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Milk, mylk or drink: Do packaging cues affect consumers' understanding of plant-based products?

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ABSTRACT

The market growth of plant-based alternatives to animal food products pushes agencies around the world to discuss specific regulations regarding their communication, terminology, and packaging design. We created and tested 18 packages of plant-based milk and plant-based chicken meat varying the "animalness" of terminology, container, image, and claim. An online survey was answered by a sample of 600 US participants. The image (cow or soybean on milk; chicken or wheat on meat) had a significant effect on the expected origin (animal or vegetable) of the products, but terminology ("milk", "mylk" or "drink"; "chicken", "strips" or "seitan"), container (plastic jug or carton box; plastic tray or glass jar), sensory claim ("creamy" or "smooth" on milk) and nutritional claim ("no cholesterol" or "low sodium" on chicken) did not. We found significant effects of the type of container on the willingness to try the meat and of terminology on the willingness to try the milk. Finally, terminology and image significantly affected consumers' expectations for the sensory characteristics of the two products. These findings can help agencies effectively regulate terminology and packaging aspects of plant-based substitutes, as well as inform industries, scientists, and designers.

1. Introduction

1.1. Protein transition

Planet Earth's natural resources are under pressure like never before (Willett et al., 2019). Food production and consumption play a fundamental role in this scenario, as they are responsible for 60 % of the loss of terrestrial biodiversity, 70 % of freshwater consumption, and 19 % and 29 % of greenhouse gas emissions, respectively (Martin et al., 2021; United Nations, 2017). Animal husbandry consumes far more natural resources than agriculture, emits four times more greenhouse gasses and uses almost 80 % of arable land for grazing and growing grain for animal feed (Ritchie, 2019). Despite demanding more natural resources, only 18 % of the calories and 37 % of the proteins consumed by humans come from animal products (Poore & Nemecek, 2018). In addition, the excessive consumption of meat is also associated with an increased risk of mortality, cardiovascular disease, colorectal cancer, and type 2 diabetes (Martin et al., 2021).

Consumers, increasingly aware of the individual and collective consequences of their food choices, show a growing tendency to reduce, replace, and even eliminate animal products such as meat, milk, and eggs from their diets (Aschemann-Witzel et al., 2021). However, the transition to an increasingly plant-based diet, also known as the protein transition, is accompanied by several cultural, culinary, and sensory conflicts, as products of animal origin are part of most traditional food cultures (Onwezen, 2022). Consequently, one of the strategies that has emerged in recent decades to facilitate and encourage the reduced consumption of animal products is the development and popularization of plant-based products that mimic foods typically made with animal-derived ingredients, such as hamburgers, sausages, nuggets, milk, cheese, and yogurts.

The term "plant-based" has recently come into use to refer to a diet that avoids the consumption of animal products (Aschemann-Witzel et al., 2021), and to denote vegetable products that try to replace those usually made from animal ingredients. Other common names are analogs, alternatives, substitutes, and simulated or mock meat (Zhang et al., 2022). There is no consensus on what constitutes a plant-based product, since not all foods made exclusively from plants are normally called plant-based. The term is mainly used to name food products that mimic the appearance, texture, taste, use, functionality, and protein content of animal counterparts (e.g., Grasso et al., 2022; Martin et al., 2021). Interestingly, while plants can be rich in proteins and animal products

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can be rich in sugars and fats, imitating animal products, especially meats, appears to involve concentrating and modifying proteins (Good Food Institute, 2021; Onwezen, 2022; Rakuten, 2022).

Consumers already see plant substitutes as more sustainable, healthier, and more ethical (Aschemann-Witzel et al., 2021; Weinrich, 2018), although there are exceptions (Clegg et al., 2021). Either way, the availability and variety of high-quality meat substitute products is expected to increase in the coming years (Hartmann & Siegrist, 2020), as these strengths and advantages can overcome the main barriers, such as negative perceptions of taste, texture, artificiality, inconvenience, and price (Aschemann-Witzel et al., 2021). The number of people consuming plant-based products in the world has already doubled from 6.7 % in 2008–2011 to 13.1 % in 2017–2019, with the most popular products being plant-based milk and meat (Alae-Carew et al., 2022; Rakuten, 2022; Smart Protein, 2021). Reasons for consuming plant-based alternatives are health (48 %), animal welfare (34 %), trying trendy food (34 %), having a vegetarian diet (30 %), and environmental concerns (24 %) (Rakuten, 2022).

In the United States of America, plant-based milk is the most important animal substitute category with a turnover of around USD 2.5 billion in 2020 (Plant-Based Food Association, 2021). The second best-selling category is meat, reaching nearly USD 1.5 billion, followed by frozen meals (520 million), ice cream (435 million), cream (394 million), and yogurt (343 million). Already 62 % of the population has tried one plant-based alternative at one time, 82 % of them have tried milk, 62 % meat, 40 % other dairy products, 22 % egg, and 18 % condiments (Rakuten, 2022). The main reasons for consuming plant-based alternatives are trying out a food trend (41 %), health beliefs (35 %), animal welfare (23 %), and allergies (23 %), while the main challenges are not seeing the need for change (44 %), taste (33 %), price (30 %), and uncertainty about product composition (21 %) (Rakuten, 2022).

1.2. Regulatory aspects

The European Union was one of the pioneers in regulating the packaging and communication of plant-based products. In October 2020, the European Commission voted to allow the use of meat-related terms for plant-based substitutes, such as “hamburger”, “nuggets”, and “sausage”, but to ban the use of dairy-related terms such as “yogurt”, “milk”, and “butter”, following a decision by the European Judiciary in 2017 (Southey, 2021). Meanwhile, the European Parliament proposed and later withdrew the Amendment 171, which aimed to prohibit vegetable dairy alternatives to make any associations with animal products or their characteristics. This included the use of words and terminology (such as “milk”, “buttery” and “creamy”), packaging features including the shape and material of prototypical containers (such as 200 g tablets for butter and one liter carton boxes for milk), images (including splashes of milk), and comparative claims (such as “contains no lactose” or “half the emissions of regular butter”) (Kwai, 2020).

The European Dairy Association argues that the use of dairy terms and images should be regarded as “hijacking” the reputation the dairy industry built up over decades, while ProVeg International argues that it is both common sense and environmentally friendly to allow their use. A survey of European consumers revealed that 42 % of respondents believe that names related to animal products should be allowed if alternatives are clearly labeled as vegetarian on the packaging, compared to 25 % who believe that the use of names should be prohibited (Kwai, 2020). In the US, this number was even higher: 76 % of consumers supported the use of traditional names in plant-based products (Antonaccio, 2020).

