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LUMINOUS INSIGHTS

Research Article

Understanding the Role of Health Consciousness in the Consumption of Plant-Based Meat Alternatives: A Sequential Mediation Model

Andrea Milena Sánchez Romero[a*] | Richard Ladwein[b]

[a]*EA 3849 CleRMa, Université Clermont Auvergne, F-63008, Clermont Ferrand, France*

[b]*LEM UMR 9221, University School of Management, Université de Lille, F-59043, Lille, France*

ABSTRACT

Plant-based meat substitutes (PBMA) offer a way to lessen the negative effects of human activity and consumption on the environment and to achieve sustainability in the food sector. This study investigates the role of health consciousness in the consumption of PBMA. We conducted a cross-sectional survey-based study with a sample of 317 French consumers. Our findings indicate that health consciousness is positively associated with awareness of PBMA. They also reveal that the effect of health consciousness on willingness to consume the products is serially mediated through awareness and attitudes toward buying the products. As such, consumers may benefit from receiving additional information that identifies the benefits of buying and eating PBMA. Consequently, managers are advised to consider promoting PBMA as compatible with multiple foodstuffs and easy-to-cook products. They also might want to raise awareness among consumers by creating long-term communication campaigns emphasizing the experiential value of consuming PBMA and holding in-store cooking classes led by expert chefs to teach consumers how to cook the products.

KEYWORDS

Awareness, health consciousness, plant-based meat alternative, sustainable diet, willingness to eat

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1. Introduction

The rise of obesity in developed countries and the COVID-19 pandemic highlight the key role of nutrition in health (Aksoy et al., 2021). High levels of red and processed meat consumption are related to fatty liver, cardiovascular disease, and insulin resistance (Pacheco et al., 2018). Pulses, algae, insects, plant-based meat products, and cultured meat have been identified as alternative sources of protein (Apostolidis & Mcleay, 2016; Onwezen et al., 2021). Among these, consumers most readily accept plant-based meat alternatives (Onwezen et al., 2021). Plant-based meat alternatives (PBMA) can be defined as 'processed food products derived from plant proteins that take the place of meat in the human diet' (Cuffey et al., 2023; Singh et al., 2021).

Considering the history of PBMA, one can distinguish three types (He et al., 2020). PBMA has been consumed by ancient civilizations in countries like China and Indonesia (He et al., 2020; Romulo & Surya, 2021; Ali et al., 2021). Traditional PBMA include tofu, seitan, tempeh, and vegetable/rice-based burgers and patties (He et al., 2020; Olayanju, 2019; Romulo & Surya, 2021; Ali et al., 2021). These products are intended to take the place of meat in the human diet without mimicking its appearance or taste. Though

Corresponding author:
Andrea Milena Sánchez Romero | andrea.sanchez@uca.fr | EA 3849 CleRMa, Université Clermont Auvergne, F-63008, Clermont Ferrand, France.

they are referred to as traditional, their production has been industrialized and they are available in supermarkets and food stores. In France, brands like *Bjorg* and *Céréal Bio* market them. With the rise of vegetarianism, especially in developed countries, alternative forms of PBMA emerged in the 1960s (He et al., 2020). The American company, *Archer Daniels Midland*, invented a product from soybean intended to resemble chopped beef, named textured vegetable protein (TVP; Kies et al., 1975). TVP is currently derived from multiple protein-rich seeds besides soybeans (e.g., lentils). Its manufacturing involves processes like extrusion, widely implemented in the food industry to produce, for instance, pasta and ready-to-eat snacks. The second modern generation of PBMA evolved with the creation of food products developed to imitate meat in terms of organoleptic properties (i.e., texture and flavor) and even nutritional facts (e.g., energy, protein, and fat; Audino et al., 2020; He et al., 2020). Their production involve extrusion, and more recently shear cell technology (He et al., 2020; Singh et al., 2021). They are intended to satisfy consumers considering eating meat alternatives while desiring to have a very similar experience to that of consuming meat (e.g., juiciness and taste). We follow a holistic approach and consider the three forms of PBMA in the present study to provide a better understanding of the whole category of products. We will refer to this category of products as PBMA.

PBMA can be considered as sustainable food products, that is 'products of a sustainable food system that fulfills the current food security and nutrition needs without depleting the economic, social and environmental basis which would ensure continued food security and nutrition for generations to come' (Talwar et al., 2021). Several research studies show encouraging results on the effectiveness of plant-based diets in reducing the risk of type 2 diabetes (Chen et al., 2021), cardiovascular disease (Heianza et al., 2020), and aggressive forms of prostate cancer (Loeb et al., 2022). In addition, the production of PBMA aims not to sacrifice living animals and responds to consumers' increasing concern about treating farm animals in a more humane manner (Heise & Theuvsen, 2017). PBMA can also contribute to mitigating the negative effects of food production on the environment. Indeed, several studies show that plant-based diets are related to lower nitrogen (Turner-McGrievy et al., 2016) and carbon footprints (Detzel et al., 2021; Saget et al., 2021).

While providing a path to attain sustainability in the food sector, the market for meat alternatives faces two challenges. One challenge concerns the belief that the action of an individual is not enough to generate a change in society (Aschemann-Witzel et al., 2020; Newman & Trump, 2022). Companies promoting PBMA need to attract new customers. They need to be empowered and encouraged to reduce or replace their meat intake with alternative products. In addition, companies must position PBMA in a transparent manner so that consumers have a clear understanding of the products' ingredients and other attributes. For instance, a law requiring additional transparency of information for agricultural and food products was launched in France in 2020. This law includes an article forbidding the use of names used to designate foods of animal origin to describe, market, or promote food containing vegetable proteins. This law may lead producers and retailers to position plant-based meat substitutes as healthy products that represent an alternative source of protein. However, there is a lack of empirical evidence on the effect of health consciousness on the consumption of PBMA. For this reason, we focus on this category of products.

