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Combating Malnutrition in Africa Through Diversification of the Food System

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Deliverable Name: Comprehensive Data for Nutrient Composition of Major Food Items

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Introduction and Objectives

This deliverable (D8 & Milestone 5) aims to generate comprehensive data that provides insights into the nutritional content of major and underutilized crops consumed across the eight selected African countries where the project is being implemented. The resulting information will support efforts to promote the production and consumption of these foods, ultimately contributing to improved food and nutrition security across the region.

Methods

Consortium-wide agreement on the target crops (Milestone 7) to be studied in the project was reached through responses submitted via a Google Form by project partners (see the Appendix). The selected crops included major crops, underutilized crops, and other relevant species (see Tables A1 and A2 in the Appendix), which served as the foundation for developing the nutrient composition database. The questionnaire was designed primarily for consortium partners to identify target crops, and most of the questions were open-ended. This structure limits the ability to generate quantitative summaries, such as the number of partners selecting specific crops.

Guided by expert advice within the consortium and informed by existing databases, we focused on a comprehensive set of nutrient elements, including: energy, water, fat, protein, carbohydrate, fibre, ash, calcium, iron, magnesium, phosphorus, potassium, sodium, zinc, selenium, copper, and vitamins (A, B1, B2, B3, B5, B7, B9, B12, C, D, E, and K).

To gather the necessary data, we conducted a literature search using google scholar to identify relevant databases containing nutritional composition data for the selected crops. In total, nine food composition databases were identified and used: West African Food Composition Table, Nigerian Food Composition Table, Kenyan Food Composition Table, Australian Food Composition Database, Brazilian Food Composition Table, USDA FoodData Central, Biodiversity for Food and Nutrition Database, FAO Compendium of Forgotten Foods in Africa, and the ANES Database.

For each species, a systematic search was conducted across all databases, and all available nutrient values were extracted. When a species appeared in multiple databases, multiple

values were recorded for each nutrient, with up to nine observations per species. For species not identified in the selected databases, additional literature searches were conducted using academic search engines such as Google Scholar, ResearchGate, PubMed and Science Direct. When multiple values were available for the same nutrient, the mean was calculated to derive a single representative value for each nutrient per species. These resources were further supplemented with data from additional published studies. The database was created using excel file (.xlsx).

Identified databases/studies were systematically reviewed to extract nutrient composition data, which were subsequently compiled into a preliminary database in Microsoft Excel. The compilation followed the Food and Agriculture Organization/International Network of Food Data Systems (FAO/INFOODS) guidelines, including the use of standardized food identifiers (tag names) and the FAO/INFOODS food composition compilation framework. Nutrient values were transcribed as originally reported in each source, together with their corresponding measurement units.

Considerable heterogeneity was observed in the reporting formats, including differences in units and denominators. To ensure comparability across species, all data were standardized and converted to common units: grams (g) for proximate components, milligrams (mg) for minerals and antinutrients, and micrograms (µg) for vitamins, all expressed per 100 g fresh weight of the edible portion (EP). For studies reporting values on a dry matter (DM) basis without accompanying moisture or DM content, conversions to fresh weight were performed using average moisture values derived from comparable literature sources (FAO/INFOODS, 2012). The standardized values were compiled into a second version of the database.

A rigorous data quality assessment was conducted to identify and exclude implausible values. The sum of proximate components (moisture, protein, fat, carbohydrate, fibre, and ash) was evaluated, and entries falling outside the acceptable range of 95–105 g per 100 g were omitted (Greenfield & Southgate, 2003). In cases where the reporting basis (dry or fresh weight) was not specified, assumptions were made based on internal consistency checks: if the sum of proximate components excluding moisture approached or exceeded 100 g, the data were assumed to be on a dry weight basis and were subsequently converted to fresh weight.

Further validation involved cross-checking mineral values against total ash content; studies in which the total mineral content exceeded twice the ash value were excluded due to likely inconsistencies. For vitamin data, no universally accepted thresholds for plausibility checks were available; therefore, these values were retained following general consistency screening.

After applying all quality control procedures, a final harmonized nutrient composition database was developed, incorporating validated data from selected studies for each species. This database formed the basis for subsequent analysis and synthesis of nutrient profiles for underutilized species in Africa.

