

Table 1: Nutrients/bioactive food compounds of interest and putative biomarkers for bioavailability & bioactivity endpoints

Nutrient	Biomarker for bioavailability	Molecules/Mechanism disturbed with deficiency	Health impact	Biomarkers of Health and Disease	Model Systems
Dietary Fiber		Digestive health	Cancer, inflammation IBD Obesity Type II Diabetes	Short chain-fatty acids Gut permeability Mucus thickness	Rodent Humans
Calcium	Ca levels Ca kinetics Bone mineral turnover PTH hormone levels	PTH hormone levels Loss of bone Shifts in microbiota	Osteoporosis Kidney Failure	Bone density MicroCT (bone architecture)	Rodent Human
Potassium	K kinetics	Rise in blood pressure, Lower BMD Higher NAE	Hypertension Osteoporosis	Blood pressure Bone density	Rodent Human
Iron	Hemoglobin, serum/plasma ferritin and soluble transferrin receptor, transferrin saturation, hepatic iron concentrations	Hemoglobin serum/plasma Ferritin, Soluble transferrin receptor, transferrin saturation,	Anemia, Risk of infection, immune competence, growth, neurodegeneration,	Hemoglobin, hematocrit, inflammatory cytokines, Hapcidin, acute phase proteins	Rodent Chicken Human Pig
Vitamin A	Vitamin A levels Serum/plasma retinol	Night vision, plasma cholesterol, immune function	Obesity, CVD, blindness	Adiposity, atherosclerosis, function of the visual cycle	Rodent Human
Zinc	Zinc levels	Immune function DNA integrity microbiome Bone turnover balance	Infection susceptibility Inflammation Cancer Osteoporosis	Inflammatory markers/cytokines Oxidative stress DNA damage	<i>In vitro</i> Rodent Zebrafish Human Chicken
Vitamin D	Vitamin D3 levels 25(OH) vitamin D3	Ca homeostasis Loss of bone Bone turnover balance Albuminuria Bone turnover - release of Pb	Osteoporosis Kidney failure Higher circulating Pb concentrations, adverse birth outcome risk	Bone density MicroCT (bone architecture) Serum Pb concentrations	Rodent Human
Vitamin E	Vitamin E isomers & metabolite levels	Oxidative stress, inflammation, and systemic vitamin E trafficking	Nonalcoholic Steatohepatitis Cancer Vascular Dysfunction Osteoporosis	Oxidative stress Inflammation markers Fatty liver pathology Pharmacokinetics *studies done in animals and translational work in humans	<i>In vitro</i> digestion system Rodents Humans
Vitamin K	Phylloquinone in plasma and lipoproteins	gamma-carboxylation of proteins, vascular calcification, bone mineralization	cardiovascular health, bone health	pharmacokinetic studies in humans; interaction of food matrix on bioavailability	Humans Rodents
Folate	C-14-folate & metabolites Polymorphisms Homocysteine Methyl Pool Plasma and RBC folate	Epigenetic alterations Methylation changes DNA damage	Cancer Heart Disease NTD Anemia	Homocysteine accumulation Methyl-pool alterations DNA damage Increased cancer risk	<i>In vitro</i> Human