Previous research agrees that health consciousness plays a central role in predicting food-related behaviors and health-related attitudes (Ajzen & Timko, 1986; Meng et al., 2019). Her and Seo (2017) showed that health-conscious consumers make 'wise' food choices (i.e., not ordering a dessert after having a healthy entrée). In addition, two studies found that health-conscious consumers are aware of the composition of functional foods (Bornkessel et al., 2014) and food safety regulations (Gedikoğlu & Gedikoğlu, 2021). The findings of these three studies suggest that health-conscious consumers are aware of nutrition. Although health consciousness could influence consumer awareness of PBMA, our literature search did

not identify research supporting this effect. Studying this relationship could shed light on the extent to which consumers' concerns about their health will guide their cognition with respect to PBMA, a novel category of sustainable products. Furthermore, past studies found health consciousness has a positive effect on the consumption of PBMA (Apostolidis & Mcleay, 2016; Gómez-Luciano et al., 2019; Vainio, 2019; Hartmann & Siegrist, 2020). They showed that the more consumers care about the impact of lifestyle on health, the more they are willing to consume PBMA. Despite their positive contributions, such studies do not explain the mechanism behind this positive effect.

Considering the aforementioned gaps in the literature, this research studies the role of health consciousness in the consumption of PBMA. We examined the effect of health consciousness on awareness of PBMA, and the sequential mediation effect of awareness and attitudes toward buying the products on the relationship between health consciousness and willingness to eat them. We applied the health consciousness model of Marsall et al. (2021) and the transtheoretical model of behavioral change (Norcross et al., 2011; Prochaska & Diclemente, 1983). Through the study of health consciousness in the context of plant-based alternative consumption, we also aimed to respond to Williams and Poehlman's (2017) call for research to better understand how consciousness can influence consumer behavior.

We structured the present article as follows. First, we present the conceptual framework and the research model. Next, we present the methodology. We then present the results followed by the discussion of the theoretical contributions and implications for companies. To conclude, we outline the limits of the study and propose avenues for further research.

2. Theoretical framework and hypotheses

2.1. The effect of health consciousness

Health consciousness can be defined as "the extent to which an individual is aware of the influence of lifestyle on health" (Lee et al.., 2014, p.31). Extensive research has studied the effects of health consciousness on food-related attitudes and behaviors (see Table 1). According to these studies, health conscious consumers hold positive attitudes toward organic food (Büyükayman et al., 2022; Chen, 2009; Nagaraj, 2021), eco-friendly furniture (Xu et al., 2020), functional food (Žeželj et al., 2012), and natural food (Talwar et al., 2021). They also are satisfied with the quality of restaurants serving healthy food, want to revisit these restaurants, and to talk positively about them (Jin et al., 2017). Additional studies have shown that health-conscious consumers have a high intention to buy organic food (Nagaraj, 2021) and eco-friendly furniture (Xu et al., 2020). They are also willing to pay a premium at an eco-friendly restaurant (Nicolau et al., 2020). Health conscious consumers seek information about and purchase natural beauty products regularly (Kim & Seock, 2009).

Past research has also examined the effect of health consciousness on the consumption of PBMA. Hartmann et al. (2018) found that participants consider consumers of insect and vegetarian food products to be more health conscious than meat consumers. Two additional studies agree that compared to meat consumers, vegetarians and consumers consuming PBMA are more aware of the impact of lifestyle on health (Hoek et al., 2004a; Vainio et al., 2016). A more recent study also found a positive correlation between health consciousness and consumption of PBMA (Siegrist & Hartmann, 2019). Additional studies have found a positive relationship between health consciousness and consumer awareness of certain foods. Consumers who care about health are aware of the ingredients of functional products (Bornkessel et al., 2014) and food safety regulations (Gedikoğlu & Gedikoğlu, 2021). The findings of these two studies suggest a possible link between health consciousness and awareness of PBMA. Nevertheless, prior research does not appear to have tested such an effect. Studying this relationship could help us better understand how consumers' concerns about health impact awareness of a novel category of sustainable products (i.e., PBMA).

Table 1. Main Findings of Studies on Health Consciousness

References	Theory/ research field	Health consciousness' role	Dependent variable	Main findings
(Hoek et al., 2004b)	Food choice attitudes	Dependent variable	Health consciousness	Vegetarians were more aware of the impact of the lifestyle on health compared to meat consumers. However, there were no significant differences between meat alternative consumers and meat consumers.
(Chen, 2009)	Value-attitude behavior theory	Independent variable	Healthy lifestyle	Health consciousness had a direct positive effect on attitudes toward organic foods and an indirect effect mediated by healthy lifestyle.
(Kim & Seock, 2009)	Beauty product shopping behavior	Independent variable	Information search, frequency of purchase	Health consciousness was positively related to information seeking about natural beauty products and frequency of purchase.
(Žeželj et al., 2012)	Functional theory of attitudes	Independent variable	Attitude toward functional food	Health motives had a direct positive effect on attitudes toward functional food.
(Bornkessel et al., 2014)	Health motivation	Independent variable	Awareness of fonctional food ingredients	Health consciousness predicted consumer awareness of the ingredients of functional foods.
(Lee et al., 2014)	Communication and corporate social responsibility	Moderating variable	Perceived corporate social responsibility	When provided with healthful menu items (e.g., fresh green salad), highly health-conscious consumers perceived a restaurant as more socially responsible compared to consumers not provided with those items.
(Vainio et al., 2016)	Eating motives	Independent variable	Consumption of meat and PBMA	Health motives were stronger among consumers who had a diet including meat alternatives (e.g., beans, soy) rather than meat (e.g., beef). Consumers undergoing a dietary change were more health concerned than those having an established diet including meat alternatives.

