Consumers' purchase intentions towards traced foods: A comparative analysis between the United Kingdom and China

Authors:

Shan Jin [a] *, Yiying Cao [b], Glyn Jones [c, e], Wenjing Li [d], Lynn J. Frewer [e]

[a] Faculty of Business and Law, University of Portsmouth, Portsmouth, PO1 3DE, UK

[b] RSK ADAS Ltd., Spring Lodge, 172 Chester Road, Helsby, WA6 0AR, UK

[c] Institute for Agri-Food Research and Innovation, FERA Sciences Ltd., National Agri-Food Innovation Campus, Sand Hutton, York, YO41 1LZ, UK

[d] School of Economics and Management, Huazhong Agricultural University, 430070, P.R. China

[e] School of Natural and Environmental Sciences, Newcastle University, Newcastle upon Tyne, NE1 7RU, UK

***Corresponding Author**

Dr Shan Jin

Address: Richmond Building, Portland Street, Portsmouth, PO1 3DE.

Email: andy.jin@port.ac.uk; Tel: +44 (0) 784 923 4549.

Co-authors

Dr Yiying Cao Yiying.Cao@adas.co.uk
Dr Glyn Jones Glyn.d.Jones@fera.co.uk
Dr Wenjing Li wenjing.li@newcastle.ac.uk
Prof Lynn J. Frewer lynn.frewer@newcastle.ac.uk

Abstract

Food traceability can potentially facilitate the identification of safe foods, and enable the authentication of different production characteristics, such as sustainability or quality attributes associated with production practices. The successful implementation of traceability systems will depend on the extent to which consumers are willing to purchase traced foods. This may vary between food categories, and the product characteristics which are being traced. This research investigated Chinese and UK consumers' responses (UK n = 1,656 and Chinese n = 1,515) to different traced foods (apples, milk and beef), using online survey methodology.

The results showed that Chinese consumers expressed greater intentions to buy traced foods than UK consumers overall. Traced beef and milk incurred higher purchase intentions than traced apples in both countries. A hybrid model has been developed and tested using partial least squares structural equation modelling. The results indicated attitudes and perceived affordability are the main determinants of purchase intentions for UK consumers, while perceived affordability and perceived ease of use are the main determinants for Chinese consumers. Consumer purchase intentions exhibited a greater dependence on existing attitudes towards traced food in general for Chinese consumers, indicating potentially stronger cognitive biases. A perceived price premium had negative impacts on UK consumers', but positive impacts on Chinese consumers' purchase intentions towards traced foods. This could relate to UK consumers being more price-conscious, while Chinese consumers regarded price premiums as signifying greater safety and quality during food decision making. Implications for the future implementation of food traceability systems in China and the UK are discussed.

Key words: Food traceability; Consumer purchase intention; Consumer attitudes; Push-Pull-Mooring theory; Structural equation modelling

1. INTRODUCTION

Food and ingredient traceability has been defined as the ability to follow the movement of a food through specified stage(s) of production, processing and distribution, which helps to control food hazards, provide reliable product information and guarantee product authenticity (FAO, n.d.). Traceability allows food companies and regulatory authorities to efficaciously monitor the location of agri-food products within supply chains and facilitate implementation of mitigation actions, e.g. product recalls, if a product is found to be non-compliant with quality or safety standards (Bosona & Gebresenbet, 2013; Food Standards Agency, 2022a; Spence et al., 2018). These benefits may potentially contribute to achieving Sustainable Development Goals (SDGs) in particular SDG 2, which calls for actions to improve food safety and nutrition and facilitate the sustainability of agri-food production systems (United Nations, 2015).

In addition to the supply of healthy foods, agri-food systems provide various ecosystem services (ES), such as soil and water quality regulation, carbon sequestration, support for biodiversity and cultural services, contributing to human wellbeing and quality of life (Power, 2010). ES may degrade if negative environmental impacts caused by agri-food production and transportation continue, such as the depletion of natural resources and increasing greenhouse gas emissions (Ferrari et al., 2019). In relation to this, SDG 12 emphasises the need for responsible consumption and production, e.g. related to impacts on the environment (United Nations, 2015). Traceability systems can record environmental information related to agri-food products, which is associated with primary production characteristics (e.g. soil, water, temperature and humidity quality) (Feng et al., 2020), as well as impact of production and transportation on the environment (e.g. the water footprint and the carbon footprint) (Kastner et al., 2011). Providing information about environmental impacts associated with products to consumers may facilitate responsible consumption (e.g. encourage them to purchase foods with lower environmental impacts). Food producers and retailers may subsequently pay more attention to addressing the environmental impacts of food production and transportation in order to meet consumer needs and preferences, thereby reshaping agri-food production systems (Garcia-Torres et al., 2019).

The actual delivery of traceability benefits associated with environmental impacts will depend on the diffusion of traceability systems within the agri-food sector. Consumers' attitudes towards food traceability, different traced foods, and the characteristics of these traced foods may drive demand within the food system. There is evidence for an overall positive consumer attitudes towards food traceability implementation, in general and in relation to specific concerns such as food fraud (Jin, Zhang, & Xu, 2017; Kendall et al., 2019; Menozzi, Halawany-Darson, Mora, & Giraud, 2015; Sander, Semeijn, & Mahr, 2018; van Rijswijk, Frewer, Menozzi, & Faioli, 2008). Attitudes towards traced food may vary across regions (e.g. in relation to socio-cultural preferences or perceived food production characteristics) and between specific products, potentially due to local experiences associated with different food risks or concerns. For instance, a meta-analysis conducted by Cicia and Colantuoni (2010) showed that European consumers are willing to pay more for traced meat than North American consumers. Menozzi et al. (2015) reported that consumers in both France and Italy have stronger intention to buy traced chicken than traced honey.

Consumers' attitdues towards food traceability may also relate to food-related incidents or "food scares". For example, Quevedo-Silva et al. (2022) found that traceability information increased Brazilian consumers' beef purchase intention to a greater extent for consumers who were more concerned about COVID-19, potentially because of their concerns about transmissibility in the supply chain. Despite a variety of studies investigating consumer attitudes, predominant attention has been paid to consumers' perceptions associated with food safety and quality issues rather than environmental issues associated with traced food (Dang & Tran, 2021). In this case, perceived quality refers to "the consumer's judgment about a product's overall excellence or superiority" (Zeithaml, 1988), which means food traceability can act as an extrinsic cue that increases consumers' perceived overall excellence of traced food in a given situation (Hansen, 2005; Ophuis & van Trijp, 1995).

1.1 Chinese and UK consumer attitudes towards traced food

This research is focused on China and the UK, which are two important food traceability markets (and potentially receptive to food traceability) in the world (market size estimated to be 1.56 billion US dollars in 2019 for both countries) (BIS Research, 2021). In addition, the international trade of food products between two countries has been steadily increasing in recent years, indicating there is a need for harmonisation of supply chain practices and standards (China-Britain Business Council, n.d.). At present, a growing number of food business entities in both the UK and China have established their own traceability systems. However, only in the UK, and not in China, are these entities mandated to record the supplier and purchaser (excluding final consumers) of each food item they handle (Food Standards Agency, 2019; State Council of the People's Republic of China, 2019). Understanding consumers' perspectives on traced food in both countries may facilitate future national and international food trade. However, there are some gaps in knowledge relevant to such a comparative analysis. For example, research focused on Chinese consumers tended to address the extent to which consumers are willing to pay for traced food, with few investigating factors that influence consumers' decision-making (Maitiniyazi & Canavari, 2020; Wu, Xu, & Gao, 2011; Yuan, Wang, & Yu, 2020; Zhang, Bai, & Wahl, 2012). In the UK, limited research has been conducted, although considerations have been made to understand willingness to pay and factors associated with consumer decision-making regarding traced foods (Dionysis et al., 2022; Spence et al., 2018).

Research has indicated that both UK and Chinese consumers value food products with environmentally certified production practices and certified food safety, with the latter being more valued (Tait et al., 2016), although this can vary by food type (Hoek et al., 2017). Integrating relevant environmental information into traceability systems can potentially drive the enhancement of environmental sustainability of food production and distribution through consumers' consumption choice (Gallo et al., 2021; Manzini et al., 2014; Matzembacher et al., 2018). However, to date, consumers' perceptions of environmental benefits associated with food traceability as well as their influence on decision-making have rarely been explored in the context of Chinese society, although limited research has been undertaken in the UK (Dionysis et al., 2022; Spence et al., 2018).

