

Consumer perceptions on the origin of infant formula: a survey with urban Chinese mothers

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Research Article

Cite this article: Shan LC, Li C, Yu Z, Regan Á, Lu T and Wall P (2021). Consumer perceptions on the origin of infant formula: a survey with urban Chinese mothers. *Journal of Dairy Research* **88**, 226–237. <https://doi.org/10.1017/S0022029921000364>

Received: 14 May 2020

Revised: 15 February 2021

Accepted: 16 February 2021

First published online: 17 May 2021

Keywords:

China; consumer; infant formula; product origin; survey

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Abstract

The consumer survey reported in this research paper aims to understand how Chinese mothers learn about and confirm the origin of powdered infant formulas (henceforward formulas), their knowledge level and preferences between formulas from different origins. With globalization, dairy companies can source ingredients for domestic production and manufacture finished products across the world. Chinese consumers are now facing a variety of formulas with different brand origin, main ingredient origin ('*nai yuan*'), manufacturing origin, and country-of-purchase. Drawing on a large representative sample of Chinese mothers who have purchased formulas, we found that most of them had intensively engaged in learning about and confirming formulas' origin through different strategies. However, they may not interpret related cues correctly: a majority of Chinese mothers incorrectly considered the 'main ingredient origin' as the 'manufacturing place' and could not necessarily recognize between 'foreign' and 'domestic' brands. Among formulas from different origins, authentic foreign branded, produced and packaged formulas showed a high popularity in Tier 1 & 2 cities and among more knowledgeable consumers. In low-tier cities, these products were equally popular as domestically branded and produced formulas using imported milk powders and other ingredients. Formulas directly acquired from overseas markets through unofficial channels were least favoured by consumers. The study shows that Chinese consumers' previous one-sided endorsement towards foreign formulas appears to have weakened. Decisions made by formula companies on the origin of the main ingredient and the place of manufacture would influence product attractiveness, and the segments of Chinese consumers to target.

In China, the landscape of the powdered infant formula (formula) supply chain and the regulations governing it have dramatically changed over the past decades. Under globalization, even before China officially became a member of the World Trade Organization (WTO) in 2001, twelve out of the twenty largest international dairy companies had established their production facilities in China (China Central Television, 2002). The largest formula manufacturers, such as Nestle, Wyeth, Abbott and Mead Johnson have all opened factories in China. These companies are producing differentiated dairy and formula products, either from their overseas factories or the Chinese factories which serve different consumer segments within the Chinese market.

The 2008 melamine crisis brought the dairy industry in China to a major crossroads. The crisis involved milk and infant formula being adulterated with melamine, a dangerous chemical, resulting in catastrophic societal impacts, including the hospitalization of over 50 000 infants and the death of 6 (Chen, 2009). Consumer confidence in domestically branded and produced formulas plummeted. In the years subsequent to the melamine crisis, China instigated a campaign to strengthen food safety control in the country. For example, during the past decade it has released its most stringent Food Safety Law in history and launched over 20 policies and regulations specifically focused on dairy products (State Council of P.R. China, 2013). The Chinese dairy industry has also taken steps to regain consumer confidence, for example, the introduction of state-of-the-art production facilities from overseas, consolidation among infant formula enterprises, creation of large-scale milk production units and standard farms, and more emphasis on food safety at all stages of the supply chain (Institute for Agriculture and Trade Policy, 2014; Xinhua Net, 2016). By 2018, 6 Chinese dairy companies had reached a revenue of over ten billion RMB (1.42 billion US dollars), with Yili and Mengniu ranked as the two largest players in the Asian dairy industry (Xinhua Net, 2019). These companies have also expanded their upstream agribusiness value chain overseas (Zhao, 2017). By the end of 2018, 17 Chinese dairy companies have invested

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in New Zealand, Australia, Ireland, France, Canada, Russia, and Southeast Asia, in areas such as the production of formulas and raw milk powders, as well as dairy farming (Xinhua Net, 2019). In China, it is becoming increasingly common to see domestically produced formulas using milk powders sourced from overseas, and imported formulas produced by Chinese companies from their overseas factories (Zhao, *et al.*, 2019). With the phenomenon of globalization, dairy companies can now source ingredients and manufacture finished product across the world. The boundary between 'imported/foreign' vs. 'domestic' products has blurred significantly. As a result of globalization, the geographical origin of formulas has become more complex and increasingly difficult for the consumer to identify or to use as a quality signal.

It is not always a simple task for a consumer to tell the quality of a product. Three categories are often used in relevant literature to characterize goods based on the different levels of difficulties involved in the quality assessment and the associated information search by consumers (Loureiro and McCluskey, 2000). The quality of search goods (e.g. a flower) can be identified relatively easily by visual observation at the time of purchase. To assess the quality of experience goods (e.g. a bottle of wine), consumption and certain level of expertise will be required. When it comes to evaluating the quality of credence goods (e.g. vitamin supplements), observations and consumption may not be sufficient. Infant formula can be seen as mainly experience goods, the nutritional compositions and origin associations of which also exhibit credence attributes. Asymmetric information problems often occur for experienced goods and credence goods, therefore, consumers often rely upon different types of instruments to reduce the risk caused by the asymmetric information problems and to lower the cost of searching. Such instruments may include quality certifications from regulatory authorities, the reputation of the manufacturer brand, or the perceived quality based on the product origin, etc. (Caswell and Padberg, 1992; Loureiro and McCluskey, 2000; Aprile *et al.*, 2012; Xie *et al.*, 2016; Yang *et al.*, 2018; Wang *et al.*, 2019; Vuong and Khanh Giao, 2020).

