*. DTU Fødevaredi-rektoratet: Søborg, Denmark. Bognár, A. (2002). *Tables on weight yield of food and retention factors of food constituents for the calcluation of nutrient composition of cooked foods (dishes)*.
Mushrooms	Martinsen Bergvatn, T. & Østerholt Dalane, J. (2014). *Vektendringsfaktorer for kjøtt og fisk, fersk pasta og noen grønnsaker*. Mattilsynet: Oslo, Norway. Öhrvik, V. & Mattisson, I. (2015). *Swedish table of ccoking yields*. National Food Agency: Uppsala, Sweden.
Vegetables	Martinsen Bergvatn, T. & Østerholt Dalane, J. (2014). *Vektendringsfaktorer for kjøtt og fisk, fersk pasta og noen grønnsaker*. Mattilsynet: Oslo, Norway. Öhrvik, V. & Mattisson, I. (2015). *Swedish table of ccoking yields*. National Food Agency: Uppsala, Sweden. Bognár, A. (2002). *Tables on weight yield of food and retention factors of food constituents for the calcluation of nutrient composition of cooked foods (dishes)*.*

* Broccoli, cauliflower and carrot was prepared within the project “Vektendringsfaktorer for kjøtt og fisk, fersk pasta og noen grønnsaker” (unpublished results) and results were similar to Bognár, hence Bognár was used.

Supplement 1d. Retention factors

Table S1d. Retentionfactors

	Vitamin C	Ref	Thiamine	Ref	Riboflavin	Ref	Vitamin B6	Ref	Folate	Ref	Vitamin B12	Ref	Vitamin D	Ref	Potassium	Ref	Alcohol	Ref
Vegetables and pulses																		
Boiling	0.55	[1–11]	0.6	[1–3, 16]	0.75	[1–3, 16]	0.7	[1–3, 16]	0.6	[2, 3, 24, 25]	N/A		0,9	T	0.7	[1]	N/A	
Frying	0.6	[3, 7, 8, 11]	0.9	[12 B]	0.95	[12 B]	0.9	[12 B]	0.7	[3]	N/A		0,9	[30]	1	[12 B]	N/A	
Owen baking	0.65	[3]	0.9	[12 C]	0.95	[12 C]	0.9	[12 C]	0.65	[24]	N/A		0,9	T	1	[12 C]	N/A	
Fruit and berries																		
Boiling	0.4	[12 A]	0.65	[12 A]	0.8	[12 A]	0.7	[12 A]	0.5	[12 A]	N/A		N/A		0.6	[12 A]	N/A	
Frying	0.8	[12 A]	0.9	[12 A]	1	[12 A]	1	[12 A]	0.8	[12 A]	N/A		N/A		1	[12 A]	N/A	
Owen baking	1	[12 A]	1	[12 A]	1	[12 A]	1	[12 A]	1	[12 A]	N/A		N/A		1	[12 A]	N/A	
Potato and root vegetables																		
Boiling	0.75	[13]	0.8	[13]	0.95	[13]	0.9	[13]	1	[13]	N/A		N/A		0.9	[13]	N/A	
Frying	0.8	[14]	0.6	[14]	0.95	[12 H]	0.95	[12 H]	0.75	[12 H]	N/A		N/A		1	[12 H]	N/A	
Owen baking	0.7	[14, 15]	0.85	[15]	0.8	[15]	0.9	[15]	0.7	[15]	N/A		N/A		1	[12 H]	N/A	
Cheese and dairyproducts																		
Boiling	N/A		0.9	[12 D]	0.95	[12 D]	0.9	[12 D]	0.8	[12 D]	0.95	[12 D]	1	[31]	1	[12 D]	N/A	
Frying	N/A		0.8	[12 D]	0.95	[12 D]	0.8	[12 D]	0.5	[12 D]	0.9	[12 D]	1	[31]	1	[12 D]	N/A	
Owen baking	N/A		0.75	[12 D]	0.95	[12 D]	0.75	[12 D]	0.5	[12 D]	0.9	[12 D]	1	[31]	1	[12 D]	N/A	
Meat, meatproducts and offals																		
Boiling	N/A		0.5	[17]	0.7	[3]	0.55	[3, 17]	0.65	[3]	0.5	[17]	0.8	[12 L]	0.6	[12 L]	N/A	
Frying	N/A		0.7	[3]	0.8	[12 I]	0.5	[1, 3]	0.85	[12 I]	0.75	[3]	0.8	[32]	0.7	[12 L]	N/A	
Owen baking	N/A		0.8	[18]	0.85	[18]	0.95	[18]	0.85	[3, 25]	0.8	[17]	0.9	[32]	0.75	[1]	N/A	
Poultry																		
Boiling	N/A		0.55	[3]	0.8	[3]	0.6	[12 J]	0.65	[3]	0.5	[12 J]	0.55	[12 J]	0.4	[12 J]	N/A	
Frying	N/A		0.35	[3]	0.65	[3]	0.7	[12 J]	0.6	[12 J]	0.7	[12 J]	0.8	[12 J]	0.95	[12 J]	N/A	
Owen baking	N/A		0.3	[3]	0.65	[3]	0.7	[12 J]	0.75	[3]	0.7	[12 J]	0.8	[12 J]	0.8	[12 J]	N/A	
Fish and shellfish																		
Boiling	N/A		0.75	[12 E]	0.7	[12 E]	0.7	[12 E]	0.85	[3]	0.65	[29]	0.8	[12 E]	0.75	[12 E]	N/A	
Frying	N/A		0.8	[12 E]	0.9	[12 E]	0.8	[12 E]	0.8	[12 E]	0.55	[29]	0.85	[12 M]	0.85	[12 E]	N/A	
Owen baking	N/A		0.95	[1]	0.8	[1, 21]	0.55	[1, 21]	0.85	[3]	0.6	[29]	0.9	[30]	0.8	[1]	N/A	

