



Effect of information on Chinese consumers' perceptions and purchase intention for beverages processed by High Pressure Processing, Pulsed-Electric Field and Heat Treatment



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ABSTRACT

High Pressure Processing (HPP) and Pulsed-Electric Field (PEF) are non-thermal technologies that add value to foods by improving safety through lowering microbial loads in addition to improving the sensory properties such as color, flavor, and texture. While Heat Treatment (HT) is more widely accepted by consumers, it is a more destructive process compared to HPP and PEF. Little is known about how Chinese consumers perceive non-thermal technologies like HPP and PEF. This research aimed to understand Chinese consumer's perceptions of non-thermal processing technologies and ways to mitigate negative perceptions. Specifically, this research sought to investigate: (a) consumers' general knowledge of food processing technologies; (b) the effect of information on consumers' perceptions of HT, HPP and PEF and how these perceptions influence decisions for their treated beverages; and (c) consumers' willingness to pay for products processed using these technologies.

Six focus groups were conducted in Hangzhou, China. When participants were provided limited and detailed technology information, six dominant consumer perceptions towards HT, HPP, and PEF emerged. Those perceptions were: (1) consumer association with the given technology, (2) trust towards the technology, (3) health, (4) food, (5) taste and quality, and (6) price. When limited information was provided, consumers were skeptical of HPP and PEF. However, the provision of detailed technology information changed participants' attitudes towards HPP and PEF technologies and increased their stated purchase intentions for the treated products. Participants were also found to place less emphasis on the price for HPP and PEF treated beverages when detailed technology information was provided. Chinese consumers were interested in having fewer additives in their foods. Non-thermally processed foods offer this benefit.

Given the change in attitudes after receiving detailed information, HPP and PEF processing technologies have potential to be widely accepted by Chinese consumers. However, to effectively promote these technologies, consumer education is needed to increase awareness of the advantages these technologies have for foods. Practical communication strategies are provided to help food manufacturers inform Chinese consumers about the benefits of these technologies.

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Introduction

Non-thermal processing technologies in China

China's rapidly growing economy (gross domestic product of 8.3 trillion U.S. dollars) (Statista, 2013) and population (1.35 billion) offer tremendous opportunities for Western food producers and exporters. However, distinct differences in behavior between Chinese and Western consumers make entering the Chinese

market challenging. Consumers may desire similar product features (e.g. brand name, quality, and flavor) but the value that consumers attach to the same product may differ cross-nationally (De Mooij, 2009, chap. 1).

Conventional Heat Treatments (HT) such as pasteurization remain widely adopted to extend shelf-life and preserve foods (Tiwari, O'Donnell, & Cullen, 2009). This is despite undesirable changes in flavor, color, texture and nutritional attributes (Morris, Brody, & Wicker, 2007). To avoid quality degradation of foods produced by thermal processing, non-thermal technologies such as High Pressure Processing (HPP) and Pulsed-Electric Field (PEF) have been developed (Timmermans et al., 2011). HPP

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involves the application of hydrostatic pressure while high-voltage pulses are used in PEF processing to inactivate microorganisms and prolong the products shelf-life (Frewer et al., 2011; Hicks et al., 2009). Both HPP and PEF operate at room temperature and are able to retain the sensory and nutritional qualities similar to the 'fresh' unprocessed product with the minimization or elimination of the need for chemical additives as compared to HT (Arvanitoyannis, 2006; Rastogi, Raghavarao, Balasubramaniam, Niranjana, & Knorr, 2007; Sonne et al., 2012).

HPP processed food products including blueberries, fruits, vegetables, pickled foods, sauces and seafood have been introduced in China (Baotou KeFa, 2011; Sharma, 2011). PEF treated foods have not been introduced to Chinese consumers (Shamsi & Sherkat, 2009). However, Chinese research groups are working on industrial applications of PEF processing (particularly liquid foods). Both HPP and PEF technologies offer opportunities for horticultural and food industries to develop a variety of value-added products to satisfy Chinese consumers' desire for safe foods without compromising flavor, freshness, naturalness, and nutritional value. To successfully develop and market these value-added products, it is necessary to understand Chinese consumers' perceptions towards HPP and PEF technologies.

