

DRAFT
WORKING DOCUMENT

TREATY ON THE DEFINITION OF

DENSITY

A Global Initiative to **Define the Spectrum of Nutritional Quality in Food**

PREPARED BY



THE
BIONUTRIENT
INSTITUTE

INTRODUCTION

RECOGNIZING the accelerating global discourse around Nutrient Density as a pivotal concept in food systems transformation;

ACKNOWLEDGING the absence of a widely accepted empirical framework to define and measure nutrient density across crop and livestock types;

AFFIRMING the collective responsibility to create food systems that restore ecosystem function, support vibrant human health, and reflect the wisdom of natural processes;

ESTABLISHING this process, we, the undersigned, aim to define Nutrient Density in food; to advance its global definition, measurement, and integration into food systems.

We endeavor to accomplish the preliminary **definitions of Nutrient Density in 20 crops by 2028**. But acknowledge that it is a continuously evolving and iterative project, deepening over time as our understandings develop.

ARTICLES

A Global Initiative to **Define the Spectrum of Nutritional Quality of Food**

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GUIDING PRINCIPLES

THEORY OF CHANGE

This Treaty is premised on the following theses:

1. **NUTRITIONAL VARIATION IS PROFOUND**

- ◆ Levels of nutrients in crops of the same may vary by 5x to 20x or more.

2. **PRODUCTION INFLUENCES NUTRITION**

- ◆ Environmental conditions, management practices, fertility regimens, epigenetics and microbiome dynamics can significantly affect nutrient profiles in food.

3. **ASSESSMENT CAN BE NON-INVASIVE**

- ◆ Instruments using methods such as spectrometry can assess nutrient density in food in real time, throughout the food supply chain.

4. **STANDARDS CAN BE ESTABLISHED**

- ◆ Each crop or food type can have a nutrient density score defined by levels and ratios of a short list of biomarkers that correlate with the overall balance of nutrients in that crop.

5. **HEALTH AND ECOLOGY ARE LINKED**

- ◆ Forms of foods that cause relatively improved human health outcomes are produced in manners that have similarly beneficial impacts on the ecosystems they are produced in.

6. **QUALITY IS SENSORY**

- ◆ Increased and improved flavor, aroma, and satiety are sensory experiences that correlate with higher nutritional quality in food.

7. **CONSUMERS WILL CHOOSE HIGHER QUALITY**

- ◆ When presented with trustworthy easily interpreted information, consumers will choose options nutritionally beneficial for themselves and their families.

8. **MARKETS CAN TRANSFORM FOOD SYSTEMS**

- ◆ Economic incentives cascade through supply chains, with the choice for higher-quality food will come improved human and ecological health outcomes.

PURPOSE

The purpose of this Treaty is to **formalize a global, coordinated effort to develop empirical standards for nutrient density in food**, expressed via a 1-to-100 scale, based on key biomarker levels and ratios in whole foodstuffs.

These standards will serve as a basis for:

- An empirical definition of relative nutritional caliber;
- That can be used for instrument calibration for invasive and non-invasive assessments;
- Which can empower decommoditized prioritization across the supply chain;
- And support consumer choice of best nutritional quality at point of purchase;
- Which will incentivize system function that preferences system function as an output.

C O O R D I N A T I N G E N T I T Y

The Bionutrient Institute (BI), having conducted foundational research in this area since 2017, shall **serve as the primary coordinating entity** for this effort. As directed by this Treaty, the BI will:

- Convene global stakeholders from a diverse spectrum of perspectives across the food system to shape and refine the methodology to define the spectrum
- Raise the funding
Oversee experimental design
- Manage sample and data collection and analysis Maintain metadata in open access platforms
- Coordinate definition process through boards of credentialed relevant specialists
- Publish conclusions in highly regarded peer-reviewed journals

FUNDING MILESTONES

Public events will be held to launch the TREATY and collect feedback at

PHASE 1 **\$5M** by January 1, 2026

PHASE 2 **\$8M** by January 1, 2027

PHASE 3 **\$13M** by January 1, 2028

These funds will support:

- Experimental design and representative sample collection from across 6 continents;
- Lab analysis and requisite human health correlation trials;
- Data housing, processing, publication, and dissemination.

