FOOD STANDARDS Australia New Zealand
Te Mana Kounga Kai – Ahitereiria me Aotearoa

Consumer literature review on labelling of plant-based protein and dairy alternatives

Effect of meat or dairy terminology, utility terms, and/or animal imagery on consumer understanding of plant-based alternatives

Cataloguing data

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Department of Agriculture, Fisheries and Forestry
GPO Box 858 Canberra ACT 2601
Telephone 1800 900 090
Web agriculture.gov.au

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Acknowledgement of Country

We acknowledge the continuous connection of First Nations Traditional Owners and Custodians to the lands, seas and waters of Australia. We recognise their care for and cultivation of Country. We pay respect to Elders past and present, and recognise their knowledge and contribution to the productivity, innovation and sustainability of Australia's agriculture, fisheries and forestry industries.

Executive Summary

Food Standards Australia New Zealand (FSANZ) was commissioned by the Australian Government Department of Agriculture, Fisheries, and Forestry to undertake a rapid review of evidence concerning the effect of meat or dairy terminology, utility terms, and/or animal images on consumer understanding of the ingredient content (that is, whether they were plant or animal based) of plant-based protein or dairy alternatives. This report outlines the methodological approach to the review, and summarises the available evidence.

A total of 16 documents (reporting 17 unique studies) were identified for inclusion in the review. The review includes peer-reviewed articles published in academic journals, as well as grey literature (i.e. unpublished theses and market research produced by industry stakeholders). Findings across studies were narratively synthesised.

The body of evidence is primarily comprised of grey literature, particularly market research undertaken by industry stakeholders, which does not always contain sufficient methodological information to ascertain risk of bias. However, there are some areas of consistency across studies that used similar methodologies, which provides some level of confidence in these findings. Meanwhile, all peer-reviewed literature was undertaken outside of Australia, and therefore caution should be applied in generalising the findings to the Australian population.

Overall, the available evidence suggests that up to 25% of Australian consumers may be confused by plant-based protein labelling currently on the market. International studies that used an experimental design suggest it is animal imagery, rather than meat terminology, that confuses consumers, however it is unclear whether these findings can be generalised to the Australian context.

There is less clear evidence available around the prevalence of consumer confusion around plant-based dairy labelling. However, the limited evidence available suggests that the vast majority of consumers correctly understand these products. Similar to the findings for plant-based protein, the weight of international studies that used an experimental design suggest that it is animal imagery, rather than dairy terminology, that causes confusion.

A key focus for future research would be filling the evidence gaps in the Australian context by investigating the demographics associated with consumer confusion and determining the effect that meat terminology, dairy terminology, and animal imagery each independently have on Australian consumers' level of understanding of plant-based protein and dairy alternatives through a high quality study that incorporates an experimental design.

Key findings

Meat and plant-based protein products

- Two Australian studies found that 75–80% of consumers are able to accurately identify plant-based protein products based on the front-of-pack labelling currently used on the market. Four surveys found that only around 6 to 12% of Australian consumers report having mistakenly purchased a plant-based protein product.

- Three experimental studies undertaken in the USA found that the use of meat terminology on plant-based protein products did not adversely impact consumer understanding of the ingredient content of the product. Two studies found that it instead supported consumers' understanding of the intended flavour of the product. There is no evidence available on whether the use of meat terminology supports consumer understanding of the product's intended use.
- One experimental study in the USA found that animal imagery slightly decreases consumer understanding of the ingredient content of plant-based protein products, and increases length of time spent assessing it. This is supported by 2 Australian studies in which 36–45% of participants identified animal imagery on plant-based protein products as a source of confusion.
- There is very little evidence available on the demographics of consumers who are more likely to mistake plant-based protein products for animal meat products. One cross-sectional study of Australian consumers found that those who mistook at least one plant-based protein product in a 6 product categorisation exercise were more likely to have one or more of the following characteristics: being male, aged 65+ years, an empty nester, speak a language other than English with family/friends, and/or have a household income of $40k or below.

Dairy and plant-based dairy alternatives

- There was limited evidence available on Australian consumers' ability to accurately identify plant-based dairy alternatives. Two studies undertaken in Australia indicated that the vast majority of consumers (up to 93%) understand the ingredient content of plant-based milks. However, as there was no methodological information provided it is not possible to be confident in this finding.
- Two studies (one US and one that did not report country of residence) found that around 70–94% of consumers understand that plant-based milks do not contain cow's milk. This compares favourably to consumer understanding of traditional cow's milk products, which were correctly understood by 64%–90% of consumers.
- Across 3 peer-reviewed experimental studies, there was either no significant effect or only a small effect of dairy terminology on consumer understanding of the ingredient content of plant-based dairy alternatives.
- Two experimental studies (US and UK) found that the use of dairy terminology on plant-based dairy alternatives enhanced consumers' understanding of the intended use of the products. One study found that it also significantly improved consumers' reported understanding of the intended flavour of the product.
- One experimental study in the USA found that animal imagery slightly decreases consumers' understanding of the ingredient content of plant-based milk, and increases the length of time consumers' spend assessing it.
- One study undertaken in the USA found that people who consumed *both* dairy and plant-based milk alternatives were more likely to associate plant-based milks with dairy milk than people who did not consume both types of products.

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Introduction

Over a number of years, concerns have been raised by meat and dairy industries in Australia that the labelling and presentation of plant-based protein and dairy alternatives may be misleading to consumers. The issue was considered by the Food Regulation Standing Committee in 2018 and the Senate Rural and Regional Affairs and Transport Legislation Committee in 2022, with both bodies noting a lack of independent, peer-reviewed research.

Food Standards Australia New Zealand (FSANZ) was commissioned by the Department of Agriculture, Fisheries and Forestry to undertake consumer and marketplace research to build the evidence-base to inform policy considerations around plant-based protein and dairy alternative product labelling. The project consists of:

- A literature review of existing evidence on the effect of meat and dairy terminology, utility terms, and animal imagery on consumers' understanding of plant-based protein and dairy alternatives;
- A consumer survey, using a representative sample of Australian consumers, to understand the extent to which Australian consumers are confused or misled about the ingredient content of plant-based and alternative products;
- A market survey of on-package labels for plant-based and alternative products, and an assessment of their alignment with agreed elements of voluntary industry labelling guidelines; and
- Considerations and suggestions on opportunities to improve product labelling.

This report forms the literature review component of the project. It addresses the following research question:

1) How does the use of meat or dairy terminology (e.g. 'meat', 'beef', or 'chicken'), utility terms (e.g. 'burger', 'patties', or 'sausage') and/or animal imagery on plant-based protein or dairy alternatives affect consumer understanding of the ingredient content of the product (i.e. being meat, plant-based, or a mixture)?

Subcomponents of the research question are as follows:

a) To what extent does the use of these terms and/or imagery confuse or mislead consumers about the ingredient content of the product?

b) To what extent does the use of these terms and/or imagery support consumers' understanding of the product's intended flavour, texture, and/or use?

c) To what extent do ingredient qualifiers (e.g. 'meat-free', 'plant-based', 'oat milk') reduce any confusion about the ingredient content of the product?

d) Are there any differences in the effect of terminology and/or imagery according to demographic characteristics (e.g. age, gender, level of education, level of literacy, language used at home)?

This report outlines the methodological approach to the literature review, and summarises the evidence that was available to answer the research question.

Background

Current labelling regulations

There are no specific labelling requirements for plant-based protein or dairy alternative products in the Australia New Zealand Food Standards Code (the Code). As such, manufacturers must adhere to general labelling requirements, including that, unless prescribed, the name of a food must be sufficient to indicate its true nature.

Some foods, including milk and some meat products, are defined in the Code and can only be sold using that name if they meet the definition and any compositional requirements. However, the Code (section 1.1.1—13(4)) also allows the use of these terms if a qualifying descriptor makes it clear the food is not a food as defined in the Code. For example, 'soy milk', 'chicken-free chicken' and 'peanut butter' are permitted to be used on product labels despite milk, chicken, and butter being standardised foods.

Requirements in the Code work in conjunction with Australian consumer law, which prohibits misleading or deceptive conduct, and making false or misleading representations about the quality, quantity, composition or origin of products, including food products. Australian consumer law includes *the Competition and Consumer Act 2010*, along with other state and territory consumer laws, and is enforced by the Australian Competition and Consumer Commission.

2018 Food Regulation Standing Committee Review

In October 2018, the Australia and New Zealand Ministerial Forum on Food Regulation noted stakeholder concerns regarding potentially misleading descriptions of food products and asked the Food Regulation Standing Committee to develop an options paper on how foods standards, including labelling, definitions, and other elements, can be used to address misleading descriptions of food.

The options paper did not find any evidence that confirmed whether or not consumers are misled about the ingredient content of plant-based alternatives to traditional dairy or meat products. It additionally noted there was a long history of non-animal products using meat or dairy terminology in their names (e.g. nut butters, fruit mincemeat, creamed corn), with no evidence to suggest that consumers fail to understand that these products are not animal-based. The options paper called for additional research to address this evidence deficit.

2021 Senate Committee Inquiry

The Senate Inquiry on the Definitions of Meat and Other Animal Products, led by the Senate Standing Committee on Rural and Regional Affairs and Transport Legislation, was announced on 15 June 2021. The Inquiry terms of reference broadly included:

- the potential impairment of Australian meat category brand investment from the use of meat terms and livestock images by plant-based and synthetic protein products

- social and economic impacts of this practice on livestock producers and businesses
- the health implications of consuming heavily manufactured protein products marketed with red meat descriptors or livestock images.

The inquiry received 226 submissions and held 6 public hearings. Some submitters to the inquiry expressed the concern that some consumers may be confused or misled by plant-based alternative protein products labelled with meat terminology, utility terms, and/or animal-based imagery.

The final report was tabled in February 2022 (Senate Rural and Regional Affairs and Transport Legislation Committee (2022)). The report found there was 'a notable lack of peer-reviewed research' concerning the issue of consumer confusion, and made 9 recommendations to the Australian Government.

A Government response to the inquiry report has yet to be released.

Methods

Literature search strategy

Literature used to assess the effect of meat or dairy terminology, utility terms, and/or animal imagery on consumer understanding of plant-based alternatives was obtained from the following sources:

- Consumer evidence submitted to the Senate Standing Committee on Rural and Region Affairs and Transport Legislation's Inquiry on the Definitions of meat and other animal products;
- Results from a literature search undertaken by the University of Adelaide in 2023, initially intended to inform a literature review from which plant-based milk and dairy labelling was subsequently scoped out;
- Searching online databases for peer-reviewed studies published since 2023 (i.e. since the literature search undertaken by the University of Adelaide);
- A Google Scholar search for literature published since 2023, first 100 hits;
- A Google search for grey literature around plant-based labelling, first 100 hits; and
- Hand-searching the reference lists and citing studies from included literature.

A total of 16 documents (reporting 17 unique studies) were included in the literature review. The literature search and screening process was conducted by one officer. More details on the literature search strategy and research review process are available in Appendix 1: Literature review methods.

Study quality assessment

Due to the short timeframes available for this literature review, a formal quality assessment of each included study was not undertaken. However, the risk of bias of each study was taken into account narratively by examining the study's strengths and limitations. Factors considered include:

- the appropriateness of the study design;

- whether the questions are clear, unambiguous, and measure what they are intended to measure without bias;
- how directly the question and design measures the outcome of interest;
- whether the sample is of a reasonable size and representative of the population of interest;
- whether any stimuli used reflect the actual environment;
- whether the methodology and results are reported adequately.

Conflicts of interest were also noted, however do not directly impact upon the narrative summary of risk of bias. Rather, conflicts of interest may indirectly influence one or more sources of bias noted.

Study design is a particularly important consideration, as it determines what conclusions are able to be made on the basis of the study. Experimental studies (e.g. randomised controlled trials) are able to determine whether a cause-effect relation exists between an intervention (such as a particular labelling element) and an outcome (such as consumer confusion). In contrast, cross-sectional surveys are able to provide self-report data and correlations, however are not able to determine whether any specific factor causes a particular outcome. Given that the research question focuses on the effect of meat terminology, utility terminology, and animal images on consumer confusion, experimental studies provide the highest level of evidence available. Studies may still be subject to risk of bias regardless of their design, and any factors that may impact risk of bias have been narratively noted for each study reviewed.

An overview of general study characteristics, including identified strengths and limitations, are available in Appendix 2: Study characteristics. Study assessments were conducted by 1 officer.

Evidence synthesis

The evidence from each study was collated thematically under the research questions in order to present a narrative overview of the available evidence. The overall quality of the evidence that was available to answer each research question is described using a narrative approach. This is because there is currently no available tool that may be used to quantitatively synthesise the quality of evidence from studies that used diverse designs. However, considerations were given to the general principles of the GRADE approach (Guyatt et al., 2011) when narratively synthesising the quality of the evidence. That is, consideration was given to the risk of bias associated with individual studies, the consistency of findings across studies, and the directness of the measures (e.g., self-reported hypothetical measures of behaviour lack directness). For example, if 2 studies provided inconsistent findings, then overall conclusions were based on the higher quality study (based on risk of bias and/or generalisability of the results to the Australian context). Write-up and synthesis was conducted by 1 officer.

The draft literature review was internally reviewed by FSANZ staff members.

Findings

Overview of study characteristics

A total of 16 documents (reporting 17 unique studies) were identified for inclusion in the literature review. Of these, 5 studies were peer-reviewed and twelve were grey literature, primarily market research commissioned by industry stakeholders (from both traditional meat/dairy and plant-based alternative industries).

Seven studies investigated meat and meat alternatives, 7 studies investigated dairy and dairy alternatives, and 3 studies investigated both meat and dairy. Seven studies were undertaken in Australia, 6 in the United States of America, one in New Zealand, one in the United Kingdom, and 2 online without restricting country of residence.

All seventeen studies were quantitative in nature. The 5 peer-reviewed studies and one piece of grey literature (a Masters' thesis) used an experimental (between-subjects) design. While methodological details were not provided for the remaining twelve studies, they either reported using or are likely to have used a cross-sectional survey design.

Findings are summarised by product type (meat/dairy) and research question. Studies are summarised by product type because there was varying levels of evidence for plant-based protein and dairy alternatives, and it is reasonable to suppose that there may be differences in the level of consumer understanding across the 2 product types.

The first time a study is introduced within the product category (meat or dairy), an overview of the study design, sample, and methodology is included. Subsequent references to that study within the product category do not contain this level of detail so as to avoid repetition. A quick-reference overview of study characteristics, including identified strengths and limitations, is available in Appendix 2: Study characteristics.

Meat and plant-based protein products

Summary of findings

A total of 10 studies examined consumers' level of understanding of plant-based protein products. Two were peer-reviewed studies while 8 were grey literature studies with varying levels of published detail. Five studies were undertaken in Australia, four in the USA, and one in New Zealand. Three were experimental, while the other 7 are reported as using or are likely to have used a cross-sectional survey design.

Key findings

Extent of consumer confusion

- Two cross-sectional surveys that used objective measures found 75-80% of Australian consumers are able to accurately identify plant-based protein products based on the front-of-pack labelling currently used on the market (Institute for Sustainable Futures 2022; Pollinate 2021). The same studies found that 10% and 18% of Australian consumers respectively reported finding plant-based protein packaging confusing after completing the exercise.

- This approximate magnitude of consumer confusion is supported by four cross-sectional surveys that found 6% to 12% of Australian consumers reported having mistakenly purchased a plant-based meat product (or 'plant-based item', in the study by Woolworths) (Colmar Brunton 2019a, 2019b; Institute for Sustainable Futures 2022; Woolworths 2021).

Effect of meat terminology

- In 3 experimental studies undertaken in the USA, the use of meat terminology on plant-based protein products did not adversely impact consumers' understanding of the ingredient content of the product (Baptista and Schifferstein (2023); Gleckel (2020); DeMuth (2019)).
- Further, in 2 of the studies, the use of meat terminology significantly improved consumers' understanding of the intended flavour of the plant-based protein products (Baptista and Schifferstein (2023); Gleckel 2020).
- It is not clear whether these findings would be generalisable to the Australian population.

Effect of animal imagery

- One experimental study in the USA found that animal imagery decreases consumer understanding of ingredient content and increases length of time spent assessing it (Baptista and Schifferstein 2023).
- It is not clear whether this finding would be generalisable to the Australian population. However, 2 Australian cross-sectional surveys found that animal imagery on plant-based protein products was reported as a source of confusion by 36% to 45% of Australian consumers (Pollinate 2021; Institute for Sustainable Futures (2022)).

