Development of a protocol based on linear programming to assess the amount of free sugars in industrially-processed foods in France

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INTRODUCTION

WHO recommends a free sugars intake lower than 10% of total energy intake

BUT

Free sugars are not available in nutritional composition database neither on food label.

OBJECTIVE

To develop and test a protocol using linear programming (LP) to estimate free sugars content in a batch of products.

Free sugars are defined as monosaccharide and disaccharide, regardless of sweetening powers, added to food and also total sugars naturally occurring in honey, syrups, fruit juices and fruit juices from concentrate.

MATERIALS AND METHODS

DATA COLLECTION

8 processed food items

OQALI database

-orange nectars
-marbled cakes
-<u>two</u> types of biscuits
-puffed corns with honey
-soft breads
-pizzas
- fresh cheeses

Selection in OQALI database of <u>3 different products</u> per food item that have the **lowest**, **median** and **highest** amount of total sugars (+ 2 for nectar containing banana puree or glucose syrup).

= **26 different products**

+ 1 additional product, whose yield factor and all ingredients amounts were known.

Extraction of nutrition and ingredients information :

1 **Ingredients list as indicated on the label**

Ingredients : orange juice from concentrate (65%), water, sugar, citric acid

2 **Nutrition facts label (NFL)**

Nutrition Information	
	Per 100 g
Energy	485 kJ / 117 kcal
Fat	8 g
Of which Saturates	3,7 g
Carbohydrate	9 g
Of which Sugars	8 g
Protein	1,4 g
Salt	0,02 g
Vitamin C	14,81 mg 19% RI*

3 **A database of all ingredients nutritional composition:**
energy, proteins, fats, carbohydrates,
total sugars, salt, free sugars (estimated using Louie et al. method)

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PROTOCOL applied to each product to assess free sugar content

Input data

1 **Ingredients list as indicated on the label**

2 **Nutrition facts label**

3 **Database of all ingredients nutritional composition**

Linear programming models

Variables : amounts of each ingredient

Constraints :
- Sum of ingredients = 100 g
- Amount of ingredient (when known) set to the labeled value
- Ingredients order conserved
- Total sugars set to the labelled value

Objective function : Minimize deviation from **NFL** (i.e. nutritional deviation)

→ **4 different LP models** varying according to the way to express the nutritional deviation

M1	M2	M3	M4
Absolute difference	Relative difference	Weighted difference with nutrients tolerance from literature (Westricht et al, 1994)	Weighted difference with European Commission nutrients tolerance for labelling

Output

Modelled amounts of ingredient in each model → **Free sugars contents**

RESULTS

For 2 products,

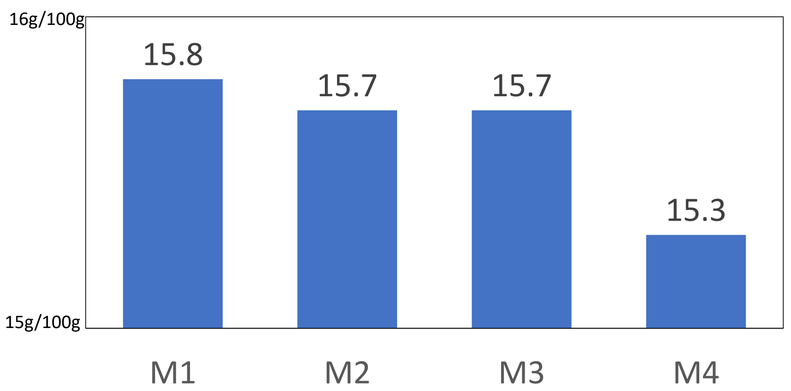
- The 4 LP models were unfeasible due to uncertainties in NFL or in nutrient compositions for ingredients or due to non-inclusion of manufacturing processes.

Biscuit topped with strawberry
53 g of total sugars (median)

« petit-beurre » biscuit
22 g of total sugars (median)

For 24 products,

- The 4 models resulted in similar ingredients amounts and free sugars content



<u>Figure 1 : Average free sugars content among 24 products, in g/100g</u>

For the additional product,

- Amount of free sugars <u>calculated</u> with known ingredients amounts and yield factor (0.92) = 27.5 g / 100g

- **Average free sugars content <u>estimated</u> from the 4 models = 27.1 g**

<u>estimation</u> of free sugars content is close to the <u>calculated</u> value

CONCLUSION

This protocol, fast when nutritional content of ingredient is available and easily reproducible seems to provide an acceptable free sugars estimation, but further work might be needed to improve models and validate the approach.