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Consumer perception of bio-based products—An exploratory study in 5 European countries

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ABSTRACT

This study explores people's perceptions (i.e., positive and negative associations, mixed feelings) regarding the concept of 'bio-based' in general and specific bio-based products. This exploratory study is one of the first consumer studies in the field of bio-based research. Three focus group discussions were organized in the Czech Republic, Denmark, Germany, Italy, and The Netherlands (with 89 participants in total) in which projective techniques were applied.

Results of these group discussions indicate that participants are unfamiliar with 'bio-based' as a concept. 'Bio-based' is most often associated with positive environmental issues as "naturalness" and "environmental friendly" but also with negative environmental associations and to a lesser extent with technological and health issues. Associations with 'bio-based' as a general concept and with particular bio-based products can be simultaneously positive and negative, which caused uncertainty and mixed feelings by the respondents. This idea highlights both the complexity of and a lack of familiarity with the concept of 'bio-based'. Consumers have a holistic perception of bio-based products, i.e., they combine their perception of different aspects of the product in an evaluation of the whole product concept (e.g., their perception of the original product, usability, production method, proportion of bio-based materials used, price, packaging material, and appearance). Discussions on 'bio-based' as a concept are more general and abstract, while discussions and associations related to bio-based products are more specific. This study's qualitative approach illustrates in detail the great variety in consumers' perceptions, which can be both cognitive and affective (including positive, negative and mixed feelings towards 'bio-based' as a concept as well as bio-based products).

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1. Introduction

In an ideal bio-based future, we will find alternatives for non-renewable resources to create prosperity and progress that are in balance with the ecological limits of this planet. Bio-based production will make more widespread use of biomass to replace fossil-based resources. In a bio-based economy, biologically derived materials will replace synthetic materials, in the production of bio-based polymers or chemicals as well as in replacement of concrete with bamboo or hemp in construction [6].

A transition towards such a bio-based economy must not only be technologically feasible and economically viable but also socially

desirable (see Ref. [15]: 17, 376). Consequently, this transition depends not only on the effort and enthusiasm of professionals and policymakers but also very much on the acceptance and involvement of consumers.

The importance of obtaining insight in ordinary people's perceptions about new technologies right from the start can be illustrated by the case of genetic modification [3,11]. Although professionals see many benefits to genetic modification, this technology is not generally accepted and might even be rejected by consumers. Because the transition towards a bio-based society is still at an early stage and little is known about consumer perception of bio-based processes and products, it is important to investigate what types of images, expectations, or concerns consumers have.

However, not much is known about consumer perceptions and reactions regarding bio-based production processes and specific bio-based consumer products. Unfortunately, consumer-oriented

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research devoted to related issues is not very helpful. Although these studies consider food consumption or environmental friendliness, no direct link is made to bio-based issues. There are, for example, studies that concentrate on consumers' willingness to buy organic food products [12] and functional foods [28] or to eat insects [16,35], consumers' reactions to environmental packaging [13,26] and environmentally friendly transport [19], or consumers' acceptance of products made with new technologies such as genetically modified products [3], nanotechnology [27] or cultured meat [36,37].

From literature on the acceptance of new technology and food product development it is known that more general and more specific notions of bio-based need to be taken into account. For example, the general perspective of 'bio-based' is in accordance with a study of Verdurme et al. [38] on consumer acceptance of new technology from a general perspective. This means that on a general level, 'bio-based' as a concept is represented as a process or as a technology. The specific level is, for example, presented in the study of Krystallis et al. [14], who show that when providing consumers with a more realistic choice context or product, is a more relevant predictor for likelihood of success of products developed with the new technology. In the case of 'bio-based' this means, for example, the production of (partially) plant-based bottles. Therefore, for an in-depth exploration of consumers perception of the term 'bio-based', we must include a) a general level in which we explore whether individuals understand the term and what type of associations respondents have with this term and b) a product-specific level in which we guide consumers to consider specific bio-based products in order to explore perceptions, associations and feelings on a product-specific level.