Demographics

- One Australian cross-sectional survey found that those who incorrectly identified at least 1 plant-based protein product in the product categorisation exercise were more likely to have 1 or more of the following characteristics: being male, aged 65+ years, an empty nester, speak a language other than English with family/friends, and/or have a household income of $40k or below (Pollinate (2021)).
- One Australian cross-sectional survey found that respondents believed that people who were 'in a rush/distracted', 'older', 'unfamiliar with plant-based meat / meat-eaters', had 'sight problems' or 'an ESL / foreign background' were more likely to mistake plant-based protein products for animal meat products (Pollinate (2021)).
- A separate Australian cross-sectional survey found that 67% of those who reported having mistakenly purchased a plant-based protein product said they did so because they were 'in a hurry/distracted and did not read the product label' while 33% said they were confused by what the product actually was (Institute for Sustainable Futures (2022)).

A more detailed description of how these findings were derived in the following sections.

Extent of consumer confusion

Objective measures of consumer confusion

Two cross-sectional surveys found that around 75-80% of Australian consumers are able to accurately identify plant-based protein products based on the front-of-pack labelling currently used on the market using an objective measure (see Table 1).

Table 1 Proportion of consumers who, on average, correctly identified plant-based protein products

Study and Funding Body	Sample size	Country	Proportion who, on average, correctly identified the ingredient content of the products
Institute for Sustainable Futures (2022) No Meat May and Vegan Australia	N = 1,014	Australia	80%
Pollinate (2021) Red Meat Advisory Council	N = 1,000	Australia	75%

Institute for Sustainable Futures (2022) was commissioned by No Meat May and Vegan Australia to undertake a survey of a broadly nationally representative sample of 1,014 Australian consumers (48% female, 5% vegetarian or vegan). Each respondent was shown a set of 15 images randomised from a total set of 60 images of plant-based or animal meat products currently available on the market. The exact stimulus was not provided, and the proportion of plant-based and animal meat images in the total set was not reported. For each image shown, the respondent was asked to indicate whether the product was a plant-based protein product, an animal meat product, or if they were unsure. The study found that 80% of respondents, on average, correctly identified the ingredient content of the product during the categorisation exercise. This was not broken down by the type of product (i.e. whether it was plant-based protein or animal meat).

Pollinate (2021) was commissioned by the Red Meat Advisory Council to undertake a cross-sectional survey of a sample of 1,000 Australian consumers that was nationally representative by age, gender, and location (51% female). Each participant was shown the same 6 products (5 plant-based protein products and 1 animal meat product) 1 by 1 for 3 seconds at a time and then asked, 'What best applies to the product you just saw?' (Response options: 'Only contains animal meat', 'Contains a mix of animal meat and plant-based ingredients', and 'Only contains plant-based ingredients').

Table 2 Proportion of responses for the product categorisation task in Pollinate (2021).

Stimulus	Only contains plant-based ingredients	Contains a mix of animal meat and plant-based ingredients	Only contains meat from animals
Beyond Meat – Beyond Burger	87%	9%	5%
Unreal Co – Beefy Brat	81%	14%	5%
Sunfed – Chicken Free Chicken	71%	13%	16%
Next! Extra Crispy Bacon	70%	12%	18%
Plant Asia – Tender Beef	67%	17%	16%
Woolworths – Beef Mince (Control)	3%	6%	91%

As shown in Table 2, between 13% and 33% of respondents miscategorised the plant-based protein products, compared to 9% who miscategorised the animal meat control. On average, 25% of

respondents miscategorised the plant-based protein products. The study authors also reported that 61% of respondents were incorrect on at least 1 of the 5 plant-based meats tested (i.e. selected either 'Only contains animal meat' or 'Contains a mix of animal meat and plant-based ingredients'). However, this measure is not the most relevant to consider for the purposes of this literature review, as it is a respondent-level measure rather than a product-level measure, and it is unlikely that individuals would be in the position of determining the nature of 5 different plant-based meat products at 1 time.

It is possible to have some level of confidence in these findings as each study used a reasonably large and broadly nationally representative sample of Australian consumers, used objective measures with realistic stimulus, and the proportion of consumers that miscategorised the plant-based protein products were broadly consistent across studies.

However, each study also contained limitations that suggests some caution needs to be taken in interpreting these findings. Relevant demographics were either not collected or not reported in each study, such as level of education and language spoken at home, which may have impacted on results. Additionally, as only front-of-pack images were shown in each study, participants were not provided with the full range of information (like the ingredients list) that would be available in reality. This suggests that these studies may tend towards an upper estimate of the level of confusion, as the provision of this information may help to reduce it. This may particularly be the case for the Pollinate (2021) study, where the limited information was compounded by giving participants only 3 seconds to review the image before an answer was required about its ingredient content. As such, this design may more accurately reflect a scenario of someone shopping in a rushed environment. In contrast, Institute for Sustainable Futures (2022) did not report how long participants were given to review the images before answering. Finally, the Institute for Sustainable Futures (2022) study did not report the proportions of plant-based vs animal meat product images contained in the total sample set of 60 images and did not report the proportion of people who correctly identified animal meat products vs those who correctly identified plant-based protein products.

In addition to the studies reported above, 2 other cross-sectional surveys (Australian Pork Limited (2021) and Center for Public Policy (2019)) reported on objective measures of consumer confusion. However, absent methodological detail, inconsistency with the results from the previous 2 studies (which had lower risk of bias due to clearer reporting of methodological information), and/or different populations give a low level of confidence in the generalisability of the findings to the Australian context.

Australian Pork Limited (2021) noted in their submission to the Senate Inquiry on the Definition of meat and other products (Submission #129) that they had conducted a recent consumer survey that found that '50 per cent of Australians believed, upon initial view of package labelling, that a 'plant-based roast pork' product was made of pork.' As the submission does not provide any methodological information about the study, such as its design, number of participants, their characteristics, the stimulus provided, amount of time given to participants, or question/s asked, it is not possible to assess the validity of the study or risk of bias.

Center for Public Policy (2019) was commissioned by the National Cattlemen's Beef Association in the USA to undertake a cross-sectional survey of a sample of 1,800+ US consumers, nationally representative by age, region and gender.

All respondents were initially presented with the term 'plant-based beef' on its own and asked to identify the likely ingredient content of a product with this description (response options: 'completely vegan, containing no meat or animal byproducts (eggs, dairy)', 'does not contain meat but may contain animal byproducts', 'can contain small amounts of meat but is primarily plant-based', and 'contains meat and there are no restrictions on the amount').

Participants were then broken up into groups (n = 350 per group) and shown images of either plant-based beef packaging, beef packaging, or advertisements. As advertisements are not within the scope of this literature review, they have been excluded from the reported results. The plant-based beef packaging that they were shown consisted of 'Beyond Burger', 'Beyond Beef', and 'Lightlife Gimme Lean', 3 products that are available in the US marketplace.

The Beyond Burger product image contains the terms 'Beyond Meat – Beyond Burger – Plant-based patties' and includes a green icon of a cow above the 'Beyond Meat' brand. The product, which looks very similar in appearance to an animal meat product, is visible through a clear window, and the packaging also includes descriptions of the intended flavour: 'Now even meatier – Marbled juiciness'.

The Beyond Beef product image contains the terms 'Beyond Meat – Beyond Beef – Plant-based ground' and includes the same green icon of a cow above the 'Beyond Meat' brand. The product, which looks very similar in appearance to animal meat, is visible through a clear film, but it does not contain descriptions of the intended flavour.

The LightLife product image contains the terms 'Lightlife – Gimme Lean – Plant-based Ground – Beef' and includes a photograph of spaghetti and meatballs. The product packaging is that of processed sausage mince or similar, although the product itself is not visible. It does not contain a description of the intended flavour.

Respondents were asked once again to identify the ingredient content, using the same response options (response options: 'completely vegan, containing no meat or animal byproducts (eggs, dairy)', 'does not contain meat but may contain animal byproducts', 'can contain small amounts of meat but is primarily plant-based', and 'contains meat and there are no restrictions on the amount').

Table 3 Ingredient expectations for a range of plant-based beef products (Source: Center for Public Policy (2019))

Stimulus and Sample Size	Completely vegan, containing no meat or dairy, eggs	Does not contain meat but may contain dairy, eggs	Can contain small amounts of meat, but is primarily plant-based	Contains meat and there are no restrictions on the amount
Term 'plant-based beef' only (n = 1,800)	45%	31%	17%	7%
Image of 'Beyond Burger' package (n = 350)	39%	29%	21%	11%
Image of 'Beyond Beef' package (n = 350)	41%	27%	22%	10%

Stimulus and Sample Size	Completely vegan, containing no meat or dairy, eggs	Does not contain meat but may contain dairy, eggs	Can contain small amounts of meat, but is primarily plant-based	Contains meat and there are no restrictions on the amount
Image of 'Lightlife Gimme Lean' package (n = 350)	37%	26%	22%	15%

Note: the total sample of 1,800 was divided into 5 groups of 350 following the terminology question. Two groups are not reported as they were shown advertising, which is not within the scope of this review.

The study found that 24% of respondents believed that a product using the term 'plant-based beef' could contain meat. When viewing their product image, between 32% to 37% of respondents in each group believed that the plant-based protein product presented could contain some amount of meat (see **Error! Reference source not found.**). It is important to note that the proportion of respondents w ho believed that a product using the term 'plant-based beef' could contain meat was not reported for each sub-group, which inhibits direct comparison.

The study's reasonably large, nationally representative sample gives some confidence in its generalisability to US consumers. However other relevant demographics were not collected and/or reported, such as level of education, language spoken at home, and whether they were vegan/vegetarian. The stimulus used was realistic, as it was taken from actual product images available in the US, however as only front-of-pack images were shown, participants were not provided with the full range of information (like the ingredients list) that would be available in practice. It is not clear how respondents were allocated to the different groups (i.e. whether it was random or not), which may have affected the results. Additionally, as the measure around 'plant-based beef' terminology alone was not reported by subgroup, a direct comparison between proportions of misidentification attributable to the terminology vs the product packaging is not possible.

It is not clear how generalisable this study would be to Australian consumers, as there is an inconsistency in the findings between this US study and the 2 Australian studies reported above (Institute for Sustainable Futures 2022 and Pollinate 2021). Differences in regulatory environments, stimuli presented and plant-based protein products available may have impacted on these results.

Self-reported consumer confusion

In addition to the objective measures outlined above, the same 2 Australian studies (Institute for Sustainable Futures (2022) and Pollinate (2021)) asked consumers about to report their level of confusion regarding plant-based protein products. It is important to note that self-report measures cannot provide an objective measure of whether consumers are being misled by the labelling of plant-based protein products as they can be highly malleable based on the respondents' prior experience (or lack of it) with plant-based protein products as well as their ability to accurately recall past experiences. As such, it is preferable to rely on objective measures to ascertain the extent of consumer confusion.

In Institute for Sustainable Futures (2022), 51% of respondents initially agreed that 'I can tell the difference between plant-based and animal meat products based on the product labels', 16% disagreed, with the remaining 33% of respondents not reported. However, after the product

categorisation exercise outlined above, where they were shown a random sample of 15 images of plant-based and animal meat products available on the market, 91% of respondents indicated Yes, when asked 'Can Australians tell the difference between plant-based and animal-based meat products?' (9% No). The 15 images shown to respondents were drawn from a bank of 60; the exact images and proportion of plant-based vs animal meat products shown were not reported. Note that the question differed between instances, with the first referring to their own experience, and the second asking respondents to answer on behalf of 'Australians' in general. This, as well as the product categorisation exercise, may have influenced the differing results.

In Pollinate (2021), following the product categorisation exercise outlined above, respondents were asked 'When it comes to being able to determine whether there is any animal meat in the product, how confusing is this packaging for you?' Responses were collected on a 5-point Likert-type scale where 1 = Not at all confusing, 2 = Not very confusing, 3 = Somewhat confusing, 4 = Very confusing, and 5 = Extremely confusing. Pollinate reported the proportion of respondents who had selected they found the packaging to be 'Somewhat', 'Very', or 'Extremely' confusing – that is, those who selected a response at the midpoint of the Likert scale and above (51%). However, this is a biased estimate as the Likert-type scale used was asymmetric, meaning that the middle category was not neutral, thus providing 3 options indicating confusion compared to two indicating no confusion. This may have inclined respondents who were otherwise neutral to indicate some level of confusion or may have signalled to participants that some level of confusion was the 'correct' answer. It is therefore not possible to make any definitive conclusions based on this question due to the substantial risk of bias.

In the same Pollinate (2021) study, respondents were asked 'Thinking about shopping for groceries, have you ever had a hard time figuring out whether a product is made of plant-based vs animal meat when looking at product packaging?'. Pollinate reported that 45% of consumers had, but the size of the sample for this question is unclear and possible response options were not reported. Three different sample sizes were reported. 'Seen plant-based meat online (n = 512); seen plant-based meat in-store (n = 802); Seen plant-based meat online or instore (n = 810)'. It is not clear what sample was asked this question. It is therefore not possible to make any definitive conclusions based on this question due to the substantial risk of bias. In a separate question, respondents were asked 'Do you think you have ever mistaken plant-based protein for animal meat due to its packaging?' 32% of respondents reported that they had, while 68% reported that they had not. This question was asked to the whole sample (n = 1000).

These same 2 studies also contained self-report measures of consumer confusion associated with product placement in physical stores or online product categorisation. In Institute for Sustainable Futures (2022), 48% of respondents agreed with the statement 'I don't mind if plant-based meats are placed near animal-based products in supermarkets, as I can tell the difference between the two'. 23% disagreed, while the other 29% is not reported. In Pollinate (2021), consumers were asked 'Thinking about shopping for groceries, have you ever had a hard time figuring out whether a product is made of plant-based vs animal meat when looking at… where the products are placed in the supermarket / how the product is categorised online.' Pollinate reported that 47% of consumers agreed that they had, at some point, 'had a hard time figuring out' whether a product is made of plant-based or animal meat either based on the location in the shop, and 42% based on online

product categorisation. However, the size of the sample for these questions is not clear and possible response options were not reported.

Four cross-sectional surveys asked Australian or New Zealand consumers to report whether they had ever mistakenly purchased a plant-based protein product. Responses ranged from 6% to 12% (see Table 3).

Table 3 Proportion of consumers who had mistakenly purchased a plant-based protein product

Study and Funding Body	Sample size	Country	Proportion who had mistakenly purchased a plant-based protein product
Colmar Brunton (2019a) Food Frontier and Life Health Foods	Not reported	Australia	9%
Colmar Brunton (2019b) Food Frontier and Life Health Foods	Not reported	New Zealand	6%
Institute for Sustainable Futures (2022) No Meat May and Vegan Australia	N = 1,014 Nat rep	Australia	12%
Woolworths (2021) ^	N = 5,700	Australia	7%^

^ Proportion of consumers who had mistakenly purchased a plant-based protein product.

Colmar Brunton (2019a, 2019b) was commissioned by Food Frontier and Life Health Foods to undertake 2 studies, 1 in Australia and 1 in New Zealand. The authors reported that the 2 studies were nationally representative, however, no sample size or participant characteristics were reported. The study design was also not reported but appears to have been a cross-sectional survey. The studies found that 91% of Australians and 94% of New Zealanders 'have never mistakenly purchased a plant-based product thinking it was its meat-based counterpart, or vice versa.' The precise response options were not reported. Of those who had mistakenly purchased a product, they were more likely to be a vegetarian or vegan in both Australia and New Zealand.

Institute for Sustainable Futures (2022) asked a broadly nationally representative sample of 1,014 Australian consumers 'Have you ever mistakenly bought or eaten plant-based meat thinking it was an animal-based meat product?'. 80% of respondents indicated that they had not, 12% indicated that they had, and 7% were not sure.

Woolworths (2021) noted in their submission to the Senate Inquiry on the Definition of meat and other products (Submission #127) that they had conducted a recent survey of 5,700 customers that found that 7% reported that they had purchased a plant-based item in error. The question wording and response options were not provided.

As neither Colmar Brunton (2019a, 2019b) or Woolworths (2021) provided any methodological information about their study, such as its design, number of participants (in the case of Colmar Brunton), their characteristics, or exact question/s asked, it is not possible to assess risk of bias. However, the consistency in findings both across these studies and with the Institute for Sustainable Futures, which asked a similar question with methodological detail, provides a limited level of confidence in the approximate magnitude of these findings. The percentage of consumers who

mistakenly purchased plant-based meat in these studies are all below the average proportion of consumers who miscategorised the product categories in the objective measures described above.

Effect of meat terminology

In contrast to the studies described thus far, which examined rates of consumer confusion when examining plant-based protein and animal meat packaging as a whole, the 5 studies reported in this section investigate how consumers respond to meat terminology on plant-based protein labels. Three of these studies used an experimental design, which allows us to determine the effect of using meat terminology on consumer understanding of the ingredient content of plant-based protein products compared to labelling that does not contain meat terminology. In addition, 2 cross-sectional surveys provide some self-report information about the effect of meat terminology.

