



NUTRACEUTICAL SCIENCE, BIOCHEMISTRY, PRODUCT DEVELOPMENT SPECIALIZATION COURSE

6 Month Comprehensive Virtual Course

A structured professional pathway for nutrition students, graduates and nutrition professionals who want to understand nutraceutical products from the level of biochemistry and molecular nutrition through ingredient science, formulation, research, safety, quality, manufacturing, regulatory review, product development, scientific affairs and responsible industry practice.

Who This Course Is For	Nutrition students, nutrition graduates and professionals who want to work in the nutraceutical or dietary supplement industry, contribute to product development, scientific affairs, research, nutrition education, regulatory support or build a responsible nutraceutical business concept.
Course Approach	The course begins with nutritional biochemistry and molecular nutrition, then progresses into ingredient science, bioavailability, formulation, research, safety, toxicology, manufacturing, quality systems, regulatory science, product development, scientific communication and industry practice.
Industry Focus	Participants are not trained to replace pharmacists, chemists, formulation scientists, quality specialists or regulatory experts. They are trained to understand the language and logic of these disciplines well enough to contribute meaningfully as nutrition professionals within multidisciplinary nutraceutical teams.
Overall Aim	To develop nutrition professionals who understand what a nutraceutical ingredient does biochemically, how evidence is generated, how products are formulated and quality controlled, how claims are reviewed, and how a scientifically defensible product or professional service is built.



COURSE ROADMAP

Month	Primary Development Area	What the Participant Should Gain
Month 1	Nutritional Biochemistry and Molecular Nutrition	Understand the biochemical pathways and molecular mechanisms that explain how nutrients and selected bioactive compounds influence human physiology.
Month 2	Nutraceutical Ingredient Science, Bioavailability and Formulation	Understand ingredient classes, chemical forms, absorption, metabolism, delivery systems, dosage forms and formulation principles.
Month 3	Evidence, Research, Safety and Toxicology	Learn how nutraceutical evidence is generated, critically appraised and translated into decisions while considering dose, safety, contraindications and interactions.
Month 4	Manufacturing, Quality Assurance and Regulatory Science	Understand how raw materials and finished products are specified, manufactured, tested, documented, labeled and reviewed within quality and regulatory systems.
Month 5	Product Development and Applied Nutraceutical Science	Learn how a scientifically defensible product concept is developed from target need to ingredient selection, formulation logic, evidence dossier and product positioning.
Month 6	Nutraceutical Industry Practice, Scientific Affairs and Startup Development	Understand professional roles within nutraceutical companies and develop a complete evidence based product or professional business concept.



MONTH 1: NUTRITIONAL BIOCHEMISTRY AND MOLECULAR NUTRITION

Theme: Understand what happens inside the body before deciding what should go inside the product.

Purpose: To give participants the biochemical foundation required to understand mechanisms of action, nutrient metabolism, enzyme activity, cellular signaling and the scientific rationale behind nutraceutical ingredients.

Week	Focus	Learning Content	Practical Application
1	Cellular Biochemistry and Enzymology	Cell structure relevant to metabolism. ATP. Enzymes. Cofactors. Coenzymes. Substrates and products. Enzyme kinetics concepts. Competitive and noncompetitive inhibition concepts. Cellular compartments and regulation of metabolic reactions.	Participants connect selected vitamins and minerals with their roles as cofactors, coenzymes or structural contributors within biochemical reactions.
2	Energy Metabolism and Metabolic Pathways	Glycolysis. Glycogen metabolism. Citric acid cycle. Electron transport chain. Oxidative phosphorylation. Fatty acid oxidation. Lipogenesis. Amino acid metabolism. Integration of carbohydrate, fat and protein metabolism.	Participants trace how selected nutrients contribute to energy metabolism and identify where common nutraceutical ingredients may theoretically influence metabolic pathways.
3	Micronutrient Biochemistry	Biochemical roles of selected B vitamins, vitamin D, vitamins A, C and E, iron, zinc, magnesium, calcium, selenium and other nutritionally relevant micronutrients. One carbon metabolism. Methylation concepts. Antioxidant systems. Oxygen transport and mineral dependent enzymes.	Participants create biochemical pathway maps showing why deficiency or excess of a nutrient can influence more than one physiological system.
4	Molecular Nutrition and Cellular Signaling	Receptors. Gene expression concepts. Transcription factors. Hormonal signaling. Insulin signaling. Inflammation. Oxidative stress. Reactive oxygen species. Cellular antioxidant systems. Gut microbiome metabolites. Nutrigenomics concepts. Introduction to xenobiotic metabolism.	Participants evaluate a common nutraceutical mechanism claim and distinguish biochemical plausibility from demonstrated human benefit.

