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Consumer responses to novel and unfamiliar foods

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The demand for sustainable foods and an increased consciousness of health and well-being, as well as other societal changes, create opportunities to develop novel foods. However, consumers are programmed from early childhood to prefer familiar foods. We now know that individual variations in disposition determine responses to novelty. Disgust, along with food neophobia and related traits, has been identified as a major barrier to accepting novel food alternatives. In this paper, we present two novel foods trends (meat alternatives and products for health and well-being) as examples of current research. We conclude that successfully launching novel foods require a deep understanding of product perception and the consumer traits that determine rejection or acceptance.

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Introduction

Within the European Union (EU), a 'novel food' is a newly developed, innovative food; a food produced using new technologies and production processes; or a food that is or has been traditionally eaten outside of the EU and has not been consumed within the EU to a significant degree [1]. Hence, the legal concept comprises foods new to the region, whether based on ingredients, production, or culture. If a product legally defined as novel resembles a known product, an individual may consider it familiar, but if a culturally familiar product has not yet been tasted, an individual may consider it novel [2]. The latter is particularly true in children, and an important goal of child feeding practices is to familiarize children with foods common in their culture, even though these foods are subjectively novel to the children [3].

Since the 1990s, major societal and scientific advances, discussed below, have shaped the research on various types of novel food. Recently, a global transformation of the food system has become an urgent future target [4••]. Consumer motivation to accept or reject these foods appears to be based on a range of mental traits (Table 1), and product developers consider individuals with specific values, attitudes, expectations, and dietary preferences during the development process. Emerging opportunities, such as new raw materials, and technologies enabling, for example, prolonged shelf-life, also promote new product development (Figure 1).

In recent years, two interrelated trends have dominated the scientific research about novel foods in Western countries. First, the impact of food production on the environment, climate change, and animal welfare has encouraged people to avoid eating meat [5,6], and meat alternatives and replacements are made from plant-based alternatives, insects, and artificial meat [7,8••]. Second, the awareness of the connection between food and health has created a market for products with health-enhancing properties [9]. Such foods contain or do not contain specific ingredients: they may be reduced in sugar, salt, or fat or increased in protein content, or they may be functional foods with health-promoting ingredients added or detrimental ingredients removed. Recent trends have resulted in new or improved production, such as organic farming [10], 3D printing technology [11], and genetic modification [12]. Although technological novelty appeals to some consumers, it induces opposition in others. Furthermore, the increased availability of unfamiliar ethnic foods offers variety and new experiences for consumers [13].

In this paper, we focus on the consumer characteristics that determine responses to novelty, and we discuss two novel food trends: meat alternatives and products for health and well-being.

How consumers process novelty

Early familiarization with foods

Prenatal exposure to flavors via amniotic fluid impacts later preferences for those flavors, and the role of the mother's milk in transferring and modifying flavor preferences has been demonstrated [14]. However, body fluids during pregnancy and breastfeeding mediate only a limited spectrum of sensory experiences that a baby will encounter when introduced to food. Research suggests that both sensitive (taste) and critical (texture) periods exist postnatally in the acquisition of food preferences,

Table 1

Potential drivers of acceptance or rejection of novel and unfamiliar foods. The list illustrates the multitude of new products and motivations, but it is not exclusive

Type of food	Definition	Acceptance	Rejection
Ethnic	Unfamiliar locally, known and 'safety tested' in another culture	Variety seeking Increased availability	Unfamiliar (weird) sensory properties Uncertainty Food neophobia
Nutritionally modified	Contains often more fiber or less fat, sodium, or sucrose than a conventional food	Health, nutrition and well-being	Sensory properties may differ from regular
Functional	Evidence based beneficial effect due to special ingredients	Health, nutrition and well-being	Price Perceived uselessness
Free from	An ingredient unfit for a part of population has been omitted (e.g., lactose, gluten, palm oil)	The absence of unhealthy or unfit ingredient	Sensory properties may differ from regular
Vegetarian and vegan	Free from meat and other animal-based material (different levels exist, fully free = vegan)	Meat avoidance Environmental concerns Moral views Health, nutrition and wellbeing Ethical value	Attached to meat Perceived inadequacy of nutritional value
Organic	Produced in traditional farming conditions without fertilizers or herbicides/pesticides	Naturalness Health, nutrition and well-being Ethical value	Price Quality defects
Plant based meat replacers	Products replacing the meat component from a dish or meal	Source of protein Ethical value	Attached to meat Sensory expectations hard to meet
Insect	Product containing whole or bruised insects	Source of protein Curiosity	Disgust Food neophobia
Artificial meat	Meat produced from stem cells without a living animal body	Sensory properties similar to meat Ethical value	Disgust Unnaturalness
Genetically modified (GMO)	Contains, consists of, or produced from genetically modified material	Price Improved quality	Unnaturalness Food technology neophobia
3D-printed	Computer-assisted design combined with 3D food printer -> products in complex patterns and shapes	Personalized nutrition	Disgust Unnaturalness Food technology neophobia

and individual dispositions toward disgust may play a role in sensitive children [15].