Western consumers' perceptions of HPP and PEF

Western consumers (U.S., U.K., European and Australia) are more positive towards HPP technology than conventional processing technology (e.g. HT). Reasons for this include environmental benefits, improved food safety and product quality that are associated with HPP (Butz et al., 2003; Delgado-Gutierrez & Bruhn, 2008; Deliza, Rosenthal, Abadio, Silva, & Castillo, 2005; Mireaux, Cox, Cotton, & Evans, 2007; Nielsen et al., 2009). European consumers (Slovenia, Hungary, Serbia, Slovakia, Norway and Denmark) responded positively to the name 'High Pressure Processing'. However, these consumers associated HPP with irradiation and Genetically Modified Organism. They also perceived HPP processed food to have unknown consequences (Mireaux et al., 2007; Nielsen et al., 2009). Overall, the perceived benefits of HPP technology seemed to outweigh the perceived risks, resulting in the introduction of treated food products in Western countries (Cardello, Schutz, & Leshner, 2007). Jams, smoothies, juices, sauces, fruit blends, guacamole, ready-to-eat meat products and seafood, including oysters, are in the U.S., Europe, Australia and New Zealand markets (Stewart, Buckle, & Cole, 2008).

U.S. and European consumers' perceptions of PEF were found to vary from slightly positive (specifically environmentally friendly, product naturalness and better food safety) to negative (skepticism and mistrust towards the technology) (Delgado-Gutierrez & Bruhn, 2008; Nielsen et al., 2009). European consumers' negative associations with PEF might be due to the name (Nielsen et al., 2009) which generated fears of electricity and linked the technology to irradiation and the microwave oven. These links in turn generate unknown long term consequences for PEF processed products (Sonne et al., 2009). Despite the skepticism towards PEF, the technology has been used to process apple juice, orange juice, milk and liquid egg for the U.S. and European markets (Raso-Pueyo & Heinz, 2010, chap. 1).

Communication plays a pivotal role in consumer acceptance of technology (Bruhn, 2007). Providing consumers with accurate information about technology can reduce uncertainty leading to improved liking and purchase intention for treated products (Cardello, 2003; Deliza, Rosenthal, & Silva, 2003; Deliza et al., 2005). Hicks et al. (2009) investigated U.S. consumers' awareness and willingness to pay for HPP processed products. They showed that 39% of the respondents were willing to pay an additional

\$0.25–\$0.50 (regardless of the value of the food product) when given an explanation of HPP and corresponding benefits.

Trade-offs between price and technology

A survey carried out in the U.K., Germany, and France by Butz et al. (2003) reported that while British and German consumers wanted products to have health benefits, they were not willing to pay more than conventionally processed product prices. French consumers were conscious of quality and willing to pay more for the HPP processed products. Jaeger (2003) investigated Brazilian and New Zealand consumers' willingness to pay for Genetically Modified mangos. Initially participants were asked if given a choice would they buy a Genetically Modified or Genetically Modified-free mango when sold at the same price. Participants were also asked whether they would be willing to purchase the Genetically Modified fruit if it was sold at a 10% discount or at 10% premium (Jaeger, 2003). The majority of the Brazilian and New Zealand consumers (83%) perceived price to be less important than concerns over Genetically Modified products (Jaeger, 2003). Similarly, Lee, Lusk, Miroso, and Oey (2014) found that price was not the most important attribute determining Chinese consumers' healthy drink consumption decisions. It was the benefit from the food product that consumers valued (Lee et al., 2014). Chinese consumers' willingness to pay for safe and quality food products as the results of HPP and PEF processing remains unexplored.

While literature presents European and U.S. consumers' perceptions towards HPP and PEF technologies, limited information is available regarding Chinese consumers' perceptions of these technologies. This research addresses this gap in literature by investigating Chinese consumers' knowledge of, perceptions towards, and willingness to pay for HPP, PEF and HT technologies. Specifically, the objectives of this research were to investigate (a) consumers' general knowledge of food processing technologies; (b) the effect of information on consumers' perceptions of HT, HPP and PEF and how these perceptions influence decisions for consuming treated beverages; and (c) consumers' willingness to pay for beverages processed using these technologies.