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Table 1 continued

(Her & Seo, 2017)	Health halo effect	Moderating variable	Intention to order desserts	Highly health-conscious consumers, who had eaten healthy entrées, showed a lower intention to order desserts than low conscious consumers. The formers indulged less and calculate more accurately food calories.
(Jin et al., 2017)	Value and quality	Independent variable	Pleasure, perceived quality, restaurant patronage, positive word-of-mouth	Health consciousness had a direct positive effect on pleasure of eating healthy food, restaurant perceived quality, restaurant patronage, and positive word-of-mouth.
(Hartmann et al., 2018)	Entomophagy and food choice motives	Dependent variable	Health consciousness	Consumers of insect and vegetarian food products were considered as more health conscious than meat consumers.
(Weinrich, 2018)	Food consumption and sustainability	Independent variable	Consumption of meat and PBMA	Group interviews conducted in France, Germany and The Netherlands showed that participants in all three countries expressed their concern about the negative effects of meat consumption on health.
(Meng et al., 2019)	Elaboration likelihood model	Moderating and independent variable	Routine use of mobile health services	Health consciousness strengthened the effect of source credibility on routine use of mobile health services (e.g., electronic health applications). However, the direct effect of health consciousness on use intention was not significant.
(Shin & Mattila, 2019)	Organic food consumption and gender	Moderating variable	Subsequent food choice (healthy vs unhealthy)	Regarding consumers with low levels of health consciousness, the findings showed that men are more likely to choose an unhealthy food when their initial choice is organic food while women are likely to do so regardless of their initial choice (i.e., organic vs conventional food).
(Siegrist & Hartmann, 2019)	Food choices and sustainability	Independent and moderating variable	Health consciousness	Health consciousness was positively related to consumption of PBMA. Highly health conscious consumers were more likely to consume PBMA than low conscious consumers.

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Table 1 continued

(Vainio, 2019)	Eating motives and information sources	Dependent variable	Perceived influence of scientific and commercial information sources	Health motives were positively related to the consumption of PBMA. Such motives were positively related to the perceived influence of scientific information sources (e.g., health professionals) and negatively related to the commercial sources (e.g., advertisements).
(Nicolau et al., 2020)	Green consumerism	Independent variable	Willingness to pay for a premium and amount of extra to pay	Health consciousness had a direct positive effect on both willingness to pay for a premium and the amount of extra to pay at an eco-friendly restaurant.
(Sakib et al., 2020)	Parasocial interaction and social comparison theory	Moderating variable	Willingness to follow recommendations on weight loss.	Health consciousness strengthened the effect of following a Youtube health promoter on willingness to eat healthier White Caucasians but not among Mexican Americans.
(Xu et al., 2020)	Theory of planned behavior	Independent variable	Attitude toward eco-friendly furniture and purchase intention	Health consciousness had a direct positive effect on both attitudes toward eco-friendly furniture and purchase intention.
(Gedikoğlu & Gedikoğlu, 2021)	Literature on food safety	Independent variable	Awareness of food safety regulation	Health consciousness predicted consumer awareness of food safety regulation.
(Martin et al., 2021)	PBMA	Independent variable	Willingness to eat PBMA and purchase intention	Repeated exposure to information about health benefits of plant-based meat alternative (i.e., lower percentage of fat and higher percentage of fiber) increased purchase intention.
(Nagaraj, 2021)	Attitudinal theory	Independent variable	Food safety concern, attitude toward organic food, purchase intention	Health consciousness had a direct positive effect on attitudes toward organic food and purchase intention. This last effect was sequentially mediated by food safety concern and attitude toward organic foods.

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Table 1 continued

(Sadiq et al., 2021)	Innovation resistance theory	Moderating variable	Purchase intention of eco-friendly cosmetics	Health conscious attenuated the negative effects of tradition and risk barrier on the intention to purchase eco-friendly cosmetics.
(Shah et al., 2021)	Value oriented adoption model	Dependent and independent variable	Intention to use 5G technology	Environmental awareness and environmental knowledge had a direct positive effect on health consciousness attitudes. This last variable had a direct positive effect on intention to use 5G technology.
(Talwar et al., 2021)	Expectancy theory	Independent variable	Attitudes toward natural products	Health consciousness had a direct positive effect on attitudes toward natural products.
(Büyükayman et al., 2022)	Risk perception	Independent variable	Attitudes toward organic food	Health consciousness had a direct positive effect on attitudes toward organic food.
Current study	Health consciousness model and transtheoretical model of behavioral change	Independent variable	Consumer awareness of PBMA, attitudes toward buying the products, willingness to try different PBMA.	Health consciousness had a direct positive effect on consumer knowledge. The effect of health consciousness on willingness to eat different PBMA was sequentially mediated by consumer awareness and attitudes toward buying the products.