A major limitation of the study is the absence of a comprehensive proximate analysis for all the different varieties, resulting in incomplete nutritional data. Consequently, some food composition profiles lack essential components, particularly fat and protein. In addition, several of the identified indigenous varieties have no existing nutrient composition data, further constraining the completeness and reliability of the analysis. As a result, we are conducting further analysis of the identified varieties (see Table A1) to generate comprehensive nutrient composition data and enable accurate reporting on their potential nutritional contributions.

Work Done

A comprehensive nutrient composition database covering major and underutilized crop species has been developed. The database comprises 196 food items, including 51 vegetables, 79 fruits, 47 seeds, and 19 roots and tubers.

The database is organized in an Excel file with eight main sheets, which include:

- Authors
- Introduction to the database
- Archival database
- Reference database
- User database statistics
- User database

- Bibliography
- Acknowledgements

The database is available on our project website and has been published in JLUdata repository (https://doi.org/10.22029/jlupub-20248). You can download a copy of the nutrient composition database using the link below:
http://www.hd4a.eu/Deliverable_D8_Nutrient_composition_database_HD4A2025.xlsx

References

1. FAO/INFOODS. (2012). FAO/INFOODS Guidelines on Conversion among different units, denominators and expressions version 1.0. Soon available at http://www.fao.org/infoods/infoods/standards-guidelines/en/ (Accessed April, 2026).
2. Greenfield, H., & Southgate, D. A. T. (2003). Food Composition Data : Production, Management, and Use. Food & Agriculture Organisation.

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Appendices

Table A1. List of selected underutilized crop species

Species name	Common name	Nominated by	Reasons for nominating
*Aframomum alboviolaceum**	Tongolo	UDS	nutritious and consumed but scarce
*Basella alba**	vine spinach Amunututu	HD4A	
*Canarium schweinfurthii**	fruit noir	UDS	nutritious and consumed but little production
*Corchorus tridens**		AR	
*Crassocephalum crepidioides**	Fireweed “ebolo"		
*Dacryodes edulis**	African pear/Ube	HD4A	
Dacryodes macrophylla	Atom	UDS	nutritious and consume but not available
*Dioscorea bulbifera**	igname aérien	HD4A, UDS	
*Dioscorea dumetorum**	bitter yam	UDS	nutritious and consume all over the country
*Ficus exasperate**		AR	
*Gongronema latifolium**	Bushbuck “utazi/arokeke"	APDC	It has culinary, medicinal, and nutritional values. It is mostly produced and consumed by south-eastern Nigeria but generally its highly underutilized in all parts of Nigeria.
*Irvingia gabonensis**	Ogbono seed/dikanut	IITA, AR	
*Lactuca taraxacifolia**		AR	
Murraya koenigii	Curry leaves	APDC	It has culinary, medicinal, and nutritional values. It is mostly used only for stew however there are different combination of foods that can go with it to increase its consumption in the country.
*Ricinodendron heudelotti**	Njansang	AR	
*Solanum torvum**		AR	
Sphenostylis stenocarpa Hochst	African yam bean	IITA	It is a potential food & nutrition security crop as it produces both a legume – beans and a tuberous root – yam.
*Trichosanthes cucumerina**	Snake tomato, tomai elejo	HD4A	
Trichoscypha acuminata	amvout	UDS	Nutritious and consume but not available
*Triumfetta pentandra**	nkui, herbe à panier	UDS	Nutritious and consumed but little production
Ceratotheca sesamoides	False Sesame	IPGRI	Nutritious and have a good texture but available essentially like wild grass
*Parkia biglobosa**	African locust bean	IPGRI	Underutilized but has a great nutritional value
*Vitex doniana**	Black Plum	IPGRI	Nutritious and consumed but little production

