



Not only veggies: Promoting healthy and familiar plant-based alternatives to traditional meat dishes with the AttiFood tool

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ARTICLE INFO

Dataset link: [AttiFood Database \(Original data\)](#)

Keywords:

plant-based proteins
sustainability
automatic attitudes
explicit attitudes
intentions
implicit association test

ABSTRACT

The prevailing dietary patterns across Western countries, characterized by reliance on animal-source products, represent significant contributors to health issues and environmental degradation. Growing evidence has highlighted the potential of transitioning from meat-heavy to more plant-rich diets to promote human health while respecting planetary boundaries. Psychological research contributes by studying people's attitudes and intentions to identify barriers and promoters of healthier food choices. This research falls within this framework, specifically focusing on plant-based protein food (PBBF). The primary aim was introducing AttiFood, a tool for investigating attitudes toward PBBF. The second was to apply AttiFood to examine the role of attitudes in increasing the intention to consume PBBF. The research consisted of three phases: creation and validation of a photographic set of stimuli featuring a wide range of protein sources, including animal- (i.e., red and white meat, fish, dairy, and eggs) and plant-based (i.e., legumes, grain, nuts and seeds) protein food; design and testing of a customized implicit association test; application study on an Italian sample assessing how the current behavior, automatic and explicit attitudes, and intentions intertwine. Results showed positive attitudes toward familiar and palatable plant-based protein food, although they were considered less tasty, convivial, and satisfying than animal-based counterparts. Multiple linear regression revealed current consumption and automatic and explicit attitudes as predictors of intention to increase PBBF consumption. This research suggests that promoting familiar and palatable alternatives to animal-based protein, as presented in the AttiFood tool, could inspire positive dietary changes.

1. Introduction

Nutrition is central to human life, as individuals' food choices impact their health and the environment (Loken, 2020). Dietary patterns in Western countries, marked by high-calorie intake and reliance on processed and animal-source foods, contribute to malnutrition, diet-related diseases, and environmental degradation (Loken, 2020; Tilman & Clark, 2014; Willett et al., 2019). Transitioning to more plant-rich, flexitarian diets can enhance health while respecting planetary boundaries, promoting sustainable eating habits without eliminating animal foods (Aiking & de Boer, 2020; Lonnie & Johnstone, 2020).

Studying food choice behaviors is crucial for developing strategies to promote healthier, sustainable diets (Biasini et al., 2021). Understanding the factors influencing protein choices can help reduce demand for animal products and encourage plant-based diets (Milford et al., 2019).

Research indicates that individual factors, such as gender, affect meat consumption. Studies show that women generally prefer fruits and vegetables, while men tend to favor meat (Fantechi et al., 2024; Seffen & Dohle, 2023). Age also influences dietary choices, with younger individuals typically consuming more meat (de Ridder et al., 2017; Godfray et al., 2018; Stevenson, 2017). Additionally, psychological factors impact food choices, particularly attitudes toward food (Conner, 1993; de Gavelle et al., 2019). Attitudes are defined as learned predispositions to act in a consistently favorable or unfavorable manner toward a particular object (Fishbein & Ajzen, 1975). They emerged as one of the strongest predictors of intentions to reduce meat consumption and adopt a plant-based diet (Carfora et al., 2020; Çoker & van der Linden, 2022; de Gavelle et al., 2019; Seffen & Dohle, 2023). These findings have been recently extended to a wider variety of plant-based foods, particularly plant-based milks (Dorina et al., 2025), plant-based yogurt alternatives

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<https://doi.org/10.1016/j.foodqual.2025.105734>

Received 13 May 2025; Received in revised form 30 September 2025; Accepted 4 October 2025

Available online 10 October 2025

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(Pandey et al., 2021), and plant-based eggs (Chen et al., 2024). These evidences were confirmed in different population segments by age group (Drolet-Labelle et al., 2023; Havermans et al., 2021; Raptou et al., 2024).

As a result, promoting healthy eating attitudes has been suggested as a potentially effective strategy for public health initiatives (Lonnie & Johnstone, 2020) and primary prevention interventions aimed at increasing consumer awareness and commitment to more sustainable dietary habits (Biasini et al., 2021). Typically, attitudes are assessed with so-called explicit, or direct, measures, as they require participants to take a stance on a topic (Songa & Russo, 2018). This approach, however, offers only partial information, as it reveals only the thoughts that a person consciously shares on the topic. Numerous studies have shown (Jacoby et al., 1992; Songa & Russo, 2018) that attitudes extend beyond a person's level of awareness and are often not immediately known or accessible. So-called indirect measures, consisting of computerized tasks based on response times, are used to study attitudes more automatically. The most widely used example is the Implicit Association Test (IAT, Greenwald et al., 1998), which measures the strength of the association between different categories and positive and negative attributes. Prior research showed that combining direct and indirect measures enhances the prediction of behavior (Greenwald et al., 1998; Maison et al., 2004).

Investigating attitudes toward and promoting the consumption of plant-based protein sources can be a compelling strategy to encourage healthier and more sustainable diets. However, most studies investigating the psychological factors involved in this transition have primarily focused on individuals' attitudes toward red meat compared to vegetables (Carfora et al., 2020; Clicerì et al., 2018; Çoker & van der Linden, 2022; de Gavelle et al., 2019; Rees et al., 2018). To enhance the inclusion of plant-based sources in the diet, these should extend beyond essential fruits and vegetables to provide protein alternatives (Rolands et al., 2025) that replace the most health- and environment-damaging animal sources, such as red meat and eggs (Huang et al., 2020). Some studies have compared traditional dishes with plant-based alternatives. For example, Winkelmaier and Jansen (2024) compared plant-based dishes (including pasta, soups, etc.) with red meat dishes; Schiano et al. (2022) compared traditional or plant-based milk; Segovia et al. (2023) compared traditional meat products with plant-based alternatives to meat. However, they neglected the issue of protein content, not including a count of the protein intake of the products. Furthermore, these studies focused on comparing particular categories of foods, rather than the broader categories of animal- or plant-based protein foods, or focused on plant-based alternatives to meat. Previous studies already revealed that plant-based alternatives to meat do not meet with great favor among consumers and are impactful on the environment (Gallagher et al., 2021; Kershaw et al., 2025; Romão et al., 2022).

By delving into the complex interplay of these factors, this research sought to contribute to the growing body of knowledge on the psychological determinants of food choices, with the ultimate goal of informing the development of evidence-based communication strategies to effectively promote the transition toward healthier and more sustainable dietary patterns.

Specifically, this research sought to challenge the traditional divide between animal-based foods, often represented by meat, and plant-based foods, typically associated with just fruits and vegetables. This study aimed to encourage further research in this area by examining broader food categories thus addressing two of the main biases regarding plant-based diets. The first concerns the belief that reducing meat in favor of a more plant-based diet necessarily involves consuming only vegetables, which are typically perceived as less tasty or satisfying (Ragunathan et al., 2006). The second relates to the ability of plant-based diets to provide an adequate protein intake, a factor particularly important for individuals with an active lifestyle (van der Horst et al., 2023). AttiFood confronts animal-based and plant-based dishes that provide equivalent amounts of protein, thus considering health and

environmental factors.

