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Consumer Knowledge and Attitudes towards Food Traceability: A Comparison between the European Union, China and North America

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Abstract. The objective of this paper is to investigate recent findings on consumer knowledge and attitudes towards food traceability across the European Union (EU), China, and North America. A critical review of academic articles published between 2003 and 2013 was performed and a total of sixteen studies were selected. Results indicated that consumers are paying increasingly attention to food safety and quality but they are still unfamiliar with the concept of traceability, especially in China. Willingness to pay (WTP) for food safety differs across countries and segments of population. Age, education, income and food safety concerns are the factors that mostly influence consumer acceptance of traceability and its attributes. Both producers and policy makers should work together to increase consumer awareness about the benefits offered by Food Traceability Systems.

Keywords: food traceability, food safety, consumer attitudes, comparative study

1. Introduction

In the last decades consumer concerns for food safety have significantly increased in both developed and developing countries. These concerns became particularly serious after food scandals such as the epidemic of the Bovine Spongiform Encephalopathy (BSE) in Europe or the milk adulterated with melamine in China. The negative effects of these scandals affect both the supply and the demand side of the food chain. Consumers feel personally damaged and are likely to change their purchasing habits, while food companies experience severe financial losses due to the sudden decline in sales. Among the tools that stakeholders in the agrifood industry adopt to increase food safety, traceability plays an important role because it enhances the transparency and safety of the food system [1]. In case of a food scandal, a traceability system can trace back the steps along the food chain to locate where the problem occurred and to withdraw the contaminated food from the market. Traceability is also a guarantee of safety and quality for consumers. Nowadays the importance of food traceability systems is well acknowledged in both developed and emerging economies and new legislations have been adopted. In the EU traceability is disciplined by Regulation number 178/2002 and is mandatory since 2005. In 2011, the Congress of the United States approved the Food Safety Modernization Act (FSMA) to improve the safety of the supply chain and in Canada the Federal Government is implementing a legislative framework that specifically addresses food traceability. Food safety assurance systems in China are still at an early stage of development, but significant steps have been taken to improve the safety and quality standards of food. In particular, on July 2009, the China's New Safety Law was introduced with the aim of improving the national food safety monitoring system.

The term traceability is not univocal and there are both formal and informal definitions. The EU defines traceability as "the ability to trace and follow a food, feed, food-producing animal or substance through all stages of production and distribution". Researchers and policy-makers have also adopted a broader description of the concept of traceability. Taking the perspective of consumers, traceability has been described as a tool to preserve the identity of food and also a credence attribute (a food attribute that is believed to be true but that cannot be directly evaluated).

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Although traceability systems are becoming more common in the food chain, consumer knowledge about traceability is still spotted and unclear. The goal of this paper is to better understand consumer knowledge and attitudes about traceability and its associated features, comparing evidence from the EU, North America and China. This is the first literature review about food traceability and consumer knowledge with a comparative perspective.

2. Method

This review includes cross-sectional studies and meta-analyses that examined consumer knowledge and attitudes towards food traceability. A total of sixteen articles were selected, of which six were conducted in the European Union, five in China and five in North America (USA and Canada). Only articles published between 2003 and 2013 were included in the review. The research was made using Google Scholar and AgEcon databases. As a criterion for inclusion, a combination of key terms *food traceability*, *consumer attitudes* and *consumer knowledge* was used. In the studies suitable for the review, traceability was measured in different ways. Some surveys included questions that explicitly addressed traceability and asked respondents to express their degree of agreement (or disagreement) towards specific statements about traced food. Other studies measured traceability indirectly, using attributes related to traceability such as the importance of origin or safety.

3. Results

The summary of the studies is presented in Table 1. For each study the following information were provided: author and year of publication, region, methodology and findings.