EXPERIMENTAL DESIGN FRAMEWORK

The initiative will follow a model refined through the BI's Beef Nutrient Density Project.

Key design principles:

1. Original Research: Conclusions will emerge from pattern recognition in data.
2. Global Sampling: All major production regions on six continents will be represented.
3. Inclusive Metadata: Production management history, soil type, genetics and epigenetics, pest and disease pressure, climate data, production economics data will be collected and assessed.
4. Multidimensional Assessment: Crop, soil, microbiome, and human health parameters will be analyzed.
5. Transparency and Open Access: All datasets will be publicly available to enable replication and innovation.

PROPOSED TIMELINES (Per Crop)

3 months: Experimental design

12 months: Sample collection (northern and southern hemispheres)

12 months: Laboratory assessment

3 months: Expert review and initial standard development

6 months: writing and publication of papers to formalize conclusions

IMPLEMENTATION & PUBLICATION

Upon completion of analysis for each crop, BI will:

- Establish preliminary nutrient density definitions in a 1-100 scale format;
- Share all metadata including spectral signature data which could be used to calibrate instruments for assessment as well as production data for producers to be able to improve their crops;
- Publish findings in reputable peer-reviewed journals;
- Advocate for industry adoption and alignment with public health policy.

APPENDECES

PRIORITIZATION	METHODOLOGICAL SUMMARY & SAMPLING PROTOCOL	TIMELINE & MILESTONE CHART	FUNDING & PROSPECTUS USE OF FUNDS
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PREPARE

A-D

09.23.25.

APPENDECES A-D



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Appendix A

Crop Prioritization List

A Global Initiative to Define the Spectrum of Nutritional Quality in Food

This list identifies the 20 globally significant crops selected for nutrient density empirical framework development and standard-setting by the end of 2028.

#	Crop Name	Scientific Name	Region(s) of Importance	Reason for Prioritization
1	Wheat	<i>Triticum aestivum</i>	Global (North America, Europe, Asia)	Staple cereal; wide consumption & nutrient variability
2	Lamb	<i>Ovis aries</i>	Global (North America, Europe, Asia)	Major staple food; nutrient dense food source
3	Rice	<i>Oryza sativa</i>	Asia, Africa, Latin America	Major staple food; critical for food security
4	Maize (Corn)	<i>Zea mays</i>	Americas, Africa, Asia	Versatile staple and feed crop; high nutrient diversity
5	Soybean	<i>Glycine max</i>	Americas, Asia	Protein-rich legume; supports sustainable rotations
6	Potato	<i>Solanum tuberosum</i>	Global	Important root crop; nutrient-dense food source

7	Tomato	<i>Solanum lycopersicum</i>	Global	High-value horticultural crop with variable nutrient content
8	Spinach	<i>Spinacia oleracea</i>	Global	Leafy green rich in micronutrients
9	Banana	<i>Musa spp.</i>	Tropics worldwide	Staple fruit crop; important micronutrient source
10	Coffee	<i>Coffea arabica</i>	Tropical regions	Economically critical; quality influences nutritional and ecological outcomes
11	Barley	<i>Hordeum vulgare</i>	Temperate zones	Important cereal with unique nutrient profiles
12	Lentil	<i>Lens culinaris</i>	Asia, Mediterranean	Key protein source legume
13	Chickpea	<i>Cicer arietinum</i>	Asia, Africa	Vital legume crop supporting nutrition and soil health
14	Apples	<i>Malus domestica</i>	Temperate regions	Widely consumed fruit with health benefits
15	Carrots	<i>Daucus carota</i>	Global	Root vegetable rich in antioxidants and vitamins
16	Milk (Dairy)	<i>Bos taurus</i>	Global	Essential nutrient source with variable quality
17	Cabbage	<i>Brassica oleracea</i>	Global	Leafy vegetable with nutrient density variability

18	Quinoa	<i>Chenopodium quinoa</i>	Andes region	High-protein pseudocereal with increasing global importance
19	Almonds	<i>Prunus dulcis</i>	Mediterranean, California	Nut crop with important nutritional fats
20	Sweet Potato	<i>Ipomoea batatas</i>	Global	Root crop important for vitamin A and micronutrients

Appendix B

Methodological Summary and Sampling Protocol

A Global Initiative to Define the Spectrum of Nutritional Quality in Food

1. Overview

This annex outlines the standardized methodology and sampling protocol to be followed for the empirical assessment of nutrient density across the 20 prioritized crops and livestock products. The approach ensures reproducibility, ecological validity, and global representativeness.