Also, it posited that investigating attitudes toward and promoting the consumption of high-protein plant-based foods, which are already part of culinary culture—such as legumes, nuts, and seeds—can nourish a positive narrative. This narrative would shift away from concepts of deprivation (the avoidance of meat) or imitation (the consumption of direct meat substitutes) (Aiking & de Boer, 2020; Lonnie & Johnstone, 2020; Vanutelli et al., 2025).

The primary aim of this research was to develop and share a tool—AttiFood—for investigating attitudes toward plant-based protein foods, concentrating on broader categories within existing culinary culture. Additionally, the study aimed to demonstrate how AttiFood could identify individuals' automatic and explicit attitudes toward extended categories of animal and plant-based proteins and examine how these attitudes influence their intentions regarding future consumption.

AttiFood comprises:

1. A validated photographic archive featuring images of protein food sourced from animals and plants
2. A specially designed Implicit Association Test (IAT) for animal and plant-based proteins
3. A set of items for assessing explicit attitudes toward animal- and plant-based protein foods.

2. Materials and methods

2.1. Creation of the picture archive

The stimuli set was defined based on compatible animal- and plant-based meal pairings with nearly equal protein content. Protein amounts were sourced from the Italian government database “Tabella di composizione degli alimenti, Aggiornamento 2019-Website,” developed by CREA (Centro di Ricerca Alimenti e Nutrizione; <https://www.crea.gov.it/alimenti-e-nutrizione>). Whether animal or plant-based, the quantity of food represented in each photo guaranteed that the final protein intake would be the same for both the stimuli in each match after consumption and the cooking process (in the case of raw food stimuli). These matches encompass different types of meals. Specifically, they include main courses (e.g., rice with ragù vs. whole emmer with vegetables), spreadable products (e.g., ricotta cheese vs. hummus), raw food (e.g., raw beef ribeye steak vs. dried borlotti beans), beverages (e.g., cow milk vs. soy milk), finger food (e.g., roasted peanuts vs. salami), soup (e.g., chicken broth vs. vegetable soup), snacks (e.g., Greek yogurt vs. seeds and cereal bars), canned food (e.g., tuna in oil vs. peanut butter), and patties (e.g., chicken and pork meatballs vs. soybeans balls). Other than the protein quantity, also the brightness of the photos was controlled, along with the food presentation (such that it would be a familiar one), dish orientation, distance from the camera, and the plate type. Fifteen pairs of animal and plant foods were established for a total of thirty stimuli (Supplementary Materials, Table S1).

30 photos were selected to create fifteen animal- and plant-based food pairs. All stimuli were photographed using a Nikon D3200 Reflex camera in a consistent setting featuring a white background. The setup was created using a professional portable photographic box measuring 60 cm × 60 cm × 60 cm. The ISO, aperture, and lens aperture were kept constant. Each stimulus was photographed from a fixed distance, measuring 45 cm in height and 35 cm in length, except for those cases in which a portrait orientation was needed. Furthermore, all stimuli had a resolution of approximately 3008 pixels wide and 2000 pixels high or vice versa. Custom labels were crafted for all products presented with the original packaging (i.e., cow milk, soy milk, and Greek yogurt). These labels were designed to mirror the main graphic elements of their counterparts in stores, ensuring compliance with the brands' copyright for the photographed products.

2.2. Validation of the photographic archive

The 30 food images from animal and plant sources were validated by asking a sample of 112 volunteers to evaluate the stimuli for familiarity, frequency of consumption, palatability, and perceived healthiness through an ad-hoc survey created with the Qualtrics Platform.

2.2.1. Participants

This research (all the phases of the AttiFood development and application) involved Italian volunteers aged between 18 and 45 years who followed omnivorous or flexitarian diets. Indeed, it was designed for Italian speakers only as most of the photographed stimuli represent typical dishes from Mediterranean cuisine. The sample's age range was kept narrow to guarantee adequate homogeneity in the behavioral performance of the IAT. Since participants were asked to assess both animal-based and plant-based foods across the four scales of familiarity, palatability, healthiness, and frequency of consumption, pescatarians, vegetarians, and vegan participants were excluded. For instance, pescatarians avoid meat, vegetarians avoid meat and fish but include eggs, milk, and dairy, while vegans exclude all of them. Therefore, only individuals who ate all the categories were included in the final sample of the two studies.

The sample for image validation comprised 112 Italian individuals with a mean age of 31.30 (SD = 6.19). Women were 61 (54.50 %). Almost one-third of participants earned a Master's degree (34.80 %).

The research was evaluated and approved by the local commission for minimal-risk studies of the Psychology Department of the University of Milan-Bicocca (protocol code: RM-2023-719).

2.2.2. Materials and procedure

Participants were recruited through snowball sampling. They received no financial incentives for participation. The questionnaire was created on the Qualtrics Platform and distributed via social networks (WhatsApp, Telegram, Facebook, LinkedIn) for online completion in January 2024. After providing informed consent, participants evaluated pictures randomly four times, assessing familiarity, frequency of consumption, palatability, and perceived healthiness, with a randomized order for both scales and pictures. Demographic information was also collected. The average time to complete this phase was 20 min.

2.2.2.1. Scales. Participants were asked to evaluate all the stimuli in terms of **familiarity**, which is defined as the ease with which they recognize the food stimulus based on their experience. The distinction between this scale and the frequency one was clarified, ensuring participants understood that they were not being asked how often they consumed the stimulus but how familiar it was to them. The familiarity was assessed via a 5-point Likert scale from 1: 'Not at all' to 5: 'Very much'. Also, participants were asked how often they usually consumed the food stimulus - **frequency**. The assessment focused on determining the extent to which the presented meal was a regular part of their diet, regardless of seasonal variations. A 5-point Likert scale was used to assess the frequency from 1: 'Never (it is not part of my diet)' to 5: 'Very often (it is part of my usual diet)'. Moreover, participants were asked to rate the meal's taste according to their personal palate preferences - **palatability**. Their responses were recorded using a 5-point Likert scale from 1: 'Not at all' to 5: 'Very much'. Finally, Responses regarding the perceived **healthiness** of the meal were recorded using a 5-point Likert scale ranging from 1: 'Not at all' to 5: 'Very much.'

2.2.2.2. Demographics and dietary habits. A 4-question section was provided covering age, gender, and education. Furthermore, participants were asked about their dietary preferences. They had to select from 9 multi-choice options, choosing the one that best represented their usual eating habits. The options included: 'I regularly eat red meat, white meat, and fish,' representing an omnivorous dietary pattern, 'I

consciously reduce the meat consumption, but still eat it occasionally,' 'I do not eat red meat, but I do eat white meat and fish,' 'I do not eat meat, but I do eat fish,' 'I eat organically grown, locally sourced foods, with a significant overlap with foods consumed in a vegetarian diet, but also some types of meat,' which all together indicated a flexitarian dietary pattern. Additionally, options such as 'I do not eat meat nor fish, but I do eat eggs and dairy,' 'I do not eat meat, fish, and eggs, but I do eat dairy,' 'I do not eat meat, fish, and dairy, but I do eat eggs' corresponded to a vegetarian diet. Finally, 'I do not eat meat and fish, nor do I consume animal source products' represented veganism (taken and modified from De Backer & Hudders, 2015). As mentioned above, pescatarians, vegetarians, and vegan participants were excluded.