Experimental studies

Two peer-reviewed experimental studies (Baptista and Schifferstein (2023) and Gleckel (2020)) and 1 unpublished experimental Masters' thesis (DeMuth (2019)), all of which were undertaken in the USA, found that the use of meat terminology on plant-based protein products did not adversely impact consumer understanding of the ingredient content of the product. Despite some limitations associated with sample size for 2 of the studies (outlined further below), consistency across the 3 studies lends confidence to this finding. However, it is not clear whether the finding would be generalisable to an Australian population.

Baptista and Schifferstein (2023) undertook an experiment with a convenience sample of 600 US consumers (49% female, 91% consumed meat). Participants were randomly allocated to 1 of 9 possible groups. Eight of the groups viewed images of a plant-based 'chicken' product that varied according to different combinations of: terminology used (chicken vs seitan vs strips), image (chicken vs wheat), container (tray vs jar), and claim (no cholesterol vs low sodium). Participants in the ninth group (the control group) viewed an image of chicken meat in a tray with an image of a chicken and a sodium claim. Respondents were asked to identify the expected content of the product on a five-point scale (1 = 100% animal, 2 = mostly animal, 3 = 50% animal, 50% vegetable, 4 = mostly vegetable, and 5 = 100% vegetable). The number of seconds and milliseconds it took respondents to answer the question was also logged.

The study found that all plant-based chicken samples had mean ratings in the range of 4.3 to 4.7 (i.e. mostly or 100% vegetable), while the control (traditional chicken) had a mean rating of 1.6 (i.e. mostly or 100% animal). This was a significant difference (all $p < .001$) and indicates that, on average, consumers accurately identified the ingredient content of both types of products regardless of the terminology used.

Only 1 plant-based sample significantly differed from the traditional chicken control in the length of time it took to respond to the question, and respondents were quicker to respond to the plant-based item. The mean response time for the traditional chicken control was 12.1 seconds, compared to 1 plant-based sample (using the term veggie strips, in a tray, with a picture of wheat and a claim about low sodium) that had a mean of 7.1 seconds [$p < .05$]). All other plant-based samples, including those that used chicken terminology, had a mean response time in the range of 7.9 to 10.9 seconds, which did not significantly differ from the mean response time for the traditional chicken control of 12.1 seconds ($p < .05$).

The study also asked participants 'Thinking on the sensory characteristics (tastes, aromas, texture, flavours) of this product, how do you expect it to be?' Response options were sweet, salty, bitter, savory, soft, juicy, crispy, beany, wheaty, cardboard, dry, chicken flavor, nutty, chewy, and fibrous. The study found that meat terminology effect consumers' sensory expectations. Plant-based protein examples labelled 'veggie chicken' were expected to have significantly more chicken flavour than samples labelled 'veggie strips' ($p < .01$) or 'veggie seitan' ($p < .05$).

Combined, these findings tell us that the use of chicken terminology on plant-based protein products did not adversely affect consumers' understanding about the ingredient content of the product or the length of time it took them to assess it compared to a traditional chicken control, and improved consumer understanding of the intended flavour of the product compared to plant-based products that did not use chicken terminology.

The study's experimental design and use of objective measures enable causal relationships to be established between different labelling elements and level of consumer understanding. However, the relatively small sample size (approx. 67 participants per group) may have lacked the statistical power to be able to detect small effects across 9 different groups which may account for the lack of effect associated with terminology. In addition, the sample was 1 of convenience and did not collect and/or report some relevant demographic characteristics (e.g. education, language spoken at home).

Gleckel (2020) undertook an experiment (between-subjects design) with a convenience sample of 155 US consumers (68% female, 66% university-educated, 13.6% vegan or vegetarian). Participants were randomly allocated to 1 of 2 groups (Group A: N = 96; Group B: N = 59) and were provided with 3 fictional names of plant-based alternative products, forming pairs across groups where 1 version of the name included meat/dairy terminology (the experimental condition) and 1 that did not (the control condition). There were 2 meat-related product pairs, and 1 dairy-related product pair. See Table 4.

Table 4 Experimental groups and conditions for Gleckel (2020)

	Group A (n = 96)	**Group B (n = 59)**
Product Pair 1	Next-Generation Meat: Plant-Based Beef Burger [Experimental condition]	Next-Generation Vegetables: Plant-Based Veggie Patty [Control condition]
Product Pair 2	Cultured Vegan Spread [Control condition]	Cultured Vegan Butter [Experimental condition]
Product Pair 3	Plant-Based Deli Slices: Bologna Style [Experimental condition]	Sandwich Slices [Control condition]

Results for product pairs 1 and 3 are reported in this section, as they concerned meat terminology. Results for product pair 2 is reported in the effect of dairy terminology section.

Questions differed between product pairs. For product pair 1 ('Next-Generation Meat: Plant-based beef burger' vs 'Next-Generation Vegetables: Plant-based veggie patty'), participants were asked:

a) Do you think this product is made from a cow? (response options: 1 = Very unlikely, 2 = Unlikely, 3 = Neither likely or unlikely, 3 = Likely, 5 = Very likely).

b) Do you think that eating this product tastes like eating vegetables? (response options: 1 = Not at all, 2 = A little, 3 = A moderate amount, 4 = A lot, 5 = A great deal)

c) Do you think this product is a good source of protein? (response options: 1 = Far below average, 2 = Below average, 3 = Average, 4 = Above average, 5 = Far above average).

For product pair 3 ('Plant-based Deli Slices: Bologna Style' vs 'Sandwich Slices'), participants were asked:

a) 'Do you think this product is made from an animal?' (response options: 1 = Very unlikely, 2 = Unlikely, 3 = Neither likely or unlikely, 3 = Likely, 5 = Very likely) and

b) 'How well can you imagine what this product tastes like?' (response options: 1 = Not at all clearly, 2 = Not so clearly, 3 = Somewhat clearly, 4 = Very clearly, 5 = Extremely clearly).

The study found no significant difference in expectations of animal content between 'Next-Generation Meat: Plant-based beef burger' (M = 0.49, SD = 0.67) and 'Next-Generation Vegetables: Plant-based veggie patty' (M = 0.51, SD = 0.57) (p = .88). Both products were thought to be very unlikely or unlikely to have been made from a cow. This indicates that the use of meat descriptors had no effect on participants' perceptions of whether a plant-based protein product contains meat.

Participants were, however, significantly more likely to expect that 'Plant-based veggie patty' would taste like vegetables (M = 1.54, SD = 1.09) compared to 'Plant-based beef burger' (M = 1.05, SD = 1.05) (p = .005). Approximately 39% of participants thought that eating the 'Plant-based beef burger' would taste 'Not at all' like eating vegetables, compared to 17% in the 'Plant-based veggie patty' group.

The study found that participants were significantly less likely to think 'Plant-based Deli Slices: Bologna Style' contained animal products (M = 0.81, SD = 1.33) compared to 'Sandwich Slices' (M = 2.72, SD = 1.17) (p < .001). A majority of participants (proportion not reported) thought that it was 'Very Unlikely' that 'Plant-based Deli Slices: Bologna Style' came from an animal, while the majority of participants (proportion not reported) thought it was 'Likely' that 'Sandwich Slices' came from an animal.

Participants were also significantly more likely to report that they could imagine the taste of 'Plant-based Deli Slices: Bologna Style' (M = 2.83, SD = 0.97) compared to 'Sandwich Slices' (M = 2.39, SD = 0.96) (p = .003). A majority of participants (proportion not reported) could imagine 'Somewhat Clearly' what 'Plant-Based Deli Slices: Bologna Style' taste like, whereas a majority of participants (proportion not reported) could 'Not So Clearly' imagine what 'Sandwich Slices' taste like.

The study's experimental design enables causal relationships to be established between labelling terminology and consumer expectations. However, the relatively small convenience sample had a large proportion of female, university-educated and/or vegan or vegetarian participants. Control conditions were also not consistent across pairings: while 'Next-Generation Meat: Plant-based beef burger' and 'Next-Generation Vegetables: Plant-based veggie patty' have a consistent style and number of words, this does not hold true for 'Plant-based Deli Slices: Bologna Style' and 'Sandwich Slices'. Outcome measures were also not consistent across product pairings, and neither was reporting of proportions.

DeMuth (2019) undertook an experimental (between-subjects) study with a nationally representative sample of 1,521 US consumers (53% female, 37% university educated, 13% vegan or vegetarian). Participants were randomly allocated to 1 of 2 groups, and each group was provided

with 4 images. Two of the images were of meat alternatives: 1 plant-based protein product currently available on the market in the US (the 'Beyond Burger'), and 1 cell-cultured meat that was within the conceptual stage ('Just Meat'). As cell-cultured meat is not within the scope of this literature review, the findings based on this product are not included in the reported results. The other 2 images were conventional meat products currently on the market in the US: 1 was 'BallPark Flame Beef Patty' and the other was 'Homestyle Beef Patty'.

The experimental component of the study focused on the meat alternatives. 1 group (Group A) saw the 'Beyond Burger' with the meat terminology currently used in the marketplace. The other group (Group B) saw the 'Beyond Burger' with terminology adapted to meet anticipated new legislative requirements that prevented the use of meat terminology (see Table 5). The stimuli was a visual of the packaging and was consistent across groups in all other ways except the use of meat terminology on the plant-based protein product. The animal meat products were consistent across groups in both appearance and terminology. No animal imagery was present on any of the packaging.

Table 5 Experimental groups and conditions for DeMuth (2019)

	Group A (Pre-Law Labelling; n = 732)	**Group B (Post-Law Labelling; n = 772)**
Plant-based protein product	Beyond Meat – The Beyond Burger – Plant-based Burger Patties	Beyond Protein – The Beyond Patty – Plant-based Patties
Animal meat product	BallPark Flame Grilled Beef Patty	BallPark Flame Grilled Beef Patty
Animal meat product	Homestyle Beef Patties	Homestyle Beef Patties

Participants were asked 'What do you think are the ingredients in this product?' with response options of: corn, wheat, ground beef, onions, peas, sesame oil, soy, beets, natural & artificial flavouring. Respondents were asked to report whether the product did or did not contain each ingredient.

The study found that 31.4% of participants in the 'Beyond Meat – The Beyond Burger: Plant-based Burger Patties' group (Group A) incorrectly selected ground beef as an ingredient, while 30.4% of participants in the 'Beyond Protein – The Beyond Patty: Plant-based Patties' group (Group B) incorrectly selected ground beef as an ingredient. In comparison, 87.4% (Group A) and 88.3% (Group B) of participants correctly identified ground beef as an ingredient in 'BallPark Flame Grilled Beef Patty', and 87.8% (Group A) and 85.2% (Group B) of participants in 'Homestyle Beef Patties'.

The study's experimental design enables causal relationships to be established between the terminology of the plant-based protein product tested and consumer expectations of ingredient content. The large and nationally representative sample also provides a good degree of confidence in its generalisability to US consumers. However, the study only tested 1 type of plant-based protein product (burger patties), and only tested a difference in terminology, limiting its ability to be generalised to a wider range of plant-based protein products that may have differing labelling elements. The study also only presented participants with an image of the front of the product, meaning that participants did not have access to the ingredient list, which does not reflect all information available to consumers in practice.

Cross-sectional surveys

In addition to the 3 experimental studies outlined above, 2 cross-sectional surveys investigated consumer attitudes towards the use of meat terminology on plant-based protein products.

In a cross-sectional survey of a nationally representative sample of 1,800+ US consumers (Center for Public Policy (2019)), respondents were asked to identify the likely ingredient content of a product that used the term 'plant-based beef' (response options: 'completely vegan, containing no meat or animal byproducts (eggs, dairy)', 'does not contain meat but may contain animal byproducts', 'can contain small amounts of meat but is primarily plant-based', and 'contains meat and there are no restrictions on the amount'). The survey found that 24% of consumers mistakenly believed that a product using the term 'plant-based beef' contains, or can contain, meat.

In the same study, meat terminology was qualitatively cited as a source of confusion for consumers after looking at 1 of 3 product images of plant-based protein products currently available on the market. The 3 products were 'Beyond Meat – Beyond Burger – Plant-based Patties', 'Beyond Meat – Beyond Beef – Plant-based Ground' and 'Lightlife – Gimme Lean – Plant-based Ground – Beef'. The exact question asked, the proportion of consumers who responded, or the frequency with which meat terminology was cited as a source of confusion was not reported.

In the Pollinate (2021) survey, consumers who reported that they found the plant-based packaging presented in the study confusing (n = 509) were asked 'And why do you say that the packaging for plant-based meat products are somewhat/very/extremely confusing for you?' Responses were open ended free text, which were then coded. Use of meat descriptors ('meat', 'chicken', etc) was reported as a source of confusion by 14% of consumers. The study also provided some qualitative data on meat terminology from the open-ended response, with consumers reporting that the use of meat terminology can be smaller than the ingredient qualifiers, or in some other way emphasised, which can confuse and mislead consumers.

In a separate question in the same study, respondents were asked 'Do you expect plant-based meat to contain at least some animal meat if the product packaging a) uses words like 'beef', 'chicken', and 'lamb'; b) describes the product as 'meat''. 51% of participants answered 'Yes' to both. Other response options were not reported. This question did not take into account the current regulatory environment, where meat terminology cannot be used on plant-based labelling without an appropriate qualifier to establish the true ingredient content of the food (e.g., 'plant-based' meat, 'meat-free' chicken, etc.).

While each of these cross-sectional studies utilised a reasonably large, nationally representative sample, the experimental studies provide a higher standard of evidence around the effect of meat terminology on consumers' understanding of plant-based protein products. This is because each of the experimental studies used objective measures and were designed in such a way as to be able to distinguish the effect of meat terminology from other labelling elements (such as any animal imagery) on consumer understanding. The cross-sectional studies, by contrast, primarily (with the exception of 1 measure in the Center for Public Policy) measured consumer attitudes towards the use of meat terminology. It is, however, unclear how generalisable the findings from the experimental studies would be to an Australian population as they were primarily based on convenience samples in the USA, without collecting or reporting key demographic info such as level of education and language spoken at home.

Effect of ingredient qualifiers

In a cross-sectional survey of 1,000 Australian consumers (Institute for Sustainable Futures 2023), 64% of consumers agreed with the statement that 'I find terms like 'meat-free' and 'meat-less' used on plant-based foods helpful to differentiate if the product contains meat or not', while 12% disagreed. Separately, 57% of respondents agreed with the statement 'I find terms like 'beef-free mince', 'plant-based chicken' or 'bacon-style slices' help me differentiate if the product contains meat from an animal or not', while 18% disagreed. These proportions do not add up to 100%, which suggests that the questions may have been optional, or there may have been a 'don't know' or 'neutral' option that was not reported.

While this study utilised a reasonably large, nationally representative sample of Australian consumers, the questions asked only measured consumer attitudes towards ingredient qualifiers and are not able to provide any objective measure of their effect on consumer understanding. Additionally, the study did not report full methodological information (e.g., the response options that were provided to participants were not reported), which makes it difficult to ascertain risk of bias.

Effect of animal imagery

Experimental studies

1 peer-reviewed, experimental study examined the effect of animal imagery on consumers' understanding of the ingredient content of plant-based chicken.

Baptista and Schifferstein (2023) undertook an experiment with a convenience sample of 600 US consumers (49% female, 91% consumed meat). Participants were randomly allocated to 1 of 9 possible groups. Eight of the groups viewed images of a plant-based 'chicken' product that varied according to different combinations of: terminology used (chicken vs seitan vs strips), image (chicken vs wheat), container (tray vs jar), and claim (no cholesterol vs low sodium). Participants in the ninth group (the control group) viewed an image of chicken meat in a tray with an image of a chicken and a sodium claim. Respondents were asked to identify the expected content of the product on a five-point scale (1 = 100% animal, 2 = mostly animal, 3 = 50% animal, 50% vegetable, 4 = mostly vegetable, and 5 = 100% vegetable). The number of seconds and milliseconds it took respondents to answer the question was also logged.

The study found that the plant-based chicken products that had an image of a chicken had a mean rating of 4.4 ± 0.9 while plant-based chicken products that had an image of wheat had a mean rating of 4.7 ± 0.6. This was a statistically significant difference ($p < .001$) and indicates that, while the plant-based chicken was clearly recognised as being plant based in all groups, the image of a chicken on the packaging slightly but significantly caused participants to expect a more animal origin. The control mean was not reported.

The study also found that the mean response time differed between plant-based chicken products that had an image of a chicken (mean = 10.5 ± 7.8 seconds) compared to plant-based chicken products that had an image of wheat (mean = 8.7 ± 6.5 seconds). This was a statistically significant difference ($p < .05$), indicating that participants took longer to identify the ingredient content for those plant-based products that had an image of a chicken than those that had an image of wheat.

