

Climate, Food Systems, Diet, Nutrition, and Health

OR16-01-26 From Farm Practices to Food Quality: Multiomics Evidence Linking Agricultural Management to Nutritional Composition

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Objectives: To determine how agricultural management practices influence the molecular composition and nutritional quality of food. Using a standardized multiomics, data-driven framework within the Periodic Table of Food Initiative (PTFI), we systematically characterized foods produced under conventional and organic/regenerative systems to identify compositional differences and molecular signatures associated with production practices. This strategy enables high-resolution characterization of compositional diversity and generates actionable evidence to provide dietary guidance, food labeling, and agricultural policy aimed at advancing both human and planetary health.

Methods: Widely consumed, protein-rich plant (nuts, seeds, legumes, grains) and animal-based foods (dairy, meats) produced under conventional and regenerative/organic systems were collected and processed using standardized PTFI protocols, including cooking, homogenization, and lyophilization prior to extraction and LC-MS analysis. Comprehensive molecular profiling was performed using an integrated multi-omics platform comprising lipidomics, ionomics, untargeted metabolomics, proteomics, and glycomics. Cross-omics datasets were harmonized and integrated using a data-driven analytical pipeline to characterize compositional diversity and identify molecular signatures linked to agricultural management.

Results: Integrated multi-omics profiling identified compositional differences between foods produced under conventional and regenerative/organic agricultural systems. This systematic molecular characterization of plant- and animal-based foods highlights the inherent complexity of food composition and indicates that production systems are associated with measurable shifts in molecular profiles and nutritional attributes. Production system-associated trends were food-dependent, with more pronounced signals observed in certain plant foods and more modest shifts in animal-derived products.

Conclusions: Together, this data-driven framework provides a foundation for future research and may inform evidence-based strategies to improve nutritional quality and strengthen food systems, advancing human and planetary health.

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OR16-02-26 Production System Influences Carotenoid and Polyphenol Concentrations in Egg Yolk

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Objectives: Carotenoids and polyphenols are plant-derived phytochemicals associated with antioxidant activity and potential health benefits. In laying hens, the deposition of these compounds into egg yolk depends on dietary exposure. Pasture-raised systems provide seasonal access to diverse forage sources, which may alter yolk phytochemical concentrations compared to conventional caged systems reliant on formulated feed. The objective of this study was to quantify carotenoid and polyphenol concentrations in egg yolks from a pasture-raised system across the grazing season and to compare these values to conventional caged eggs.

Methods: Egg samples were collected monthly from a pasture-raised laying hen system in Ohio from May through December. Twelve conventional caged egg samples were collected at a single time point to serve as a production system control. Yolk samples were pooled and analyzed for individual and total carotenoids and polyphenols using liquid chromatography-mass spectrometry (LC-MS).

Results: Pasture-raised yolks exhibited significantly higher lutein (up to 8885 µg/100 g) and α-cryptoxanthin (2164 µg/100 g) compared to caged controls, 4283 µg/100 and 188 µg/100 respectively ($p < 0.05$). Vitamin A metabolites varied seasonally, peaking mid-season. Polyphenols such as chlorogenic acid, hydroxybenzoic acid, and kaempferol-3-glucuronide, were significantly elevated in pasture-raised yolks, with notable seasonal fluctuations ($p < 0.05$). Several phenolic compounds, including chlorogenic acid and 4-hydroxybenzoic acid peaked mid-season, indicating seasonal trends in forage availability.

Conclusions: Egg yolk phytochemical composition is influenced by production system and seasonal forage access. Pasture-raised hens exhibited enhanced deposition of plant-derived carotenoids and polyphenols relative to conventional caged controls, with concentrations varying across the grazing season. These results support the concept that forage diversity and seasonal dietary exposure can translate into measurable differences in the bioactive profile of animal-derived foods.