2.2.3. Statistical analysis

In all the research phases, analyses were performed using Jamovi (Version 2.3.28, The Jamovi project, 2022, retrieved from <https://www.jamovi.org>) and IBM SPSS Statistics, version 29 (SPSS, Chicago, IL, USA). Descriptive statistics were calculated for all the variables. Mean and standard deviation (SD) were reported for continuous variables, and percentages were reported for categorical variables. The normal distribution of the data was tested by calculating skewness and kurtosis indices; the recommended range of ± 2 and ± 7 was considered for normality, respectively (West et al., 1995).

To determine the eight pairs of food images for the IAT, the average values of familiarity, consumption frequency, palatability, and healthiness for the animal-based and plant-based stimuli were compared within each pair. The matches in which the animal-based food and its plant-based counterpart exhibited the most similar means were identified for each scale. Then, the mean scores obtained from food stimuli in each category (animal and plant-based protein) were calculated for each of the four scales.

Finally, independent sample *t*-tests were performed to evaluate the differences in familiarity, consumption frequency, palatability, and healthiness between animal-based and plant-based stimuli. Assumption checks were performed before each *t*-test by evaluating skewness and kurtosis to check the normal distribution of the variables and Levene's test to check the variances' homogeneity. Based on the results of the assumption checks, *t*-tests were performed using Welch's Test (for normal distribution and unequal variances) or Student's Test (for normal distribution and equal variances).

2.2.4. Results

Descriptive statistics of the scales used to validate the 30 food images are reported in the Supplementary Materials (Table S2). All images and their scores for familiarity, frequency of consumption, palatability, and perceived healthiness are free to download in the Supplementary Materials.

The eight animal- and plant-based food images pairs with the most closely aligned mean across all four scales were selected (Fig. 1 and Table 1). These pairs represent the final set of target stimuli for the IAT.

Then, the mean scores obtained from food stimuli in each category (animal and plant-based protein) were calculated for each of the four scales. Levene's tests were not significant ($p > 0.05$); therefore, Student's *t*-tests were performed. The tests revealed that the means of the animal protein category and plant-based protein category were not statistically different in any of the four scales.

2.3. Design and testing of the IAT

To identify automatic associations between plant-based protein food, animal-based protein food, and positive or negative attributes, an adapted version of the Implicit Association Test (IAT, Greenwald et al., 1998, 2003) was designed. Participants were prompted to associate eight couples of adjectives with positive vs. negative valence, with the eight couples of pictures representing plant-based vs. animal-based dishes (Fig. 2). All adjectives were extrapolated from a previous



Fig. 1. Examples of two paired animal and plant-based protein dishes: rice with ragù vs. whole emmer with vegetables (A), and caciotta cheese vs. almonds (B).

Table 1

Descriptive statistics of the target stimuli for the IAT.

Stimulus	Code	Protein quantity (g)/100 g	Familiarity		Consumption Frequency		Palatability		Healthiness	
			Mean	SD	Mean	SD	Mean	SD	Mean	SD
Polenta with ragù	PA1	4.6	3.83	1.18	2.96	1.1	3.88	1.08	2.67	0.85
Pasta with beans	PV1	4.9	3.96	1.09	3.17	1.19	3.67	1.12	3.38	0.92
Ricotta cheese	PA2	8.8	3.75	1.28	3.1	1.16	3.37	1.15	3.14	0.89
Hummus	PV2	6.2	3.65	1.31	2.79	1.35	3.39	1.26	3.81	0.92
Boiled eggs	PA8	12.4	4.48	0.84	3.88	1	3.5	1.07	3.65	0.87
Walnuts	PV8	10.5	4.27	1.02	3.15	1.18	3.33	1.08	3.85	0.88
Fresh shrimps	PA10	13.6	4.27	1	3.14	1.1	3.88	1.12	3.39	0.89
Hazelnuts	PV10	13.8	3.94	1.2	2.83	1.26	3.27	1.07	3.57	1.02
Lamb ribs	PA11	22.7	3.81	1.19	2.69	1.12	3.28	1.26	2.65	0.88
Green peas soup with bread	PV11	17.8 [9.7 (peas) + 8.1 (bread)]	3.48	1.26	2.75	1.18	2.96	1.05	4.05	0.77
Rice with ragù	PA12	6.7	3.5	1.22	2.92	1.23	3.32	1.01	3.11	0.74
Whole emmer with vegetables	PV12	6.2	3.68	1.26	3.12	1.28	3.31	1.18	4.21	0.81
Meatballs (chicken and pork)	PA14	15	3.01	1.19	2.46	1.12	3.02	1.14	2.54	0.83
Soybeans balls	PV14	16.2	3.11	1.18	2.67	1.16	3.36	1.02	3.01	0.92
Greek yogurt	PA15	9	3.96	1.32	2.84	1.38	2.9	1.23	3.72	0.92
Seeds and cereal bars	PV15	11	3.44	1.3	2.18	1.13	2.78	1.15	2.83	0.9

qualitative study investigating attitudes toward PBPf through focus groups (Vanutelli et al., 2025). The adjectives were: ‘Bad’ vs. ‘Good’, ‘Inferior’ vs. ‘Superior’, ‘Negative’ vs. ‘Positive’, ‘Tasteless’ vs. ‘Tasty’, ‘Isolated’ vs. ‘Convivial’, ‘Deficient’ vs. ‘Satisfying’, ‘Hard’ vs. ‘Easy’, and ‘Looser’ vs. ‘Winner’. The stimuli for the two target food categories were described in paragraph 2.2.4.

The IAT structure comprises seven blocks, each with its corresponding classification labels and trial counts, as summarized in Table 2.

The underlying assumption was that individuals harboring numerous biases against plant-based protein food would find it easier (i.e., exhibit lower response times) to associate the plant-based category with negative attributes than with positive attributes. The strength of automatic association between food categories and positive or negative attributes was quantified by the D-index, which is a score derived from the standardized mean difference in response times between target-attribute pairings that are ‘inconsistent with the hypothesis’ and pairings that are ‘consistent with the hypothesis’. In the present study, response times and errors were treated following the guidelines for the improved D-index scoring algorithm (Greenwald et al., 2003) and they were

automatically calculated through an open-source web app designed for Qualtrics (Cui et al., 2021; Jungnickel et al., 2022).

The D-index value typically ranges from -1 to $+1$. A higher D-index (more positive) indicated a stronger association between pairings ‘consistent with the hypothesis’ (in the present study, the association between animal-based protein food and positive attributes). Conversely, a negative D-index suggested a stronger association between pairings ‘inconsistent with the hypothesis’ (in the present study, the association between PBPf and positive attributes). A D-index equal to zero indicated the absence of a significant preference for either food category. Errors were managed by requesting participants to correct their responses. A pilot study was conducted to test the design of the IAT.

2.3.1. Participants

To ascertain the task’s effective implementation on Qualtrics and to ensure it was user-friendly for participants, we administered it to a pilot sample. This approach allowed us to gather feedback and consider any modifications to the protocol. The sample comprised 72 Italian individuals with a mean age of 27.60 (SD = 5.97); 37 respondents were



Fig. 2. An example from the IAT protocol of AttiFood.

