Consumer willingness to pay for traceable food products: A scoping review protocol

1. Introduction

1.1 Rational

In recent years, traceability has become an increasingly important tool in national and international food supply chains (Sun, Wang, and Zhang, 2017; Olsen and Borit, 2013). This has been driven, at least in part, by numerous hazardous and expensive food safety scares around the world, which have prompted increased pressure from downstream businesses and consumers to expand traceability of food products (Olsen and Borit, 2013; Lee et al., 2011; Feng et al., 2009).

Definitions of traceability are often general and nonspecific because traceability systems can be designed to achieve a range of goals and objectives. Broadly, food product traceability\(^1\) refers to a system of recordkeeping that tracks specific products or product attributes as they flow through the food production supply chain (Golan et al., 2004). However, there is no currently accepted standard definition of traceability, and a number of conflicting definitions exist (Badia-Melis, Mishra, and Ruiz, 2015; Olsen and Borit, 2013). Following a critical examination of definitions in published literature, Olsen and Borit (2013) proposed the following definition of food product traceability: *The ability to access any and all information relating to that which is under consideration, throughout its entire life cycle, by means of recorded identifications*. Critically, this definition does not limit the type of characteristics about which information is recorded, it does not limit the form or unit size of products under consideration, it supports tracing at any point in the supply chain, and it specifies recordkeeping as a foundational aspect of all traceability systems (Olsen and Borit, 2013). In practice, traceability systems can be characterized according to the breadth, depth, and precision of a specific system: breadth refers to the amount of information recorded by the system; depth refers to the span of the system within the supply chain, or how far forward or backward the system traces; and precision refers to the level of accuracy with which a product’s movement or characteristics can be identified in the system (Golan et al., 2004). The breadth, depth, and precision of a specific traceability system may vary depending on the objectives, costs, and benefits of the firm(s) involved (Smith et al., 2005; Golan et al., 2004).

Traceability represents a potentially crucial part of a comprehensive approach to mitigating and managing food safety risks and associated costs. The costs of food safety disruptions can be enormous; for example, the total cost of a well-publicized 2008 outbreak of listeriosis linked to contaminated delicatessen meat in Canada was estimated to be $242 million (Thomas et al., 2015). Traceability systems can help to strengthen food safety management at the firm level by hastening the identification of safety problems, improving the effectiveness of product recalls, reducing amounts and costs of products withdrawn, minimizing negative publicity, restoring consumer confidence in the safety of a firm’s products, and preserving a firm’s reputation through effective crisis management (Ringsberg 2014; Hobbs et al., 2005; Smith et al., 2005; Golan et al., 2004). Additional food safety-related public benefits of traceability systems include improved detection of food safety disruptions, less public exposure to food hazards, improved public confidence in general food production and safety systems, reduced monitoring and inspection costs, and clarified legal liability (Hobbs et al., 2005; Golan et al., 2004).

\(^1\) Hereafter, food product traceability will be referred to as simply ‘traceability’. It should be understood that subsequent mentions of traceability refer specifically to traceability of food products and related attributes.
Traceability can also be used by firms to improve supply-side management and logistics, and to differentiate and market products with credence attributes\(^2\) (Ringsberg 2014; Smith et al., 2005; Golan et al., 2004). Benefits to firms of adopting traceability include improved efficiency and reduced inventory management costs, improved communication between business partners, fraud prevention, and broader sales of differentiated products (Badia-Melis, Mishra, and Ruiz, 2015; Olsen and Borit, 2013; Smith et al., 2005; Golan et al., 2004). Further, information from traceability systems can support geographic product designations, quality verification and certification, country-of-origin labelling, compliance with export market requirements, and biosecurity efforts (Schwägele 2005; Smith et al., 2005).

However, traceability systems also impose costs on the firms that implement them, such as increased data collection and storage costs, costs of tracking technologies such as RFID technology or DNA barcoding, and costs incurred when separating products for tracking purposes (Badia-Melis, Mishra, and Ruiz, 2015; Golan et al., 2004). Additional concerns include data security, data integration and interoperability challenges, a lack of unified technology specifications and standards, technical knowledge requirements, veracity and integrity of data inputs, proprietary information protection, and increased liability in food safety events (Wu et al., 2016; Badia-Melis, Mishra, and Ruiz, 2015; Ringsberg 2014; Hobbs et al., 2005; Schwägele 2005; Smith et al., 2005).