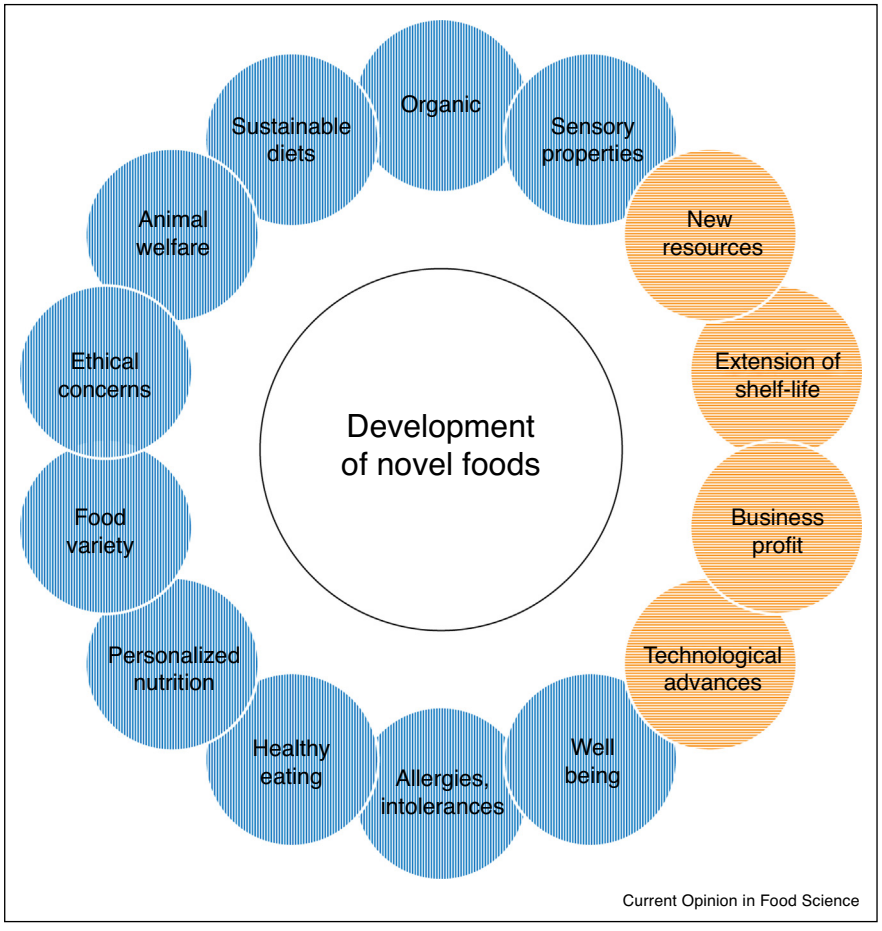
Food neophobia, the reluctance to eat or the avoidance of new foods, manifests in children toward the second year of life and is likely to prevent experimenting with food, thereby limiting the experience of different types of food [16]. Neophobia is associated with difficulties in correctly categorizing products [17], and improved categorization may result from long-term exposure to visual cues [18]. The ability to learn to like available food varies by individuals and may be difficult for some, but consensus prevails concerning the importance of exposure to the acceptance of food products and the development of food habits [3,16].

Power of familiarity and expectations

Familiarity with a food brings with it the certainty of what the food is and a reduced anxiety and suspicion of the food [3]. In the process of familiarization, a food is integrated into an individual's diet and it becomes acceptable. Because familiarity with a product provides an advantage over the novelty of an unfamiliar product, familiar products are usually better liked than unfamiliar products [2,19]. The deeply rooted preference for familiarity was recently demonstrated in Indonesian adults whose hedonic ratings of original and modernized traditional products were positively correlated with ratings of food as 'traditional' and were negatively correlated with ratings of food as 'modern' [20]. Researchers propose that exposure is the main building block of familiarity, while theoretical knowledge of a product is a secondary factor [19].