A significant positive correlation between UK consumers' perceived environmental friendliness of traced beef (minced beef and beef steak) and their purchase intentions has been observed, but surprisingly, the perceived environmental friendliness was not in the final models for explaining UK consumers' purchase intentions, thereby failing to indicate its actual impact (Spence et al., 2018). UK consumers' perceived environmental benefits associated with traced coffee can positively affect their purchase intention (Dionysis et al., 2022). However, participants in this research were recruited from only one UK university with 82.2% below 40 years' old, which, together with the relatively small sample size, has largely limited the ability of generalisation of its findings, and it was unclear whether differences in the impacts of perceived environmental benefits existed across food categories. In addition, during the COVID-19 pandemic, consumers' concerns around food insecurity have significantly increased in both countries (Food Standards Agency, 2022b; Wang et al, 2020), which might have affected their acceptance of food traceability (Nguyen et al., 2022; Quevedo-Silva et al., 2022). This has raised the demand for updating the current knowledge about consumers' acceptance of food traceability in both countries.

This research aims to investigate how Chinese and UK consumers perceive traced food, and in so doing, address the following research questions:

- What is consumers' purchase intention towards traced food?
- What factors drive consumers' purchase intention?
- Are there food categories that consumers prioritise in terms of traceability?
- What are the similarities and differences between Chinese and UK consumers in terms of their responses to traced food, given different historical experiences of food safety events in the two countries?
- What are the implications for food policy and marketing strategy?

The research will make three main contributions to the existing literature. First, it will narrow the knowledge gap by offering more information about factors that motivate and/or impede consumers' acceptance of traced food in China and the UK. Second, it will enable understanding of Chinese and UK consumers' responses to information about the potential environmental benefits that can be traced through the food supply chain, which, at present, has infrequently been investigated. Third, comparisons will be made in terms of consumer responses to traced food across countries, food types and socio-demographic groups. These contributions can more precisely inform future development and promotion of traceability for both countries and trade between them, and for different food products associated with different supply chain problems, providing evidence for policy development and accelerating technology diffusion.

2 FRAMEWORK DEVELOPMENT

2.1 Theoretical foundation

The proposed hybrid model was derived from the Push-Pull-Mooring (PPM) theory (Bansal, 2005; Hsieh et al., 2012) and integrated into the Technology Acceptance Model (TAM) (Davis, 1989; Davis et al., 1989). PPM model comprises three major effects (push, pull and mooring effects) that influence consumers' intention to switch from a product/service to a more attractive and preferable alternative (Bansal, 2005), including new food products, e.g. organic food and traced food (Ghufran et al., 2022; Lin & Wu, 2021; Nguyen et al., 2022). In terms of consumer acceptance of traced food, the "push" effect refers to forces that drive consumers away from non-traced food; the "pull" effect represents positive factors associated with the attractiveness of traced food; and the "mooring" effect refers to personal and social factors that either maintain current consumer behaviours (i.e. purchasing of non-traced food" or facilitate them adopting or “switching” to traced food (Nguyen et al., 2022). The TAM employs perceived usefulness and perceived ease of use to explain people’s attitudes towards, and intention to use a new technology (Davis et al., 1989), including food traceability technology (Lin & Wu, 2021; Tseng et al., 2022).

2.2 Push and pull effects

Previous research has indicated that people can be “locked” into a particular technology or practice that has become normative or standard within a specific area of application (Arthur, 1989). The “lock-in” acts as a barrier to new alternative products or services to be accepted (Czajkowski & Sobolewski, 2016; Murray & Häubl, 2007; Shih, 2012), including in relation to food products (Frank, 2007; Janssen & Jager, 1999; Taghikhah et al., 2020). In the context of traced food, factors that drive consumers away from non-traced food (the push effect) and those related to the attractiveness of traced food (the pull effect) need to be considered. Nguyen, Yeh and Huang (2022) reported that the perceived risk associated with non-traced food has a positive impact on Chinese consumers’ intention to buy traced food, although specific food categories were not considered; rather, the focus was on foods in general. A similar push effect was seen in relation to consumers’ choice of organic food, in which consumers who self-report concerns about food risks tend to have stronger intention to buy organic food as an alternative to conventionally produced foods (Ahangarkolaee & Gorton, 2021; Hsu, Chang, & Lin, 2016). The perceived (health and potentially environmental) threats posed by conventional foods drive self-protective food choices, e.g. switching to foods perceived to be safer and of higher-quality (Chen, 2016). As such, it is assumed:

H1: The higher the perceived risk of a non-traced food product, the higher purchase intention for the corresponding traced product.

The perceived benefits of traced food “pull” consumers to choose traced food, in particular when comparing it with non-traced food (Loureiro & Umberger, 2007; Nie & Luo, 2019; Wang & Tsai, 2019). These benefits can be associated to improved food safety and quality as well as lower environmental impacts (Dang & Tran, 2021). Another pull effect may relate to the greater ease of accessing and understanding the traced information for consumers (termed as “*perceived ease of use”* in the TAM), as extra cognitive effort is not needed to change choices (Kim & Woo, 2016; Lin & Kuo, 2020; Tseng et al., 2022), thereby increasing perceived benefits and acceptance of traced food (Kim & Woo, 2016). Thus, it is assumed:

H2: Consumers' perceived benefits associated with tracing a food product positively affect their attitudes towards ***(a)****, and intention to buy, the traced product* ***(b)****.*

H3: Greater perceived ease of accessing and understanding information linked to a traced food product positively affects perceived product benefits.

H4: Greater perceived ease of accessing and understanding the traced information linked to traced food product positively affects attitudes towards ***(a)****, and intention to buy* ***(b)****, the product.*

2.3 Mooring effect

Personal or social factors act to maintain existing food choices or facilitate "switching" to new alternatives (the mooring effect). For example, Lin and Wu (2021) reported that consumer attitudes towards traced food influenced their purchase intentions. Passive attitudinal components (i.e. attitude towards a particular product or service) can predict active components of consumer acceptance (i.e. intention to use a particular product or service) (Dickinger, Arami, & Meyer, 2008; Lee, Cheung, & Chen, 2005; Teo & Noyes, 2011). Thus, it is assumed:

H5: More positive attitudes towards a traced food product increase intention to purchase the product.

Costs incurred by changing or switching have also been regarded as an important mooring effect associated with consumers' behaviours (Bansal, 2005). In the context of traced food, the potential price increase (i.e. "premium" for traced food) compared to the corresponding non-traced product may occur due to establishing and operating traceability systems (Klemperer, 1987; Murray & Häubl, 2007). There is evidence that consumers' perceived premium in relation to price discourages their choice of sustainably produced or organic food compared to conventionally produced alternatives (Gan, Wee, Ozanne, & Kao, 2008; Smith, Huang, & Lin, 2009). However, higher price has also been reported to be positive predictor of consumer perceptions of product or service quality (Rao, 2005; Zhou et al., 2002), including in relation to food product choices (Gundala & Singh, 2021; Wang, Gao, Heng, & Shi, 2019). Here, it is assumed:

H6: Perceptions of perceived price premium associated with a traced food product affects consumer attitudes towards ***(a)****, and intention to buy* ***(b)****, the product, either positively or negatively.*

Some consumers (e.g. those who are more affluent) may perceive premium priced foods to be affordable. In this context, the greater the perceived affordability of a food product, the more positive are consumers' attitudes and purchase intentions (Bihan et al., 2010; Smith et al., 2009; Voon et al., 2011). Thus, we assume:

*H7: The perceived affordability of a traced food product positively affects consumers' attitudes towards **(a)**, and intention to buy **(b)**, the product.*

Based on the conceptual model of food choice process, consumers' past experience can affect their current food decision-making (Conner & Armitage, 2002; Devine, Connors, Bisogni, & Sobal, 1998; Furst et al., 1996). As some traced foods are available on the Chinese and UK markets at the time of collection, consumers might have been exposed to information about, or had purchase experience of, traced foods (Food Standards Agency, 2019; Liu, Gao, Nayga, Snell, & Ma, 2019), catalysing attitude formation towards traced food in general. It is assumed that:

*H8: A positive existing attitude towards traced food in general maintains positive effects on consumers' perceived benefits of **(a)**, attitudes towards **(b)**, and intention to buy **(c)**, specific traced food products.*

Based on the above hypotheses, a framework that explains consumers' acceptance of traced foods has been developed (Fig.1).