Table 2
IAT structure.

Block	N of trials	Function	Concept categories	Left key response	Right key response
1	20	Practice	Target	Plant	Animal
2	20	Practice	Attribute	Positive	Negative
3	20	Practice	Target & Attribute	Plant & Positive	Animal & Negative
4	40	Critical	Target & Attribute	Plant & Positive	Animal & Negative
5	20	Practice	Attribute	Negative	Positive
6	20	Practice	Target & Attribute	Plant & Negative	Animal & Positive
7	40	Critical	Target & Attribute	Plant & Negative	Animal & Positive

Note. The protocol includes four counterbalanced conditions to mitigate potential order effects related to category labels. In summary, if a participant follows the pattern outlined in the table, subsequent participants will respond to the target category “plant-based protein” or the positive attributes using the right-key button.

women (51.40 %). Most participants earned a high school degree (33.30 %) or a Bachelor’s degree (29.20 %). The majority of the sample was employed (63.90 %). Most participants followed an omnivorous diet (79.20 %); only 20.80 % followed a flexitarian diet. Most respondents completed the questionnaire on their smartphones (83.30 %); the remaining 16.70 % on their pc.

2.3.2. Materials and procedure

Participants were recruited through snowball sampling. A questionnaire was created on the Qualtrics Platform and distributed via social networks (WhatsApp, Telegram, Facebook, and LinkedIn) for online completion in March 2024. Participants signed informed consent and reported their age, gender, education level, working status, and dietary preferences. The IAT was administered using an open-source web app for Qualtrics (Cui et al., 2021; Jungnickel et al., 2022). The Qualtrics questionnaire, including the IAT, was optimized for smartphone use.

2.3.3. Statistical analysis

Descriptive statistics were calculated on the sample’s sociodemographic characteristics and the D-index of the IAT.

2.3.4. Results

The mean D-Index was -0.07 ($SD = 0.52$). As outlined in the procedure section, a positive D-Index indicated a stronger association

between positive attributes and animal-based protein food. In contrast, a negative D-Index indicated a stronger association between positive attributes and plant-based protein food. The results indicated that participants did not show a clear attitude for either of the two food categories. The mean accuracy rate was high (92.2 %), indicating that most respondents were able to complete the task with ease (Table 3).

3. Application of AttiFood: Exploring how current behavior, attitudes, and intentions intertwine

3.1. Methods

3.1.1. Participants

Participants were recruited through the Bilendi online platform (<https://www.bilendi.it>). Bilendi srl is a panel provider offering innovative solutions for the collection and management of quantitative and qualitative research data, operating in Europe and the USA. It provided financial incentives for participation. Initially, 327 potential participants expressed interest; however, 27 individuals did not complete the survey, and 20 other participants provided less than 70 % correct responses on the IAT. As a result, the final sample consisted of 280 Italian participants, 145 women (51.80 %). They had a mean age of 31.50 ($SD = 7.77$). Almost half of the participants earned a high school degree (48.90 %). The majority of the sample was employed (82.60 %). Most participants followed an omnivorous diet (92.10 %); only 7.90 % followed a flexitarian diet. Most respondents completed the questionnaire on their smartphones (64.20 %); the remaining 35.80 % on their pc.

The sample size adequacy was established using power analysis (Cohen, 2013) with G*Power Version 3.1.9.7 (Faul et al., 2007). We calculated the sample sizes required for each analysis outlined in the study. Below, we report the sample size calculation for the test that

Table 3
Descriptive statistics of the D-Index and Accuracy.

	D-Index	Accuracy (%)
Numerosity	72	72
Mean	-0.07	92.20
Standard Deviation	0.52	6.34
Minimum	-1.33	61.70
Maximum	0.86	100.00
Skewness	-0.31	-2.78
Standard Error skewness	0.28	0.28
Kurtosis	-0.31	11.20
Standard Error kurtosis	0.56	0.56

necessitated the largest sample, namely independent-sample *t*-test with the following parameters: two tails, $d = 0.50$ (medium effect size), $\alpha = 0.05$, power = 0.95. The sample size calculated was 210 individuals. Based on these considerations, the study's sample size was sufficient to detect medium-sized effects. To further check the statistical power, we computed the achieved power, given α , sample size, and effect size of the resulting model using the same software.

3.1.2. Materials and procedure

The Qualtrics questionnaire was accessible online via mobile phone or computer in July 2024.

The first section included information about the study's aims and procedures. Next, participants were required to sign informed consent and declare sociodemographic information (see paragraph 2.2.2).

The dietary habits were then examined using the Questionnaire to measure Mediterranean diet (QueMD, Gnagnarella et al., 2018). It is a validated 15-item questionnaire to measure respondents' adherence to the Mediterranean Diet (MD). The questionnaire includes questions regarding the nine food items usually considered as key components of the Mediterranean Diet (wholegrain cereals, raw or cooked vegetables, legumes, fresh fruits, dried fruits, red or processed meat, fish, wine, and olive oil), as well as other commonly consumed items (white meat, dairy products, carbonated beverages or soft drinks, butter, cooking cream or margarine, manufactured sweets, or pastries). Respondents indicate how frequently they consume each item using a five-point scale that ranges from "never" to "often." Daily consumption is considered for whole grains, vegetables, fruits, dairy products, olive oil, butter, and wine, while weekly consumption is set for meat, soft drinks, sweets, fish, nuts, and legumes. The alternate Mediterranean Diet Score (aMed) is calculated according to the guidelines provided by Gnagnarella et al. (2018) by assigning 1 point to respondents reporting food consumption above the Italian National levels for each of the following items typical of the Mediterranean Diet: wholegrain products (≥ 1 /day), vegetables (≥ 2 /day), fresh fruits (≥ 2 /day), olive oil (≥ 3 /day), wine (maximum 1–2 glasses/day for males or 1 glass/day for females), red meat (≤ 1 to 3/week), fish (≥ 2 /week), dried fruits (≥ 2 /week), legumes (≥ 2 /day). The sum score ranged between 0 (minimum MD adherence) and 9 (maximum MD adherence); it can be dichotomized to define cases of low (aMed < 5) and high (aMed > 4) adherence to MD.

The final part of the online questionnaire assessed three outcome measures:

- Automatic attitudes (IAT) toward animal- and plant-based protein food (PBPF)
- Explicit attitudes toward animal- and PBPF
- Intention to increase plant-based protein consumption

The IAT was the first outcome. Its design and implementation have been extensively described before. Explicit attitudes toward animal- and plant-based protein food were the second outcome. These variables were measured by asking participants to think about protein food (one item referred to plant-based and one to animal-based) and evaluate it on a 7-point Likert scale using eight pairs of adjectives within a semantic differential scale (adapted from Maggino & Mola, 2007). The adjectives used were the same as the IAT. In order to pursue the aims of the study, the mean score across responses to all adjectives was calculated to obtain a synthetic index representing the mean explicit attitude toward animal- and plant-based protein food. A higher score indicated a more positive attitude. The two scores showed good internal consistency (Cronbach's $\alpha = 0.90$). The intention to increase plant-based protein consumption was the third outcome. A specifically designed item inquired participants about their intention to increase consumption of PBPF on a 5-point Likert scale from 1: 'Absolutely not' to 5: 'Absolutely yes'. The choice to use a single item to assess intention is justified by previous research defining it as a highly pragmatic measure and effective in predicting implementation (Fishman et al., 2020).

