M ELiSSA

Technical Note

Memorandum of Understanding 19071/05/NL/CP

MELISSA FOOD CHARACTERIZATION: PHASE 1

TECHNICAL NOTE: 98.3.34

FOOD DATABASE COMPILATION

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TABLE OF CONTENTS

List of Tables

List of Abbreviations

ADF	Acid Detergent Fibre test (digestibility)
ADL	Acid Detergent Lignin test (digestibility)
AOAC	Association of Analytical Communities
IPL	Institut Paul Lambin
MFC	MELiSSA Food Characerisation
NDF	Neutral Detergent Fibre test (digestibility)
TDF	Total Dietary Fibre test (digestibility)
USDA	United States Department of Agriculture

1 Introduction

This document is limited to the evaluation of the data gathering procedure needed for harmonisation and approval, before entry in the MELiSSA food database structure.

The MELiSSA food database still needs extensive modifications, beyond what was assumed at the start of the MFC Phase1 Project, as outlined in TN 98.3.33 (Management of the accumulated food data) composed by MFC partner IPL. This document briefly outlines the needs for efficient data gathering.
Since no functional database was available during MFC Phase1, data gathering was harmonised based on nutritional analysis results of raw and processed bench test crop harvest. The data were organised in tabular form (basic data sheet template) for reporting in TN98.4.21 and 98.4.22.

The procedure will have to be updated with an extended data sheet template to accommodate the extensive list with all experimental, nutritional, processing and waste parameters selected for inclusion in a final version of the MELiSSA food database .

For MFC1, the available resources (e.g. harvest quantity) for nutritional analysis limited the crop analysis protocols to a list of parameters identified as of highest impact on nutritional value, taking into account crop-specific parameters. Processing quality parameters indicative of the performance of one or more processing approaches were included for durum wheat, given the larger harvest quantity of these trials.

The nutritional composition of food products derived from growth-chamber based culture under artificial illumination and in hydroponic culture is known to be different from results commonly obtained in field agriculture. Hence for the MFC1 bench test experiments, reference values from commonly used databases (e.g. USDA, Souci) were reported for comparison.

It is of utmost importance to link the nutritional data to the crop yield, harvest timing and crop production energy use (linked to growth environment settings), as reported in the TN98.4.1 and 98.4.2 documents, in order to provide the possibility for extended functionality of the database. An overview of the most relevant parameters is included in the table below.
The same applies for crop processing related data, which include a comparable nutritional analysis, and estimations of processing equipment energy use.

As crops also provide water purification and atmosphere revitalisation functions, relevant production rates should also be included. As crops also produce compounds that are difficult to degrade within a bioregenerative system, waste characterisation and thus a measure of fibre composition is needed. The non-degradable part is in majority present in the inedible part of the plant, and is assessed by the analysis already established within the MELiSSA program (NDF/ADF/ADL) yielding lignin, cellulose and hemicellulose content measures.

NDF/ADF/ADL is the most relevant method of choice (and established as a MELiSSA protocol) for assessing the biodegradability of (typically) non-edible plant parts, although edible parts should also be characterized for non-degradable components. TDF (Total Dietary Fibre, and subcomponents in the future) analysis protocols can be used for edible nutritional analysis according to AOAC standards.

The database should contain entries for the most optimal and representative experiment carried out at a given time, for a given crop cultivar that has been accepted for inclusion into the MELiSSA crop list.

The evaluation of the MFC1 bench test data gathering will help to gradually expand the capability of harmonised data gathering and to reach the final goal of scheduling and providing a balanced crew menu based on inclusion of an important share of (sealed) growth chamber derived crop products.