Vegetable alternatives to dairy products have been on the market for years (e.g., margarine, soy milk, tofu), so dairy terminology (including milk, yogurt, cheese) seems to be already regulated in most countries (Zhang et al., 2022). This is not the case with meat substitutes, whose packaging regulations have only recently come under discussion. Japan and France are among the first countries to approve regulations, but they went in opposite directions, as France imposed restrictions while Japan was lenient (Marshall et al., 2022; Neo, 2021). While France only allows very low percentages of vegetable protein in products called “sausage”, “omelet”, “nugget”, “ham”, “steak”, “pâté” or “terrine” (France, 2022), the Japanese rules allow the use of terms such as “milk” and “meat” on plant-based products, as well as names such as “new butter” or “next cheese” and negative claims (e.g. “not a dairy product” or “no fish used”), as long as the label makes it clear that the product is not animal-based (Neo, 2021).

The discussions abroad and the diversity of state legislation on this subject put pressure on the Food and Drug Administration in the USA to regulate the permitted terminology for plant-based products (Abbott, 2021; Selyukh, 2019). At least six states already have legislation restricting the use of terms related to animal products, and the National Association of Beef Farmers has made it one of its priorities to “fight false and misleading marketing” of “fake meat”, as it believes that people would have difficulty distinguishing animal from plant products (Elzerman et al., 2013; Selyukh, 2019). Interestingly, this movement against plant-based meat in the USA can be linked to the butter lobby in the 1880s and 1890s that called margarine “inherently fraudulent” and urged 34 states to forbid the addition of yellow coloring or even require that margarine be colored pink (Ball & Lilly, 1982).

1.3. Perception of packaging information

Food packaging not only serves to protect the product physically, chemically, and microbiologically, but also serves as a powerful communication tool to attract consumers’ attention, support a visual identity, increase or decrease appetite, change feelings, influence perceptions of healthiness, sustainability and value, and convey messages regarding the taste of the product and its market positioning (Piqueras-Fiszman & Spence, 2015; Velasco & Spence, 2019). Although people’s understanding and the credibility of packaging information is generally mediocre, legislation rarely covers design aspects, allowing producers to convey implicit and explicit messages on product category, brand, quantity, ingredients, origin, and sensory profile through graphical elements (typeface, image, icons, color), claims (environmental, sensory, social, and economic), logos, packaging shape, and material (Schifferstein et al., 2021).

Claims concerning protein content, environmental impact, and health benefits mitigate sensory rejection and increase consumers’ willingness to purchase plant-based products (Apostolidis & McLeay, 2016; Carvalho et al., 2022; Folkvord et al., 2020; Estell et al., 2021; Grasso et al., 2022; Krpan & Houtsma, 2020; Martin et al., 2021; Piester et al., 2020; van Loo et al., 2020; Weinrich, 2018; Ye & Mattila, 2021). However, sensory and hedonic claims such as “spicy”, “crunchy”, “indulgent”, and “yummy” - or celebrity endorsement (Park et al., 2022) - have been shown to be better drivers of preference and acceptance than environmental and health claims in several food categories, such as vegetables and insects (Deroy et al., 2015; Papies et al., 2020; Turnwald & Crum, 2019; Turnwald et al., 2019).

The International Food Information Council (2021) indicated that USA consumers preferred the term “plant-based burger” over “veggie burger”, “meatless burger”, or “meat alternative” when presented with a picture of a vegetable product, and that they preferred “plant-based chicken” over “plant-based strips”, “meatless chicken”, or “vegan chicken”. However, if the product was primarily made from soy, they preferred to call it “soy strips” or “soy-based strips”. Another study showed that adding the term “vegetarian” to a label may have a negative effect as it may decrease product choice (Hielkema & Lund, 2022) and Bryant and Barnett (2019) reported that labeling lab-grown meat as “clean meat” generated more positive associations than calling it “lab-grown meat”.

Considering that familiarity and convenience are important barriers for consumers to replace animal products (Graça et al., 2019), the use of traditional terminology encourages consumption by providing ideas for

use, recipes, and appropriate preparation methods, besides activating connections to cultural values. Research by Marshall et al. (2022) showed that vegetarian dishes with names related to traditional dishes (e.g., "cauliflower steak", "vegetable kebab", and "soy meatballs") were preferred over dishes with "neutral" names (e.g., "cauliflower slice", "vegetable skewers", and "soy pieces"). However, there is a limit to how far such creative food descriptions can be stretched, with a British retailer facing backlash after launching overpriced and plastic-wrapped cauliflower slices called "cauliflower steaks" (The Guardian, 2018). In addition, meat-related names might sound fake or bring negative associations to people who avoid animal products for their ecological and ethical disadvantages (Elzerman et al., 2013).

In a study with 1800 US consumers, 63 % chose farm-raised beef when given the choice between a burger made from beef, lab-grown meat, pea protein or plant-based animal-like protein (van Loo et al., 2020). Adding brands increased the choice for beef to 72 %, while providing environmental and animal welfare information had only a limited effect on market shares. In addition, most participants were against calling the alternatives "beef" (81 %) and opposed a 10 % tax on conventional beef (64 %). Even when plant-based and lab-grown alternatives were significantly reduced in price (up to 50 %), the majority still opted for farm-raised beef.

1.4. Present study

The general objective of the present study is to evaluate the effects of typical terms and visual aspects of animal products on the willingness to try (WTT), understanding of origin (animal or vegetable), and sensory expectations for plant-based substitutes among consumers from the USA, which is the country with the highest meat production, gross consumption, and meat consumption per capita (Whitton et al., 2021). A plant-based milk drink and a meat product were chosen as the two most consumed categories of plant-based alternatives, both in the USA and globally (Rakuten, 2022). Chicken was chosen as the most consumed meat in the world and in the USA (Shahbandeh, 2023). We created realistic images of packaging mockups varying in terminology, container type[1], image, and sensory or nutrition claim. For each product, we asked consumers to identify the expected origin (animal or vegetable) and we measured how long it took them to judge. They also rated their willingness to try the product and indicated the expected sensory characteristics through a check-all-that-apply (CATA) task.