The study also asked respondents 'Thinking on the sensory characteristics (tastes, aromas, texture, flavours) of this product, how do you expect it to be?' Response options were sweet, salty, bitter,

savory, soft, juicy, crispy, beany, wheaty, cardboard, dry, chicken flavor, nutty, chewy, and fibrous. The study found that products with an image of wheat were expected to have significantly less chicken flavour ($p < .001$) and be wheatier ($p < .05$) than products with the image of a chicken.

Combined, these findings tell us that the use of chicken imagery on plant-based protein products slightly but significantly decreases consumer understanding about the ingredient content of the product and the length of time it took them to assess the ingredient content compared to plant-based products that used wheat imagery. However, the image of a chicken also significantly improved consumers' understanding of the intended flavour of the product compared to products that used wheat imagery.

The study's experimental design and use of objective measures enable causal relationships to be isolated between different labelling elements and level of consumer understanding. That is, the effect of animal imagery on consumer understanding was able to be objectively determined and isolated from the effect of meat terminology. However, the sample was 1 of convenience and did not collect and/or report some relevant demographic characteristics (e.g. education, language spoken at home) and it is not clear whether these findings would be generalisable to the Australian population.

Cross-sectional surveys

In 2 cross-sectional surveys of Australian consumers (Pollinate (2021); Sustainable Futures 2022), animal imagery on plant-based protein products was reported as a source of confusion.

In the Pollinate (2021) survey, consumers who reported that they found the plant-based packaging presented in the study confusing (n = 509) were asked 'And why do you say that the packaging for plant-based meat products are somewhat/very/extremely confusing for you?' Responses were open ended free text, which were then coded. Animal imagery was the most reported source of confusion, with 36% of respondents mentioning this. The study also provided some qualitative data on animal imagery from the open-ended response, with consumers reporting that images (especially photos) of animals draw their attention away from the use of ingredient qualifiers like 'plant-based'.

In a separate question in the same study, respondents were asked 'Do you expect plant-based meat to contain at least some animal meat if the product packaging uses images/icons of animals (e.g. cows, chickens, and pigs). 54% of participants answered 'Yes'. Other response options were not reported.

In the Institute for Sustainable Futures (2022) survey, 45% of respondents agreed with the statement 'I find the use of animal images on plant-based meats confusing', while 27% disagreed. The remaining 28% was not reported. Separately, 38% agreed with the statement 'I find that animal images featured on plant-based meat products help me understand the type of meat that the plant-based product is trying to replicate', while 29% disagreed. The remaining 33% was not reported.

Animal imagery was also cited qualitatively as a source of confusion on plant-based protein labelling in the study undertaken by Center for Public Policy (2019). Participants' qualitative responses were captured after they had examined their product image, each of which contained a small icon of a cow above the brand. The exact question was not reported.

As in the section above, the experimental study provides a higher standard of evidence around the effect of animal imagery on consumers' understanding of plant-based protein products. This is

because the study used an objective measure and was designed in such a way as to be able to distinguish the effect of animal imagery from other labelling elements (such as meat terminology) on consumer understanding. The cross-sectional studies, by contrast, measured self-reported sources of confusion and consumer attitudes towards the use of animal imagery. However, it is not clear how generalisable the findings from the experimental study would be to the Australian population as it was based on a convenience sample in the USA, without collecting or reporting key demographic info such as level of education and language spoken at home.

Demographics

Pollinate (2021) found that those who incorrectly identified at least 1 plant-based protein product in their product categorisation exercise were more likely to have 1 or more of the following characteristics: being male, aged 65+ years, an 'empty nester', speak a language other than English with family/friends, and/or a household income of $40k or below.

In the same study, respondents suggested that people who were 'in a rush/distracted', 'older', 'unfamiliar with plant-based meat / meat-eaters', who had 'sight problems' or had 'an English-as-a-second language / foreign background' would be more likely to mistake plant-based protein products for animal meat products.

Institute of Sustainable Futures (2023) asked those who reported having mistakenly purchased a plant-based protein product why they thought they had done so. 67% said it was because they were in a hurry/distracted and did not read the product label, while 33% said they were confused by what the product actually was.

The Pollinate study provides an objective measure of the demographics that are more likely to find the labelling of plant-based protein products confusing, based on a statistical analysis of those who incorrectly identified a product in their product categorisation exercise. As such, there is some level of confidence in these findings. In comparison, the other reported measures in both Pollinate (2021) and Institute of Sustainable Futures (2023) are based on self-report or conjecture, and there is a resulting low level of confidence in these findings.

Dairy and plant-based alternatives

Summary of findings

A total of 7 studies examined consumers' level of understanding of plant-based dairy products. Three were peer-reviewed studies while 4 were grey literature studies of varying published detail. Three studies were undertaken in Australia, 3 in the USA, and 1 in the UK. Three used experimental designs, while the other 4 are reported as using or are likely to have used a cross-sectional survey design.

Key findings

Extent of consumer confusion

- There was limited evidence available on Australian consumers' ability to accurately identify plant-based dairy alternatives.
- Three studies (1 cross-sectional study undertaken in the US and 2 peer-reviewed studies undertaken online without reporting country of residence information) found that around 70–94% of consumers understand that plant-based milks do not contain cow's milk. This compares

favourably to consumer understanding of traditional cow's milk products, which were correctly understood by 64%–90% of consumers (Feltz & Feltz 2019; International Food Information Council Foundation (2018)).

- Two studies undertaken in Australia with no methodological information provided indicated that the vast majority of consumers (up to 93%) understand the ingredient content of plant-based milks or items (Sanitarium (2021); Woolworths (2021)).

Effect of dairy terminology

- Across 3 peer-reviewed experimental studies, there was either no significant effect or only a small effect of dairy terminology on consumer understanding of the ingredient content of plant-based dairy alternatives.
  - Two peer-reviewed experimental studies found no significant effect of dairy terminology on US consumers' understanding of the ingredient content of plant-based dairy alternatives (Baptista and Schifferstein (2023); Gleckel (2020)).
  - One peer-reviewed experimental study undertaken in the UK found a small but significant effect, where plant-based alternatives labelled with milk terminology were more likely to be misidentified as coming from an animal source compared to those not labelled with milk terminology. However, the increase was small, and misidentification was very infrequent, with less than 1 product out of 10 being misidentified on average regardless of whether milk terminology was used (De-Loyde et al., 2023).
  - The difference in study findings may be due to different regulatory contexts: plant-based milk alternatives are not currently able to be labelled with milk terminology in the UK, whereas they are in the US, potentially leading to different levels of consumer familiarity. Nevertheless, the UK finding is small and misidentification infrequent, suggesting dairy terminology does not have a meaningful impact on consumer accuracy in identifying plant-based milks.
- Two experimental studies (undertaken in the US and UK) found that consumers were significantly more likely to understand how to use plant-based dairy alternatives that used milk terminology compared to those that did not (De-Loyde et al., 2023; Gleckel (2020)). In 1 of the studies, the use of dairy terminology also significantly improved consumers' reported understanding of the intended flavour of the product (Gleckel (2020)).
- It is not clear whether these findings would be generalisable to the Australian population.
- There is no evidence available on the effect of ingredient qualifiers such as 'dairy free' on consumers' perceptions of plant-based dairy alternatives.

Effect of animal imagery

- One experimental study in the USA found that animal imagery slightly decreases consumer understanding of ingredient content of plant-based milk and increases the length of time consumers' spend assessing the product's ingredient content (Baptiste and Schifferstein (2023)).

Demographics

- There is no evidence available on the demographics of consumers who are more likely to mistake plant-based dairy alternatives for traditional dairy products.

Extent of consumer confusion

Objective measures of consumer confusion

Two peer-reviewed experimental studies (reported in 1 document) found that participants were significantly better at accurately identifying plant-based milks and cheese products compared to animal-derived milks and cheese products (both $p < .001$).

Feltz and Feltz (2019) undertook 8 separate experiments around consumer accuracy at identifying plant-based and animal-based milk items, of which 2 are of relevance to this review. The 2 studies in question were each a between-subject design and undertaken with an online convenience sample of 125 consumers recruited online. Country of residence was not collected or reported.

In the first study (N = 125, 51% female, 65% university-educated, 16% rural), participants were divided into 2 groups. Each group was shown a total of 6 images drawn from a bank of 8 total: 4 animal-based milks (1% milk, 2% milk, skim milk, whole milk) and 4 plant-based milks (almond milk, coconut milk, rice milk, soy milk). A sample of the stimulus was provided, which were real plant-based and animal milks from different countries around the world. 1 group saw 4 animal-based milks and 2 plant-based milks. The other group saw 2 animal-based milks and 4 plant-based milks. All 6 images were presented at once on the screen, and participants were instructed to select the items that were made with real cow's milk by clicking on the image.

The study found that participants were reliably better at identifying plant-based items compared to animal-based items ($p < .001$). 94% of participants accurately identified the plant-based milks, compared to 77% that accurately identified the cow milks. The different ratio of animal to plant-based milks shown to the different groups did not significantly affect accuracy.

In the second study (N = 125, 42% female, 62% university-educated, 46% rural), participants were similarly divided into 2 groups. Each group was shown a total of 6 images drawn from a bank of 8 total: 4 animal-based cheese products (cheddar cheese, cheese dip, cream cheese, and Swiss cheese) and 4 plant-based cheese products (vegan cheddar cheese, vegan cream cheese, vegan nacho sauce, and vegan cheese slices). A sample of the stimulus was provided, which were real plant-based and animal cheese products from different countries around the world. 1 group saw 4 animal-based cheese products and 2 plant-based cheese products. The other group saw 2 animal-based cheese products and 4 plant-based cheese products. All 6 images were presented at once on the screen, and participants were instructed to select the items that were made with real cow's milk by clicking on the image.

As with the first study, this study found that participants were reliably better at identifying plant-based cheese products compared to animal-based cheese products ($p< .001$). 90% of participants accurately identified the plant-based cheese products, while 64% accurately identified the cow's milk cheese products. Once again, the different ratio of animal to plant-based milks shown to the different groups did not significantly affect accuracy.

Although this study had an experimental design, the experimental conditions only related to the proportion of animal- and plant-based products viewed by participants, which is not a relevant measure for this literature review. It is also unclear how participants were allocated to groups. Additionally, the samples for both studies were convenience samples that did not collect information about relevant demographic characteristics, such as country of residence and vegan/dairy free

status, limiting our understanding of the context in which participants were responding. The stimulus used was realistic, as it was taken from actual product images available around the world, however only a limited range of products were tested. Additionally, as only front-of-pack images were shown, participants were not provided with the full range of information (like the ingredients list) that would be available in practice. It was also not reported how long participants were given to review the images before selecting a response.

One cross-sectional survey in the US examined rates of accuracy of identification for plant-based milks and spreads compared to animal-based milks and spreads.

International Food Information Council Foundation (2018) undertook a survey of a nationally representative sample of 1,000 US consumers with funding provided by Danone North America PBC. Participants were initially presented with a series of plant- or animal-based milk names, and asked whether they thought the product contains cow's milk (response options: 'Contains cow's milk', 'Don't know', and 'Does NOT contain cow's milk'). Results from this portion of the study are reported in the section 'Effect of dairy terminology'.

Respondents were then shown a series of product labels (not provided in the study report), and were asked to indicate what ingredients they believed were likely to be in the product (response options: 'Milk from cows', 'Plant-based ingredients', 'Neither', and 'Don't know'). The order of the products presented is not known.

Table 7 Responses to whether a variety of plant-based products contain cow's milk, based on product images (International Food Information Council Foundation (2018))

Product (Image)	Milk from cows	Plant-based ingredients	Neither	Don't know
Rice milk	6%	73%	7%	14%
Cashew milk	7%	70%	8%	15%
Almond milk	8%	71%	9%	12%
Soy milk	8%	70%	7%	15%
Almond butter	8%	65%	11%	16%
Peanut butter	15%	54%	16%	15%
Chocolate milk	85%	5%	3%	7%
Organic milk	79%	8%	3%	10%
Butter	75%	8%	7%	10%
Lactose-free milk	64%	14%	8%	14%

As shown in **Error! Reference source not found.**, around 70% of respondents correctly understood t hat rice milk, cashew milk, almond milk, and soy milk contained plant-based ingredients. In comparison, 75% of respondents correctly identified that butter contained milk from cows, and 64% of respondents correctly identified that lactose-free milk did as well. Peanut butter and almond butter had higher rates of misattribution than all of the plant-based milks, with only 54% and 65% of respondents, respectively, correctly answering that they contained plant-based ingredients.

The study's reasonably large, broadly nationally representative sample gives some confidence in its generalisability to US consumers. However, other relevant demographics were not collected and/or

reported, such as level of education, language spoken at home, and whether they were vegan or dairy free. The order of the products presented is not known, so it is unclear if any order effects may have influenced the results. Stimuli images were not provided, so it is not known what relevant labelling elements (e.g. terminology, images, ingredient qualifiers) participants were responding to when answering the survey.

Self-reported consumer confusion

Consumer research undertaken by Sanitarium (2021) was reported to have found that 'overwhelmingly, consumers understood the different ingredient content of the 2 types of products', that is dairy milk and plant-based milk. There was no methodological information available for this study, such as design, sample number, sampling method, participant characteristics, stimulus provided, or question/s asked. It is therefore not possible to assess risk of bias.

A cross-sectional survey undertaken by Woolworths (2021) found that 7% of consumers reported having purchased a 'plant-based item' (which may have included plant-based dairy) in error. There was no methodological information available for this study, such as design, sampling method, participant characteristics, or question/s asked. It is therefore not possible to assess risk of bias.

Effect of dairy terminology

Experimental studies

Two peer-reviewed experimental studies (Baptista and Schifferstein (2023) and Gleckel (2020)) undertaken in the USA found no significant effect of dairy terminology on US consumers' understanding of the ingredient content of plant-based dairy alternatives. However, 1 peer-reviewed experimental study (De-Loyde et al. 2023) found a small but significant effect, where plant-based alternatives labelled with milk terminology were more likely to be misidentified as coming from an animal source. This may be due to the differing regulatory context of the UK: plant-based milk alternatives are not currently able to be labelled with milk terminology in the UK, whereas they are in the US, potentially leading to different levels of consumer familiarity with the terms. Nevertheless, the UK effect was small and misidentification very infrequent, with less than 1 product out of 10 being misidentified on average regardless of whether milk terminology was used, suggesting that dairy terminology does not have a meaningful impact on consumer accuracy in identifying plant-based milks.

Two of the same peer-reviewed experimental studies (Gleckel 2020 and De-Loyde et al. 2023) also found a significant effect of dairy terminology on consumers' understanding of the use of plant-based dairy alternatives. Consumers were significantly more likely to understand how to use plant-based dairy alternatives that were described using milk terminology compared to those that were not.

Baptista and Schifferstein (2023) undertook an experiment (between-subjects design) with a convenience sample of 600 US consumers (49% female, 91% consumed meat). Participants were randomly allocated to 1 of 9 possible groups. Eight of the groups viewed a soy milk product that varied according to different combinations of: terminology used (milk vs mylk vs drink), image (cow vs soybean), container (paper carton vs plastic bottle), and claim (creamy vs smooth). Participants in the ninth group (the control group) viewed an image of cow's milk in a plastic bottle with an image of a cow and a creamy claim. Respondents were asked to identify the expected content of the product

on a five-point scale (1 = 100% animal, 2 = mostly animal, 3 = 50% animal, 50% vegetable, 4 = mostly vegetable, and 5 = 100% vegetable). The number of seconds it took respondents to answer the question was also logged.

The study found that all soy milk samples had mean ratings in the range of 4.2 to 4.8 (i.e. mostly or 100% vegetable), while the control (cow's milk) had a mean rating of 1.5 (i.e. mostly or 100% animal). This was a significant difference (all $p < .001$) and indicates that, on average, consumers accurately identified the ingredient content of both types of products regardless of the terminology used.

There was no significant difference in the amount of time taken to assess any of the soy milk samples compared to the cow's milk control ($p > 0.20$).

The study also asked respondents, 'Thinking on the sensory characteristics (tastes, aromas, texture, flavours) of this product, how do you expect it to be?' Response options were: sweet, bitter, salty, starchy, chalky, bran, malty, milky flavour, leafy flavour, beany, rancid, bland, and thick. The study found that all soy milk samples were expected to have less milky flavour, have more of a leafy flavour, and be thinner, more bland, beany, chalky, and starchy compared to the milk control (all $p < .01$), regardless of the terminology used. The only difference caused by the terminology used on soy milk samples was that samples labelled 'drink' were expected to be significantly chalkier than samples labelled 'mylk' ($p < .01$).