	Vitamin C	Ref	Thiamine	Ref	Riboflavin	Ref	Vitamin B6	Ref	Folate	Ref	Vitamin B12	Ref	Vitamin D	Ref	Potassium	Ref	Alcohol	Ref
Egg																		
Boiling	N/A		0.8	[12 F]	0.8	[12 F]	0.8	[12 F]	0.95	[24, 26]	0.8	[12 F]	0.9	[30, 33]	1	[12 F]	N/A	
Frying	N/A		0.85	[12 F]	0.85	[12 F]	0.9	[12 F]	0.7	[24]	0.95	[12 F]	0.85	[33]	1	[12 F]	N/A	
Owen baking	N/A		0.85	T	0.85	T	0.9	T	0.7	T	0.95	T	0.4	[33]	1	T	N/A	
Cereals																		
Boiling	N/A		0.65	[12 G]	0.65	[3, 22]	0.6	[23]	0.6	[27]	0.9	[12 G]	1	[12 G]	0.65	[12 G]	N/A	
Frying	N/A		0.8	[12 G]	0.75	[22]	0.8	[23]	0.9	[27]	0.95	[12 G]	1	[12 K]	1	[12 G]	N/A	
Owen baking	N/A		0.6	[19, 20]	0.95	[19]	0.55	[20]	0.6	[28]	1	[12 K]	0.75	[33]	1	[12 K]	N/A	
Fat and oil																		
Boiling	N/A		N/A		N/A		N/A		N/A		N/A		0.9	[34]	N/A		N/A	
Frying	N/A		N/A		N/A		N/A		N/A		N/A		0.8	[33]	N/A		N/A	
Owen baking	N/A		N/A		N/A		N/A		N/A		N/A		0.45	[33]	N/A		N/A	
Alcohol																		
Boiling	N/A		N/A		N/A		N/A		N/A		N/A		N/A		N/A		0.35	[35]
Frying	N/A		N/A		N/A		N/A		N/A		N/A		N/A		N/A		0.4	[35]
Owen baking	N/A		N/A		N/A		N/A		N/A		N/A		N/A		N/A		0.25	[35]

