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Superfoods: A super impact on health and the environment?

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Abstract

Given the current trend in superfoods consumption and the forecasts for their growth in the coming years, this article provides an overview of the three sustainability dimensions of the novel market, addressing consumers' perception from a social and economic perspective, and focusing on their environmental performance. The review highlights the need for regulation and provision of well-designed information for consumers, among whom are segments that currently mistrust their health claims, which are mainly the motivating reason for consumption. On the other hand, the carbon footprint of superfoods production is similar to that of other conventional agri-foods, although distribution from the countries of origin and future changes to intensive and commercially-oriented production systems to meet demand could endanger this column of sustainability.

Addresses

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Keywords

Life cycle assessment (LCA), Consumers' perception, Sustainability, Agri-food, Health claims, Carbon footprint (CF).

Introduction

In recent years, events such as armed conflicts, the COVID-19 pandemic, climate variability and extremes, or economic slowdowns and downturns have exacerbated priority problems and challenges already facing humanity, most notably food insecurity [1]. Getting on track towards ending this issue and achieving a food sector capable to adapt to them is not an easy task; it requires an evolution of food policies, dietary guidelines, and food safety strategies towards an approach that consider sustainability and its social, economic and environmental dimensions, leaving behind the traditional perspective just based on nutrition and health [2]. In this transition, the promotion, acceptance and consumption of novel nutrient sources [3], as well as the consequent redesign of food systems without threatening the environment [4] are presented as part of the solution.

This search for updating and restructuring diets has led to a surge in the demand of foods with multiple benefits, amongst which are superfoods, in an attempt to establish healthier patterns in a more "smart way" [5]. The term "superfood" is a marketing name, i.e., it does not have medical or official definition, but it is frequently associated with agri-products with extraordinary amounts of nutrients or bioactive ingredients, with specific biological properties and positive effects in physical and emotional health [6]. The growing trend in their consumption is mainly based on these health claims, but their success should not be solely determined by a socio-health perspective, but there must be a sustainable balance taking into account blind spots that sometimes remain under-represented, commonly the environmental aspects [7]. For this reason, the goal of this review is to provide an overview of the different sustainability dimensions of the superfoods sector, addressing both the socio-economic perception among consumers and focusing on the theoretical and actual environmental performance of these products. Based on this information, future prospects and opportunities will be drawn in order to achieve more resilient and sustainable food systems involving stakeholders, policy makers and consumers.

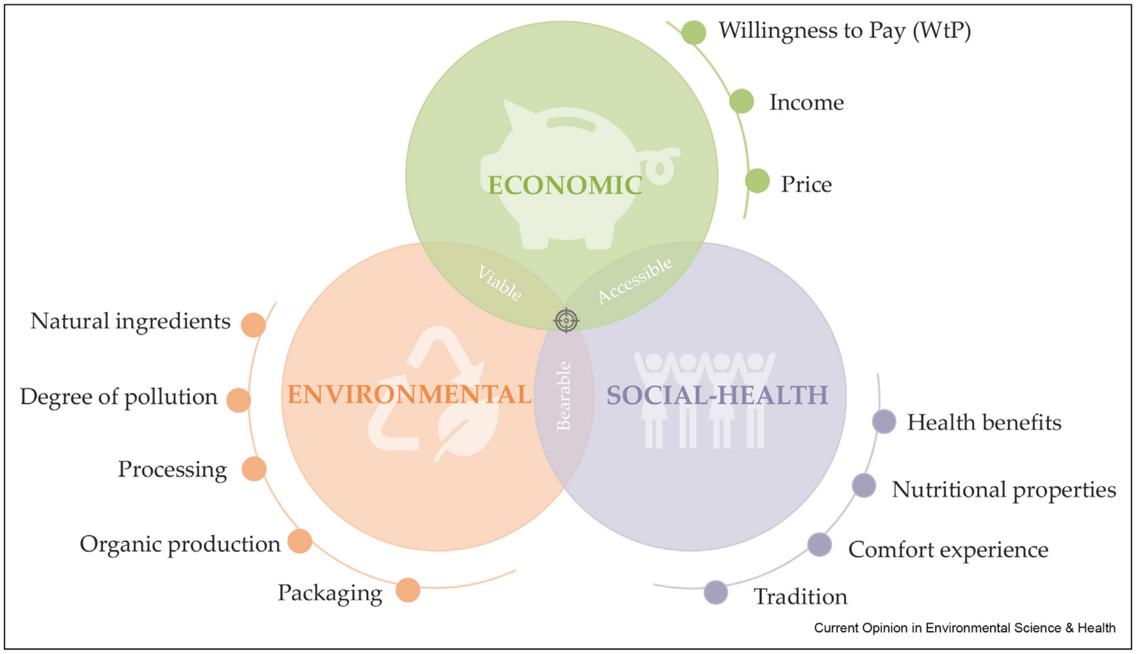
The superfood economy: Perceptions on the sustainability of the novel market