3.1.3. Statistical analysis

A one-sample *t*-test was performed to ascertain if the distribution of the D-Index was significantly different from 0.

Paired-sample *t*-tests were used to compare explicit attitude items referring to animal- vs plant-based protein foods.

Independent sample *t*-tests were performed to evaluate the differences in the outcome measures in function of gender and education.

A Pearson's correlation matrix was produced to control for any association between age and the outcome measures and to explore the associations between the aMed index, animal- and plant-based protein food consumption and the three outcome variables. According to Cohen's guidelines (Cohen, 2013), correlations were identified as effect size measures. They were interpreted as weak ($|0.10| < r < |0.29|$), moderate ($|0.30| < r < |0.49|$), or strong ($|0.50| < r < |1|$).

Finally, a multiple linear regression model was performed to evaluate the simultaneous impact of the relevant variables on the intention to increase PBPF consumption. Adjusted R^2 and F-test values were calculated to assess explained variance and model fit.

3.2. Results

3.2.1. Description of the outcomes and their associations with sociodemographic variables and dietary habits

3.2.1.1. Automatic attitudes toward animal- and plant-based protein food.

The mean D-index was 0.09 (SD = 0.65). The participants displayed a slightly more favorable automatic attitude toward animal- than plant-based protein food (Fig. 3). The one-sample *t*-test confirmed that the mean D-index was significantly greater than 0 [$t(279) = 2.30$; $p = 0.011$; Cohen's $d = 0.14$; achieved power = 0.76].

Men exhibited a more favorable automatic attitude toward animal-based protein food (Mean = 0.21; SD = 0.65) than women (Mean = -0.02 ; SD = 0.63) [$t(278) = 3.02$; $p = 0.003$; Cohen's $d = 0.36$; achieved power = 0.85]. The D-index value was not associated with either age [$r(278) = 0.01$; $p > 0.05$] or education [$r(278) = 0.16$; $p > 0.05$].

Nearly half of the participants (39.60 %) stated that their eating habits generally aligned with the Mediterranean Diet (aMed > 4), while 60.40 % did not follow the Mediterranean Diet (aMed < 5).

The D-index value was negatively associated with the aMed [$r(278) = -0.15$; $p = 0.015$; achieved power = 0.71]: participants less adherent to the Mediterranean Diet exhibited a slightly more favorable automatic attitude toward animal-based protein food.

3.2.1.2. Explicit attitudes toward animal- and plant-based protein food.

Overall, participants expressed a mean positive attitude toward PBPF (Mean = 5.04; SD = 1.12). Considering the single items of the scale (Table 4), participants showed a particularly favorable attitude when PBPF was assessed on a scale from bad to good, followed by the negative vs. positive scale. The least favorable attitude was recorded on the isolated vs. convivial scale. Paired sample *t*-tests suggested that the differences between plant-based vs. animal-based protein food attitudes were significant when food was assessed on a scale from negative vs. positive [$t(279) = 5.07$; $p < 0.001$; Cohen's $d = 0.30$; achieved power = 0.99], tasteless vs. tasty [$t(279) = -4.71$; $p < 0.001$; Cohen's $d = -0.28$; achieved power = 0.99], isolated vs. convivial [$t(279) = -5.01$; $p < 0.001$; Cohen's $d = -0.26$; achieved power = 0.99], deficient vs. satisfying [$t(279) = -4.27$; $p < 0.001$; Cohen's $d = 0.30$; achieved power = 0.99]. Plant-based protein food was judged as more positive than animal-based protein food; animal-based protein food was judged as more tasty, convivial, and satisfying than plant-based protein food (Table 4).

The mean explicit attitude toward PBPF was not associated with either gender [$t(278) = -0.47$; $p > 0.05$], age [$r(278) = 0.02$; $p > 0.05$], or education [$t(278) = 0.36$; $p > 0.05$].

It was positively associated with the aMed [$r(278) = 0.27$; $p < 0.001$;

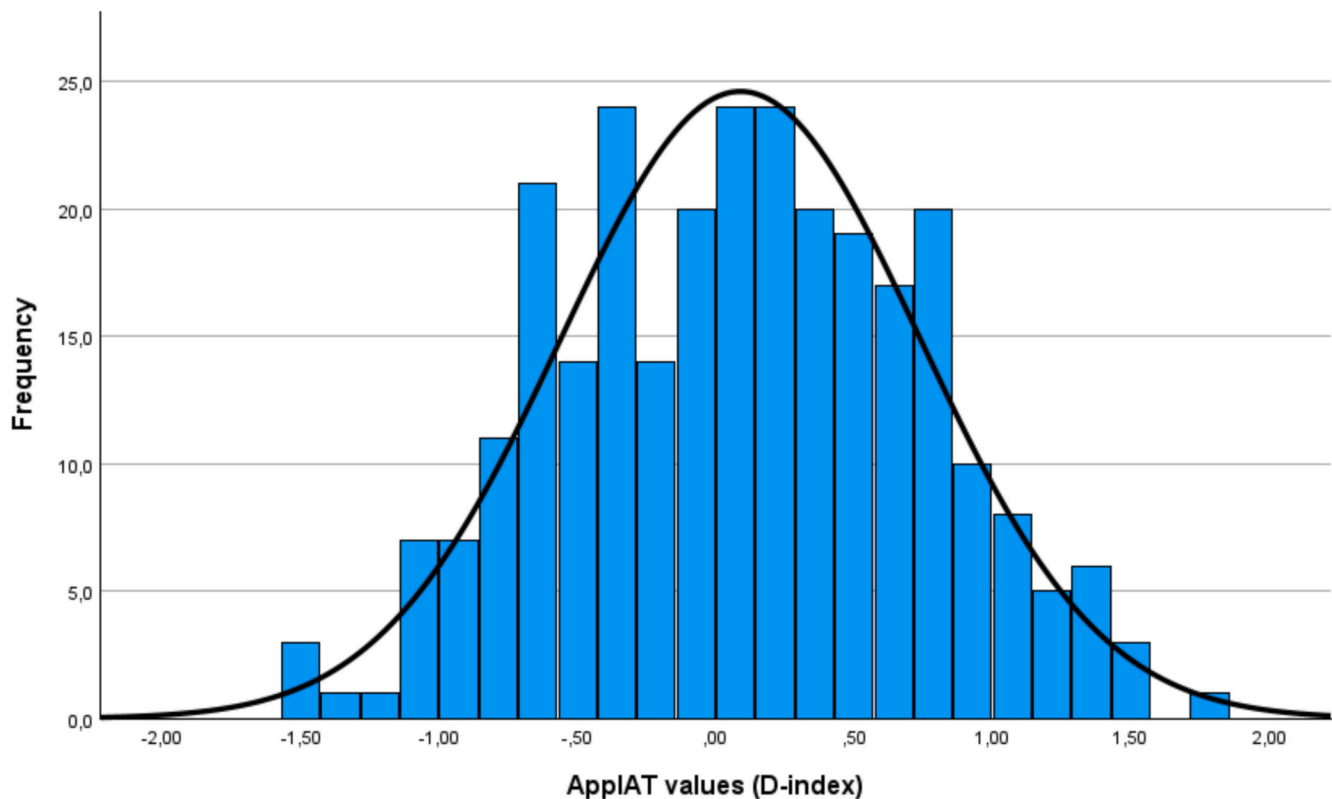


Fig. 3. Distribution of the D-Index. 56 % of the sample displayed a positive D-index.