Table A2. Lists of crops targeted in HD4A	
Targeted crop category	Specific crop
Vegetable	Amaranthus
	Cucumber (Cucumis sativus)
	Bell Pepper (Capsicum Spp),
	Bitter leaves (Vernonia amygdalina),
	Bushbuck (Gongronema latifolium)
	Cabbage (Brassica oleracea),
	Carrot (Daucus carota),
	Clove basil (Ocimum gratissimum),
	Ewedu (Corchorus olitorius)
	False cubeb leaves (Piper guineense),
	Fluted pumpkin (Telfairia occidentalis),
	Ginger (Zingiber officinale),
	Hibiscus sabdariffa (Bissap extract),
	Lettuce (Lactuca sativa),
	Moringa oleifera (Moringa extract),
	Okra (Abelmoschus esculentus),
	Spinach (Spinacia oleracea),
	Spring Onions (Allium fistulosum),
	Tomatoes (Solanum lycopersicum)
Cereal & grains	Maize (Zea mays),
	Rice (Oryza sativa, O. glaberrima)
	Sorghum (Sorghum bicolor)
	Wheat (Triticum aestivum)
	Finger millet (Eleusine coracana
Others	Cooking bananas and Plantains (Musa paradisiaca)
	Dessert bananas (Musa acuminata),
Legume	Cowpea (Vigna unguiculata),
	Soybean (Glycine max),
	Cyperus esculentus lativum (Tiger nut extract),
Roots and tubers	Cassava (Manihot esculenta),
	Potatoes (Salanum tuberosum),
	Sweet potatoes (Ipomoea batatas),
	Yam (Dioscorea alata, D. cayenesis),
Non-forest timber products	Adansonia sp (Boabab pulp extract),
	Tamarindus indica (Tamarind extract),

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Questionnaire for selection of underutilised crop species in HD4A project sites

We are collating information on the consortium's target crops under the HD4A project. This would be used as the consortium-wide agreement on nutritious target crops species/varieties. Please indicate the crops of interest to you under this project, and the reasons for selection by responding to the questions in the form. Most questions require an response, if it does not apply to you, please enter "Not applicable" in the field.

* Indicates required question

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1. Which organisation are you representing?

Mark only one oval.

- Justus-Liebig University Giessen (JLU)
- AfricaRice (AR)
- Katolieke Universiteit Leuven (KUL)
- Universiteit Gent (UGENT)
- Max Planck Gesellschaft (MPG)
- Centro de Investigación y Tecnología Agroalimentaria de Aragon (CITA)
- Centre d'Excellence Régional contre la Faim et la Malnutrition (CERFAM)
- Africa Projects Development Centre (APDC)
- MANOBI Africa (MANOBI)
- International Institute of Tropical Agriculture (IITA)
- Food Security for Peace and Nutrition- Africa (FSPN)
- De Montfort University (DMU)
- University of Dschang (UD)
- Entreprise en Sante et Securité au Travail (ESST)
- Universitätsklinikum Heidelberg (UKHD)
- Agri-Business Vocational Training Center (AVTC)
- International Plant Genetic Resources Institute (IPGRI)
- Opportunities Industrialization Center (OIC)
- University of Copenhagen (UCPH)
- Kenyatta University (KU)
- Center of Plant Systems Biology and Biotechnology (CPSBB)

2. Please indicate your contact email in case additional questions or clarifications are required.

3. Have you included any of the major crops below among your study/ implementation crops in this project? Please select those that you have below.
Tick all that apply.

- [ ] Rice (Oryza sativa, O. glaberrima)
- [ ] Maize (Zea mays)
- [ ] Finger millet (Eleusine coracana)
- [ ] Sorghum (Sorghum bicolor)
- [ ] Wheat (Triticum aestivum)
- [ ] Soybean (Glycine max)
- [ ] Cowpea (Vigna unguiculata)
- [ ] Yam (Dioscorea alata, D. cayenesis)
- [ ] Sweet potatoes (Ipomoea batatas)
- [ ] Cassava (Manihot esculenta)
- [ ] Potatoes (Salanum tuberosum)
- [ ] Cabbage (Brassica oleracea)
- [ ] Lettuce (Lactuca sativa)
- [ ] Tomatoes (Solanum lycopersicum)
- [ ] Okra (Abelmoschus esculentus)
- [ ] Spinach (Spinacia oleracea)
- [ ] Carrot (Daucus carota)
- [ ] Cooking bananas and Plantains (Musa paradisiaca)
- [ ] Dessert bananas (Musa acuminata)

4. Are there other target crops that you have selected to work on apart from the under-utilised crops selected by the consortium (indicated at the end of this form) or the crops mentioned above? *

5. If you answered "yes" above, please indicate in the field below, the additional crops using their scientific names (with common and indigenous names in parenthesis). If you selected "no" write "not applicable".

