

A Rapid Evidence Review on Consumer Responses to Precision Fermentation

Food Standards Agency¹

¹ Analytics Unit, Food Standards Agency

Keywords: Novel foods, Wider consumer interests, Regulated Products

<https://doi.org/10.46756/001c.136898>

FSA Research and Evidence

Precision fermentation is a food processing technique that uses genetically modified microorganisms such as yeast or bacteria to produce foods. For example, precision-fermented dairy is where cow DNA is put into microorganisms like yeast so that the yeast can produce dairy without the need for traditional animal farming. An evidence review was undertaken to examine consumer responses to precision-fermented foods. Most of the available evidence examined precision-fermented dairy. The key findings based on the UK evidence are outlined below. A more detailed description of the findings that incorporates the international evidence is available in the Executive Summary.

People are more willing to try precision-fermented dairy/egg than they are to regularly purchase or incorporate these products into their diet

- Over half of people in the UK (52-68%) are willing to try precision-fermented dairy/egg.
- However, only a minority (17-35%) are willing to regularly purchase or include these products in their diet.

People tend to agree that precision-fermented dairy/egg has benefits, however, people also have some concerns about these products

- Perceived benefits and motivators for consuming precision-fermented dairy/egg include curiosity about its taste and perceiving the products to be beneficial for animal welfare, the environment, and health.
- Perceived risks/concerns and demotivators for consuming precision-fermented dairy/egg include concerns about its safety, unnaturalness and affordability.

- People feel uncertain about how to categorise precision-fermented foods and thus may question whether these products are vegan or vegetarian.

When consumers have no prior knowledge of what precision-fermented dairy/egg is, the term 'animal-free' is more likely to be associated with plant-based products compared to other terms

- However, when consumers have prior knowledge of precision-fermented dairy/egg, they perceive the term 'animal-free' to be most effective at differentiating the product from both animal-based and plant-based products.
- It is unclear whether any term sufficiently conveys allergen information to consumers.

Most people either feel unsure about whether precision-fermented dairy should be sold in the UK in future, or think that it should not be on sale

- Limited evidence was available on consumers' level of trust in the regulation of precision-fermented foods.

1. Executive Summary

A rapid evidence review was undertaken on consumer perceptions and consumption intentions regarding precision-fermented foods. Precision-fermented foods are foods made from genetically modified microorganisms such as yeast or bacteria. Searches of electronic databases and hand-searching were used to identify 19 studies. The review includes peer-reviewed journal articles as well as grey literature.

Most studies examined consumer responses to precision-fermented dairy, with some also examining precision-fermented egg or precision-fermented foods in general without specifying a particular type of food. One international study examined precision-fermented lactoferrin in infant formula products. Limited evidence was available regarding consumer views on whether precision-fermented foods are halal or kosher, on consumer trust in the regulation of these foods, and comparing views between vegans/vegetarians/flexitarians and omnivores.

The key findings are summarised below (in more detail than the Abstract), grouped by research question. All findings are based on UK evidence, except where otherwise stated.

How willing are consumers to consume precision-fermented foods?

- Over half of people in the UK (52-68%) are **willing** to try precision-fermented dairy/eggs, whereas a minority are willing to **regularly purchase** the products (35%) or **add them to their diet** (17-31%).
 - Consistent with the UK evidence, **international evidence** suggests that people are more willing to try or purchase precision-fermented foods than they are to regularly purchase or incorporate them into their diet.
 - Willingness to try and regularly purchase precision-fermented dairy is similar between the UK and USA, but more prevalent in other countries such as Brazil, India.
 - Although there are some differences between different demographic groups, the **most important predictors of purchase intentions** of precision-fermented dairy in the UK are having positive perceptions of the product, followed by having higher consumption levels of conventional dairy.
 - Limited UK evidence also suggests that **flexitarians** are the most likely to be willing to purchase precision-fermented **dairy** (vs. omnivores)
 - Conversely, limited **international evidence** suggests that **vegans** are the most likely to be willing to consume precision-fermented **egg**.
2. International evidence suggests that people are also more **willing to purchase** precision-fermented foods if they:
- Trust food manufacturers
 - Perceive the product to be useful
 - Feel knowledgeable about the product
 - Do not perceive risks to farmers' livelihoods
 - Are not concerned about market power of large companies
 - Do not have a fear of new food technologies.

What are consumers' views on the risks and benefits of precision-fermented foods?

3. People tend to agree that precision-fermented dairy has environmental and animal-welfare **benefits** when they are provided with this information. Other recognised benefits may be its perceived nutritional value and potential to increase food security.
 4. However, people also perceive precision-fermented dairy to be less natural and slightly less safe than conventional dairy. People may also be **concerned** about threats to farmers.
- **Motivators** for consuming precision-fermented dairy/egg include curiosity about its taste and perceiving the product to be safe, similar in taste/texture/smell to conventional foods, beneficial for food security, beneficial for animal welfare, healthy and environmentally-friendly.
 - **Demotivators** for consuming precision-fermented dairy include concerns about its safety (e.g., concerns about chemicals, ingredients and long-term side effects), unnaturalness and affordability.
 - International evidence suggests that peoples' **perceived benefits** of precision-fermented foods are **more important** predictors of consumption/purchase intentions than their perceived risks.
 - Some perceived benefits/concerns are more important for some **demographic groups** than others:
 - Women are more likely than men to be worried about the chemicals and ingredients, and to be motivated by the product not requiring animals to be farmed.
 - Men and younger people are more likely to be motivated by the product being cheaper than conventional products.
 - Compared to non-farmers, farmers are more likely to be convinced of the risks of precision-fermented dairy, and are less likely to be convinced of the benefits.

- People in the UK perceive precision-fermented dairy to be less natural, less safe, less ethical and less environmentally-friendly than people from Brazil or India.
- People feel uncertain about how to categorise precision-fermented dairy/egg and therefore may question **whether** the product is vegan or vegetarian.

How does the terminology applied to precision-fermented foods influence consumer perceptions?

- When consumers have no **prior knowledge** of precision-fermented dairy/egg, the terms 'animal-free' and 'non-animal' are more likely to be associated with plant-based products compared to other terms.
- However, when consumers **have prior knowledge** of what precision-fermented dairy/egg is, they *perceive* the terms 'animal-free' or 'non-animal' to be most **effective at differentiating** the product from both animal-based and plant-based products.
- It is unclear whether the terms 'animal-free' or 'non-animal' sufficiently convey **allergen information** to consumers, with or without any prior knowledge of the product.
- The terms 'animal-free' and 'made from fermentation' are **perceived most positively** by consumers when they have no prior knowledge of precision-fermented dairy/egg.
- The term 'animal-free' is ranked as the **most appealing** when consumers have prior knowledge of precision-fermented dairy/egg.

What do consumers think about FSA involvement, regulation and labelling of precision-fermented foods?

- Most people either feel unsure about whether precision-fermented dairy should be **sold in the UK** (37%) or think that it should not be on sale (34%).
- People are **more likely** to think that precision-fermented dairy should be sold in the UK in future if they are:

- Male
 - Younger
 - University educated
 - An ethnic minority (vs. white ethnicity)
 - Have a mid-range income (vs. lower income)
 - Have heard of fermentation or precision-fermented dairy
 - Are vegan/vegetarian/pescatarian/flexitarian (vs. omnivore)
- Limited international and UK evidence suggests that people who are already open to trying novel foods generally have trust in the regulation of precision-fermented dairy. No evidence was available on the broader UK population.
 - Limited international evidence from Australia suggests that caregivers have trust in the regulation of precision-fermented lactoferrin in infant formula products.

2. Introduction

Fermentation is a traditional food processing technique that uses microorganisms like yeast or bacteria to make foods such as yogurt, cheese, and beer. *Precision fermentation* is a similar food processing technique, except that the microorganisms have had their DNA altered to make food products. Precision fermentation has been used by the food industry for years, for example, to make citric acid (a common preservative in foods) and non-animal rennet (an enzyme used in cheese production).

The food industry is currently exploring how to make new types of precision-fermented foods, such as precision-fermented dairy and eggs. For example, precision-fermented dairy is where cow DNA is put into microorganisms so they can produce milk proteins such as casein and whey. These milk proteins are then combined with other ingredients to produce dairy products such as milk and cheese, without the need for traditional animal farming. Precision-fermented dairy and eggs are not yet available in the UK. However, precision-fermented dairy is currently available for sale in the USA and Singapore from the company Perfect Day (Dang, 2023; Mendlly-Zambo et al., 2021). Perfect Day's precision-fermented dairy is lactose-free, but it is a cow's milk allergen (Perfect Day, n.d.).

A rapid evidence review was undertaken on consumer perceptions and consumption intentions regarding precision-fermented foods. All types of food products produced through precision fermentation were in scope, including older forms such as non-animal rennet/citric acid and newer forms such as precision-fermented dairy/eggs.

There are many other terms that have been used by the industry and in the literature to refer to precision-fermented foods (e.g., 'animal-free', 'non-animal', 'yeast-derived', 'synthetic'). Throughout this report, the term 'precision-fermented' is used.

The rapid evidence review investigated the following research questions:

1. How willing are consumers to consume precision-fermented foods?
 - a. Which demographic groups are more or less willing to consume these products?
2. What are consumers' views on the risks and benefits of precision fermentation?
 - a. How do views differ by demographics? Do people consider these products to be vegan/vegetarian, kosher and halal?
3. How does the terminology applied to precision fermentation influence consumer perceptions?
4. What do consumers think about regulation and labelling of precision-fermented foods?
5. What are consumers' views on the role of government for these products?

3. Methods

A rapid evidence review was undertaken to identify in-scope studies. The rapid evidence review includes peer-reviewed articles published in academic journals, as well as grey literature, such as government reports and non-government organisation reports.

The rapid evidence review also includes analysis of the FSA's February 2025 wave of the [Consumer Insights Tracker](#) (CIT; Food Standards Agency (FSA), 2025b). The CIT is the FSA's monthly online survey that measures consumers' behaviour and attitudes in relation to food. The CIT includes a nationally representative sample of approximately 2,000 adults across England, Wales and Northern Ireland. More information about the CIT is available on the FSA website, as linked above.

3.1. Literature search strategy

UK and international literature were searched from 2015 – 2025 to include studies within the last 10 years.

Literature was identified by:

- Searching three online databases for peer-reviewed studies
- Searching Google Scholar (first 100 hits)
- Checking studies obtained from a previous literature search on cell-cultivated products (FSA, 2025a)
- Examining the reference lists and citing studies of all included studies.

In addition, one new study was sent via email from the Good Food Institute (GFI, 2025). More detail on the literature search strategy and research review process are available in Appendix A (Section 1.1).

3.1.1. Study quality assessment

The quality of each individual study was not assessed using a standardised quality assessment tool (or checklist), given the anticipated high number of included studies and the need to produce a timely evidence synthesis. Rather, the general strengths and limitations of each study were considered in the narrative when forming overall conclusions. This is a commonly used approach when conducting rapid evidence reviews (Tricco et al., 2015).

3.2. Analysis of FSA survey data

Data from the FSA's CIT survey were analysed using R statistical software. Descriptive statistics (percentages) were calculated to give a general overview of participants' responses. Binomial logistic regression was used to determine whether there were any significant differences between participants' responses based on various demographic factors. All analyses were based on weighted data.

More detail on the data analysis methods is available in Appendix A (Section 1.2)

3.3. Evidence synthesis

Evidence was narratively synthesised from studies identified through the literature search and the FSA's CIT survey data. The findings were grouped thematically by research question.