3.1. European Union

Six studies were selected for the EU, of which two were conducted in Spain, one in Belgium and three were cross-countries. One of the studies was a meta-analysis [2]. Overall consumers have positive attitudes towards food traceability and its features as origin, safety and quality. However the WTP for traceable foods differs across regions, segments of population and food items. For example, a study conducted in Spain [3] noted that some consumers believed that traceability had a positive effect on beef safety, while others believed that it was unnecessary and costly. Concerning food traceability knowledge, consumers that belong to consumer associations were more likely to be familiar with traceability systems than those who were not part of any food organization. A survey across different European countries showed that attitudes towards traceability were in general positive, but consumers from Southern Europe were more aware of traceability than their Northern counterparts and were also more willing to pay for it [4]. Gellynck *et al.* [5] investigated the most important attributes of traceability for Belgian consumers. They distinguished between functional and process attributes. Functional attributes are those related to the system efficiency such as chain monitoring, while process attributes are related to food processing such as information about origin or production methods. Results suggested that, among traceability information presented on labels, the indication of origin was the most preferred and useful, at least for meat products. A study by Kehagia *et al.* [6] showed that labels are important for European consumers, but participants also asked for easily understandable symbols. Similar results were found in a study conducted in Spain [7] that showed how consumers valued traceability especially when it is associated to recognizable attributes as origin and safety.

3.2. China

A total of five surveys investigating consumer knowledge and attitudes towards traceability were included in the review. All of the surveys focused on a particular Province or on one or more cities and different food products were taken into consideration. A study conducted in the Shandong Province [8] examined the willingness to buy traceable pork. The great majority (97.3%) showed attention to food safety, but only 36.9% of interviewees control the labels when they buy pork meat. The study also found that the willingness to buy traced pork seemed positively related to education and income, was higher in families with pregnant women and attention towards food safety. Similar findings were found in two studies conducted respectively in Beijing and Shanghai [9], [10]. Although few consumers knew what traceability was, higher educated consumers and those between 20 and 35 years of age were the most concerned about the quality and safety of different food items and their WTP was higher than in other socio-economic groups. A study found that consumers seemed to have positive attitudes towards traced milk compared to not traced milk [11]. Specifically, who issued traceability certificates was also valued, and consumers were more likely to trust government and food companies rather than third party bodies. The same study found that there was a positive WTP for traced milk (6.09 RMB per $\frac{1}{4}$ kg of cow milk) and it was higher for milk carrying

information certified by the government. Similar results were found in a study conducted in Nanjing [12], where WTP was positive for milk, but also for pork and edible oil. Consumers were also more likely to buy traced food when they were provided with information about food traceability.

Table 1. Characteristics and results of the studies examined about consumer knowledge and attitudes towards food traceability in European Union, China and North America