There are different factors belonging to the three pillars of sustainability that influence the perception and decision making of superfood consumers. These main aspects are summarized in Figure 1 and described in Section 2.1 and 2.2.

Socio-economic dimensions

Given the ambiguity of the definition of superfood, "super" is a subjective term and based on consumer market perception [8]. This comprehension differs worldwide and is based on regional dietary habits, which will make it difficult to agree upon a general and globally accepted definition [9]. In fact, 26% of the

Figure 1



Factors that influence consumers' perception and decision making about superfoods.

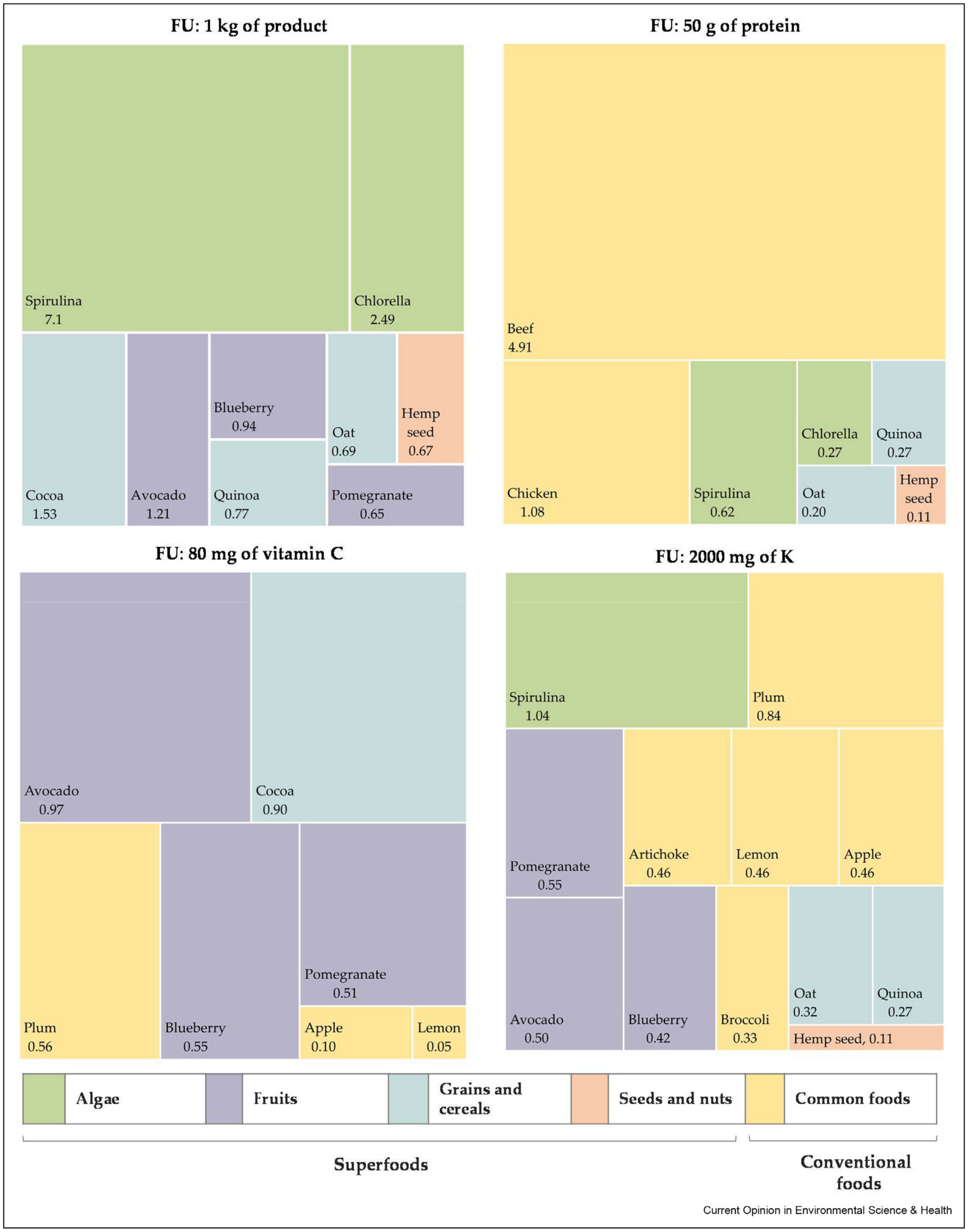
respondents in a German survey on the consumers' perception of superfoods stated that they had never heard the term [10]. Likewise, Franco Lucas et al. [11] reported that 15% of the Swiss polled stated to be unfamiliar, not particularly interested in, or not convinced regarding the benefits of superfoods, their sustainability, or how healthy they are. This low level of acceptance is directly related to the lack of knowledge about the characteristics of these products, even though there are quite studies analyzing their nutritional properties and pros and cons of their consumption. For instance, Vidovic et al. [12] evidenced the health-promoting effects of goji berries, like anti-inflammatory and antioxidant activities, as well as the side effects when consumed in large amounts. AlFadhly et al. [13] stood out the extraordinary protein concentration of spirulina, proposing it as an interesting nutrient source for developing countries, while Iftikhar Hussain et al. [14] highlighted not only the quantity of protein in quinoa, but also its quality. Based on this scientific evidence, provide well-designed information to population would result in a shift in attitude for consumers, making clear the need to devise and promote effective communication strategies [15].