The majority of studies in the scientific literature examined the attitudes, perception and consumption habits for plant-based alternatives, and a few others measured the effects of terminology on liking and food choice (see Section 1.3). To the best of our knowledge, this is the first study to evaluate if packaging design and information is able to mislead consumers about the origin of plant-based products, which is something fundamental in this period of societal interest in the protein transition, of creation and popularization of new products (see Section 1.1), and of discussion on how to regulate the packaging and communication of these new categories of food and beverages (see Section 1.2).

We expect that characteristics associated with traditional animal products will result in greater willingness to try the product, higher ratings of animal origin, and more selection of sensory attributes related to an animal origin than characteristics associated with plant-based alternatives. In addition, the use of animal-related characteristics in the packaging is likely to increase respondents' confusion about the nature of the product, leading to more time being spent on determining the origin of the product (animal or vegetable). The outcome of the study may help government agencies, food industries, food services, scientists, designers, and consumers understand how these factors influence understanding of the nature of the product and the expectations for plant-based food and beverages.

[1] For clarity, we chose to refer to the whole stimuli (container with graphic elements) as "packaging" and to the independent variable defining package shape/material (i.e. glass jar, plastic tray, carton box and plastic jug) as "container".

2. Materials and methods

2.1. Participants

600 participants were recruited on Prolific (Prolific, Oxford, UK). All participants recruited were over 18 years old and were born in and lived in the United States of America. The participants were between 18 and 84 years old (mean age = 39.1); 49.2 % were female, 50.3 % male, and 0.5 % preferred not to state their gender. About ethnicity, 76.7 % identified themselves as white, 8.3 % as black, 4.0 % as Asian, 5.5 % as mixed, 3.7 % as "other" and 1.8 % preferred not to answer. Regarding their diet, 2.3 % reported being vegan, 4.5 % vegetarian, 31.0 % flexitarian, 60.2 % omnivore, and 2.0 % having other diets. Participants rarely (few times a year or never) consumed plant-based milk (58.66 %) or plant-based meat (75.50 %). The frequency of consumption of vegetable and animal products are shown in Fig. 1. Participants received a small financial compensation for their time according to the platform standards. This research project was conducted in agreement with the Declaration of Helsinki and approved by the Human Research Ethics Committee of Delft University of Technology (approval number 1332).

2.2. Stimuli

Milk and meat substitutes were chosen as plant-based products. As milk substitute we used soy milk, which is one of many plant-based milk-like drinks that are offered. As alternative for chicken meat, we used seitan, which is a wheat-based traditional Asian product that has a texture that is close to meat. The four independent variables were chosen based on the Amendment 171 proposed to the European Parliament in 2021, which proposes restrictions on terminology, container type, packaging elements, and nutritional and sensory claims related to animals or animal products on packaging of dairy alternatives (Southey, 2021). The packaging variables and treatments for the plant-based milk were terminology ("milk", "mylk" or "drink"), container (carton box or plastic jug), image (cow or soybean), and sensory claim ("creamy" or "smooth"). For the plant-based meat, these were terminology ("chicken", "strips" or "seitan"), container (plastic tray or glass jar), image (chicken or wheat), and nutrition claim ("low sodium" or "no cholesterol").

The treatments have been chosen based on market research of packaging for plant-based products found on the first page of results on Google Shopping. For terminology, the common names of the animal products, i.e. "milk" and "chicken", were tested against the equally common general/neutral terms, "drink" and "strips," respectively. Although "milk" has a clear biological definition, which is the liquid produced by the mammary glands of mammals, it could be argued that it is also a product category with specific sensory characteristics and culinary uses. We have also included a third term for both products. For the milk we used the intentionally misspelled "mylk", following a popular marketing strategy used by companies such as Daily Harvest™, Good Mylk™, Miracle Kitchen™, and Rebel Kitchen™. For the plant-based meat, we used the word "seitan", which is the Japanese term for isolated wheat gluten and also the common term for this product in the English language.

For the milk container, we chose the popular plastic jug commonly used for milk in the US as "animal" variant (68 % market share) and the carton box (24 % market share) commonly used for plant-based milk in the US as "vegetable" variant (Food and Agriculture Organization, 2010). The containers for the meat product were a plastic tray found for most chicken products sold on Google Shopping and a glass jar often used for seitan. For the images, we contrasted an illustration of an animal (a cow or a chicken) with an illustration of a vegetable (soybean or

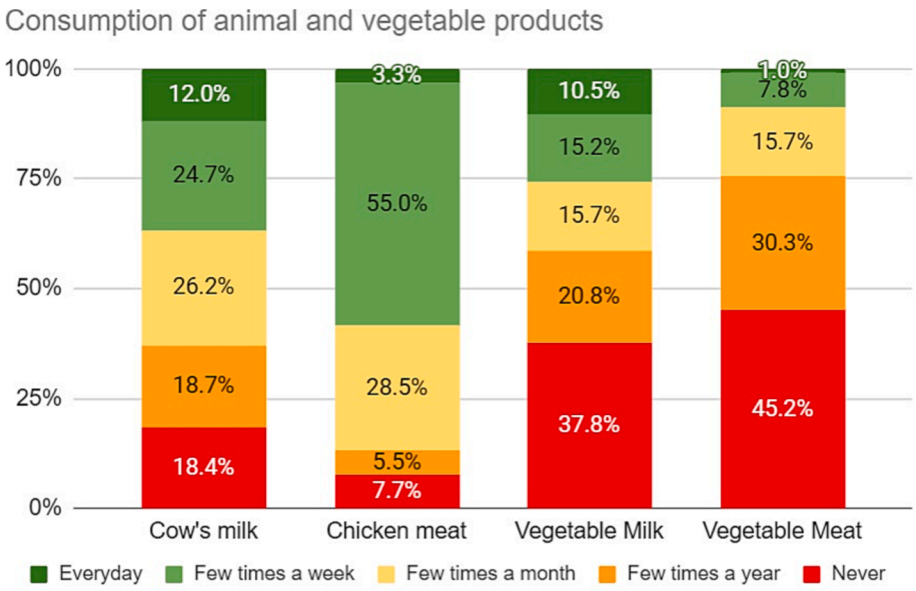

Fig. 1. Participants' (N = 600) frequency of consumption of cow's milk, chicken meat, vegetable milk and vegetable meat.

wheat). Although the use of animal images may seem out of line, it was considered acceptable because some plant-based brands use an animal image in a humorous context on their packaging. For instance, The Bored Cow™ plays with the idea that plant-based products render cows "unemployed".