When forming overall conclusions, more weight was given to higher quality studies. Where available, more weight was also given to UK studies, provided they were of sufficient quality. The general strengths and limitations of each study were considered and are narratively described throughout the report (see section 3.1.1 above).

4. Results

4.1. Overview of study characteristics

Nineteen studies were eligible for inclusion. Most studies (n = 14) were peer-reviewed articles published in academic journals, whereas five were grey literature (i.e., research produced by government and non-government agencies).

Most studies (n = 13) were quantitative designs (experiments or surveys), five were qualitative designs (interviews or focus groups), and one was a mixed design (survey with both closed- and open-ended questions).

Eight studies were based in the UK only, 10 were based internationally only (Australia, Brazil, Canada, Denmark, Germany, India, Poland, Singapore, Turkey, USA), whereas two were based in the UK as well as other countries. Where appropriate, more weight is given to the UK evidence in the current report.

Most studies (n = 12) examined consumer responses to precision-fermented dairy only. One (international) study examined precision-fermented egg only, whereas one (UK) study examined both precision-fermented dairy and egg. Four studies examined precision-fermented foods in general without specifying a particular food. One (international) study examined precision-fermented lactoferrin in infant formula¹.

4.2. How willing are consumers to consume precision-fermented foods?

Thirteen studies examined consumers' willingness to purchase or consume precision-fermented foods. Four studies were based in the UK only, 8 were based internationally only (Germany, Turkey, USA, Canada, Singapore, Denmark), and one was based in the UK as well as other countries for direct comparison (USA, Germany, Brazil, India).

¹ Lactoferrin is a protein found in both human breastmilk and cow's milk and can play a role in protecting infants against infection (Manzoni, 2016, 2019; as cited in Mankad & Carter, 2025). Only lactoferrin from cows' milk is currently used in infant formula products. Precision-fermented lactoferrin would involve putting human lactoferrin DNA into yeast cells so that the yeast cells can produce lactoferrin.

Most studies (n = 9) examined precision-fermented dairy only, whereas one international study examined precision-fermented egg only, and one UK study examined both precision-fermented dairy and egg. Two international studies examined precision-fermented foods in general without specifying a particular food type to consumers.

4.2.1. Overview of key findings

- Over half of people in the UK (52-68%) are **willing to try** precision-fermented dairy/eggs.
 - Whether people in the UK are **willing to purchase** precision-fermented dairy/eggs varied considerably across studies (21-56%).
 - Studies reporting a higher percentage of people willing to try or purchase precision-fermented dairy/eggs used positively-framed terminology (e.g., “legendary mozzarella”, rather than “precision-fermented” or “synthetic” dairy), and provided participants with a description of the product emphasising its benefits (lower carbon footprint, no antibiotics).
 - A minority of people in the UK are willing to **regularly purchase** precision-fermented dairy/eggs (35%), or **add them to their diet** alongside or in-place of conventional dairy/eggs (17-31%).
 - Few people in the UK (15-16%) are **willing to pay more** for precision-fermented dairy/eggs than conventional dairy/eggs.
 - Consistent with the UK evidence, **international evidence** suggests that people are more willing to try or purchase precision-fermented foods than they are to regularly purchase or incorporate them into their diet.
 - Willingness to try precision-fermented dairy is similar between the UK and USA, but more prevalent in other countries such as Brazil, India and Germany.
5. Willingness to purchase and regularly purchase precision-fermented dairy is similar between the UK and USA/Germany, but more prevalent in Brazil and India.
 6. People in the UK are **more likely** to be willing to purchase and/or incorporate precision-fermented dairy in their diet if they:

- Are male
 - Are younger
 - Have a higher income
 - Are university educated
 - Are an ethnic minority (vs. white ethnicity; limited evidence)
 - Are from urban (vs. rural) locations
 - Are politically liberal (vs. conservative)
 - Are more religious
 - Have previously heard of precision-fermented dairy
 - Have higher consumption levels of conventional dairy
 - Perceive the product to be tasty, ethical, environmentally-friendly, or natural.
- The **most important predictors** of purchase intentions of precision-fermented dairy in the UK are having positive perceptions of the product, followed by having higher consumption levels of conventional dairy.
 - Limited UK evidence suggests that people are also more willing to purchase precision-fermented **dairy** if they are vegetarian, pescatarian or flexitarian (vs. omnivore), with **flexitarians** being the most likely. There is no difference between vegans and omnivores.
 - Conversely, limited **international** evidence suggests that vegans, vegetarians and flexitarians are more willing to consume precision-fermented **egg**, with **vegans** being the most likely.
 - **International evidence** suggests that people are also more willing to purchase precision-fermented foods if they:
 - Trust food manufacturers
 - Perceive the product to be useful
 - Feel knowledgeable about the product
 - Do not perceive risks to farmers' livelihoods

- Are not concerned about market power of large companies
 - Do not have a fear of new food technologies
7. International evidence suggests that peoples' perceived benefits of precision-fermented foods are more important predictors of consumption/purchase intentions than their perceived risks.

A more detailed description of the evidence is provided below, grouped by research question: percentage of consumers willing to consume precision-fermented foods; who is more willing to consume precision-fermented foods.

4.2.2. Percentage of consumers willing to consume precision-fermented foods

Most of the thirteen studies reported the percentage of participants who were willing to consume and/or purchase precision-fermented foods (as opposed to group means from Likert scale ratings, for example). Given evidence that consumption intentions significantly differ between countries (see section 4.2.4 – 'Who is more likely to be willing to consume precision-fermented foods?'), findings are reported separately for UK and international studies.

4.2.2.1. UK studies

All five UK studies examined participants' willingness to try and/or purchase precision-fermented dairy (a one-time behaviour). In addition to these one-time behavioural measures, two of these studies also examined repeated behavioural measures such as participants' willingness to regularly purchase precision-fermented dairy or incorporate them into their diets. Given that single studies examined multiple types of measures, this allows clear comparison of the prevalence of each type of behavioural measure.

One UK study also examined both precision-fermented dairy and egg, which allows comparison of the prevalence of consumption intentions between these different product types.

[Table 1](#) provides an overview of the methods and findings of each UK study. The evidence regarding each behavioural measure is also summarised below.

4.2.2.1.1. Willingness to try

Two nationally-representative UK studies examined whether consumers are willing to try precision-fermented dairy/eggs (GFI, 2025; Zollman Thomas and Bryant, 2021). Across both studies, over half of participants (52-68%) were willing to try precision-fermented dairy/eggs. The study reporting the higher percentage of participants willing to try these products (Zollman Thomas & Bryant, 2021) used positively framed terminology (e.g., “legendary mozzarella”, rather than “precision-fermented dairy”) and provided participants with a description of the product emphasising its benefits (lower carbon footprint, no antibiotics). Participants’ willingness to try precision-fermented dairy vs. egg was similar (GFI, 2025).

One additional study (Ford et al., 2024) sampled a small university cohort and found that all participants were willing to taste precision-fermented yoghurt. However, findings from this small non-representative sample are not generalisable to the wider UK population.

4.2.2.1.2. Willingness to purchase

Three nationally-representative studies examined whether participants were willing to purchase precision-fermented dairy/eggs. Findings varied considerably from a minority (21-28%; The Grocer, 2018; GFI, 2025) to over half (58.5%; Zollman Thomas & Bryant, 2021) of participants willing to purchase the products. Again, the higher percentage of participants willing to purchase the product in Zollman Thomas and Bryant’s (2021) study may be attributed to the environmental and antibiotic-free benefits described to participants. Willingness to purchase precision-fermented dairy and egg was again found to be similar (GFI, 2025).

The Grocer (2018) examined participants’ willingness to purchase multiple types of precision-fermented dairy products, including “synthetic milk”, ice-cream made from “synthetic milk”, cheese made from “synthetic milk”, yoghurt made from the “synthetic milk” and a milkshake made from “synthetic milk”. Although the percentage of participants willing to purchase “synthetic milk” (28%) appears substantially lower than the percentage willing to purchase ice-cream, cheese, yoghurt and a milkshake made from the “synthetic milk” (35 – 49%), it is important to consider that participants were provided with different response options across these different products and thus the results are not comparable. That is, when asked about their purchase intentions of synthetic milk, participants could respond ‘yes’, ‘no’, or ‘unsure’. Conversely, when asked about their purchase intentions of the products made from synthetic milk, participants could select all that apply and did not have a ‘don’t know’ option. It is

therefore unclear whether the different findings are due to the different types of products examined, the different response formats, or a combination of both.

4.2.2.1.3. Willingness to regularly purchase/incorporate in the diet/pay more

Two studies also examined repeated behavioural intentions (willingness to include in the diet or regularly purchase), as opposed to only one-time behaviours (willingness to try or purchase). A minority of participants were willing to purchase precision-fermented dairy/eggs regularly (34.6%; Zollman Thomas & Bryant, 2021), or add them to their diet alongside or in-place of conventional dairy/eggs (17-31%, FSA, 2025b; GFI, 2025). In addition, few participants were willing to pay more for precision fermented dairy (15%) or eggs (16%) than conventional dairy or eggs (GFI, 2025).

4.2.2.2. International studies

All nine international studies examined participants' willingness to try or purchase precision-fermented foods. Five of these studies also examined repeated behavioural measures such as participants' willingness to regularly purchase precision-fermented foods or incorporate them into their diets.

Most international studies (n = 6) examined precision-fermented dairy, whereas two studies examined precision fermentation in general. One study examined precision-fermented egg.

It is challenging to make comparisons across the different international studies given that they sampled different countries and also varied in other methodological features (e.g., type of terminology and description of the product provided to participants). Conclusions regarding different behavioural measures are therefore only possible where these were compared within single studies.

Overall, four international studies that examined multiple behavioural measures (Kossmann et al., 2023; Köhl et al., 2024; Zollman Thomas et al., 2023; Zollman Thomas & Bryant, 2021) consistently found that the percentage of participants willing to try (51-92%) or purchase (42-86%) precision-fermented foods was higher than the percentage of participants willing to regularly purchase (26-68%) or incorporate the product into their diet (20-41%)². This is consistent with the UK evidence. Studies that reported only one type of behavioural measure (Aydemir et al., 2023;

² Although Powell et al. (2023) also compared multiple behavioural measures, this study is not included in the range of reported percentages since it was based on a small, non-representative sample (see [Table 2](#)).

