Food and Agriculture Organization of the United Nations

Recipe and other calculations

Last update : January 2021

U. Ruth Charrondiere, PhD

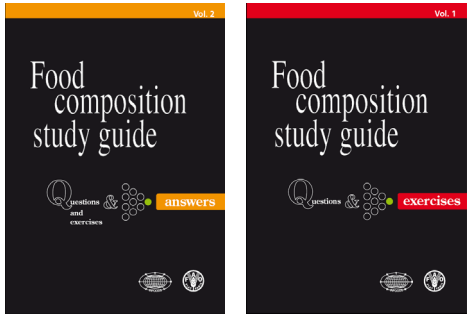
FAO

Food and Agriculture Organization of the United Nations

FAO/INFOODS courses

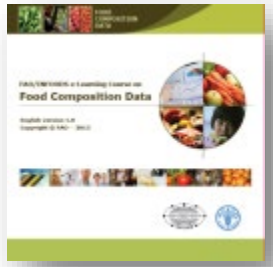
FAO/INFOODS Food Composition Study Guide (2009) – distance learning:

- 17 modules, peer reviewed
- Comprehensive
- Static (2 books)
- Read many documents, questions and answers
- Takes 2 weeks to complete



FAO/INFOODS e-Learning Course on Food Composition Data (2013)

- 14 lessons, peer reviewed
- Focuses on essentials
- Stand-alone and interactive
- On-line and CD
- Takes 10 h to complete



Food and Agriculture Organization of the United Nations

Why do we need recipes?

Mixed dishes and cooked foods represent the bulk of foods consumed globally

Food composition: Analyzing composite dishes is expensive due to the many recipe variations available.

- Recipe calculation allows the compiler to develop as many recipe variations as needed (e.g. porridge made with milk vs porridge made with water)
- Common recipes change over time, recipes can be updated and modified.

Food consumption:

Recipe calculation used to

- calculate the nutrient intake of reported mixed dishes when these are missing in the FCT/FCDB (→ consumption surveys)
- advise on healthy dishes for a diet (→ diet counseling)

Food Labels:

- Nutrition data

Adapted from Rittenschober, 2017

Food and Agriculture Organization of the United Nations

Calculation

1. Calculation procedures based on recipes for missing complex foods, e.g. cakes, sauces, or soups.

2. Calculation procedures for missing cooked foods
(= recipe calculation with 1 ingredient)

3. Calculation procedures to adapt to water and fat contents between foods

4. Calculation procedures to estimate NV of based on fat-free dry matter (USDA)

Food and Agriculture Organization of the United Nations

Compilation steps for recipe calculation

1. Select dish/cooked food
2. Collect recipes for this dish/cooked food
3. Collate necessary information on ingredients
4. Decide on recipe calculation method
5. Document

Food and Agriculture Organization of the United Nations

Yield and retention factors

- Yield factor (YF): % weight change in foods or recipes due to cooking. Should be measured
- Nutrient retention factor (RF): % retention of nutrients, especially vitamins and minerals, in food or dish after, e.g. storage, preparation, processing, warm holding or reheating. Use EuroFIR or USDA
- Edible coefficient (ED): % weight loss when discarding inedible weight from a food. Should be measured or from FCT

➔ Published ED, RFs and YF not available for all foods. Best to measure ED and YF.

Sources for recipes

- Standard/most used recipe book
- From associations, e.g. bakery association
- field work collecting ingredients quantitatively and qualitatively

==> accept variations between individuals

==> estimation better than no value

Food and Agriculture Organization of the United Nations

Transform into gram edible portion (1)

Ingredients of omelette with onions and tomatoes

- 2 eggs
- 2 table spoons milk
- 1 tea spoon butter
- 1 big onion
- 2 small tomatoes

Transform into gram edible portion (2)

- Do not use standard portions from other countries → source of error because weights and dimensions of portions are different between countries
- Better to sample ingredients and weight and take their dimensions → more accurate and can also be used in food consumption surveys
- edible coefficients could be used from other sources but better to also weigh edible portions in own country

Food and Agriculture Organization of the United Nations

Sources of error in recipe calculations

- Inappropriate weight of water or forgetting to add water
- Forget to add fat for frying
- Forget to apply edible coefficient
- Inappropriate use of yield and retention factors
- Apply nutrient values per 100g and forget to adjust for actual weight
- missing nutrient values in ingredients (higher impact the higher content and/or amount in recipe)
- introducing zero values in recipes (while ingredients had missing values)
- wrong food match between ingredients and foods in FCDB