For the sensory claim on milk, we tested Amendment 171's polemical proposal to regulate terms whose relationship to animal products has faded over the years, such as "creamy" (Southey, 2021). Although "creamy" stems from cream - the high-fat liquid obtained from milk - it has become a general texture descriptor for smooth, soft, full-bodied, dense liquid or solid products, including food, beverages, and cosmetics (Merriam-Webster, 2023). As a neutral alternative, we chose the descriptor "smooth". Since Amendment 171 would also forbid comparisons to animal products in claims like "no lactose" or "less greenhouse gas emissions", we chose "no cholesterol" as an animal-related option for the meat product, because cholesterol is exclusively found in animal products, and "low sodium" as neutral nutritional claim.

The four variables and their levels can be combined in 24 (3 × 2 × 2 × 2) different samples. Since the main goal of this study was to evaluate the main effects of each variable and we did not expect any relevant interactions (Baptista et al., 2022), an orthogonal design (Table 1) was used to restrict the number of samples to eight (Addelman, 1962). A ninth sample without the "soy" or "veggie" text and with all animal-related levels ("milk", plastic jug, cow image, and "creamy" for milk; "chicken", plastic tray, chicken image, and "no cholesterol" for meat) was added as a control sample to each product category. A researcher with a background in design created packaging mockups, as shown in Fig. 2.

2.3. Procedure

The 600 participants recruited through Prolific were directed to a questionnaire in Qualtrics XM (Qualtrics, Provo, EUA) and informed about the research, their rights, and financial compensation. We used an incomplete block between-participants design where each participant evaluated one of the nine milk samples and one of the nine meat samples in a balanced and monadic presentation. They also answered a math question - "please calculate 4 times 6" - to check for their attention and to spot any bots. The presentation order of the three sections (meat, milk, and math check) was randomized and balanced among the participants.

For each packaging sample, they were asked three questions and they could not go back to a question after submitting their answer to it. First, participants were asked "if a sample of this product was offered to you, would you try it?" and they answered their WTT using a five-point scale with "definitely not", "probably not", "maybe", "probably yes", and "definitely yes" as labels. Then participants were asked "still about the same product, what do you think is the origin of this product?" and answered on a five-point bipolar scale with "100 % animal", "mostly animal", "50 % animal, 50 % vegetable", "mostly vegetable", and "100 % vegetable" as labels. We recorded the time they took to answer this question in seconds. In the last part, participants were asked "thinking on the sensory characteristics (tastes, aromas, texture, flavors) of this product, how do you expect it to be?" and answered checking all that applied. For the milk, the descriptors "sweet", "bitter", "salty", "starchy", "chalky", "bran", "malty" were selected from N'Kouka et al. (2004) and supplemented with "milky flavor", "leafy flavor", "beany",

Table 1
The eight milk and meat samples and their controls.

	Milk				Meat			
	Terminology	**Container**	**Image**	**Claim**	**Terminology**	**Container**	**Image**	**Claim**
1	Milk	Plastic	Cow	Creamy	Chicken	Tray	Chicken	Cholesterol
2	Milk	Carton	Bean	Smooth	Chicken	Jar	Wheat	Sodium
3	Mylk	Plastic	Cow	Smooth	Strips	Tray	Chicken	Sodium
4	Mylk	Carton	Bean	Creamy	Strips	Jar	Wheat	Cholesterol
5	Drink	Plastic	Bean	Creamy	Seitan	Tray	Wheat	Cholesterol
6	Drink	Carton	Cow	Smooth	Seitan	Jar	Chicken	Sodium
7	Mylk	Plastic	Bean	Smooth	Strips	Tray	Wheat	Sodium
8	Mylk	Carton	Cow	Creamy	Strips	Jar	Chicken	Cholesterol
Control	Milk	Plastic	Cow	Creamy	Chicken	Tray	Chicken	Sodium

Fig. 2. Samples 2, 5, 8, and control of meat and samples 4, 5, 6, and control of milk.

"rancid", "bland", and "thick". For evaluating the meat, the descriptors "sweet", "salty", "bitter", "savory", "soft", "juicy", "crispy", "beany", "wheaty", "cardboard", "dry", "chicken flavor", "nutty", "chewy", and "fibrous" were selected from Ettinger et al. (2022).

After evaluating one sample of each product category, participants answered questions about their consumption of animal and plant-based products. To "which of the following terms best defines your eating pattern?", they could answer "vegan: I never eat any animal product, so I do not consume any dairy, eggs, honey, fish or meat", "vegetarian: I never eat any kind of meat, but I do consume other animal products like dairy, eggs and/or honey", "flexitarian: I eat animal products, but I voluntarily reduce their consumption", "omnivore: I don't voluntarily avoid or reduce the consumption of animal products", or "other". To indicate how often they consumed cow's milk, plant-based milk, chicken meat, and plant-based meat, they used a scale with "never", "few times a year", "few times a month", "several times a week", and "every day" as options.

Finally, the participants were invited to answer questions about their attachment and attitudes towards animal products. They were asked to indicate their agreement with each sentence on a five-point scale with categories "strongly disagree", "somewhat disagree", "neither agree nor disagree", "somewhat agree", and "strongly agree" for the following sentences adapted from the Meat Attachment Questionnaire (Graça et al., 2015): "to consume animal products is one of the good pleasures in life", "I am a fan of animal products", "by consuming animal products I'm reminded of the suffering of animals", "to consume animal products is disrespectful towards life and the environment", "to consume animal products is an unquestionable right of every person", "I don't picture myself without consuming animal products regularly", and "if I didn't consume animal products, I would feel weak". Similarly, they responded to the following sentences about attitudes toward ethical food choices (Vanhonacker et al., 2013): "it is important to me that the food I eat has been produced in a way that:" "animals have not experienced pain", "animals' rights have been respected", "is environmentally friendly", and "has not shaken the balance of nature". The questionnaire ended with the opportunity for participants to write down any comments they had about the study.

2.4. Data analysis

Analyses focused either on contrasting the control animal-based stimulus with the eight plant-based stimuli (N = 600) or estimating the effects of the four variables (terminology, image, container, claim) among the eight plant-based samples. For the latter analyses, the observations on the control sample were excluded from the data set (meat: N = 534; milk: N = 532). For both types of analyses, we performed a one-way analysis of variance (ANOVA) for each of the three dependent variables (WTT, origin, time) for each of the two products (milk or

meat). Whenever significant F tests were found for the sample or terminology variable, a Dunnett test or a Tukey test, respectively, were run and corrected by Holm-Bonferroni. Data from the CATA task were analyzed by variable through Cochran's Q test, followed by corrected pairwise McNemar tests (Meyners et al., 2013). Differences between demographic groups and correlations with meat attachment or attitudes were tested by Student's T-test or Pearson's correlation.