2. Research Framework

- **Original Research and Data-Driven Insights:**
Conclusions will be based on pattern recognition from comprehensive, multi-dimensional data sets including nutrient biomarkers, soil health, microbial communities, and human health outcomes.
- **Ecological Validity:**
The study acknowledges that nutrient-dense foods reflect the health of the ecosystems they are grown in, incorporating soil microbiome, agronomic practices, and climate influences.
- **Global Sampling Coverage:**
Samples will be collected from major production regions across six continents, capturing intra-species variation influenced by environment and management.
- **Open Access and Transparency:**
All data collected will be made publicly available to promote validation, innovation, and wide adoption.

3. Sampling Protocol

Step	Description	Details
1	Experimental Design	Define sampling sites representing diverse agroecological zones; finalize biomarker lists per crop. (3 months)
2	Sample Collection	Collect representative samples from both northern and southern hemispheres during growing seasons. (12 months)
3	Metadata Recording	Document detailed metadata: variety, soil type, crop management history, pest pressure, climate data, and economic factors.
4	Sample Preservation	Freeze samples at -80°C immediately after collection to ensure stability for lab analysis.
5	Laboratory Assessments	Conduct multi-omics nutrient profiling including elemental analysis, vitamin content, phytochemicals, and microbial assessments. (6 months)
6	Human Health Correlation Studies	Where applicable, link nutrient profiles with biomarker and health outcomes from clinical or epidemiological studies.
7	Data Analysis and Standard Development	Analyze patterns, define biomarker signatures, and establish nutrient density scores on the 1–100 scale. (3 months)
8	Peer Review and Publication	Submit findings for expert review and publish in open- access and peer-reviewed journals.

4. Key Biomarkers and Metrics

- Nutrient concentrations (e.g., vitamins, minerals, fatty acids)
- Beneficial phytochemicals (e.g., polyphenols, antioxidants)
- Biomarker ratios indicative of nutritional quality and ecological integrity
- Soil and microbiome indicators supporting nutrient availability

Nutrient Density Analysis includes:

Detailed analysis for all whole food crops

Fats	Total Fat, Fatty Acids: SFA, PUFA, MUFA, Omega 3, Omega 6, Omega 6:3 Ratio, 47 Individual Fatty Acid Species. Total Cholesterol
Protein	Total Protein, Amino Acids
Carbohydrates	Total Carbohydrates Sugars: Lactose, Glucose, Galactose, Maltose, Fructose Total Fiber, Insoluble, Soluble
Vitamins	Vitamin A: Retinol B vitamins: B1, B2, B3, B5, B6, B7, B9, B12 Vitamin C Vitamin D Vitamin E: Alpha Tocopherol
Minerals	Sodium, Calcium, Potassium, Iron, Manganese, Phosphorous, Sulfur, Magnesium, Cobalt, Iron, Nickel, Copper, Zinc, Selenium
Heavy Metals	Lead, Mercury, Cadmium, Arsenic
Bioactives	Polyphenols - Flavanoids, Phenolics Terpenes - Carotenoids

5. Quality Assurance

- Use of standardized, validated laboratory protocols
- Replicate samples and controls to ensure data reliability
- Cross-laboratory calibration and inter-comparison exercises
- Documentation of all procedures and raw data for reproducibility

6. Data Management and Access

- Centralized database managed by the Bionutrient Institute
- All datasets anonymized and available on open-access platforms
- Data formats designed for interoperability with global food system stakeholders

7. Timeline Summary

Activity	Duration
Experimental Design	3 months
Sample Collection	12 months
Laboratory Assessment	12 months
Data analysis, expert review, and establishment of nutrient density standards	3 months
Expert Review & Standard Development	6 months