Given the costs of implementing, monitoring, and maintaining traceability systems, prices may be necessarily higher for traceable products compared to their non-traceable counterparts (Khuu et al., 2019; Sun, Wang, and Zhang, 2017). It is therefore critical to determine whether consumers value traceability and how much of a premium they might pay for traceable products (Hou et al., 2019; Zhang, Bei, and Wahl, 2012). International evidence suggests that consumers might have a positive and nontrivial willingness to pay (WTP) for traceable food (Hou et al., 2019; Dickinson and Bailey, 2005). In a meta-analysis of 23 previous studies, Cicia and Colantuoni (2010) report that on average, consumers were willing to pay a 16.71% premium for meat that is traceable to the farm of origin. In Canada, Hobbs et al. (2005) found that study participants were willing to pay a positive amount for traceable beef and pork sandwiches, but WTP values were significantly higher for products that also carried additional food safety and animal welfare guarantees. Dickinson and Bailey (2005) investigated consumer WTP for red meat traceability in the US, Canada, the UK, and Japan, and estimated average premiums for traceability ranging from 7-25%, and premiums for combined quality attributes ranging from 21-49%. In China, Hou et al. (2019) reported WTP premiums of 2.9 yuan (20.7% premium) for traceable pork and 3.4 yuan (24.3% premium) for traceability combined with other food safety assurances; Xu et al. (2019) reported that consumers would pay, on average, a 39.7% premium for traceable pork; Jin, Zhang, and Xu (2017) found that consumers would pay a 34.3% premium for apples with abbreviated traceability information and 44.5% premiums for more detailed information; Wu et al. (2016) reported premiums of 1.22-2.79 yuan for pork products with varying levels of traceability; Zhang, Bei, and Wahl (2012) found that consumers would pay premiums of 21.7%, 19.8%, and 16.7% for traceable milk, cooking oil, and pork, respectively;

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\(^2\) Credence attributes are those that are difficult to detect by consumers even after consumption of the product. Credence attributes are divided into content attributes, which are physical characteristics of a product such as calcium in enriched orange juice, and process attributes, which are characteristics of the production process such as organic or fair trade status (Golan et al., 2004).
and Feng et al. (2009) found that consumers were willing to pay an average premium of 6% for traceable fish products. Khuu et al. (2019) report that consumers in Vietnam would pay a 24% premium for traceable pork, and in a Korean study, Lee et al. (2011) found that consumers would pay on average a 39% premium for traceable imported beef.

Results from previous studies indicate a wide range of potential WTP values for traceability around the world. In addition, factors such as age, gender, education, income level, knowledge of food safety, and risk attitudes may affect consumer WTP (Hou et al., 2019; Jin, Zhang, and Xu, 2017; Zhang, Bei, and Wahl, 2012; Lee et al., 2011; Feng et al., 2009; Dickinson and Bailey, 2005). However, the direction and significance of these effects are not consistent across studies. For example, Hou et al. (2019) found that age was negatively related to WTP and both income and education had a positive impact on WTP, whereas Lee et al., 2011 found that income and education had opposite effects on WTP, and in the study by Hobbs et al. (2005), age, gender, education, and income level did not significantly affect WTP values.

Traceability in food production is a complex and multifaceted issue of international importance. Consumer responses to traceable foods vary considerably in different contexts and for different food products, although there appears to be an underlying assumption that consumers value more traceability than is currently available; however, additional economic research is necessary to validate this assumption (Hobbs et al., 2005). To support the development of consumer-compatible traceability systems worldwide, there is a need to collate and summarize the existing literature on consumer WTP for traceability to determine the nature of current evidence and to identify research gaps. Scoping reviews provide a transparent research method for identifying and mapping the complete body of research on a specific topic (Pham et al., 2014; Arksey and O’Malley, 2005). Scoping reviews can be used to establish the extent of existing literature, to determine the feasibility of conducting a systematic review, and/or to identify gaps in the literature (Levac, Colquhoun, and O’Brien, 2010; Arksey and O’Malley, 2005). A scoping review is therefore proposed to support and guide future research on consumer WTP for traceability.

1.2 Objectives
The objective of this scoping review is to comprehensively summarize previous research on consumer WTP for traceability in food products, both to identify gaps in the existing literature and to assess the feasibility of conducting a systematic review of the topic.

2. Methods
2.1 Protocol and registration
This protocol was developed based on the guidelines in the Preferred Reporting Items of Systematic Reviews and Meta-Analyses Extension for Scoping Reviews (PRISMA-ScR) (Tricco et al., 2018). This protocol will be made publicly available via the University of Guelph Atrium.

2.2 Scoping review framework
This scoping review will be conducted based on the framework described in the PRISMA-ScR documentation (Tricco et al., 2018).
2.3 Research question
The research question for this scoping review is: *What is the nature and extent of the existing evidence on consumer willingness to pay (WTP) for traceable food products?*

2.4 Eligibility criteria
In order to be eligible for inclusion in the scoping review, articles must meet the following criteria:

1. Articles must be peer-reviewed publications, conference proceedings, or industry reports
   a. Articles must be at least 500 words in length and report on primary data
2. Articles must be published in English. Due to time and resource constraints, translation services for non-English-language articles are not available
3. Articles must have been published within the past 20 years (i.e. from 2001 to the search date).