Development Outcome: Participants should understand the biochemical role of nutrients and bioactive compounds well enough to evaluate mechanism claims without confusing mechanistic plausibility with clinical effectiveness.



MONTH 2: NUTRACEUTICAL INGREDIENT SCIENCE, BIOAVAILABILITY AND FORMULATION

Theme: The name of the ingredient is only the beginning.

Purpose: To teach participants how ingredient chemistry, chemical form, absorption, metabolism and formulation influence the performance and quality of a nutraceutical product.

Week	Focus	Learning Content	Practical Application
5	Nutraceutical Ingredient Categories	Vitamins. Minerals. Amino acids. Fatty acids. Botanicals. Plant extracts. Polyphenols. Probiotics. Prebiotics. Postbiotic concepts. Enzymes. Protein and peptide ingredients. Fiber ingredients and selected functional bioactives.	Participants develop an ingredient classification library that records source, intended function, major biochemical relevance and important scientific considerations.
6	Absorption, Distribution, Metabolism and Excretion	Gastrointestinal absorption. Transporters. First pass metabolism concepts. Tissue distribution. Metabolism. Excretion. Dose response. Saturable absorption. Food effects. Timing and individual variability.	Participants compare why identical labeled doses of different ingredient forms may not necessarily produce identical biological exposure.
7	Ingredient Forms and Bioavailability	Mineral salts. Chelated forms. Esterified forms. Standardized botanical extracts. Active constituent concepts. Particle size concepts. Solubility. Stability. Strain specificity for probiotics. Ingredient standardization.	Participants compare several forms of one nutraceutical ingredient and prepare a balanced scientific comparison without assuming one form is universally superior.
8	Dosage Forms and Formulation Fundamentals	Capsules. Tablets. Powders. Liquids. Gummies. Sachets. Effervescent products. Excipients. Binders. Fillers. Coatings. Flavoring. Sweeteners. Ingredient compatibility. Solubility. Stability. Palatability and delivery considerations.	Participants select an appropriate dosage form for different hypothetical product concepts and explain the practical and scientific reasons for their decision.

Development Outcome: Participants should understand how ingredient identity, chemical form, dose, delivery system, absorption and formulation are connected.



MONTH 3: EVIDENCE, RESEARCH, SAFETY AND TOXICOLOGY

Theme: A good formulation needs more than a good mechanism.

Purpose: To develop the ability to evaluate efficacy, dose, safety, research quality and scientific substantiation before supporting a nutraceutical recommendation or product concept.

Week	Focus	Learning Content	Practical Application
9	Evidence Based Nutraceutical Science	Mechanistic research. In vitro studies. Animal studies. Observational research. Clinical trials. Randomized trials. Systematic reviews. Meta analyses. Evidence hierarchy and common limitations.	Participants compare multiple studies of one ingredient and decide what conclusions the overall evidence can reasonably support.
10	Nutraceutical Clinical Research	Research question. Target population. Intervention. Comparator. Dose. Duration. Outcomes. Biomarkers. Surrogate outcomes. Clinical outcomes. Inclusion and exclusion criteria. Adherence. Confounding. Statistical significance and practical importance.	Participants design the basic framework of a hypothetical human nutraceutical study and justify the selected population, dose, duration and outcomes.
11	Safety and Nutritional Toxicology	Dose response. Upper intake concepts. Adverse effects. Toxicity. Acute and chronic exposure concepts. Safety margins. Vulnerable populations. Pregnancy. Lactation. Children. Older adults. Renal and hepatic concerns. Botanical safety and contamination considerations.	Participants prepare a structured safety profile for one selected nutraceutical ingredient.
12	Interactions and Postmarket Safety	Nutrient interactions. Drug supplement interactions. Supplement stacking. Absorption interactions. Metabolic interactions. Contraindications. Adverse event recognition. Postmarket surveillance concepts and responsible documentation.	Participants analyze a simulated supplement history containing multiple products and identify potential safety concerns, interactions and information that requires escalation.

Development Outcome: Participants should be able to evaluate whether a nutraceutical claim is supported by appropriate evidence and whether the proposed use is safe for the intended population.



MONTH 4: MANUFACTURING, QUALITY ASSURANCE AND REGULATORY SCIENCE

Theme: A scientifically interesting formula is not enough if the finished product cannot reliably meet quality standards.

Purpose: To introduce participants to the systems used by nutraceutical companies to control raw materials, manufacturing, documentation, finished product quality, labeling and regulatory compliance.