Table 1. Summary of UK studies that examined participants' willingness to consume and/or purchase precision-fermented (PF) foods. Studies shaded grey are deemed lower quality due to use of a small non-representative sample

Reference and sample*	Product type and term	Provided description about PF	Measures and response options	Findings
Ford et al. (2024) 62 from UK (mostly university cohort; non-representative sample)	"Precision-fermented yoghurt"	Neutral description, refers to taking DNA from a cow non-invasively and putting it into a yeast cell.	Participants provided with traditional yoghurt labelled as precision-fermented yoghurt with the option of tasting it	All participants were willing to taste the product labelled 'precision fermented yoghurt'
FSA (2025b) 1,035 from England, Wales and Northern Ireland	"Precision-fermented dairy (e.g., milk and cheese)"	Neutral description, refers to being similar to fermentation but also how it is different and refers to the use of DNA. Describes as 'without traditional animal farming'	If it was authorised for sale in the UK, how willing or unwilling would you be to include precision-fermented dairy products in your diet? (very willing/somewhat willing/somewhat unwilling/very unwilling/don't know)	31% were somewhat willing or very willing to include PF dairy in their diet. 44% were somewhat unwilling or very unwilling, and 25% were unsure
GFI (2025) 1,035 from UK	"New way of producing dairy products like cheese and ice-cream" "New way of producing egg products like egg whites and meringues"	Neutral description, refers to 'without using animals'. States similar to brewing beer, refers to the use of DNA.	Which of the following are you likely to do? Select all that apply: - Try them if you were given a free sample or someone else prepared it for you - Purchase them to prepare at home - Purchase a meal made with them at a restaurant - Substitute conventional egg products with them at least some of the time - Add them to your diet alongside or replacing conventional egg products - Pay a higher price for them than conventional egg/dairy products - None of the above	53% would try PF dairy products and 52% would try PF egg products if given a free sample or someone else prepared it for them 23% would purchase PF dairy and 21% would purchase PF eggs for home 20-23% at a restaurant 20-21% substitute at least some of the time 20-17% add to diet alongside or replace 15-16% would pay more 10% would select none of these options.
The Grocer (2018)	"Synthetic" milk and the following products	"In the US, a company is using genetically engineered yeast based on cow DNA to	Would you ever buy this kind of synthetic milk? (yes/no/not sure)	28% said they would buy synthetic milk, 32% would

Reference and sample*	Product type and term	Provided description about PF	Measures and response options	Findings
1,061 from England, Scotland and Wales	made from synthetic milk: ice-cream, cheese, yoghurt, milkshake	produce a 'synthetic' milk that has the same taste and nutrition as traditional milk but can be made without farming animals."	Would you ever buy the following dairy products made from synthetic milk? (Select all that apply).	not, 40% were not sure. 49% likely to buy ice-cream made from synthetic milk, 46% cheese, 45% yoghurt, 35% milkshake, 38% would buy none of them.
Zollman Thomas and Bryant (2021) 1,249 from UK	"Legendary's new mozzarella"	Refers to copying cow DNA. States it has the same taste as conventional cheese with lower carbon footprint, does not involve animals, antibiotics or lactose. Used branding term 'legendary mozzarella'	Would you be willing to try/purchase/regularly purchase Legendary's new mozzarella? (definitely yes/probably yes/unsure/probably no/definitely no)	67.6% definitely or probably willing to try (17.6% unsure, 14.7% definitely or probably not willing) 58.5% willing to buy (24.7% unsure, 16.9% probably or definitely not willing) 34.6% willing to buy regularly (41.1% unsure, 24.4% probably or definitely not willing).

*All are nationally representative samples by at least age and gender, except where otherwise stated (Ford et al., 2024).

Hartman Group, 2023; Szczepanski et al., 2024) reported percentages that are generally consistent with the range reported by the studies above that examined multiple measures. Notably, the study that reported the highest percentages (up to 92%) provided participants with a description of the product that listed off the most benefits (lower carbon footprint, no antibiotics or lactose; Zollman Thomas & Bryant, 2021).

In contrast to other studies, Banovic and Grunert (2023) reported group mean ratings from Likert scales, rather than the percentage of participants willing to purchase precision-fermented foods. In this study, participants were asked if they would buy a product if produced with precision fermentation technology (on a scale from 1 [definitely no] to 7 [definitely yes]), and group mean ratings ranged from 3.94 to 4.70 across different countries. This indicates that on average, willingness to purchase the product ranged from participants being uncertain to slightly willing. The ratings were also influenced by the type of information provided to participants about the product, such that those who read about the product being natural were significantly more willing to purchase it than those who read about its environmental benefits. Research by the GFI (2025) also found that when descriptions of precision-fermented foods referred to “encoding microorganisms with DNA”, consumers found the product to be unappealing. Notably, not all international studies included reference to microorganisms and DNA in the product descriptions that were provided to participants. Although framing effects were out of scope for the current review, this further demonstrates the impact of different product information on consumers’ willingness to consume or purchase precision-fermented foods, thus making comparisons across different studies challenging. While different product information was also prevalent across the UK studies (see section 4.2.2.1), differences by country further complicates interpretation of the international findings.

[Table 2](#) provides an overview of the methods and findings of each international study to demonstrate their methodological differences and thus where they are not comparable. A more detailed discussion comparing consumption intentions across different countries is provided in section 4.2.3 (‘Who is more likely to be willing to consume precision-fermented foods?’) where this was compared within single studies.

4.2.3. Who is more likely to be willing to consume precision-fermented foods?

Nine of the previously described studies also examined whether willingness to consume precision-fermented foods significantly differed across different demographic groups (Banovic & Grunert, 2023; FSA,

Table 2. Summary of international studies that examined participants' willingness to consume and/or purchase precision-fermented foods. Studies shaded grey are deemed lower quality due to use of non-representative samples or biased response options.

Reference and sample*	Product type and term	Provided description about PF	Measures and response options	Findings
Aydemir et al (2023) 215 university students from Turkey (non-representative sample)	Animal-free milk	Yes – content unknown	Would you consume animal-free milk? (yes/no)	32.55% would consume
Banovic and Grunert (2023) study 3 1,028 from Denmark 1,004 from Germany 1,000 from Poland	Precision fermentation in general	One group provided with a description emphasising naturalness, and another group emphasising environmentally-friendly. Does not refer to DNA/genes or animals. “Precision fermentation is a natural and wholesome (vs. sustainable and environmentally-friendly) process that uses yeasts as a factory to produce 100% pure protein.”	I would buy a product if produced with precision fermentation technology (1 = definitely no, 7 = definitely yes)	Mean purchase intentions ranged from 3.94 to 4.70 across the different countries. Purchase intentions were significantly higher for participants who read about the product being natural vs. environmentally-friendly
Hartman group (2023) 2,519 from USA	Precision fermentation in general (protein, sweetener and vitamin C given as examples)	Measured with no description then again after providing neutral description that does not refer to DNA or microorganisms: “Precision fermentation uses yeast or microorganisms that are enhanced through science to convert minerals or plant matter into food ingredients like protein, sweetener and vitamin C”	Likelihood to purchase Biased response options where 3/5 indicate generally likely to purchase (not at all likely, not very likely, somewhat likely, very likely, extremely likely)	<u>After no description</u> : 43% somewhat/very/extremely likely to purchase <u>After neutral description</u> : 56% somewhat/ very/extremely likely to purchase
Kossmann et al (2023) 1,487 from Germany	Alternative cheese	Neutral description, plus says it can't be distinguished from cows cheese in terms of taste, texture or nutrition. Refers to microorganisms and DNA, but	I am willing to try alternative cheese/use as a substitute for cheese made from cow's milk/ buy/buy on a regular basis (1 = fully disagree, 7 = fully agree)	58.8% willing to try 49.2% willing to <u>buy</u> 40.5% willing to <u>substitute</u> for

Reference and sample*	Product type and term	Provided description about PF	Measures and response options	Findings
		both positive and negative aspects of this are provided.		cheese made from cow's milk 34.1% willing to <u>buy regularly</u>
Kühl et al (2024) 2,035 from Germany	Animal-free cheese	Neutral description, plus says it is the same quality as milk products derived from cow's milk. Does not refer to DNA or imply that microorganisms are genetically modified. States cows are not needed.	Willingness to try/buy regularly/substitute for cheese made from cow's milk/pay more than cheese made from cow's milk (1 = "Absolutely not" to 5 = "Absolutely yes")	57% definitely or rather willing to <u>try</u> (23% unsure, 20% not willing) 32% willing to <u>buy regularly</u> 24% willing to completely <u>substitute</u> traditional dairy cheese 14% willing to <u>pay more</u> than for traditional dairy cheese
Powell et al (2023) 115 from Canada (non-representative sample)	Yeast-derived milk/cream, and ice-cream	Neutral but states these products should provide the same eating and cooking experience of animal-derived foods, refers to genes, refers to rennet. Refers to use of cell cultures "rather than relying on animals"	Likelihood to try/purchase/incorporate regularly into their diet/replace traditional counterparts (very likely, likely, neither likely/unlikely, unlikely, very unlikely)	<u>Willing to try:</u> 43.5% (milk/cream), 38.3% (ice-cream) <u>Willing to purchase:</u> 31.3% (milk/cream), 27.8% (ice-cream) <u>Willing to incorporate regularly into the diet:</u> 25.2% (milk/cream), 20.0% (ice-cream) <u>Willing to replace traditional counterparts:</u> 15.7% (milk/cream), 17.4% (ice-cream)
Szczepanski et al (2024) 25 adolescents from Germany (non-representative sample)	Animal-free milk	Yes – content unknown	Are you willing to consume animal-free milk as an alternative to cow's milk? (open-ended responses, interviews)	92% (23/25) said they would be willing to try, buy <u>or</u> drink animal-free milk as an alternative to cow's milk.

Reference and sample*	Product type and term	Provided description about PF	Measures and response options	Findings
Zollman Thomas and Bryant (2021) [#] 1,020 from Brazil 1,051 from Germany 825 from India 1,009 from USA	Legendary's new mozzarella	Refers to copying cow DNA. Referred to same taste as conventional cheese with lower carbon footprint, does not involve animals, antibiotics or lactose. Used branding term 'legendary mozzarella' which may have also had an impact.	Would you be willing to try/purchase/regularly purchase Legendary's new mozzarella? (definitely yes/probably yes/unsure/probably no/definitely no)	<u>Willing to try:</u> 92.0% (Brazil), 93.4% (India), 75.9% (Germany), 64.9% (USA) <u>Willing to buy:</u> 85.5% (Brazil), 91.1% (India), 63.7% (Germany), 53.8% (USA) <u>Willing to regularly buy:</u> 68.0% (Brazil), 73.9% (India), 36.1% (Germany), 36.3% (USA)
Zollman Thomas et al (2023) 1,001 from USA 1,001 from Germany 1,004 from Singapore	Precision fermentation egg	Neutral except referred to as identical in taste and nutrition, no involvement of animals. Pictures shown of traditional egg. Refers to changing the DNA of micro-organisms.	Willingness to try/ order from a restaurant/ purchase from a supermarket/purchase regularly/visit a restaurant where guests have the option to substitute chicken egg for this product (1 = definitely not, 2 = probably not, 3 = probably yes, 4 = might or might not, 5 = definitely yes)	<u>Willingness to try</u> (probably or definitely): 61% (Germany), 51.3% (USA), 56.2% (Singapore) <u>Willingness to purchase:</u> 57.2% (Germany), 47.9% (USA), 48.1% (Singapore) <u>Willingness to regularly purchase:</u> 34.2% (Germany), 30.5% (USA), 25.6% (Singapore) <u>Willingness to order from a restaurant/visit a restaurant where guests have the option to substitute:</u> 55.1/43.9% (Germany), 46.7/42.0% (USA), 53.6/46.9% (Singapore)

*All are nationally representative samples by at least age and gender, except where otherwise stated (Aydemir et al., 2023; Powell et al., 2023; Szczepanski et al., 2024).

[#]Zollman Thomas and Bryant (2021) also included UK participants, and these findings are reported in [Table 1](#). See section 4.2.3.1 below for a more detailed discussion of the cross-country comparisons.

2025b; Hartman Group, 2023; Kossmann et al., 2023; Kühl et al., 2024; Powell et al., 2023; The Grocer, 2018; Zollman Thomas et al., 2023; Zollman Thomas & Bryant, 2021).

Findings were sometimes mixed between the UK studies, likely due to the different measures examined (i.e., willingness to purchase vs. willingness to include in the diet). Regardless, if a demographic factor predicted at least one of these measures, then it may be interpreted as a predictor of acceptance and consumption intentions more generally.

A more detailed description of the evidence regarding each demographic factor is provided below.

