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Nutrient essentiality revisited

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ARTICLE INFO

Article history:
 Received 18 November 2014
 Received in revised form 10 January 2015
 Accepted 19 January 2015
 Available online

Keywords:
 Nutrient
 Essentiality
 Fibre
 Plant sterols
 Polyphenols

ABSTRACT

With increased understanding of the complex roles nutrients play within metabolic pathways, the purpose of this contribution is to explore the rationale for expanding the definitions and criteria for nutrient essentiality. A further objective was to develop three case study scenarios to probe issues surrounding the definition of essentiality using dietary fibre, plant sterols and polyphenols. Current definitions and criteria for “essentiality” were reviewed through an environmental scan of the scientific literature. Additionally, international regulatory bodies were asked whether the terms “nutrient” and/or “essential nutrient” are regulated in their respective jurisdictions. Regulatory bodies including the EFSA, the US FDA, HC and FSANZ were found not to currently possess regulated definitions for the term “essential nutrient”. Case studies examining fibre, plant sterols and polyphenols served as a means of presenting evidence for expanding the list of functional food constituents regarded as meeting criteria for essentiality. For each example, certain instances applied where these case study bioactives met criteria of essentiality. Thus, in order to reflect advances in current science, a series of non-classical compounds known to have bioactivity should be considered for their potential essentiality under certain situations.

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Contents

1. Introduction	204
2. Methods	204
3. Results	204
4. Case studies	205

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<http://dx.doi.org/10.1016/j.jff.2015.01.024>
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4.1. Case study # 1: fibre	205
4.2. Case study # 2: plant sterols	205
4.3. Case study # 3: polyphenols	207
4.4. Case studies summary	207
5. Conclusion	207
Funding and sponsorship	208
Declaration of interest	208
References	208

1. Introduction

From a clinical perspective, evidence for nutrient essentiality dates as far back as the 1670s when a British physician, Sydenham, reported observations that a tonic of iron filings produced improved clinical responses in anaemic patients (Harper, 1993). However, it was not until 1906 that essentiality for life, and of a specific organic molecule, was established when Willcock and Hopkins showed that a supplement of the amino acid tryptophan prolonged survival in mice given a tryptophan-deficient diet (Harper, 1993). By 1950, some 35 nutrients, including various essential fatty acids, amino acids, vitamins and minerals, had been identified as essential (Harper, 1999). For the most part, single nutrients were chemical compounds with a definable chemical structure, which may occur in clusters. In general terms, a nutrient was deemed essential when its removal caused a state of metabolic and/or clinical hypofunction, which could be normalized when that nutrient was added back in the diet. More recently, it could be argued that the notion of essentiality has been broadened. A new definition is one which goes beyond the level needed for minimal support for normal growth, development and maintenance of health to affording a level of protection against chronic degenerative diseases, if consumed beyond this minimal requirement. Therefore, the objective of this paper is to review current definitions and criteria for nutrient essentiality, and to present three case studies with a supportive rationale for why some functional food constituents should be re-evaluated in terms of their essentiality for specific populations and/or physiological conditions.

2. Methods

An environmental scan of the literature was conducted January 2013 using combinations of the terms “criteria”, “definition”; and “essential nutrient”, “nutrient essentiality”, “conditionally essential nutrient” within the search engines PubMed and Google Scholar. No limits on the year of publication or language were used. Three contemporary nutrition textbooks were also consulted (Erdman, Macdonald, & Zeisel, 2012; Shils, Olson, Shike, & Ross, 1999; Whitney & Rolfes, 2002). Hand searching within the reference lists of textbooks and articles identified from the environmental scan was also conducted to locate further definitions and identify criteria for the aforementioned terms.

Additionally, inquiries were forwarded to international regulatory bodies including, the European Food Safety Authority (EFSA), the U.S. Food and Drug Administration (US FDA), Health Canada (HC), and Food Standards Australia New Zealand (FSANZ), as well as international organizations including the Institute of Medicine (IOM) and the Australian Government’s National Health and Medical Research Council (NHMRC), asking whether the terms “nutrient” and/or “essential nutrient” are regulated in their respective jurisdictions.

Three case studies were also developed for the functional food constituents fibre, plant sterols, and polyphenols, components not currently considered as essential nutrients but possessing desirable health effects. A draft report was then reviewed and discussed by a group of international nutritional science experts.

3. Results

Based on current definitions, a “nutrient” is first and foremost considered a component of food useful to an organism for its growth, or functioning. More pragmatically, a nutrient is one for which a ‘Nutrient Reference Value’ (NRV) exists, the NRV provides a level to meet requirements for health (Codex Alimentarius Commission, 1985). Nutrients tend to belong to one of six broad categories: minerals, water, carbohydrates, lipids, proteins and vitamins; and they provide energy or structural materials and regulating agents to support growth, maintenance and repair of the body’s tissues as well as being needed for growth, development, and maintenance of a healthy life. A deficit of a nutrient will cause characteristic biochemical or physiological changes to occur. The intake of certain nutrients at a particular level may reduce the risk of some diseases (Codex Alimentarius Commission, 1991; European Commission, 2006; Whitney & Rolfes 2002).

“Non-nutrients” tend to be defined as food constituents which do not fit in the six aforementioned categories, but contribute in a general manner to body functioning. This category can include phytochemicals, pigments and additives (Whitney & Rolfes, 2002) and generally speaking do not possess defined NRVs. The European Commission (EC) Regulation (No. 1924/2006) defines “other substance”, in the context of health claims, as any substance other than a nutrient which has a nutritional or physiological effect (European Commission, 2006).

Regulatory bodies including the EFSA, the US FDA, HC and FSANZ do not currently report formal definitions for the term “essential nutrient” and generally refer to standard

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