References

1. Severi, S., Bedogni, G., Zoboli, G.P., Manzieri, A.M., Poli, M., Gatti, G., Battistini, N., (1998). Effects of home-based food preparation practices on the micronutrient content of foods. *European Journal of Cancer Prevention*, 7: 331–335. http://dx.doi.org/10.1097/00008469-199808000-00009

2. Pearson, M., Engman, J., Rundberg, B., von Malmborg, A., Wretling, S., & Öhrvik, V. (2013). *Grönsaker och rotfrukter – analys av näringsämnen*. Livsmedelsverkets rapportserie nr 10/2013.Swedish National Food Agency: Uppsala.

3. Lešková, E., Kubíková, J., Kováčiková, E., Košická, M., Porubská, J. & Holčíková, K., (2006). Vitamin losses: Retention during heat treatment and continual changes expressed by mathematical models. *Journal of Food Composition and Analysis* 19(4):252–276. http://dx.doi.org/10.1016/j.jfca.2005.04.014

4. Pellegrini, N., Chiavaro, E., Gardana, C., Mazzeo, T., Contino, D., Gallo, M., Riso, P., Fogliano, V. & Porrini, M. (2010). Effect of Different Cooking Methods on Color, Phytochemical Concentration, and Antioxidant Capacity of Raw and Frozen Brassica Vegetables. *J. Agric. Food Chem*. 58: 4310–4321. http://dx.doi.org/10.1021/jf904306r

5. Moriyama, M. & Oba, K. (2008). Comparative Study on the Vitamin C Contents of the Food Legume Seeds. *J Nutr Sci Vitaminol*, 54: 1–6. http://dx.doi.org/10.3177/jnsv.54.1

6.Galgano, F., Favati, F., Caruso, M., Pietrafesa, A. & Natella, S. (2007). The Influence of Processing and Preservation on the Retention of Health-Promoting Compounds in Broccoli. *J Food Sci* 72: 130–135. http://dx.doi.org/10.1111/j.1750-3841.2006.00258.x

7. Xu, F., Zheng, Y., Yang, Z., Cao, S., Shao, X. & Wang, H., (2014). Domestic cooking methods affects the nutritional quality of red cabbage. *Food Chemistry* 161: 162–167. http://dx.doi.org/10.1016/j.foodchem.2014.04.025

8. Zhang, J., Ji, R., Hu, Y., Chen, J. & Ye, X. (2011). Effect of three cooking methods on nutrient components and antioxidant capacities of bamboo shoot (Phyllostachys praecox C.D. Chu et C.S. Chao) *J Zhejiang Univ-Sci B (Biomed & Biotechnol)* 12(9):752–759.

9. Yuan, G., Sun, B., Yuan, J. & Wang, Q. (2009). Effgects of different cooking methods on health-promoting compounds of broccoli. *J Zhejiang Univ Sci B,* 10(8): 580–588. http://dx.doi.org/10.1631/jzus.B0920051

10. Baardseth, P., Bjerke, F., Martinsen, B. K. & Skrede, G. (2010). Vitamin C, total phenolics and antioxidative activity in tip-cut green beans (Phaseolus vulgaris) and swede rods (Brassica napus var. napobrassica) processed by methods used in catering. *J Sci Food Agric*, 90: 1245–1255. http://dx.doi.org/10.1002/jsfa.3967

11. Miglio, C., Chiavaro, E., Visconti, A., Fogliano, V. & Pellegrini, N. (2008). Effects of Different Cooking Methods on Nutritional and Physicochemical Characteristics of Selected Vegetables. *J Agric Food Chem*, 56: 139–147. http://dx.doi.org/10.1021/jf072304b