Recipe naming

- Give a name which is understandable for users
- Put additional explanation into recipe name to distinguish different ingredients, e.g.
  - between regions (if ingredients or preparation is different)
  - different main ingredient (e.g. couscous with fish, mutton or vegetarian)

Recipe calculation systems

1. Summing of raw ingredients (not recommended for cooked foods)
2. Ingredient method
3. Total recipe method
4. Mixed method (yield at recipe level and nutrient retention at ingredient level)

Summing of raw ingredients

- Sum weight of each raw ingredient
- No application of YF or RF
- Bring value to 100g

➔ For cooked foods or dishes, not comparable with other methods

➔ Underestimates NV

➔ Not recommended but used in many software (as simplest) and often for labelling

Ingredient method

- Sum weight of each ingredient as in consumed recipe (edible, yield and retention factors applied at ingredient level)
- The nutrient values of the recipe will be calculated based on the weight of the relative proportion of each ingredient
- **Check that yield factors are applied to fluids**

Ingredient method

- **Advantages**
  - need to know weight loss at ingredient level (what is also needed to calculate value of cooked food)
  - no need to decide to which food category recipe belongs
- **Disadvantages**
  - only estimated weight loss of recipe (not measured for whole recipe)

Total recipe method

- Sum weight of each raw ingredient as in recipe
- Measure fat and water change
- Apply yield and retention factors at recipe level based on food group of main ingredient

Total recipe method

- **Advantages**
  - weight loss is measured, therefore more precise
- **Disadvantages**
  - more measurements needed
  - need to decide to which food category the recipe belongs

Mixed method

- Sum weight of each raw ingredient as in recipe
- Measure fat and water change, if possible
- Apply yield factor at recipe level based on food group of main ingredient and the retention factors at ingredient level

→ Most used and recommended recipe calculation method

Mixed method

- **Avantages**
  - weight loss is measured, therefore more precise
  - need to decide to which food category the recipe belongs to apply the retention factors

- **Disadvantages**
  - more measurements needed

Food and Agriculture Organization of the United Nations

Calculation methods for recipes

Ingredient Method	Ingredient 1: NV x 1/YF x RF Ingredient 2: NV x 1/YF x RF Ingredient 3: NV x 1/YF x RF ---------- Recipe: Sum of above
Recipe Method	Ingredient 1: NV Ingredient 2: NV Ingredient 3: NV ---------- Recipe: Sum of above x 1/YF x RF
Mixed Method	Ingredient 1: NV x RF Ingredient 2: NV x RF Ingredient 3: NV x RF ---------- Recipe: Sum of above x 1/YF

Comparison of NVs of recipes due to different RF and calculation methods

- Recipe and Mixed Method provide similar NVs except where differences in RF are big (low retention results in significant lower NVs with recipe method)
- Ingredient Method provides randomly significantly different results compared to other methods
- Bognar's RF are available for many foods/food groups and cooking methods as compared to Bergstroem or McCance and Widdowson

→Verification through analytical determination are needed to determine which method and set of RF give correct results

→ All results are relatively similar and close to analytical variation

Food and Agriculture Organization of the United Nations

Cooked foods are single-ingredient recipes

==> to calculate NVs of cooked foods based on same food (raw or other cooked method)

Concept:

- NV of raw/cooked food derived from national FCT
- apply yield factor linked to a specific cooking method (weight loss can be water and/or fat).
- apply retention factors
- for fatty meat and poultry (> 5% fat in raw food) used as foods, a fat loss (FL) coefficient will be applied as fat is leaking out of the food

FAT LOSS COEFFICIENTS (FLC)

	Non-fatty foods, ingredients, lean meat and poultry (<5% fat)	Fatty meat and poultry (5- 15 % fat)	Very fatty meat and poultry (%fat>15)
Fat loss coeff. (FLC)	0%	7%	13-15%
Water loss	100%	93%	85-87%

Source: EPIC

Tools for recipe calculation

- Excel file developed to easily calculate the nutrient composition of cooked dishes. It comes with two explanatory videos. See Food Composition Explained website https://www.foodcomponline.info
- FAO/INFOODS Compilation Tool
- Softwares using RF and YF

Food and Agriculture Organization of the United Nations

What about data documentation?

Never forget to document

For recipes:

- method of calculation
- source of recipes (e.g. cooking book)
- retention and yield factors
- ingredients quantification and qualification
- main cooking method

Food and Agriculture Organization
of the United Nations

Argumentation about analyzing or calculating NVs of recipes

Food and Agriculture Organization of the United Nations

Analyse or calculate NVs of recipes

Inter- and intra-individual variation in recipe preparation

Variation of NV in analytical determination

Variation of NV when calculating recipes using yield and retention factors

Why analyze recipes if calculated NV are within variability of recipe preparation?