The study's experimental design and use of objective measures enable causal relationships to be established between different labelling elements and level of consumer understanding. However, the relatively small sample size (approx. 67 participants per group) may have lacked the statistical power to be able to detect small effects across 9 different groups, which may account for the lack of statistically significant effect. In addition, the sample was 1 of convenience and did not collect and/or report some relevant demographic characteristics (e.g. education, language spoken at home).

Gleckel (2020) undertook an experiment (between subjects design) with a convenience sample of 155 US consumers (68% female, 66% university-educated, 13.6% vegan or vegetarian). Participants were randomly allocated to 1 of 2 groups (Group A: N = 96; Group B: N = 59) and were provided with 3 fictional names of plant-based alternative products, forming pairs across groups where 1 version of the name included meat/dairy terminology (the experimental condition) and 1 that did not (the control condition). There were 2 meat-related product pairs, and 1 dairy-related product pair. See Table 6.

Table 6 Experimental groups and conditions for Gleckel (2020)

	Group A (n = 96)	**Group B (n = 59)**
Product Pair 1	Next-Generation Meat: Plant-Based Beef Burger [Experimental condition]	Next-Generation Vegetables: Plant-Based Veggie Patty [Control condition]
Product Pair 2	Cultured Vegan Spread [Control condition]	Cultured Vegan Butter [Experimental condition]
Product Pair 3	Plant-Based Deli Slices: Bologna Style [Experimental condition]	Sandwich Slices [Control condition]

Results for product pair 2 is reported in this section, as it concerned dairy terminology. Results for product pairs 1 and 3 are reported in the effect of meat terminology section.

Questions differed by product pair. For product pair 2 ('Cultured vegan butter' vs 'Cultured vegan spread'), respondents were asked to report:

a) 'Do you think that this product contains dairy from cows?' (Response options: 1 = Very unlikely, 2 = Unlikely, 3 = Neither likely nor unlikely, 4 = Likely, 5 = Very likely),

b) 'How well can you imagine what this product tastes like?' (Response options:1 = Not at all clearly, 2 = Not so clearly, 3 = Somewhat clearly, 4 = Very clearly, 5 = Extremely clearly)

c) 'Do you think this product would be used for baking biscuits?',

d) 'Do you think this product would be used on toast?', and

e) 'Do you think this product would be used on pasta?'

The last 3 questions had response options of 1 = Very unlikely, 2 = Unlikely, 3 = Neither likely nor unlikely, 4 = Likely, 5 = Very likely.

The study found no significant difference in participants' expectations that the product contained dairy from a cow between 'Cultured Vegan Butter' (M = 0.71, SD = 0.99) and 'Cultured Vegan Spread' (M = 0.92, SD = 1.49) (p = .25). Participants on average thought that it was 'Unlikely' or 'Very Unlikely' that either product contained dairy from a cow.

Significantly more participants reported that they could imagine the taste of 'Cultured Vegan Butter' (M = 4.14, SD = 0.98) compared to 'Cultured Vegan Spread' (M = 3.52, SD = 1.26) (p < .001). Participants on average thought that they could 'Very Clearly' or 'Extremely Clearly' imagine what 'Cultured Vegan Butter' tastes like, while they could 'Somewhat Clearly' or 'Very Clearly' imagine the taste of 'Cultured Vegan Spread'.

Significantly more participants understood that 'Cultured Vegan Butter' could be used on pasta (M = 2.98, SD = 1.02) or baking biscuits (M = 2.64, SD = 1.20) than 'Cultured Vegan Spread' (pasta: M = 2.41, SD = 1.17; biscuits: M = 1.89, SD = 0.62) (both p < .001). On average, participants thought it was 'Likely' that 'Cultured Vegan Butter' could be used on pasta or for baking biscuits, while it was 'Neither Likely nor Unlikely' that 'Cultured Vegan Spread' could be used in the same way.

There was no significant difference in participants' understanding that 'Cultured Vegan Butter' could be used on toast (M = 3.00, SD = 0.58) compared with 'Cultured Vegan Spread' (M = 3.11, SD = 0.63) (p = .38). On average, participants though it was 'Likely' that both products could be used on toast.

The study's experimental design enables causal relationships to be established between labelling terminology and consumer expectations. However, the relatively small convenience sample had a large proportion of female, university-educated and/or vegan or vegetarian participants.

De-Loyde et al. (2023) undertook an experiment (between-subjects design) with a convenience sample of 352 UK consumers (50% female, 57% university-educated, 16.5% either vegan or dairy-free, 100% fluent in English). Participants were randomly allocated to 1 of 2 groups. They provided participants in both groups with images of 20 drink cartons: 10 milk substitute cartons, 5 dairy milk cartons, and 5 'other' drink cartons. In 1 group (n = 168) the 10 milk substitutes did not use the term 'milk', whereas in the other group (n = 184) the 10 milk substitutes did use the term 'milk'. Participants were asked to identify whether each product could be added to a cup of tea or coffee

(response options: yes/no/unsure) and whether they thought the product comes from an animal source or not (response options: yes/no/unsure).

The study found that participants in the Milk Labelling Group misidentified significantly more milk substitutes as being a product that came from an animal source (M = 0.6, SD = 1.3) compared to participants in the No Milk Labelling Group (M = 0.1, SD = 0.5) ($p < .001$, OR = 4.7). The study authors also reported that, in total 64% of participants in the Milk Labelling Condition did not misidentify any milk substitutes, compared to 89% in the No Milk Labelling condition. However, this measure is not the most relevant to consider for the purposes of this literature review, as it is unlikely that individuals would be in the position of determining the ingredient source of 10 different milk substitutes at 1 time. However, while this was a significant difference it may not be a meaningful one, as the increase was only by an average 0.5 products out of 10 milk substitutes, and misidentification was very infrequent in both conditions, with less than 1 product out of 10 being misidentified on average.

The study also found that participants in the Milk Labelling Condition correctly identified significantly more milk substitutes as being a product that could be added to a cup of tea or coffee (Mean = 8.2 out of 10, SD = 2.8) compared to those in the No Milk Labelling Condition (Mean = 7.6 out of 10, SD = 2.7) ($p = .040$, OR = 1.4). The study authors also reported that, in total, 53% of participants in the Milk Labelling Condition correctly identified that all 10 milk substitute products could be added to a cup of tea or coffee, compared to 38% in the No Milk Labelling Condition. However, this measure is not the most relevant to consider for the purposes of this literature review, as it is unlikely that individuals would be in the position of determining the use of 10 different milk substitutes at 1 time. However, while this was a significant difference it may not be a meaningful one, it was only on average by 0.6 products out of 10 milk substitutes, and the majority of people correctly identified the use of a majority of products on average.

The study's experimental design enables causal relationships to be established between product images and consumer's understandings of use and ingredient source. A pilot study conducted in advance of the main study also helped to inform the final design and ensure sample numbers were sufficiently powerful to detect small effects. However, the convenience sample had a large proportion of university-educated and/or vegan or dairy-free participants. It also explicitly excluded participants who were not fluent in English. The stimuli images were not provided in the study, so the total labelling context (i.e. use of images or ingredient qualifiers) is not clear.

Cross-sectional surveys

One cross-sectional survey in the US (International Food Information Council Foundation (2018)) asked participants to identify whether a range of milks, including both plant-based and cow milks, contain cow's milk based on the name alone.

As shown in **Error! Reference source not found.**, around 75% of respondents correctly understood t hat rice milk, cashew milk, almond milk, soy milk, and coconut milk do not contain cow's milk, while 7-9% incorrectly believed it did, and 16-20% were not sure. Similar levels of understanding were evident for 'non-fat milk' (79% correctly classified), and skim milk (73% correctly classified), while less than half of respondents correctly understood that lactose-free milk contains cow's milk (48%).

Table 9 Responses to whether a variety of plant-based and animal-based milks contain cow's milk, based on terminology (International Food Information Council Foundation (2018))

Product (Terminology only)	Contains cow's milk	Does NOT contain cow's milk	Don't know
Rice milk	7%	73%	20%
Cashew milk	8%	72%	20%
Almond milk	9%	75%	16%
Soy milk	9%	75%	16%
Coconut milk	9%	73%	18%
Whole milk	90%	4%	5%
Chocolate milk	85%	7%	9%
Non-fat milk	78%	9%	12%
Skim milk	74%	14%	13%
Lactose-free milk	48%	31%	22%

One cross-sectional survey in Australia found that 19% of respondents thought that alternative 'milks' contain cow's milk. While 1 cross-sectional survey in the US found that 'a significant minority' (proportion not specified) of consumers associate some plant-based milks with dairy milk. There was very limited methodological information available for either of these studies, with no details provided about the design or question/s asked. It is therefore not possible to assess risk of bias.

Dairy Australia (2020) commissioned Lewers Research to undertake a survey of a nationally representative sample of around 1,300 Australians aged 18+ years for their Dairy Australia Trust Tracker in 2019 and 2020. In 2019, the survey found that 15% of consumers believed that plant-based beverages contain cow's milk (n = 1,326), while in 2020 19% of consumers believed the same (n = 1,293). The exact question and response options were not provided.

Ipsos (2018) were commissioned by the US National Dairy Council to undertake a cross-sectional survey with a nationally representative sample of 2,010 US consumers aged 18+ years (6% plant-based milk only consumers). It was reported that 'dairy milk products are highly associated with 'dairy milk', yet a significant minority of consumers do associate some plant-based milks with dairy milk.' This association was found to be strongest when the term 'milk' was more prominent on the package, and was more likely among consumers who purchase both dairy and plant-based milk.

Effect of ingredient qualifiers

There was no evidence available on the effect of ingredient qualifiers such as 'dairy free'.

Effect of animal imagery

One peer-reviewed, experimental study undertaken in the US examined the effect of animal imagery on consumers' understanding of the ingredient content of soy milk. Baptiste and Schifferstein (2023) undertook an experiment (between-subjects design) with a convenience sample of 600 US consumers (49% female, 91% consumed meat). Participants were randomly allocated to 1 of 9 possible groups. Eight of the groups viewed a soy milk product that varied according to different combinations of: terminology used (milk vs mylk vs drink), image (cow vs soybean), container (paper

carton vs plastic bottle), and claim (creamy vs smooth). Participants in the ninth group (the control group) viewed an image of cow's milk in a plastic bottle with an image of a cow and a creamy claim.

The study found that the soy milk samples that had an image of a cow had a mean rating of 4.4 ± 1.0, while the soy milk samples that had an image of a soybean had a mean rating of 4.7 ± 0.6. This was a statistically significant difference ($p < .05$) and indicates that, while soy milk was clearly recognised as being soy milk in all groups, the image of a cow on the packaging slightly but significantly caused participants to expect a more animal origin. The control mean was not reported.

The study also found that the mean response time differed between soy milk products that had an image of a cow (mean = 10.5 ± 9.0 seconds) compared to soy milk products that had an image of a soybean (mean = 8.7 ± 5.4 seconds). This was a statistically significant difference ($p < .05$), indicating that participants took longer to identify the ingredient content for those soy milks that had an image of a cow than those that had an image of a soybean.

The study also asked respondents, 'Thinking on the sensory characteristics (tastes, aromas, texture, flavours) of this product, how do you expect it to be?' Response options were: sweet, bitter, salty, starchy, chalky, bran, malty, milky flavour, leafy flavour, beany, rancid, bland, and thick. The study found that soy milk samples that had an image of a soybean were expected to be 'beanier' ($p < .05$) than samples with an image of a cow.

The study's experimental design and use of objective measures enable causal relationships to be established between different labelling elements and level of consumer understanding. However, the sample was 1 of convenience and did not collect and/or report some relevant demographic characteristics (e.g. education, language spoken at home).

Demographics

There was very little evidence available on the demographics of consumers who are more likely to misidentify plant-based milk alternatives as coming from an animal source.

Ipsos (2018) found that people who consumed both dairy and plant-based milk alternatives were more likely to associate plant-based milks with dairy milk. However, there was little methodological detail which limits confidence in the findings, and it is not clear whether it would be generalisable to an Australian context.

Limitations

The body of evidence was primarily comprised of grey literature, particularly market research undertaken by industry stakeholders, which did not always contain sufficient methodological information to ascertain risk of bias. However, there were some areas of consistency across studies that used similar methodologies, which provides some level of confidence in these findings. Where conclusions have been based solely upon these types of studies, it has been noted in the report.

All peer-reviewed literature was undertaken outside of Australia or New Zealand, primarily in the United States of America. There is some evidence, where similar types of unpublished cross-sectional surveys were conducted in Australia and the United States, that consumer understandings of plant-based protein and dairy alternatives may differ between these 2 countries (i.e. US studies appear to evidence a higher degree of confusion). This may be due to external factors such as different

regulatory contexts or the prevalence of plant-based protein and dairy alternative available in each marketplace. Caution should therefore be applied in generalising the findings of any of these studies to the Australian population.

Conclusions

FSANZ was commissioned by the Department of Agriculture, Fisheries and Forestry to undertake a review of the evidence on consumer understanding of plant-based protein and dairy alternatives labelling. The review sought to answer the following research question:

1) How does the use of meat or dairy terminology (e.g. 'meat', 'beef', or 'chicken'), utility terms (e.g. 'burger', 'patties', or 'sausage') and/or animal imagery on plant-based protein or dairy alternatives affect consumer understanding of the ingredient content of the product (i.e. being meat, plant-based, or a mixture)?

The review is based on a total of 16 documents (containing 17 unique studies), which varied substantially in available methodological detail. Nevertheless, some general conclusions may be drawn based on the consistency of the findings across studies. They are outlined, by product category.

Meat and plant-based protein products

Extent of consumer confusion

From the limited available evidence, it appears that 75 to 80% of Australian consumers are able to accurately identify plant-based protein products based on the front-of-pack labelling currently used on the market. This finding is based on two, broadly nationally representative studies of 1,000 Australian consumers that used similar objective measures based on product categorisation of currently available products (Institute for Sustainable Futures (2022); Pollinate (2021)). While it differs substantially from a similar product categorisation exercise undertaken in the US, where only 63% to 68% of consumers correctly identified that 3 plant-based protein products did not contain meat, it is supported by self-reported data that only between 6% to 12% of Australian/New Zealand consumers had mistakenly purchased plant-based protein products (Colmar Brunton 2019a, 2019b; Institute for Sustainable Futures (2022); Woolworths 2021). As noted in the body of the report, 1 of the studies found a much higher percentage (32%) had 'mistaken plant-base meat for animal meat' but did not specify whether they had purchased it. The design of these studies did not allow for an objective evaluation of the effect of different labelling elements (e.g. meat terminology, animal imagery, ingredient qualifiers) on consumers' understanding.

Effect of meat terminology

Three experimental studies undertaken in the United States of America found that the use of meat terminology on plant-based products does not adversely impact consumers' understanding about the ingredient content of the product (Baptista and Schifferstein 2023; Gleckel 2020; DeMuth 2019). Two of the studies found that, rather, it supported consumers' understanding of the intended flavour of the product (Baptista and Schifferestein (2023); Gleckel (2020)). There was no evidence available on whether the use of meat terminology supports consumer understanding of the product's intended

use. However, it is not clear whether these findings would be generalisable to the Australian population.

There is very little evidence available on the effect of ingredient qualifiers on consumers' understanding of the ingredient content of plant-based protein products.

Effect of animal imagery

One peer-reviewed experimental study that tested animal imagery found that animal images slightly but significantly affected participants' expectation of ingredient content (such that they expected it to have a higher degree of animal content) and increased the length of time that it took participants to respond to the question (Baptista and Schifferstein (2023)).

This suggests that animal imagery makes it harder for consumers to quickly and accurately determine the ingredient content of plant-based protein products, however as it was only tested in the US context, and there is some evidence that US consumer understanding of plant-based protein products may differ substantially from those of Australia, it is not clear whether this finding is generalisable to the Australian context. However, 2 Australian cross-sectional surveys found that animal imagery on plant-based protein products was reported as a source of confusion by 36% to 45% of Australian consumers (Pollinate 2021; Institute for Sustainable Futures (2022)).

Demographics

There was very little evidence around the demographics of consumers who were more likely to mistakenly identify plant-based protein products as an animal-based product. One Australian survey found that those who mistook at least 1 plant-based protein product as being animal-based were more likely to have 1 of the following characteristics: being male, aged 65+ years, an empty nester, speak a language other than English with family/friends, and/or have a household income of $40k or below.