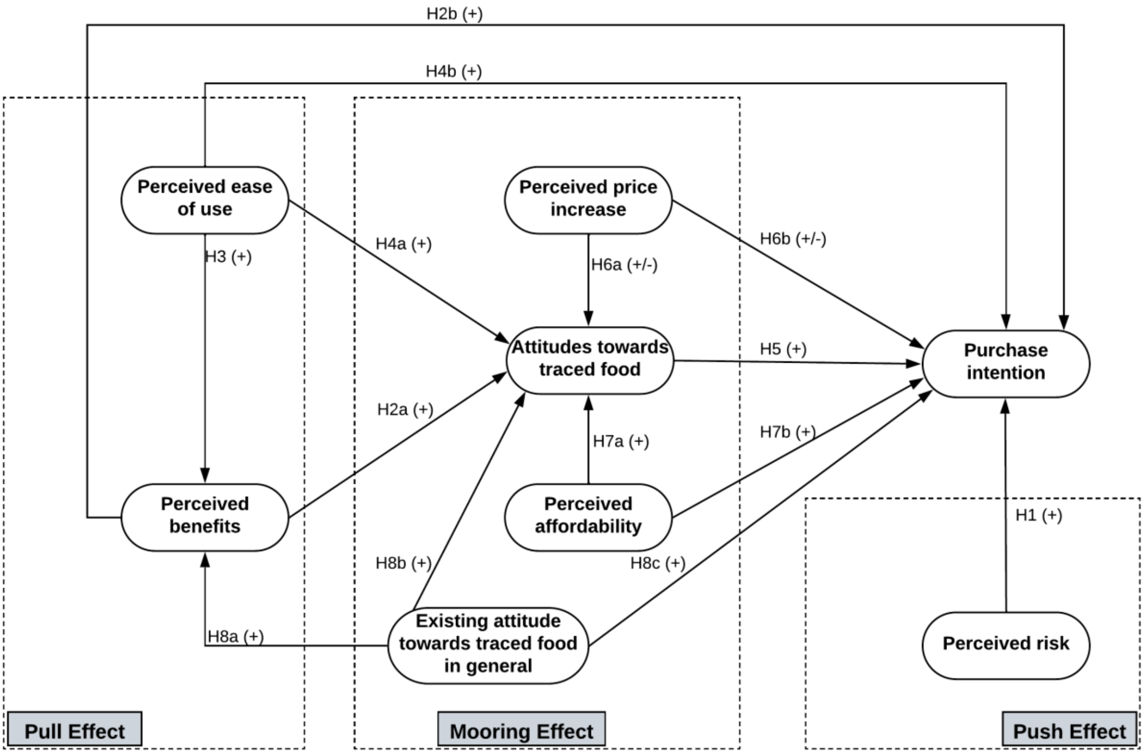

Figure 1. Framework of explaining consumer acceptance of traced foods

Note: The direction of the hypothetical relationship is specified in parentheses.

3 METHODOLOGY

3.1 Selection of food categories

Apple, milk and beef were selected to cover different food categories (fruit, dairy and meat products) that are widely consumed in both in both China and the UK. Milk and beef production can cause relatively higher negative impacts on the environment compared with apple production in both countries (Ritchie & Roser, 2022). Differences exist between China and the UK in terms of *per capita* consumption, and historical food safety incidents, which might evoke different levels of consumer risk perceptions.

3.1.1 Apples

Apples are consumed in China to a greater extent compared to the UK (22.35 *versus* 13.31 kilograms *per capita* per year) (FAO, 2019). There have been few food safety issues associated with apple production over and above those associated with fruit production in general, for example consumer concerns about pesticides used in production which may pose negative impacts on the environment and human health (Boccaletti & Nardella, 2000).

3.1.2 Milk

Milk represents an important food category in both China and the UK, while the *per capita* consumption of milk in China is far lower than in the UK (23.3 *versus* 209.96 kilograms per year) (Ritchie et al., 2019). However, one of the most infamous food safety incidents in recent times involving the adulteration of milk with Melamine emerged in China as a documented national food incident in 2008. Melamine (or tripolycyanamide) is an industrial chemical in the production of melamine resins, which are used in laminates, glues, adhesives, and plastics. When added to milk, melamine increases the nitrogen content, which suggests a false increase in protein concentration (Chan et al., 2008). The contaminated milk entered the supply chain for infant formula, which resulted in ill health and mortality in children. Other risks have resulted in human health problems associated with fraudulent and accidental issues within the Chines dairy sector (Wu et al., 2018). Consumer risk perceptions and concerns about milk are, as a consequence, at a high level in China (Li et al., 2021).

3.1.3 Beef

Beef consumption ranks number three on terms of consumption in both China and the UK, in which poultry and pork meat dominates the national meat menu. UK beef *per capita* consumption, however, is higher than China (11 *versus* 4 kilograms per year), although the growth of beef consumption in China is expected to continue (Grimmelt et al., 2023; OECD, 2023). Beef was associated with the BSE scandal (which represented a threat to human health). This was widely reported when the link between BSE (the bovine form of the disease) and new variant Creutzfeldt-Jakob disease (nvCJD) (the human form) was announced in 1996 (Frewer & Salter, 2002). Although BSE and nvCJD were identified in other countries, human and animal mortality, and regulatory impact were comparatively most intense in the UK (Budka et al., 2008). Concerns about UK meat production in general, including in relation to beef, were subsequently amplified by the UK Foot and Mouth crisis in 2001, which resulted in the mass culling of cattle and other animals (Poortinga et al., 2004); and the Horsemeat scandal in 2013, where horsemeat was found in the UK beef supply chain in order to promote fraudulent economic interests (Barnett et al., 2016; Regan et al., 2015). Together, these incidents provided a signal to consumers that the UK beef supply chain was vulnerable to food fraud, despite earlier food safety threats, and that the regulatory processes designed to protect consumers were not effective in relation to consumer protection.

3.2 Procedure

A survey instrument was developed in English, translated into Chinese and then back-translated into English by a member (SJ) of the project team. The survey design was informed by the existing consumer food-related attitude and behaviour literature (see e.g. Grunert et al., 2014; Magnusson et al., 2001, 2003; Michaelidou & Hassan, 2008; Singh & Kathuria, 2016), and used adapted versions of previously validated measurement scales to make it specific to the context of traced food. The final survey included items measuring respondents' perceived risks of the non-traced foods, existing attitudes towards traced food in general, perceptions of, attitudes towards and purchase intentions of the corresponding traced foods. Detailed origins of the items are listed in Supplementary Material Table A. The respondents were asked to rate different statements on five-point Likert scales (1 = "strongly disagree" to 5 = "strongly agree"). Online food shopping and socio-demographic information (i.e. gender, age, educational level and annual household income) were also recorded in the surveys (see Table A in Supplementary Material). The only difference between UK and Chinese surveys related to the design of their annual household income due to the difference average income between the two countries. Ethical approval for the research was granted by the lead author's university ethics committee in December 2019 (Ref: 18226/2019).

The English and Chinese surveys were piloted using 50 UK and 50 Chinese consumers. Based on the feedback, the surveys were adjusted to ensure the relevance of questions to consumers in both countries while ensuring the two surveys were identical in content. The measurement invariance (configural and compositional invariance considered here) of constructs between the two countries was established using SmartPLS software (Henseler et al., 2016) (Supplementary Material Table B). The reliability and validity of the constructs were also assessed for both Chinese and UK data (Supplementary Material Table D).

3.3 Sampling and Participants

The English and Chinese surveys were administered online by a survey company (Qualtrics LLC) from January to March 2022 to 2,000 UK and 2,000 Chinese consumers, quota sampled on the basis of sex, age and education. After eliminating surveys where respondents provided inconsistent data or failed to complete the surveys, 1,656 British responses and 1,515 Chinese responses remained. UK respondents had a mean age of 46.28 (SD = 16.00), with female respondents accounting for 51.1%. Of the UK respondents, 40.7% received tertiary education. This approximates the population characteristics identified in the 2011 UK Census (Office for National Statistics, 2013) and mid-2020 population estimates (Office for National Statistics, 2021). Chinese respondents had a mean age of 41.21 (*SD* = 14.82). Female respondents accounted for 47.1% of the sample. Of the Chinese respondents, 18.5% had received tertiary education, which approximates the population characteristics identified in the 2020 Chinese Census (National Bureau of Statistics of China, 2021). Socio-demographic information of respondents is provided in Table 1.