In addition, research in eligible articles must include the following aspects based on the PICO framework (Higgins et al., 2021; EFSA 2015):

4. Population: Individual consumers of end-use food products
5. Intervention/Exposure: Documented traceability of any depth, breadth, or precision at any level of the food supply chain, in any of the following industries: beef, veal, pork, poultry and eggs, seafood, fruit, vegetables, grains, and oils/oilseeds
6. Comparator: WTP values or prices for equivalent non-traceable food products
   a. This criterion may not be relevant to all articles depending on the study design
7. Outcomes: Willingness to pay for traceable food products, measured either as a monetary amount or as a percentage price premium
   a. WTP may be measured using either hypothetical (e.g. stated preference, contingent valuation, conjoint analysis) or non-hypothetical methods (e.g. experimental auctions, real choice experiments)

2.5 Information sources
The following databases will be electronically searched for relevant articles: MEDLINE (via Ovid), CAB Direct, Agricola (via ProQuest), Web of Science, EconLit, AgEcon Search, Business Source Complete, ABI/Inform (via ProQuest), and Engineering Village (via Elsevier). In addition, one member of the review team will hand search the most relevant journals and conference proceedings within the search timeframe to identify additional articles.

2.6 Search
The proposed search terms used in the search are identified in Table 1 and are based on the eligibility criteria outlined above. The Boolean operators ‘AND’ and ‘OR’ will be used to connect search terms. The search string will be modified for each database as appropriate.

Table 1: Proposed search terms based on eligibility criteria for inclusion in the scoping review

<table>
<thead>
<tr>
<th>#</th>
<th>Search Terms</th>
</tr>
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</table>

3 This starting search date was selected as a several crucial pieces of traceability legislation came into force in 2002, namely the EU Regulation (EC) 178/2002 and the US Public Health, Security, and Bioterrorism Preparedness and Response Act (Ringsberg 2014; Smith et al., 2005). Further, cattle identification became mandatory in Canada in 2002 under the Canadian Cattle Identification Agency (Hobbs et al., 2005).
<table>
<thead>
<tr>
<th>1. General Food Industry</th>
<th>food* OR agricultur* OR “animal product*” OR crop*</th>
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<tbody>
<tr>
<td>2. Specific Industries</td>
<td>meat* OR livestock OR beef OR veal OR steak OR ribeye OR flank sirloin OR cow OR cows OR cattle OR bovine OR calf OR calves OR slaughterhouse* OR feedlot* OR pork OR ham OR sausage* OR loin OR bacon OR pig OR pigs OR swine OR hog OR hogs OR porcine OR poultry OR fowl OR chicken OR chickens OR turkey OR turkeys OR geese OR goose OR duck OR ducks OR egg OR eggs OR “aquatic product*” OR aquaculture OR fish OR shellfish OR seafood OR shrimp OR shrimps OR lobster OR lobsters OR salmon OR crab OR crabs OR groundfish OR pelagic* OR fisheries OR dairy OR milk OR cheese OR yogurt OR yoghurt OR holstein* OR vegetable* OR tomato* OR potato* OR carrot* OR beet* OR bean OR beans OR onion* OR cabbage* OR fruit OR fruits OR apple* OR cranberry OR cranberries OR blueberry OR blueberries OR grape* OR peach* OR pear* OR prune* OR apricot* OR cherry OR cherries OR strawberry OR strawberries OR berries OR raspberry OR raspberries OR produce OR oilseed* OR canola OR soy OR soybean* OR flax OR flaxseed* OR sunflower* OR peanut* OR rapeseed* OR grain* OR cereal* OR wheat OR “red fife” OR “canadian western red spring” OR “canadian western amber durum” OR “canadian prairie spring red” OR oat* OR corn OR maize OR barley OR rye OR alfalfa</td>
</tr>
<tr>
<td>3. Population/Consumer</td>
<td>consumer* OR customer* OR purchaser* OR buyer* OR producer* OR industr* OR “supply chain” OR “food business” OR “food businesses” OR wholesale* OR distribut* OR supermarket* OR retail* OR export*</td>
</tr>
<tr>
<td>4. Intervention/Traceability</td>
<td>traceability OR traceable OR tracing OR trace OR “production path”</td>
</tr>
<tr>
<td>5. Outcome/Willingness to Pay</td>
<td>willingness-to-pay OR “willingness to pay” OR wtp OR “price premium*” OR “stated preference*” OR “contingent evaluation*” OR “contingent valuation*” OR “conjoint analysis” OR “conjoint analyses” OR “choice experiment” OR “choice modeling” OR “choice modelling” OR “revealed preference*” OR “hedonic price*” OR “experimental market*” OR auction OR “preference ranking*” OR “real choice”</td>
</tr>
</tbody>
</table>

The search will require at least one term from 1 or 2; and at least one term from 3; and at least one term from 4; and at least one term from 5.