Materials and methods

Research location and participant selection

Research was conducted in Hangzhou, Zhejiang Province, China. Hangzhou was selected as it is the capital, economic and political center of Zhejiang Province (The Editorial Department of Hangzhou, 2011). The researchers' *guanxi*-based relationship (personal connection) in Hangzhou enabled access to six different companies for participant recruitment and completion of focus groups. Although the six companies fall under one telecommunications umbrella organization, each is otherwise independent.

Participant selection for the focus group was restricted to adults 20 years of age or older, living in Hangzhou, and consumers of healthy beverages. A healthy beverage consumer was defined as an individual who consumed a healthy beverage at least once in the 3 months prior to participating in the study. Individuals were permitted to self-define the term 'healthy beverages'. For the purpose of this research the term 'healthy beverages' was used as a tool to discuss consumers' perceptions towards the technologies. Ethical approval was granted by the University of Otago Human Ethics Committee (Reference number: 12/194).

Focus group procedure

Focus groups were conducted in Mandarin. To ensure that the protocol, language and constructs were appropriate for the Chinese

Table 1
Moderator's guide for each of the four stages of the focus group sessions.

Section 1: General knowledge of food processing technologies

- What food and beverage processing technologies have you heard of?
- What do you think the purposes of food processing technologies are?
- How do you feel about such technologies being used in food and beverage processing?
- How do you feel about having the technology being used to process food and beverages labeled on product packaging?

Section 2: Initial perceptions of HT, HPP and PEF

- What is your initial reaction to these technologies?
- Based on this limited information, which of the three products would you most likely buy? Why?

Section 3: The effect of detailed information on perceptions of HT, HPP and PEF

- If the same beverages were processed in these three different ways, which would you most likely buy? Why?
- What has encouraged or stopped you from choosing HPP and PEF? What would it take for you to choose a beverage which has been treated with HPP and PEF? (Ask these questions only if participants most likely to buy the untreated or the HT processed beverage).

Section 4: Participants' willingness to pay for HT, HPP and PEF treated healthy beverages

- How many of you would be willing to purchase HPP and/or PEF treated healthy beverages if these products were sold at 10% below current market price for a conventional processed beverage (e.g. HT)? Why?
- How many of you would be willing to purchase HPP and/or PEF treated healthy beverages if they were sold at a 10% premium? Why?

Ask participants to fill out questionnaire about socio-demographic details.

**This table does not present the precise questions as asked during the focus groups since the exact way in which the questions were formulated depended on the way in which the discussion developed.*

shelf-life and preserve the quality of the healthy beverages." Participants were then asked to provide their opinion towards these technologies. In addition, participants were asked to imagine they were in a supermarket or a convenience store and had decided to purchase a healthy beverage. Participants were asked to choose which of the three treated products (HT, HPP or PEF) they would most likely purchase through a show of hands and state their reasons why.

The third section of the focus group investigated participants' perceptions of HT, HPP and PEF technologies with the provision of detailed information. The general process of three technologies and how they affect healthy beverages were explained to the participants in a table format (Table 2) and included: description of process, shelf-life, the need for additives, stability of color and flavor, nutritional value, and environmental impacts (Sánchez-Moreno, De Ancos, Plaza, Elez-Martínez, & Cano, 2009; Timmermans et al., 2011). The presented information was designed to provide the outcomes of the application of these processes. To facilitate the understanding of HT, HPP and PEF, the moderator compared these processing technologies to a freshly squeezed healthy beverage. After information was presented, participants were asked to give their opinions of the different technologies and the resulting treated beverages. To understand the effect of this information on participants' stated purchase decisions for healthy beverages, participants were once again asked to imagine they were in a supermarket or a convenience store and had decided to purchase a healthy beverage. Participants were then asked to choose which of the three products (HT, HPP or PEF) they would most likely purchase through a show of hands and state their reasons why.

In the fourth section of the focus groups, participants' willingness to pay for HPP and PEF treated healthy beverages was studied. Participants were presented two purchase situations. In the first situation, participants were asked if they would be willing to purchase a healthy beverage processed by HPP and/or PEF if the beverages were sold at 10% below the current market price for that of a conventionally processed beverage (e.g. HT). In the second situation, participants were asked whether they would purchase a healthy beverage processed by HPP and/or PEF if the product was sold at a 10% premium.