Table 4
Descriptive statistics of explicit attitudes and results of the paired sample t-tests.

	Plant-based protein		Animal-based protein		P value
	Mean	SD	Mean	SD	
(1) Bad ... Good (7)	5.50	1.44	5.36	1.45	$p > 0.05$
(1) Inferior ... Superior (7)	4.90	1.29	4.95	1.37	$p > 0.05$
(1) Negative ... Positive (7)	5.33	1.41	4.79	1.47	$p < 0.001$
(1) Tasteless ... Tasty (7)	4.91	1.57	5.45	1.46	$p < 0.001$
(1) Isolated ... Convivial (7)	4.72	1.42	5.28	1.44	$p < 0.001$
(1) Deficient ... Satisfying (7)	4.89	1.52	5.35	1.38	$p < 0.001$
(1) Hard ... Easy (7)	5.05	1.44	4.93	1.44	$p > 0.05$
(1) Loser ... Winner (7)	5.03	1.42	4.85	1.35	$p > 0.05$
Mean score	5.04	1.12	5.12	1.10	$p > 0.05$

Note. Participants answered the following on a scale from 1 to 7: “Think about plant-based protein foods (pasta or rice, especially whole grains, legumes, nuts, and seeds). What are the most appropriate adjectives to describe it?” “Now think about animal-based protein foods (meat, fish, eggs, dairy products). What are the most appropriate adjectives to describe it?”

achieved power = 0.99]; participants more adherent to the Mediterranean Diet were more favorable toward PBPF.

3.2.1.3. *Intention to increase plant-based protein consumption.* Descriptive statistics indicated that participants generally intended to increase their consumption of PBPF (Mean = 3.43; SD = 0.98; range: 1–5).

This variable was not associated with either gender [$t(278) = 0.14$; $p > 0.05$], age [$r(278) = -0.04$; $p > 0.05$] or education [$t(278) = -1.48$; $p > 0.05$].

It was positively associated with the aMed [$r(278) = 0.28$; $p < 0.001$; achieved power = 0.99]; participants more adherent to the Mediterranean Diet were more inclined to increase plant-based protein consumption.

3.2.2. *Associations between current behavior, attitudes, and intention*

A correlation matrix was produced to explore the associations between the current behavior, automatic and explicit attitudes, and intention to increase plant-based protein food consumption in the future. All variables were significantly associated (Table 5).

A multiple linear regression model was performed to evaluate the simultaneous association of the relevant variables on the intention to increase plant-based protein consumption. It explained 11.70 % of the variance and estimated a medium effect size ($f^2 = 0.14$; achieved power = 0.99); a significant regression equation was found [$F(3, 276) = 13.30$, $p < 0.001$]. The analyses showed a significant simultaneous impact of the aMED (standardized $\beta = 0.29$, $p < 0.05$), automatic (standardized $\beta = -0.12$, $p < 0.05$), and explicit attitude (standardized $\beta = 0.24$, $p < 0.001$) on the intention to increase PBPF consumption (Table 6). Participants adhering more closely to the Mediterranean diet and displaying more favorable attitudes, both automatic and explicit, toward plant-based protein foods indicated a stronger intention to increase their consumption of these foods.

Table 5
Correlation coefficients (Pearson’s r) among the study’s variables.

	aMED	D-Index	Explicit Attitude
D-Index	-0.145*	-	-
Explicit Attitude	0.273***	-0.244***	-
Intention	0.280***	-0.193**	0.304***

Note. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Degrees of freedom = 278. aMED = Alternate Mediterranean Diet Score. D-Index = Automatic attitude. A positive D-index indicates a stronger association between animal-based protein foods and positive attributes; conversely, a negative D-index suggests a stronger association between plant-based protein foods and positive attributes. Explicit Attitude = Synthetic index representing the mean explicit attitude toward plant-based protein (range: 1–7). Intention = Intention to increase plant-based protein consumption.

Table 6

Multiple linear association of adherence to the Mediterranean Diet, automatic and explicit attitudes on the intention to increase plant-based protein consumption ($n = 280$).

Predictor	t-test	P value	Standardized β	95 % Confidence Interval	
				Lower	Upper
Intercept	8.55	<0.001			
aMED	2.43	0.016	0.288	0.055	0.521
D-Index	-2.04	0.042	-0.119	-0.233	-0.004
Explicit Attitude	4.06	<0.001	0.242	0.125	0.359

4. Discussion

The primary aim of this research was to develop and share AttiFood, a tool for investigating attitudes toward plant-based protein foods, focusing on broad food categories common in existing culinary cultures. AttiFood aims to stimulate discussion around the need to explore attitudes and promote the consumption of plant-based foods that (1) have a high protein content – thus not limited to fruits and vegetables – and (2) are part of traditional culinary practices, meaning they are not processed meat substitutes. We are confident that emphasizing these two aspects can encourage a healthy and sustainable diet by moving away from the concepts of deprivation (avoiding meat) or imitation (consuming direct meat substitutes) (Aiking & de Boer, 2020; Lonnie & Johnstone, 2020; Vanutelli et al., 2025). Additionally, this study aimed to demonstrate how AttiFood could identify individuals' automatic and explicit attitudes toward extended categories of animal and plant-based proteins and examine how these attitudes influence their intentions regarding future consumption.

As mentioned in the introduction, prior research has primarily focused on comparing red meat to vegetables (Carfora et al., 2020; Çoker & van der Linden, 2022; de Gavelle et al., 2019; Seffen & Dohle, 2023), specific categories of food without highlighting protein content (Chen et al., 2024; Dorina et al., 2025; Pandey et al., 2021; Schiano et al., 2022; Winkelmaier & Jansen, 2024), or plant-based meat substitutes (Segovia et al., 2023). The novelty of this study consisted of comparing dishes of animal and plant origin that contained equivalent protein amounts and were matched for familiarity and palatability, all within the current culinary culture. By sharing AttiFood with the scientific community through this manuscript, we aim to promote best practices in research on plant-based protein foods and foster further advancements in this important field.

4.1. AttiFood: Picture archive, IAT for assessing automatic attitudes and stimuli for evaluating explicit attitudes

The development study of AttiFood enabled the creation of an archive of 30 images. They were balanced based on photographic, visual, and protein content and assessed for familiarity, consumption frequency, palatability, and perceived healthiness. Since each image is defined by an average score for all these parameters, the archive represents a valuable and novel tool for other researchers. Also, it includes food types beyond the typical focus on (red) meat vs. vegetables (Carfora et al., 2020; Çoker & van der Linden, 2022; de Gavelle et al., 2019; Rees et al., 2018). The careful selection of a set of balanced target images (taken from the archive) and a set of adjectives chosen based on the results of a previous qualitative study (Vanutelli et al., 2025) allowed the design of a tailored IAT.