4.2.3.1. Country

Four studies examined differences by country (Banovic & Grunert, 2023; FSA, 2025b; Zollman Thomas et al., 2023; Zollman Thomas & Bryant, 2021).

Analysis of the FSA's CIT data (FSA, 2025b) found no significant differences between England, Wales and Northern Ireland regarding participants' willingness to include precision-fermented dairy in their diet. However, this analysis was limited due to the low sample sizes across Wales (n = 114) and Northern Ireland (n = 114) relative to England (n = 1,869).

Zollman Thomas and Bryant (2021) compared willingness to try, purchase and regularly purchase precision-fermented dairy between participants from the UK, Brazil, Germany, India and the USA. Willingness to try the product was not significantly different between the UK and USA (68% and 65%, respectively), but was significantly more prevalent in India (93%), Brazil (92%), and Germany (76%). Willingness to purchase (59-64%) and regularly purchase (35-36%) was not significantly different between the UK and USA/Germany, but was significantly more prevalent in India (74-91%) and Brazil (68-86%). Although samples from each country were nationally representative by age and gender, the authors noted that the samples from Brazil and India were skewed towards richer and more urbanised people. Given other evidence that people from urban locations and with higher incomes are more willing to purchase or consume precision-fermented foods (see sections 4.2.3.2 and 4.2.3.5), this could partly account for these cross-country differences. However, given how large the cross-country differences are (e.g., 65% vs. 93% willing to try the product) and additional evidence that income and urbanisation are relatively weak predictors of consumption/purchase intentions (see section 4.2.3.10), it is unlikely that the skewed samples entirely account for these cross-country differences.

The two remaining studies compared consumption or purchase intentions of precision-fermented foods among international countries only (Banovic & Grunert, 2023; Zollman Thomas et al., 2023). Both studies found small

cross-country differences in participants' willingness to consume or purchase precision-fermented foods. More detail on these findings is available in Appendix B.

4.2.3.2. Urban vs rural location

Two UK studies (FSA, 2025b; Zollman Thomas & Bryant, 2021) and two international studies (Zollman Thomas et al., 2023; Zollman Thomas & Bryant, 2021) compared consumption or purchase intentions between participants living in urban vs. rural locations.

Analysis of the FSA's CIT data (FSA, 2025b) found no significant differences between urban vs. rural UK participants' willingness to include precision-fermented dairy in their diet. This finding is inconsistent with Zollman Thomas and Bryant (2021), who found that those living in UK urban areas were more willing to purchase precision-fermented cheese than those living in UK rural areas. A possible explanation for these different findings is the different measured examined. That is, Zollman Thomas and Bryant (2021) measured participants' willingness to purchase precision-fermented dairy, whereas FSA (2025b) measured participants' willingness to include precision-fermented dairy in their diet. In addition, data regarding urban vs. rural location was only available for England and Wales (not Northern Ireland) in FSA (2025b). Whereas it is unclear which countries within the UK were sampled in Zollman Thomas and Bryant (2021).

International evidence suggests that urban vs. rural location is a significant predictor of purchase/consumption intentions for some countries (and measures/product types) but not others. More detail on the mixed international evidence on urban vs. rural location is available in Appendix B.

4.2.3.3. Age

Three UK studies examined differences by age (FSA, 2025b; The Grocer, 2018; Zollman Thomas & Bryant, 2021) and consistently found that younger people were more likely to be willing to purchase or incorporate precision-fermented dairy in their diet.

International evidence suggests that age is a significant predictor of consumption intentions for some countries and product types, but not others. Several studies have found that younger people were more willing to consume precision-fermented dairy and egg in Germany (Kühl et al., 2024; Zollman Thomas et al., 2023; Zollman Thomas & Bryant, 2021). This finding is also consistent in the USA regarding precision-fermented dairy

(Zollman Thomas & Bryant, 2021), however, age is not a significant predictor of consumption intentions of precision-fermented egg in the USA or in Singapore (Zollman Thomas et al., 2023³).

4.2.3.4. Gender

Two UK studies examined differences by gender (FSA, 2025b; Zollman Thomas & Bryant, 2021). Analysis of the FSA's CIT data (FSA, 2025b) found that males were significantly more likely to be willing to include precision-fermented dairy in their diet than females. Conversely, Zollman Thomas and Bryant (2021) found no significant differences in willingness to purchase precision-fermented cheese between males and females in the UK. These different findings may be explained by the different measures examined (willingness to include in the diet vs. willingness to purchase).

International evidence suggests that gender is a significant predictor of consumption intentions for some countries and consumption measures but not others. For example, Zollman Thomas and Bryant (2021) found no significant differences based on gender in the USA, Germany or India, however, females from Brazil were more likely to be willing to purchase precision-fermented cheese than males from Brazil. A more detailed description of the mixed international evidence on gender is available in Appendix B.

4.2.3.5. Education and income

Two UK studies examined whether level of education and income predicted consumption (FSA, 2025b) or purchase (Zollman Thomas & Bryant, 2021) intentions regarding precision-fermented dairy. Analysis of the FSA's CIT data (FSA, 2025b) found that participants who were university educated (vs. not university educated) were significantly more likely to be willing to include precision-fermented dairy in their diet, however, there were no significant differences based on income. Conversely, Zollman Thomas and Bryant (2021) found no significant differences based on level of education, however, people with a higher income were significantly more willing to purchase precision-fermented cheese. No UK studies examined whether level of education or income predicted consumption or purchase intentions of precision-fermented egg.

The international evidence again varied depending on the type of country and products examined (dairy vs. egg). A more detailed description of the mixed international evidence is available in Appendix B.

³ In Zollman Thomas et al. (2023), age was initially a significant predictor of consumption intentions of precision-fermented egg in the USA, however, this became non-significant after controlling for frequency of conventional egg consumption.

4.2.3.6. Ethnicity

Only one (UK) study examined differences by ethnicity, although the analysis was limited such that the majority of the sample was white (FSA, 2025b). Comparisons were therefore only possible between white ($n = 1,836$) vs. minority ($n = 234$) ethnicities. This analysis found that participants from an ethnic minority were significantly more likely to be willing to include precision-fermented dairy in their diet.

4.2.3.7. Dietary pattern

Two UK studies and four international studies compared participants' willingness to purchase or consume precision-fermented foods between vegans/vegetarians/ pescatarians/flexitarians and omnivores. Flexitarians are those who primarily have a vegetarian diet but occasionally eat meat or seafood.

One of the UK studies (FSA, 2025b) found no significant difference between vegans/vegetarians/pescatarians/flexitarians (vs. omnivores) willingness to include precision-fermented dairy into their diet. However, the difference was close to being significant ($p = 0.068$; see Appendix A – section 1.2.1). This analysis was limited such that it was necessary to combine vegans/vegetarians/pescatarians/flexitarians into one category due to small sample sizes. Conversely, the second UK study (Zollman Thomas & Bryant, 2021) found that flexitarians, pescatarians and vegetarians were significantly more willing to purchase precision-fermented cheese than omnivores. Whereas there was no significant difference between vegans' and omnivores' willingness to purchase precision-fermented cheese. This highlights the importance of separating vegans and vegetarians/pescatarians/flexitarians in analysis. Zollman Thomas and Bryant (2021) also found that participants with higher conventional cheese consumption were also more willing to purchase precision-fermented cheese.

This same study (Zollman Thomas & Bryant, 2021) also sampled other countries including the USA, Germany, Brazil and India. Consistent with the UK findings, participants with higher conventional cheese consumption were more willing to purchase precision-fermented cheese across all countries. Being flexitarian was also a consistent predictor of willingness to purchase precision-fermented cheese, although findings regarding vegans, vegetarians and pescatarians differed across countries. For example, only flexitarians and vegetarians (compared to omnivores) were more willing to purchase precision-fermented cheese in the USA. Whereas in Germany, all groups were more willing to purchase precision-fermented cheese than omnivores, which is generally consistent with other research based in Germany (Kühl et al., 2024).

However, one limitation of Zollman Thomas and Bryant's (2021) research is that the sample sizes for each dietary group were not reported. It is therefore unclear whether there were adequate sample sizes of vegans/vegetarians included in the survey, which is a common problem in nationally-representative surveys (e.g., see Zollman Thomas et al., 2023 below). There was also a very small sample of vegans ($n = \text{approx. } 26$) in the German-based research by Köhl et al. (2024), which is likely why the authors chose to merge vegans with vegetarians into one category for analysis (as in FSA, 2025b).

Only one study compared flexitarians', vegetarians' and vegans' willingness to consume precision-fermented egg compared to omnivores (Zollman Thomas et al., 2023). This study sampled international countries only. Although the findings slightly differed across different countries, vegans were generally a more prominent predictor of consumption intentions of precision-fermented egg than for precision-fermented dairy as previously described. For example, in the USA, both vegans and flexitarians were more willing to consume precision-fermented egg than omnivores, whereas there were no significant differences between vegetarians and omnivores (see Appendix B for a more detailed description of differences by country). However, confidence in the findings regarding vegans and precision-fermented egg is low, given the small number of vegan participants included in Zollman Thomas et al.'s (2023) study ($n = 18\text{-}34$ across countries). The study also found that participants with higher consumption levels of organic eggs (i.e. higher welfare standard eggs) or plant-based egg alternatives were more willing to consume precision-fermented egg.

4.2.3.8. Political views and importance of religion

One study (Zollman Thomas & Bryant, 2021) compared UK, USA, German, Indian and Brazilian consumers' willingness to purchase precision-fermented cheese based on different political views (on a scale from very conservative to very liberal) and importance of religion in one's life (on a scale from not very important to very important). Notably, type of religion was not measured in this study.

In the UK and USA, those who were more politically liberal were significantly more willing to purchase precision-fermented cheese. Conversely, in Brazil, those who were more politically liberal were significantly *less* willing to purchase precision-fermented cheese. Political view was not a significant predictor of purchase intentions in Germany nor India.

In the UK, those who were more religious were also significantly more willing to purchase precision-fermented cheese. Conversely, in Germany, those who were more religious were significantly *less* willing to purchase precision-fermented cheese. Importance of religion was not a significant predictor of consumption intentions in the USA, Brazil nor India.

4.2.3.9. Other factors

Several additional factors beyond demographic differences were examined by two UK studies and five international studies.

The UK evidence found that people were more likely to be willing to purchase precision-fermented cheese if they perceived the product to be tasty, ethical, environmentally-friendly, and natural (Zollman Thomas & Bryant, 2021). Perceived safety, healthiness and nutrition of the product did not significantly predict purchase intentions of precision-fermented cheese (Zollman Thomas & Bryant, 2021).

Analysis of the FSA's CIT data (FSA, 2025b) also found that UK participants were significantly more likely to be willing to include precision-fermented dairy in their diet if they had previously heard of precision-fermented dairy. This finding regarding product familiarity is generally consistent with international evidence from the USA (Hartman Group, 2023), where people were more likely to purchase precision-fermented foods after receiving neutral information about the product (56%), compared to when they received no information about the product (43%). Hartman Group (2023) also found that, of those who reported being familiar with precision fermentation, 77% were likely to purchase precision-fermented foods.

The remaining international evidence produced consistent conclusions where people who perceived benefits of precision-fermented foods were significantly more willing to purchase or consume it, whereas people who perceived risks were significantly *less* willing to purchase or consume it (Banovic & Grunert, 2023; Kossmann et al., 2023; Köhl et al., 2024; Zollman Thomas & Bryant, 2021). However, the exact types of benefits/risks that predicted consumption or purchase intentions differed across countries. The same study that examined UK participants (Zollman Thomas & Bryant, 2021) also examined other countries, and thus provides a clear comparison of cross-country differences. [Table 3](#) below summarises each perceived product attribute that was measured in Zollman Thomas and Bryant (2021), and whether each attribute significantly predicted purchase intentions of precision-fermented cheese for each country.