Among superfoods connoisseurs, different reasons come into play that influence consumption decisions. One of the strongest and most positive predictors is the health benefit perception and comfort feeling, either from superfoods in general [16], or specific ones, such as kale [17], amaranth [18], or quinoa [19]. This perception became the COVID-19 an important driver of superfoods consumption [20], in an attempt by population to improve their health and fitness in the face of the pandemic. However, the consumption is highly patterned by income, educational and cultural factors; higher socioeconomic groups make more health-conscious food choices than lower ones, leading to inequalities in dietary intake [21]. A significant percentage of consumers consider price as a decisive factor (24% according to Meyerding et al. [22]), and even a small group (around 5%) do not consume superfoods for that reason [10]. In contrast, some consumers admit to being willing to pay up to 20% more for a functional food or superfood because of its taste or properties [23].

Environmental dimension: Theoretical and actual impacts of superfoods

According to different surveys, a segment of consumers presents environmental awareness about superfoods, showing preference toward eco-friendly living practices. The study of Wiedenroth and Otter [24] reported that the product degree of environmental pollution and unnecessary packaging are important aspects for health-conscious consumers of blueberries. Likewise, customers show concern about the production method, with a positive connection to organic production and natural ingredients [22], and favoring freshness or mildly processed foods [25]. Nevertheless, some consumers have doubts about the environmental

Figure 2



Representation of the GWP impacts (measured in kg CO_2 equivalent/FU) associated with the production and processing of best-known superfoods and some conventional foods, considering mass and nutritional aspects.

sustainability of superfoods [16]. On the one hand, they are supposed to be produced with little or no technological intervention, using traditional production practices originated from indigenous cultures, and therefore characterized as minimally processed foods [26]. But, on the other side, buying non-locally produced foods requires a more intensive use of energy and transportation, generating significant environmental burdens, and producing a possible deterioration of the product quality [27].