Table 1. Sample characteristics and Kruskal-Wallis *H* Test results associated with the comparison of purchase intentions

(a) UK

	n (%)	Traced Apples			Traced Milk			Traced Beef		
		Mean Rank	*t* values (df)	*p*	Mean Rank	*t* values (df)	*p*	Mean Rank	*t* values (df)	*p*
Food shopping										
Non-online	1,133 (68.4%)	798.21	3.853 (1)	< 0.001	804.13	3.104 (1)	< 0.01	801.13	3.482 (1)	< 0.001
Online	523 (31.6%)	894.11			881.3			887.78		
Sex										
Male	807 (48.7%)	839.27	0.836 (2)	0.659	826.52	0.063 (2)	0.969	838.82	0.825 (2)	0.662
Female	846 (51.1%)	818.16			830.2			818.94		
Prefer not to say	3 (0.2%)	847.5			881.33			747.83		
Age group										
18-24 years	182 (11%)	727.12	16.126 (4)	< 0.01	716.61	16.59 (4)	< 0.01	730.57	10.698 (4)	< 0.05
25-34 years	277 (16.7%)	840.05			830.07			854.31		
35-44 years	293 (17.7%)	902.84			894.56			866.07		
45-54 years	335 (20.2%)	822.63			843.62			835.19		
Over 54 years	569 (34.4%)	820.49			820.6			823.98		
Education level										
Upper-secondary education or less	982 (59.3%)	775.09	34.957 (2)	< 0.001	782.69	26.289 (2)	< 0.001	792.6	14.776 (2)	< 0.01
Undergraduate degree or diploma	525 (31.7%)	887.2			877.43			872.49		
Postgraduate	149 (9%)	973.65			957.99			910.09		
Annual household income (GBP)										
Less than 25,000	490 (29.6%)	751.76	23.491 (5)	< 0.001	756.32	28.546 (5)	< 0.001	717.08	51.529 (5)	< 0.001
25,000-34,999	318 (19.2%)	834.03			806.22			838.29		
35,000–44,999	281 (17%)	836.17			836.29			854.84		
45,000–54,999	208 (12.6%)	915.01			865.43			858.05		
55,000–64,999	135 (8.2%)	887.84			879.3			869.05		

Over 64,999	224 (13.5%)	862.79			943.35			973.42		

(b) China

China	n (%)	Traced Apples			Traced Milk			Traced Beef		
		Mean Rank	*t* values (df)	*p*	Mean Rank	*t* values (df)	*p*	Mean Rank	*t* values (df)	*p*
Food shopping										
Non-online	415 (27.4%)	640.51	6.563 (1)	< 0.001	645.54	6.285 (1)	< 0.01	665.53	5.18 (1)	< 0.001
Online	1,100 (72.6%)	802.33			800.43			792.89		
Sex										
Male	801 (52.9%)	803.48	19.305 (2)	< 0.001	783.51	6.079 (2)	< 0.05	788.16	9.747 (2)	< 0.01
Female	713 (47.1%)	706.77			729.27			723.49		
Prefer not to say	1 (0.1%)	852.5			808.5			1202.5		
Age group										
18-24 years	247 (16.3%)	713.28	46.389 (4)	< 0.001	727.86	74.745 (4)	< 0.001	748.41	50.241 (4)	< 0.001
25-34 years	324 (21.4%)	853.04			898.43			870.87		
35-44 years	309 (20.4%)	811.19			816.15			783.31		
45-54 years	264 (17.4%)	769.86			718.55			758.7		
Over 54 years	371 (24.5%)	652.03			635.06			644.24		
Education level										
Upper-secondary education or less	1,235 (81.5%)	749.8	5.686 (2)	0.058	740.15	17.401 (2)	< 0.001	744.62	8.97 (2)	< 0.05
Undergraduate degree or diploma	263 (17.4%)	782.47			821.14			806.94		
Postgraduate	17 (1.1%)	975.09			1078.12			972.59		
Annual household income (CNY)										
less than 65,000	159 (10.5%)	571.44	38.293 (4)	< 0.001	573.36	34.334 (4)	< 0.001	584.68	30.323 (4)	< 0.001
6,5000–74,999	122 (8.1%)	720.8			753.19			756.68		
7,5000–84,999	171 (11.3%)	743.04			760.21			784.16		
8,5000–94,999	352 (23.2%)	795.16			794.1			795.02		

Over 94,999	711 (46.9%)	791.3	781.71	772.36

3.4 Data analyses

3.4.1 Comparison of consumer responses

Descriptive analyses were undertaken to provide an overall picture of UK and Chinese respondents' risk perceptions of three selected foods and their reactions to corresponding traced foods. Friedman tests were used to test for significant differences in respondents' purchase intentions across different types of traced food. Welch's unequal variances *t*-test was used to test if there were significant differences between UK and Chinese respondents regarding their intentions to purchase each traced food category. Kruskal-Wallis *H* Test was used to test if there were significant differences in purchase intentions across socio-demographic groups. Non-parametric tests were chosen primarily because the data violated normality and sample sizes differed between some groups (Delacre et al., 2017; Fagerland & Sandvik, 2009; Lantz, 2013). These analyses were undertaken using IBM SPSS Statistics Version 24.

3.4.2 Partial Least Squares-Structural Equation Modelling

This research aims to explore the extent to which a proposed model can explain UK and Chinese consumers' acceptance of traced foods. The exploratory approach has made partial least squares-structural equation modelling (PLS-SEM) a suitable methodology for the analysis (Reinartz et al., 2009). SmartPLS software was used for modelling (Ringle et al., 2015). PLS-SEM has been used to extend established theories to understand consumers' novel technology adoption across countries (Albertsen, Wiedmann, & Schmidt, 2020; Fernandes & Oliveira, 2021; Yan, Filieri, Raguseo, & Gorton, 2021).

To ensure the reliability and validity of the reflective measurement models, different criteria were met, including the internal consistency reliability (Cronbach's alpha $\alpha > 0.65$ and composite reliability $\rho > 0.7$), the indicator reliability (retaining indicators with loadings > 0.65), the convergent validity (values of average variance extracted (AVE) > 0.5) and the discriminant validity (a) an indicator's outer loadings on a construct being higher than its outer loadings with other constructs; b) Fornell-Larcker Criterion; and c) the heterotrait-monotrait ratio (HTMT) < 0.9) (Hair et al., 2017). The formative measurement models were validated by ensuring no collinearity (the outer variance-inflation-factor (VIF) values < 5) and the significance and relevance of indicators (retaining indicators with a significant outer weight (i.e. $p < 0.05$) or with an insignificant outer weight but an outer loading above 0.5) (Hair et al., 2017).

The structural models were validated by ensuring no collinearity between constructs (the inner VIF values < 5); the significance and relevance of model relationships (p < 0.05 for ensuring significance and *t* values for comparing the relevance); satisfactory coefficients of determination using the R^2 values (to be compared with the R^2 values in previous research); acceptable f^2 effect size (the values of 0.02, 0.15 and 0.35 represent a small, medium and large effect, respectively); the predictive relevance (Stone-Geisser's Q^2 value > 0); and good model fit (the standardised root mean square residual (SRMR) < 0.08) (Hair et al., 2017; Henseler et al., 2014; Hu & Bentler, 1998; Rigdon, 2012; Stone, 1974).

4 RESULTS

4.1 Perceptions of non-traced and traced food

Of the different food categories, non-traced beef was perceived to involve the highest risk and non-traced apples were perceived to be associated with the lowest risk by both Chinese and UK respondents (Table 2). The Chinese respondents perceived higher levels of risk associated with non-traced apples, milk and beef compared to the UK respondents (Table 2). Mann-Whitney U tests indicated that there were significant differences between Chinese and UK respondents' perceived risk for all food categories (U = 692394.5, $p < 0.001$ for apples; U = 702113, $p < 0.001$ for milk; U = 847032, $p < 0.001$ for beef). Friedman tests indicated statistically significant differences in Chinese respondents' levels of perceived risk associated with three non-traced foods ($\chi^2(2) = 79.315$, $p < 0.001$) and in UK respondents' perceived risk ($\chi^2(2) = 391.479$, $p < 0.001$). *Post hoc* analysis with Wilcoxon signed-rank tests indicated that both Chinese and UK respondents perceived non-traced beef to involve significantly higher risk than apples ($Z = -9.368$, $p < 0.001$ for China; $Z = -17.819$, $p < 0.001$ for the UK) and milk ($Z = -4.04$, $p < 0.001$ for China; $Z = -15.342$, $p < 0.001$ for the UK), and non-traced milk significantly higher than apples ($Z = -6.987$, $p < 0.001$ for China; $Z = -6.183$, $p < 0.001$ for the UK).