At the end of the focus group, participants completed a socio-demographic questionnaire. Each focus group was audio and video recorded and was approximately one hour in duration. Upon completion of the focus groups, 100 RMB (~USD 16) was given to each participant.

Content analysis

Verbatim transcripts were taken in Mandarin from the audio and video recorders and back translated into English. English transcripts were entered into NVivo 10 (NVivo, 2012), a software package designed for analysis of qualitative data. Data relating to a

culture, two pilot focus groups were conducted in Dunedin, New Zealand (September 2012) prior to the main study in China. Selection criteria for participation in the pilot was identical to the main study with the exception that individuals were of Chinese ethnicity from mainland China living in New Zealand for 2 years or less.

Six focus groups of eight participants each ($n = 48$) were conducted in Hangzhou between December 2012 and February 2013. Focus groups were guided by a moderator and an assistant. The focus group session was divided into four sections, with each section following a set protocol to provoke discussion about different food processing technologies (Table 1).

Section one aimed to understand consumers' general knowledge of food processing technologies. Participants were asked to express their honest thoughts, opinions, and beliefs as there were no right or wrong answers. They were asked what types of food processing technologies they had heard of, their purposes and consequences on the food products.

Section two aimed to investigate participants' perceptions of HT, HPP and PEF technologies with the provision of limited information. Participants were introduced to the three processing technologies (HT, HPP and PEF) and were informed that: "All these technologies can kill bad bacteria and pathogens, extend the product

Table 2
Information scenario given to participants with regards to Heat Treatment, High Pressure Processing and Pulsed-Electric Field for healthy beverages.

	Description of process	Shelf-life	Additives	Color	Flavor	Nutritional value	Water and energy usage	Current practices
Freshly squeezed healthy beverage	Unprocessed	3–4 days	Not required	Unchanged	Unchanged	Unchanged	Minimal amount required	Freshly squeezed vegetable and fruit juice
Heat-treated healthy beverage	Uses heat	6–8 months	Required	Changed	Changed	Changed	Required	Milk, canned food, juices etc.
High Pressure Processed healthy beverage	Uses high pressure (>600 MPa)	6–8 months	Not required	Unchanged	Unchanged	Unchanged	Required less than Heat Treatment	Sliced meats, hams, sauces, juices etc.
Pulsed-Electric Field treated healthy beverage	Uses short bursts of electricity	6–8 months	Not required	Unchanged	Unchanged	Unchanged	Required less than Heat Treatment	Fruit juices, liquid eggs, milk, etc.

particular topic was categorized and given a code. Around 250 free nodes were initially created and later revised and categorized according to specific topic areas. A node tree and different node sets were then constructed within each topic. This was done to understand consumers' general knowledge of food processing technologies, how the effect of information influences consumers' perceptions of HT, HPP and PEF and decisions for their treated beverages, and consumers' willingness to pay for these processed healthy beverages.

Results and discussion

Participant overview

Forty-eight consumers (21 men and 27 women) participated in the six focus groups (Table 3). The majority of the participants were between 20 and 29 years old (69%), single (58%), white collar workers (e.g. office workers and professionals) (83%) with a high income (80%, >30,000 RMB) (compared to the average income of 23,979 RMB per person in 2011, National Bureau of Statistics of China. *Income of Urban, 2012*) and had a university degree (92%).

Knowledge and perceptions of food processing technologies

Chinese participants considered food processing technologies as tools to transform raw materials to food products for consumption (e.g. from malt to bread, raw milk to yoghurt). All participants were familiar with conventional food processing technologies. When asked which food processing technologies they were familiar with, canning, curing, marinating, frying, bottling, pasteurization, fermentation, drying, freezing, and pressing were commonly mentioned.

Participants (>70%) held positive attitudes towards food processing technologies in general. Convenience was considered an important advantage of processed over unprocessed products in terms of transportation (to many other places/countries), storage

(at room temperature), and consumption (availability of finished products). Participants commented that the development of technologies can make food safer, healthier, tastier, more convenient, and cheaper.