2 Data Harmonisation table to be fed into the MELiSSA Food Database

Tab. 1 Data harmonisation table for MELiSSA Food Database

A. Source of food: name(s) and descriptive terms.			
B. Name and identification of the food			
1. Name of food in national language of the country (name of the national language).			
2. Local name of food (name of local language or dialect).			
3. Nearest equivalent name of this food in English.			
4. Country or area in which food sample was obtained.			
5. Food group and code for this food in database used in the laboratory/country (give database citation).			
6. Food group and code for food in regional nutrient database (give database citation).			
7. Codex Alimentarius or INFOODS food indexing group.			
C. Description of "single" (one ingredient) foods			
1. Description of "single" foods			
a. Food source (English).			
b. Scientific name of food source (Latin).			
2. Part of plant or animal.			
3. Country or area of origin.			
4. Manufacturer's name and address. Batch or lot number.			
5. Other ingredients (including additives).			
6. Food processing and/or preparation; where processed/prepared.			
7. Preservation method.			
8. Degree of cooking. (Raw / cooked in function of time or energy)			
9. Agricultural production conditions.			
10. Maturity or ripeness			
11. Storage conditions.			
12. Grade.			
13. Container and food contact surface.			
14. Physical state, shape, or form.			
15. Color			
16. Other descriptors not covered above.			
17. Photograph or drawing of this food.			
D. Description of "mixed" (multi-ingredient) foods			
1. Ingredients and quantities if available; source of ingredient information.			
2. Recipe procedure.			
3. Place where multi-ingredient food was made.			
4. Photograph or picture.			
5. Manufacturer's name and address.			
6. Container and food contact surface.			

7. Preservation method.			
8. Storage conditions.			
9. Final preparation of this multi-ingredient food.			
E. Customary uses of food (Optional for single or mixed foods)			
1. Typical portion weight and corresponding household measure or size.			
2. Availability; frequency and season of consumption.			
3. Usual place of food in the diet (time of day, place in meal, etc.).			
4. Food users.			
5. Specific purposes of the food; special claims.			
F. Sampling and laboratory handling of food			
1. Date of collection.			
2. Weight(s) of sample(s).			
3. Percentage edible portion; nature of edible portion.			
4. Percentage of refuse; nature of refuse.			
5. Place of collection: supplier(s); type of outlet(s).			
6. Handling between supplier and laboratory.			
7. Handling on arrival at laboratory.			
8. Laboratory storage and subsequent handling.			
9. Strategy for analyses.			
10. Reason for doing analyses.			
G. Food Processing and preparation (to be elaborated)			
1. Number of processing steps undertaken			
2. Storage periods: number, duration, conditions			
3. Characterisation of processing/storage step 1 …. X			
4. Characterisation processing/storage equipment: energy, crew time …			
5. Effects / losses due to processing/storage steps			
H. Experimental parameters			
1. Seed source			
2. Seed germination (%)			
3. Seed expiry date			
4. GMO clasification			
5. Days to emerge			
6. Lab and growth room in which the experiment was performed			
7. Experiment Code			
8. Growth period / maturation time (yield in function of time)			
9. Plant height			
10. Yield edible			
11. Harvest Index (edible / total mass; dry weight basis, inedible part also contains the roots)			
12. Resource usage - water (liter/growth period = water transpired)			
13. Resource usage - crew harvest time			
14. Resource usage - energy for environmental control			
15. Resource usage - light energy (PPF), photoperiod x intensity (mol PPF/m2) integrating complete growth period			
16. Number of leaves per plant			