12. Bognàr, A. (2002). *Tables on weight yield of food and retention factors of food constituents for the calculation of nutrient composition of cooked foods (dishes), part 2*.
A. tabell 36
B. tabell 28, 30, 33, 35
C. tabell 28, 30, 33
D. tabell 1
E. tabell 20, 22
F. tabell 2
G. tabell 37, 38
H. tabell 31, 32
I. tabell 3, 4, 6, 8, 10, 1
J. tabell 12, 16
K. tabell 38
L. tabell 4, 6, 8, 10, 18
M. tabell 20, 22, 24
13. Öhrvik, V., Mattisson, I., Wretling, S. & Åstrand, C. (2010). *Potato – analysis of nutrients*. Livsmedelsverkets rapportserie nr 19/2010. Swedish National Food Agency: Uppsala.
14. Fillion, L. & Henry, C.J.K., (1998). Nutrient losses and gains during frying: a review. *Int J Food Sci and Nutr*. 49: 157–168. http://dx.doi.org/10.3109/09637489809089395
15. Augustin, J., Johnson, S.R., Teitzel, C., True, R.H., Hogan, J.M., Toma, R.B., Shaw, R.L. & Deutsch, R.M. (1978). Changes in the nutrient composition of potatoes during home preparation: II. Vitamins. *American Potato Journal*, 55(12): 653–662. http://dx.doi.org/10.1007/BF02852138
16. Alajaji, S.A. & El-Adawy, T.A. (2006). Nutritional composition of chickpea (Cicer arietinum L.) as affected by microwave cooking and other traditional cooking methods. *J of Food Comp and Anal*, 19: 806–812. http://dx.doi.org/10.1016/j.jfca.2006.03.015
17. Riccio, F., Mennella, C. & Fogliano, V. (2006). Effect of cooking on the concentration of Vitamins B in fortified meat products. *Journal of Pharmaceutical and Biomedical Analysis*, 41: 1592–1595. http://dx.doi.org/10.1016/j.jpba.2006.01.061
18. Fødevaredirektoratet (2000). *Tab af B-vitaminer i kød ved anvendelsen af forkallige stor køkkenteknologier.*
19. Ranhotra, G.S. & Gelroth, J.A. (1986). Stability of Enrichment Vitamins in Bread and Cookies. *Cereal Chem*. 63(5):401–403.
20. Batifoulier, F., Verny, M. -A., Chanliaud, E., Rémésy, C. & Demigné, C. (2005). Effect of different breadmaking methods on thiamine, riboflavin and pyridoxine contents of wheat bread. *Journal of Cereal Science*, 42: 101–108. http://dx.doi.org/10.1016/j.jcs.2005.03.003
21. Badiani, A., Stipa, S., Bitossi, F., Pirini, M., Bonaldo, A., Gatta, P. P., Rotolo, M. & Testi, S., (2013). True retention of nutrients upon household cooking of farmed portion-size European sea bass (Dicentrarchus labrax L.). *Food Sci and Tech*, 50: 72–77. http://dx.doi.org/10.1016/j.lwt.2012.06.026
22. Bui, L. T. T. & Small, D. M. (2009). Riboflavin in Asian noodles: The impact of processing, storage and the efficacy of fortification of three product styles. *Food Chemistry* 114: 1477–1483. http://dx.doi.org/10.1016/j.foodchem.2008.11.048

23. Bui, L. T. T. & Small, D. M. (2012). The stability of pyridoxine hydrochloride used as a fortificant in Asian wheat flour noodles. *Food Chemistry* 130: 841–846. http://dx.doi.org/10.1016/j.foodchem.2011.07.093

24. Bassett, M. N. & Sammán N. C. (2010). Folate content and retention in selected raw and processed foods. *Archivos latinoamericanos de nutricion*, 60: 298–305.