Often seen by consumers as a quality signal, the country of origin (COO) labelling aggregates many intrinsic and extrinsic product attributes linked to the product origin (Loureiro and Umberger, 2007). The use of COO labels on food products has expanded quickly in the last decade, reflecting the increasing importance of using this attribute as a way of product differentiation in the marketplace. Different levels of geographical regions can form the base of the COO related labels: a country can be used as the product origin (e.g. Made in Germany); a smaller geographical area within a country, where given quality, reputation, or other characteristic of the good is essentially attributable to, can be used to promote certain products (e.g. Parma ham, Burgundy wines) and a group of countries can also be promoted under the same 'umbrella' geographical origin (e.g. product from the EU) to capitalize the collective reputation beyond country borders (Menapace, *et al.*, 2011; EU Commission, 2015).

Extensive research studies have documented the effects of COO labelling on consumers' perception of product quality and consequently the influence on consumer preference and purchasing behaviours. Evidence has shown that consumers exhibit different levels of preference for products from different countries or regions, COO labels have an effect on consumers' purchase intention, and consumers are often willing to pay a price premium for products that carry certain origin attributes (Maheswaran, 1994; Loureiro and McCluskey, 2000; Loureiro and Umberger, 2007; Diamantopoulos, *et al.*, 2011; Menapace,

et al., 2011; Aprile, *et al.*, 2012; Gao, *et al.*, 2014; Xie, *et al.*, 2016; Wang, *et al.*, 2019). Previous studies have shown that product origin exerts substantial influence on Chinese consumers' (especially first-time parents) evaluation and purchasing of formula, with imported products being preferred by a large proportion of consumers because of their high confidence in product quality and safety from developed Western countries (El-Benni, *et al.*, 2019; Gong and Jackson, 2013; Li, *et al.*, 2017; Kendall, *et al.*, 2018; Yang, *et al.*, 2018; Zhang, *et al.*, 2018). Country stereotypes, consumer ethnocentrism, product familiarity and experience, product involvement and some cultural value differences were found to drive the country-of-origin effects (Chattalas, *et al.*, 2008; Yang, *et al.*, 2018).

One main critique of the research literatures on COO effect is the lack of consistency and clarity of the COO construct, in other words, there has been high level of confusion as to what 'origin' and its associated terms mean (Roth and Diamantopoulos, 2009; Gürhan-Canli *et al.*, 2018; Ingenhoff, *et al.*, 2019). The cross-board and multi-country nature of the global value chain structure and the increasing complexity of production facilitation for global companies means that the COO construct has become more complex. Loosely using the terms of 'country of origin' to conduct COO research may lead to insufficient research design and derives findings and implications that are less relevant in providing practical insights to regulators and marketers.

There is no precise definition of 'product origin': its meaning depends on each individual company's communication and consumer perception (Yang, *et al.*, 2018). The origin of infant formula can involve three dimensions: brand origin (i.e. the place/country/region where the brand was founded and developed), origin of the main ingredients (i.e. the origin of the milk from which the various milk powders and proteins were derived) and manufacturing origin (i.e. place of production and packaging) (Li, *et al.*, 2011; Yang, *et al.*, 2018). These dimensions have been highlighted in the marketing and advertising of formulas (Zhao, *et al.*, 2019). In addition, there is a fourth element: place-of-purchase. Some affluent Chinese consumers have low confidence in formulas sold domestically, and make direct purchase of formulas from foreign countries, usually through their friends and relatives overseas, purchasing agents, and overseas eCommerce platforms (Hanser and Li, 2015). It has been estimated that direct overseas acquisition accounts for nearly 20% of China's formula market share over the past few years (Li, *et al.*, 2019).

There is limited understanding on Chinese consumers' conceptualization and knowledge of formula's origin. Preliminary qualitative studies suggest that Chinese consumers lack the ability to correctly interpret cues about origin. For instance, they were not necessarily able to distinguish some domestic and foreign brands, and they had low awareness of the complex supply chain underlying international brands (Gong and Jackson, 2012; Hanser and Li, 2015; Kendall, *et al.*, 2018). There is a lack of quantitative insights on this issue. On the market, Chinese consumers are confronted with a wide range of choices from formulas imported in their original packaging (with either foreign or Chinese brands), to domestically produced formulas (either Chinese or foreign branded). It is unknown how these product categories are perceived differently by Chinese consumers.

To address these knowledge gaps, the current quantitative study mainly aims to investigate (1) how Chinese consumers learn about and confirm the geographical origin of infant formula; (2) their knowledge level on issues around this and (3) their perceptions and preferences between categories of formulas

from different origins. The consumer insights generated from this study can help dairy companies to navigate their advertising and supply-chain distribution strategies, and to assist any public communication campaigns to empower the decision making of formula consumers.

Materials and methods

Data collection and sample

An online anonymous survey was carried out to collect data in March 2020. Given that females typically are more engaged in child-raising and food shopping, the participants were Chinese mothers with children between 0 and 3 years, who had purchased infant formula during the past three years, including baby formula (0–6 month), follow-on formula (6–12 month) and toddler formula (from 12 month on). To be eligible, the participant must have had a role in the purchasing decisions. On behalf the research team, a well-known global market research firm administered the survey and recruited the participants from their existing mothers' panel, which has over 500 000 active members across different geographical regions, and socio-economic backgrounds. Participants were recruited from 57 cities in 31 provinces/municipalities (i.e. China's highest level of administrative divisions) across all seven geographical regions (i.e. Northwest China, North China, Northeast China, East China, Southwest China, Central China and South China). Soft quotas were set up to make sure the sample reflected the national population's geographical distribution, and to make sure 50% of participants were from developed cities (i.e. tier 1 and 2 cities) and the other 50% were from less-developed cities (i.e. low-tier cities). The survey was scripted online. Participants accessed the survey through their digital devices such as computers, tablets and mobile phones. The survey took approximately eight minutes to complete. The research received research ethics exemption (reference number: LS-E-20-10-Shan-Wall) from the Office of Research Ethics at University College Dublin. Informed consent was obtained from each participant.