Negative perceptions of food processing technologies were also revealed. Approximately half of the participants made negative links between processed foods and safety, nutritional content, and the product's fresh and naturalness. Processing and excess manipulation (e.g. cell destruction) were considered to be negative outcomes of technological development. Similarly, Verbeke, Pérez-Cueto, Barcellos, Krystallis, and Grunert (2010) found European consumers to be critical of excessive intervention and manipulation of food, preferring conventionally processed meat for its simple and minimal processing (Verbeke et al., 2010).

Around one-fifth of the participants in the present study believed that food processing technologies might lead to more expensive products due to transportation, processing, packaging and equipment related costs. Participants were also concerned with environmental consequences of using novel technologies (e.g. water pollution).

Chinese participants viewed food processing technologies as unavoidable due to the modern way of living. Despite concerns and uncertainty towards food processing technologies, participants tended to perceive the benefits of these technologies to be greater than the risks. Participants had few thoughts on whether food manufacturers should provide processing technology information on the product label. Instead, product labeling should emphasize food safety, ingredient and shelf-life information. Participants did comment that technology information is usually 'too technical' and they would not understand it even if provided on the product package. Regardless, there was general agreement that labeling with technology information (even if it is scientific and difficult to understand) is still better than without that information. Such labeling would increase their purchase intention of the product. The provision of technology information has been found to increase consumers' expected liking and purchase intention towards the processed product (Cardello, 2003; Deliza et al., 2003, 2005).

Initial perceptions of HT, HPP and PEF

Six dominant consumer perceptions towards HT, HPP, and PEF were derived from content analyses. Those perceptions included: (1) consumer association with the given technology, (2) trust towards the technology, (3) health, (4) food, (5) taste and quality, and (6) price (see Table 4). To help illustrate each of the dominant perceptions arising from the focus groups, excerpts from the discussions are now quoted. The effect of information on participants' perceptions of different technologies and how this influences their consumption decisions for beverages processed using these technologies is discussed and compared to the Western consumers based on the extant literature.

All participants had heard of HT and had some knowledge about HT processes due to information from the media or product packaging (e.g. pasteurization label on milk products was cited). HT was considered a traditional processing method and closely related to consumers' daily lives with approximately 80% of the participants expressing trust towards HT. However, one-fifth of the participants were concerned with how high temperatures changed a product's nature. One commented: "I'm worried that the product's original state, flavor and its nutritional content will change due to temperature... as far as I understand, milk is not suitable to be heated as the nutrition content will be degraded."

HPP and PEF were unfamiliar terminologies, although 10% mentioned hearing about HPP on the Internet. HPP and PEF are both emerging and non-conventional technologies and a lack of famil-

Table 3
Socio-demographic profiling of focus group participants (n = 48).

Characteristics	Percentages (%) n = 48
<i>Gender</i>	
Male	44
Female	56
<i>Age</i>	
20–29	69
30–39	29
40–49	2
<i>Marital status</i>	
Single	58
Married, without children	17
Married, with children	25
<i>Occupation</i>	
White collar	83
Blue collar	15
Others	2
<i>Annual income (RMB)</i>	
<10,000	6
10,000–30,000	14
30,001–60,000	40
60,001–90,000	17
90,001–150,000	21
150,001–300,000	2
<i>Education level</i>	
Secondary school	2
Polytechnic	6
University	92

Table 4
Summary of dominant consumer perceptions towards Heat Treatment, High Pressure Processing and Pulsed-Electric Field based on the extent of technology information provided.