Appendix C

Timeline and Milestone Chart

A Global Initiative to Define the Spectrum of Nutritional Quality in Food

1. Overview

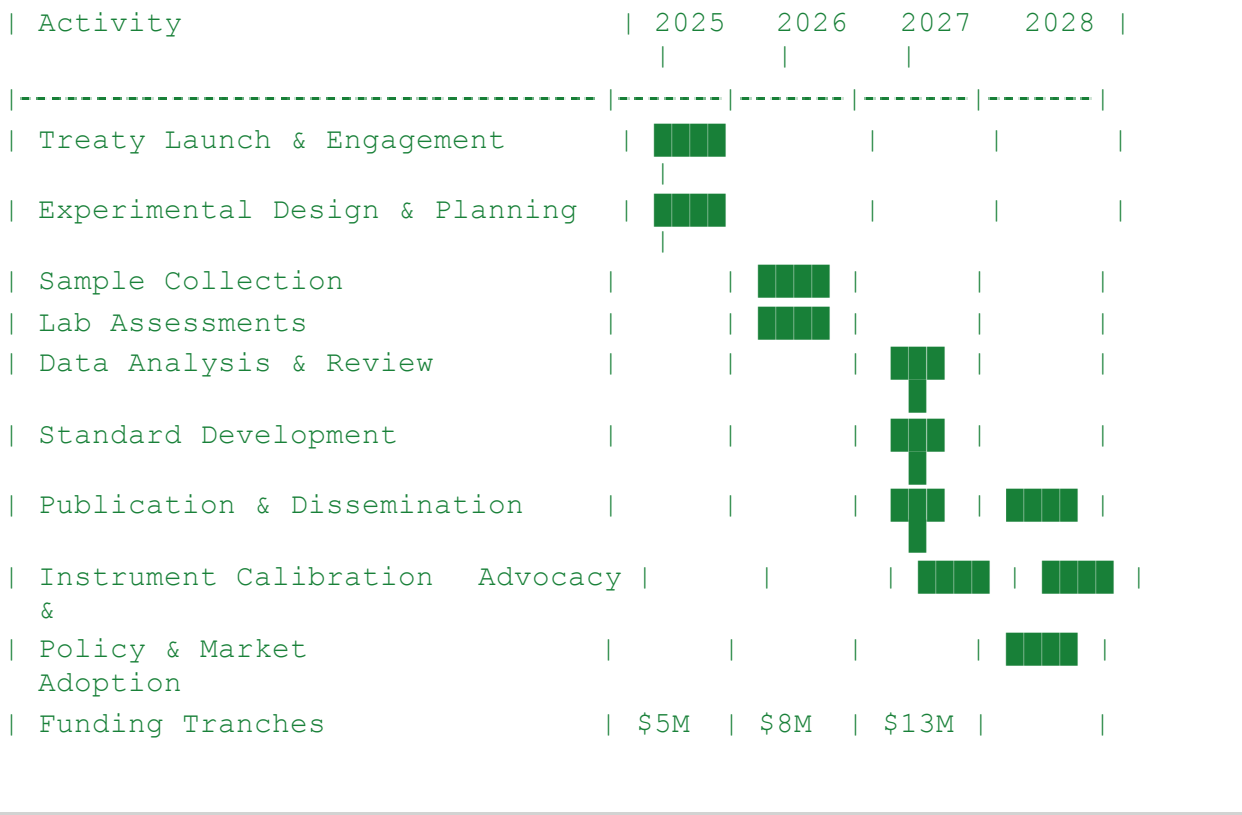
This annex outlines the projected timeline from 2025 to 2028 for the development, validation, publication, and implementation of nutrient density standards across 20 prioritized crops and livestock products. It highlights key milestones and deliverables by project phases.

2. Project Timeline & Milestones

Phase	Time Period	Key Activities	Milestones & Deliverables
Phase I: Initiation & Experimental Design \$5M funding tranche to be achieved by January 1, 2026	Q1 2025 – Q1 2026	- Formal Treaty launch events (Australia, Europe, North America, South America, Africa) - Finalize methodology and crop prioritization - Design experimental protocols and sampling plans - Secure initial funding (\$5M)	- Treaty launched globally - Approved experimental design - Sampling protocols finalized - \$5M funding milestone achieved by 1 Jan 2026
Phase II: Sample Collection & Lab Analysis \$8M funding tranche to be achieved by January 1, 2027	Q2 2026 – Q1 2027	- Sample collection across 6 continents for 20 crops - Metadata and environmental data gathering - Sample preservation and shipment - Begin laboratory nutrient and biomarker assessments - Secure second funding tranche (\$8M)	- Completion of global sample collection - Initiation of multi-lab analysis - Comprehensive metadata database established - \$8M funding milestone achieved by 1 Jan 2027