Dairy and plant-based dairy alternatives

Extent of consumer confusion

There was limited evidence available on Australian consumers' ability to accurately identify plant-based dairy alternatives. Three studies (1 cross-sectional study undertaken in the US and 2 peer-reviewed experimental studies undertaken online without reporting country of residence information) found that around 70–94% of consumers understand that plant-based milks do not contain cow's milk. This compared favourably to consumer understanding of traditional cow's milk products, which were correctly understood by 64%–90% of consumers (Feltz & Feltz 2019; International Food Information Council Foundation (2018)). It is not clear how generalisable this would be to the Australian context. However, 2 studies undertaken in Australia with no methodological information provided indicated that the vast majority of consumers (up to 93%) understand the ingredient content of plant-based milks or items (Sanitarium (2021); Woolworths (2021)).

Effect of dairy terminology

Two peer-reviewed experimental studies undertaken in the US found no significant effect of dairy terminology on US consumers' understanding of the ingredient content plant-based dairy

alternatives (Baptista and Schifferstein (2023); Gleckel (2020)). However, 1 peer-reviewed experimental study undertaken in the UK found a small but significant effect, where plant-based alternatives labelled with milk terminology were more likely to be misidentified as coming from an animal source (De-Loyde et al. 2023). The different study findings may be due to the different regulatory contexts: plant-based milk alternatives are not currently able to be labelled with milk terminology in the UK, whereas they are in the US, potentially leading to different levels of consumer familiarity. Nevertheless, the UK finding is small and misidentification very infrequent, suggesting that dairy terminology does not have a meaningful impact on consumer accuracy in identifying plant-based milks.

Two of the peer-reviewed studies (Gleckel 2020; De-Loyde et al. 2023) found that dairy terminology significantly improves consumers' understanding of the intended use of plant-based dairy alternatives. Consumers were significantly more likely to understand how to use plant-based dairy alternatives that were described using milk terminology, compared to those that were not. Once again, it is not clear whether these findings would be generalisable to the Australian context. One of the peer-reviewed studies (Gleckel 2020) found that dairy terminology significantly improves consumers' understanding of the intended flavour of the 'cultured vegan butter' vs 'spread', whereas another peer-reviewed study (Baptista and Schifferstein (2023)) found little difference in expected flavour based on whether soy milk used milk, mylk, or drink terminology.

One cross-sectional survey undertaken in the US (International Food Information Council Foundation 2018) found that around 75% of respondents understood that all plant-based milk alternatives tested (rice, cashew, almond, soy, and coconut milks) did not contain cow's milk based on the name alone. Similar levels of understanding were evident for 'non-fat milk' (79% correctly classified), and skim milk (73% correctly classified), while less than half of respondents correctly understood that lactose-free milk contains cow's milk (48%). Only 1 similar survey was conducted in Australia, which found a somewhat higher proportion (81%) correctly identified that 'alternative milks' do not contain cow's milk. However, as almost no methodological information was available on this study, it is not possible to be confident in the findings.

Effect of animal imagery

One peer-reviewed experimental study that tested animal imagery found that animal images slightly but significantly affected participants' expectation of ingredient content (such that they expected it to have a higher degree of animal content) and increased the length of time that it took participants to respond to the question (Baptista and Schifferstein (2023)).

There is no evidence available among Australian consumers, and it is not clear how generalisable this finding would be to the Australian context.

Demographics

There was very little evidence around the demographics of consumers who were more likely to mistakenly identify plant-based dairy alternatives as containing traditional dairy. One US survey (Ipsos 2018) found that people who consumed both dairy and plant-based milk alternatives were more likely to associate plant-based milks with dairy milk. However, there was little methodological detail which limits confidence in the findings, and it is not clear whether it would be generalisable to an Australian context.

Appendices

Appendix 1: Literature review methods

All decisions regarding inclusion/exclusion criteria were made prior to the literature search commencing unless otherwise stated.

Inclusion criteria

The review included studies that examine:

- The effect of using meat or dairy terminology, utility terms, animal imagery, and/or ingredient qualifiers on consumers' self-reported and objective understanding of the ingredient content of plant-based meat or dairy alternatives.

Given that the literature review is based primarily on existing searches, no restrictions were placed with respect to year of publication, study type (e.g., experiments, surveys, focus groups, interviews, observational studies), participant characteristics (e.g. age, geographic location), or specific outcome measures.

No restrictions were placed on the type of information that participants are exposed to in studies regarding plant-based meat or dairy alternatives

Peer-reviewed publications, as well as grey literature (e.g. unpublished theses, research produced by governmental agencies and non-governmental organisations, including industry stakeholders) were included.

Exclusion criteria

The review excluded all sources that do not include original empirical data (such as narrative review articles, opinion papers, discussion papers, and media articles).

The review excluded studies that looked at plant-based meat and dairy alternatives in countries that predominantly use languages other than English due to the uncertainties that differing languages would introduce around the meaning of specific terminology.

The review also excluded studies that solely examined:

- Consumers' preferences and/or expectations around terminology used to describe plant-based meat and dairy alternatives.
- Consumers' understandings of the nutritional equivalence of plant-based meat and dairy alternatives with their conventional counterparts, including when considering the effect of differing terminologies on this understanding.
- The effect of meat or dairy terminology, utility terms, animal imagery, or ingredient qualifiers on consumers' willingness to purchase and/or consume a plant-based meat or dairy alternative product.

- The effect of using alternative terminology (i.e. terminology that does not include any reference to traditional meat or dairy counterparts) for plant-based meat and dairy alternatives on consumers' perceptions, acceptance, or willingness to consume the product.
- Consumers' perceptions, acceptance or attitudes towards plant-based meat or dairy alternatives, their motivations for consuming them, or willingness to purchase or consume them.
- Prevalence of plant-based meat or dairy alternatives, or the different terminology used on plant-based meat or dairy alternatives in the market.
- Number or demographic characteristics of plant-based meat or dairy alternative consumers, vegetarians, or vegans.
- Economic analyses of the value of the plant-based meat or dairy alternative market or the number of people it employees, either on its own or relative to the traditional meat and dairy industries, both now and into the future.
- Actual nutritional equivalence or 'healthiness' of plant-based meat or dairy alternatives compared to their conventional counterparts.
- Consumers' sensory experiences compared between plant-based meat or dairy alternatives and their conventional counterparts.

Literature sources

Literature for the review was obtained from the following sources:

- Consumer evidence submitted to the Senate Standing Committee on Rural and Region Affairs and Transport Legislation's Inquiry on the Definitions of meat and other animal products;
- Results from a literature search undertaken by the University of Adelaide to inform a literature review from which plant-based milk and dairy labelling was subsequently scoped out;
- Searching online databases for peer-reviewed studies in English published between 2023 and 2024 (i.e. since the literature search undertaken by the University of Adelaide);
- A Google search for grey literature around plant-based labelling, first 100 hits; and
- Hand-searching the reference lists and citing studies from included literature.

Search undertaken by the University of Adelaide

In 2023, FSANZ commissioned Dr Shao Jia Zhou and Dr Lenka Malek from the University of Adelaide's School of Agriculture, Food and Wine to undertake a literature review to assess consumers' understanding, acceptance, and behaviours in response to alternative proteins, including both cell-based and plant-based meat and dairy alternatives. The literature search was undertaken in March 2023, however plant-based meat and dairy alternatives were subsequently scoped out from the literature review due to time constraints.

Literature sources

Four online databases were searched for literature published in English from January 2012 to March 2023. These databases were:

- PubMed
- Scopus
- Web of Science
- PsycINFO

Additional searches were also performed to incorporate relevant information from published theses, industry, government and regulatory authorities by searching documents available on the websites of the following organisations or databases:

- Research referred to in the Senate Inquiry into plant-based meat labelling;
- ProQuest Dissertations & Theses Global;
- Checking the reference lists of all included studies;
- Checking the citing studies of all included studies (using Google Scholar)
- Further literature provided by FSANZ, obtained from the following sources:
  - Direct email request to the International Social Science Liaison Group;
  - Direct email request to social science team in Singapore Food Agency;
  - Direct email request to CSIRO;
  - Reference FSANZ already had on file;
  - Searching publication records of known relevant researchers via ResearchGate/university websites (Dr Lenka Malek, Dr Diana Bogueva, Prof Dora Marinova);
  - Examining the reference lists and citing studies of all relevant studies FSANZ has on file;
  - Examining the reference list of the FAO report.

Inclusion criteria

The literature search included the following studies that addressed the following themes relevant to the current literature review:

- Consumers' views and/or preferences regarding terminologies used to differentiate plant-based proteins from traditional proteins and labelling requirements;
- If consumers unintentionally purchase plant-based proteins when they mean to purchase traditional proteins, and whether any labelling elements contribute to (or prevent) any convention.

Systematic reviews that examine any of the themes/outcomes listed above, and assessed has having high quality based on the AMSTAR 2 were also eligible to be included.

Exclusion criteria

The literature search excluded studies related to plant-based meat and dairy alternatives that met the following criteria:

- Studies that focus on the production process, sensory evaluation, trends or physiological aspects of consumption of plant-based meat or dairy alternatives, but do not report any outcomes relating to consumers' perceptions and information preferences.

- Sources that do not include original empirical data (such as narrative review articles, opinion papers, discussion papers).
- Eligible studies published before 2012 or eligible systematic reviews published before 2018, or full-text publications are not available, or studies published in a language other than English.

Search strings

The following search strings were used for searching the 4 databases outlined above. Note that the search strings and listed citations include both plant-based and cell-based meat and dairy alternatives, and included a wider range of research questions associated with cell-based products.

Table 7 Search strings used for search by the University of Adelaide

Database	Search string	Citations
PubMed (Human only)	('plant protein*'[Title/Abstract] OR 'cultured'[Title/Abstract] OR 'clean'[Title/Abstract] OR 'vitro'[Title/Abstract] OR 'cell-based'[Title/Abstract] OR 'cultivated'[Title/Abstract] OR 'lab-grown'[Title/Abstract] OR 'cellular agriculture'[Title/Abstract] OR 'plant-based'[Title/Abstract]) AND ('meat'[Title/Abstract] OR 'beef'[Title/Abstract] OR 'chicken'[Title/Abstract] OR 'dairy'[Title/Abstract] OR 'milk*'[Title/Abstract] OR 'cheese*'[Title/Abstract] OR 'yogurt'[Title/Abstract] OR 'yoghurt'[Title/Abstract] OR 'fish*'[Title/Abstract] OR 'seafood*'[Title/Abstract]) AND ((('health knowledge, attitudes, practice'[MeSH Terms] OR 'Health Knowledge'[Title/Abstract] OR 'attitude*'[Title/Abstract] OR 'practi*'[Title/Abstract] OR 'aware'[Title] OR 'understand*'[Title]) AND ()) OR 'interpret*'[Title] OR 'familiar*'[Title] OR 'perce*'[Title] OR 'belie*'[Title] OR 'accept*'[Title] OR 'willing*'[Title] OR 'inform*'[Title] OR 'inten*'[Title] OR 'purchas*'[Title] OR 'value'[Title] OR 'seek'[Title] OR 'influenc*'[Title] OR 'benefit*'[Title] OR 'risk*'[Title] OR 'cons*'[Title] OR 'motiv*'[Title] OR 'confus*'[Title] OR 'mislead*'[Title] OR 'choice*'[Title] OR 'prefer*'[Title] OR 'ultra-processed'[Title] OR 'term*'[Title] OR 'label*'[Title] OR 'Consumer Behavior'[MeSH Terms] OR 'consumer behavio*'[Title/Abstract] OR 'Choice Behavior'[MeSH Terms] OR 'Choice Behavior'[Title/Abstract] OR 'Choice Behaviour'[Title/Abstract] OR 'Food Preferences'[MeSH Terms] OR 'food preference*'[Title/Abstract] OR 'food technology/ethics'[MeSH Terms] OR 'market*'[Title/Abstract])	766
Web of Science	(TS=('plant NEAR/2 protein*' OR 'cultured NEAR/2 meat' OR 'cultured NEAR/2 dairy' OR 'clean NEAR/2 meat' OR 'clean NEAR/2 dairy' OR 'cell NEAR/2 based meat' OR 'cell NEAR/2 based dairy' OR 'cultivated NEAR/2 meat' OR 'cultivated NEAR/2 dairy' OR 'lab NEAR/2 grown meat' OR 'lab NEAR/2 grown dairy' OR 'cellular agriculture' OR 'plant NEAR/2 based meat' OR 'plant NEAR/2 based dairy' OR 'cultured NEAR/2 fish' OR 'cultured NEAR/2 seafood' OR 'clean NEAR/2 fish' OR 'clean NEAR/2 seafood' OR 'cell NEAR/2 based fish' OR 'cell NEAR/2 based seafood' OR 'cultivated NEAR/2 fish' OR 'cultivated NEAR/2 seafood' OR 'lab NEAR/2 grown fish' OR 'lab NEAR/2 grown seafood' OR 'cellular agriculture' OR 'plant NEAR/2 based fish' OR 'plant NEAR/2 based seafood')) AND (TS=('Health Knowledge' OR Attitude* OR Practi* OR 'Consumer Behavio*' OR 'Choice Behavior' OR 'Choice Behaviour' OR 'Food Preference*' OR market* OR Aware*, OR understand*, OR interpret* OR familiar* OR perce* OR attitude* OR belie* OR benefit* OR risk* OR accept* OR willing* OR inform* OR intent* OR purchas* OR motivation* OR influenc* OR value OR seek OR confus* OR mislead* OR choice* OR prefer* OR ultra-processed OR term* OR label*))	88
Scopus	(TITLE ('plant protein*' OR cultured OR clean OR vitro OR cell-based OR cultivated OR lab-grown OR 'cellular agriculture' OR 'plant-based')) AND (TITLE (meat* OR beef OR chicken OR dairy OR milk* OR cheese* OR yogurt OR yoghurt OR fish* OR seafood*)) AND (TITLE ('health knowledge' OR attitude* OR practi* OR 'consumer behavio*' OR 'choice behavior' OR 'choice behaviour' OR 'food preference*' OR market* OR aware*, OR understand*, OR interpret* OR familiar* OR perce* OR attitude* OR belie* OR benefit* OR risk* OR accept* OR willing* OR inform* OR intent* OR purchas* OR motivation* OR influenc* OR value OR seek OR confus* OR mislead* OR choice* OR prefer* OR ultra-processed OR term* OR label*))	573
PsycINFO	(('plant protein*' or cultured or clean or vitro or cell-based or cultivated or lab-grown or 'cellular agriculture' or plant-based) and (meat or beef or chicken or dairy or milk* or cheese* or yogurt or yoghurt or fish* or seafood*)).ti,ab. and (('Health Knowledge' or Attitude* or	121

	Practi* or 'Consumer Behavio*' or 'Choice Behavior' or 'Choice Behaviour' or 'Food Preference*' or market* or Aware*, or understand*, or interpret* or familiar* or perception* or perceive* or attitude* or belie* or benefit* or risk* or accept* or willing* or information* or intent* or purchas* or motivation* or influenc* or value or seek or confus* or mislead* or choice* or prefer* or ultra-processed or term* or label*).ti. or *Consumer Attitudes/ or *Consumer Behavior/ or *Motivation/ or *Consumer Ethics/ or *social values/ or *Consumer Protection/ or *Warning Labels/ or *Behavioral Intention/ or knowledge level/ or *'knowledge (general)'/)	
Final	All databases combined & duplicates removed	1305

FSANZ online database searches

Six online databases were searched via EBSCO Discovery for literature published from January 2023 to June 2024 (i.e. since the literature search undertaken by the University of Adelaide). These databases were:

- Science Direct
- Food Science Source
- FSTA – Food Science and Technology Abstracts
- MEDLINE with Full Text
- SocINDEX with Full Text
- EconLit with Full Text

The search was limited to peer-reviewed journal articles in English, published between 1 January 2023 and 1 June 2024 and was undertaken using a simple Boolean search term combination. The search string used was:

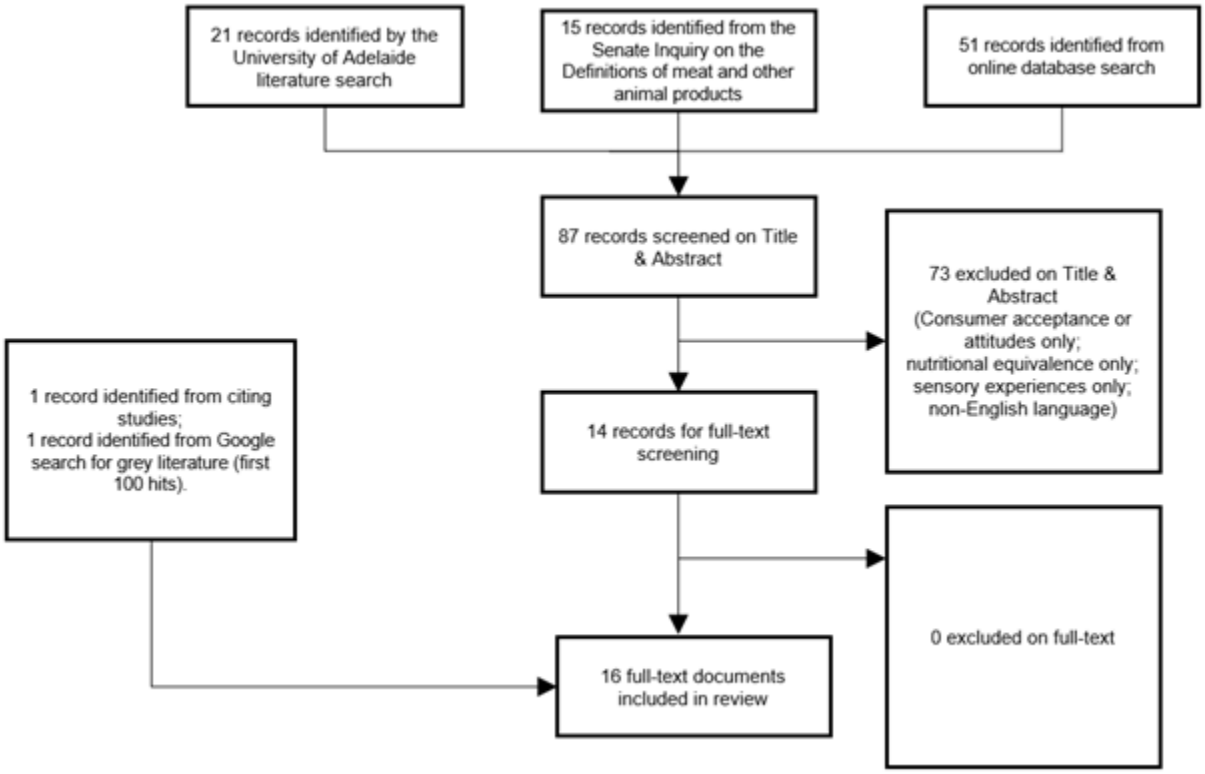
TI (consumer*) AND AB (plant-based OR 'plant protein*' OR alternative OR substitute OR fake OR mock) AND AB (meat OR beef OR bacon OR chicken OR pork OR fish* OR seafood* OR dairy OR milk* OR cheese* OR eggs OR yoghurt OR yogurt OR cream) AND (understand* OR confus* OR percept* OR misle* OR comprehen*) AND (label* OR pack* OR image* OR term*)

Research review process

FSANZ reviewed the results from the University of Adelaide's literature search and excluded studies that did not meet the inclusion criteria for the current review. This resulted in 21 potentially relevant records. The final report and submissions made to the Senate Inquiry on the Definitions of meat and other animal products were reviewed for consumer evidence, and 15 potentially relevant records were identified. An online database search for literature published in 2023–2024 found 51 potentially relevant records. 73 out of scope papers were removed based on title and/or abstract. No documents were identified as being out of scope on the basis of full-text review. In addition, 2 documents were identified from a Google search for grey literature (first 100 hits), and searching citing studies of included documents using Google Scholar. This resulted in 16 full text documents (reporting 17 unique studies) being included. All stages of the screening process were conducted by 1 officer.

Figure 1 shows the number of documents retrieved at various stages of the review process. The information depicted in Figure 1 is based on the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA; Moher et al., 2010).

Figure 1 Number of documents retrieved at various stages of the review process.



Data extraction

The data extracted from each study included: authors, published year, study year, product (meat or dairy), study design, stimuli, sampling technique and sample size, sample demographic characteristics (age, gender, ethnicity, education, SES/income, health/diet status or other relevant characteristics such as language used at home), sample limitations identified in the study, data analysis approach, outcome measures, findings by research question, ethics clearance, limitations acknowledged by authors, and funding body.

The data was summarised for each study and is presented in Appendix 2. Data extraction was completed by 1 officer.

Appendix 2: Study characteristics

Table 8 Experimental studies

Study, Product, Country	Sampling approach	Participant characteristics	Design/stimuli/measures	Key findings	Strengths and limitations	Funding body or conflicts of interest
Baptista and Schifferstein (2023) Meat Dairy USA	N = 600 US consumers Convenience sample Recruited through Prolific online platform	Aged 18 – 84 years (Mean = 39.1) 49.2% female 77% White 8% Black 4% Asian 6% Mixed 4% Other 2% preferred not to answer 60% omnivore 31% flexitarian 5% vegetarian 2% vegan 2% other 59% rarely/never consumed plant-based milk 76% rarely/never consumed plant-based meat	Design Experimental (between-subjects) design. Eight treatment conditions (soy/veggie + terminology) and one control. Treatment conditions varied terminology used (dairy: milk/mylk/drink, meat: chicken/strips/seitan), container (dairy: plastic/carton, meat: tray/jar), image (dairy: cow/bean, meat: chicken/wheat), and claim (dairy: creamy/smooth, meat: cholesterol/sodium). Stimuli Images of milk and soy milk products, varying according to the conditions described above. Images of chicken and seitan products, varying according to the conditions described above. Relevant measures Expected origin of the product (response options: 100% animal, mostly animal, 50% animal, 50% vegetable, mostly vegetable, and 100% vegetable) Number of seconds taken to answer the above question.	Chicken Although all plant-based samples were clearly recognised as a vegetable alternative compared to the control, the image of a chicken caused participants to expect a more animal origin and take longer to select their response than the image of wheat. This finding is significant ($p < .001$). Participants also took more time to evaluate product origin when the image was a chicken rather than wheat. Participants expected products using the term 'veggie chicken' to have significantly more chicken flavour than products using the terms 'veggie strips' ($p < .01$) or 'veggie seitan' ($p < .05$). Participants expected products that had an image of wheat to have less chicken flavour ($p < .001$) and be 'wheatier' ($p < .05$) than	Strengths Experimental design. Considered effects of meat/milk terminology and images. Stimulus available for review. Limitations Convenience sample, where not all potentially relevant demographic characteristics were collected (e.g. education). Small sample size lacks the statistical power to be able to detect small effects across 9 conditions.	Funded by the Pride and Prejudice Project under the 4TU.Federation, an alliance of 4 universities of technology in the Netherlands. This group aims to support healthy lifestyles through chronic disease prevention.

Study, Product, Country	Sampling approach	Participant characteristics	Design/stimuli/measures	Key findings	Strengths and limitations	Funding body or conflicts of interest
				products with an image of a chicken. Terminology was not found to mislead consumers about the origin of the product. Milk Although all plant-based samples were clearly recognised as a vegetable alternative compared to the control, the image significantly affected understanding of origin ($p < .001$). Participants expected a more animal origin when the image was a cow than a soybean. Participants also took more time to evaluate product origin when the image was a cow than a soybean. Participants expected products labelled with 'drink' to be significantly chalkier than products labelled 'mylk' ($p < .01$). Participants expected products with an image of a soybean to be significantly 'beanier' ($p < .05$) than products with an image of a cow. Terminology was not found to mislead consumers about the origin of the product.		

Study, Product, Country	Sampling approach	Participant characteristics	Design/stimuli/measures	Key findings	Strengths and limitations	Funding body or conflicts of interest
De-Loyde et al. (2023) Milk UK	N = 352 UK consumers Convenience sample Recruited from Prolific online platform.	50% female 18+ years, mean age = 38 (SD = 13.2). 57% university educated. Fluent in English. 16.5% either vegan or dairy-free.	Design Experimental (between-subjects) survey design. Two conditions: No Milk Labelling condition (n = 168), where milk substitutes were not labelled with the term 'milk' (as per current UK regulation), and Milk Labelling Condition (n = 184), where milk substitutes were relabelled with the term 'milk'. Stimuli Participants were presented with images of 20 drink cartons: 10 milk substitute cartons, 5 dairy milk cartons, and 5 'other' drink cartons, and for each carton they were asked to respond to 3 different questions. Relevant measures Number of milk substitutes correctly identified as a product that could be added to a cup of tea or coffee. % of participants who correctly identified that the milk substitutes could be added to a cup of tea or coffee. Number of milk substitutes misidentified as coming from an animal source. % of participants who did not misidentify any milk substitutes as coming from an animal source.	Product use Participants in the Milk Labelling Condition correctly identified 0.6 more milk substitutes as being a product that could be added to a cup of tea or coffee (M = 8.2, SD = 2.8) compared to participants in the No Milk Labelling Condition (M = 7.6, SD = 2.7). This was a significant difference (p = .040, OR = 1.4). 53% of participants in the Milk Labelling Condition correctly identified all milk substitutes, compared to 38% in the No Milk Labelling condition. Product origin Participants in the Milk Labelling Condition misidentified 0.5 more milk substitutes as being a product that came from an animal source (M = 0.6, SD = 1.3) compared to participants in the No Milk Labelling condition (0.1, SD = 0.5). This was significant difference (p < .001, OR = 4.7). 64% of participants in the Milk Labelling condition did not misidentify any milk	Strengths Experimental design. Pilot study was conducted to inform final design and sample numbers. Limitations Non-representative convenience sample is highly educated, with a relatively high percentage who were vegan/dairy-free, and only included those fluent in English. Stimuli images not provided, so total labelling context (i.e. images, ingredient qualifiers) is not clear.	None identified.

Study, Product, Country	Sampling approach	Participant characteristics	Design/stimuli/measures	Key findings	Strengths and limitations	Funding body or conflicts of interest
				substitutes, compared to 89% in the No Milk Labelling condition. Across the 2 conditions, only 12 (3%) participants misidentified more than one milk substitute as coming from an animal source.		
DeMuth (2019) Meat USA	1,521 US consumers. Nationally representative Recruited from Survey Sampling International.	53% female 18-34 yrs: 32% 35-54 yrs: 33% 55+: 36% High school or less: 24% Some college: 39% Bachelor, Grad, Professional Degree: 37% 60% White 18% Black/African American 9% Hispanic/Latin American 6% Asian 8% Other < $20k: 18% $20k - $39k: 28% $40k - $59k: 23% $60k - $79k: 17% $80k - $99K: 7% $100k+: 8% Vegetarian: 8% Vegan: 5%	Design Experimental (between-subjects) survey design. Two conditions: 1 group saw products with labels consistent with the marketplace prior to legislation that restricted the use of meat terminology (pre-legislation; n = 732) and 1 group saw labels consistent with the marketplace after the introduction of the legislation (post-legislation; n = 772). Stimuli Two meat alternatives and 2 meat products were shown to participants: The Beyond Beef Burger (plant-based protein product), JUST Meat (cell-cultured meat – considered to be a meat alternative), Ball Park Flame Grilled Beef Patty (meat product), Homestyle Beef Patty (meat product). Two versions of the Beyond Beef Burger: Pre-legislation: 'Beyond Meat - The Beyond Burger: Plant-based Burger Patties' Post-legislation: 'Beyond Protein – The Beyond Patty: Plant-based Patties'.	For the Beyond Burger. 31.4% of participants in the pre-legislation group incorrectly selected ground beef as an ingredient and 30.4% in the post-legislation group. For the meat products, 85% to 89% of participants correctly identified ground beef as an ingredient across the 2 conditions.	Strengths Experimental design. Nationally representative sample. Stimulus available for review. Limitations Only tested 1 plant-based protein product product. Participants only saw an image of the front of the products; they did not have access to the ingredients list. Does not consider the potential impact of animal imagery (the Beyond Meat image did not include animal imagery in either condition).	None identified

Study, Product, Country	Sampling approach	Participant characteristics	Design/stimuli/measures	Key findings	Strengths and limitations	Funding body or conflicts of interest
			Stimuli was visual and consistent with current appearance of the products in all other way except the meat terminology. Relevant measures: 'What do you think are the ingredients in this product?' Response options: Corn, wheat, ground beef, onions, peas, sesame oil, soy, beets, natural & artificial flavouring.			
Feltz and Feltz (2019) Dairy Online	2 x N = 125 Convenience samples Recruited through Amazon's Mechanical Turk	Study 1 (n = 125) 51% female 65% university-educated 73% White 5% Black/African American 6% Hispanic/Latin American 10.4% Asian or Pacific Islander 6% Other < $20k: 18% $20k - $39k: 21% $40k - $49k: 11% $50k - $75k: 22%[a] $60k - $99K: 14% $100k+: 12% 16% rural Study 2 (n = 125) 42% female 62% university-educated 74% White 10% Black/African	Design Experimental (between subjects) design. Stimuli In 1 study, participants were presented with a set of images of milk products that are commercially available in different countries. One condition saw 4 animal-based and 2 plant-based milk products, and the other condition saw 2 animal-based products and 4 plant-based products. Animal-based milk products were: 1% milk, 2% milk, skim milk, whole milk. Plant-based milk products were: Almond milk, coconut milk, rice milk, soy milk. In another study, participants were presented with a set of images of cheese products that are commercially available in different countries. As above, 1 condition saw 4 animal-based and 2 plant-based cheese products, and the other condition saw 2 animal-based and 4 plant-based cheese products.	In both studies, participants were significantly better at identifying plant-based items compared to animal-based items ($p < .001$). Study 1 94% of participants accurately identified the plant-based milk products, while 77% identified the animal-based milk items. Study 2 90% of participants identified the plant-based cheese items, while 64% identified the animal-based cheese items.	Strengths Sample of stimulus available for review. Limitations Relatively small convenience sample with a high proportion of university-educated participants and (Study 2) rural participants. Relevant demographic characteristics, such as country of residence and vegan/dairy free status not collected and/or reported. Experimental design was only relevant to the different proportions of animal/plant-based products viewed.	None identified.

Study, Product, Country	Sampling approach	Participant characteristics	Design/stimuli/measures	Key findings	Strengths and limitations	Funding body or conflicts of interest
		American 6% Hispanic/Latin American 3% Other < $20k: 9% $20k - $39k: 21% $40k - $49k: 15% $50k - $75k: 30% $60k - $99K: 12% $100k+: 13% 46% rural [a]Note that the income ranges are as reported, including 1 overlapping range.	Animal-based cheese products were: Cheddar cheese, cheese dip, cream cheese, and swiss cheese. Plant-based cheese products were: Vegan cheddar cheese, vegan cream cheese, vegan nacho sauce, and vegan cheese slices. Relevant measures Participants were asked to select which of the 6 products were made with 'real cow's milk'.			
Gleckel (2020) Meat Dairy USA	155 US consumers Convenience sample Recruited through Survey Monkey	Mean age 52 (range 21 to 76) 68% female 65.8% university educated 25% rural 13.6% vegetarian	Design Online quantitative, experimental (between-subjects) design. Stimulus Participants were presented with 3 fictional names of foods, some of which used traditional meat or dairy terminology and some which did not, forming pairs across groups with 1 control. Group A (n = 96): (i) 'Next-Generation Meat: Plant-based beef burger', (ii) 'Cultured vegan spread', and (iii) 'Plant-based deli slices: Bologna style'. Group B (n = 59): (i) 'Next-Generation Vegetables: Plant-based veggie patty', (ii) 'Cultured vegan butter', and (iii) 'Sandwich slices'. Relevant measures	Animal content No significant difference in expectations of animal content between 'plant-based beef burger' and 'cultured vegan butter' and controls. Participants significantly ($p < .001$) less likely to think 'plant-based deli slices: bologna style' contained animal products compared to 'sandwich slices'. Expected flavour Participants significantly ($p < .05$) more likely to report that they could imagine the taste of cultured vegan butter and plant-based deli	Strengths Experimental design with controls. Limitations Small, non-representative convenience sample. Sampling approach not fully detailed. Substantially more people in condition Group A than condition Group B. Stimuli were verbal only; no images of packaging were used. Control conditions not consistent across pairings (the 'sandwich slices'	Author writes a column for '1 Green Planet', an online magazine focusing on animal and environmental activism and sustainable lifestyles.

Study, Product, Country	Sampling approach	Participant characteristics	Design/stimuli/measures	Key findings	Strengths and limitations	Funding body or conflicts of interest
			Participants were asked to report: i) how likely it was that the product was made from an animal or contained animal products, ii) how clearly they could imagine the taste of the product (vegan butter/spread and deli/sandwich slices), iii) how likely it would be to taste like vegetables (plant-based beef burger/veggie patty), iv) whether it is a good source of protein (beef burger/veggie patty), v) likelihood that it would be used for a range of common applications (cultured vegan spread/butter only). Responses were captured using various 5-point Likert scales.	slices: bologna style compared to their controls. Participants significantly ($p = .005$) more likely to expect that plant-based vegie patties would taste like vegetables compared to plant-based beef burgers. Product use Participants significantly ($p < .05$) more likely to understand vegan butter can be used on pasta and to make biscuits compared to vegan spread. No significant difference in understanding it can be used on toast.	control condition deviates from the pattern). Outcome measures not consistent across pairings. Proportions not always reported. Given these limitations, the study's conclusions appear overstated.	