Perceived sensory quality, consisting of appearance, texture, and chemosensory attributes, is the cornerstone of acceptance, and familiarization with a product consolidates expectations about sensory quality. When sensory (intrinsic) properties are combined with name, packaging, labeling, and the like (extrinsic properties) in a manner that does not match expectations, there is a risk of failure in the marketplace [21]. For novel products, expectations can be tailored, as consumers do not yet know what to expect. Literature shows that many opportunities exist to experiment with intrinsic and extrinsic properties to create, confirm, and disconfirm expectations [22].

Figure 1



Motives for the development of novel foods from the perspective of the consumers (in blue) and the industry (in yellow).

Dispositions and traits that shape responses to novel foods

Several instruments have been developed to operationalize the mental constructs that predict the acceptance of novel foods. They usually consist of sets of statements that the respondents rate using the Likert scale that indicates the disapproval or approval of a statement.

Food neophobia is a well-established and undisputed barrier to trying novel foods. The publication of the Food Neophobia Scale (FNS) [23], which quantifies the trait of food neophobia, has encouraged further research on novelty perception. Additional instruments measuring this trait have been developed [24•], some specifically aimed at children [25] and, even more specifically, at their responses to fruits and vegetables [24•]. However, none of the other tools have exceeded the popularity of the FNS in regular research use.

To focus on the fear of new food technologies, the Food Technology Neophobia Scale (FTNS) was developed [26]. The FNS and FTNS are commonly used to examine responses to low acceptance ratings of novel foods. They quantify different aspects of neophobic disposition, as demonstrated by their relatively low correlations in different populations [26–31] ranging from −0.12 to 0.33 (Table 2).

Widely different versions of the FNS and FTNS have been translated into many languages and used in published research, as demonstrated in Table 2. Modified and translated instruments may measure the intended disposition, but there is often no proof that they do. Reducing the number of statements without reliability testing is suspicious and risky. Although back-translations help to find linguistically similar expressions, the underlying cultural meanings also require consideration [32••]. The FNS and FTNS have both been developed and validated in affluent Western societies, and they have performed well in similar cultures. However, it is unclear to what extent the statements resonate in different socioeconomic or cultural surroundings.

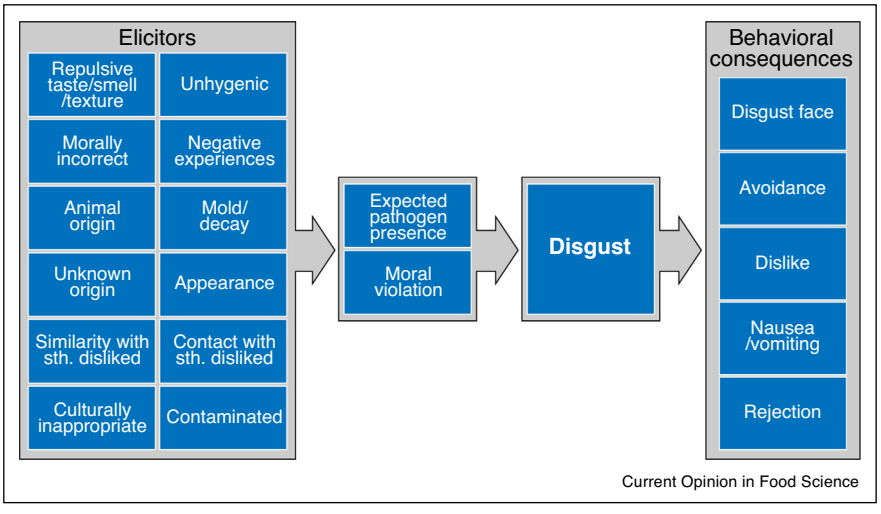
Table 2

Characteristics of a few recent studies reporting correlations (Pearson's r) between FTNS (Food Technology Neophobia) [26] and FNS (Food Neophobia) [23]