17. Number of tillers per plant			
18. Stress resistance preliminary observations			
19. Water transpiration rate (time; area or volume units; purified)			
20. Oxygen production rate (time; area or volume units)			
21. CO2 consumption rate / NCER			
I. Experimental setpoints			
1. Photoperiod (hours/day)			
2. Spectrum (Light source type and spectrum if available)			
3. Light intensity (at canopy level at full-grown size vegetative phase?) (micromol PPF/m2/s)			
4. Lamp lifetime – intensity at fixed point in chamber (time from light change)			
5. Atmosphere - T day			
6. Atmosphere - T night			
7. Atmosphere - RH			
8. Atmosphere - ethylene remediation			
9. Liquid phase - T (depending on developmental stage)			
10. Liquid phase - Nutrient solution recipe			
11. Acid / base used for pH adjustment of the nutrient solution			
J. Waste (non-edible plant parts); (fibre composition indicating biodegradability)			
1. Root - fibre characterisation (lignin, cellulose, hemicellulose)			
NDF		%	
ADF		%	
LIGNIN		%	
C		%	
N		%	
P		%	
K		%	
Mg		%	
Ca		%	
2. Shoot - fibre characterisation (lignin, cellulose, hemicellulose)			
NDF		%	
ADF		%	
LIGNIN		%	
C		%	
N		%	
P		%	
K		%	
Mg		%	
Ca		%	
3. Elemental analysis (CHOSNP, minerals, protein, carbohydrate)			
K. Harvest processability quality parameters			
1. Wheat			

gluten			
alveograph			
kernel appearance			
semolina quality			
2. Potato			
Starch content			
protein content			
tuber appearance			
3. Soybean			
High dry matter content			
Uniform size of seeds			
Clear hilum: seeds with dark hilum have not different nutritional values but their products (flour or okara, for example) have dark parts. This affects sensory acceptability.			
Light seeds coat			
L. Anti-nutritional compounds			
1. Wheat			
protease inhibitors - Trypsin and chymotrypsin inhibitors			
Anti alpha amylases			
Galactosides			
Phytic acid			
Non starch polysaccharides			
Lectins			
2. Potato			
Protease inhibitors - Trypsin, chymotrypsin and carboxypeptidases inhibitors			
Vasopressines amines (histamine, octopamine, phenylephrine, tyramine, tryptamine)			
Non starch polysaccharides			
Oxalate			
Glycoalkaloids (chaconines, solanines, solamarines)			
Lubminin			
Rishitin			
Patatine (protein, can induce allergy)			
3. Soybean			
Antivitamin D			
Antivitamin E			
Antivitamin B12			
Glucosinolate			
Galactosides			
Phytic acid: *a strong chelator of important minerals such as calcium, magnesium, iron and zinc (Kumar et al., 2006)*			
Non starch polysaccharides			
Lectins			

Tannins			
Phyto-oestrogens (Lignans, flavones, isoflavones, isocoumarin, oestrone, pomegranate, coumestrol, genistin, mirestrol)			
Kunitz trypsin inhibitors *(Kumar et al., 2003)*			
Haemagglutinating isolectins: *are carbohydrate-binding proteins (Van Damme Els et al., 1997)*			
M. Full Nutritional analysis (edible part)			
Total Dietary Fibre analysis (TDF)			
Component name		**Unit**	**# deci-mals**
Density		g/mL	2
Edible portion coefficient			2
Energy (standardized): sum of carbohydrates x 17 + protein x 17 + fat x 37 + alcohol x 29 + dietary fibre x 8		kJ	0
Energy (standardized): sum of carbohydrates x 4 + protein x 4 + fat x 9 + alcohol x 7 + dietary fibre x 2		kcal	0
Water		g	1
conversion factor to calculate total protein from nitrogen			2
Nitrogen, total		g	2
protein, total; calculated from total nitrogen		g	2
protein from plant origin		g	2
protein from animal origin		g	2
fat, total (standardized)		g	2
fatty acids, total saturated		g	2
fatty acids, total monounsaturated		g	2
fatty acids, total polyunsaturated		g	2
fatty acids, total trans		g	2
Cholesterol, method unknown		mg	2
carbohydrate, available; calculated by difference (standardized)		g	2
starch, available		g	2
sugar		g	2
sugar, added		g	2
fibre, total dietary; determined gravimetrically by the AOAC total dietary fibre method (Prosky and similar methods) (standardized)		g	2
fibre; method of determination unknown or mixed methods		g	2
Fibre, water-insoluble		g	2
Fibre, water-soluble		g	2
alcohol		g	2
Available org acids		g	2
ash		g	2
calcium		mg	2
iron		mg	2
magnesium		mg	2
phosphorus		mg	2
potassium		mg	2