Table 9 Cross-sectional surveys

Study, Subject, Country	Sampling approach	Participant characteristics	Design/stimuli/measures	Key findings	Strengths and limitations	Funding body or conflicts of interest
Australian Pork Limited (2021) Meat Australia	Not reported	Not reported	Not reported. However, appears to be a cross-sectional survey.	'A recent consumer insights survey conducted by APL shows that 50 per cent of Australians believed, upon initial view of package labelling, that a 'plant-based roast pork' product was made of pork.'	Limitations No methodological information.	Undertaken by Australian Pork Limited.

Study, Subject, Country	Sampling approach	Participant characteristics	Design/stimuli/measures	Key findings	Strengths and limitations	Funding body or conflicts of interest
Center for Public Policy (2019) Meat USA	N = 1,800+ US consumers Nationally representative. Sampling approach not reported.	Nationally representative by age, region, and gender among 18-65 year olds.	Design Cross-sectional survey. Stimulus Respondents were initially presented with the term 'plant-based beef' and asked to identify its likely ingredient content from a range of 4 possible options (see results column). Respondents were then broken up into groups (n = 350) and shown different stimulus. Three were images of plant-based beef product packages. Respondents were once again asked to identify the ingredient content from the same range of 4 possible options. Two pieces of stimulus were ads for plant-based beef, the results of which are not reported here. Measures Identify the ingredient content. Response options: Is completely vegan, containing no meat or animal byproducts (eggs, dairy). Does not contain meat but may contain animal byproducts. Can contain small amounts of meat, but is primarily plant-based. Contains meat and there are no restrictions on the amount.	'Plant-based beef' results Base: All 1,800+ consumers: 45% of consumers believe 'plant-based beef' is 'completely vegan, containing no meat or animal byproducts (eggs, dairy).' 31% believe it 'does not contain meat but may contain animal byproducts.' 17% believe it 'can contain small amounts of meat, but is primarily plant-based.' 7% believe it 'contains meat and there are no restrictions on the amount.' Beyond Burger results Base: n = 350: 39% believed the 'Beyond Burger' is 'completely vegan, containing no meat or animal byproducts'. 29% believed it 'does not contain meat but may contain animal byproducts (eggs, dairy, etc.)' 21% believed it 'can contain small amounts of meat, but is primarily plant-based.' 11% believed it 'contains meat and there are no restrictions on the amount.'	Strengths Reasonably large, nationally representative sample weighted to the US census. Both 'plant-based beef' terminology and images of product packaging provided as stimulus. Stimulus available for review. Limitations Limited methodological information provided. Forced choice: no 'don't know' option. Unknown whether the products in question did or did not contain dairy or eggs, so correctness of responses is not apparent.	Commissioned and reported by National Cattlemen's Beef Association.

Study, Subject, Country	Sampling approach	Participant characteristics	Design/stimuli/measures	Key findings	Strengths and limitations	Funding body or conflicts of interest
				Sources of confusion on the package were: References to 'meatier' and 'marbled juiciness'. Image of a cow. Beyond Beef results Base: n = 350: 41% believed the 'Beyond Beef' is 'completely vegan, containing no meat or animal byproducts'. 27% believed it 'does not contain meat but may contain animal byproducts (eggs, dairy, etc.)' 22% believed it 'can contain small amounts of meat, but is primarily plant-based.' 10% believed it 'contains meat and there are no restrictions on the amount.' Sources of confusion on the package were: Looks like, and is packaged like, meat Use of 'beef' term Image of a cow. Lightlife Gimme Lean Base: n = 350: 37% believed the 'Beyond Beef' is 'completely vegan, containing no meat or animal byproducts'.		

Study, Subject, Country	Sampling approach	Participant characteristics	Design/stimuli/measures	Key findings	Strengths and limitations	Funding body or conflicts of interest
				26% believed it 'does not contain meat but may contain animal byproducts (eggs, dairy, etc.)' 22% believed it 'can contain small amounts of meat, but is primarily plant-based.' 15% believed it 'contains meat and there are no restrictions on the amount.' Sources of confusion on the package were: Beef terminology Packaged like meat 'Plant-based ground'		
Colmar Brunton (2019a) Meat Australia	Not reported.	'Nationally representative'. No further details provided, including the number of respondents.	Design Not reported. Appears to have been a cross-sectional survey design. Relevant measures Not reported. Proportion who had mistakenly purchased a plant-based product or meat-based product thinking it was its counterpart.	'91% of Australians have never mistakenly purchased a plant-based product thinking it was its meat-based counterpart, or vice versa. And of the 9 percent who have mistakenly purchased the wrong product, they were more likely to be a Vegetarian or Vegan.'	Limitations No methodological details provided.	Commissioned by Food Frontier and Life Health Foods. Reported by Food Frontier.
Colmar Brunton (2019b) Meat New Zealand	Not reported.	'Nationally representative'. No further details provided, including the	Design Not reported. Appears to have been a cross-sectional survey design. Relevant measures Not reported. Proportion who had mistakenly purchased a plant-based	'94% of New Zealanders have never mistakenly purchased a plant-based product thinking it was its meat-based counterpart, or vice versa. And of the 6 percent who have mistakenly purchased	Limitations No methodological details provided.	Commissioned by Food Frontier and Life Health Foods. Reported by Food Frontier.

Study, Subject, Country	Sampling approach	Participant characteristics	Design/stimuli/measures	Key findings	Strengths and limitations	Funding body or conflicts of interest
		number of respondents.	product or meat-based product thinking it was its counterpart.	the wrong product, they were more likely to be a Vegetarian or Vegan.'		
Dairy Australia (2020) Dairy Australia	1,293 Australian consumers aged 18+ years (2020) 1,326 Australian consumers aged 18+ years (2019) Quota-based sampling.	Nationally representative. Data weighted to be representative by age, gender and location. 41.4% of sample buy alternative milks.	Not reported. Appears to be a cross-sectional survey design. No stimuli appear to have been provided. % think that alternative 'milks' contain cow's milk.	In 2019, 15% of respondents thought that plant-based beverages contain cow's milk. In 2020, 19% of respondents thought that plant-based beverages contain cow's milk.	Strengths Reasonably large, nationally representative sample weighted by age, gender and location. Repeated questions across years. Limitations Limited methodological details provided.	Commissioned by Dairy Australia
Institute for Sustainable Futures (2022) Meat Australia	N = 1,014 Australian consumers Recruited through Kantar's global research panel.	'Aiming to be nationally representative' 48% female 73% urban 18-34 years: 31% 35-54 years: 35% 55+ years: 35% 76% omnivore 16% flexitarian 4% vegetarian 2% pescatarian 1% vegan	Design Cross-sectional survey. Stimuli Each respondent was shown a randomised set of 15 images of plant-based and animal-based meat products from a total set of 60 images. For each image shown, the respondent was asked to indicate whether the product was a plant-based meat product, an animal-based product, or if they were unsure. Relevant measures % correctly identified the product (plant-based or animal-based meat). % who felt they could tell the difference between plant-based and animal-based meat products based on the names, descriptions and images.	On average, 80% of respondents correctly identified the nature of the product. When asked, 90% of respondents felt they could tell the difference between plant-based and animal-based meat products. 12% of respondents said they had mistakenly bought or eaten a plant-based meat product thinking it was an animal-based product. 7% were unsure. Of those who said they had mistakenly bought a product before, the majority (67%) said they were in a hurry/distracted and did not	Strengths Broadly nationally representative sample by age, gender, diet, and urban/rural location. Some objective measures. Sample of stimulus available for review. Limitations Limited methodological detail. Proportion of plant-based meat and animal-based meat product images used in the activity is not reported. Some relevant demographic details (e.g.	Funded by No Meat May and Vegan Australia.

Study, Subject, Country	Sampling approach	Participant characteristics	Design/stimuli/measures	Key findings	Strengths and limitations	Funding body or conflicts of interest
			% who reported having mistakenly bought or eaten plant-based meat thinking it was an animal-based meat product. % report being able to tell the difference between plant-based meats and animal-based meats based on the product label. % who find the use of animal images on plant-based meats confusing. % who find animal images help understanding of the type of meat the plant-based product is trying to replicate.	read the product label. 33% said they were confused by what the product actually was. 51% reported being able to tell the difference between plant- and animal-based meats based on the product labels. 16% disagreed. 45% reported finding the use of animal images on plant-based meats confusing. 27% disagreed. 38% found the use of animal images on plant-based meat products helps their understanding of the type of meat the plant-based product is trying to replicate. 29% disagreed.	education, income) not collected or not reported.	
International Food Information Council Foundation (2018) Milk USA	N = 1,000 US consumers Data collected via Online Survey of American Adults by Lincoln Park Strategies.	Nationally representative sample weighted to ensure proportional results.	Design Limited methodological detail. Appears to be a cross-sectional survey. Stimulus Respondents were initially presented with series of product names (see results). They were then shown a series of images of items they could find in the grocery store. Measures 'And of the products below which do you think contains cow's milk?' Response	Without looking at labels *Rice milk* 7% believed it contains cow's milk 20% didn't know *Cashew milk* 8% believed it contains cow's milk 20% didn't know *Almond milk* 9% believed it contains cow's milk 16% didn't know *Soy milk*	Strengths Nationally representative sample. Tested both terminology on its own and images of product labels. Limitations Limited methodological detail provided. Stimulus (images of product packaging) not provided, so it is unknown what labelling elements	Funded by Danone North America PBC.

Study, Subject, Country	Sampling approach	Participant characteristics	Design/stimuli/measures	Key findings	Strengths and limitations	Funding body or conflicts of interest
			options: 'Contains cow's milk', 'Don't know' and 'Does NOT contain cow's milk.' 'For each, please indicate what ingredients you believe are likely to be in the product.' Response options: 'Milk from cows', 'Plant-based ingredients', 'Neither', and 'Don't know.'	9% believed it contains cow's milk 16% didn't know *Coconut milk* 9% believed it contains cow's milk 18% didn't know *Whole milk* 4% believed it didn't contain cow's milk 5% didn't know *Chocolate milk* 7% believed it didn't contain cow's milk 9% didn't know *Non-fat milk* 9% believed it didn't contain cow's milk 12% didn't know *Skim milk* 14% believed it didn't contain cow's milk 13% didn't know *Lactose-free milk* 31% believed it didn't contain cow's milk 22% didn't know When looking at labels *Rice milk* 6% believed it contains cow's milk 14% didn't know	participants were responding to. Response options differed between terminology and product label questions, making it difficult to compare.	

Study, Subject, Country	Sampling approach	Participant characteristics	Design/stimuli/measures	Key findings	Strengths and limitations	Funding body or conflicts of interest
				7% believed it contained neither cow's milk nor plant-based ingredients *Cashew milk* 7% believed it contains cow's milk 15% didn't know 8% believed it contained neither cow's milk nor plant-based ingredients *Almond milk* 8% believed it contains cow's milk 12% didn't know 9% believed it contained neither cow's milk nor plant-based ingredients *Soy milk* 8% believed it contains cow's milk 15% didn't know 7% believed it contained neither cow's milk nor plant-based ingredients *Almond butter* 8% believed it contains cow's milk 16% didn't know 11% believed it contained neither cow's milk nor plant-based ingredients *Peanut butter* 15% believed it contains cow's milk		

Study, Subject, Country	Sampling approach	Participant characteristics	Design/stimuli/measures	Key findings	Strengths and limitations	Funding body or conflicts of interest
				15% didn't know 16% believed it contained neither cow's milk nor plant-based ingredients *Chocolate milk* 5% believed it was plant-based 7% didn't know 3% believed it contained neither cow's milk nor plant-based ingredients *Organic milk* 8% believed it was plant-based 10% didn't know 3% believed it contained neither cow's milk nor plant-based ingredients *Butter* 8% believed it was plant-based 10% didn't know 7% believed it contained neither cow's milk nor plant-based ingredients *Lactose-free milk* 14% believed it was plant-based 16% didn't know 8% believed it contained neither cow's milk nor plant-based ingredients		

Study, Subject, Country	Sampling approach	Participant characteristics	Design/stimuli/measures	Key findings	Strengths and limitations	Funding body or conflicts of interest
Ipsos (2018) Dairy USA	N = 2,010 US adults aged 18+ Nationally representative. Sampling approach unknown.	Aged 18+ Weighted to US Population Census 2016. Dairy milk only consumers = 914 Dairy milk and plant-based milk consumers = 789 Plant-based milk only consumers = 110.	Design Cross-sectional survey. Measures Products associated with the term 'dairy milk'.	'Dairy milk products are highly associated with 'dairy milk', yet a significant minority of consumers do associate some plant-based milks with dairy milk. The association of plant-based milks with dairy milk is strongest when the term 'milk' is more prominent on the package. Consumers who purchase both dairy milk and plant-based milks are most likely to associate plant-based milks with dairy milk.'	Limitations Very limited methodological information provided.	Funded by the US National Dairy Council.
Pollinate (2021) Meat Australia	1,000 Australian consumers. Respondents sourced from PureProfile.	Nationally representative. Age, gender and location weighted to reflect ABS 2020 population data. 51% female 18-34 yrs: 32% 35-54 yrs: 33% 55+: 35% 32% regional	Design Cross-sectional survey design. Stimulus 3-second packaging association test showed 6 supermarket products: 5 x plant-based meat (Beyond Meat – Beyond Burger, Unreal Co – Beefy Brat, Sunfed – Chicken Free Chicken, Next! – Extra Crispy Bacon, Plant Asia – Tender Beef), and 1 x animal meat control (Woolworths – Beef Mince). Relevant measures Accuracy of product content identification ('What best applies to the product you just saw?' Response options: 'Only contains animal meat', 'Contains a mix of	Accuracy of product identification Participants' misattribution of plant-based meat product content ranged from 13% to 33% (averaging 25%). In addition, 9% incorrectly identified the product content of the control (beef mince). Those who mistook at least 1 plant-based meat product as containing animal meat were more likely to be male, aged 65+, empty nesters, speak a language other than English with family/friends, and/or have a household income of $40k or below ($p < .05$).	Strengths Nationally representative sample by age, gender, and location. Objective measures used. Products shown in-survey used a range of different brands, meat terminology, utility terms, and animal imagery. Included a control. Stimulus available for review. Limitations A number of demographic characteristics not reported, despite being	Commissioned by Red Meat Advisory Council

Study, Subject, Country	Sampling approach	Participant characteristics	Design/stimuli/measures	Key findings	Strengths and limitations	Funding body or conflicts of interest
			animal meat and plant-based ingredients', 'Only contains plant-based ingredients') Self-reported level of confusion, including based on product packaging, product placement in-store, and/or product categorisation online. Self-reported experiences in mistaking plant-based meat for animal meat. Self-reported main source of confusion for plant-based meat packaging among those who found it confusing.	Self-reported confusion 47% of respondents had 'had a hard time figuring out whether a product is made of plant-based vs animal meat' when looking at where the products are placed in the supermarket. 45% had had a hard time when looking at product packaging. 42% had had a hard time when looking at how the product is categorised online. 18% identified plant-based meat packaging as 'very' or 'extremely' confusing. 32% of respondents reported that they had mistaken plant-based meat for animal meat in the past. Self-reported top 3 sources of confusion Asked to those respondents who found it plant-based meat packaging at least somewhat confusing (n = 509). 36% identified animal imagery as a top 3 source of confusion. 23% 'packaging just looks like animal meat'.	collected (such as education). Limited details of data analysis. Limited range of products tested. Participants only saw an image of the front of products; they did not have access to the ingredients list. Time allowed for the association test was very short (3 seconds per product). Use of an asymmetric Likert scale to measure self-reported confusion (the middle category is not neutral and is reported as indicating confusion).	

Study, Subject, Country	Sampling approach	Participant characteristics	Design/stimuli/measures	Key findings	Strengths and limitations	Funding body or conflicts of interest
				21% 'hard to understand'. 19% 'hard to read / small font'. 14% identified 'uses meat descriptors ('meat', 'chicken', etc.). All other sources of confusion were each chosen by less than 10% of respondents.		
Sanitarium (2021) Dairy Australia	Not reported.	Not reported.	Not reported.	'Sanitarium has also conducted consumer research on labelling of plant milks compared to dairy milks and found that, overwhelmingly, consumers understood the different nature of the 2 types of products.'	Limitations No methodological detail provided.	Undertaken by Sanitarium.
Woolworths (2021) Not reported Australia	N = 5,700 Woolworths customers	Not reported.	Design Not reported. Appears to be a survey of Woolworths customers. Measures Purchased a plant-based item in error.	7% of customers said they have purchased a plant-based item in error.	Limitations No methodological detail provided.	Undertaken by Woolworths.

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