Author and Year of Publication	Region	Methodology	Findings
Cicia and Colantuoni, 2010 ^[2]	Europe (cross-countries)	Meta-analysis of 23 studies	Consumers across countries are giving increasing importance to meat traceability and its attributes. WTP for traceable meat varies across countries and is also highly sensitive to prices variations. The most requested attributes appear to be “food safety”, “farm traceability”, “animal welfare”.
Gracia and Zeballos, 2005 ^[3]	Europe (Spain)	Surveys Factor and Cluster Analysis	Both consumers and producers have positive attitudes towards food beef traceability. Different attitudes were reported. The majority of consumers think that traceability increases consumer safety and confidence in beef safety perception, but they are also worried about the related higher costs. Some consumers believe that traceability systems are unnecessary because the quality of beef was already adequate.
Giraud and Halawany, 2006 ^[4]	Europe (cross-countries)	Focus group	Definition and interest towards traceability varies among the EU countries. In most cases, traceability is strongly perceived as related to genuine origin for most participants. In Southern Europe (France, Italy, Malta, Slovenia and Spain) the awareness of traceability is higher than in Northern Europe. Southern countries consider traceability as a buying and confidence criterion.
Gellynck et al., 2006 ^[5]	Europe (Belgium)	Survey data, cluster analysis	Functional attributes of meat chain are such as organizational efficiency and chain monitoring are highly important but not as market drivers, while process attributes related to origin and production method are more likely to attract consumers interest.
Kehagia et al., 2007 ^[6]	Europe (cross-countries)	Focus group	Dissimilarities across different countries exist in consumer perceptions of traceability for both a perceived low-risk food as honey and a high-risk food as meat. Dissimilarities also exist between consumer expectations and information they require. Labels are important in provide consumers with food quality and safety information, but some consumers believe that these labels should be more understandable.
Angulo and Gil, 2007 ^[7]	Europe (Spain)	Survey	Consumer WTP for certified beef depends on income, level of beef consumption, the average price of beef products, safety perception. In general, 73% of consumers were not willing to pay an extra price for labels of traceability per se. Traceability alone pays small role in consumer choice.
Bu et al., 2013 ^[8]	China (Shandong Province)	Household survey	Consumers show high expectations towards the introduction of traceability system. They tend to buy traceable pork with breeding and slaughter information. Education, income, attention to safety and pregnancy are the most important factors influencing food purchasing behaviors.
Feng et al., 2009 ^[9]	China (Beijing)	Consumer survey, associations measures	There is a shortage of safety knowledge concerning fish products. Age, education, price and safety perceptions are the most important factors influencing WTP for traced fish. On average, consumers are WTP a 6% premium for safety and traced fish.
Hou, 2011 ^[10]	China (Shanghai)	Consumer survey	Consumers know little about food traceability, but they care for fresh food safety products. Consumer WTP is affected by education, income, age, trust on information and safety perception. Consumers have however a low WTP for traced fresh fruits.
Bai et al., 2013 ^[11]	China (Xi’an, Wuhan, Shenyang, Xiamen)	Survey Experimental data	Urban consumers have a strong desire for traceable milk and are willing to pay a significant positive premium for it. Their willingness to pay is higher if certificates come from government, followed by industrial association and third party.
Zhang et al., 2012 ^[12]	China (Nanjing)	Consumer survey	Consumers are WTP a significant positive price premium for food traceability for milk, pork and vegetable cooking oil; the WTP differs across products. Consumer WTP was positively affected by consumer knowledge about food traceability and awareness of food quality and safety-related certifications; socio-demographic factors (especially income and age) affect consumers WTP.
Dickinson and Bailey, 2005 ^[13]	Europe (UK), Asia (Japan), North America (USA, Canada)	Experimental design (Vickrey auctions) to generate WTP	Consumers are willing to pay a non-trivial premium for traceability, and even higher WTP for traceability provided characteristics like additional meat safety and human animal treatment guarantees. Across countries, a percentage of consumers (from a minimum of 9% to a maximum of 48%) were unwilling to pay a positive amount for traceability alone.
Ward et al., 2005 ^[14]	United States	Auction experiments	Information about traceability and country of origin is valuable to consumers, especially after the BSE episode. Information about food traceability and origin are valuable for US consumers.
Umberger et al., 2003 ^[15]	United States (Chicago and Denver)	Experimental auctions	Three quarter of the consumers interviewed was willing to pay an 11% and 24% premium for country-of-origin-label (COOL) for steak and hamburger. They were also willing to pay an extra premium for steak labeled as “Born and raised in the US”.
Hobbs et al., 2005 ^[16]	Experimental auctions	North America (Canada)	Canadian consumers value traceability and food safety. However, if traceability information is not paired to quality verification, is of limited value to individual consumers. It is thus suggested to bundle traceability with quality assurance schemes to increase consumers WTP for traced meat.
Loureiro and Umberger,	United States	Choice experiments	In the meat sector, consumers evaluated USDA food safety inspection more than any of the other choice set attributes including country-of-origin labeling, traceability and

Individuals with higher income, higher education and young adults (35 years old or below) were also more likely to buy traced products than other population groups.