sodium		mg	2
Chloride		mg	2
Zinc		mg	2
copper		mg	2
manganese		mg	2
iodine		µg	2
Fluoride		µg	2
Molybdenum		µg	2
selenium		µg	2
cobalt		µg	2
Boron		µg	2
Bromide		µg	2
Nickel		µg	2
Chromium		µg	2
Vanadium		µg	2
Aluminium		µg	2
Tin		µg	2
Arsenic		µg	2
vitamin A; retinol activity equivalent (standardized)		µg	2
vitamin A; calculated by summation of the vitamin A activities of retinol and the active carotenoids (Total vitamin A activity = mcg retinol + 1/6 mcg beta-carotene + 1/12 mcg other provitamin A carotenoids.)		µg	2
retinol		µg	2
beta-carotene equivalents (This value is the sum of the beta-carotene plus ½ the quantity of the other carotenoids with vitamin A activity)		µg	2
vitamin D (D2+D3) (standardized)		µg	2
vitamin D equivalent (Vitamin D3 + 5 x 25-hydroxycholecalciferol)		µg	2
vitamin E ; calculated by summation of the vitamin E activities of the active tocopherols and tocotrienols; expressed as alpha-tocopherol equivalents (standardized). (VITE = a-tocopherol + 0.4 b-tocopherol + 0.1 g-tocopherol + 0.01 d-tocopherol)		mg	2
alpha-tocopherol		mg	2
vitamin K, total		µg	2
thiamin		mg	2
riboflavin		mg	2
niacin equivalents, total (standardized). (NIAEQ = niacin + 1/60 tryptophan)		mg	2
pantothenic acid		mg	2
vitamin B-6, total; calculated by summation (standardized)		mg	2
folate, total; microbiological assay (standardized)		µg	2
folate, dietary folate equivalent (Dietary folate equivalent (DFE) = food folate (pteroylpolyglutamates) + 1.7 x synthetic folic acid (pteroylmonoglutamic acid)		µg	2
biotin		µg	2
vitamin B-12		µg	2
vitamin C (standardized) (L-ascorbic acid + L-dehydroascorbic acid)		mg	2
Fructose		g	2

Glucose		g	2
Lactose		g	2
Maltose		g	2
Amylopectin		g	2
Amylose		g	2
Dextrins		g	2
Saccharose		g	2
Pentosan		g	2
Hexosan		g	2
Cellulose		g	2
Polyuronic acid		g	2
C 4:0		g	2
C 6:0		g	2
C 8:0		g	2
C 10:0		g	2
C 12:0		g	2
C 14:0		g	2
C 15:0		g	2
C 16:0		g	2
C 17:0		g	2
C 18:0		g	2
C 20:0		g	2
C 22:0		g	2
C 24:0		g	2
C 14:1 cis, n-5		g	2
C 16:1 cis n-7		g	2
C 18:1, n-9		g	2
C 18:1, cis n-7		g	2
C 20:1, n-11		g	2
C 22:1, n-9		g	2
C 22:1, n-11		g	2
C 24:1, cis, n-9		g	2
C 18:2, cis, n-6		g	2
C 18:3, cis, n-3		g	2
C 18:4, cis, n-3		g	2
C 20:4, cis, n-6		g	2
C 20:5, cis, n-3		g	2
C 22:5, cis, n-3		g	2
C 22:6, cis, n-3		g	2
Sum n-3 fatty acids		g	2
Sum n-6 fatty acids		g	2
Isoleucin		mg	2
Leucine		mg	2
Lysine		mg	2
Methionine		mg	2
Cystine		mg	2
Phenylalanine		mg	2