Consumer awareness can be defined as "consumers' understanding and recognition of a product" (Li et al., 2022). Marsall et al. (2021) predict that higher levels of concern about health will be associated with higher levels of health literacy (i.e., being aware of treatments of illnesses that concern them). Health conscious consumers are prone to evaluate their health in greater detail and seek out health information from a variety of sources to determine their current state of health (Marsall et al., 2021). Hence, we propose that health-conscious consumers are likely to be more aware of PBMA. When consumers are concerned about the impact of their lifestyle and food choices on their health, they may be aware of the need to reduce meat consumption. They may be more aware of meal alternatives, such as PBMA available on the market. As such, our first hypothesis states:

H1. Health consciousness has a positive effect on awareness of PBMA.

2.2. The effect of awareness of PBMA and attitudes toward buying these products

Consumers who aware of a given product can explain what it means and recognize it among other products (Li et al., 2021). Consumer awareness is the first stage in considering a product, followed by knowledge, which may lead to a purchase or usage (Rayne et al., 2020; Shaikh et al., 2020; Zandstra et al., 2016). Communication campaigns and media are essential in making consumers aware of the availability and features of a product (Barroso & Llobet, 2012; Zandstra et al., 2016). Awareness implies knowing that a product exists (e.g., in supermarkets and grocery stores), while knowledge refers to what or how much consumers know about this product (Park et al., 1994; Shaikh et al., 2020). Dickinson and Shaver (1982) consider awareness a means for consumers to defend their rights. Consumers who are aware of a product's features, laws, and means of recourse can solve problems affecting their level of satisfaction. For example, they can request the correction of a billing error on their account. Consumer awareness is therefore a precondition for acquiring knowledge of a product (Bornkessel et al., 2014; Rayne et al., 2020).

The transtheoretical behavior change model posits that behavioral change is a process unfolding over time (Norcross et al., 2011; Prochaska & Diclemente, 1983). This process involves moving through five stages (i.e., precontemplation, contemplation, preparation, action, and maintenance). In the precontemplation stage, individuals are unaware of their problem while their relatives are. In the contemplation stage, individuals are aware of their problem and consider changing their behavior. However, they have difficulty committing and acting. In the preparation stage, individuals expect to act in the next month and adopt slight changes in their behavior. In the action stage, individuals modify their behavior, experience, and environment to overcome the problem. Action involves making drastic changes and requires investing time and energy. Individuals reach this stage when they have modified their behavior for 1-6 months. Finally, in the maintenance stage, individuals struggle to maintain the gains achieved through behavior change.

Awareness-raising is necessary to progress from precontemplation and contemplation to preparation (Norcross et al., 2011; Prochaska & Diclemente, 1983). When individuals realize they are doing something wrong, they assess the benefits of changing their behavior and think about making small adjustments to their behavior. Subsequently, they are ready to change their behavior, but should struggle to avoid relapse. If individuals are not aware of the advantages of changing their behavior, this change will be temporary. Previous studies in the food domain have shown a positive relationship between awareness of foods and attitudes toward them. Huang et al. (2006) found that consumers who had heard of genetically modified foods reported a more favorable attitude toward these products than consumers who had not heard of them. Carfora et al. (2022) found that participants' attitudes toward eating PBMA were directly influenced by their awareness of the environmental effects of meat production. Hence, we propose that the more consumers are aware of PBMA, the more they accept the idea of buying these products. Once they are aware of the existence of the products (e.g., having seen the products in the supermarket or having heard about them), they recognize the advantages of

consuming them (e.g., reducing meat consumption). We thus formulate the following hypothesis:

H2. Awareness of PBMA has a positive effect on attitudes toward buying these products.

Nystrand and Olsen (2020) found that more positive attitudes toward functional products are associated with increased consumer intentions to buy such products. These findings coincide with knowledge-attitude theory's (Kallgren & Wood, 1986) postulate that attitudes can guide individuals' behavioral responses. Consequently, we propose that the more consumers perceive the purchase of PBMA as positive, the more they are willing to consume them. We thus formulate the following hypothesis:

H3. Attitudes toward buying PBMA have a positive effect on willingness to eat these products.

Several studies suggest that consumer awareness is a necessary condition for the development and growth of a market as it influences purchase intention and willingness to pay. Two studies found that consumers who are aware of the availability of organic products and understand their characteristics are more likely to purchase them (Briz & Ward, 2009) and to pay a premium (Li et al., 2022). Two studies also showed that consumers who are aware of environmental certifications are more willing to pay for a certified versus non-certified food product (Aprile & Punzo, 2022; Valenciano-Salazar et al., 2021). Another study found that the more consumers understand the benefits of remanufactured products, the more they are willing to buy them (De Silva et al., 2021). Bi (2019) found that customers are more inclined to choose a given service provider when they are aware of efforts made by the company to build an online community. A more recent study found that consumers who are aware of the environmental impact of meat consumption are capable of progressing from not having the intention to reduce meat consumption to consider eating less meat (Hielkema & Lund, 2021). The findings of the aforementioned studies are in line with the transtheoretical model of behavioral change (Norcross et al., 2011; Prochaska & Diclemente, 1983). As discussed, this model posits that awareness-raising is a necessary condition for behavioral change. Hence, we propose that the more consumers are aware of the existence of PBMA, the greater their willingness to purchase these products. Once consumers are aware of the availability of the products and understand their benefits, they are better able to accept them and contemplate eating them. We thus formulate the following hypothesis:

H4. Awareness of PBMA has a positive effect on willingness to eat these products.