Questionnaire

The questionnaire was led by a consumer scientist and co-designed with a professional working in the formula industry. Both of them were Chinese native speakers, thus the questionnaire was initially developed in the Chinese language, and the translation was only used for discussions with team members who are English speakers. Demographic and background questions were placed at either the beginning or the end of the questionnaire, depending on whether the question was used for screening eligible participants.

The survey began with a question on factors influencing formula purchasing decisions, in order to understand the importance of product origin in a wide decision-making context (Table 2). Response options for this question were informed by literature (El-Benni, *et al.*, 2019; IIMedia Research, 2019). Next, participants were asked about whether and how they had learned about/confirmed the origin of formulas (Table 3). The response options were based on expert tips for formula consumers (State Administration for Market Regulation, 2016, 2018; Xinhua Net, 2017), and a quick review of companies' communications about formulas origin on JD.com and Tmall.com (i.e. Alibaba) – China's top two eCommerce platforms. The third section included five questions identifying Chinese mothers' knowledge

level on formula origin (Table 4). The questions were based on the landscape of formula production, formula-related national policies and standards (Ministry of Health of P.R. China, 2011; State Administration for Market Regulation, 2016) and previously identified consumer concerns and knowledge gaps as reported in media and literature (Hanser and Li, 2015; Xinhua Net, 2017; Kendall, *et al.*, 2018; IIMedia Research, 2019). Lastly, two questions (Table 5) were included to examine Chinese mothers' risk perception and preferences for six categories of formulas that are currently on the market. These categories have different brand origins, main ingredient origins, manufacturing origins and purchasing places.

The questionnaire was pilot tested with seven Chinese mothers who had purchased formulas. A further test was conducted after the questionnaire was scripted online, to make sure all logical paths functioned properly, and that the survey interface was user-friendly on different digital platforms.

Data analysis

Data analyses were conducted using IBM SPSS Statistics version 24. To enable cross-groups comparison, education status was recoded into two categories – high (with university degrees) and low. Income levels were merged into two categories – high (15 000 RMB and above per capita per month) and low. By using 15 000 RMB as the threshold, we ended with two groups with similar sample size. Knowledge about formula origin was computed as a score: the full score was 5 points (i.e. 1 point for each of the five questions); and for each question, the score was the percentage of answering options that the participant selected correctly. Participants' knowledge scores were normally distributed as shown in the histogram, and were merged into three categories: high (3.89–5.00, i.e. top 23.5%), medium (2.89–3.88, i.e. middle 51.4%), and low (lower than 2.89, i.e. bottom 25.1%). χ^2 tests were carried out to compare population groups on categorical variables. Independent *T* tests and one-way ANOVA tests were used on continuous variables, depending on whether the comparisons were between two or three groups. A one-way repeated measures ANOVA with the post-hoc Bonferroni test was applied to compare participants' risk perceptions of different categories of formulas.

It is worth mentioning that following a reviewer's suggestion, the authors performed another classification of participant's knowledge scores – high (top 33.3%, middle 33.3% and bottom 33.3%), and re-run all the analysis to check the stability of results. The old and new classifications showed very similar results, which confirmed the stability of our results.

Results

Participant characteristics

Participant characteristics have been summarized in Table 1. A majority of the participants were young mothers below 35 years (90.8%) and had completed university-level education (72.6%). The sample was biased towards better educated mothers, partly because all participants were recruited from cities. Around half of the participants (51.1%) purchased both domestic and foreign formulas; 26.2% solely relied on foreign products and 22.5% solely relied on domestic products. Offline maternal and infant shops (70.3%) and domestically-based cross-border eCommerce platforms (49.7%) were participants most-used purchasing channels.

Table 1. Characteristics of the sample (N = 1000)

Sample characteristics	%	% (population ^a)
Age ^b (yr)		
18–25	14.8	
26–30	50.6	
31–35	25.4	
36–40	7.3	
41–50	1.9	
Geographical area		
North China	12.0	12.3
Northeast China	8.0	8.2
East China	30.0	29.7
Central China	16.0	16.2
South China	12.0	11.9
Southwest China	15.0	14.4
Northwest China	7.0	7.2
Residential place ^c		
Tier 1	15.1	
Tier 2	35.4	
Low-tier cities	49.5	
Education		
Secondary school and below	2.7	
College, senior occupational/technical school	24.7	
University bachelor's degree	68.5	
Master's degree or higher	4.1	
Occupation status		
Working full-time	59.1	
Working part-time/freelance	16.2	
Housewives	24.7	
Household gross monthly per-capita income		
less than RMB 6000	2.0	
RMB 6000–9999	14.2	
RMB 10 000–14 999	31.9	
RMB 15 000–19 999	31.3	
RMB 20 000 and higher	20.4	
Refuse to answer	0.2	
Role in making purchase decisions of infant formula ^d		
Sole decision-maker	95.7	
Joint decision-maker	4.3	
Current status (multiple choices) ^e		
A mother of child(ren) under 1 year	25.4	
A mother of child(ren) between 1–3 years	77.5	
Type of product purchased in the past three years (multiple choices) ^f		
Baby formula (0–6 month)	66.3	

(Continued)

Table 1. (Continued.)