In terms of traced food in general, the Chinese respondents held more positive attitudes than the UK respondents at the time of survey (Table 2). The Mann-Whitney U test showed that there was a significant difference between Chinese and UK respondents (U = 928920, $p < 0.001$). Concerning the three traced food categories, both Chinese and UK respondents had relatively positive purchase intentions. However, the Chinese respondents expressed higher perceived benefits, ease of accessing and understanding information associated with traceability and affordability for traced foods, and more positive attitudes and greater purchase intentions (Table 2). Mann-Whitney U tests showed that there were significant differences between Chinese and UK respondents' purchase intentions for all food categories (U = 603657.5, $p < 0.001$ for apples; U = 617370.5, $p < 0.001$ for milk; U = 660699, $p < 0.001$ for beef).

Despite beef traceability being perceived to be associated with higher prices and lower affordability compared to apples and milk, the UK respondents reported the greatest purchase intention for traced beef and the lowest purchase intention for traced apples (Table 2). Friedman tests were conducted to compare the UK respondents' purchase intentions of three traced foods, which showed significant differences across food types ($\chi^2(2) = 30.849$, $p < 0.001$). *Post hoc* analysis with Wilcoxon signed-rank tests indicated significant differences in purchase intentions between apples and milk ($Z = -2.148$, $p < 0.05$); between apples and beef ($Z = -4.994$, $p < 0.001$); and between milk and beef ($Z = -3.342$, $p < 0.01$). The Chinese respondents' purchase intentions for traced milk and beef were slightly higher than for traced apples. Wilcoxon signed-rank tests indicated significant differences in purchase intentions between apples and milk ($Z = -2.890$, $p < 0.01$); between apples and beef ($Z = -3.05$, $p < 0.01$); and no significant difference between milk and beef.

Table 2. Respondents' responses associated with selected foods

Constructs	**Apples**				**Milk**				**Beef**			
	UK		**China**		**UK**		**China**		**UK**		**China**	
	Mean	***SD***	**Mean**	***SD***	**Mean**	***SD***	**Mean**	***SD***	**Mean**	***SD***	**Mean**	***SD***
Perceived risk associated with non-traced food	2.70	0.94	3.50	0.99	2.86	0.10	3.62	0.95	3.18	0.98	3.68	0.93
Perceived benefits of traced food	3.58	0.77	4.04	0.56	3.60	0.79	4.07	0.55	3.69	0.78	4.09	0.54
Perceived ease of accessing and understanding traced information	3.28	0.77	3.99	0.61	3.38	0.80	4.03	0.62	3.39	0.84	4.05	0.61
Attitudes towards traced food	3.66	0.74	4.13	0.55	3.70	0.79	4.18	0.54	3.81	0.80	4.18	0.55
Perceived price increase	3.66	0.89	3.97	0.91	3.74	0.89	3.97	0.87	3.85	0.89	4.02	0.85
Perceived affordability	3.39	0.94	4.13	0.75	3.48	0.98	4.16	0.72	3.34	1.03	4.12	0.76
Purchase intention	3.46	0.84	4.16	0.56	3.49	0.87	4.19	0.56	3.54	0.86	4.19	0.57

4.2 Socio-demographic predictors of purchase intentions

In order to better identify segments of consumers who are potentially more supportive of traced food, the influences of online food shopping and socio-demographic attributes on respondents' purchase intentions were investigated using Kruskal-Wallis *H* Test (Table 1). The results showed significant differences in purchase intentions between those with and without online food shopping experience, as well as between at least one pair of subgroups (e.g. associated with age, education and household annual income) for both UK and Chinese respondents and across three types of foods. Post hoc tests (Dunn's pairwise tests) were then used to compare every two subgroups (see Table C in Supplementary Material). The main findings are provided in Table 3.

Table 3. Socio-economic predictors of purchase intention

Individual attributes	UK	China	Comparison by country
Online food shopping experience	31.6% of the respondents shopped online for food. These respondents had significantly greater intentions to purchase traced foods than those without online food shopping experience.	72.6% of the respondents shopped online for food had significantly greater intention to purchase traced food than those without online food shopping experience.	No obvious difference was observed.
Gender	No significant difference in purchase intention was identified between genders.	Male respondents had significantly greater intentions to purchase traced foods than female respondents.	Significant difference in purchase intention between genders was observed only for Chinese respondents, with male respondents expressing higher purchase intentions.
Age	The 18-24 age group had significantly weaker intentions to purchase traced foods compared to the other age groups. The 35-44 age group had a greater intention to purchase traced foods compared to the 18-24, 45-54 and over 54 age groups for apples; the18-24 and over 54 age groups for milk; and the18-24 age group for beef.	The 25-34 age group had significantly greater intentions to purchase traced foods compared to the other age groups (with the exception of the 35-44 age group regarding apples). The over 55 age group had significantly lower intentions to purchase traced foods compared to the other age groups (except to the 18-24 age group regarding the purchase intention for traced apples).	Of the UK respondents, the 18-24 age group had the lowest purchase intention, while the 35-44 age group had the highest purchase intention. In contrast, of the Chinese respondents, the over 54 age group had the lowest and the 25-34 age group had the highest purchase intention.
Educational levels	Respondents with tertiary education had significantly stronger intention to purchase traced foods compared to respondents in the other educational group.	Respondents with tertiary education had significantly stronger intention to purchase traced milk and beef compared to respondents in the other educational group. No significant difference in purchase intention of traced apples was identified between educational levels.	Among the UK and Chinese respondents, those with tertiary education had higher purchase intention for all three food products, except in the case of apples for Chinese respondents.
Annual household income	Respondents with annual household income lower than 25,000 GBP exhibited significantly weaker intentions to purchase traced foods than the other income groups (with the exception of the 25,000-34,999 GBP group regarding purchase intention of traced milk). Those with annual household income over 64,999 GBP had significantly stronger purchase intentions for traced milk compared to those lower than 45,000 GBP, and had stronger purchase intention of traced beef than the other income groups.	Respondents with annual household income lower than 65,000 CNY had significantly lower intentions to purchase traced foods compared to the other income groups,	Respondents with lower annual household income had lower intention to purchase traced food both in the UK and China. However, UK respondents with relatively higher annual household income (over 64,999 GBP) were more likely to buy traced milk and beef.

4.3 Results of PLS-SEM

4.3.1 Evaluations of the model

All reliability and validity criteria were met for the measurement models for each traced food for both UK and Chinese respondents (see Table D-H in Supplementary Material). The values of SRMR were all smaller than 0.08, indicating a good model fit across traced foods. All the variance inflation factor (VIF) values were smaller than 5, indicating there were no critical collinearity problems between the assessed constructs. The R^2 values for the intention to purchase traced foods ranged from 0.567 to 0.604 for UK respondents and from 0.511 to 0.521 for Chinese respondents. Compared to existing studies into purchase intention of traced food (Buaprommee & Polyorat, 2016; Dang & Tran, 2020; Spence et al., 2018; Yuan et al., 2020), the model had a satisfactory level for explaining both UK and Chinese respondents' purchase intentions. Stone-Geisser's Q^2 values were larger than 0, representing satisfactory predictive relevance (Stone, 1974).

Standardised values of path coefficients β, the respective *t*-values, 95% confidence intervals and f^2 were also obtained (see Table 4). Here, the t value > 1.96 (two-tailed tests, significance level = 10%) and p-value < 0.05 represent a significant correlation between two variables. Hypothesis 6a was rejected regarding UK respondents, indicating perceived price increase associated with traced foods had no significant impact on attitudes. Hypothesis 6a was rejected regarding Chinese respondents' attitudes to traced apples, which means price increase had no significant impact on Chinese respondents' attitudes towards traced apples. Hypothesis 4a was rejected regrading UK respondents' responses to apples, indicating perceived ease of accessing and understanding information about traced apples had no significant impact on UK respondents' related attitudes. All the other hypotheses were supported.

4.3.2 Modelling results

The results of PLS-SEM showed different impacts of the factors on consumers' purchase intentions of traced foods (Table 4). In order to better compare the total power of factors that could explain respondents' intentions to buy different traced foods, effect size f^2 was selected as a suitable indicator (Hair et al., 2017), where the values of 0.02, 0.15 and 0.35 represent a small, medium and large effect, respectively (Cohen, 1988). Of those factors included in the models to predict purchase intentions, some factors could interact with each other. The analyses suggested that four major themes could be elicited, together with the relevant modelling results from both countries. Table 5 summarises the findings included in Table 4.