B ₁₂	B ₁₂ levels TCII saturation Methylmalonic acid	Epigenetic alterations Methylation changes DNA damage	Cancer Heart Disease Cognition Anemia Demyelination disease	Homocysteine accumulation Methyl-pool alterations DNA damage Increased cancer risk Memory tests	<i>In vitro</i> Human
Bioactive lipids	Lipid oxidative products, Bioaccessibility, sphingolipids	Oxidative stress, inflammation, adipogenesis	Inflammatory diseases, obesity	Inflammatory markers, total fat accumulation	<i>In vitro</i> , <i>C. elegans</i> , <i>Drosophila</i> , humans, rodents
Essential Amino Acids	Lysine, Methionine	Protein Biosynthesis	Protein deficiency	Cognition, disease resistance,	Animal feeding for protein efficiency
Dietary exosomes and their RNA and protein cargos	Foreign RNAs in plasma; plasma and urine metabolites (purines); mixed lymphocyte reaction; activation of Toll-like receptors	Cognition (loss of learning, increased seizure activity); gut inflammation, fertility and postnatal growth	Cognition; fertility; inflammation	Plasma cytokines, plasma microRNAs, gut microbiome, cognitive performance, aberrant plasma and urine levels of purine metabolites	Humans, mice; gut bacteria
Soy isoflavones	Isoflavone metabolite levels	Estrogen metabolism Anti-inflammatory perturbations microbiota	Bone health Cancer Heart Disease	Bone density MicroCT (bone architecture) Inflammatory markers *studies done in animals and translational work in humans	Rodents Humans Chicken
Green tea catechins	Catechins and host- and microbiota-derived metabolites	Gut-liver inflammatory and oxidative stress responses; adipogenesis	Heart Disease Nonalcoholic Steatohepatitis Obesity Cancer Cognition Bone health	Inflammatory markers Oxidative stress Fatty liver pathology Cancer risk Lipid accumulation *studies done in animals and translational work in humans Bone density Bone architecture	Ex vivo fermentation, <i>C. elegans</i> , Rodents Humans Chicken
Isothiocyanates	Isothiocyanate & metabolite levels	Epigenetic alterations Altered detoxification Oxidative stress microbiota	Cancer	Epigenetic changes Detoxification pathways Cancer risk/incidence Oxidative stress *studies done in cells, animals and translational work in humans	<i>In vitro</i> Rodent Human
Indole-3-carbinol	Metabolite	adipogenesis, immune regulation, gut permeability, microbiota	obesity, intestinal inflammation, type 1 diabetes	Total fat accumulation; intestinal permeability T cell differentiation, macrophage polarization, bacterial dysbiosis	<i>C. elegans</i> , <i>Drosophila</i> , Rodent
Stilbenoids	Resveratrol, piceatannol	Adipogenesis, aging, antioxidative responses	Obesity, aging	Total fat accumulation, lifespan	<i>C. elegans</i>
Anthocyanins and Phenolic acids	Levels of anthocyanins and metabolites	Inflammation, Oxidative Stress, insulin signaling pathways, adipocyte differentiation Angiogenesis Vascularization	Obesity Inflammation CVD cancer Acute and chronic wounds	Inflammation Oxidative stress Cardiovascular perturbations	<i>In vitro</i> Rodent Pigs Rabbits Chicken

		Wound closure	IBD (UC)	Adipocyte growth/differentiation Insulin resistance Impaired glucose tolerance Gut barrier function Bacterial dysbiosis Mucosal immunity	
Nitrate and nitrite	Nitric oxide, nitrosothiols, nitroalkenes, nitroamines	Vascular function, blood pressure, efficiency of muscle contraction	CVD risk, chronic kidney disease risk, cognition	Endothelial dysfunction, increased blood pressure, reduced endurance upon physical exertion	Rodents Zebrafish
Ellagitannins and ellagic acid	Urolithins via gut microbial hydrolysis	Inflammation, oxidative stress, vascular function, blood pressure, efficiency of muscle contraction	CVD, obesity and cancer risk, cognition	Inflammatory markers, oxidative stress	Zebrafish
Egg and Dairy Proteins	N/A	Inflammation, oxidative stress, vascular function, blood pressure	CVD, diabetes, metabolic syndrome, gut health	Brachial artery flow-mediated dilation, oxidative stress, inflammation, cardiometabolic indices	Humans
Carotenoids	Carotenoid levels	Vision, plasma cholesterol, oxidative stress	age-related macular degeneration, CVD, mitochondrial function, inflammation, NAFLD	visual impairment, atherosclerosis,	Rodents Humans
Bean protein	Cellular biomarkers	Diabetes,	Diabetes, inflammation	Inflammatory markers, oxidative stress, lipid metabolism	Rodents <i>In vitro</i> (Cell culture)
Fatty acids	Serum fatty acid concentrations	Bone turnover - release of Pb	Higher circulating Pb concentrations, adverse birth outcome risk	Serum Pb concentrations	Humans