The ANOVA, Dunnett, and Tukey tests were performed by the package "car" (Fox & Weisberg, 2019), "DesTools" (Andri et al., 2022), and "multcomp" (Hothorn et al., 2008), respectively, on Rstudio (Rstudio, Boston, USA). T-tests and Pearson correlation were run on package "stats" (R Core Team, 2017) and Cochran's Q and McNemar on package "cata" (Castura, 2021) also on RStudio. Graphs were made on Google Sheets (Google, Mountview, USA). Differences were considered significant at $p \leq 0.05$.

3. Results

3.1. Chicken

In the first ANOVAs, we tested for significant differences between the control sample and the eight experimental samples with Dunnett's *t*-test. The three ANOVAs corrected by Holm-Bonferroni showed a significant sample effect for the dependent variables origin ($F[8,591] = 110.8$, $p < 0.001$) and time ($F[8,591] = 2.64$, $p < 0.001$), but not for WTT ($F[8,591] = 1.86$, $p = 0.06$). Post-hoc Dunnett t-tests corrected by Holm-Bonferroni for multiple comparisons indicated that all eight samples were different from the control for the origin variable ($M_{control} = 1.6$; $4.3 < M_{exp} < 4.7$; all $p < 0.001$), while only sample 7 differed significantly from control for the time it took participants to choose a response ($M_{control} = 12.1$; $M_7 = 7.1$, $p < 0.05$; all other $7.9 < M_{exp} < 10.9$).

In the following ANOVAs, we examined the effects of the four independent variables for the eight experimental samples. The three ANOVAs corrected by Holm-Bonferroni showed significant effects of container on WTT ($F[1,528] = 11.5$, $p < 0.01$) and of image on origin ($F[1,528] = 20.4$, $p < 0.001$) and on time ($F[1,528] = 8.1$, $p < 0.05$) (Table 2). The means indicate that the willingness to try was higher for the plastic tray than for the glass jar. In addition, the image of the chicken caused participants to expect a more animal origin and take longer to select their response than the image of wheat.

The frequencies of terms used by participants to describe their sensory expectations for each sample are shown in Fig. 3. Cochran's Q test showed that the control sample was expected to have more chicken flavor ($p < 0.001$), to be chewier ($p < 0.01$), softer ($p < 0.01$), and juicier ($p < 0.05$), to have less cardboard flavor ($p < 0.01$) and to be less fibrous ($p < 0.001$), crispy ($p < 0.001$), beany ($p < 0.01$), less nutty ($p < 0.01$), and wheaty ($p < 0.001$) than the average of the eight vegetable samples. Among the eight plant-based samples, Cochran's Q test indicated that terminology ($p < 0.001$) and image ($p < 0.001$) had significant effects. Post-hoc McNemar tests indicated that samples labeled "chicken" (1 and 2) were expected to have significantly more chicken flavor ($p < 0.01$), be chewier ($p < 0.01$), less dry ($p < 0.01$), less salty ($p < 0.05$), and less crispy ($p < 0.001$) than samples labeled "strips" (3, 4, 7 and 8) and to have more chicken flavor ($p < 0.05$), be chewier ($p < 0.05$), and less crispy ($p < 0.05$) than samples labeled "seitan" (5 and 6). Furthermore, samples with the image of wheat (2, 4, 5, and 7) were expected to have significantly less chicken flavor ($p < 0.001$), be crispier ($p < 0.05$), and wheatier ($p < 0.05$) than samples with the image of chicken (1, 3, 6, and 8).

Table 2
Marginal means and standard deviations for willingness to try, expected origin, and time to evaluate origin as a function of animal or vegetable treatment.

			Animal	Veg	Veg 2
Chicken	Container	WTT**	3.4 ± 1.3	3,0 ± 1.3	
	Image	Origin***	4.4 ± 0.9	4.7 ± 0.6	
	Image	Time*	10.5 ± 7.8	8.7 ± 6.5	
Milk	Terminology	WTT*	3.1 ± 1.4^{ab}	3,3 ± 1.3^{a}	2.8 ± 1.2^{b}
	Image	Origin***	4.4 ± 1.0	4.7 ± 0.6	
	Image	Time*	10.5 ± 9.0	8.7 ± 5.4	

For milk terminology, "milk" is the animal treatment, "mylk" is veg and "drink" is veg 2.
Values marked with the same letter were not significantly different in Tukey test corrected by Holm-Bonferroni.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

3.2. Milk

As with the meat samples, we first tested for significant differences between the control sample and the eight experimental samples. The three ANOVAs corrected by Holm-Bonferroni showed a significant sample effect for origin ($F[8,591] = 111.5$, $p < 0.001$), but not for WTT ($F[8,591] = 2.33$, $p > 0.20$) or time ($F[8,591] = 2.016$, $p > 0.20$). Post-hoc Dunnett t-tests corrected with Holm-Bonferroni for multiple comparisons indicated that all 8 samples were different from the control sample for the origin variable ($M_{control} = 1.5$; $4.2 < M_{exp} < 4.8$; all $p < 0.001$).

In the following ANOVAs, we investigated the effects of the four independent variables for the eight experimental samples. The three ANOVAs corrected by Holm-Bonferroni showed significant effects of terminology on WTT ($F[1,526] = 4.47$, $p < 0.05$) and of image on origin ($F[1,526] = 28.62$, $p < 0.001$) and on time ($F[1,526] = 6.81$, $p < 0.05$). Post-hoc Tukey test corrected by Holm-Bonferroni showed that participants were more willing to try samples labeled "mylk" than samples labeled "drink" ($p < 0.05$) (Table 2). In addition, participants expected a more animal origin and took more time to evaluate origin when the image was a cow than when it was a soybean.

The frequencies of the terms participants used to describe their sensory expectations for each milk sample are shown in Fig. 4. Cochran's Q test showed that the control was expected to have a milkier flavor ($p < 0.001$), be thicker ($p < 0.001$), have less leafy flavor ($p < 0.01$), and be less bland ($p < 0.001$), beany ($p < 0.001$), chalky ($p < 0.001$), and starchy ($p < 0.01$) than the average of the eight vegetable samples. Overall, the vegetable milks were expected to have very similar flavor profiles. Nonetheless, Cochran's Q test on the eight plant-based samples indicated that terminology ($p < 0.01$) and image ($p < 0.05$) had significant effects on the sensory expectations. Post-hoc McNemar tests indicated that samples labeled "drink" (7 and 8) were expected to be significantly "chalkier" ($p < 0.01$) than samples labeled "mylk" and that samples with the soybean image (2, 4, 5, and 7) were expected to be "beanier" ($p < 0.05$) than samples with the image of a cow (1, 3, 6, and 8).