2.7 Relevance screening
Following the search, all citations will be imported into EndNote X7.8 (Thomson Reuters, Toronto, ON). Subsequently, remaining citations will be imported into the web-based systematic review program Distiller SR (Evidence Partners Incorporated, Ottawa, ON) for duplicate removal, relevance screening, and data extraction. Two reviewers will independently screen the titles and abstracts of each citation for relevance to the research question. Any conflicts between the responses of the two reviewers will be resolved by consensus. A pilot test will take place in which all reviewers will examine the first 100 citations, followed by a discussion of any conflicts.
or uncertainties. Any necessary changes will be made to the first-round screening questions following that discussion. Reviewers will use an electronic form with the following questions to complete the first-round screening:

Q1. Was the study published in 2001 or later?
Q2. Is the title and/or abstract available in English?
Q3. Does the title and/or abstract describe at least some level of traceability for at least one food product?
Q4. Does the title and/or abstract describe research conducted in end-use consumers of food products?
Q5. Does the title and/or abstract include a measure of willingness to pay (WTP)?

Each question will include the responses ‘YES’, ‘NO’, and ‘UNCLEAR’. A citation will be excluded only if two reviewers independently answer ‘NO’ to one or more of the above questions, or both reviewers agree to answer ‘NO’ following a consensus meeting.

After the first round of screening, the full texts of all remaining citations will be retrieved; articles will be excluded if the full text cannot be retrieved. Two reviewers will independently review the full texts to determine relevance, and agreement by both reviewers is necessary to include or exclude any article. Any conflicts will be resolved by consensus. All reviewers will participate in a pilot test of five full-text articles to ensure consistent application of screening questions and to resolve any uncertainties about the application of those questions. Adjustments to the screening form may be made based on discussions following the pilot test. The following questions will appear on the full-text screening form to determine relevance:

Q1. Is the full text available?
Q2. Is the full text available in English?
Q3. Is the full text >500 words?
Q4. Does the article describe research conducted in individual consumers of end-use food products?
Q5. Does the article include an assessment of willingness to pay (WTP) for at least some level of traceability for at least one food product?

Responses to each of the above questions will be either ‘YES’ or ‘NO’. An article will be excluded if both reviewers answer ‘NO’ to any of the screening question. If any article is excluded at this stage, the reason for exclusion will be documented.

2.8 Data charting process
An electronic data charting form will be developed and applied using Distiller SR. Data extraction will be conducted in duplicate, with any conflicts will be resolved by consensus. Reviewers will conduct a pilot test of the data extraction form with five full-text articles. The pilot test will ensure consistent data extraction practices between reviewers and will help to resolve any questions or uncertainties regarding items on the data extraction form. Changes may be made to the data extraction form to improve clarity following the pilot test discussions.

2.9 Data items
Data will be extracted for each of the fields identified in Table 2.

### Table 2: Data charting fields to be included on the data extraction form

<table>
<thead>
<tr>
<th>Data Items</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>General Study Characteristics</strong></td>
</tr>
<tr>
<td>Year of publication; Year study was conducted (if applicable); Country in which study was conducted (if unavailable, indicate country of first author)</td>
</tr>
<tr>
<td><strong>Study Population</strong></td>
</tr>
<tr>
<td>Number of consumers; demographics of consumers (age, gender, education, income levels)</td>
</tr>
<tr>
<td><strong>Food Industry</strong></td>
</tr>
<tr>
<td>Specific food product(s) under consideration (beef, veal, pork, poultry, eggs, seafood, fruit, vegetables, grains, oils/oilseeds, other*)</td>
</tr>
<tr>
<td><strong>Traceability System</strong></td>
</tr>
<tr>
<td>Depth of traceability system (farm, processor, distributor, retail, all, other*)</td>
</tr>
<tr>
<td><strong>Willingness to Pay</strong></td>
</tr>
<tr>
<td>Method of WTP valuation (hypothetical, non-hypothetical); Average WTP value (monetary); Average WTP premium (% over baseline)</td>
</tr>
</tbody>
</table>

*Reviewers will be allowed to add responses to these items if additional relevant responses are identified in the retrieved articles

#### 2.10 Synthesis of results
Data will be collected and exported to Microsoft Excel 16.35 for Mac (Microsoft Corporation, Redmond, WA) for analysis. Descriptive tables will report summaries of general study characteristics, traceability systems under consideration, and WTP methods and values. Narrative descriptions, as well as tables and figures, will be used to summarize findings.

#### 2.11 Dissemination of results
The scoping review methods and results will be prepared for publication in a peer-reviewed journal to be selected at a later date.

**Funding**
This study will receive no external funding.

**References**