Week	Focus	Learning Content	Practical Application
13	Raw Materials and Supplier Qualification	Raw material identity. Ingredient specifications. Supplier documentation. Certificates of analysis. Purity. Strength. Composition. Contamination limits. Botanical identity. Standardized extracts. Supplier qualification concepts.	Participants review a simulated raw material specification and certificate of analysis and identify missing, weak or concerning information.
14	Manufacturing and Good Manufacturing Practice Concepts	Manufacturing workflow. Receiving. Weighing. Blending. Processing. Filling. Packaging. In process controls. Batch records. Master manufacturing records. Cleaning. Traceability. Deviations. Documentation and manufacturing consistency.	Participants map the journey of a hypothetical nutraceutical product from incoming raw material to packaged finished product.
15	Quality Assurance and Quality Control	Difference between quality assurance and quality control. Identity testing. Purity. Potency or strength. Composition. Microbial contamination. Heavy metals. Adulterants. Stability testing concepts. Finished product specifications. Batch release and complaint handling.	Participants develop a quality review framework for a hypothetical finished nutraceutical product.
16	Regulatory Science, Labels and Claims	Nutrition claims. Health claims. Structure and function type claims where applicable. Disease claims. Ingredient eligibility. New or novel ingredient concepts. Label review. Required statements. Market specific differences. Regulatory intelligence and responsible claim substantiation.	Participants conduct a mock scientific and regulatory review of a product label and identify claims that require stronger substantiation or revision.

Development Outcome: Participants should understand how a nutraceutical product moves from raw material through manufacturing and quality systems to a compliant finished product and market label.



MONTH 5: PRODUCT DEVELOPMENT AND APPLIED NUTRACEUTICAL SCIENCE

Theme: Build the product backward from the evidence and consumer need, not forward from a marketing trend.

Purpose: To show participants how an industry product progresses from an identified need to a scientifically defensible product concept, formulation and evidence dossier.

Week	Focus	Learning Content	Practical Application
17	Product Concept Development	Identifying consumer need. Target population. Intended nutritional function. Competitive landscape. Ingredient selection. Evidence level. Dose feasibility. Safety. Product differentiation and scientific positioning.	Participants develop a product concept brief for a selected population and explain why the proposed product is needed.
18	Formulation Evaluation	Single ingredient and combination formulations. Ingredient compatibility. Dose feasibility. Serving size. Delivery form. Stability. Taste and sensory considerations. Cost constraints. Product complexity and scientific rationale for each ingredient.	Participants critically evaluate a hypothetical multi ingredient formulation and remove ingredients that do not have a clear scientific or practical rationale.
19	Applied Product Categories	Micronutrient products. Women's nutrition. Healthy ageing. Metabolic wellness. Gastrointestinal products. Probiotics and prebiotics. Sports nutrition products. Plant based products and selected functional ingredients.	Participants select one product category and prepare an ingredient comparison based on mechanism, evidence, dose, safety and formulation feasibility.
20	Building the Scientific Product Dossier	Product rationale. Ingredient monographs. Biochemical mechanisms. Evidence summaries. Safety summaries. Interaction profile. Dose rationale. Claims substantiation. References. Consumer education and scientific training material.	Participants build a scientific dossier for their own proposed nutraceutical product concept.

Development Outcome: Participants should be able to contribute meaningfully to a product development discussion by explaining why an ingredient, form, dose and claim are scientifically justified.



MONTH 6: NUTRACEUTICAL INDUSTRY PRACTICE, SCIENTIFIC AFFAIRS AND STARTUP DEVELOPMENT

Theme: Understand where a nutrition professional fits inside the industry.

Purpose: To prepare participants for professional roles within nutraceutical companies and for responsible independent product or service development.

Week	Focus	Learning Content	Practical Application
21	Careers Inside the Nutraceutical Industry	Research and development. Scientific affairs. Nutrition affairs. Product development. Regulatory support. Quality liaison. Product training. Scientific communication. Consumer education. Marketing review. Product management and research coordination.	Participants map nutraceutical industry roles and identify the knowledge and competencies required for their preferred career direction.
22	Scientific and Technical Communication	Ingredient monographs. Scientific briefs. Product training documents. Evidence summaries. Technical frequently asked questions. Responsible marketing review. Communicating with research, regulatory, quality, sales and healthcare professionals.	Participants prepare a professional scientific training document for a hypothetical nutraceutical product.
23	Product Commercialization and Ethical Business	Target market. Product positioning. Pricing concepts. Contract manufacturers. Supplier communication. Packaging. Claims. Professional education. Ethical marketing. Conflict of interest. Transparency and responsible product promotion.	Participants develop a commercialization framework that keeps evidence, safety, quality and ethics central to the business decision.
24	Final Industry Project and Product Defense	Integration of biochemistry, ingredient science, evidence, formulation, quality, regulation and commercial strategy. Multidisciplinary decision making and recognition of areas that require specialist expertise.	Participants present and defend a complete nutraceutical product concept as if presenting to a multidisciplinary research, quality, regulatory and management team.