Table 3. Summary of whether product attributes significantly predicted purchase intentions of precision-fermented cheese for each country in Zollman Thomas et al. (2021). Ticks indicate positive significant predictors, whereas crosses indicate non-significant predictors.

Product attribute	UK	USA	Germany	Brazil	India
Tasty	✓	✓	✓	✓	✓
Ethical	✓	✗	✓	✗	✓
Environmental	✓	✗	✗	✗	✓
Natural	✓	✓	✗	✗	✗
Safe	✗	✓	✗	✗	✗
Healthy	✗	✓	✓	✗	✗
Nutritious	✗	✗	✗	✗	✗

In addition to the perceived benefits outlined in [Table 3](#) above, further international evidence found that people were more willing to purchase precision-fermented foods if they trusted food manufacturers, perceived the product to be useful, and felt knowledgeable about the product (Banovic & Grunert, 2023; Kossmann et al., 2023). These additional factors predicted peoples' risk/benefit perceptions towards precision-fermented foods, which subsequently predicted purchase intentions. Furthermore, people were *less willing* to consume precision-fermented foods if they perceived risks to farmers' livelihoods, were concerned about market power of large companies, or had a fear of new food technologies (Banovic & Grunert, 2023; Köhl et al., 2024). These additional factors were not measured in the UK studies, except for product familiarity which produced consistent results.

4.2.3.10. What is the most important predictor?

Two UK studies provided insight into the relative importance of different demographic predictors (FSA, 2025b; Zollman Thomas & Bryant, 2021).

Zollman Thomas and Bryant (2021) found that broader consumer views regarding the potential benefits of precision-fermented cheese (particularly taste) were stronger predictors of willingness to purchase the product than demographic predictors such as age, income, diet and religious/political views⁴. Out of the demographic predictors, having higher levels of conventional cheese consumption was the most important followed by being flexitarian (vs. omnivore) and holding politically-liberal views. Although vegetarians and pescatarians were also significantly more willing to purchase precision-fermented cheese (compared to omnivores), these predictors were not as strong as being flexitarian.

⁴ When Zollman Thomas and Bryant (2021) only included demographic factors in their regression model, adjusted R^2 was 0.12. However, when the authors only included perceived product characteristics regarding taste, ethics, the environment, and naturalness, adjusted R^2 was much higher at 0.39.

Analysis of the FSA's CIT data (FSA, 2025b) showed that familiarity of precision-fermented dairy was of similar importance in predicting willingness to include precision-fermented dairy in the diet compared to demographic predictors such as age, gender, education and ethnicity⁵. Overall, all predictors together explained a relatively small portion of the variation in participants' responses ($R^2 = 0.11$) compared to the predictors included in Zollman Thomas and Bryant's (2021) statistical model ($R^2 = 0.39$)⁶. Unlike Zollman Thomas and Bryant (2021), the CIT survey (FSA, 2025b) did not measure broader consumer views regarding the potential benefits of precision-fermented dairy. Further details of the regression model used for analysis of the CIT survey is available in Appendix A (section 1.2).

In contrast to the evidence regarding precision-fermented dairy (Zollman Thomas & Bryant, 2021), international evidence from Zollman Thomas et al. (2023) found that being vegan was a more important predictor of willingness to consume precision-fermented egg than being flexitarian. The authors suggested that the different findings between their research on precision-fermented dairy (Zollman Thomas & Bryant, 2021) and precision-fermented egg (Zollman Thomas et al., 2023) could be that egg may be a more difficult product for vegans to find suitable replacements for. The research on precision-fermented egg did not include UK participants.

Of the international studies that examined consumers' perceived risks and benefits of precision-fermented foods, perceived benefits were more important predictors of consumption and purchase intentions than perceived risks (Banovic & Grunert, 2023; Kossmann et al., 2023; Köhl et al., 2024). Although no UK study compared the relative strength of perceived risks and benefits in predicting consumption/purchase intentions of precision-fermented foods, this finding is highly consistent with available UK evidence regarding consumption intentions of cell-cultivated meat (FSA, 2025a).

⁵ For the FSA's CIT data (FSA, 2025b), R^2 values were similar when each predictor was removed from the regression model, indicating that they were of similar importance (R^2 ranged from 0.09-0.11).

⁶ Although the R^2 metrics used in these two studies were slightly different (Cohen's pseudo R^2 from logistic regression vs. adjusted R^2 from linear regression), both are generally interpreted as values closer to 0 indicating a poorer fit meaning the model explains a smaller portion of the variation, whereas values closer to 1 indicating a better fit meaning the model explains a larger portion of the variation (Cohen et al., 2003; Field, 2018).

4.3. What are consumers' views on the risks and benefits of precision fermentation?

Seventeen studies examined consumers' views on the risks and benefits of precision-fermented foods. Four studies sampled UK participants only, 12 studies sampled international countries only, whereas one study sampled both the UK and other countries. This section of the review mostly focuses on the UK evidence with only brief reference to the international evidence. This is due to the high volume of studies and the challenges in interpreting mixed findings from different countries that also varied in other methodological features (see [Table 2](#)).

In the UK (and international) studies, participants were primed with information emphasising particular benefits about precision-fermented foods. Although this may reflect a real-world context where companies may choose to market such benefits, it does not provide insight into how consumers may trade-off both positive and negative information about these products. Therefore, no study sufficiently examined whether perceived benefits are more or less prevalent among consumers than perceived risks/concerns.

Two UK studies examined consumers' perceived benefits or risks/concerns about precision-fermented foods. Whereas three studies examined whether consumers perceived certain benefits or concerns as reasons to consume precision-fermented foods (motivators) or as reasons to not consume precision-fermented foods (demotivators). Most of the UK evidence was on precision-fermented dairy, with one study also examining motivators for consuming precision-fermented egg.

4.3.1. Overview of key findings

- People in the UK tend to agree that precision-fermented dairy has environmental and animal-welfare benefits when they are provided with this information. Limited evidence also suggests that other recognised benefits may be its perceived nutritional value and potential to increase food security.
- However, people in the UK also perceive precision-fermented dairy to be less natural and slightly less safe than conventional dairy. Limited evidence suggests that people may also be concerned about threats to farmers.

- Motivators for consuming precision-fermented dairy/egg include curiosity about its taste and perceiving the product to be safe, similar in taste/texture/smell to conventional cheese, beneficial for food security, beneficial for animal welfare, healthy and environmentally-friendly.
- Demotivators for consuming precision-fermented dairy include concerns about its safety (e.g., concerns about chemicals, ingredients and long-term side effects), unnaturalness and affordability.
- Some perceived benefits/concerns are more important for some demographic groups than others:
 - Women are more likely than men to be worried about the chemicals and ingredients
 - Women are more likely than men to be motivated by the product not requiring animals to be farmed
 - Men and younger people are more likely to be motivated by the product being cheaper than conventional products
 - Compared to non-farmers, farmers are more likely to be convinced of the risks of precision-fermented dairy, and are less likely to be convinced of the benefits.
 - People in the UK perceive precision-fermented dairy to be less natural, less safe, less ethical and less environmentally-friendly than people from Brazil or India.
- People feel uncertain about how to categorise precision-fermented dairy/egg and therefore may question whether the product is vegan or vegetarian.

A more detailed description of the evidence is provided below, grouped by research question: perceived benefits and motivators; perceived risks/concerns and demotivators; who is more likely to have concerns or believe there are any benefits; do people consider precision-fermented foods to be vegetarian and kosher/halal.

4.3.2. Perceived benefits and motivators

As noted above, some studies only examined participants' perceived benefits of precision-fermented dairy/egg, whereas other studies examined whether participants perceived particular benefits as reasons for consuming the product. Given that different studies did not always examine the same types of benefits/motivators, they are not comparable. Additionally, participants were often provided with different product information across the different studies, which may have influenced their perceptions. It is therefore not possible to make a conclusion about the most prevalent benefits, and whether these align with the most important motivators. Rather, this section is only able to provide a summary of some of the perceived benefits and motivators without ordering them in importance.

4.3.2.1 .Perceived benefits

Two UK studies examined consumer perceptions of various benefits of precision-fermented dairy (Crawshaw & Piazza, 2023; Zollman Thomas & Bryant, 2021).

Zollman Thomas and Bryant (2021) examined participants' perceptions of both precision-fermented cheese and conventional cheese. In this study, a nationally representative sample of UK participants rated each product on various attributes (on a scale from 1 to 7), allowing comparison between the different products. Participants rated precision-fermented cheese as more ethical and environmentally friendly than 'mass market' and 'premium' conventional cheese products. Participants also rated precision-fermented cheese to be just as tasty as 'mass-market' conventional cheese, although less tasty than 'premium' conventional cheese products⁷. Notably, participants were previously provided with a description of precision-fermented cheese that emphasised its animal-free, taste and environmental benefits which likely influenced their perceptions.

Consistent with Zollman Thomas and Bryant (2021), Crawshaw and Piazza (2023) found that non-farmers tended to agree that there are environmental benefits (81% of participants agreed) and animal treatment benefits (68%) of precision-fermented milk. Again, participants were previously provided with a description of the product emphasising these benefits. Although this study was based on a small, non-representative sample (n = 53), consistency with Zollman and Bryant's (2021) nationally

⁷ Zollman Thomas and Bryant (2021) also sampled participants from other countries outside the UK. Although participants' perceptions of the healthiness and nutritiousness of products were also tested, these findings were not reported separately for UK participants.

representative study increases confidence in these findings. Crawshaw and Piazza also found that non-farmers tended to agree with other types of benefits, including curiosity about the taste (72%), high nutritional value (60%) and food security (60%), however no nationally-representative study is available to corroborate these findings. The study also investigated farmers' perceptions of precision-fermented milk, and found that farmers are generally less convinced about the benefits of precision-fermented milk than non-farmers. These group differences are further discussed elsewhere (see section 4.3.4: 'Who is more likely to perceive some types of benefits and risks/concerns?').

In contrast to Zollman Thomas and Bryant (2021), Crawshaw and Piazza (2023) found that only a minority of non-farmers agreed that the product would have a good taste (47%) or good texture (43%). In addition to the different sampling methods, a possible explanation for these discrepant findings is that precision-fermented cheese was referred to as "legendary mozzarella" in Zollman Thomas and Bryant's study, which may have made the product appear tastier to participants than in Crawshaw and Piazza's study.

4.3.2.2. Perceived motivators

Three additional studies examined whether participants considered a particular benefit to be a reason for consuming precision-fermented dairy/egg (Ford et al., 2023; GFI, 2025; The Grocer, 2018). Although the previously described studies examined participants' perceived benefits of precision-fermented foods, they did not examine whether these benefits subsequently motivated participants to consume the product.

In the Grocer (2018), participants were asked what (if anything) would encourage them to buy precision-fermented milk, and were provided with a list of options to select from (including the option to select none of them). The most prevalent response was being confident that the product was safe (selected by 43% of participants), followed by knowing that it tasted, looked and smelled the same as conventional milk (35%) and that it was healthier than conventional milk (31%). These reasons were slightly more common than environmental benefits (28%), not needing to use animals (23%) and food security benefits (21%). Similar results were found by GFI (2025), such that a portion of participants reported being motivated to consume precision-fermented dairy/egg due to animal welfare benefits (selected by 43% of those who previously said they would purchase the product), health benefits (41%), curiosity/novelty (34%), taste (25%) and the environment (22%). It is not possible to determine the most prevalent motivators given that the two studies did not test the same factors and thus they are not comparable (e.g. The Grocer, 2018 tested safety perceptions whereas GFI 2025 did not).