2.3. The sequential mediating effect of awareness of PBMA and attitudes toward buying these products

Given the theoretical basis of our previous hypotheses, we further expect that the relationship between health consciousness and willingness to eat PBMA is sequentially mediated by awareness of and attitudes toward PBMA. When consumers are concerned about the impact of their lifestyle and food choices on their health, they may be aware of the need to reduce meat consumption. Consequently, they may seek to inform themselves about the alternatives available on the market to replace meat, such as PBMA (Kemper, 2020). Such information may increase their awareness of and positive attitudes toward PBMA and, as a result, willingness to consume such meat alternatives. H5 formalizes our prediction of sequential mediation:

H5. Awareness of PBMA and attitudes toward buying PBMA sequentially mediate the effect of health consciousness on willingness to eat these products.

3. Methodology

3.1. Data collection and sample

Three-hundred and seventeen participants, who received a small monetary compensation for answering our online survey, took part in this study. We defined the sample size by applying the '10 times rule,' which is based on the assumption the size of the sample should be 10 times the maximum number of paths hypothesized in a structural model (Hair et al., 2017). The survey first asked respondents their opinions about meat substitutes like steaks, sausages, and cutlets made with cereals or vegetables. These examples were given to make it clear that we were referring to processed food products made from vegetable proteins. Most respondents indicated that

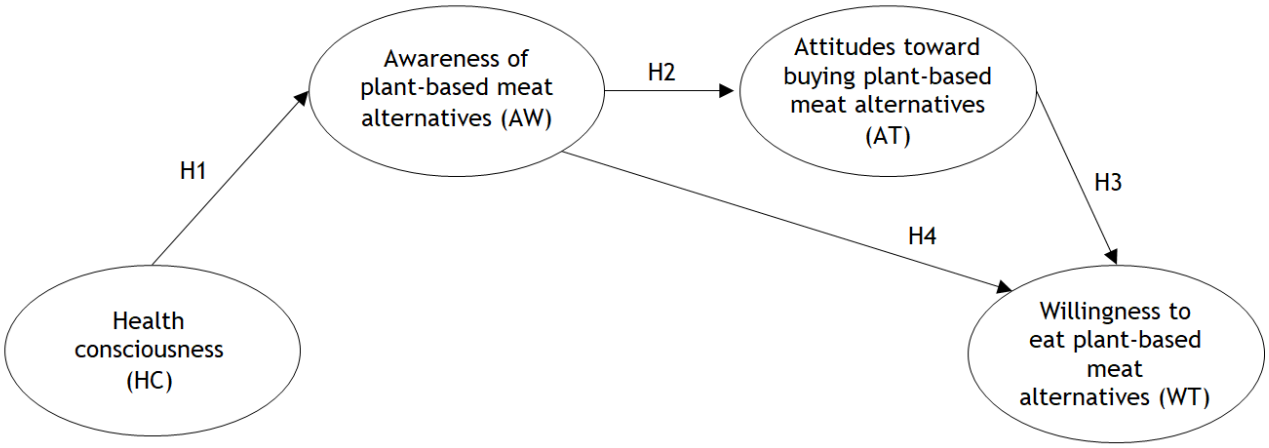


Figure 1. Conceptual Research Model

Table 2. Sample Profile (n = 317)

Catagory	Items	% Population	Frequency sample	% Sample
Gender	Women	52.2%	157	49.5%
	Men	47.8%	160	50.5%
Age	15-24 years	15.1%	34	10.7%
	25-39 years	23.6%	125	39.4%
	40-54 years	25.2%	97	30.7%
	55 and more	36.1%	61	19.2%
Socioprofessional category	Contractors	4.6%	24	7.5%
	Managers and intermediate professions	24.5%	142	44.8%
	Employees and workers	31.2%	94	29.6%
	Retired and inactive	39.7%	57	18.1%
Consumption of meat substitutes	No		122	38.5%
	Yes		195	61.5%
Product type (If Yes)	Traditional PBMA		47	24.1%
	First generation PBMA		5	2.6%
	Second generation PBMA		153	78.5%
	Pulses (lentils and beans)		13	7.7%
	Algae		1	0.5%

they had eaten meat substitutes (61.5%). Among these consumers, 24.1% reported eating tofu, tempeh, seitan or vegetable-based patties (i.e., traditional PBMA), while 2.6% had eaten texturized soy-based products (i.e., first generation PBMA), and 78.5% had consumed products such as meat-like textured burger patties and sausages (i.e., second generation PBMA). A small minority of consumers claimed to have eaten lentils and beans (7.7%) and seaweed (0.5%). Several national and private label brands (e.g., Sojasun, Bjorg, Herta, Céréal Bio, Jardin Bio, Beyond Meat, Beyond Burger, and Carrefour Veggie) were mentioned by 7.2% of consumers. Then, respondents rated their awareness of, attitudes toward buying, and willingness to eat PBMA. A fourth scale measured consumers' health consciousness. Finally, respondents provided socio-demographic data (see Table 2; 49.5% female and 39.4% between '25-39 years'). We opted for a cross-sectional research design to facilitate examination of a model that explored the relationship between health consciousness, two sequential mediators, and willingness to eat PBMA while ruling out potential alternative explanations (Spector, 2019). We recruited participants from the Foule Factory panel, and screened all the responses to increase the reliability of our data (Chmielewski & Kucker, 2020).

3.2. Measurement scales

We measured all constructs using 5-point Likert scales (1 = strongly disagree to 5 = strongly agree). We used two items to measure willingness to eat PBMA (Tan et al., 2016; Wilks et al., 2019). Awareness of PBMA was measured using two items (Verbeke et al., 2015). A three-item scale measured attitudes toward buying PBMA (Koklic et al., 2019). A scale used by Ophuis (1989) and Sakib et al. (2020) gauged health consciousness as it demonstrated reliability and validity in both studies. The items were translated from English into French and then back-translated by another person to ensure a consistent translation. Table 3 presents the measurement scales.