Table 2: Active and Planned Collaborative Studies

Collaborative Studies	Participants
Absorption and metabolism modeling	NE, OH, OR, IA, IN, AZ, NY
Biomarker discovery, assessment measurements and validation	AZ, IL, OR, OH, OR, CA-B, IA, NY, CA-D, OK
Development of novel technological approaches and their applications	HI, IL, KS, MA, NE, OR, OH, MT, NJ, MO, IA, IN, FL, NY, ME
Model organisms	KS, NE, OR, CAB, AZ, NY, HI, OK
Animal models	HI, IL, MA, KS, NE, OR, OH, CA-B, CT, CA-D, PA*, AZ, IN, NY, ME, OK
Human and population-based studies	IL, KS, NE, OR, OH, CA-B, OK, MT, IA, IN, FL, CT, AZ, RI
Microbiome studies/gut health	NE, OR, OH, IN, AZ, IN, MT, NY, CA-D, OK, CT
Susceptibility factors (age, sex, race, disease, environment, gene interactions)	OR, OH, CA-B, OK, IA, IN, RI, AZ, CA-D, CT
Obesity	CT, ME, AZ, IL, OH, HI, OR, OK
Maternal Obesity	NE, OK

Malnutrition	IL, KS, OK, MT, IA, FL, NY, CA-D, RI
Neurological/brain function	NE, OR, CA-B, CA-D, AZ
Metabolic disease/diabetes, fatty liver, osteoporosis	NE, OR, OH, CT, ME, IL, AZ, HI, OK
Cardiovascular disease	NE, OR, OH, IN, CT, ME, IL, AZ, OK
Cancer	NE, OR, IL
Inflammatory bowel diseases - Ulcerative colitis	IN, CT

*The member at PA moved to Purdue University (IN)

Table 3. Resources

Station	PI	Special Research Capability
AZ	Teske, Jennifer	Animal models, body composition, behavioral measures of sleep, physical activity, energy expenditure, feeding, brain site-specific microinfusion, molecular biology, qPCR, EEG and EMG, radiotelemetry.
	Duca, Frank	Environmental and genetic interactions in altering the gut microbiota and nutrient-sensing pathways of the intestine in obesity and diabetes.
CA-B	Shane, Barry	molecular biology, genomics, genetic variation, animal models, cellular and <i>in vitro</i> systems, human studies
CA-D	Ehrlich, Allison	Gnotobiotic mouse models, mucosal immunology (T cell differentiation, macrophage polarization), gut health, dietary indoles and aryl hydrocarbon receptor activation
	Liu, Yanhong	Antimicrobial resistance of food-borne bacteria, alternatives to antibiotics, feed-based health technologies to improve animal health.
	Ji, Peng	Micronutrient deficiency and excess and dietary bioactive compounds on neurodevelopment, gut health and host resilience to infections
CT	Lee, Ji-young	Dysregulation of energy metabolism, chronic inflammation and dyslipidemia, lipid metabolism and inflammatory signaling pathways, molecular targets for liver fibrosis and fibrogenic pathway, epigenetic regulations
	Blesso, Christopher	Lipid metabolism and chronic inflammation, lipoprotein particle functionality, phospholipid/sphingolipid metabolism, cardiovascular disease, human studies, rodent models of disease
FL	Andrade, Juan	Sensors for biological and food matrices, nutrient and bioactive analysis, bioavailability and bioefficacy of nutrients, food product development, food fortification, encapsulation technologies, global food and nutrition security
HI	Ho, Kacie	Effect of pre-harvest conditions and processing on bioavailability of carotenoids, minerals, and polyphenols, colloidal emulsion-based delivery systems for enhancing carotenoid or polyphenol bioavailability
	Yang, Jinzeng	Control of blood glucose in prediabetes models by papaya leaf and seaweed juice.
IL	Amengual, Jaime	Role of vitamin A, carotenoids, and other bioactive products in cardiovascular disease and obesity. Inflammation and immune function and its relationship with atherosclerosis.
	DeMejia, Elvira	Bioactive peptides and proteins in foods, inflammation, markers of type 2 diabetes, cancer, and cardiovascular disease risk
IN	Reddivari, Lavanya	Bioavailability and bioactivity of dietary fibers and flavonoids (anthocyanins); structure function relationships; interaction of fibers, flavonoids and gut bacteria; complexation of fibers and flavonoids; intestinal inflammation (IBD); chemical-induced and genetic models of ulcerative colitis; germ-free and gnotobiotic mice models.
IA	White, Wendy S	Bioavailability and metabolism of carotenoids, including beta-carotene and lutein, use of stable isotopic tracers to measure to bioefficacy of beta-carotene in humans, nutritional genomics, biofortification to combat vitamin A malnutrition.
KS	Lindshield, Brian	Micronutrient bioavailability, protein quality, food aid development and assessment, international agricultural development nutrition and health assessment
ME	Klimis-Zacas, Dorothy	Nutritional Physiology and Biochemistry, Nutrition and Vascular Function and Metabolism, Berry bioactives and their role on chronic disease (Cardiovascular, Hypertension, Metabolic Syndrome, Wounds). Development of transdermal nanocarriers for bioactive compound delivery.