Mark only one oval.

- ◯ Yes
- ◯ No

7. Please list which crops grow wildly below and the seasons that they grow in parenthesis

8. Please list which crops have been domesticated below and the seasons that they are cultivated in parenthesis.

9. How long does it take to produce the target crops? .....

10. Please indicate reasons for selection?

Tick all that apply.

- [ ] Underutilised
- [ ] Widely grown and consumed
- [ ] Nutritious benefits unknown
- [ ] Preparation methods limited
- [ ] Processing methods limited
- [ ] Acceptability in new forms unknown
- [ ] Knowledge on food safety required
- [ ] Scaling, diversified delivery required
- [ ] Production, domestication method unknown
- [ ] Other reasons (please indicate below)

11. Please indicate other reasons for selection here.

12. Are there any antinutrient(s) that could affect consumption/utilization among the selected crops?

Mark only one oval.

- Yes
- No
- I do not know

13. If you responded "yes" to the above, please indicate the antinutrient and the crop it is associated with.

14. What is unique about the crop(s)? Please indicate the crops(s) and then the unique attributes?

15. For certain crops, is consumption limited to certain group(s) of people? (e.g. pregnant women, lactating mothers, men, children of certain age range, etc.)
Mark only one oval.

- Yes
- No
- I do not know

17. If you responded "yes", please mention the crop(s) and the unique group that consumes it (them).

Tick all that apply.

- [ ] Nationally-consumed
- [ ] Regionally-consumed
- [ ] Ethnically-consumed

18. Which of the following consumption patterns apply to the crops?

Nationally-consumed (please list below)

Regionally-consumed (please list below)

Ethnically-consumed (Please list below)

19. Any social behavior attached to its consumption?

Mark only one oval.

- Yes
- No
- I do not know

20. If you responded "yes" above, please indicate what the social behaviors are and which crops they apply to in the field below.

21 Are the consortium-selected under-utilised crops among your target crops under HD4A? Please select those that are.

Tick all that apply.

- [ ] Aframomum alboviolaceum
- [ ] Basella alba (Malabar spinach, vine spinach, Ceylon spinach and Indian spinach)
- [ ] Canarium schweinfurthii (bush candle, African olive, African elemi, or canarium)
- [ ] Corchorus tridens (Horn-Fruited Jute)
- [ ] Coula edulis (African walnut/Gabon fruit)
- [ ] Crassocephalum crepidioides (Thickhead weed, Redflower ragleaf, Fireweed)
- [ ] Dacryodes edulis (Bush Butter Tree, Safou or Atanga)
- [ ] Dacryodes macrophylla (Atom fruit)
- [ ] Dioscorea bulbifera (Air yam)
- [ ] Dioscorea dumetorum (bitter yam, cluster yam, trifoliate yam, or three-leaved yam)
- [ ] Ficus exasperata (Sandpaper Fig, Hairym fig)
- [ ] Gongronema latifolium (Bush Buck, amaranth globe, Swallow apple and Sodom apple)
- [ ] Irvingia gabonensis (Wild mango, African mango, bush mango)
- [ ] Lactuca taraxacifolia (African wild lettuce leaf)
- [ ] Murraya koenigii (Curry leaf)
- [ ] Ricinodendron heudelotti (English African wood-oil nut tree; African nut tree; African wood (Liberia, Kunkel)
- [ ] Solanum torvum (pendejera, turkey berry, devil's fig, pea eggplant, platebrush or susumber)
- [ ] Sphenostylis stenocarpa Hochst (African yam bean)
- [ ] Trichosanthes cucumerina (snake gourd, serpent gourd, chichinda padwal and Snake Tomato)
- [ ] Trichoscypha acuminata (amvout)
- [ ] Triumfetta pentandra (Fivestamen Burrbark)
- [ ] Ceratotheca sesamoides (False sesame)
- [ ] Parkia biglobosa (African locust bean)
- [ ] Vitex doniana (Plack plum)