Table 4. Estimation results of the model across traced foods

(a) UK

Hypotheses		Traced Apples				Traced Milk				Traced Beef			
		β	*t* values	f^2	95% CI	β	*t* values	f^2	95% CI	β	*t* values	f^2	95% CI
H1	PR -> PI	0.115***	6.014	0.027	[0.084, 0.147]	0.091***	5.496	0.018	[0.065, 0.118]	0.101***	5.184	0.021	[0.069, 0.134]
H2a	PB -> AtTF	0.636***	29.185	0.799	[0.599, 0.671]	0.669***	34.653	0.873	[0.636, 0.700]	0.649***	28.701	0.783	[0.611, 0.685]
H2b	PB -> PI	0.150***	4.067	0.017	[0.090, 0.212]	0.183***	5.294	0.026	[0.128, 0.242]	0.114***	3.259	0.009	[0.057, 0.172]
H3	PEoU -> PB	0.370***	15.131	0.202	[0.330, 0.410]	0.431***	17.894	0.266	[0.393, 0.471]	0.394***	15.651	0.227	[0.351, 0.434]
H4a	PEoU -> AtTF	0.015^{ns}	0.798	0.001	[-0.016, 0.047]	0.046*	2.564	0.005	[0.017, 0.075]	0.044**	2.435	0.004	[0.014, 0.074]
H4b	PEoU -> PI	0.115***	5.203	0.021	[0.079, 0.152]	0.137***	6.090	0.030	[0.100, 0.174]	0.134***	5.650	0.026	[0.094, 0.173]
H5	AtTF -> PI	0.376***	10.378	0.098	[0.316, 0.435]	0.369***	10.856	0.099	[0.312, 0.423]	0.389***	11.572	0.104	[0.334, 0.444]
H6a	PPI -> AtTF	-0.025^{ns}	1.579	0.002	[-0.052, 0.001]	-0.006^{ns}	0.343	0.000	[-0.033, 0.022]	0.022^{ns}	1.242	0.001	[-0.007, 0.052]
H6b	PPI -> PI	-0.059***	3.306	0.007	[-0.089, -0.030]	-0.040*	2.109	0.003	[-0.070, -0.009]	-0.045*	2.121	0.004	[-0.079, -0.010]
H7a	PA -> AtTF	0.098***	5.495	0.025	[0.069, 0.128]	0.057***	3.265	0.008	[0.028, 0.085]	0.029*	1.862	0.002	[0.003, 0.055]
H7b	PA -> PI	0.173***	8.314	0.054	[0.138, 0.206]	0.183***	8.446	0.064	[0.147, 0.218]	0.253***	10.763	0.114	[0.214, 0.292]
H8a	GA -> PB	0.397***	16.242	0.233	[0.356, 0.436]	0.314***	12.529	0.141	[0.273, 0.356]	0.374***	15.129	0.206	[0.334, 0.415]
H8b	GA -> AtTF	0.255***	11.867	0.156	[0.227, 0.299]	0.220***	12.211	0.133	[0.191, 0.250]	0.238***	11.242	0.141	[0.204, 0.274]
H8c	GA -> PI	0.107***	4.318	0.016	[0.066, 0.147]	0.082***	3.664	0.009	[0.044, 0.118]	0.053*	2.301	0.004	[0.016, 0.092]

(b) China

Hypotheses		Traced Apples				Traced Milk				Traced Beef			
		β	*t* values	f^2	95% CI	β	*t* values	f^2	95% CI	β	*t* values	f^2	95% CI
H1	PR -> PI	0.059***	3.164	0.012	[0.029, 0.091]	0.034*	1.667	0.003	[0.001, 0.067]	0.071***	3.607	0.010	[0.041, 0.102]
H2a	PB -> AtTF	0.453***	15.222	0.269	[0.404, 0.502]	0.494***	16.997	0.341	[0.445, 0.542]	0.520***	20.093	0.382	[0.477, 0.562]
H2b	PB -> PI	0.111***	3.316	0.013	[0.056, 0.166]	0.086**	2.641	0.007	[0.034, 0.139]	0.096**	3.212	0.009	[0.048, 0.144]

H3	PEoU -> PB	0.352***	12.968	0.157	[0.308, 0.397]	0.338***	11.266	0.144	[0.289, 0.388]	0.367***	13.677	0.174	[0.322, 0.410]
H4a	PEoU -> AtTF	0.123***	4.611	0.021	[0.080, 0.168]	0.108***	3.954	0.018	[0.064, 0.154]	0.101***	4.166	0.016	[0.062, 0.142]
H4b	PEoU -> PI	0.170***	6.213	0.038	[0.125, 0.215]	0.244***	8.716	0.083	[0.198, 0.292]	0.281***	10.509	0.108	[0.237, 0.323]
H5	AtTF -> PI	0.215***	6.742	0.047	[0.162, 0.268]	0.202***	6.308	0.039	[0.149, 0.254]	0.168***	5.216	0.026	[0.117, 0.222]
H6a	PPI -> AtTF	0.007^{ns}	0.349	0.000	[-0.027, 0.042]	0.055**	2.709	0.006	[0.022, 0.089]	0.068***	3.279	0.010	[0.035, 0.103]
H6b	PPI -> PI	0.083***	3.931	0.012	[0.048, 0.117]	0.034*	1.667	0.002	[0.001, 0.067]	0.033*	1.624	0.002	[0.001, 0.068]
H7a	PA -> AtTF	0.119***	5.140	0.023	[0.079, 0.155]	0.059**	2.502	0.006	[0.020, 0.097]	0.052**	2.552	0.005	[0.018, 0.086]
H7b	PA -> PI	0.241***	9.956	0.093	[0.201, 0.280]	0.226***	8.938	0.085	[0.184, 0.267]	0.258***	10.113	0.114	[0.217, 0.299]
H8a	GA -> PB	0.341***	11.226	0.148	[0.291, 0.391]	0.359***	12.560	0.163	[0.313, 0.406]	0.347***	12.110	0.156	[0.301, 0.395]
H8b	GA -> AtTF	0.205***	7.738	0.062	[0.161, 0.250]	0.216***	8.255	0.069	[0.173, 0.259]	0.207***	8.001	0.068	[0.164, 0.249]
H8c	GA -> PI	0.171***	5.662	0.041	[0.122, 0.223]	0.185***	6.891	0.046	[0.141, 0.230]	0.133***	5.001	0.024	[0.089, 0.177]

Note: $*p < 0.05$; $**p < 0.01$; $***p < 0.001$; β = path coefficients; 95% CI = 95% confidence interval; ns = non-significance; PB = perceived benefits of traced food; PEoU = perceived ease of use; AtTF = attitude towards traced food; GA = existing attitudes towards traced food in general; PPI = perceived price increase; PA = perceived affordability; PR = perceived risk of non-traced food; PI = purchase intention.

Table 5. Summary of modelling results

Themes	**UK Respondents**	**Chinese Respondents**	**Summary**
Explanatory power of the model	The R^2 values indicate that the proposed model can explain 56.7%, 60.4% and 57.3% of the variance of UK respondents' intention to purchase traced apples, milk and beef.	The R^2 values indicate that the proposed model can explain 51.1%, 52.1% and 52.1% of the variance of Chinese respondents' intention to purchase traced apples, milk and beef.	The proposed model consistently showed satisfactory explanatory power across traced food categories and countries. The explanatory power is slightly higher for the UK context compared to the Chinese context.
Factors affecting purchase intention	All the candidate factors had significant impacts on UK respondents' intention to purchase traced food. The respondents' attitudes towards the traced foods and perceived affordability had greater positive impacts on their purchase intentions compared to the other factors (based on the values of f^2 in Table 4).	All the candidate factors had significant impacts on Chinese respondents' purchase. The respondents' perceived affordability had the biggest positive impacts on their purchase intentions across the traced foods. Their perceived ease of accessing and understanding the traced information had relatively greater positive impacts on purchase intentions for the traced milk (f^2 = 0.083) and beef (f^2 = 0.108).	Despite all the candidate factors having significant impacts on both UK and Chinese respondents' purchase intention across traced food categories, none of these factors showed medium and large impacts (all the relevant f^2 smaller than 0.15). Also, there was difference between two countries regarding the influence of factors on purchase intention.