Tyrosine		mg	2
Threonine		mg	2
Tryptophan		mg	2
Valine		mg	2
Arginine		mg	2
Histidine		mg	2
Alanine		mg	2
Aspartic acid		mg	2
Glutamic acid		mg	2
Glycine		mg	2
Proline		mg	2
Serine		mg	2
polyphenols		mg	2
lycopene		µg	2
lutein		µg	2
Lutein+Zeaxanthin		µg	2
Anthocyanidins		µg	
flovonols		µg	2
Monomeric flavanols		µg	2
Flavanones		µg	2
Total Isoflavonoids		µg	2
Daidzein		µg	2
Histamine		mg	2
Serotonine		Mg	2
Tryptamine		µg	2
tyramine		µg	2
Purines		mg	2
Nitrates		mg	2
Nitrites		mg	2
Sulfates		mg	2
Polyols		g	2
Glutathione		mg	2
Malic Acid		mg	2
Citric acid		mg	2
oxalic acid total		mg	2
succinic acid		mg	2
gluconic acid		mg	2
salicilic acid		µg	2
Total Phospholipids		mg	2
Total stérols		mg	2
Solanine		µg	2
Chaconine		µg	2

3 References

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4 ESTEC Review and UGent replies

General		
	The Technical note aims at defining the management of food accumulated data within the general MELiSSA Food characterisation activity. The document proposes a structured, exhaustive and standardised food datasheet, which is to be entered in the MELisSA Food database. However it is not clear today that the MELiSSA food database can easily use this datasheet as a list of entries. This will need to be clarified at a later stage. The datasheet proposed is nonetheless very valuable today.	
	If the document describes the proposed food datasheet, it does not explain what has to be exactly entered as a data documentation (e.g. entry C.6, what type of information is expected here: the type of operational equipment, the conditions of processing, the time of processing,...?). Based on the format of the datasheet and the absence of explanation on how to fill it in, it is assumed that it is left to the free interpretation of whoever will fill in this datasheet. This will need to be clarified at a later stage.	
	The full process of management of the data is not explained. Where it starts, where it ends, who does what and what are the pre-requisite for the people who will enter the process,…all those points will need to be clarified before entering in the characterisation phase.	
	It is not clear to the reader if the datasheet proposed is meant to be used to document bench tests data, or if it is meant to be used to characterisation data. This shall be clarified and if the datasheet is aiming at characterisation data, then an adaptation for the bench test data should be provided (minimum data necessary from bench tests can be just underlined in the datasheet itself).	The proposed datasheet is meant to be used to document bench test data. It covers plant physiology, nutritional analysis and food processing parameters. Initially, we imagined to edit a datasheet for each plant, process or bench test. We felt it was necessary to list exhaustively all the features regarding nutritional information for the first MELiSSA plants analyzed. Subsequently, taking into account all features, we can establish a classification of plants and identify the plants or cultivars that best meets all criteria of interest (nutrition, growth rate, weight, energy, waste ...). This document is an adaptation of material

		included in TN98.3.33. Indeed, the UBP MELiSSA food database is a simple basis. To date, any new food composition database should be constructed using the golden standard. The INFOODS system seems the most comprehensive and most used. Thus, we used the basic UBP database supplemented by INFOODS data with specific information related to the first Melissa varieties. Because we sincerely believe that the UBP Melissa database needs to be more expanded and updated (see TN98.3.33). We think it is appropriate to be comprehensive so that the designers of the UBP MELiSSA database can include all these data right from the start of the development. But we also know that we will initially not be able to complete all the fields due to limitations such as amount of material, cost analysis, ... Therefore the datasheet has to be adapted in the future in order to reasonably suit the preliminary selection of cultivars.
	The document has been renamed, for unknown reason, into "food database compilation". Original title, as per contract (i.e. "management of accumulated food data"), shall be restored.	According to UGent documentation, it is TN98.3.33 which is entitled 'Management of accumulated food data'. TN98.3.34 is entitled 'Food database compilation'. Please, confirm.
	Providing that the clarification requested row 5 is answered in the present worksheet, and the technical note title is restored, the TN is accepted.	