Sample characteristics	%	% (population ^a)
Follow-on formula (6–12 month)	68.9	
Toddler formula (from 12 month on)	65.6	
Origin of the infant formula that your child(ren) mainly consume (select maximum 2 options)		
China	73.6	
Europe	31.0	
Australia and New Zealand	53.7	
United States	8.4	
Other country	0.9	
Unsure	0.2	
Main purchasing channels (select maximum 2 options)		
Offline supermarkets	30.4	
Offline maternal and infant shops	70.3	
Domestic eCommerce platforms	23.0	
Domestically-based cross-border eCommerce platforms (e.g. Alibaba Tmall International, JD.com Worldwide)	49.7	
Overseas direct purchasing (e.g. through friends, relatives, shopping agents and overseas online shopping websites)	14.3	

^aPopulation statistics is based on census data (National Bureau of Statistics of P.R. China, 2011).

^bScreening question: participants who selected 'under 18 yrs' or '50+' were screened out, because it is very rare that a women older than 50 years is a mother of 0–3 year-old kids.

^cThe Chinese city tier system is a hierarchical classification of cities, which has been widely used by analysts to study consumer behaviour, income level, and local trends to help business strategies. Cities at a higher tier are larger and more prosperous than cities at a lower tier. Tier 1 cities include: Beijing, Shanghai, Guangzhou and Shenzhen. Tier 2 cities include Tianjin, Chongqing (i.e. two out of four municipalities under the direct administration of central government) and a majority of provincial capitals. Low-tier cities mainly include prefectural-level cities.

^dScreening question: participants who selected 'The decision was made by others' was screened out.

^eScreening question: participants who selected 'Neither' was screened out.

^fScreening question: participants who selected 'I have not purchased any of the above products in the past three years' was screened out.

Factors influencing the purchase of formulas

Purchasing decisions were mostly influenced by the nutritional profile (61.8%), followed by place/country of main ingredients (49.1%), the baby/infant's reaction to the product (42.2%) and claims suggesting no additives (39.1%) (Table 2). Factors relevant to the origin of the formula demonstrated various levels of importance: main ingredient origin was highly important, especially among tier 1 (62.7%) and tier 2 cities (52.7%), and higher-income groups (52.6%). Brand (33.3%) and manufacturing origin (31.4%) were moderately important, and the purchasing place was least important (15.5%).

Strategies used to learn about/confirm the origin of the formula

Over 90% of participants had engaged in learning about or confirming the origin of formulas (Table 3). Different strategies were used by the participants to do this. Almost 60% of participants

Table 2. Factors influencing Chinese mothers' purchasing decisions of formulas ($N = 1000$)

When purchasing formulas, what factors influence your decisions most? (select maximum 5 options)?	%
Nutritional composition and nutritional substances	61.8
Place/country of main ingredients	49.1
If the baby/child likes the product	42.2
Claims suggesting free from a certain additive	39.1
Brand	33.3
Place/country of production	31.4
Manufacturing methods (dry mix, wet mix, produced directly from the liquid form of milk)	28.6
Hypoallergenic formula (i.e. allergy friendly)	27.6
Anti-counterfeit designs, availability of traceability information	23.1
Organic	23.0
Recommendation from whom I trust	19.0
Price, sales promotion	17.0
Purchasing place (domestic, overseas)	15.5
Other	0.0

Note: answering options were presented in a randomized order for each participant.

had paid attention to communications of product origins in formula advertisements. Participants primarily relied on labels on the packaging (especially the origin of the main ingredient, details on the production place) and manufacturer's traceability platform/official website to verify the product origin. It is worth noting that 31.9% of participants would also check the prefix code within the bar code – a country code indicating where the manufacturer is registered. Only a small percentage of participants would check the manufacturer's record or the product's certificate made available by the government. Cross-group comparisons revealed substantial differences among groups. A general pattern was that participants at a higher social-economic status (i.e. higher tier cities, higher income and education levels) were more likely to use a variety of strategies to learn about or verify formulas' origins.

Knowledge of formulas' origins

Participants performed better on some questions than others (Table 4) and the results did show a few knowledge gaps. Over half of the participants incorrectly considered 'place/country-of-production' as 'origin of the main ingredient' (Q1). The former concept, according to the national rules for food labelling (GB7718-2011), refers to the manufacturing place, which in many cases is not the place where the milk is collected. A large proportion of participants were not aware of the 'foreign' nature of certain brands which have gained high market share in China (e.g. Wyeth, Abbott, Aptamil) (Q2). Participants performed relatively well on the rest of the test: a majority were aware that the brand origin may not indicate the main ingredient origin or manufacturing origin (Q3), consumers can obtain authentic imported formulas through domestic regular channels (Q4), and formulas directly purchased from foreign countries involve high risks (Q5). It is worth noting that over 40% of

participants did not know that China now requires that imported pre-packaged foods (including formulas) must bear Chinese labels (Q3, the third item). Overall, participants from different demographic groups performed similarly on this knowledge test.

Risk perception and purchase intention of formulas from different origins

Chinese mothers were presented with six categories of formulas from different origins. In terms of product safety and quality, all categories were perceived 'reliable' or close to 'reliable' (except for category 6 – foreign-branded formulas directly purchased from overseas market through unofficial channels) (Table 5). 'Foreign-branded formulas imported in their original packaging' (category 4) were perceived safer and better quality than other categories by a small margin.