	Limited technology information			Detailed technology information		
	Heat Treatment	High Pressure Processing	Pulsed-Electric Field	Heat Treatment	High Pressure Processing	Pulsed-Electric Field
Consumer association with the given technology	Traditional processing method has been used for many years Related to daily lives	Complex and sophisticated technology I could not imagine what High Pressure Processing is	Too 'technical' sounds like radiation No idea at all about Pulsed-Electric Field	Traditional processing method	Sophisticated	Too complex I still don't understand how Pulsed-Electric Field works
	Similar to cooking at home	Like pressure cooker	Maybe Pulsed-Electric Field is the best technology but uncertainty exists about it			
	Like heating drinks normally	Like hard tack biscuit Like vacuum packaging Only big companies are capable to use this technology	Like microwave oven Uses electricity May be more environmentally friendly			
Trust towards the technology	I trust this technology	I don't really trust this technology	I don't trust Pulsed-Electric Field	I still trust this technology because it is the conventional method that has been used for many years	I trust High Pressure Processing	I still don't trust Pulsed-Electric Field
	I am a conservative person, Heat Treatment is the safest processing technology for me Cooked food is safer	It is too sophisticated	It doesn't feel safe I am scared of electricity		High Pressure Processing is closer to our daily lives as opposed to Pulsed-Electric Field Young consumers are more accepting of this new technology	I am scared of electricity I am worried that Pulsed-Electric Field will have radiation side effects
Health	May not be as healthy as fresh product	May not be as healthy as fresh product	May have harmful side effects to health	During processing, additives may be added that will harm health	No additives are added Healthy, nutritious	No additives are added May have radiation and harmful side effects on health
Food safety	Microorganisms are killed	Microorganisms may be killed	Microorganisms may be killed	Can effectively kill microorganisms	Can effectively kill microorganisms	Can effectively kill microorganisms
Taste and quality	May alter product's original state and flavor May cause loses in vitamin content	May alter product's shape and flavor May cause nutritional loss	May alter product's original state and flavor May kill all good and bad bacteria and cause nutritional loss	The product's flavor is changed Cause loses in nutritional content	Flavor, color and nutritional content remained unchanged The freshness of food product is preserved	Flavor, color and nutritional content remained unchanged
Price	–	–	–	–	May result in more expensive food product	May result in more expensive food product

ilarity is not surprising (Hendrickx & Knorr, 2002, chap. 9; Soliva-Fortuny, Balasa, Knorr, & Martin-Belloso, 2009).

HPP was considered a complex and sophisticated technology. Around 10% of the participants were uncertain about HPP and worried that the product's shape, flavor and nutritional content may be altered due to the high pressure: "Will HPP compress or squeeze the food product and change the shape of it like the hard tack biscuit selling on the market? Will the pressure cause any changes to the flavor and nutritional content of food?"

The name 'Pulsed-Electric Field' evoked negative feelings among most of the participants, whose primary associations were with electricity, radiation, and harmful side effects. Fear, suspicion

and uncertainty towards the degradation of flavor and nutritional content were expressed: "Scare! I hear 'Pulsed-Electric Field' and I imagine electricity! I've never heard of it. Maybe PEF is the best technology overall but I am really unsure about it. . . ."; "Radiation, PEF, microwave oven. . . . it is confusing! I have no concept about PEF at all! It's too professional to me."

Following the discussion of initial perceptions towards HT, HPP and PEF, participants were asked their purchase intention for healthy beverages processed using each of these technologies (Fig. 1). Fifty-six percent indicated a purchase intention of HT processed beverages while 31% and 13% would purchase HPP and PEF processed beverages, respectively.

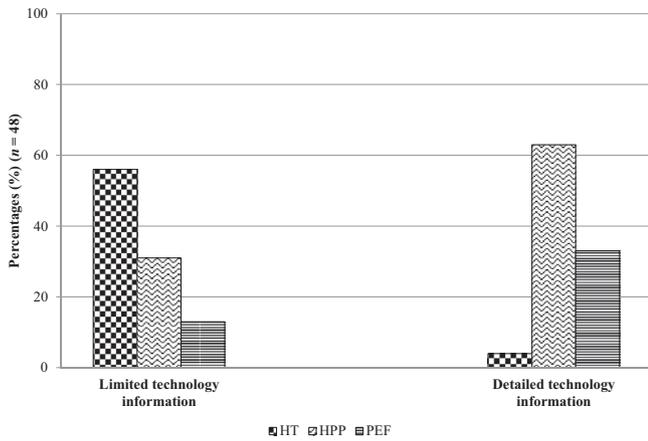


Fig. 1. Chinese participants stated purchase intention for preferred healthy beverage based on the extent of technology information provided ($n = 48$).

Those choosing to purchase HT (56%) processed beverages indicated that concerns over food safety lead them to choose the most familiar technology. Similarly, Cardello (2003) showed that U.S. consumers had lower concern levels for conventional processing such as heat pasteurization than HPP technology. With the provision of limited technology information, HPP and PEF were perceived as high-risk technologies. Participants high-risk perception of PEF parallels Nielsen et al. (2009) where participants' fear towards PEF was expressed through notions of radiation, electricity, cell destruction, and microwaves due to information deficit.