Correlation FNS x FTNS	Population		Country in which measured	Language	Items on scales	Reference
	n	Demographics				
0.18	294	69 % women 18 . . . >60 years	Australia	English	FNS complete: 10 items FTNS complete: 13 items 7-pt Likert scales	[26]
0.14	229	80 % women 19–63 years	Finland	Finnish, FTNS back-translated	FNS complete: 10 items FTNS complete: 13 items 7-pt Likert scales	[27]
0.24	368	61 % women 18–79 years Meat consumers	Belgium	Not mentioned	FNS abbreviated: 6 items FTNS abbreviated: 4 items 5-pt Likert scales	[31]
0.33	400	65 % women Mean age 25.5 years Meat consumers	Hungary	Not mentioned	FNS abbreviated: 6 items FTNS abbreviated: 4 items 5-pt Likert scales	[29]
−0.12	372	56.5 % women Mean age 20 years	Chile	Spanish, FTNS back-translated	FNS abbreviated: 6 items FTNS abbreviated: 9 items 6-pt Likert scales	[30]

Another important mental disposition related to food neophobia is disgust, and a multi-item instrument to quantify food-related disgust sensitivity was recently developed and validated [33]. From an evolutionary point of view, disgust is part of the behavioral immune system that prevents contact with or ingestion of potentially harmful agents by provoking avoidance behaviors [34]. Disgust toward a food can be elicited by many factors (Figure 2), including texture and appearance, the ingredients' origins, or contamination with unacceptable objects or materials. Cultural and societal convictions and norms determine what is considered disgusting, and the perception of disgust is deeply rooted in an individual's culture. A predisposition to be easily disgusted (high disgust sensitivity) hinders the acceptance of novel foods, even when they are potentially beneficial [35]. Disgust sensitivity predicts the lack of acceptance of novel foods, particularly for novel animal-based foods [36,37] and novel food technologies [38•]. Strategies to reduce disgust toward unfamiliar foods are needed for greater acceptance of future food innovations. Increasing parental support, the visibility of novel products, and positive eating experiences will help younger generations accept alternative food products [39,40].

Figure 2



Conceptual model showing how potential food-related disgust elicitors (left) lead to behavioral consequences such as the typical disgust face and avoidance of the food (right).

A variety seeking scale, called the VARSEEK, [41] has repeatedly been found to negatively correlate with the FNS [42]. These scales have common theoretical foundations in that they measure the tendency to explore food options [42]. Eight statements of the VARSEEK largely resemble those of the FNS and reveal low neophobia in high variety seekers. However, the desire to alternate between foods, whether familiar or unfamiliar, is missing from this measure and should be represented in an operationalized construct [42,43]. Additionally, a technical shortcoming of the VARSEEK is the unbalanced number of positive and negative statements. An improved scale that captures the variation in individual variety seeking should help to predict consumers' inclinations to seek and utilize a range of familiar and novel products.

The naturalness of food is an important, albeit not legally defined, attribute that consumers seek. Individuals across cultures and countries vary in what they perceive as natural and in how important naturalness is for their food choices. Perceived naturalness can be based on aspects such as the type of farming (e.g. organic, local), production method (e.g. unprocessed), or ingredients (e.g. no additives). Scales measuring individual preference for naturalness [44] show the diverse definitions of this construct used both by researchers and consumers [45••]. The lack of perceived naturalness elicits a fear of unknown risks associated with a novel product. A perceived lack of naturalness also hinders the acceptance of genetically modified food ingredients and new food preservation methods and technologies, such artificial meat [37,46•,47].

Behind neophobic and related responses are often other traits. For example, food neophobia is negatively related to openness and extraversion [48,49], and to sensation seeking, which is the tendency to seek novel and intense stimuli and the willingness to take risks [50]. Moreover, food neophobia is linked to food preferences. A low food neophobia level acts as a marker of an increased liking for fruits and vegetables, and for pungency and sourness in foods [51]. A large-scale Italian research suggested that perceived pungency and sourness are 'warning' sensations [52,53]. In contrast, a high food neophobia level predicts a decreased liking for any food, with the latest evidence coming from a large population study in New Zealand [54]. Food neophobia is associated with reduced dietary quality and several health-related biomarkers [55]. Because of substantial consequences for health, there is an urgent need to understand mental processes, such as food neophobia, that guide and limit food choices. A lot remains to be investigated of the impact of cognitive and affective influences during ontogenesis.

Novel food trends

Meat alternatives

To satisfy the protein needs of the growing world population, new resource-saving alternatives to conventional Western animal-based proteins are being sought. Protein sources in other regions and cultures, such as insects [36] and jellyfish [56], have been tested in the European and Western food markets. Except for those who are already familiar with entomophagy or who seek adventurous food choices, people generally react with disgust and refuse to eat these unfamiliar foods [36]. A survey across 13 countries found large variations in the rejection of insect-based foods, with rejection most likely to occur in Europe, the United States, and Australia, and among older people [57].