Despite minor between-category differences in terms of risk perception, when being asked about the purchase intention, participants expressed clear preferences for certain categories over the other. The top two favoured categories were foreign-branded formulas imported in their original packaging (category 4, 44.7%) and domestically branded and produced formulas using imported main ingredients (category 2, 35.5%). An interesting pattern observed was that participants from Tier 1/2 cities and those at a higher socio-educational status expressed a strong preference for category 4 over category 2; in comparison, their counterparts almost equally preferred these two categories. Lastly, participants expressed least interest in formulas directly purchased from a foreign country through unofficial channels (category 6, 12.5%).

Discussion

The current study offers unique insights with regards to Chinese consumer perceptions of formulas' origin. Drawing on a big sample of Chinese mothers from cities of four tiers in different geographical regions, our study investigated how consumers learn about formulas' product origin, what their knowledge levels are and their preferences between formulas from different origins. The findings have strong implications for the dairy industry both in China, and globally.

Our study confirmed the importance of product origin in consumers' formula purchasing behaviour. Especially in Tier 1 and 2 cities, and among those at a higher social-educational status, product origin was second only to the product's nutritional profile in influencing consumers' purchasing decision-making. Over 90% of Chinese mothers made an effort to learn about and confirm the production origin.

In China, product origin is frequently featured in formula advertisements on different media channels, conveying messages such as '100% produced and packaged overseas', and imported good-quality main ingredient ('nai yuan'), which is usually accompanied by imagery of green pastures and blue skies – symbols of an unpolluted natural environment (Gong and Jackson, 2013; Zhao, *et al.*, 2019). Our results showed that Chinese mothers did pay attention to the product origin information in the advertisements, however they also intensively used other means (especially labels on the packaging, and manufacturer's official website/product traceability platform) to confirm. From a cultural perspective, Chinese consumers are risk averse – they tend to collect more information to reduce uncertainties and avoid risks (Yang, *et al.*, 2018). For dairy companies, this suggests the importance of carefully providing complete and consistent

Table 3. Percentages of participants who used a given strategy to learn about or confirm the origin of formulas

	Total (N = 1000)	Rank	City tier			P value ^a	Education		P value	Income		P value	
			Tier 1	Tier 2	Low-tier		High	Low		High	Low		
Have you ever learned about/confirmed the origin of formulas you purchased?													
Yes	91.7		99.3	95.8	86.5	***	92.8	88.7	*	96.5	86.5	***	
<i>(If answering 'yes' to the above question) How have you learned about/confirmed the product origin? (multiple-choice)</i>													
<i>(Product advertising)</i>	• Advertisement/marketing communication, such as 'main ingredients ('nai yuan') sourced from country X', 'main ingredients ('nai yuan') sourced from advantageous dairy farming areas'	37.2	5	50.5	41.7	30.1	***	41.5	25.9	***	41.4	32.4	**
	• Advertisement/marketing communication, such as 'imported from country X in the original packaging/container', '100% imported from country X'	40.9	4	48.7	43.7	36.6	*	44.4	31.8	***	47.2	34.1	***
<i>(Labels on the packaging)</i>	• Information about the source of the main ingredients on the packaging (e.g. the ingredient – whole milk powder is from country X')	48.2	3	56.7	51.5	43.2	**	50.3	42.7	*	50.1	46.2	
	• Place/country of production, manufacturer details on the packaging	60.9	1	70.7	70.4	51.1	***	64.7	50.7	***	65.4	56.1	**
	• The first few digits of the bar code on the packaging	31.9		36.0	30.7	31.5		30.7	35.0		34.0	29.7	
	• If the product is labelled in a foreign language	21.6		20.0	17.5	25.1	*	20.0	25.9	*	21.7	21.6	
<i>(Further information seeking)</i>	• Check product traceability information or the official website of the manufacturer	48.7	2	62.0	56.6	39.0	***	51.8	40.5	**	56.3	40.5	***
	• Confirm the manufacturer's details on governments' website (e.g. China's Certification and Accreditation Administration)	25.1		44.0	24.8	19.6	***	25.3	24.5	***	28.2	21.8	*
	• Request or inquire the product's inspection and quarantine certificate	13.0		24.0	13.8	9.1	***	14.2	9.9		15.7	10.0	**
Other	0		0	0	0		0	0		0	0		
(Product advertising)^b	59.3		70.0	62.1	54.1	**	62.9	49.6	***	65.0	53.0	***	
(Labels on the packaging)^c	87.2		94.0	91.8	81.8	***	87.9	85.4		90.3	84.0	**	

Background colour: dark grey – over 60%; grey – 50.1–60%; light grey – 40.1–50%.

^aLevel of the significance of statistical differences between demographical groups, based on χ^2 tests.^bPercentages of participants who selected any item under the 'product advertising' category.^cPercentages of participants who selected any item under the 'labels on the packaging' category.* $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$.

