Understanding Chinese consumer behaviour regarding sustainable diets: Intention to reduce meat consumption and adopt protein alternatives

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Master of Research Sensory Science

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I hereby declare that this dissertation is all my own work, except as indicated in the text:

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I hereby declare that I have all necessary rights and consents to publicly distribute this dissertation via the University of Nottingham's e-dissertation archive.

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Abstract

With the alarming global challenges of climate change, water scarcity, population growth and food security, adopting a sustainable diet can be considered as one of the strategies to help our planet. China represents 19% of the global population, and little research has conducted to date to understand sustainable diet adoption for Chinese consumers. This study aimed to explore Chinese consumers' intentions towards adopting a sustainable diet – reducing meat intake and adopting meat alternatives. An online questionnaire was disseminated to recruited 778 consumers in Shanghai (China). Although limited information is available in China regarding sustainability, the results suggest that Chinese consumers are generally aware of sustainable diets and have good environmental awareness to a range of food behaviours and food items. However, they tend to underestimate the environmental impact of different types of meat. When exploring different consumer segmentations, non-meat eaters had higher environmental awareness than meat eaters, indicating environmental awareness could be one of the motivating factors determining whether or not consumers would eat meat. However, when looking into the three meat eater groups, no such difference was found, indicating those consumers who choose to consume meat, had lower environmental awareness. In general, Chinese consumers' meat attachments scores were relatively lower than other countries reported in literature. Consumers showing low meat attachment tended to have higher behavioural control and personal norm in relation to reducing their meat consumption, however, subjective norm does not affect consumers' meat attachment. The majority of the consumers indicated they were willing to reduce meat consumption, and identified food safety, environmental and health benefits as their strongest motivators, while animal welfare was

identified as the least motivating factor. When asking consumers option on adopting three meat alternatives (meat substitutes, edible insects, and cultured meat), consumers were more willing to adopt meat substitutes and cultured meat than edible insects. Food safety and environment indicated as primary motivational factors for adopting the three meat alternatives, indicating food safety and environmental benefit are the two key considerations when promoting meat alternatives. This study highlighted valuable information regarding Chinese consumers' intention to reduce their meat intake and adopt meat alternatives, further studies exploring the effect of cross cultural impact sustainable diet are required.

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List of Abbreviations

Abbreviation	Meaning or Description
TPB	Theory of Planned Behaviour
PBC	Perceived Behaviour Control
SN	Subjective Norm
PN	Personal Norm
NME	Non-meat Eater
ME	Meat Eater
LME	Low Meat Eater
SME	Standard Meat Eater
HME	High Meat Eater

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Chapter 1 Introduction

1.1 Research outline

There are four chapters in this thesis. Chapter 1 provides an introduction to sustainable diets and the current literature that have shown to influence consumers' adoption of sustainable diets, followed by the research gap and the study's aims and hypotheses. Chapter 2 is materials and methods chapter, which described the details of questionnaire design. Chapter 3 is the results and discussion chapter. Chapter 4 is the study's conclusion, which summarises the key findings of this research and lists the study's limitations and future work.

1.2 General introduction

Twenty-two critical global issues, including population growth, water scarcity, health, food and climate change have been highlighted by the United Nations (UN, 2020). The world population is projected to reach 9.1 billion in 2050 and further increase to 11.2 billion in 2100 (UN, 2019). In order to meet the needs of growing population, the food production needs to increase by 70% by 2050. However, food systems are becoming increasingly vulnerable due to climate change, water scarcity and other challenges. As shown by previous research, food is linked closely with human health, and is closely linked to global challenges including hunger epidemic, and rise in the obesity rates (Edenhofer, 2014). Global agricultural and food activities release more than 25% of total greenhouse gases (GHG) (Tilman and Clark, 2014). Thus, those due to theses

challenges, there is an urgent need to implement sustainable food production and promote a sustainable and healthy diet. China is one of the most populous countries globally, with 1.44 billion people representing 19% of the global population (UN, 2019). Understanding Chinese consumers' willingness to adopt a sustainable diet and to explore their motivations and barriers in adopting a sustainable diet can help policymakers better develop strategies to promote a sustainable diet, which is believed to help the global environment and public health (Burlingame and Dernini, 2012).

This thesis explores the behavioural intentions of Chinese consumers towards the adoption of sustainable diets through conducting an online survey from Chinese consumers living in Shanghai. As suggested by Burlingame and Dernini (2012) research, sustainable diet can be achieved for consumers by changing a range of behaviours, including reducing meat consumption, adopting meat alternatives, reducing food waste, eating more seasonable fruits and vegetables and eating more local foods. This study evaluated Chinese consumers' opinions regarding reducing meat consumption and adopting meat alternatives. The aim of adopting sustainable diets is believed to protect the environment and benefit consumer health, food safety, and animal welfare (Burlingame and Dernini, 2012). The current study explores factors contributing to Chinese consumers' intention to reduce meat consumption and adopt meat substitutes through the previous established Theory of Planned Behaviour (TPB) (Graça, Calheiros and Oliveira, 2015; Lentz et al., 2018). The four key factors were investigated in this study included meat attachment (MAQ), subjective norm (SN), perceived behavioural control

(PBC), and personal norm (PN). In addition, consumers motivations to adopt a range of meat alternatives were also explored in the current study.