3.3. Consumption, attachment, and attitudes

Participants' responses for their attachment to eating meat and their attitudes towards ethical food choices are shown in Fig. 5. The majority are hedonically attached to eating meat (69.8 % agree to some level that they are "a fan of animal products"), while also being concerned about the ethics of their food choices (on average 59.7 % agree that animal wellbeing and environment effects are important). They mostly do not consider eating animal products disrespectful (60.7 %) or questionable (44.5 %) and they do not see themselves stopping eating animal products (51,8 %). Furthermore, they are not afraid that stop eating meat would make them feel weak (52.3 %).

After recoding the values on the two reversed items (3 and 4), we averaged ratings on the scales measuring attachment to eating meat (seven items, Cronbach's $\alpha = 0.85$) and their attitude to ethical food choices (four items, $\alpha = 0.90$). As expected, their WTT for plant-based alternatives was positively correlated with participants' scores on their attitude toward ethical food choices ($r = 0.13$, $p < 0.001$) and negatively correlated with their attachment to eating meat ($r = -0.16$, p

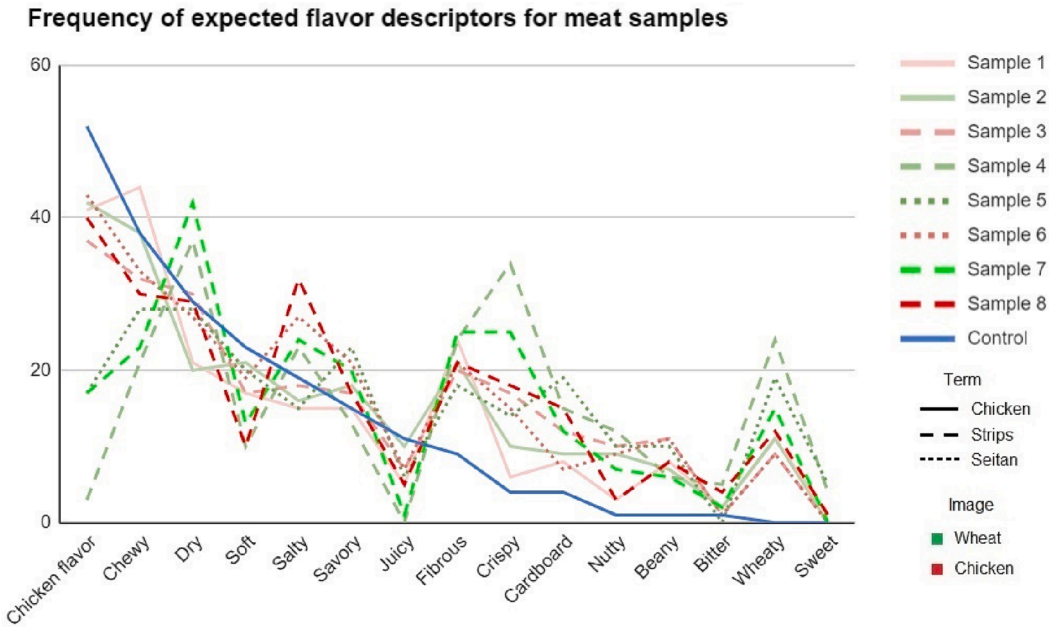

Fig. 3. Frequency of sensory descriptors expected by participants for each meat sample.

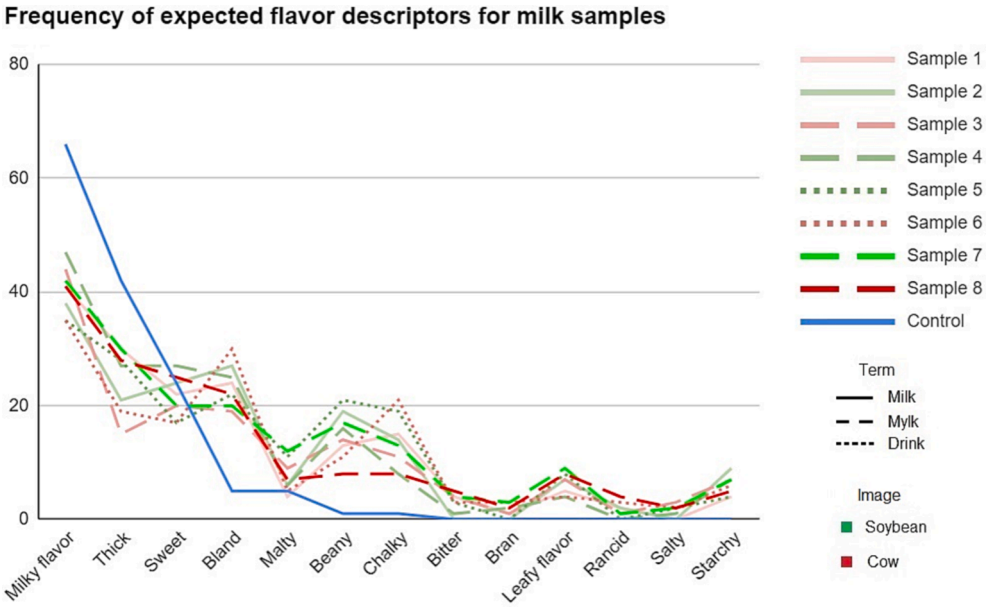

Fig. 4. Frequency of sensory descriptors expected by participants for each milk sample.

< 0.001). No relationships were found with ratings of origin ($p > 0.20$) or time ($p > 0.20$).

On average, women and men were equally willing to try the vegetable samples (means 3.15 and 3.12, respectively, $T = 0.40$, $p > 0.20$), rated the origin similarly (means 4.53 and 4.57, $T = 0.71$, $p > 0.20$) and took approximately the same amount of time to evaluate the origin of the samples (means 9.83 s and 9.41 s, $T = 0.23$, $p > 0.20$).