Table 4. Participants' knowledge on origins of formulas (*N* = 1000)

Items	%	(% correct) ^a
Q1. In relation to formulas' 'place-of-production' and origin of main ingredients (' <i>nai yuan di</i> '), which statements do you agree with?		
'Place-of-production' refers to the source of main ingredients, i.e. where the cow/sheep milk is collected (<i>incorrect</i>)	54.5	(45.5)
'Country-of-production' refers to the source of main ingredients (<i>incorrect</i>)	55.6	(44.4)
'Place-of-production' refers to where the raw ingredients are processed into formulas	67.8	(67.8)
formulas must be produced near their the source of the main ingredients (<i>incorrect</i>)	34.9	(65.1)
Q2. Which brands do you think are foreign brands? ^b		
Wyeth	48.8	(48.8)
Aptamil	56.0	(56.0)
Abbott	45.4	(45.4)
Beingmate (<i>Chinese brand</i>)	36.7	(63.3)
Yashili (<i>Chinese brand</i>)	25.5	(74.5)
Friso	65.1	(65.1)
MeadJohnson	68.4	(68.4)
Feihe (<i>Chinese brand</i>)	0.0	(100)
Q3. In relation to formulas' brands, which statements do you agree with?		
Foreign-branded formulas typically use imported main ingredients	67.3	(67.3)
Foreign-branded formulas must be produced in a foreign country (<i>incorrect</i>)	33.8	(66.2)
Domestic-branded formulas can be produced from imported main ingredients	70.4	(70.4)
Domestic-branded formulas can only be produced in China (<i>incorrect</i>)	16.4	(83.6)
Q4. In relation to ' <i>yuan-zhuang jin-kou</i> (YZJK)' formulas (i.e. formulas imported in the original packaging), which statements do you agree with?		
Only formulas labelled in a foreign language are truly YZJK (<i>incorrect</i>)	23.4	(76.6)
YZJK formulas obtained through regular channels should be labelled in Chinese	58.2	(58.2)
YZJK formulas obtained through regular channels must have met China's food standards	79.0	(79.0)
Only formulas directly purchased from overseas market are truly YZJK (<i>incorrect</i>)	15.1	(84.9)
Q5. In relation to ' <i>hai-tao</i> ' and ' <i>dai-gou</i> ' formulas (i.e. directly purchased from foreign countries through overseas eCommerce platforms, overseas contacts and shopping agents), which statements do you agree with?		
' <i>Hai-tao</i> ' and ' <i>dai-gou</i> ' formulas must be authentic products (<i>incorrect</i>)	18.1	(81.9)
' <i>Hai-tao</i> ' and ' <i>dai-gou</i> ' formulas may be fake or of poor-quality	64.0	(64.0)
' <i>Hai-tao</i> ' and ' <i>dai-gou</i> ' formulas may involve food safety risks in their transportation process	65.5	(65.5)
' <i>Hai-tao</i> ' and ' <i>dai-gou</i> ' formulas must comply with China's food standards (<i>incorrect</i>)	28.3	(71.7)

^aPercentages of participants who answered a given item correctly

^bAll brands selected are among popular brands in the Chinese market (Chinabaogao.com, 2019; IIMedia Research, 2019; Yang and Yu, 2019).

Note: for each question, there was an answering option 'none of the above', which was not included in the table

product origin information across all selected communication channels. We noticed that up to 31.9% of Chinese mothers relied on the prefix code (i.e. country code) to verify product origin. This is probably due to the fact that some formula companies, for their own interest, have explicitly educated consumers about using the prefix code as an indicator of country of production, based on our observation on formulas' advertisements on eCommerce platforms. However, such communication can be misleading and undermine fair competition, since the prefix code only indicates the manufacturer's registration place (GS1 China, 2013). For international formula companies with multiple brands and production lines across the world, a product's registration place can be very different from its actual manufacturing place (Sina, 2011). Furthermore, our results showed that Chinese mothers seldom use the Chinese governments'

certification website or product inspection certificate to confirm product origin, potentially due to low awareness or a perception that the source is not credible (Zhang *et al.*, 2016; Ismagilova *et al.*, 2020). More efforts are required to promote the availability of these platforms to consumers.

In relation to consumer knowledge of formulas' origin, our study revealed two major knowledge gaps. A substantial proportion of Chinese mothers viewed 'origin of the main ingredients' as 'the place/country of production', possibly due to their lack of knowledge on the production process, i.e. they might consider the liquid form of milk being directly mixed with other nutrients and then dried into the powder (i.e. the 'wet-mix' process). In practice, many manufacturers are using a 'dry-mix' or a 'dry and wet combined' process, which allows them to use main ingredients sourced from a foreign country or region (Blanchard, *et al.*,

Table 5. Participants' risk perception and purchase intention of formulas from different origins ($N = 1000$)