4. Results

4.1. Common method variance

We tested the constructs for common method bias (CMB) by applying two different techniques, (Kock, 2015). First, we ran a single-factor test (Harman, 1976). The results showed the unrotated solution with all items included produced one factor accounting for 38.50% of the variance (KMO = 0.84; Bartlett's test $p < 0.001$; number of factors extracted = 1). Then, we ran a common latent factor test, which consists of adding a latent variable modeled to be measured by all items (Podsakoff et al., 2003). The results showed the common variance, estimated as the square of the common factor of each path before standardization, was equal to 10.89%. Both tests indicated that CMB bias did not have a meaningful impact on the study results.

4.2. Measurement model assessment

We tested the validity and reliability of the measurement instruments. Item AT2 and HC1 were removed because of collinearity issues (VIF > 5) and non-significant standardized loading respectively. Item HC4 was also removed because we could not achieve adequate fit via modification indices and standardized residual covariance was above the threshold of 2.58 recommended by Jöreskog and Sörbom (1995). Constructs reflecting the remaining measured items showed adequate reliability (Table 3). Cronbach alphas and composite reliability coefficients were above the threshold of 0.7 (Hair et al., 2017). The measures showed convergent and discriminant validity (Fornell & Larcker, 1981). The average variance extracted of each construct was above the threshold of 0.5. AVE values were higher than the R^2 observed for the relationships between the constructs, which provided evidence of discriminant validity (Table 4). Assessment of the cross-loadings (Table 5) also confirmed the discriminant validity of the constructs (Hair et al., 2014).

4.3. Model and direct hypothesis testing

Confirmatory factor analysis using the package 'Lavaan' in R (Rosseel, 2012) indicated that the hypothesized structural model fit the data well (x^2= 54.218, df = 23, p = < 0.001; RMSEA = 0.065; CFI = 0.980; TLI = 0.969; χ/df = 2.357). We compared the hypothesized model (M1) to an alternative model that included two additional relationships (M2). In M2, health consciousness was related to attitudes toward buying PBMA and willingness to eat (x^2= 52.407, df = 21, p < 0.001; RMSEA

Table 3. Questionnaire Introduction and Constructs' Reliability Indicators

Introduction				
We would like to know your opinions about meat replacement products (e.g., steaks, sausages, and cutlets made from cereals or vegetables). Have you ever eaten meat substitutes? If yes, which ones?				
Constructs	Items	Loadings	Cronbach's Alpha	Composite reliability
Attitudes toward buying PBMA (Koklic et al., 2019)	AT1. Buying meat substitutes is a good idea.	0.957	0.896	0.950
	AT2. Buying meat substitutes makes sense.	Deleted item		
	AT3. Buying meat substitutes is beneficial.	0.946		
Health consciousness (Ophuis, 1989; Sakib et al., 2020)	HC1. I have the impression that I sacrifice a lot for my health.	Deleted item	0.743	0.851
	HC2. I consider myself very health conscious.	0.904		
	HC3. I think that I take health into account a lot in my life.	0.855		
	HC4. I think it is important to know well how to eat healthily.	Deleted item		
	HC5. I am willing to sacrifice a lot to eat as healthy as possible.	0.656		
Awareness of PBMA (Verbeke et al., 2015)	AW1. I have heard about meat substitutes.	0.921	0.830	0.922
	AW2. I know what meat substitutes mean.	0.928		
Willingness to eat PBMA * (Tan et al., 2016; Wilks et al., 2019)**	WT1. I am willing to eat meat substitutes in the future.*	0.948	0.897	0.951
	WT2. I am willing to eat meat substitutes regularly.**	0.956		

Table 4. Convergent and Discriminant Validity

	AT	HC	AW	WT	AVE	Mean
Attitudes toward buying PBMA (AT)	1	0.010	0.091	0.637	0.905	3.238
Health concern (HC)		1	0.030	0.021	0.659	3.625
Awareness (AW)			1	0.125	0.855	4.069
Willingness to eat PBMA (WT)				1	0.907	2.951

Table 5. Cross Loadings*

	AT	HC	SN	WT
AT1	**0.957**	0.096	0.306	0.801
AT3	**0.946**	0.091	0.267	0.713
HC2	0.098	**0.904**	0.175	0.159
HC3	0.043	**0.855**	0.191	0.053
HC5	0.103	**0.656**	0.017	0.134
AW1	0.287	0.132	**0.921**	0.319
AW2	0.272	0.185	**0.928**	0.333
WTE1	0.725	0.104	0.348	**0.948**
WTE3	0.792	0.167	0.325	**0.956**

The formulation of the items is available in Table 3 .