25. McKillop, D. J., Pentieva, K., Daly, D., McPartlin, J. M., Hughes, J., Strain, J. J., Scott, J. M. & McNulty, H. (2002). The effect of different cooking methods on folate retention in various foods that are amongst the major contributors to folate intake in the UK diet. *British Journal of Nutrition*, 88: 681–688. http://dx.doi.org/10.1079/BJN2002733

26. Strandler, H. S., Jastrebova, J. & Mattisson, I. (2011). Folate content in Swedish eggs: influence of breed, feed and processing. *European Food Research and Technology*, 233(6): 923–930. http://dx.doi.org/10.1007/s00217-011-1587-5

27. Bui, L. T. T. & Small, D. M. (2007). Folates in Asian Noodles: III. Fortification, Impact of Processing, and Enhancement of Folate Intakes. *Journal of Food Science*, 72: 288–293. http://dx.doi.org/10.1111/j.1750-3841.2007.00378.x

28. Öhrvik, V., Öhrvik, H., Tallkvist, J. & Witthöft, C. (2010). Folates in bread: retention during bread-making and in vitro bioaccessibility. *European Journal of Nutrition*, 49(6): 365–372. http://dx.doi.org/10.1007/s00394-010-0094-y

29. Nishioka, M., Kanosue, F., Yabuta, Y. & Watanabe, F. (2011). Loss of Vitamin B12 in Fish (Round Herring) Meats during Various Cooking Treatments. *J Nutr Sci Vitaminol*, 57: 432–436. http://dx.doi.org/10.3177/jnsv.57.432

30. Mattila, P., Ronkainen, R., Lehikonen, K. & Piironen, V. (1999). Effect of Household Cookign on the Vitamin D content in Fish, Eggs, and Wild Mushrooms. *Journal of Food Composition and Analysis*, 12: 153–160. http://dx.doi.org/10.1006/jfca.1999.0828

31. Wagner, D., Rousseau, D., Sidhom, G., Pouliot, M., Audet, P. & Vieth, R. (2008). Vitamin D3 Fortification, Quantification, and Long-Term Stability in Cheddar and Low-Fat Cheeses. *J Agric Food Chem*, 56: 7964–7969. http://dx.doi.org/10.1021/jf801316q

32. Purchas, R., Zou, M., Pearce, P. & Jackson, F. (2007). Concentrations of vitamin D3 and 25-hydroxyvitamin D3 in raw and cooked New Zealand beef and lamb. *Journal of Food Composition and Analysis*, 20: 90–98. http://dx.doi.org/10.1016/j.jfca.2006.07.001

33. Jakobsen, J. & Knuthsen, P. (2014). Stability of vitamin D in foodstuffs during cooking. *Food Chemistry*, 148: 170–175. http://dx.doi.org/10.1016/j.foodchem.2013.10.043

34. Skattad från [33]. *Retention skattas högre än för stekning på grund av mer skonsam metod för vitamin D.*

35. USDA Table of Nutrient Retention Factors Release 6.

TemaNord 2015:568

Nordic Council of Ministers

Ved Stranden 18
DK-1061 Copenhagen K
www.norden.org

Improving food composition data by standardizing calculation methods

Food composition data is important in nutritional policy making. However, food analyses are expensive and to use analysed values only is not economically justifiable; hence recipe calculations are important for the quality of food composition databases. The aim with this project, financed by the Nordic Council of Ministers, was to improve and standardize the recipe calculation method.

A general recipe calculation method was developed, implemented and validated by comparing analysed and calculated content. The method and the foods recalculated within the project will be used in national dietary surveys and are available to the public through the national food composition databases. This report may be used as a guide through recipe calculations. Furthermore, the importance of well-structured methods for recipe calculations and possible consequences otherwise are highlighted.

TemaNord 2015:568
ISBN 978-92-893-4310-7 (PRINT)
ISBN 978-92-893-4312-1 (PDF)
ISBN 978-92-893-4311-4 (EPUB)
ISSN 0908-6692

9 789289 343107