In other studies, different methodological choices have been made with respect to both stimuli and adjectives. Regarding the stimuli selection, Clicerì et al. (2018) drew from an open-source database and applied four main selection criteria: expected taste, aesthetic appeal, perceived difficulty of preparation, and evaluation of the dish as plant-based, dairy-based, or meat-based. In our case, we opted to control for

these additional factors (perceived healthiness, familiarity, and frequency of consumption) as they could potentially influence the results. In particular, the dimensions of familiarity and frequency were intended to ensure an adequate and balanced knowledge of the presented foods, and to exclude plant-based products that were less known or difficult to obtain. For this reason, we also opted to create our database from scratch in order to better capture the variety and typicality of Italian cuisine. Another point of attention concerned verifying that plant-based products were not perceived as healthy but less appetizing than their animal-based counterparts, since this is a recurring theme from consumers' perspective (Rosenfeld et al., 2024).

With regard to attributes, previous research opted for using either more general/abstract adjectives (Winkelmaier & Jansen, 2024), or food-related adjectives (Schiano et al., 2022), as in our methodology. In other cases (Segovia et al., 2023), two parallel versions were created, with adjectives related either to health aspects or to sustainability aspects. This choice was made because the study included an intervention aimed at modifying behaviors, seeking to identify the specificities of the two domains. We argue that the strength of our approach lies in the use of adjectives directly derived from a qualitative investigation (Vanutelli et al., 2025), employing the same food categories and thus pre-identifying the crucial nodes around which choices could be polarized. However, future developments could distinguish the effects on implicit attitudes with respect to different and more specific adjective pairs, depending on the research objectives. Also, a direct comparison of the two approaches should be conducted to highlight strengths and weaknesses of the methodological choices.

We believe that the operational steps of this research—including the creation and validation of ad hoc images, the selection of specific adjectives to serve as attributes in the IAT, and their use in a semantic differential scale for detecting explicit attitudes—can function both as a methodological model for developing similar protocols and as practical tools for direct application in studies focused on plant-based food.

4.2. What participants say about plant-based protein food

Analyzing the results of the AttiFood application study, a significant premise is that less than half of the participants sufficiently adhered to the Mediterranean Diet. This trend is in line with previous Italian studies that revealed an overall high intake of meat parallel to a low intake of vegetables, fruit, and legumes (Dinu et al., 2021; Vitale et al., 2021). The present study reinforces the idea that many dietary choices among the Italian population need adjustment to align with the recommended guidelines for a healthy and sustainable diet (Willett et al., 2019).

Participants in the AttiFood application study generally expressed a positive explicit attitude toward PBPF. Additionally, the mean score for PBPF was similar to that of animal-based food. This favorable attitude toward plant-based proteins suggests, albeit indirectly, that the exposure to the selected food categories in AttiFood, designed to make plant-based foods as familiar as animal-based ones, did not create a strong preference for animal-based protein sources.

However, while PBPF was perceived as more *positive* than its animal counterpart, the latter was regarded as more *tasty*, *convivial*, and *satisfying*. These findings align with our earlier qualitative study (Vanutelli et al., 2025). In that study, omnivorous participants described plant-based protein food using positive adjectives such as *nutritious* and *healthy*, nevertheless mentioning the perceived relinquishment of taste and specific flavors. Participants expressed the challenge of giving up meat. They acknowledged that adopting a plant-based diet presents several social challenges, particularly given that dining is often viewed as a time for conviviality and sharing in Italian culture. Similarly, a study by Rosenfeld et al. (2024) explored attitudes toward vegan and plant-based foods, revealing that omnivores tended to have low expectations about the tastiness of vegan options. Furthermore, Lea and Worsley (2003) demonstrated that meat consumption can be associated with feelings of attachment and hedonic pleasure. Moreover, previous

research highlighted how adopting a plant-based diet can expose one to social stigma and, thus, isolation (Markowski & Roxburgh, 2019).

4.3. What participants leave unsaid: Automatic attitudes toward animal/plant-based dishes

The D-index obtained in the IAT was positive, indicating a preference for animal-based protein food, but close to zero, suggesting that the preference was not substantial. This result should be regarded as being in contrast with the majority of the existing literature. For example, in their study including a direct comparison between vegetables and meat, Ciceri et al. (2018) found that participants responded more rapidly when category pairings grouped vegetables with positive emotions and meat with negative emotions. Similarly, Winkelmaier and Jansen (2024), when comparing plant-based dishes with meat-based dishes, reported a strong pro-vegetarian food bias. Their dataset, however, included a wide variety of food categories, such as pasta, soups, and salads. These examples, like the previous study, involve foods that do not constitute a direct nutritional counterpart to meat. Vegetables are often consumed as side dishes accompanying meat, but they do not implicitly require giving something up. In contrast, in our case, the meals can represent a complete alternative, based on the premise that a more plant-based diet might be promoted in the future. Supporting this hypothesis, another study reported findings more consistent with ours, showing a preference for the traditional option. Specifically, Schiano et al. (2022) compared traditional and plant-based milk. Their data revealed that more than 70 % of participants exhibited a strong (34.4 %), moderate (22.7 %), or slight (16.3 %) preference for dairy milk. It is therefore possible that when participants are presented with direct substitutes of familiar products, feelings of sacrifice may emerge — a phenomenon often described in the literature when considering a potential switch toward a more plant-based diet (Lea & Worsley, 2003; Rosenfeld et al., 2024). Although our results also indicate a slight preference for the traditional counterpart, the mean d-index is not as markedly biased as in the case of milk.

This result may be attributed to the methodological choice of presenting plant-based protein options that were equally familiar and palatable as their animal-based counterparts while avoiding images of less familiar vegan protein food (like tofu or seitan) or meat alternatives (like vegan burgers, sausages, and alternative to cheese).

Again, although indirectly, this finding insinuates that there might be just a slight resistance to plant-based protein foods when they are rooted in culinary traditions and perceived as familiar and tasty. It supports the idea that promoting familiar and tasty plant-based protein foods, like those featured in AttiFood, could be an effective strategy for promoting a transition from meat-heavy to more plant-rich, flexitarian diets able to foster human health while respecting planetary boundaries (Aiking & de Boer, 2020; Loken, 2020; Tilman & Clark, 2014; Vitale et al., 2021; Willett et al., 2019). This approach overcomes the common practice of demonizing animal-based protein sources or conveying a message of deprivation (Aiking & de Boer, 2020; Lonnie & Johnstone, 2020).