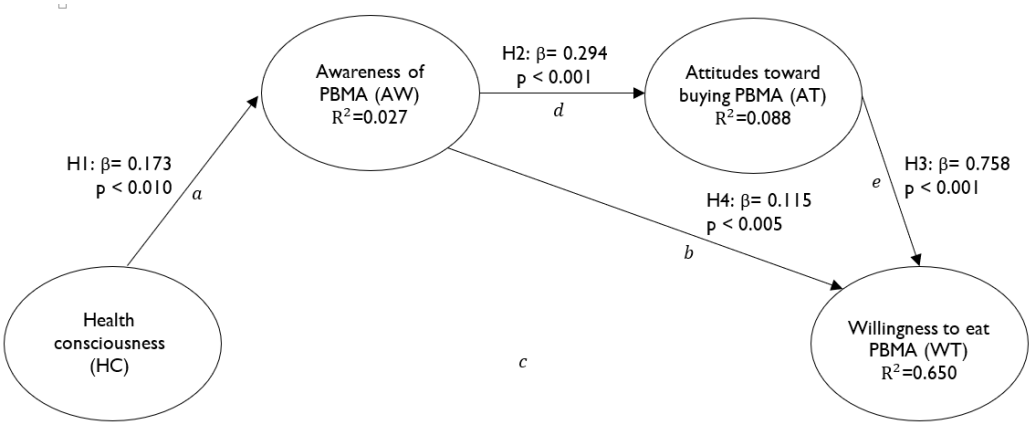
= 0.069; CFI = 0.980; TLI = 0.966; χ/df = 2.495). A chi-square difference test did not indicate a better fit for any of the models ($\Delta\chi$/df = 1.8114/5, p = 0.404). However, the values of the AIC and BIC showed a better fit of M1 (AIC = 7132.2; BIC = 7214.9) compared to M2 (AIC = 7134.4; BIC = 7224.6).

After validating the model, we tested the research hypotheses. We tested direct effects using SMARTPLS 4. This solution is suitable for testing structural equation models on small-size samples, and as in our situation, data that are not normally distributed (Hair et al., 2011). As Figure 2 shows, the results supported all five hypotheses. Health consciousness had a direct positive effect on awareness of PBMA (ß = 0.173; p < 0.010), in support of H1. Awareness of PBMA had a direct positive effect on attitude toward buying PBMA (ß = 0.294; p < 0.001), in support of H2. Awareness of PBMA had a direct positive effect on willingness to eat these products (ß = 0.115; p < 0.005), supporting H4. The findings also showed attitudes toward buying PBMA had a direct positive effect on willingness to eat these products (ß = 0.758; p < 0.001), which supported H3.

4.4. Mediation hypothesis testing

We tested simple and sequential mediation effects using Hayes PROCESS macro (2018). We ran Model 6 with parameter estimates based on 10,000 bootstrap samples. The predictor variable for the analysis was health consciousness (HC). The mediators for the analysis were awareness of PBMA (AW) followed by attitude toward buying PBMA (AT). The outcome variable was willingness to eat PBMA (WT), and the covariates were gender and age.

We identified the indirect effects of health consciousness on willingness to eat by using letters (see Figure 2). We examined the role of the first mediator (i.e., awareness). We found a positive indirect effect of awareness on the link between health consciousness and willingness to eat $(a \times b = .031)$. This effect was significant as zero did not fall in the 95% confidence interval [.009 to .059]. In the indirect path, a unit increase in health consciousness increased subjective knowledge by .284 units (a, 95% CI [.177 to .390]), on a 0 to 1 scale. Holding constant health consciousness, a unit increase in awareness increased willingness to eat by .111 units (b, 95% CI [.039 to .183]). On the



Indirect effects of health consciousness on willingness to eat
HC→ AW→ WT : (*a* x *b*) = .031, CI 95% [.009 to .059]
H5 : HC→ AW→ AT→ WT : (*a* x *d* x e) = .074, CI 95% [.042 to .113]
HC→ WT : (*c*)=.048, CI 95% [-.018 to .116]

Effets of the covariates
GENDER→AW = -.177, CI 95% [-.389 to .035]
GENDER→AT = -.024, CI 95% [-.231 to .182]
GENDER→WT = -.094, CI 95% [-.224 to .035]
AGE→AW = -.002, CI 95% [-.011 to .005]
AGE→AT = -.001, CI 95% [-.009 to .006]
AGE→WT = -.003, CI 95% [-.008 to .001]

Figure 2. Results

contrary, the direct effect of health consciousness on willingness to eat was not significant (c = .048, CI 95% [-.018 to .116]). As the indirect effect was significant but the direct effect was not, the results showed an indirect-only mediation (Zhao et al., 2010).

Finally, we assessed the effect of both mediators. We found a positive sequential mediation effect of awareness and attitude toward buying the products on the link between health consciousness and willingness to eat (a x d x e = .074). This effect was significant as zero did not fall in the 95% confidence interval [.042 to .113], supporting H5. In the indirect path, a unit increase in health consciousness increased awareness by .284 units (a, 95% CI [.177 to .390]). Holding constant health consciousness, a unit increase in awareness increased attitude by .351 units (d, 95% CI [.243 to .459]), which unitary increase strengthened willingness to eat by .749 units (e, 95% CI [.679 to .819]). Rather than being direct, the effect of health consciousness on willingness to eat was indirect only. Finally, neither gender or age had a significant effect on the hypothesized relationships.

5. Discussion

5.1. Theoretical contributions

The present research makes two contributions to the literature on PBMA. First, it provides a better understanding of health-conscious consumers by revealing a positive effect of health consciousness on awareness of PBMA. These results add to previous literature that had shown health-conscious consumers are aware of functional food ingredients and food safety regulations (Aprile & Punzo, 2022; Valenciano-Salazar et al., 2021). The results suggest that the more consumers care about their health, the more they are likely to be aware of PBMA as they may seek information about the composition and benefits of consuming such products. Health-conscious consumers may be receptive to communication campaigns by companies promoting PBMA, as they need to gain enough understanding to contemplate consuming the products.