1.3 Sustainable diets

1.3.1 Defining sustainable diets

The FAO proposed and promulgated a standard definition of sustainable diets at the Rome Conference in mid-2010 as: '*Sustainable Diets are those diets with low environmental impacts which contribute to food and nutrition security and to healthy life for present and future generations. Sustainable diets are protective and respectful of biodiversity and ecosystems, culturally acceptable, accessible, economically fair and affordable; nutritionally adequate, safe and healthy; while optimizing natural and human resources'* (Burlingame and Dernini, 2012).

As defined by the FAO definition, the main reason for a sustainable diet is to mitigate the environmental impact of agricultural production in the first place (Burlingame and Dernini, 2012). Additionally, sustainable diets can help food and nutrition security. However, when the FAO definition emerged, researchers gradually enriched it and created national guidelines for sustainable diets.

Sweden was the first country to introduce sustainable eating guidelines. In 2009, the national food administration and environmental protection agency put forward nine actual pieces of

advice relating to meat consumption, increasing vegetable, fruit, and organic food consumption, adopting sustainable sources and consuming more local food (Konde et al., 2009). In 2013, the UK green food project was launched with nine principles (Table 1-1）. The messages are similar between the UK and Sweden, and suggested moderating meat consumption, having a balanced diet, following product seasonality, and consuming more plant-based food and alternatives. In addition, UK sustainable diets guidelines also include statements regarding maintaining a healthy body and reducing food waste (Defra, 2013; E.P.H., 2016).

Table 1-1 Sweden and UK sustainable diets principles

Sweden Environmentally effective food choices	UK green food project
Eat less meat. Replace it with the vegetarian meal; choose local meats or organic if available	Eat a varied balanced diet to maintain a healthy body
Eat fish two or three times weekly from a sustainable source	Eat more plant-based foods, including at least five portions of fruit and vegetable daily
Eat fruit, vegetables, berries. a good rule of thumb is to choose a seasonal, local and preferably organic product	Value your food. Do not waste it
Choose locally grown potatoes and cereals rather than rice	Moderate your meat consumption, and enjoy Bees, beans, nuts and other
Choose pesticide-free or organic when possible	Choose fish sourced from sustainable stocks.
Choose rapeseed oil rather than palm oil	Seasonality and capture methods are essential here
Eat fish 2-3 times weekly from sustainable sources	Include milk and dairy products in your diet or seek out plant-based alternatives
Eat fruit, vegetables, berries; a good rule of thumb is to choose seasonal, local and preferably organic products	Drink tap water
Choose locally grown potatoes and cereals rather than rice	Eat fewer foods high in sugar and salt

Notes: Table 1-1 ref from Lang and Mason (2018). The Sweden Environmentally food choices initial ref from National Food Administration (2008); The UK Green food project ref from Garnett and Strong (2015)

1.3.2 Importance to follow a sustainable diet

The low environmental impact was the first benefit defined by the FAO to adopt as sustainable diet (Burlingame and Dernini, 2012). Global agricultural and food activities release more than 25% of all greenhouse gases (GHG) (Tilman and Clark, 2014; Edenhofer, 2014). Aleksandrowicz et al. (2016) claimed that over 70% of GHG emissions and land use and 50% of water use could be reduced by shifting from a typical Western diet to a more environmentally sustainable diet. Poore and Nemecek (2018) summarised the current food systems for greenhouse gas emissions (GHG) from different foods. As shown in Figure 1-1, the GHG emissions from animal-based foods are significantly higher than the plant-based foods. It is also interesting to note that the GHG emissions from cheese are greater than those from pig meat, suggesting that certain foods groups may generate greater environmental impact. The GHG emissions from plant-based foods such as tofu wheat, vegetables, and fruits produce low emissions. This data suggests that, in terms of environmental impact, reducing meat consumption or adopting a plant-based diet would produce less environmental impact in comparison to animal-based diet. These two behaviour changes are most widely discussed when referring to a sustainable diet.