The rapidly growing assortment of plant-based meat alternatives that mimic the texture and taste of conventional meat is supposed to attract more consumers than novel, exotic protein sources such as insects. These products are mainly based on cereals, pulses, and soy [7]. However, if given a choice, many consumers prefer beef over plant-based burgers [58], and a lack of motivation to eat more sustainably is a barrier to the regular consumption of plant-based meat alternatives [59].

Another approach to reducing the negative externalities of meat production without sacrificing the perceived attributes of meat is the *in-vitro* growth of meat from animal cells. Upscaling from the laboratory—that is, making 'cultured' or 'clean' meat from single red muscle fibers—to industrial-scale thick steaks is one challenge, and consumer acceptance is another. A lack of perceived naturalness, a disgust response, and the fear of unknown risks associated with the new technology may reduce the willingness of people to eat cultured meat [46•]. However, information can play a major role [60]. Providing positive information, such as highlighting similarities with familiar products and focusing on the benefits, is an important communications strategy for increasing the acceptance of such novel protein sources [37].

In their thorough analysis of the technological and societal costs of meat alternatives, van der Weele *et al.* [7] recommend support for existing plant-based meat alternatives and pulses, as their sustainability gains are immediate and significant compared to insects and cultured meat. Environmental concerns call for solutions, some of which are viable and some may ultimately be a waste of resources.

Products for health and well-being

Health and well-being are important factors for many consumers. A recent qualitative study involving more than 8,000 respondents across 14 countries asked open-ended questions about associations of food, drinks, and feeling good [61]. As expected, taste and hedonic aspects were most important in creating good feelings, but health was particularly important for anticipated good feelings in the future.

Protein-rich foods are often closely associated with health and feeling good [61,62], and 'free-from' products are aimed at those for whom a specific ingredient is perceived to be detrimental. Consumers have the tendency for categorical (yes/no) thinking [63] which may lead to simplified assumptions, such that the presence of a component (e.g. protein) or the avoidance of another (e.g. gluten) promotes health [62,64]. Although such claims are often baseless, food plays a role in health and well-being beyond physical effects by promoting satisfaction and happiness [64–66]. Engaging in ethical and sustainable consumption in accordance with one's lifestyle and convictions promotes harmony and balance, and feeling good may arise from the use of such food products (e.g. organic, fair trade, animal-free) [66,67].

The increasing market share of novel vegetarian and vegan foods may indicate an increasing willingness to act according to ethical (animal-free) and sustainable standards [68]. However, people may choose vegetarian foods because of practical constraints, egoistic (e.g. health, enjoyment, identity) or altruistic (e.g. environmental, societal) motives, a desire to be vegetarian (a complex identity matter in itself), or emotions such as disgust toward eating meat [69].

Conclusions and future views

Consumers can benefit from novel foods that fulfill particular dietary needs, provide variety and convenience, and meet ethical and sustainable consumption requirements. In particular, acceptable and desired meat replacements have a great potential to be successful in the Western world [4••]. However, many novel foods remain niche products, and consumers tend to reject certain types of novel foods that evoke disgust or lack naturalness. Developers of novel food products must identify consumer expectations and factors leading to consumer rejection at an early stage of product development.

Identifying barriers to and drivers of the acceptance of novel foods requires proper measurement. Validated scales to measure dispositions and mental states or processes related to food acceptance are necessary. Tools to measure mental traits are the first step, and the research could go further with ambitious experimental designs and collection of qualitative and quantitative data. Deep knowledge of human behavior is needed to understand food selection processes, and genuinely multidisciplinary research is recommended.

Research on children helps us understand the basis of acceptance and rejection of foods. For novel foods, such as insects, to be accepted, early familiarization during childhood is crucial. Accessibility plays a central role, and it poses an additional barrier to trying and eating novel and perhaps suspicious products, in both developed and developing countries, for both adults and children.

The omnivore's dilemma, that is, neophilia versus neophobia, has shaped the evolution of human dietary behavior [70] and is still one of the biggest hurdles when it comes to introducing novel and unfamiliar foods. Reversing the reluctance to accept novel foods and ingredients may become critical if access to certain food resources becomes more difficult. For this reason, research on neophobia and disgust in populations for which novelty is not just a luxury but a requirement when other resources are lacking would extend our understanding of the phenomenon and help resolve critical food situations facing many people around the world.

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