3.3. North America

Five studies were selected for North America, of which one reported findings for both Canada and USA, one was conducted in Canada only and three in the US. All the studies focused on the meat sector but none of them was representative of the Canadian or the US population because experimental auctions were used.

The literature on food traceability increased significantly after the diagnosis of a BSE case on December 2003 in Washington State (the only case in the USA). In Canada three cases of BSE were identified between 2003 and 2004 and this also stimulated research on consumer acceptance of traceability. A study from Dickinson and Bailey [13] found that consumers were willing to pay for traceability of red meat. However, both Canadian and American consumers valued meat traceability alone less important than food safety and animal welfare requirements. The same study also found that additional knowledge of food-borne diseases increased the WTP in the United States but decreased WTP in Canada. Ward et al. [14] found that traceability was valuable to US consumers and uncertainty for food safety increased after the identification of a BSE case in 2003. The study also found that a large percentage of US consumers would support a mandatory traceability system in the meat sector and that they would be willing to pay for it. Umberger [15] found that quality was the primary factor determining consumers' meat-purchasing decisions, and hamburger and steak were the beef products that consumers wanted to be labeled with country of origin. In addition, the most searched attributes for beef were freshness, food safety inspection price and leanness. The great majority (73%) were willing to pay an extra premium for the country-of-origin (COOL) label. In Canada, Hobbs et al. [16] found that consumers were willing to pay nontrivial amounts for traceability assurance, but results varied according to the type of meat considered. These results suggest that US consumers value meat traceability information in a different way for different meat products.

4. Discussion

Results reported in Table 1 show that there are interest and positive attitudes towards traceability in the EU, Asia and North America. However knowledge and attitudes towards food traceability differ vertically, across segments of population within countries, and also horizontally, across countries within same the population groups. These differences regard the knowledge of traceability system, the WTP for traceable food, and the importance given to food safety and quality assurance schemes. Among European consumers, food traceability is mostly associated with origin and safety, and with the possibility to withdraw products that are found to not respect quality and safety standards. In some cases in the European Union, the term traceability is also related to traditional producing methods that are associated to a guarantee of quality and identity preservation [6]. US consumers are quite familiar with food traceability and its features, at least in the meat sector. They value information on food safety, quality and also country of origin, although origin is less important than it is for Europeans. Similar results were found for Canadian consumers. In China, consumers are still unfamiliar with the concept of traceability, but concerns for food quality and safety are becoming more important in purchasing habits. Attention towards food safety is greater among higher educated people and, also, among younger adults. As in the United States USDA label are important [17], Chinese consumers seem to trust certification coming from the government or its bodies. If consumers in the EU and North America are concerned about the traceability of meat (especially beef), Chinese consumers are more concerned about milk. This indicates that food safety is strictly related to the food sector where the scandal experienced by the country occurred. In all the studies analyzed consumers WTP for safety and quality cue is positive, however the higher price of traced food represents the greatest obstacle for consumers. From the studies analyzed in this paper, it emerges a general agreement on the necessity to effectively communicate to consumers what traceability is and to strengthen how it guarantees more safety and quality. This is translated into implementing educational programs targeting different segments of consumers or developing quality assurance schemes that use labels easily and immediately understandable by consumers. In addition, given that the higher price of traced food represents the greatest obstacle, programs that financially help private operators should be promoted, especially in emerging economies. Traceability gives consumers the possibility of checking what is happening throughout the food chain and thus increasing the control they have (or they perceive of having) on the food system. This will likely reduce their perceived risk and will increase trust in the stakeholders of the food chain.

5. Conclusion

Tracing a food product along all the steps of the food chain requires the adoption of advanced technology systems that are expensive and sophisticated. The final effect will be a higher price for the consumer. However the consumer may be willing to pay more for the guarantee of food safety, provided that he or she will be able to recognize and appreciate the increased value of the product. Public authorities should increase consumer awareness about traceability systems, especially in China where food legislation is at an early stage.

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