To get an objective view of this issue, some authors have developed the Life Cycle Assessment (LCA) of superfoods. These studies are still quite limited, mainly existing for the most widely known and consumed superfoods and in which, for the most part, only a cradle to gate approach was considered (involving production and processing) and the Carbon Footprint (CF) is analyzed [28]. Based on the most recent literature, Figure 2 illustrates a summary of the environmental impacts in the global warming potential (GWP) category for different superfoods considering both mass and nutritional aspects. These graphs evidence the conflicts and synergies between health and environmental sustainability when calculating the burdens linked to the weight or the properties of the products [29]. When considering the mass (functional unit (FU) of 1 kg of food), dried seaweed superfoods, such as chlorella [30] or spirulina [31] report the highest CF among superfoods due to higher resource use and more processing steps, followed by grains, fruits, and seeds. However, if the protein content is involved, it turns out that these algae-based products have great potential to substitute meat-based products, like chicken [32] or beef [33]. In this regard, other high-quality vegetable proteins coming from quinoa [34], oat [35], or hemp seeds [36] are even more competitive. In relation to vitamin C, especially present in fruits or grains, a slight tendency to high burdens can be observed in superfoods such as cocoa [37] or avocado [38] although the difference with conventional foods is not too significant and even the opposite results can easily be reported in other studies subjected to different growing conditions, climate, etc. On the other hand, similar CFs are obtained between common fruits, such as apple [39] or lemon [40], and superfruits, like blueberries [41] or pomegranate [42] considering their K content, while for seeds and grains the burdens are slightly lower. Therefore, it can be deduced that the performance in the production and processing of superfoods is comparable to that of conventional agri-food products and not significant trends towards greater environmental sustainability are evidenced. However, a better response than animal-based products can be glimpsed, positioning this food category as the most critical, as has already been reported by other authors [43], and opening the door to focus further research in this line, particularly in the substitution of animal proteins by vegetable proteins. However, as previously mentioned, the distribution of superfoods may represent an environmental hotspot although it is omitted in most of the LCA studies. Even though in some cases its production is being adapted to different geographical areas far from its country of origin, such as spirulina [44] or quinoa [45], in order to shorten supply chains, there are still some who remain anchored and linked only to specific cultures (e.g., camu—camu). In this regard, Pedrischi et al. [46] reported that, as expected, avocado exportations supposing overseas and road transport, e.g., from Chile to Germany, presented the highest carbon emissions, whereas the trade at national level provided the lowest impacts. In contrast, Majewski et al. [47] proposed that shortening supply chains does not automatically entail a more environmentally sustainable alternative to long supply chains, similarly than reducing transportation distances between producers and consumers may not lead to a better eco-efficiency as small quantities are typically transported in short supply chain deliveries.

Expectations and opportunities for the future

The value of the superfoods market worldwide was situated at 152 billion dollars in 2021, and it is expected to grow by an additional 41% by 2027 [48]. Increasing healthcare costs, growing geriatric population, food innovations, changing lifestyle and rising health awareness are some of the main factors benefitting the demand for superfoods and the overall market growth [49]. Under these expectations, the provision of information to consumers on the characteristics and properties of superfoods is a priority line of action. In this sense, the regulation of these products worldwide is crucial in order to possess their classification and establish strict minimum requirements for the products to have their health claim accepted.

On the other hand, the production of superfoods is already putting added pressure on the current food sector, especially considering that this increase in the demand will force the industry to change into intensive and commercially-oriented production systems, causing profound impacts on landscape, diets or carbon footprint, among others [5]. Achieving a sustainable intensification in agriculture is an important strategy to respond the combined challenge of achieving food security while including mitigation and adaptation measures to climate change and other environmental phenomena [50]. This implementation must be supported by science-based policies that provides a solid framework, including targets addressing the reduction of synthetic resources, the promotion of the efficient use of water or the evaluation of agricultural productivity and ecosystem services in the long term [51]. In addition, the lack of transparency and traceability of food supply chains create concern among consumers and stakeholders about food information credibility, quality and safety, for which the digitalization and information exchange can tackled by technologies such as the Internet of Thing (IoT), blockchain, or distributed ledger technologies (DLTs) [52], which would also help in tracking a product and its environmental impacts.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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