Comment

Questions and Concerns Re: Blue Water Footprints Reported in “Water Footprint of Meat Analogs: Selected Indicators According to Life Cycle Assessment”

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Abstract: The article “Water Footprint of Meat Analogs: Selected Indicators According to Life Cycle Assessment,” Water 2019 11: 728 by Fresán et al. analyzes the water footprints (WFs) of 39 meat analogs and their associated eutrophication and ecotoxicity potential. We have several questions and concerns about the WFs presented in this study, which in some cases are an order of magnitude larger than those reported for similar products in other published works. Additionally, at least some of the WFs of other meat analogs and conventional meats—to which the authors compare their results—appear to misrepresent the cited literature. We encourage the authors to provide clarification on how the WF values for meat analogs are so much higher than those reported in other studies and to verify the comparison values reported from other sources.

Keywords: water footprint; meat analog; meat substitute; life cycle assessment

1. Introduction

Fresán, Marrin, Mejia, and Sabaté published an analysis of the water footprints (WFs) of 39 meat analogs, and their associated eutrophication and ecotoxicity potential [1]. Analyses such as these are timely and important given the rapidly growing market presence of plant-based meat analogs, and the limited research comparing their environmental impacts to those of conventional meats.

We have several questions and concerns about the WFs presented in this study, which in some cases are an order of magnitude larger than those reported for similar products in other published works. We are also concerned that some of the values presented from other studies appear to misrepresent the cited literature. Throughout, we assume the authors’ use of the term “water consumption” refers to blue water only, per their explanation on page 4.

2. Water Footprints of Meat Analogs

The blue WF reported by Fresán and colleagues for all phases of the meat analog production process (3800 L/kg) is significantly higher than those reported in other studies of plant-based meat analogs: 29 L/kg [2], 107 L/kg [3], and 180 L/kg [4]. Furthermore, in Table 3, Fresán and colleagues report the blue WF for Morningstar Farms meat analogs as ranging from 1100–2000 L/kg, however these

values appear to misrepresent the original source [5], which reports a range of 0.00114–0.00264 m³/60 g, or 19–44 L/kg.

Considering just the ingredients used in the meat analogs assessed by Fresán and colleagues, the mean blue WFs attributable to the on-farm production of ingredients as reported in Table 2 (pg. 6) were 944 m³/1000 kg, or 944 L/kg. These values are considerably higher than the global average blue WFs reported by Mekonnen and Hoekstra [6,7] for primary products used in meat analogs: 70 L/kg for soy, 342 L/kg for wheat, 244 L/kg for eggs (in shell), and 181 L/kg for oats. We do not expect the WFs of these raw ingredients to match those of the processed ingredients used in meat analogs (e.g., isolated soy protein), and Fresán and colleagues' results would be highly dependent on the country of production as well as the extraction rates and method of coproduct allocation used in converting the WFs of primary products into processed ingredients. Even so, it would be helpful if the authors could explain why the blue WF of the ingredients is as high as it is.

3. Water Footprints of Conventional Meats

At least some of the WFs of conventional meats that Fresán et al. [1] present in Table 3 appear to misrepresent the cited literature. For example, Dettling et al. [5] reported blue WFs for beef burgers, pork sausage patties, and chicken sausage patties as 0.0467 m³/60 g (778 L/kg), 0.0142 m³/60 g (237 L/kg) and 0.00754 m³/60 g (126 L/kg), respectively, but were presented by Fresán et al. [1] as 8400 L/kg, 2900 L/kg, and 8000 L/kg, respectively.

Fresán et al. [1] report a blue WF for unprocessed chicken and pork to be 4000 L/kg, citing Berardy, Costello and Seager [8]. Berardy et al. [8] is a secondary source that reported the WF for chicken and pork based on data from Hoekstra [9]. Hoekstra [9] reported a WF of 3900 L/kg for chicken and 4800 L/kg for pork, however this was the total WF (blue + green + grey), and thus should not be used in a table comparing blue WFs of different products.

Fresán et al. [1] also include a second WF value for pork as “140⁶”, though it is unclear how this is intended to be interpreted. As a point of comparison, Mekonnen and Hoekstra [10] estimated the global average blue WF of poultry to be 313 L/kg and pork to be 459 L/kg.

4. Conclusions

We applaud Fresán and colleagues for tackling the important topic of quantifying the WFs of meat analogs. We encourage the authors to provide clarification on how the WF values for meat analogs are so much higher than those reported in other studies. Additionally, we suggest that the blue WFs reported from other studies in Table 3 are verified with the original sources.

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