4. Discussion

In this study, we investigated whether participants understood the nature of vegetable milk and meat alternatives based on their packaging. Indeed, the participants expected the control sample to be more animal than all the vegetable samples, with differences as large as 1.56 (chicken control) and 1.52 (milk control) versus 4.55 (mean for veggie meat samples) and 4.55 (mean for soymilk samples) on a 5-point scale. It is worth emphasizing that milk sample 1 looks exactly like the control sample, except for the addition of the word "soy" and its expected origin was rated 4.33. These results indicate that adding "veggie" or "soy" on a package is enough to make consumers aware of the plant-based nature of a product, at least when evaluating a single package on a screen.

In addition to the comparisons with the control, we examined the effects of terminology, container, image, and sensory or nutritional claims on WTT, expected origin, time to evaluate origin, and expected sensory attributes. Table 4 shows an overview of the effects we found.

Terminology significantly influenced the willingness to try the milk product and affected the sensory descriptors for both products. Participants were more open to trying the plant-based beverage product and expected it to be less chalky if it was called "mylk" instead of "drink". The meat samples labeled "chicken" were expected to be chewier, less

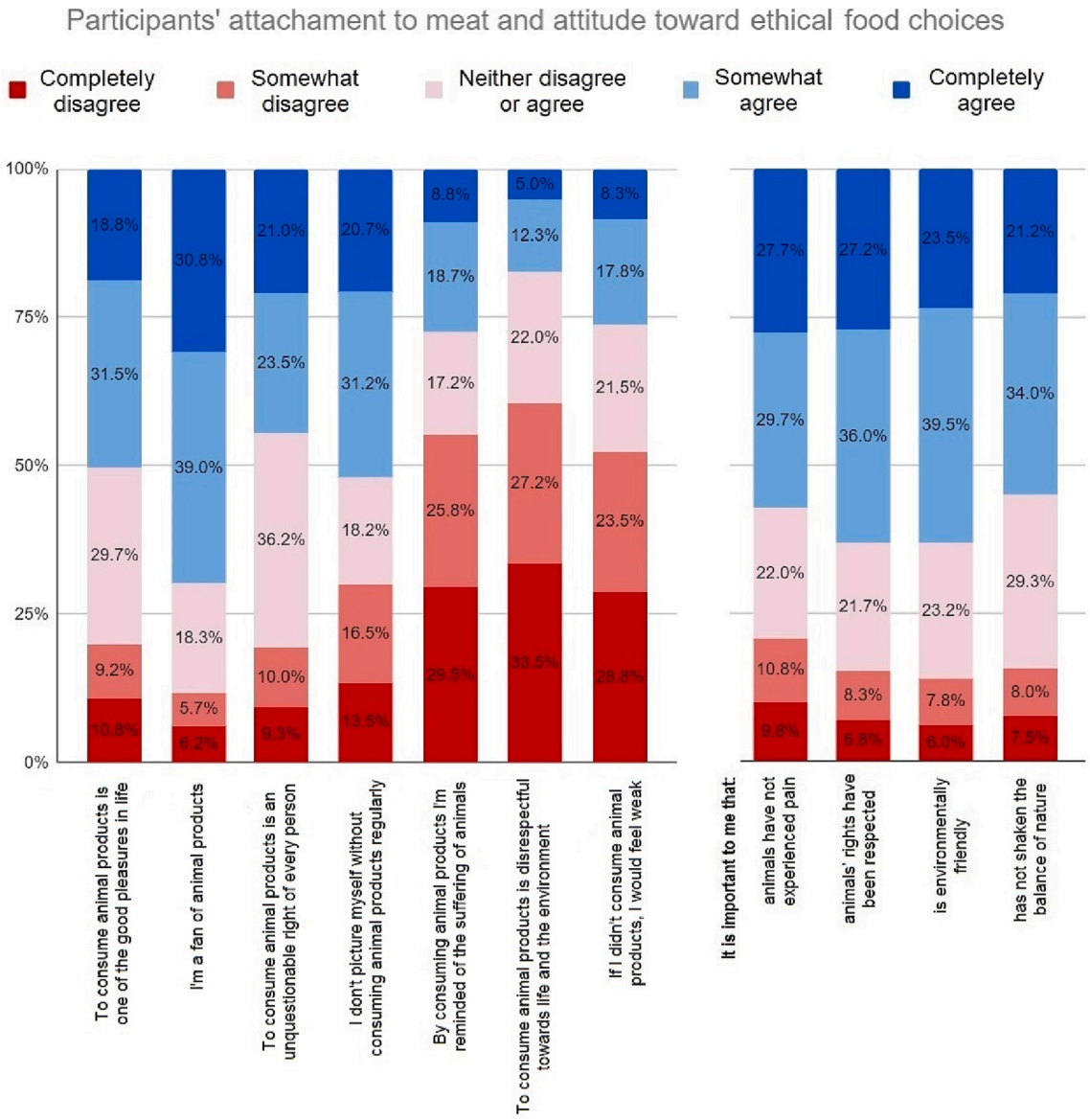

Fig. 5. Participants' (N = 600) attachment to eating meat and attitudes towards animal products.

Table 4
Summary of significant effects of terminology, container, image and claim on willingness to try, expected origin, time to evaluate origin, and sensory expectations.

	WTT	Origin	Time	Sensory
Terminology	Milk			Milk & Chicken
Container	Chicken			
Image		Milk & Chicken	Milk & Chicken	Milk & Chicken
Claim				

dry, less crispy and more chicken flavored than the ones labeled "strips" or "seitan". A previous study reported positive effects of animal-related terminology on willingness to eat and acceptance of vegetarian dishes (Marshall et al., 2022). In our study, we only see a positive effect of animal-related terminology in the effect of the name "chicken" on the expected sensory properties for the meat pieces.

The type of container only affected the willingness to try the vegetable meat, possibly because the glass jar was very unfamiliar for chicken meat. On the other hand, carton boxes are a common container for milk in the USA, although they are mainly used for organic and vegetable milk. The atypicality of packaging can increase consumers' attention and processing time, which can lead to better or worst acceptance, depending on factors like the manipulated variable, consumer attitudes, and the combination with claims (Dörnyei & Lunardo, 2021; Schoormans & Robben, 1997; van Ooijen, Fransen, Verlegh, & Smit, 2016). In our study, the type of container did not affect ratings of expected origin, but it would be interesting to test this effect in a real shopping context, as it could play a more prominent role when multiple products are presented side by side and decisions are made faster and more intuitively (Gil-Pérez et al., 2020).