A limitation of the previously described studies (GFI, 2025; The Grocer, 2018) was that participants were provided with a pre-determined list of reasons to select from, with no ability to provide any alternative reasons. Qualitative research by Ford et al. (2023) more broadly examined motivational factors using open-ended responses, although the sample was limited to a university cohort. Nevertheless, participants identified similar motivators as found in the quantitative studies. That is, curiosity about the taste and animal welfare were key motivators for trying the product, with some also referring to the advantages for the environment and lactose intolerant individuals.

4.3.3. Perceived risks/concerns and demotivators

As with the evidence regarding perceived benefits and motivators, some studies only examined participants' perceived concerns of precision-fermented dairy/egg, whereas other studies examined whether participants perceived particular concerns as reasons for not consuming the product. Given that different studies did not always compare the same types of concerns/demotivators, they are not comparable. It is therefore not possible to make a conclusion about the most prevalent concerns, and whether these align with the most important demotivators. Rather, this section is only able to provide a summary of some of the perceived concerns and demotivators without ordering them in importance.

4.3.3.1. Perceived risks/concerns

The two UK studies that examined consumers' perceived benefits of precision-fermented dairy also provide insight into consumers' perceived risks or concerns about the product (Crawshaw & Piazza, 2023; Zollman Thomas & Bryant, 2021).

As previously described, Zollman Thomas and Bryant (2021) examined UK participants' perceptions of both precision-fermented cheese and conventional cheese. In this study, a nationally representative sample of UK participants rated each product on various attributes (on a scale from 1 to 7), allowing comparison between the different products. The authors reported that UK participants rated precision-fermented cheese to be less natural and slightly less safe than conventional cheese (exact mean ratings are not reported in the paper).

These findings are generally consistent with Crawshaw and Piazza (2023), who found that a substantial proportion of non-farmers perceived precision-fermented milk to be unnatural (42%). Crawshaw and Piazza did not examine whether participants had concerns about the safety of precision-fermented milk, although they did examine other perceptions not tested in Zollman Thomas and Bryant (2021). That is, Crawshaw and Piazza found that just over half of non-farmers (53%) were concerned that the product posed a threat to farmers. A minority of non-farmers

also agreed with other concerns, such as the product being against their culture, values or tradition (8-13%), its bad taste (13%) and texture (8%), their reluctance to try new foods (6%) and not trusting the companies that make the product (19%). Farmers tended to be more convinced of the risks of precision-fermented milk than non-farmers, which is further discussed elsewhere (see section 4.3.4: 'Who is more likely to perceive some types of benefits and risks/concerns?'). Overall, Crawshaw and Piazza's findings are limited because they are based on small, non-representative samples. It is therefore not possible to make definitive conclusions on the exact percentage of the UK population with these concerns. Rather, the study offers tentative insight into what some of these concerns may be.

4.3.3.2. Perceived demotivators

Two studies examined whether participants considered a particular risk or concern to be a demotivator for consuming precision-fermented dairy (Ford et al., 2023; The Grocer, 2018).

In the Grocer (2018), participants were asked what (if anything) would put them off buying precision-fermented milk and were provided with a list of options to select from (including the option to select none of them). The most prevalence response was that they would worry what chemicals or ingredients it contained (selected by 50%), followed by it not being natural (43%) and its possible long-term side effects (37%). Other selected demotivators were if it would be more expensive than conventional milk (33%), it would be made in a laboratory (29%), it wouldn't taste, look or smell the same as conventional milk (27%), its just not right (23%) and it would still contain cow DNA (10%).

Ford et al.'s (2023) qualitative research more broadly examined demotivational factors using open-ended responses, rather than limiting participant responses to a pre-defined list of factors to select from. Consistent with the Grocer (2018), prominent themes included concerns regarding the unnaturalness and affordability of the product. In addition, participants generally spoke about wider consumer acceptance as a barrier, with one example quote: "it would be hard for people to wrap their heads around."

4.3.4. Who is more likely to perceive some types of benefits and risks/concerns?

Four of the previously described UK studies also examined demographic differences regarding perceived benefits or concerns about precision-fermented foods (Crawshaw & Piazza, 2023; GFI, 2025; The Grocer, 2018; Zollman Thomas & Bryant, 2021). Comparisons were made based on gender, age, farmers vs. non farmers, and country. As with the findings on consumption intentions (see section 4.2.3), predictors of some types

of benefits/concerns tended to differ by country. Given the high volume of international evidence, this section of the review focuses on the UK evidence. International evidence is only considered where single studies sampled multiple countries, including the UK.

The Grocer (2018) found that certain benefit/risk perceptions were more important for some genders and age groups than others. That is, women were more likely than men to be put off precision-fermented milk due to worries about the chemicals and ingredients it contained. Women were also more likely than men to be motivated to consume the product if they knew it didn't require the animal to be farmed. Whereas men and those who were younger (aged 18-24) were more likely to be motivated to consume the product due to it being cheaper than conventional milk.

As previously described, Crawshaw and Piazza (2023) compared perceptions of precision-fermented milk between farmers and non-farmers, and found that non-farmers were more likely to be convinced of the benefits of precision fermented milk than farmers. That is, non-farmers were significantly more likely to agree with the following benefits: it is better for the environment (81% vs. 51%), it is a better use of natural resources (81% vs. 49%), it is a good source of protein (66% vs. 36%), and curiosity about its taste (72% vs. 42%). Whereas farmers were more likely to be convinced of the risks of precision-fermented milk than non-farmers, particularly regarding the perception that the product goes against their culture or values (38% vs. 8%).

GFI (2025) sampled participants from both the UK and other countries, and found that the top motivators for consuming precision-fermented dairy/egg slightly differed across countries. Similar to the UK, the top motivator for participants from Germany was animal welfare, whereas the top motivator for people in the USA and Spain was health benefits. In France, the top motivator was curiosity/novelty. As shown in [Table 4](#) below, these differences across countries were small. For example, the percentage of participants selecting 'animal welfare' only varied from 31-45% across countries. In addition, animal welfare, health and curiosity/novelty were consistently found to be the top three reasons across all counties (albeit in different orders).

Table 4. The percentage of participants in each country that selected each reason when asked why they are interested in trying precision-fermented dairy/egg. The most prominent reason for each country is shaded grey. Data are from GFI (2025).

Reason	UK	Germany	Spain	USA	France
Animal welfare	43%	45%	38%	31%	35%
Health	41%	34%	46%	48%	37%
Curiosity/novelty	34%	41%	45%	36%	40%
Environmental	33%	25%	27%	26%	23%

Reason	UK	Germany	Spain	USA	France
Taste	25%	28%	25%	28%	25%
No cholesterol	17%	14%	25%	20%	13%
No antibiotics	13%	20%	14%	21%	13%
Food safety	15%	13%	21%	20%	9%
Global food security	16%	14%	18%	16%	14%
Price	15%	12%	14%	16%	12%
Lactose free	8%	9%	13%	14%	9%

Zollman Thomas and Bryant (2021) also compared other countries to the UK. However, in contrast to GFI (2025), they did not determine whether particular product attributes were seen as reasons to try the product. Rather, they asked participants to simply rate precision-fermented cheese on the following qualities: safety, naturalness, environmental, ethical, tasty, nutritious, and healthy (on a scale from 1 to 7, where 1 = negative and 7 = positive). Participants from Brazil and India rated precision-fermented cheese as more natural and safer than participants in the UK, USA and Germany. Whereas Brazil, India and the USA rated the product to be more ethical and environmentally-friendly than those in the UK and Germany. Perceived tastiness, healthiness and nutritiousness were similar across countries.

4.3.5. Do people consider precision-fermented foods to be vegetarian/vegan, kosher and halal?

Two studies provide some insight into consumers' vegan and/or vegetarian perceptions of precision-fermented foods (Broad et al., 2022; Powell et al., 2023). Whereas a third study examined how consumers' categorise precision-fermented foods more broadly (GFI, 2025).

Broad et al. (2022) examined 34 participants' views on precision-fermented dairy using focus-groups across the UK, USA, Germany and Singapore. Participants were pre-selected for their generally favourable attitudes towards trying new foods and towards the role of technology in society. The findings are therefore only generalisable to this type of consumer, and were not reported separately by country. When discussing precision-fermented dairy, participants wondered how to categorise it and questioned whether it should be considered vegan, plant-based or real dairy.

Peoples' general uncertainty about how to categorise precision-fermented foods was also evident in GFI's (2025) nationally representative survey, which included the UK as well as other countries. When asked whether they would associate precision-fermented dairy with being 'plant-based', 'animal-based' or 'not from plants or animals', few participants (5-10%)

correctly understood that it was neither from plants nor animals. The authors noted that participants tended to divide food into animal and plant-based, but precision-fermentation did not fit into that framework.

Similar findings were reported in Powell et al.'s (2023) study which was based on a small, non-representative sample of Canadians (n = 115). In this study, participants were asked if they thought that precision-fermented dairy was vegan and vegetarian (response options: strongly agree, agree, neutral, disagree, strongly disagree). When asked about the product being vegan, the most prevalent response was that people were neutral (selected by 42.6%) which may indicate uncertainty (27.0% generally agreed, whereas 30.4% disagreed). When asked about the product being vegetarian, just over half of people (50.4%) agreed, whereas 33% were neutral and 16.5% disagreed. Overall, this suggests that there were a variety of perceptions about whether the product was vegetarian or vegan (with no clear majority view), although people may be more uncertain about the product being vegan than vegetarian.

Limited evidence was available regarding halal views of precision-fermented foods, whereas no study examined kosher views. One qualitative study based on a small sample of university students from Turkey (Aydemir et al., 2023) reported that 4.3% of participants would not consume precision-fermented milk because they did not think it was halal. However, this finding is based on a small university cohort and thus may not represent the entire halal community.

4.4. How does the terminology applied to precision fermentation influence consumer perceptions?

Only one study examined consumer appeal and perceived understanding of different terminologies (GFI, 2025). The study examined precision-fermented dairy/egg, and sampled consumers from the UK as well as other countries (France, Germany, Spain, USA). In their published report, GFI did not report all findings separately by country. However, GFI provided the FSA with a report on UK consumers only, which is summarised below.

Further research is required to determine the influence of different terminologies on consumers' understanding of the true nature of precision-fermented foods, particularly regarding their understanding of the allergen potential of these products. Further evidence gaps are identified below.

4.4.1. Overview of key findings

- When consumers have **prior knowledge** of what precision-fermented dairy/egg is, they *perceive* the terms 'animal-free' or 'non-animal' to be most **effective at differentiating** the product from both animal-based and plant-based products.
- However, when consumers have **no prior knowledge** of precision-fermented dairy/egg, the terms 'animal-free' and 'non-animal' are more likely to be associated with plant-based products compared to other terms.
- It is unclear whether the terms 'animal-free' or 'non-animal' sufficiently convey **allergen information** to consumers, with or without any prior knowledge of the product.
- The terms 'animal-free' and 'made from fermentation' are **perceived most positively** by consumers when they have no prior knowledge of precision-fermented dairy/egg.
- The term 'animal-free' is ranked as the **most appealing** when consumers have prior knowledge of precision-fermented dairy/egg.