	The perceived risk of non-traced food, perceived benefits of traced food, and perceived ease of accessing and understanding traced information had relatively small positive impacts on UK respondents' intentions to buy all of the three traced foods. The respondents' existing attitudes towards traced food in general also had positive impacts on their intention to buy the three traced foods, despite being smaller impacts. The perceived price increase had negative impacts across all three traced foods, despite being the smallest impacts.	The respondents' existing attitudes towards food traced food in general and attitudes towards the three traced foods had relatively small positive impacts on purchase intentions. The positive impacts of perceived risk, perceived benefits of traced foods, and perceived price increase on purchase intentions were limited.	The impacts of factors on purchase intentions differed between two countries by comparing the values of f^2 in Table 4. In particular, the perceived price increase was a negative predictor of UK respondents' purchase intentions for all the three traced foods, but a positive predictor for the Chinese respondents.
	UK respondents' perceived affordability had a greater positive impact on the purchase intention of the traced beef compared to the traced apples and milk. Their existing attitudes towards traced food in general had a bigger positive impact on their purchase intention of the traced apples than of the traced milk and beef.	For Chinese respondents, the perceived ease of accessing and understanding traced information had bigger impacts on the intention to buy the traced milk and beef compared to the traced apples.	The impacts of some factors on purchase intentions varied by the types of traced foods, such as perceived affordability and existing attitudes towards traced food in general for UK respondents and perceived ease of accessing and understanding traced information for Chinese respondents.
Interrelationships between different factors	UK respondents' attitudes towards specific traced foods were affected by their existing attitudes towards traced food in general, and perceived ease of accessing and understanding traced information (except for apples), benefits and affordability associated with the specific traced foods. No significant impact was found for the perceived price increase. The power of the respondents' existing attitudes towards traced food in general, perceived ease of accessing and understanding traced information of specific foods and perceived benefits of specific traced foods in predicting attitudes towards specific traced foods was relatively stable across food categories, with the first factor all having medium impacts and the latter factor having large impacts. Perceived affordability had greater predictive power for traced apples than milk and beef.	Chinese respondents' attitudes towards specific traced foods were affected by their existing attitudes towards traced food in general, and perceived ease of accessing and understanding traced information, benefits, price increase (except for apples) and affordability associated with the specific traced foods. The power of the respondents' existing attitudes towards traced food in general, perceived ease of accessing and understanding traced information and perceived benefits associated with the specific traced foods in predicting attitudes towards specific traced foods was relatively stable across food categories, with the latter two factors all showing medium impacts. Perceived affordability had greater predictive power for traced apples than milk and beef. Perceived price increase was positive predictors for traced milk and beef, despite having very small effects.	Existing general attitudes and perceived benefits were more influential among UK respondents, and the perceived ease of accessing and understanding traced information more influential among Chinese respondents. Perceived affordability had greater predictive power for traced apples than milk and beef for both UK and Chinese respondents. Perceived price increase was a predictor of UK respondents' attitudes, but tended to be a positive predictor for Chinese respondents.

	The UK respondents’ existing attitudes towards traced food in general and perceived ease of accessing and understanding traced information of specific foods both had medium positive impacts on their perceived benefits of the specific traced foods.	The Chinese respondents’ existing attitudes towards traced food in general and perceived ease of accessing and understanding traced information of specific foods both had medium positive impacts on their perceived benefits of the specific traced foods.	The impacts of the respondents’ existing attitudes towards traced food in general and perceived ease of accessing and understanding traced information of specific foods on their perceived benefits of the specific traced foods were similar across food categories and countries.
Perceptions associated with environmental issues	UK respondents perceived higher risk associated with negative environmental impacts caused by food production than food safety- and quality-related issues. Milk (Mean = 3.13, *SD* = 1.13) and beef production (Mean = 3.41, *SD* = 1.13) related to higher environmental risk than apple production (Mean = 2.77, *SD* = 1.06). However, the perceived environment-related benefit (indicator loadings ranging from 0.228 to 0.261) contributes less to the respondents’ overall benefit perceptions compared to the food safety- (indicator loadings ranging from 0.493 to 0.547) and quality-related (indicator loadings ranging from 0.346 to 0.416) benefits across food categories.	Chinese respondents perceived similar levels of risk associated with negative environmental impacts caused by food production (Mean values from 3.49 to 3.72) to food safety- (Mean values from 3.52 to 3.66) and quality-related issues (Mean values from 3.50 to 3.65). Milk (Mean = 3.63, *SD* = 1.13) and beef production (Mean = 3.72, *SD* = 1.10) related to slightly higher environmental risk than apple production (Mean = 3.49, *SD* = 1.20). However, the perceived food safety-related benefit (indicator loadings ranging from 0.646 to 0.655) contributes more to the respondents’ overall benefit perceptions compared to quality-related (indicator loadings ranging from 0.370 to 0.406) and environment-related benefits (indicator loadings ranging from 0.298 to 0.353) across food categories.	The potential positive environmental impacts of traced foods have significant contribution to the respondents’ benefit perceptions in both countries, despite the lower perceived relevance than food safety- and quality-related impacts.

5 DISCUSSION

5.1 UK and Chinese consumers’ responses to non-traced and traced food

UK consumers showed relatively low risk perceptions for apples and milk and a slightly over medium risk level for beef (Table 2), which might result from the effects of previous beef-related food incidents in the UK. Relatedly, UK consumers expressed stronger intention to buy traced beef, despite perceiving a higher price increase and lower affordability associated with traced beef compared to traced apples and milk. This is consistent with the findings of recent studies which have shown slightly positive scores being associated with UK consumers’ intentions to buy traced beef and coffee, with the traced beef being scored higher in this respect (Dionysis et al., 2022; Spence et al., 2018). In addition, UK consumers’ willingness to pay a premium for applying traceability to red meat might have decreased as the impacts of food scares have attenuated psychologically (Dickinson & Bailey, 2005; Spence et al., 2018). This resonates with the negative impact of price increase on purchase intentions, and the relatively low perceived affordability of traced beef observed here.

In contrast, Chinese consumers have shown consistently high preferences for traced foods over the past decade (Maitiniyazi & Canavari, 2020; Wu et al., 2011; Yuan et al., 2020; Zhang et al., 2012). The results of this research suggest that Chinese consumers express greater intentions to purchase all three traced foods compared to UK consumers. Their perceived risks associated with the three non-traced food categories were all over the mid-range level (mean values ranging from 3.50 to 3.68 in Table 2), with milk and beef being perceived to be associated with higher risks than apples. This suggests that dairy- and meat-related food safety incidents have influenced societal concerns about food safety issues in China. As a result, Chinese consumers’ purchase intentions to buy traced beef and traced milk were both significantly greater than that for traced apples.

5.2 Factors affecting consumer responses to traced food

There were similarities between Chinese and UK consumers’ responses to traced foods. First, the hybrid model based on the PPM theory and the TAM has shown satisfactory levels of explanatory power concerning both UK and Chinese consumers’ purchase intentions of traced food. The push, pull and mooring effects have significant impacts on consumer intentions in both countries. Taken together, these effects may lead to more positive purchase intentions. Second, the model has also explained how other factors have shaped consumer attitudes, given that attitudes are one of the most important factors shaping purchase intentions (Ding, Liu, Yang, & Ma, 2022; Dionysis et al., 2022; Spence et al., 2018). For both UK and Chinese consumers, existing attitudes towards traced food in general, perceived benefits and affordability associated with specific traced food products largely shape their attitudes towards traced products, with perceived benefits being the most influential.

Several differences were identified regarding factors affecting UK and Chinese consumers' responses to traced food. For instance, the perceived ease of accessing and understanding traceability information was more influential in affecting Chinese consumers' purchase intentions compared to UK consumers. The ease of accessing and understanding traceability information increased purchase intentions among Chinese consumers to a greater extent than impacts of consumer attitudes especially for traced milk and beef. This was, however, not the case for UK consumers, where consumer attitudes had greater impacts on purchase intentions, as has been found in other countries (e.g. France and Italy) (Menozzi et al., 2015). This might be because the perceived risk issues associated with non-traced milk and beef are of high societal concerns in China, leading to Chinese consumers' high need for traced information that helps them mitigate relevant risks in their food decision-making.