In the current study, we therefore aim to provide a broad understanding of consumer perception of bio-based by distinguishing between 'bio-based' as a general concept and products that make use of bio-based materials. Additionally, in accordance with the definition of perceptions, we not only focus on cognitive aspects but also include affective aspects (i.e., feelings and emotions) in our analysis [33]. For a newly-published study taking also but differently people's emotions into account with respect to the bio-based economy, see Ref. [29]. Consequently, this study allows us to improve our understanding of the current level of awareness and acceptance of 'bio-based' as a general concept and more product-specific conceptions of 'bio-based' among contemporary Europeans.

1.1. Relevant literature

Directly related to bio-based topics are two studies that focus on consumer acceptance of bio-based packages [2,21]. A closer look at the studies shows that the first [2] focuses on the quality perception of blueberries after storage in a bio-based package. That is, the main focus is not the bio-based packages but consumers' answers to questions about the quality of the blueberries. The second study [21] explores the technical quality of bio-based materials used for food packaging. This study does not include consumer perception of bio-based packages as such and therefore does not provide an in-depth analysis of consumer perceptions of bio-based products or processes.

In addition to these two studies, a recent study by Koenig-Lewis et al. [13] focuses on consumers' cognitive and affective responses to ecological packaging. Although Koenig-Lewis et al. do not explicitly focus on the concept of 'bio-based', the stimulus material they use in their study (i.e., a bottle made partly of plant-based material) can be viewed as an example of a bio-based product. One of the most relevant aspects of this study is that the authors find that emotions rather than rational evaluations are the key driver in the intention to purchase the plant-based bottle. This study thus provides

evidence that consumers, when confronted with environmentally friendly purchase options, react not only rationally but also emotionally; this is something that may also be reflected in consumer reactions to bio-based products.

The results from one of the few preliminary explorations with a focus on bio-based processes and products that has been carried out thus far can be found in *Industrial Biotechnology*. This study of Walter [39] presents a large survey among US and Canadian consumers that shows that most respondents have only a limited understanding of what makes household products environmentally friendly. Moreover, a minority of the respondents indicate that they recall hearing the term 'bio-based' to describe products or product ingredients. The most commonly mentioned bio-based products (unprompted) are fuel products (e.g., ethanol and biodiesel), cleaning products (e.g., detergents, soaps), fabric and clothing (e.g., lingerie, hemp, bamboo), and household and personal care products (e.g., paper products). Despite little familiarity with these products, respondents show a strong interest in purchasing such products when they are comparable to non-bio-based products in terms of price and benefits.

Other preliminary research that focuses on consumer attitudes towards bio-based products and processes includes two focus group studies in The Netherlands. Both studies show overlap in their findings: Tertium [32] considers the general concept of 'bio-based', while the Athena study [40] concentrates more specifically on bioplastics. These studies suggest that contemporary consumers do not have a clear notion of 'bio-based' as a concept and do not have much ready knowledge of bio-based plastics either. Furthermore, consumers display negative reactions, such as 'expensive' or 'activistic', as well as positive reactions, such as 'green', 'organic' or 'progressive'. In summary, bio-based products and processes are, from a consumer perspective, still in their infancy. They are hardly an issue in the everyday life of ordinary consumers but are related to all sorts of associations and generate few ideas about behavioural consequences or personal commitments. Generally, such findings are corroborated in a survey study amongst Dutch citizens [34].

The examples mentioned above confirm that, to date, research on consumer perceptions of bio-based processes and products is limited. Insights in consumer acceptance of bio-based is necessary in order to get insight if labelling of bio-based is needed and how this should be done. Consumer perception is therefore key, and our approach is to study consumer perception from the perspective of bio-based both as a general concept and specifically, from the perspective of several bio-based products. Below, we examine to what extent our focus groups (N=89) in five European countries compare similarly or dissimilarly to the exploratory consumer studies mentioned above. Our study extends previous studies by conducting a large-scale qualitative study that explores how consumers perceive bio-based processes and products. Previous studies differ in the type of research or focus on one specific product alone. This study complements these findings by exploring how 'bio-based' is perceived in both a general and a product-specific manner and thus also compares different products.

In the following section, we present a detailed description of our methodological approach and the focus group discussions. Section 3 provides the results obtained from these focus groups, which are discussed and reflected upon methodologically in section 4. A short final section presents the conclusions of this paper.

2. Methods

2.1. Selection of participants

Fifteen focus groups were held in five European countries in four different regions: Germany and The Netherlands representing (i)

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