

Environmental impact, micronutrient adequacy, protein quality, and fatty acid profiles of plant-based beverages compared with cow's milk: a sustainability assessment



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Abstract

Background Understanding trade-offs between the environmental and nutritional sustainability dimensions of plant-based beverages compared with cow's milk is an increasingly pertinent question in light of the expanding adoption of plant-based diets. The objective of this work was to quantify the nutrient densities (by means of a novel nutrient profiling system), protein quality, fatty acid profiles, and environmental impact (eg, deforestation, global warming potential, and water usage) of milk and plant-based drinks. We assessed cashew, soy, almond, hemp, oat, spelt, rice, and coconut drinks, and compared these with cow's milk from arable-land-based, pasture-raised, grass-fed systems.

Methods We combined literature (based on a keyword search in Web of Science) and database (eg, ecoinvent) data to estimate environmental effects from production to packaging, and we measured the nutrient contents of all drinks in a laboratory setting. In accordance with a points-of-differentiation framework, we developed a novel metric to rank food items—the Food Substitute Index—which takes into account national (in this study, Switzerland's) nutrient deficiencies across various dietary patterns. Environmental and scenario analyses were also done to ascertain the influence of product formulation.

Findings Our results suggest a high risk of nutrient deficiencies with the introduction of plant-based beverages into the food supply, unless these beverages are fortified with additional nutrients. Regarding combined environmental–nutritional sustainability scores, cow's milk has moderate scores (when compared with plant-based beverages) because its high nutrient density partly compensates for its high environmental impact. Among plant-based beverages, soy drink has high combined scores when produced in France, but not in Brazil. Coconut-based and cashew-based drinks have low average sustainability scores. Hemp-based drinks show promise as a suitable alternative to cow's milk due to its favourable fatty acid profile. On average, spelt-based drinks have moderate sustainability scores; rice-based and almond-based drinks are characterised by low to moderate scores, whereas oat-based drinks have moderate to high scores.

Interpretation The nutrient density and environmental impact of beverages varies greatly even for a single beverage type. This high variation suggests that recommendations of optimal beverages to cover nutritional deficiencies in an environmentally friendly manner are complex to produce. Continual development of nutrient profiling systems will be needed as the health burden of nutrient deficiencies becomes more apparent.

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Contributors

AG was responsible for conceptualisation, data collection, calculations, and writing of the first draft. TN and AM were responsible for conceptualisation and supervision. BW measured nutrient values. AG and TN accessed and verified all underlying data. All authors contributed to the revision of the abstract.

Declaration of interests

We declare no competing interests.

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