The effect of detailed information on perceptions of HT, HPP and PEF

Participant anxiety towards HPP and PEF diminished with the provision of detailed technology information emphasizing the process, its safety and benefits. This is illustrated in the following two exemplar quotes: "Most importantly, HPP and PEF can minimize or eliminate the need for additives throughout the processing. It's good for my health!" and "After the explanation, I'd probably buy HPP and/or PEF treated products because safety will be guaranteed."

Price emerged as a concern since participants perceived HPP and PEF treated food and beverage as value-added products. Sixty percent of the participants stated that HPP and PEF treated healthy beverages would result in more expensive products as these technologies involve more complex processing and technological issues as compared to HT.

Participants were asked which of the healthy beverages processed using these three technologies would they prefer (Fig. 1). Fifty-two percent of the participants who had previously said that they would purchase HT healthy beverage changed their preferred purchase decision. Sixty-three percent now stated that they would purchase HPP treated healthy beverage. Intention to buy PEF treated healthy beverage has increased significantly from 13% to 33%. Only 4% of participants mentioned that they would still prefer to purchase HT processed healthy beverages.

The perceptions of risks and benefits are important determinants influencing consumers' acceptance and purchase decisions for technology processed food product (Rollin, Kennedy, & Wills, 2011). Consumers purchase a product if they perceive benefits in that product (Deliza et al., 2005). The greatest advantage of HPP and PEF that contributed towards participants' positive perceptions and increased purchase intention was associated with the technologies ability to minimize or eliminate the need for additives (e.g. preservatives, colorings, etc.). The addition of additives was considered a very negative outcome of technological development. This explains why 52% of the participants changed their purchase

decisions from HT to HPP and/or PEF after the provision of detailed information. A recent report revealed that seven out of ten Chinese consumers were trying to avoid drinks with artificial ingredients, with the majority wanting to purchase drinks with natural ingredients (Brenchley, Trombini, & Lintott, 2012). The reduction of preservatives in HPP and PEF processed products has contributed to positive consumer perceptions of these technologies resulting in increased product preference and satisfaction (Nielsen et al., 2009). Similar to European consumers (Nielsen et al., 2009), Chinese consumers tended to appreciate the expected naturalness, improved taste and high nutritional value of the HPP and PEF processed products.

While the focus group participants seemed to appreciate the benefits of HPP and PEF technologies (e.g. kill microorganisms, extend product shelf-life, and preserve the product's flavor, color and nutritional content without the need of additives), only a third of the participants chose to purchase PEF treated healthy beverage as opposed to the 63% who chose HPP processed. The participants were concerned about the long-term effect of consuming PEF treated foods. Participants claimed that more solid research must be carried out to demonstrate product safety. Sonne et al. (2012) also found European consumers more accepting of HPP than PEF as it was perceived to be a more "natural" technology. Overall, information about the processing technology was useful in developing a more positive attitude towards HPP and PEF food products.

Participants' willingness to pay for HT, HPP and PEF processed healthy beverages

When participants were given the scenario that HPP and PEF treated healthy beverages were to be sold at 10% below current market price for a conventionally processed healthy beverage (e.g. HT), the majority of the Chinese participants (96%) were willing to purchase these products (Fig. 2). The fact that HPP and PEF products were sold at cheaper prices further motivated Chinese participants' purchase intention.

When participants were asked if they would purchase HPP and/or PEF treated healthy beverages if sold at a 10% premium compared to HT, 90% were willing to purchase the product at the premium. The willingness to pay a premium for these products indicates participants perceived HPP and PEF foods to be value-added products.