Second, this research highlights the importance of awareness of PBMA in the consumption of these products. While prior research had examined the effect of environmental awareness on the consumption of

PBMA (Carfora et al., 2022; Hielkema & Lund, 2021), this research studied a different form of awareness, that is product awareness. The results showed that awareness of PBMA mediated the effect of health consciousness on willingness to eat PBMA. They also showed its positive effect on attitudes toward buying the PBMA and willingness to eat them. The results indicate that health-conscious consumers should be made aware of PBMA. Learning about PBMA may encourage some health-conscious consumers to try the products, whereas others may want to assess their benefits first. Additionally, our findings indicate that awareness of PBMA and attitudes toward their purchase sequentially mediated the association between health consciousness and willingness to eat PBM. By creating awareness about PBMA benefits, health-conscious consumers can be encouraged to develop positive attitudes and become willing to eat them. Together, these results correspond to the transtheoretical model of behavioral change (Norcross et al., 2011; Prochaska & Diclemente, 1983), which highlights the role of awareness in shaping attitudes and behavioral change, and facilitate extension of this theory to the context of PBMA consumption. Our study adds to the research on how consumer consciousness affects behavior, as requested by Williams and Poehlman (2017).

5.2. Managerial implications

We address some recommendations for companies (e.g., producers, retailers, and restaurants) to develop a long-term communication strategy to raise consumer awareness on PBMA. Companies are advised to promote PBMA as food products compatible with basic foodstuffs (e.g., bread, butter, and pasta) and easy to cook. Product packaging and restaurant menus should emphasize those attributes.The exact composition of the products should be better highlighted on the packaging to give a 'value' of proof to advertising claims. The packaging should display photos of the products accompanied by other everyday foodstuffs. Providing consumers with additional information complementing information from the packaging could encourage them to feel positive about PBMA and try them (Martin et al., 2021).

Companies may also use online (e.g., social media, internet websites) and offline channels (e.g., magazine ads, television ads) to promote PMBA. The messages should emphasize the experiential benefits of PBMA, like the joy of discovering new flavors and savoring plant-based foods. One idea could be to make a social media campaign that shows viewers different plant-based foods from around the world. Consumers reactions (i.e., attitudes and purchase intention) are more favorable when they are exposed to messages using figurative rather than literal language to describe the benefits of a product (Polyorat et al., 2007; Ye & Mattila, 2021).

Retailers may want to organize events such as cooking classes with chefs who specialize in alternative protein. Chefs should choose simple recipes that look good and use PBMA with basic ingredients and sauces to enhance flavor (Michel et al., 2021). Popular dishes like plant-based burgers, tacos, or pasta dishes could be considered. Small portions of the finished dishes could encourage consumer try PBMA. Customers may also get recipe cards and coupons for discounts to reproduce the dishes and share them with others.

6. Conclusions

6.1. Main conclusions of the study

We studied the role of health consciousness in the consumption of PBMA. We conducted a literature review and applied two theories (the health consciousness model; Marsall et al., 2021) and (the transtheoretical model of behavioral change; Norcross et al., 2011; Prochaska and Diclemente, 1983). We conducted a cross-sectional study among a sample of 317 consumers in France. The findings revealed that awareness of PBMA mediated the link between health consciousness and willingness to eat the products. This link was also sequentially mediated by awareness of PBMA and attitudes toward buying them. Health-conscious consumers may require additional information (e.g., composition, health effects) to hold positive attitudes toward buying this novel category of products and contemplate eating them. Awareness of the products' benefits and characteristics reduces consumers' uncertainty about the outcomes of the consumption experience (e.g., unnatural taste and

texture) and enhances their attitudes toward buying the products and willingness to eat them. We thus provide, for the first time, empirical evidence of the significance of this effect in the context of PBMA. Companies should market PBMA as easy-to-use and compatible with basic foods. They should also increase awareness through long-term communication campaigns emphasizing the experiential value of PBMA, and cooking events and tastings.

6.2. Limitations and avenues for further research

Like all research, our work has certain limits. We conducted a cross-sectional study to understand the relationship between health consciousness, awareness of PBMA, attitudes toward buying PBMA, and intention to eat them. We focused on variables related to the individual. However, food consumption and food choice also depend on product attributes (i.e., product naturalness, quality, and price fairness), social eating norms, and situational factors (i.e., product availability; Konuk, 2019; Mancini et al., 2017; Salmivaara et al., 2021). We can learn more about how health awareness and attitudes towards PBMA affect people's willingness to eat through a study including moderating variables. Additionally, we concentrated on personal factors that positively influence PBMA. Extensive research shows food neophobia and disgust also represent barriers to the consumption of PBMA (Onwezen et al., 2021). Studying the interaction between the tendency to avoid new foods and health consciousness could help us provide additional insights for companies to target consumers who are reluctant to try new foods. Finally, the relationships in the model could be conditioned by the type of PBMA consumed by the respondents. Additional data is required to compare the responses of individuals eating traditional PBMA and those eating first- and second-generation PBMA.

Future studies could explore the effect of the eating behavior of socially connected peers on the consumption of PBMA and product characteristics like perceived naturalness, quality, and price fairness. They could shed light on the situational and product-related factors that better predict purchase intention and intake of PBMA. Based on a well-being perspective (Wünderlich et al., 2021), further studies could also explore how the interaction with animals and attitudes toward them influence the consumption of PBMA. It could also be interesting to study the role of health consciousness in the consumption of PBMA in developing countries, determine to what extent this variable influences the consumption of these products in less mature markets, and test the generalizability of the results. Finally, other studies could investigate the barriers to the consumption of PBMA. For instance, they could explore the effect of perceived health risks and distrust in food technology (Weinrich, 2018), factors highlighted by consumers aiming to either reduce the consumption of meat or avoid it.

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ORCID

Andrea Milena Sánchez Romero | https://orcid.org/0000-0003-0154-8513

Richard Ladwein | https://orcid.org/0000-0003-0062-510X

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