Arguments against analysis of recipes

- Precise measure of one single combination of ingredients prepared (in general) by one person
- Often ingredients are not representative of the foods consumed in the country but taken from shop around the corner
- Any variation in cooking method or ingredient makes the NVs of the analysed recipe not transformable to a similar recipe

→ better to analyse raw ingredients representative of the food supply and calculate recipes. Variation still smaller than that of inter-individual variation

Food and Agriculture Organization
of the United Nations

Missing data and their calculation

Which data can be missing?

- Specific nutrients for all foods
  = missing nutrient
- One nutrient value (NV) for a given food
  = missing value
- All NVs for a given food
  = missing food
- (documentation)
- density/ specific gravity
- edible part/ refuse/ waste

Food and Agriculture Organization
of the United Nations

Do FCTs have missing data?

Most FCTs/FCDBs have missing data

including those of developed countries

Are missing data harmful?

- Missing data can be treated as zero in data use (nutrient intake estimation)
- If not treated as zero, missing data are estimated by user on personal basis

==> Diminished and/or incomparable nutrient intake estimates

Why missing data?

- Not comfortable to assign value of sufficient quality
- Not considered important
- unknown that these missing foods are important in food intake or that some components are of public health concern
- tradition ==> only raw foods in FCT
- policy ==> better no value as unsure value
- no data for manufactured foods
- cost and capacity

Food and Agriculture Organization of the United Nations

Determine important foods

- Compare with food consumption data
- Conduct rapid assessment
- Key food approach
- Investigate about potential foods to be exported

Determine important components

- Proximates / macronutrients are always needed to determine energy
- Interest in country, e.g. programmes, research, etc
- Interest for trade, e.g. label requirements of import countries
- Food safety requirements
- with RDA

Complete missing data

- Analyse foods
- Estimate from similar food within or outside FCT
- Calculate
- Presume as zero

➔ **whatever you decide to do document data**

Food and Agriculture Organization of the United Nations

Caution when borrowing values into FCDB

1. Check that it is the same food
- taxonomic name, species
- meat cut
- description
- fat, water, protein content
- composition of brandname (esp. between countries)
- fortification??

2. Check that it is the same nutrient
- comparable definition
- comparable analytical method
- same expression (CHO as monosach. or sum of fraction, unit etc)

Food and Agriculture Organization of the United Nations

Calculation

1. Calculation procedures based on recipes for missing complex foods (e.g. cakes, sauces, or soups) or of cooked foods (= simple one ingredient recipe calculation)

2. Calculation procedures to adapt to water and fat contents between foods

3. Calculation procedures to estimate NV of dairy products based on fat-free dry matter

Food and Agriculture Organization of the United Nations

Adapt to water and fat contents between foods

- Fat-soluble vitamins depend on fat content
- Water-soluble vitamins and minerals depend on water content
- Amino acids depend on protein content

--> if fat/water/protein content between foods is over a certain limit (e.g. >10%) the corresponding NVs should be adapted

Adapt to water and fat contents between foods

Example:

Food with missing vitamin E value has 10 g fat/100g food and the food, from which value should be copied, has 30g fat and 30mg Vitamin E (TE)

30mg VitE x 10g fat/ 30g fat = 10mg VitE

Note: many fat-soluble vitamins are not depending on the fat content but on other factors such as genetics or feed. So carefully investigate if adjustment to be done. INFOODS does not recommend adjustments of fat-soluble vitamins to fat content

Impute on a non-fat solid basis (USDA)

- reference nutrient per 100 g(100 -(new food item H20 + new food item fat))/(100 - (reference item H20 + reference item fat) = new nutrient per 100 g

Example: calculate Ca content of Brie cheese based on blue cheese.

- 528 x (100 – 17.68 -48.42) / (100 -28.74 - 42.41) = 445 mg Ca (in USDA table there is 184 mg Ca for brie cheese)

➔ better analytical data than calculated

Estimate some nutrients

- estimate zero values: e.g. fibre in meat, alcohol in most foods, vitamin C in cereals, vitamin B_{12} in plant foods
- Tryptophan contribution to niacin equivalent can be estimated as about 1% of protein value

Food and Agriculture Organization of the United Nations

Conclusion

From a user perspective: Better to have values for important foods and components (including cooked foods and recipes) than none at all.

But: Always document your data

For more on food composition, visit www.fao.org/infoods