Images were found to be the most influential packaging features in this study, affecting the expected origin of the product, the time taken to evaluate origin, and the expected sensory properties of both products. The importance of images on food packaging is well documented in the literature (Baptista et al., 2022; Benn et al., 2015; Gil-Pérez et al., 2020; Piqueras-Fiszman et al., 2013; Simmonds & Spence, 2017; Underwood et al., 2001), which is likely enhanced by the primacy of visual information in the shopping stage of product consumption (Schifferstein et al., 2013). One possible explanation is that images require less cognitive effort and more easily generate expectations than text (Benn et al., 2015). Intriguingly, however, imagery had no effects on the

willingness to try the products, perhaps because trying products is more related to the participants' consumption habits.

Although the origin of vegetable products with animal images was judged differently from the control, using an image of a chicken or cow significantly affected the understanding of the origin of the product. Not only does it increase the estimated percentage of the product that participants think is of animal origin, but it also increases the time they spend making their judgment, which probably indicates that it confuses them. This result resembles studies that researched incongruity between packaging images and product content or nature (Smith et al., 2015; Timmerman & Piqueras-Fiszman, 2019). Even if the images do not completely mislead consumers, they at least raise doubts, demanding more effort and time to understand the nature of the product.

We did not find any differential effects of the claims displayed on the packages. This suggests that words that may have an association with animal products do not mislead consumers about the product's origin. Apparently, consumers do not perceive claims like "creamy" or "no cholesterol" as exclusively animal or plant-related and this would argue against strict regulations on the use of such terms. Although nutritional and sensory claims are reported to influence willingness to buy, willingness to pay, preference and acceptance of plant-based alternatives (Grasso et al., 2022; Papies et al., 2020; Piester et al., 2020; Ye & Mattila, 2021), whether such claims are specific to animals or plants or are neutral does not lead to significant differences.

In this study, we compared the effects of different types of information on the perception and appreciation of two types of animal and plant-based products. Our study shows the most noticeable effects for the images and the terminology used to describe the product. Even if the meanings are equivalent (such as the term "chicken" and the image of a chicken), the effects may not be the same and using both may result in an accumulation of effects. Besides the content of the information, the form in which it is presented is important to predict its effects on consumer interpretation and the resulting behavior. As visual information is processed differently than textual information (Paivio, 1971), the effects are likely to be different as well (Smith et al., 2015).

Schifferstein et al. (2022) recently showed that the effectiveness of communicating consumer benefits through text, images, or stylistic elements of food packages differed substantially between the three mediums. Their study suggests that choosing the wrong medium may even backfire in some cases. Food packaging rules and regulations tend to focus on text rather than images, although health claim regulations include image restrictions as well (Schifferstein et al., 2021; Smith et al., 2015). Nonetheless, showing a chicken and a cow on the packaging of vegetable products can also be understood as showing ingredients that are not present (European Union, 2011), and the use of these images on plant-based products is therefore prohibited in many countries, including the USA (Food and Drug Administration, 2013). And even if unregulated, products that violate consumer expectations can backfire at the time of tasting (Timmerman & Piqueras-Fiszman, 2019).

Unsurprisingly, we found correlations between willingness to try vegetable products and attitudes supporting ethical food choices and detachment from meat, confirming that participants who are more concerned about animal rights, animal suffering, environmental impact and are less hedonically attached to animal products are more open to vegetable alternatives (Eckl et al., 2021). Although meat consumption and attitudes are generally related to gender (Lax & Mertig, 2020) and previous research has shown that only women were influenced by sustainability and taste claims when it came to replacing a regular burger with a vegetarian alternative (Piester et al., 2020), our study found no association between gender and WTT or origin ratings. Our findings are partly in line with recent studies showing that younger, more educated, vegetarian, and male individuals from the USA tend to have stronger preferences for plant-based and lab-grown alternatives compared to farm-raised beef (van Loo et al., 2020) and that gender was not associated with the effects of animal-relatedness of dish names (Marshall et al., 2022). Possibly, gender is only a relevant factor for the consumption of red meat, since it is more related to masculinity (Rozin et al., 2012).

The main limitation of the present study was that it was not conducted in a real shopping or consumption context. Thus, it does not account for the environmental complexity and distractions that might be encountered in a real shopping situation and cannot predict people's actual buying behavior. It would be interesting to conduct future studies by presenting packages and product samples in realistic shopping or consumption contexts (e.g., online or brick-and-mortar retail environments, coffee houses, restaurants). In addition, the current study is limited to US consumers, the products we examined (milk and meat alternatives), and the variables tested. Future studies could investigate participants with different cultural backgrounds, use different plant-based products (e.g., cheese, yogurt, desserts), or expand the range of variables studied (e.g., colors, brands, fonts, the nature of images or illustrations, material textures, vegetarian and organic certificates, environmental claims). Furthermore, we have now focused only on packaging, whereas people can be influenced by different types of information they see, such as product information, advertisements, and social media posts. All these sources can affect how packaging information is processed and how likely people are to notice and buy plant-based products.

5. Conclusions

This study investigated how packaging cues influence willingness to try, understanding of origin, time to evaluate origin, and sensory expectations of plant-based milk and meat in 600 consumers from the US population. Compared to control samples, all plant-based samples were clearly recognized as vegetable alternatives regardless of terminology, image, container, and claim. However, comparison between the vegetable samples showed that images of animals did influence the assessments of expected origin, the time to evaluate origin, and the sensory expectations of both products.

Apparently, the addition of words like "veggie" or "soy" on packaging for plant-based alternatives usually makes consumer aware of the vegetable nature of the product. However, animal images still confuse consumers to some degree and, therefore, we suggest that prohibiting the use of animal images could help protect consumers from confusion.

We did not find clear evidence that the other factors (animal-related terminology, type of container, or claims) misled consumers about the origin of the products, but the two first factors did influence their willingness to try the product and their sensory expectations. As it is quite common for companies to use packaging cues to influence the way consumers perceive their products, we do not regard these effects as a reason for prohibiting their use. Therefore, we suggest that food producers and food service providers should be free to vary in terminology, packaging materials and packaging shape to support consumers' intentions to adopt a healthier and more sustainable diet.

Data

All study materials and datasets will be made publicly available in the TU Delft repository at https://doi.org/10.4121/21740075.v1

CRediT authorship contribution statement

Iuri Y.F. Baptista: Conceptualization, Formal analysis, Methodology, Project administration, Resources, Visualization, Writing – original draft, Writing – review & editing. **Hendrik N.J. Schifferstein:** Conceptualization, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Writing – original draft, Writing – review & editing.

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.

Data availability

The data will be made publicly available through the TU Delft repository after publication of the paper at https://doi.org/10.4121/21740075.v1

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