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Perceptions of Insects and Algae as Alternative Protein Sources †

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Abstract: Algae and insects are commercially available food products that can be alternative protein sources to meat, fish, and eggs, even if consumers find them less appealing. This study analyzed the opinions of a non-random sample of Portuguese adults, using an online, self-fulfillment questionnaire. We collected valid questionnaires from 188 participants. Previous intake history was low for insect-based products (11%) but not for algae (61%). Protein bars with insect flour or algae were considered the most appealing products based on alternative protein sources. Consumer education is needed to promote insects as alternative protein sources.

Keywords: algae; alternative protein sources; insects; nutrition

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1. Introduction

With the worldwide population increase and growing environmental and food concerns, finding sustainable and safe alternatives to meet the demand for food is becoming increasingly important, especially when considering the need for high-protein food [1,2]. Various alternative protein sources (APSs) are under study, but insects and algae stand out as commercially available alternatives.

Insects are a common component of the diet for a significant portion of the global population. However, especially in Western countries, insects are not commonly consumed, and their intake is often repudiated by a large part of the population [3,4]. Nevertheless, insects have gained significance as an ingredient in the development of functional food products. They can be consumed whole, dried as snacks, or made into flour that can be used in various food products such as energy bars or even pasta [5].

The consumption of algae is more frequent in Asian populations and mainly appears in Western countries as part of vegetarian diets or in ethnic restaurants. Due to their nutritional richness, algae are also marketed in the form of nutritional supplements, containing high levels of fiber, protein, and micronutrients [6]. Despite this, many consumers characterize them as products with less-appealing sensory characteristics [6,7].

The goal of this study was to analyze the opinions of the adult population in Portugal regarding insects and algae as alternative protein sources.

2. Materials and Methods

A quantitative, descriptive, cross-sectional study was carried out on a non-random sample of Portuguese adults recruited by promoting the study on social media and through personal and institutional email contacts.

A self-administered online questionnaire was used for data collection. It was not possible to identify a validated survey tool in the scientific literature that would meet the goal of this study, so a questionnaire was specifically created for this inquiry, comprising

questions related to sociodemographic data and opinions and knowledge about APSs. The questions were based on those included in several studies on alternative protein sources and research related to dietary preferences [8,9]. Questions were operationalized as multiple-choice, close-ended questions, on Likert scales ranging from 1 (completely disagree/not willing) to 5 (completely agree/very willing).

Statistical analysis was conducted using the Statistical Package for Social Sciences (SPSS) software, version 29.0. Statistical significance for all inferential procedures was set at 0.05. As variables did not adhere to a normal distribution, non-parametric tests (Mann–Whitney and Kruskal–Wallis) were used.

All ethical aspects for this type of study were strictly followed, including data confidentiality and participant anonymity.

3. Results

A total of 188 valid responses were obtained, with 71% (n = 133) from female participants and 29% (n = 55) from male participants. The mean age was 31.4 ± 13.1 years old, without significant gender differences ($p > 0.05$). A total of 86% (n = 162) of participants were of Portuguese nationality, and the majority were employed (n = 76; 40%) or were students (n = 69; 37%).

The intake history of insects and algae is shown in Table 1.

Table 1. Intake history for insects and algae in all participants (n = 188).

Intake History	Insects (n; %)	Algae (n; %)
Never tried	168; 89.4	73; 38.8
Tried, but will not eat again	12; 6.4	27; 14.4
Eat at least once a month	1; 0.5	18; 9.6
Eat rarely	7; 3.7	70; 37.2

Previous intake history of insects was low, as only 11% (n = 20) of participants had that experience. Most of those (60%, n = 12) are not willing to try it again. Algae was consumed previously by a wider number of participants (61%; n = 115).

We did not find any statistically significant differences in intake history according to gender, age, employment status, or nationality ($p > 0.05$).

The answers to the Likert-type questions assessing opinions are presented in Table 2.

Table 2. Opinions on insects and algae as alternative protein sources, in all participants, on a Likert-type scale ranging from 1 to 5 (n = 188).

	Insects (M ± SD) [1]	Algae (M ± SD)
Compared to fish, meat, and eggs, they are...		
... as sustainable	3.3 ± 1.2	3.5 ± 1.2
... as nutritionally balanced	3.0 ± 1.2	3.1 ± 1.2
How important are the following characteristics, when considering these products as alternatives to meat, fish and eggs?		
Price	3.0 ± 1.3	3.2 ± 1.3
Texture	2.6 ± 1.4	2.6 ± 1.3
Appearance	2.5 ± 1.4	2.4 ± 1.3
Taste	2.7 ± 1.4	2.5 ± 1.3
Availability in supermarkets/shops	2.9 ± 1.5	3.3 ± 1.4
Willingness to replace fish, meat and eggs	3.1 ± 1.5	3.1 ± 1.4

[1] Mean ± standard deviation.

When analyzing answers to Likert-type questions using frequencies, 17% of participants (n = 32) were somewhat willing and 25.5% (n = 48) were very willing to replace

meat, fish, or eggs with insect-based products. The willingness associated with algae-based products reached 24.5% (n = 46) for somewhat willing and 19.7% (n = 37) for very willing.

When asked to identify the characteristic of insect-based products which was considered the most important characteristic impacting the willingness to replace meat, fish, and eggs, price was the highest rated (3 $\pm$ 1.3).

The most appealing products based on alternative protein sources were identified as protein bars with insect flour (2.3 $\pm$ 1.3) or with algae (3.3 $\pm$ 1.2). The least appealing was the consumption of whole insects (1.6 $\pm$ 1.1).

No statistically significant differences ($p > 0.05$) were found in the perceptions and opinions based on any of the sociodemographic variables under study.

4. Discussion

Our results show that consumers are willing to replace meat, fish, and eggs with insect- and plant-based products, despite having limited experience with these products, especially in the case of insect-based products. This is in accordance with previous studies that identified this trend in society, perhaps due to the effects of market globalization [1,10]. Nevertheless, participants seem to prefer preparations where the natural appearance of these products is somewhat disguised. Research suggests that Western cultures, in regard to protein alternatives, are more willing to eat a processed product than one presented in a more traditional fashion [4,8,10].

Contrary to other studies suggesting that alternative protein sources are more attractive to young people [11], our results do not show significant differences in opinions with age.

We identify as a limitation in our study the fact that participants were a small, non-random sample, and they had digital skills to access our online questionnaire. This may have introduced a selection bias, as people who were more interested in or motivated by the subject, or who had a higher educational level, were more likely to answer the questionnaire. Despite this limitation, we believe that our research provides valuable information on the subject and identifies some characteristics that can be used by manufacturers when considering how to improve the acceptability of alternative protein source products.

5. Conclusions

We conclude that an important number of adult consumers are willing to consider the inclusion of insect-based and algae-based products in their diet, as long as those products are processed, readily available in supermarkets, and have a similar price to traditional, protein-rich products.

These results can be useful for the development of consumer-appealing products based on insects and algae.

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Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data presented in this study are available on request from the corresponding author due to privacy restrictions.

Conflicts of Interest: The authors declare no conflicts of interest.

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