Question items	Mean ^c	SD	City tier			<i>P</i> value ^a	Education			Income			Knowledge level on formula's origin			
			1	2	3,4		High	Low	<i>P</i> value	High	Low	<i>P</i> value	High	Medium	Low	<i>P</i> value
How would you perceive the safety and quality of each category of formula products? ^b																
1) Domestic brand, domestic main ingredients, produced domestically	3.89 ⁽²⁾	0.80	3.88 ⁽¹⁾	3.96 ^{(2),(3),(4)}	3.84 ^{(1),(2)}		3.86 ⁽²⁾	3.95 ^{(2),(3)}		3.89 ⁽²⁾	3.89 ^{(2), (3)}		3.93 ^{(2),(3)}	3.88 ^{(2),(3)}	3.86 ⁽¹⁾	
2) Domestic brand, imported main ingredients, produced domestically	3.95 ^{(2),(3)}	0.85	3.94 ⁽¹⁾	4.01 ^{(3),(4)}	3.92 ⁽²⁾		3.97 ^{(3),(4)}	3.92 ^{(2),(3)}		3.96 ⁽²⁾	3.95 ^{(2), (3)}		4.03 ⁽³⁾	3.92 ^{(2),(3)}	3.96 ⁽¹⁾	
3) Domestic brand, produced overseas, using overseas main ingredients	3.87 ⁽²⁾	0.89	3.81 ⁽¹⁾	3.81 ⁽²⁾	3.92 ⁽²⁾		3.89 ^{(2),(3)}	3.81 ^{(1),(2)}		3.90 ⁽²⁾	3.83 ⁽²⁾		3.76 ⁽²⁾	3.84 ⁽²⁾	4.02 ⁽¹⁾	**
4) Foreign brand, imported in its original packaging, labelled in Chinese	4.04 ⁽³⁾	0.84	4.19 ⁽²⁾	4.10 ⁽⁴⁾	3.96 ⁽²⁾	**	4.04 ⁽⁴⁾	4.04 ⁽³⁾		4.10 ⁽³⁾	3.99 ⁽³⁾	*	4.26 ⁽⁴⁾	3.99 ⁽³⁾	3.96 ⁽¹⁾	***
5) Foreign brand, imported main ingredients, produced in China	3.92 ⁽²⁾	0.82	3.98 ^{(1),(2)}	3.90 ^{(2),(3)}	3.92 ⁽²⁾		3.92 ^{(2),(3)}	3.93 ^{(2),(3)}		3.90 ⁽²⁾	3.95 ^{(2), (3)}		3.91 ^{(2),(3)}	3.89 ^{(2),(3)}	4.00 ⁽¹⁾	
6) Foreign brand, directly purchased from a foreign country, labelled in a foreign language	3.68 ⁽¹⁾	0.91	3.75 ⁽¹⁾	3.57 ⁽¹⁾	3.73 ⁽¹⁾	*	3.67 ⁽¹⁾	3.71 ⁽¹⁾		3.68 ⁽¹⁾	3.68 ⁽¹⁾		3.45 ⁽¹⁾	3.69 ⁽¹⁾	3.88 ⁽¹⁾	***

(Continued)

Table 5. (Continued.)

Question items		City tier				Education			Income			Knowledge level on formula's origin			
		1	2	3,4	<i>P</i> value ^a	High	Low	<i>P</i> value	High	Low	<i>P</i> value	High	Medium	Low	<i>P</i> value
If the price is acceptable to you, which category of formulas would you purchase for your child (ren) (select maximum 2 options)?	%	1	2	3,4		High	Low		High	Low		High	Medium	Low	
					<i>P</i> value ^d			<i>P</i> value			<i>P</i> value				<i>P</i> value
1) Domestic brand, domestic main ingredients, produced domestically	29.4	24.7	28.5	31.5		27.4	34.7	*	27.9	31.0		30.2	30.0	27.5	
2) Domestic brand, imported main ingredients, produced domestically	35.5	32.7	32.7	38.4		34.3	38.7		34.4	36.8		28.9	37.5	37.5	
3) Domestic brand, produced overseas, using overseas main ingredients	23.7	23.3	19.4	26.9	*	24.1	22.6		23.2	23.9		20.9	24.9	23.9	
4) Foreign brand, imported in its original packaging, labelled in Chinese	44.7	50.0	49.0	40.0	*	47.0	38.7	*	46.2	43.0		59.1	43.0	34.7	***
5) Foreign brand, imported main ingredients, produced in China	27.4	27.3	30.1	25.5		28.2	25.2		26.7	28.3		25.1	27.4	29.5	
6) Foreign brand, directly purchased from a foreign country, labelled in a foreign language	12.5	16.0	14.4	10.1		13.4	10.2		14.5	10.4		14.0	11.1	13.9	

Background colour: dark grey – 50% and above; grey – 40–49.9%; light grey – 30–39.9%.

^aLevel of the significance of statistical differences between demographical groups, based on independent T tests or one-way ANOVA tests.

^bA five-point scale was used for this question, where 1 = very unreliable; 2 = unreliable; 3 = neutral; 4 = reliable; 5 = very reliable.

^cValues with different superscript numbers are significantly different based on Bonferroni's test ($P < 0.05$).

^dLevel of the significance of statistical differences between demographical groups, based on χ^2 tests.

* $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$.

2013). Similar to previous qualitative findings (Gong and Jackson, 2012; Hanser and Li, 2015), our results indicated that Chinese mothers were not necessarily able to recognize between foreign and domestic brands, although all the brands we selected were popular brands (IIMedia Research, 2019; Yang and Yu, 2019). This finding should be considered in a wider context as the Chinese formula market has drawn many domestic and overseas players: in 2018 there were 30 big brands occupying 75.3% of market, and a number of smaller brands occupying the rest of the market (Yang and Yu, 2019). Overwhelmed by so many brands, consumers may choose to only pay attention to companies or brands from their preferred country (Yang, *et al.*, 2018). In addition, Chinese dairy companies' overseas acquisition in recent years, may have added more mystery to the brand origin (Reuters, 2019; Xinhua Net, 2020).

We presented six categories of formulas from different origins to participants. Previous studies have shown that Chinese consumers consider brands from developed western countries as a symbol of high quality, and they still lack confidence in the safety of domestic infant formulas (Zhu, *et al.*, 2016; Li, *et al.*, 2019). In contrast, we observed that, in terms of product safety and quality, domestically branded and produced formulas were perceived comparable with authentic foreign products (especially among consumers in low-tier cities), and formulas directly purchased from overseas through unofficial channels were perceived least reliable. This suggests that consumer confidence in domestic formulas has improved. In recent years, China has strengthened the supervision and communication of the safety and quality of formula products. Domestic formula products have reached a qualification rate of 99%, and problems were almost only found in small/medium sized manufactures (Legal Office FAOLEX, 2017; State Council of P.R. China, 2017). Meanwhile, there have been a few food safety incidents reported on foreign formulas (e.g. the salmonella outbreak in a French formula company, Aptamil baby milk formula complaints in the UK) (World Health Organization, 2017; BBC News, 2018), receiving very negative publicity in China (Xinhua News, 2017; Guancha, 2018). The 'halo' effect of the foreign brand on product safety perception appears to have weakened in recent years, even though the COO effect for foreign brand still exists.