A more detailed description of the study is provided below, grouped by the type of measure examined (consumer understanding vs. consumer appeal).

4.4.2. Consumer understanding of different terminologies

In GFI (2025), UK participants were provided with a list of terminologies for precision-fermented dairy/egg, including: 'Animal-free', 'non-animal', 'made from precision brewing', 'made from precision fermentation', 'cultivated', 'made from microflora'. Participants were asked to rate each terminology on how effective it is at making it clear that the product is: 1) produced differently from conventional animal-based dairy or eggs, and 2) produced differently to plant-based dairy or eggs. For both questions, the response options were: very effective, somewhat effective, not sure/no opinion, somewhat ineffective, very ineffective. Importantly, participants had already been provided with a definition of precision-fermented dairy/egg and so they already knew that the products were different from both animal-based and plant-based products.

Participants rated the terms 'animal-free' and 'non-animal' to be the most effective at differentiating the product from animal-based products (rated as somewhat to very effective by 64% and 62% of participants, respectively). The other terms were rated as somewhat to very effective by less than half of participants (42-47%). Similarly, the terms 'animal-free' and 'non-animal' were rated as the most effective at differentiating the product from plant-based products ('animal-free' and 'non-animal' were rated as effective by 61% and 58%, respectively, whereas the other terms were rated as effective by 45-49%).

It is important to consider that GFI (2025) tested UK participants' *perceived understanding* of a term when they already had prior knowledge of the product. The researchers did not report UK participants' *objective understanding* of the terms when they had no prior knowledge of the product. However, the GFI's (2025) publicly available report does offer some insight into consumers' objective understanding based on evidence from multiple countries combined. This report states that *before* participants were provided with a definition of precision fermentation, they were asked whether they would associate each term with the following: 'plant-based (made from plants),' 'animal-based (e.g., from a cow or chicken),' and 'not from plant or animal.' Participants could select all that apply. Based on combined data from the UK, USA and France, the term 'animal-free' had the highest association with plant-based products ('plant-based' was selected by 26% of participants for this term) compared to other terms (where 'plant based' was selected by 5-15%)⁸. This finding is inconsistent with how participants perceived the different terms after they had been provided with a definition of precision fermentation, as previously described.

Previous research on cell-cultivated meat⁹ also suggests that participants' perceived understanding of different terms may be different to their objective understanding when they have no prior knowledge of the product (FSA, 2025a). For example, when provided with a description of what cell-cultivated meat is, consumers perceive the terms 'cultivated' or 'cultured' meat to be *moderately* descriptive. Conversely, a relatively small percentage of consumers can accurately identify the true nature of 'cultivated' or 'cultured' meat when asked to do this without any prior knowledge of the product.

⁸ Correctly understanding that the product was not from plants or animals was similarly low across all terms (selected by 5-10%). Few participants associated the product with being 'animal-based' across all terms (selected by 2-7%).

⁹ Cell-cultivated meat is where meat is grown from animal cells. This is different from precision-fermented dairy/egg which uses microorganisms like yeast to produce dairy/egg proteins. Similar to precision-fermented foods, there are many terms often used to refer to cell-cultivated meat (e.g., 'cell-cultivated', 'cultured', 'cultivated', 'lab-grown').

It is also important to consider that GFI's (2025) research did not test consumers' perceived allergenicity of the product. That is, whether participants understood that precision-fermented dairy/egg would not be safe to consume for those with an allergy to cow's milk/chicken egg. It is therefore unclear whether the terms 'animal-free' or 'non-animal' would cause consumer confusion in that regard.

4.4.3. Consumer appeal of different terminologies

GFI (2025) also asked UK participants whether they would associate each term with the following words: 'innovative', 'healthy', 'ethical', 'natural', 'sustainable', 'artificial', 'lab-grown', 'unhealthy' (select all that apply). Participants were asked this question *before* they were provided with a definition of precision fermentation. For analysis purposes, the authors defined the first five options as positive perceptions, and the last three options (i.e., 'artificial', 'lab-grown', 'unhealthy') as negative perceptions. Net positivity was calculated by subtracting the average percentage of participants selecting negative associations from those selecting positive associations. Only the terms 'animal-free' and 'made from fermentation' had net-positive associations (the net positive associations for were 7% and 1%, respectively). The terms 'made from microflora' (-3%) and 'cultivated' (-3%) had the most negative associations (other net positive associations ranged from -2%-0%) The terms 'animal-free' and 'made from fermentation' therefore generated the most positive perceptions among UK consumers.

After receiving a definition of precision fermentation, participants were asked to rank the terms in order from most to least appealing. The term 'animal-free' was the highest ranked name in all countries, except for France where 'non-animal' was ranked highest.

Additionally, participants were provided with a list of ingredient names and asked which option was most appealing. The options ranged from shorter terms such as 'animal-free whey protein' and 'cultivated whey protein' to longer terms such as 'animal-free whey protein made from precision fermentation.'¹⁰ In the UK, the most commonly selected option was

¹⁰ All 16 ingredient name options were: Animal-free whey protein, None of the above, Non-animal whey protein, Cultivated whey protein, Animal-free whey protein made from precision fermentation, Animal-free whey protein made from fermentation, Animal-free whey protein made from precision brewing, Whey protein made from precision brewing, Non-animal whey protein made from precision fermentation, Whey protein made from fermentation, Non-animal whey protein made from precision brewing, Whey protein made from precision fermentation, Non-animal whey protein made from fermentation, Cultivated whey protein made from precision fermentation, Cultivated whey protein made from fermentation, Cultivated whey protein made from precision brewing.

'animal-free whey protein' (selected by 28% of participants), followed by 'non-animal whey protein' (12%), followed by 'none of the above' (10%). The term 'animal-free whey protein' was also most selected across all other countries, except France where 'none of the above' was most prevalent (selected by 15% of French participants). The authors noted that consumers prefer shorter, simpler ingredient names since the top three names across all countries consisted of a name in front of the ingredient with nothing following it (i.e., 'animal-free whey protein', 'non-animal whey protein', and 'cultivated whey protein'). However, it is unclear whether the findings reflect consumers' preference for shorter names, their preference for particular words, or a combination of both. For example, a name using the terms 'precision-fermented' or 'fermentation' with the same number of words as the other shorter options was not tested (e.g., 'precision-fermented whey protein' or 'fermented whey protein').

Finally, when asked which term they can imagine using personally when discussing the products with friends or family, the most prevalent response across all countries was 'animal-free' (e.g., selected by 52% of UK participants), followed by 'non-animal' (42% of UK participants).

4.5. What do consumers think about FSA involvement, regulation and labelling of precision-fermented foods?

One nationally-representative survey examined consumer views on whether precision-fermented dairy should be sold in the UK.

Limited evidence was available on consumer trust in the regulation of precision-fermented foods, and no studies examined consumer views of the FSA or labelling of precision-fermented foods.

4.5.1. Overview of key findings

- Most people either feel unsure about whether precision-fermented dairy should be sold in the UK (37%) or think that it should not be on sale (34%).
- People are more likely to think that precision-fermented dairy should be sold in the UK in future if they are:
 - Male
 - Younger
 - University educated
 - An ethnic minority (vs. white ethnicity)

- Have a mid-range income (vs. lower income)
 - Have heard of fermentation or precision-fermented dairy
 - Are vegan/vegetarian/pescatarian/flexitarian (vs. omnivore)
- Limited international and UK evidence suggests that people who are already open to trying novel foods generally have trust in the regulation of precision-fermented dairy. No evidence was available on the broader UK population.
 - Limited international evidence from Australia suggests that caregivers have trust in the regulation of precision-fermented lactoferrin in infant formula products.

4.5.2. Consumer views on whether precision-fermented foods should be sold in the UK

The FSA's CIT (FSA, 2025b) examined whether people think that precision-fermented dairy should or should not be sold in the UK in future (response options: 'Yes, it should definitely be on sale in the UK in future'; 'Yes, it should probably be on sale in the UK in future'; 'No, it should probably not be on sale in the UK in future'; 'No, it should definitely not be on sale in the UK in future').

Most participants either felt unsure about whether precision-fermented dairy should be sold in the UK (37%) or thought that it should not be on sale (34%). Only 29% of participants thought that it probably or definitely should be sold in the UK. [Figure 1](#) shows the percentage of participants that selected each response option.

(2025b)_selecting_each_response_option" data-medium-image-url="https://s3.amazonaws.com/production.scholastica/public/attachments/f2887dfb-4505-4889-83c0-b52b50b7b678/medium/ Figure_1._The_percentage_of_participants_from_the_CIT_(2025b)_selecting_each_response_option" alt="Figure 1">

Figure 1. The percentage of participants from the CIT (FSA, 2025b) selecting each response option when asked if they think that precision-fermented dairy should be sold in the UK in future (response options on Y axis of the figure).

4.5.2.1. Who is more likely to think that precision-fermented foods should be on sale?

Binomial logistic regression analysis of the FSA's CIT data (FSA, 2025b) showed that people were more likely to think that precision-fermented dairy should be sold in the UK in future if they were male, younger,

university educated, an ethnic minority (vs. white ethnicity), had a mid-range income (£35,000-59,000 vs. up to £19,999), had previously heard of fermentation or precision-fermented dairy, or were vegan/vegetarian/pescatarian/flexitarian (vs. omnivore).

It is unclear why participants with a mid-range income (but not a higher income of £60,000+) were more likely to think that precision-fermented foods should be sold in the UK. Nevertheless, differences by income were small, with a minority of participants across all income categories (26%-36%) reporting that precision-fermented foods should be sold in the UK. Additionally, while statistically significant (p -values < 0.05), all significant predictors accounted for a relatively small amount of the variation in participants' responses ($R^2 = 0.12$), similar to the regression analysis on consumption intentions (see section 4.2.3.10).

Country and urban (vs. rural) location were not significant predictors. Although having previously heard of 'precision fermented *dairy*' was a significant predictor (as noted above), having heard of 'precision fermentation' more generally was not a significant predictor. Further details of the binomial logistic regression model are available in Appendix A (section 1.2).

4.5.3. General views on regulation, the FSA and labelling of precision-fermented foods

Two studies reported evidence regarding consumer trust in the regulation of precision-fermented foods. One study sampled participants from both the UK and other countries (Broad et al., 2022), whereas the second study sampled participants from Australia. No studies examined consumer views about the FSA in particular, or on labelling of precision-fermented foods. Both studies are limited such that they did not utilise nationally representative samples of the UK population.

Broad et al. (2022) examined 34 participants' views on precision-fermented dairy using focus-groups across the UK, USA, Germany and Singapore. Importantly, the participants were pre-selected for their generally favourable attitudes towards trying new foods and towards the role of technology in society. The findings are therefore only generalisable to this type of consumer, and were not reported separately by country. To prompt discussion about the product, participants were provided with both positive statements (e.g., "breakthrough technology makes new things possible") and negative statements (e.g., "we shouldn't mess with nature") regarding precision-fermented dairy. However, there were slightly more positive than negative statements provided which may have skewed participants' views (4 vs. 5 statements). Participants tended to express faith

in the judgment of government agencies that regulate food, such that they would trust a product's safety if it was allowed to be sold in stores and restaurants.

Mankad and Carter (2025) also used focus groups to examine 17 Australian caregivers' views on precision-fermented lactoferrin in infant formula products. Participants were those who currently formula-feed their infant, either exclusively or mixed with breastmilk. Participants were provided with a description of the benefits of precision-fermented lactoferrin, including its equivalence to human-derived lactoferrin, and its environmental and health benefits compared to lactoferrin from cows. They were then asked several questions about the product to prompt discussion, including what their immediate reactions were to the product, if any aspects of the technology worried or interested them, and their general acceptance of the product. The authors reported that support for the product was conditional upon regulatory authorities providing approval for market release, for which there was high trust.