Lee et al. (2014) also found price not to be an obstacle for Chinese consumers to acquire premium quality food products. Other studies have made similar claims about an emerging segment of

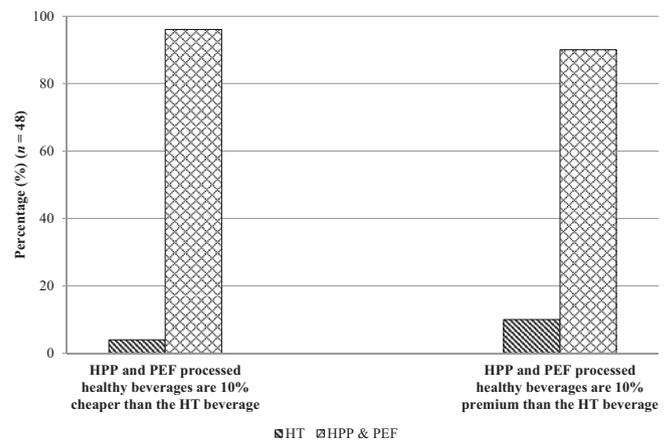


Fig. 2. Chinese participants' willingness to pay for healthy beverages processed by Heat Treatment, High Pressure Processing and Pulsed-Electric Field ($n = 48$).

high-end consumers who are willing to pay a modest premium for nutritious, safe, and quality food products in China (Wang, Zhang, Mu, Fu, & Zhang, 2009; Xu, Zeng, Fong, Lone, & Liu, 2012).

Implications for communicating technology information to Chinese consumers

The lack of consumer knowledge for innovative and emerging food technologies can impede their uptake (Behrens, Barcellos, Frewer, Nunes, & Landgraf, 2009; Mújica-Paz, Valdez-Fragoso, Samson, Welti-Chanes, & Torres, 2011). Effective communication of processing technologies and their benefits is essential for the successful marketing of food processed using novel technologies in China.

This study revealed that the detailed information about the processing technology substantially increased Chinese consumers' purchase intention towards the HPP and PEF treated healthy beverages. According to Deliza et al. (2003), providing adequate and true information to consumers may help them to make their food choices. The question is how much information is considered adequate? In the research by De Barcellos et al. (2010), the authors reported that European consumers did not want to have detailed knowledge of the production process, but rather preferred a conscious 'lack of knowledge'. In contrast, Chinese participants indicated more information should be given about the benefits of HPP and PEF processing in addition to the scientific information behind these technologies.

The principle of these technologies and the benefits on food products could be provided to Chinese consumers in detailed brochures or videos. Educating consumers about HPP and PEF would likely decrease the level of consumers' perceived risk and increase trust towards the products of these technologies. The issue of additives was of particular interest to the Chinese participants. When promoting HPP and PEF treated foods, a useful communication tool would be presenting consumers with labels highlighting the minimal use of additives.

Media visibility (e.g. television, radio, internet, newspaper and magazine) is integral to promoting food products (Kotler, Roberto, & Lee, 2002, chap. 2). Advertisements could include promoters such as the public health authorities (e.g. Ministry of Health China) and the academy (e.g. university researchers). Since science and technology are areas where many consumers lack knowledge, food consumption decisions may be highly influenced by trust in social institutions that promote and introduce technological novelties in the market (Behrens et al., 2009). Previous research demonstrated that advertisements tend to be more effective when opinion leaders (e.g. political leaders, scientists, and experts) recommend or promote products to target Chinese consumers (Lowe & Corkindale, 1998).

Conclusions

Focus group discussions suggest that Chinese participants were generally open-minded and receptive towards HPP and PEF technology. In order to increase awareness of HPP and PEF technologies among Chinese consumers, information regarding the processing technologies and associated benefits to foods should be given. The reduced need for additives in HPP and PEF treated foods, compared to HT was of particular interest to Chinese consumers. Price was found to be a less important factor in determining purchase decisions about HPP and PEF treated healthy beverages. Participants were willing to pay a premium for HPP and PEF products once detailed information about the technology was provided. Therefore, consumer education is essential for successful marketing of non-thermal processed products. Nevertheless, education

should start with the food manufacturers by including the non-thermal technology information on the product label informing consumers of the benefit of this technology on the product.

Future cross-cultural analyses comparing consumers' perceptions of HPP and PEF technologies from different cultures and socio-demographics characteristics (within China) or countries are warranted. Insights gained in this study indicate an opportunity for HPP and PEF processed food to enter the Chinese market. However, the success of such products in the Chinese market is dependent on effective communication of the benefits these technologies have on foods.

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