The UK results may reflect a social amplification and attenuation of risk, where events associated with the occurrence of hazards interact with psychological, social, institutional, and cultural processes in ways that can increase (amplify) or reduce (attenuate) individual and social perceptions of risk and shape risk behaviours (Kasperson et al., 1988; Masuda & Garvin, 2006), which has been demonstrated to have occurred in relation to food safety issues (Breakwell & Barnett, 2003; Chung & Yun, 2013; Frewer et al., 2002). This would suggest that risk mitigation measures may be more reassuring in the UK, potentially as a consequence of enforcement of one-up-one-down traceability through the supply chain, and the information which has been provided about this.

Chinese consumers' purchase intentions were more dependent on their existing attitudes towards traced food in general than was the case for UK consumers, for all food categories. This means that Chinese consumers could be more likely to extend their existing attitudes directly to their intentions to purchase traced foods in other product categories, resulting in stronger cognitive biases influencing their decision-making compared to UK consumers. Similar biases have been reported in research into consumer decision-making about organic food and genetically modified food (Jin et al., 2022; Vega-Zamora, Torres-Ruiz, Murgado-Armenteros, & Parras-Rosa, 2014). In other words, those consumers who have negative existing attitudes towards traced food in general are less likely to buy specific traced foods regardless of different food types or traced information. This negative impact was found to be greater among Chinese consumers than UK consumers. As existing general attitudes can be shaped by consumers' previous experience, traced foods as well as food retailers selling traced foods should be more strictly regulated by relevant authorities in China, leading to greater consumer approval of the national regulatory process associated with traced foods, and the food products governed by this. In addition, the perceived price increase had opposite effects on consumer purchase intentions in the two countries, with negative effects on purchase intentions for UK consumers but positive effects on purchase intentions for Chinese consumers. Zhou and his colleagues (2002) reported that Chinese consumers who are highly risk averse have to depend on price to infer product quality. This could be the case here, as Chinese consumers perceived relatively high levels of risk perceptions associated with the selected food categories and thus regarded the increased price as credible "signal" about better safety and quality of the traced food, thereby increasing their purchase intentions. UK consumers, however, tended to be more sensitive to food prices, with higher process reducing purchase intention (Angelo, Gloinson, Draper, & Guthrie, 2020). It is not clear whether the cost of living crisis, which is extant at time of writing, would further exacerbate this effect in the UK (Iacobucci, 2022) and China, where increases have been slower (TRADING ECONOMICS, 2022).

5.3 Policy and marketing implications

Some implications for policy and marketing strategy can be identified. As has been demonstrated, willingness to pay for traced food may vary according to socio-cultural context, and across food categories, although people generally hold positive attitudes towards traceability as a concept. Price setting and identifying target segments of people to whom to promoting traced food, is important. First, unless it is required through regulation, traceability should be prioritised for food categories associated with higher public risk perceptions and concerns. Even where traceability of foods and ingredients is compulsory, resources for information provision and publicity about traceability should focus on those supply chains which are perceived to be "risker". Such an alignment with consumer preferences and priorities might lead to more positive consumer attitudes towards traced food in general, which could in turn increase the acceptability of tracing the other food categories and benefit future promotion of traced food products.

Second, the benefits that tracing food potentially brings to the environment have been identified as important by consumers, and positively affecting consumer attitudes and purchase intentions towards foods which have been demonstrated to have lower negative environmental impacts. At present, food safety- and quality-related benefits were more prominent in influencing consumers' purchase intentions. It is likely that those consumers who are more concerned about the environmental impacts of food production would show a preference for traceability of environmentally positive characteristics (e.g. reduced use of agricultural chemicals, shorter supply chains). Tailoring information to individual's consumer preferences (for example, using virtual smart cards or point of sale scanning technologies) may further demonstrate the advantages of traceability systems.

Consumers' interest in tracing multiple types of information through the food supply chain, and the type of information they wanted traced, differed by food category (Liu, Li, Steele, & Fang, 2018). When integrating multiple types of information into traceability systems, the increased costs and complexity of information needed may mean that what is traced is dependent on consumers' risk concerns in relation to a particular product category. For example, if food safety risk perceptions are low in relation to apples, but people are concerned about the impacts of production on the environment, it is the latter information which needs to be "carried" through the traceability system. Should a food safety incident occur within that supply chain, the existence of the traceability system means that products can rapidly be recalled. In addition, information relevance and consumer understanding should be particularly addressed in Chinese society, as the ease of accessing traceability information, and understanding and interpreting its meaning, is one of the most important factors influencing Chinese consumers' purchase intentions towards traced foods.

Third, the strategy of price setting may differ between the UK and China. In China, increasing the price of a specific food product may lead to consumers' greater intention to buy this traced product as price might be utilised as a quality "cue" in association with traceability implementation. UK consumers may be more sensitive to food prices. Therefore, in the UK, information should focus on improved food safety, quality and sustainability issues associated with production. In terms of different socio-demographic groups of people, there are certain groups more likely to purchase, and potentially seek out, traced food, such as those who buy food online, those aged between 25-55 (35-44 in the UK and 25-34 in China), with higher educational levels, or with relatively higher annual household income. Different promotion strategies or policy interventions can be developed to target these groups as priority market segments. Moreover, in both countries, the measurement of market size for food traceability (ideally including information about specific food categories being traced) as well as the cost and benefit analysis of different product promotion strategies regarding specific traced foods should be undertaken in the future, thereby better informing the choice of suitable price setting and promotion strategies for different traced food products.

5.4 Limitations and future research directions

Although this research has made several theoretical and practical contributions to the literature, there are limitations that need to be considered when interpreting the results. First, the results of this research showed the proposed model had satisfactory levels of explaining variance in both Chinese and UK consumers' intentions to purchase traced foods, and some factors indicated similar effects between two countries. These can be used as a starting point for understanding consumer perceptions, attitudes and behavioural intentions in relations to traced foods in different countries with a different history of food safety issues and regulatory approaches. However, although the socio-demographic quota sampling was used to ensure research participants are as nationally representative as possible, using online surveys for data collection might have excluded groups of individuals who have limited access to the internet, and on whom future research should be focused. Also, as regional differences in food consumption behaviour may exist within and between countries, it is important to take this into account when developing regional policies and traceability practices.

Second, although multiple factors affecting consumer responses to traced food has been identified, it is also important to consider personal food habits, such as food choice motives (Steptoe et al., 1995; van't Riet et al., 2011; Verain et al., 2021) or the extent to which people make habitual food choices (e.g., van't Riet et al., 2011), and social norms, for example, what constitutes appropriate consumption patterns within specific groups (Higgs, 2015). These factors may also influence consumer responses to food traceability, and should be investigated in future research. Traceability information may also affect consumer responses to imported foods, as previous research has indicated that traceability information of imported products could be regarded as a food authenticity or quality cues by consumers (Kendall et al., 2018). This should be further explored in consideration of specific food categories to be traced. In addition, there may exist a gap between the research participants' purchase intentions and actual purchase behaviour in relation to the traceability attributes included here, which should be explored using actual purchase data in the future when (and if) this becomes available.

Third, when making comparisons within and between countries, non-parametric tests were applied. Given the debate on the choice of parametric and non-parametric test methods (see e.g. Fagerland & Sandvik, 2009; Khan & Rayner, 2003; Lantz, 2013), it might be worth applying parametric tests and comparing the results with those based on non-parametric tests, thereby better informing the choice of test methods. The inability to test two-way effects (thus ruling out other possible effects between constructs using PLS-SEM) might represent another methodological limitation. Future research could address this by using covariance-based structural equation modelling to better test and confirm the hybrid model proposed in our research (Dash & Paul, 2021).

6 CONCLUSION

In summary, this research contributes to the understanding of UK and Chinese consumers' decision-making about traced food in several ways. First, Chinese consumers have greater intentions to purchase all three traced food products compared to UK consumers. People with higher household income and higher levels of education are more likely to purchase traced food. Second, consumers' purchase intentions for traced food vary by food category, with greater purchase intentions for traced beef and milk than traced apples. Third, of the identified factors that shape consumers' purchase intentions, the ease of accessing and understanding traceability information plays a more important role for Chinese consumers, whereas attitudes have a greater impact on purchase intentions for UK consumers. Fourth, the differences between Chinese and UK consumers regarding the effects of the factors on their purchase intentions have indicated that it may be important to use target strategies to promote traced foods in the two markets, including in relation to consumers' existing general attitudes towards traced food, the (perceived) complexity of traced information, price setting and choice of target socio-demographic groups for marketing.

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Declarations of Interest

None

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