

FOOD QUALITY & SAFETY

What is food quality and safety?

It is the combination of three types of properties:

- 1) Concentration of nutrients (e.g. nutrient density) and phytochemicals (e.g. secondary metabolites or bioactives)
- 2) Chemical forms and nature of the compounds making up the produce (e.g. glycosylation status, carbon-rich inputs creating nanoparticles and chelation of minerals in soil, etc..)
- 3) Health / safety attributes (e.g. freedom from pathogens, mycotoxins, chemical contaminants, and toxic levels of minerals or phytochemicals)
- 4) Sensory attributes: organoleptic qualities (e.g. taste, flavour, aroma, colour/visual appearance, texture/ mouth feel and storage stability).
- 5) The gut microbiome and environmental microbiomes, included those associated with food produce, affect the link between food quality and health.

What influences food quality?

- 1) Environmental factors (soil attributes, climate)
- 2) Crop / animal genetics (cultivar / variety)
- 3) Management practices (including types and amount of input used, e.g. glyphosate)
- 4) Post-harvest handling (processing, storage)

There is scant data on the impact of RA on food quality

What is nutrient density?

Nutrient density = nutrient content per serve and/or per 110kcal and/or per 100g

National and international standards:

- ▶ Nutrient Profiling Scoring Criterion (NPSC) (NZ and Australia): only includes macronutrients
- ▶ Nutrient Rich Food Index (NRF): initially focussed on limiting saturated fats, sugars, and sodium, subsequent versions include positive nutrients.

Note: We don't eat foods in isolation and even a diet based on a lot of high nutrient density foods could still lack several essential nutrients

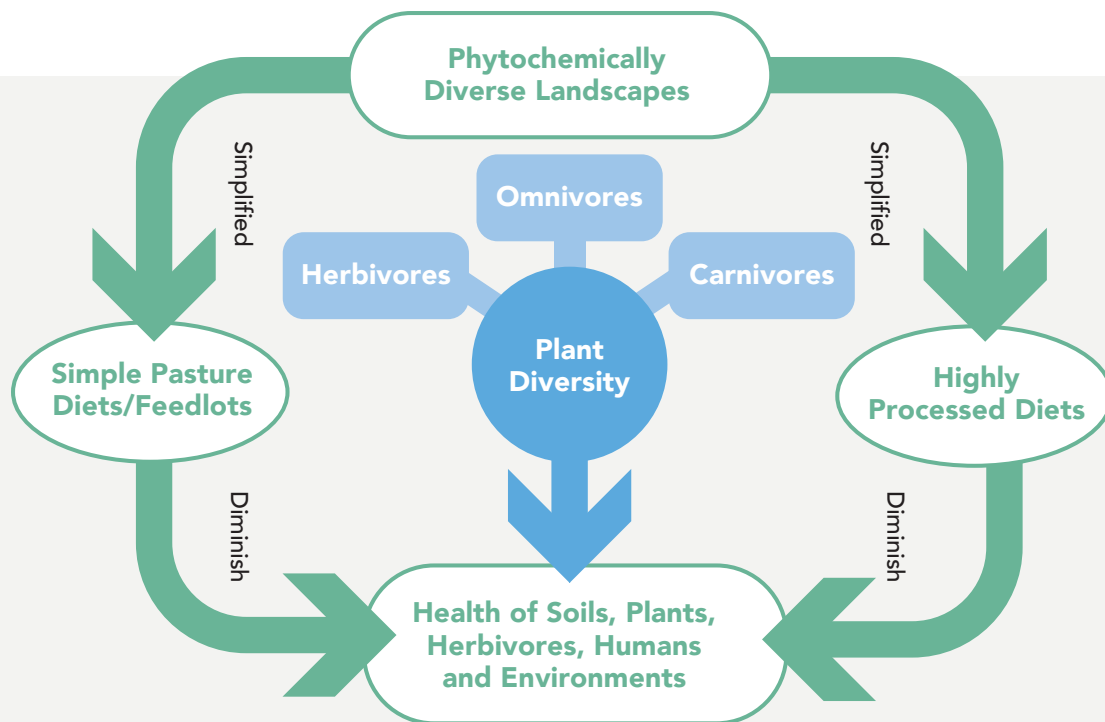
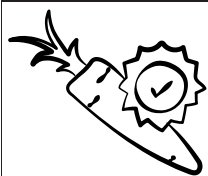


FIGURE 1. The health of life in soils, plants, herbivores, humans, and environments (land, water, and air) is tied to plant diversity—phytochemical richness—across landscapes. From Provenza et al 2019. *Frontiers in Nutrition* 6:26.



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How might RA impact on food quality & safety?

Potential (claimed) impacts of RA on ecosystem	Impact of RA on food quality to be tested
Improved soil health (fertility, mineral balance, biological activity, structure)	increased protein contents?
	other N-rich compounds?
	mineral concentration / "balance" in produce?
Improved water cycle & temperature regulation	"dilution effect"?
	temperature-sensitive compounds? (e.g. vitamins)
Increased plant diversity	Do companion plants affect the nutritional qualities of crops / forage? Much research is still needed to confirm, quantify and understand the link between plant diversity and food quality.
Use of mineral balancing inputs, bioamendments and biostimulants	food mineral content?
	unintended plant uptake of excess / harmful nutrients?

How can we assess food quality / safety, including nutrient density?

In general, metrics are specific to the nature of the produce and to the desired use of the produce (purpose and type of consumer).

- ▶ There is no universal suite of quality / safety Indicators. Some existing indicators are not benchmarked. Other indicators are not yet validated. Some benchmark systems are country specific.
- ▶ Below is a list of the types of compounds that can be quantified to assess food / fibre quality:
- ▶ Brix (used in sugar, wine, fruit, honey industries – and newly for rice)
 - ▶ used by RA practitioners to assess plant health status.
 - ▶ user and context specific
 - ▶ No current calibration across farms and users for forage, arable and vegetable crops
 - ▶ *Further research required to test Brix as a potential proxy of plant-based food quality, when used in combination with other indicators*
- ▶ Chlorophyll (possible indicator of nutrient, but unlikely indicator of phytochemical concentration)
- ▶ Macronutrients (Carbohydrates and protein)
- ▶ Vitamins
- ▶ Minerals
- ▶ Phytochemicals (produce-specific, desired or not, depending on health benefits / anti-nutritional and/or sensory impact)
- ▶ human olfactory system (trained professional / panellist "taster") – there is currently no "technology" superior to human for differentiating the key sensory properties of food, and most humans.
- ▶ Other produce-specific indicators – e.g. intra-muscular fat (marbling) for Wagyu beef
- ▶ Trace residues from agricultural chemicals (e.g. herbicides) and some heavy metals.