In relation to product preferences, from our results, authentic foreign branded, produced and packaged products (i.e. 'yuan-zhuang-jin-kou' formulas) showed a high popularity in Tier 1&2 cities and among richer and more knowledgeable consumers. In low-tier cities, these products are not necessarily more popular than domestically branded and produced formulas using imported main ingredients. This echoes the different marketing strategies used by foreign *vs.* domestic formula companies: foreign companies normally target the high-end market in big cities, whereas domestic companies tend to take advantages of their rich resources and deeper roots to occupy a great number of small cities spreading out in the country (Yang and Yu, 2019).

Our study found that 'foreign main ingredients' is considered by formula consumers as one of the most important COO factors that influence purchasing decisions. This finding reveals the potential opportunity for companies to develop ingredient brand as a co-branding strategy which may increase the overall brand equity of the final product. The value of such ingredient branding can be further explored by ingredient producers as well as final product manufacturers through product promotion and marketing communications.

Our results implied that, for domestic companies, the use of imported main ingredients would increase product attractiveness.

It is important to educate consumers regarding the difference between the origin of production and main ingredient origin, which should be incorporated into the companies' promotion and marketing communication strategies. However, placing the factory in a foreign country may result in decreased consumer interest. Historically, before China had tightened the rules on overseas production and the importation of formulas in 2014, a Chinese company can register a 'foreign-sounding' brand in a western country, and engage a local less-qualified manufacturer to produce customized formulas for the Chinese market (Chemlinked, 2014; Lexology, 2014; Shenzhen Consumer Council, 2015). Many Chinese consumers bought these products, then realized these 'foreign' brands did not exist in the foreign markets at all and subsequently felt cheated (Shenzhen Consumer Council, 2015). Consumers may still be under the shadow of that memory and may have become more suspicious about a Chinese company moving their production facilities overseas. Increased information transparency facilitated by Chinese authority will be welcomed to reduce asymmetric information problem and to allow consumers to make informed purchase decisions. For foreign brands, based on our results, having the product manufactured in its Chinese factories (as opposed to overseas factories) would reduce the appeal of the products, but only to a small extent if the main product ingredient still come from overseas. However, this strategy can help the company to expand production scale, lower production and transportation costs, and consequently increase revenue in China (Hu, 2009).

In the past, and particularly in the aftermath of the melamine crisis, it was often the case that worried Chinese parents reached out to available overseas contacts/resources, or even made personal trips to buy imported formulas, causing retailers in Hong Kong and some western developed countries to put restrictions on such purchases (BBC News, 2013; The New York Times, 2013). Chinese mothers' enthusiasm for formulas directly purchased overseas through unofficial channels seems to have decreased, according to our findings. For instance, our participants expressed minor concerns on the purchasing place and the language printed on the packaging, as well as high risk perception and low purchase intention of such products.

Findings from this paper reinforce the importance of using a multi-dimensional origin construct to carry out COO effects research. Chinese consumers' perception and purchasing intentions for formula are affected differently by the origin of the main ingredients, compared to the origin of the brand and place of production. A more simplified origin conceptual framework design that does not distinguish the origins of main ingredients, the brand and the place of production will be insufficient to capture the essential value chain structure of the IMP industry, and thus inadequate to identify the relevant COO impact on consumers' perception, preference, and purchasing intentions for IMP products.

The present study has its limitations. In the survey environment, by presenting a series of questions upfront and six categories of formulas, we had somehow educated participants about the complexity around formulas' origins on the market. In reality, when consumers (especially first-time parents) are confronted with a wide range of product options, it can be questioned to what extent they are aware of the existence of different categories of domestic and foreign formulas, and how well they are able to interpret cues on product origin correctly. Experiments using real product examples or in-market observation-based studies can be carried out to answer these questions. Another limitation is that our sample is biased to well-educated city people. In

addition, we only included mothers in the study sample and did not consider other family members who may have played roles such as the initiator, influencer, and decider. Despite these limitations, this study offers new insights on the perceptions and attitudes of Chinese consumers for the international dairy industry and can support the development of more targeted approach to product development and product marketing.

In conclusion, Chinese consumers have substantial concerns about the origin of infant formulas and make efforts to verify the information, although they may not necessarily interpret product-origin related cues correctly. Their previous one-sided endorsement towards foreign formulas appears to have weakened over the years. To serve the Chinese market, domestic and foreign formula companies can source the main ingredients and establish the production facilities across the world. Their decisions on where to source the main ingredients, and the manufacturing place would influence the attractiveness of the final products, and the specific consumer segments they should target.

Acknowledgements. This study was financially supported by the Kerry Group Newman Fellowship 2018–2020 (University College Dublin Foundation), and the EU-China-Safe project (Delivering an effective, resilient and sustainable EU-China food safety partnership) project (the European Union's Horizon 2020 research and innovation programme under grant agreement No. 727864). The funders played no role in the study, nor in the writing of the report or in the decision to submit the article for publication.

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