5. Conclusions

A rapid evidence review was undertaken on consumer perceptions and consumption intentions regarding precision-fermented foods. The review summarises 19 studies, and includes articles published in peer-reviewed journal articles as well as grey literature. Most studies examined consumer responses to precision-fermented dairy, with some also examining precision-fermented egg or precision-fermented foods in general without specifying a particular type of food. One international study examined precision-fermented lactoferrin in infant formula products.

Limited evidence was available regarding consumer views on whether precision-fermented foods are halal or kosher, on consumer trust in the regulation of these foods, and comparing perceptions and consumption intentions between flexitarians/vegetarians/ vegans and omnivores. No evidence was available on consumer understanding of the allergen risk of precision-fermented foods. Future research is therefore required to address these evidence gaps.

All conclusions below are based on UK evidence, except where otherwise stated. It is possible that the international evidence is not generalisable to the UK population in these instances, particularly given additional evidence that willingness to try or regularly consume precision-fermented foods is less prevalent in the UK than in some other countries.

Over half of people in the UK (52-68%) are **willing to try** precision-fermented dairy/eggs, whereas only a minority are **willing to regularly purchase** the products (35%) or **add them to their diet** (17-31%). Although there are some differences between different demographic groups, the

most important predictors of purchase intentions of precision-fermented dairy are having positive perceptions of the product, followed by having higher consumption levels of conventional dairy.

Limited UK evidence also suggests that flexitarians are the most likely to be willing to purchase precision-fermented dairy (vs. omnivores), whereas limited international evidence suggests that vegans are the most likely to be willing to consume precision-fermented egg. Precision-fermented egg may be more appealing to vegans than precision-fermented dairy since there are fewer plant-based alternatives for conventional egg than dairy. However, the evidence regarding differences by dietary pattern is limited either because the researchers reported low sample sizes of vegans/vegetarians in their study or did not report on the sample sizes which creates some uncertainty in the findings. There is also some evidence that people have a variety of views about whether precision-fermented dairy/egg is vegan or vegetarian, and that people generally feel uncertain about how to categorise these products.

Consistent with the UK evidence, international evidence suggests that people are more willing to try or purchase precision-fermented foods than they are to regularly purchase or incorporate them into their diet. However, overall willingness to try and regularly purchase precision-fermented dairy is more prevalent in some countries than in the UK, such as Brazil and India. International evidence suggests that people are also more willing to purchase precision-fermented foods if they trust food manufacturers, perceive the product to be useful, feel knowledgeable about the product, do not perceive risks to farmers' livelihoods, are not concerned about the market power of large companies, and do not have a fear of new food technologies. These additional factors were not examined in the UK studies, except for feeling knowledgeable about the product where findings were consistent with the international evidence.

People tend to agree that precision-fermented dairy/egg has benefits, however, people also have some concerns about these products. Perceived benefits and motivators for consuming precision-fermented dairy/egg include curiosity about its taste and perceiving the products to be beneficial for animal welfare, the environment, and health. Whereas perceived risks/concerns and demotivators for consuming precision-fermented dairy/egg include concerns about its safety, unnaturalness and affordability. It is not possible to conclude which types of benefits or concerns are most prevalent or important to consumers. This is because different studies examined different types of benefits or concerns and provided participants with different product information which may have influenced their perceptions. The studies are therefore not comparable.

Future research is therefore required where UK consumers are provided with neutral information about precision-fermented foods and/or a balanced description of both positive and negative views of these products.

International evidence suggests that peoples' perceived benefits of precision-fermented foods are more important predictors of consumption/purchase intentions than their perceived risks. Although no UK study compared the relative importance of perceived risks and benefits in predicting consumption/purchase intentions, this finding is highly consistent with available UK evidence regarding consumption intentions of cell-cultivated meat (FSA, 2025a).

When consumers have prior knowledge of what precision-fermented dairy/egg is, they perceive the **terminology** 'animal-free' to be most effective at differentiating the product from both animal-based and plant-based products. The term 'animal-free' is also most appealing to consumers. However, when consumers have no prior knowledge of what precision-fermented dairy/egg is, the term 'animal-free' is more likely to be associated with plant-based products compared to other terms. It is also unclear whether the term 'animal-free' (or any other term) would cause confusion about the allergen risk of precision-fermented dairy/egg, as no study has examined this.

Most people either feel unsure about whether precision-fermented dairy should be sold in the UK in future, or think that it should not be on sale. People who are already open to trying novel foods generally trust in the **regulation** of precision-fermented dairy. However, no evidence was available on the broader UK population. Consistent with the limited UK evidence, international evidence suggests that caregivers trust in the regulation of precision-fermented lactoferrin in infant formula products.

Submitted: April 17, 2025 BST. Published: May 07, 2025 BST.



This is an open-access article distributed under the terms of the Creative Commons Attribution 4.0 International License (CCBY-4.0). View this license's legal deed at <http://creativecommons.org/licenses/by/4.0> and legal code at <http://creativecommons.org/licenses/by/4.0/legalcode> for more information.

References

- Aydemir, M. E., Okan, Y. T., & Takım, K. (2023). Generation Z consume animal-free milk? A Türkiye experience. *Food and Health*, 9(3), 254–261. <https://doi.org/10.3153/FH23023>
- Banovic, M., & Grunert, K. G. (2023). Consumer acceptance of precision fermentation technology: A cross-cultural study. *Innovative Food Science & Emerging Technologies*, 88, 103435. <https://doi.org/10.1016/j.ifset.2023.103435>
- Broad, G. M., Zollman Thomas, O., Dillard, C., Bowman, D., & Le Roy, B. (2022). Framing the futures of animal-free dairy: Using focus groups to explore early-adopter perceptions of the precision fermentation process. *Frontiers in Nutrition*, 9, 997632. <https://doi.org/10.3389/fnut.2022.997632>
- Cohen, J., Cohen, P., West, S. G., & Aiken, L. S. (2003). *Applied multiple regression/correlation analysis for the behavioral sciences* (3rd ed.). Lawrence Erlbaum Associates, Inc., Publishers.
- Crawshaw, C., & Piazza, J. (2023). Livestock farmers' attitudes towards alternative proteins. *Sustainability*, 15(12), 9253. <https://doi.org/10.3390/su15129253>
- Dang, H. L. (2023). *Precision fermentation adds value to food supply chain, not competition – Perfect Day*. Food Navigator, Asia. <https://www.foodnavigator-asia.com/Article/2023/01/24/precision-fermentation-adds-value-to-food-supply-chain-not-competition-perfect-day>
- Field, A. (2018). *Discovering statistics using SPSS* (5th ed.). Sage Publications.
- Food Standards Agency (FSA). (2025a). *A rapid review on consumer responses to cell-cultivated products*. <https://doi.org/10.46756/001c.129280>
- Food Standards Agency (FSA). (2025b). *Consumer Insights Tracker*. <https://www.food.gov.uk/research/consumer-interests-aka-wider-consumer-interests/consumer-insights-tracker#monthly-consumer-insights-tracker-reports>
- Ford, H., Gould, J., Danner, L., Bastian, S. E. P., & Yang, Q. (2023). “I guess it’s quite trendy”: A qualitative insight into young meat-eaters’ sustainable food consumption habits and perceptions towards current and future protein alternatives. *Appetite*, 190, 107025. <https://doi.org/10.1016/j.appet.2023.107025>
- Ford, H., Thibodeau, M., Newton, L., Child, C., & Yang, Q. (2024). Investigating the effect of sharing environmental information on consumer responses to conventional and hypothetical ‘precision fermented’ yoghurt. *International Journal of Food Science and Technology*. <https://doi.org/10.1111/ijfs.17228>
- Good Food Institute (GFI). (2025). *Precision fermentation nomenclature and messaging*.

- Hartman Group. (2023). *The Growing Consumer Opportunity for Precision Fermentation*. <https://www.hartman-group.com/webinars/42796319/the-growing-consumer-opportunity-for-precision-fermentation>
- Kossmann, H., Schulze, H., Mergenthaler, M., & Breunig, P. (2023). Acceptance of animal-free cheese products: Evidence from an information experiment in Germany. *Food Quality and Preference*, 111, 104984. <https://doi.org/10.1016/j.foodqual.2023.104984>
- Kühl, S., Schäfer, A., Kircher, C., & Mehlhose, C. (2024). Beyond the cow: consumer perceptions and information impact on acceptance of precision fermentation-produced cheese in Germany. *Future Foods*, 10, 100411. <https://doi.org/10.1016/j.fufo.2024.100411>
- Mankad, A., & Carter, L. (2025). Primary carers' readiness for human lactoferrin in infant formula using precision fermentation. *Future Foods*, 11, 100526. <https://doi.org/10.1016/j.fufo.2024.100526>
- Manzoni, P. (2016). Clinical benefits of lactoferrin for infants and children. *The Journal of Pediatrics*, 173, S43–S52. <https://doi.org/10.1016/j.jpeds.2016.02.075>
- Manzoni, P. (2019). Clinical studies of lactoferrin in neonates and infants: an update. *Breastfeeding Medicine*, 14(S1), S25–S27. <https://doi.org/10.1089/bfm.2019.0033>
- Mendly-Zambo, Z., Powell, L. J., & Newman, L. L. (2021). Dairy 3.0: cellular agriculture and the future of milk. *Food, Culture & Society*, 24, 675–693. <https://doi.org/10.1080/15528014.2021.1888411>
- Perfect Day. (n.d.). *Animal-free milk protein*. <https://perfectday.com/animal-free-milk-protein/>
- Powell, L. J., Mendly-Zambo, Z., & Newman, L. L. (2023). Perceptions and acceptance of yeast-derived dairy in British Columbia, Canada. *Frontiers in Sustainable Food Systems*, 7, 1127652. <https://doi.org/10.3389/fsufs.2023.1127652>
- Szczepanski, L., Bahlmann, L., Rötter, C., Eylering, A., & Fiebelkorn, F. (2024). *Adolescents' Attitudes Toward Milk Alternatives and Their Motives for (Non-) Consumption*. <https://doi.org/10.2139/ssrn.4932054>
- The Grocer. (2018). 'Test tube milk' more likely to win Brits than lab-grown meat. <https://www.thegrocer.co.uk/sourcing/test-tube-milk-more-likely-to-win-brits-than-lab-grown-meat/571598.article>
- Tricco, A. C., Antony, J., Zarin, W., Striffler, L., Ghassemi, M., Ivory, J., ... Straus, S. E. (2015). A scoping review of rapid review methods. *BMC Medicine*, 13, 1–15. <https://doi.org/10.1186/s12916-015-0465-6>
- Zollman Thomas, O., & Bryant, C. (2021). Don't have a cow, man: consumer acceptance of animal-free dairy products in five countries. *Frontiers in Sustainable Food Systems*, 5, 678491.

Zollman Thomas, O., Chong, M., Leung, A., Fernandez, T. M., & Ng, S. T. (2023). Not getting laid: Consumer acceptance of precision fermentation made egg. *Frontiers in Sustainable Food Systems*, 7, 1209533.

Supplementary Materials

Appendices - Consumer responses to precision fermentation

Download: <https://science.food.gov.uk/article/136898-a-rapid-evidence-review-on-consumer-responses-to-precision-fermentation/attachment/280286.docx>