Phase III: Data Analysis, Standard Setting & Dissemination \$13M funding tranche to be achieved by January 1, 2028	Q2 2027 – Q4 2028	- Analyze biomarker data and develop 1–100 nutrient density scales - Conduct expert review and validation - Publish peer-reviewed findings and open-access datasets - Standard able to be used to calibrate instruments and tools for industry use - Advocate for policy and market adoption - Secure final funding tranche (\$13M)	- Nutrient density standards published - Industry instrument calibration guidelines released - Public access to data and tools - Policy engagement and adoption begins - \$13M funding milestone achieved by 1 Jan 2028
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3. Gantt Chart Visualization



4. Summary of Key Deliverables

- **2025:** Formal Treaty establishment and stakeholder engagement worldwide
- **2026:** Completion of global sample collection and initiation of lab analyses
- **2027:** Data analysis, expert review, and establishment of nutrient density standards
- **2028:** Publication, dissemination, industry calibration, and policy advocacy

Appendix D

Funding Prospectus and Use of Funds

A Global Initiative to Define the Spectrum of Nutritional Quality in Food

1. Overview

To meet the Treaty's objectives by 2028, the initiative requires a total investment of \$26 million USD, distributed across three project phases. This funding will support scientific research, global sampling, laboratory analysis, data infrastructure, tool development, stakeholder engagement, and open-access publication of nutrient density standards.

2. Funding Breakdown by Phase

Phase	Time Period	Funding Target	Purpose
Phase I	Q1 2025 – Q1 2026	\$5 million USD	- Finalize methodology and protocols - Convene international stakeholders - Launch Treaty awareness events - Establish data systems and infrastructure
Phase II	Q2 2026 – Q1 2027	\$8 million USD	- Global sample collection across 6 continents - High-resolution metadata and environmental data - Nutrient biomarker and soil lab analyses
Phase III	Q2 2027 – Q4 2028	\$13 million USD	- Data modeling and pattern recognition - Develop 1–100 nutrient density scoring scales - Peer-reviewed publications - Open-access toolkits and standards released for industry calibration - Global advocacy, outreach, and adoption support

3. Detailed Use of Funds

Category	Estimated Allocation	Use Cases
Scientific Research & Lab Analysis	\$9.5M	Nutrient and biomarker analysis, microbial assessments, method development, lab coordination
Global Sampling & Logistics	\$6.0M	Crop and livestock sample collection, shipping, preservation, storage at -80°C
Data Systems & Modeling	\$3.5M	Database design, data management, analytics, visualization, digital infrastructure
Stakeholder Engagement & Events	\$2.0M	Treaty launch events, working group coordination, translation and facilitation
Publishing & Dissemination	\$1.5M	Open-access peer-reviewed papers, public data platforms, educational materials
Instrument Calibration for Industry Tool Development	\$2.0M	Development of calibration protocols for industry adoption
Contingency / Administrative Support	\$1.5M	Legal, operational, communications, and financial management services

4. Funding Sources & Partnership Opportunities

The Treaty welcomes investment from a range of contributors:

- **Philanthropic Foundations**
- **Government and Public Health Agencies**
- **Multilateral Organizations (e.g., UN, FAO, WHO)**
- **Food and Agriculture Corporations**
- **Academic and Research Institutions**
- **Impact Investors & Family Offices**

In-kind contributions (e.g., lab space, soil testing, analytical support, technical tools) are also highly valuable and welcome.

5. Investment Benefits & ROI

- **Social Return on Investment:** Data-driven transformation of food systems toward health, ecology, and transparency
- **Scientific Legacy:** Co-creation of the first global nutrient density standards
- **Visibility & Leadership:** Recognition at major treaty events and in peer-reviewed publications
- **Network Access:** Participation in global working groups and strategic alliances
- **Market Influence:** Shaping a regenerative economy rooted in quality, nutrition, and ecosystem restoration

6. Learn more, and make your submission:

To support this initiative or request additional details, please visit:



The Bionutrient Institute

 <https://www.bionutrientinstitute.org/treaty>

 Strategic and philanthropic inquiries welcome.

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