Development Outcome: Participants should finish the course understanding both the science of nutraceuticals and the professional systems required to work responsibly within the nutraceutical industry.



FINAL INDUSTRY PORTFOLIO

Portfolio Component	Final Output
Biochemical Mechanism Map	A pathway based explanation of the molecular and metabolic relevance of a selected nutraceutical ingredient.
Ingredient Monograph	A scientific profile covering identity, chemistry, biochemical role, form, dose, evidence, bioavailability and safety.
Evidence Appraisal	A critical evaluation of human research supporting a selected ingredient or product claim.
Safety Profile	A structured review of adverse effects, contraindications, interactions and special population considerations.
Raw Material Review	A simulated supplier and ingredient specification assessment.
Certificate of Analysis Exercise	Interpretation of key identity, purity, strength and contamination information.
Product Quality Framework	A structured approach to reviewing raw material and finished product quality considerations.
Regulatory Claim Review	A scientific assessment of proposed product claims and the evidence required to support them.
Formulation Review	A documented rationale for ingredient selection, forms, doses, combinations and delivery format.
Scientific Product Dossier	A complete scientific evidence, safety and rationale package for a proposed nutraceutical concept.
Technical Communication	A professional product education or scientific affairs document.
Industry Career Map	A defined pathway toward the participant's preferred nutraceutical industry role.
Product or Startup Concept	A responsible commercial or professional nutraceutical concept built around evidence, safety, quality and feasibility.
Final Product Defense	A multidisciplinary presentation defending the scientific and commercial logic of the proposed product.



EXPECTED INDUSTRY READINESS TRANSFORMATION

At Entry	At Completion
I know that magnesium is a mineral.	I understand its biochemical roles, ingredient forms, dose considerations, interactions and product development implications.
I know antioxidants reduce oxidative stress.	I understand redox biology well enough to distinguish biochemical mechanisms from exaggerated antioxidant marketing.
I know which ingredients are popular.	I can evaluate whether an ingredient has a scientific, formulation and commercial rationale.
I mainly read the supplement facts label.	I can critically examine ingredient identity, form, dose, serving size, claims and quality information.
I do not understand what happens inside a supplement factory.	I understand the journey from raw material qualification through manufacturing, quality control and finished product release.
Quality assurance and quality control sound like the same thing.	I understand their different functions and how both contribute to finished product quality.
One positive paper convinces me that an ingredient works.	I can evaluate population, dose, formulation, duration, endpoints and study limitations before drawing conclusions.
I want to work in nutraceuticals but do not know where I fit.	I understand professional opportunities across research, scientific affairs, product development, nutrition education, regulatory support and commercial teams.
I want to develop my own product.	I understand that a viable product requires biochemistry, evidence, safety, formulation, quality, regulation and commercial feasibility to work together.

FINAL LEARNING PATHWAY

Stage	Learning Progression
Stage 1	Understand cellular biochemistry and enzyme systems.
Stage 2	Understand nutrient metabolism and molecular nutrition.
Stage 3	Classify nutraceutical ingredients and understand ingredient forms.
Stage 4	Evaluate bioavailability, absorption, metabolism and dosage forms.
Stage 5	Understand how nutraceutical evidence is generated and critically appraised.
Stage 6	Evaluate safety, toxicology, contraindications and interactions.
Stage 7	Understand raw material specifications and supplier documentation.
Stage 8	Understand manufacturing, quality assurance and quality control.
Stage 9	Review labels, claims and market specific regulatory requirements.
Stage 10	Develop and evaluate a nutraceutical product concept.
Stage 11	Build a scientific product dossier and technical communication material.
Stage 12	Understand nutraceutical industry roles and multidisciplinary collaboration.
Stage 13	Develop a responsible product, service or startup concept.

COURSE PHILOSOPHY

This course is designed to move participants beyond knowing supplement names or memorizing product uses. The goal is to understand the science, evidence, quality systems and professional decision making that sit behind a nutraceutical product. A nutrition professional working in this industry should be able to communicate with multidisciplinary teams, recognize the limits of their own expertise, question weak claims and contribute to products and services that are scientifically responsible.