4.4. Measures gaps and intersections: A launchpad for future investigations

This study adopted a combination of different measures that in some cases align while in others emphasize different aspects. A first point concerns the discrepancy between the evaluations expressed by the participants in the AttiFood design phase—which allowed for the selection of dish pairs precisely based on perceived taste similarity—and the explicit attitudes reported by participants in the AttiFood application study, which instead indicated plant-based protein dishes as less tasty than their animal-based counterparts. This discrepancy is likely due to the type of stimuli presented for evaluation. In the design phase, participants were shown picture stimuli depicting concrete examples of

healthy and traditional dishes. In contrast, in the application study, participants were asked to express their evaluations using semantic differential scales referring to more abstract food categories, such as grains, legumes, nuts, and seeds. In this second case, participants had to rely on their mental representations. Explicit attitudes are known to be more strongly influenced by social and cultural factors (Fazio & Olson, 2003; Rudman, 2004). Given the widespread belief that plant-based products are less tasty (Rosenfeld et al., 2024), participants may have conformed to prevailing social norms. This aspect is particularly relevant when considering the potential impact of the stimuli presented to the public and potential consumers. Overall, the AttiFood findings suggest that providing concrete examples that contextualize and guide choices may be an effective strategy.

A second point concerns the different types of measures—explicit and automatic—used in the application study. These measures pointed in the same general direction, indicating a slight preference for animal-based products. The D-index was significantly different from zero, though only slightly positive. Explicit attitudes were generally favorable toward both food categories, but more frequently favored animal-based products for taste, satisfaction, and conviviality. Taken together, explicit and automatic measures align, indicating a consistent pattern of (slight) preference.

It is worth noting that distinct values have been collected for explicit attitudes, whereas just one general D-index has been computed, which likely encompasses multiple underlying aspects that remain to be explored in greater detail.

4.5. Intention to increase the consumption of plant-based protein food

Participants demonstrated sufficient openness to increase their consumption of PBPF, with a mean score of 3.43 (range: 1–5). This finding is more favorable than previous studies, which indicated that omnivorous participants were generally little inclined to alter their eating habits. It is worth noting that previous studies primarily focused on the intention to reduce meat consumption (Carfora et al., 2020; Çoker & van der Linden, 2022; de Gavelle et al., 2019; Seffen & Dohle, 2023).

The correlational analyses revealed an association between eating habits, automatic and explicit attitudes, and intentions to increase the consumption of PBPF. Participants who adhered more closely to the Mediterranean Diet and showed a more positive automatic attitude toward plant-based protein also exhibited more favorable explicit attitudes and expressed a greater intention to boost their consumption of these foods. These findings are consistent with prior research, which has shown that both explicit (Carfora et al., 2020; Çoker & van der Linden, 2022; de Gavelle et al., 2019; Seffen & Dohle, 2023) and automatic (Muschalik et al., 2020) attitudes are strong predictors of intentions to reduce meat consumption and to adopt a plant-based diet. The regression model showed that the intention to increase the consumption of PBPF was simultaneously associated with automatic and explicit attitudes toward these foods.

4.6. The role of sociodemographic variables

Among the sociodemographic variables, the unique significant association was between gender and automatic attitudes. Women demonstrated a more favorable automatic attitude toward PBPF than men. This finding aligns with previous studies indicating that women and men exhibit distinct dietary patterns, with women consuming more fruits and vegetables while men tend to eat more meat (Fantechi et al., 2024). Prior research also suggested that gender is a significant predictor of attitudes and intention, with women showing greater intention to decrease their meat intake (Seffen & Dohle, 2023) and being more open to vegetarianism (Keller & Siegrist, 2015; Love & Sulikowski, 2018). The interpretation of these results concerns conformity to traditional gender roles, mainly influenced by the relationship between meat and masculinity (Rosenfeld & Tomiyama, 2021). In the present

research, the association between gender and automatic attitudes, but not with explicit attitudes or intentions, could be attributed to the methodological choice of presenting the extended categories of animal- and plant-based protein foods, broadening the focus beyond meat vs. vegetables: although individuals - mainly men - may consciously recognize compelling arguments in favor of plant-based protein foods, their impulsive reactions to them might be still anchored to traditional gender roles that imply an association between meat and masculinity. Indeed, prior research suggests that automatic attitudes change more gradually over time than explicit attitudes (Wilson et al., 2000). As a final consideration, the emergence of gender differences exclusively in automatic attitudes highlights the importance of adopting an integrated approach that considers both explicit and automatic attitudes (Cliceri et al., 2018).

Previous studies have examined the impact of age on food choices (Andreoli et al., 2021; Pfeiler & Egloff, 2018). However, this research did not find a significant association between age and the outcome variables. This result is not surprising, considering the age range of the present sample was kept narrow to ensure homogeneity in behavioral performance. The young age of the sample is also justified by the evidence that younger segments of the population are more prone to meat consumption (Pfeiler & Egloff, 2018) and thus are more suitable targets for educational interventions toward healthier and more sustainable diets.

4.7. Study limitations

This study is not without limitations. The protocol focuses on typical Mediterranean dishes, making it ecologically relevant within the Italian cultural context. However, its generalizability may be limited in populations with diets that differ significantly from the Mediterranean one. Additionally, future developments could consider incorporating dishes that are not only balanced in protein content but also in other macronutrients, mainly carbohydrates and fats, as well as overall caloric intake. Lastly, the sample in this study does not accurately reflect the educational attainment of the broader Italian population. Approximately one-third of the participants (34.8 %) held a university degree, which aligns with the European Union average of 35.1 % but exceeds the 21.6 % observed in the Italian population (source: <https://www.istat.it/wp-content/uploads/2024/07/REPORT-livelli-istruzione.pdf>). Given the topic's significance, collecting data from a more representative sample would be valuable.

5. Conclusion

The current study introduced the AttiFood tool, which is now available to other scholars in the field. This tool, encompassing a comprehensive visual archive and tools for assessing automatic and explicit attitudes, could be a valuable model for future studies. This study also examined the impact of explicit and automatic attitudes on the intention to increase the consumption of PBPF. Overall, the results of this study suggest that researchers could effectively promote healthier and more sustainable diets by focusing on nutritious, healthy, and sustainable plant-based protein foods that are familiar and palatable. We are confident that promoting these alternatives to animal-based protein has the potential to inspire positive dietary changes and enhance acceptance among consumers.

CRedit authorship contribution statement

Roberta Adorni: Writing – review & editing, Writing – original draft, Software, Methodology, Investigation, Formal analysis, Conceptualization. **Maria Elide Vanutelli:** Writing – review & editing, Writing – original draft, Methodology, Investigation, Formal analysis, Conceptualization. **Arianna Mammano:** Writing – review & editing, Writing – original draft, Visualization, Investigation. **Viviana Carolina Cambieri:**

Writing – review & editing, Investigation. **Marco D'Addario:** Writing – review & editing, Supervision, Funding acquisition. **Patrizia Steca:** Writing – review & editing, Supervision, Funding acquisition.

Funding sources

Funder: Project funded under the National Recovery and Resilience Plan (NRRP), Mission 4 Component 2 Investment 1.3 - Call for tender No. 341 of 15 March 2022 of Italian Ministry of University and Research funded by the European Union – NextGenerationEU; **Award Number:** Project code PE00000003, Concession Decree No. 1550 of 11 October 2022 adopted by the Italian Ministry of University and Research, CUP D93C22000890001, Project title “ON Foods - Research and innovation network on food and nutrition Sustainability, Safety and Security – Working ON Foods”.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgments

None.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.foodqual.2025.105734>.

Data availability

Picture database attached and will be made freely available to everyone. Research database available upon request [AttiFood Database \(Original data\)](#) (Mendeley Data)

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