MO	Gruen, Ingolf U	Analytical chemistry with applications in food composition, flavor chemistry and the influence of food ingredients on quality attributes of foods
MT	Giroux, Michael	Plant breeding and cereal quality expertise. Bread, pasta, noodles, production and quality testing. Subject preference testing.
NE	Natarajan, Sathish Kumar Yu, Jiujiu Zempleni, Janos	Maternal obesity-induced Complications, Placental Lipid Metabolism, Bioactive Lipids, Bioactive Nutrients Dietary exosome-like nanoparticles, chronic inflammation, NLRP3 inflammasome, obesity-related diseases Bioavailability studies, drug delivery, exosome biology, gut microbiome, molecular biology, RNA biology, transgenic models, human studies
NY	Tako, Elad	Specialty fields: Fe and Zn bioavailability, Dietary bioactives, Animal models, Molecular biology, intestinal morphology, energetic status, microbiome. Essential micronutrients and dietary bioactives (including discovery) assessment by using a unique dual in vivo (<i>Gallus gallus</i>) system. Effects of dietary bioactives and physiological status (as obesity, mineral deficiencies) on intestinal functionality, morphology and microbiome, in vivo.
OH	Bruno, Richard	<i>In vitro</i> and animal models, flavonoids, polyphenols, vitamin E (alpha- and gamma-tocopherol) and metabolites, carotenoids, oxidative stress, inflammation, cardiometabolic disorders (metabolic syndrome, (pre)diabetes, nonalcoholic steatohepatitis, vascular endothelial function), human intervention studies
OK	Lin, Dingbo	Food biochemistry, egg lutein, egg xanthophylls, food bioactive compounds and chronic disease prevention - inflammation, diabetes, obesity, vitamin A and inflammation, maternal obesity and offspring health risk, epigenetics, precision nutrition and carotenoids metabolism, mitochondrial function and immunoregulation
OR	Ho, Emily Dallas, David Iwaniec, Urszula	Molecular biology, epigenetics, signal transduction, chemoprevention studies in cell culture, animal models (mouse, zebrafish), and humans; mineral metabolism and gene regulation (humans), nutrient/gene/epigene interactions, nutrient/environment interactions Examine survival of pathogen-specific human milk immunoglobulins in the infant gut, toxic metabolites and gut inflammation, digestion and putrefaction via peptidomics, metabolomics, microbial sequencing and inflammatory protein analysis Imaging (dual energy absorptiometry, microcomputed tomography, histomorphometry), animal models (mice, rats, monkeys), mineral metabolism, bone metabolism, adipose tissue, osteoimmunology, cancer metastasis
RI	Oaks, Brietta	Maternal micronutrient deficiencies, nutrient/environment interactions, human studies, dietary intake, multivariate modeling