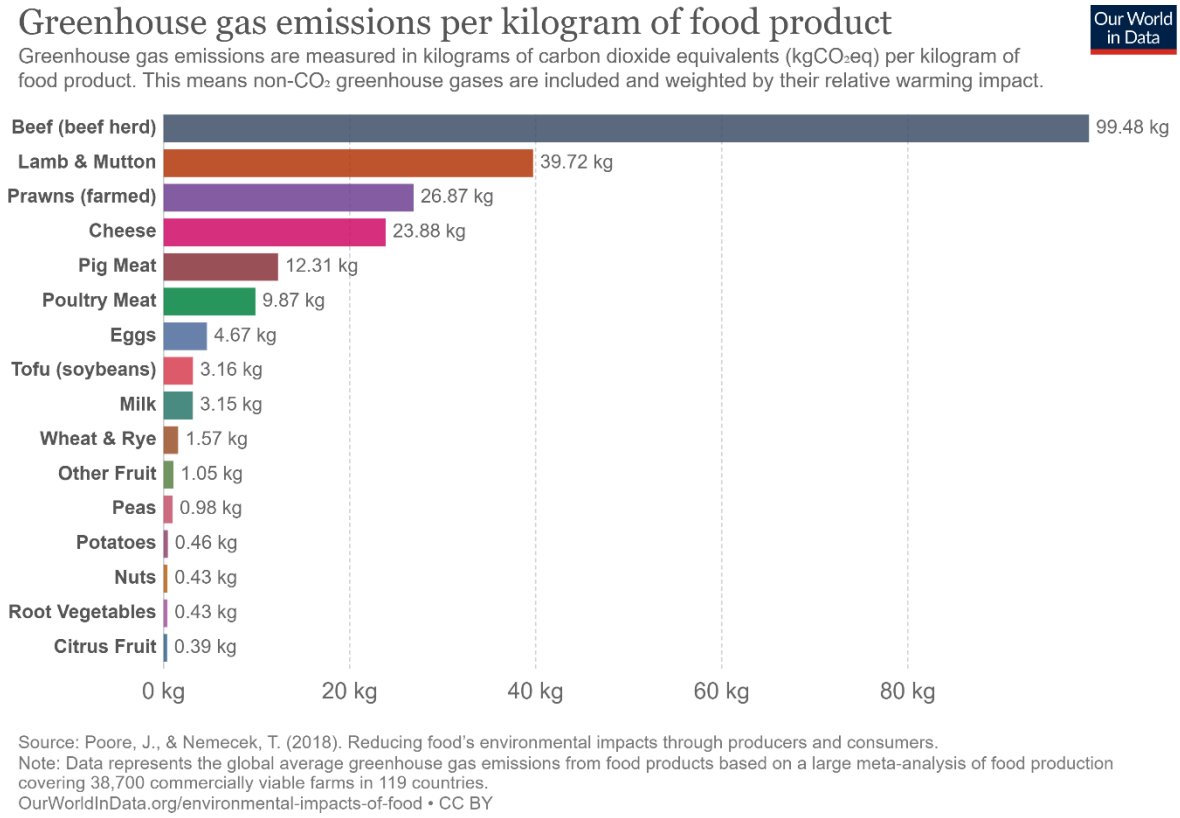

Figure 1-1 Greenhouse gas emissions per kilogram of food product

As known from previous studies, a sustainable diet does not only benefit the environment; it also has health benefits (Aleksandrowicz *et al.*, 2016). There is evidence that shifting to a sustainable diet has significantly reduced mortality rates and risks (Aleksandrowicz *et al.*, 2016; Tilman and Clark, 2014). The health benefits of a sustainable diet stem from the predominance of fruit and vegetables in the diet and the low consumption of red and processed meat which have been previously associated with lower type II diabetes, mortality, and coronary heart disease (Tilman and Clark, 2014).

1.3.3 Mediterranean diet as an example of a sustainable diet

In recent years, the Mediterranean diet, a diet rich in vegetables, whole grains, sea food and legumes - has been hailed as a case study for sustainable diet (Burlingame and Dernini, 2012; Dernini et al., 2017). Due to containing less meat and dairy than a typical Western diet, it is considered both healthy and sustainable. Davis et al. (2015) have summarised 15 independent reports spanning 46 years precisely for the Mediterranean diet for the different grams of food consumed per day. As indicated in Figure 1-2, the Mediterranean diet can be summarised as rich in plant-based food, has a simple approach to food processing and use of local, seasonal ingredients, use vegetable oils (olive oil) instead of animal oils and butter for cooking, limit the maximum consumption of 100g red meat per day and as much lean meat as possible. In addition to a balanced dietary structure, the Mediterranean diet also emphasises a healthy lifestyle, and an optimistic attitude towards life, with daily exercise.

Research showed Mediterranean diet can significantly reduce greenhouse gas emissions compared to other dietary models and protect biodiversity (Dernini *et al.*, 2017; Aleksandrowicz *et al.*, 2016). Compared to traditional omnivorous diets, the Mediterranean diet has reduced the incidence of type II diabetes and mortality (Tilman and Clark, 2014). In particular, several studies have demonstrated that the Mediterranean diet can help to prevent several chronic and degenerative diseases and have a lower incidence of some metabolic syndromes (Dernini et al., 2017).

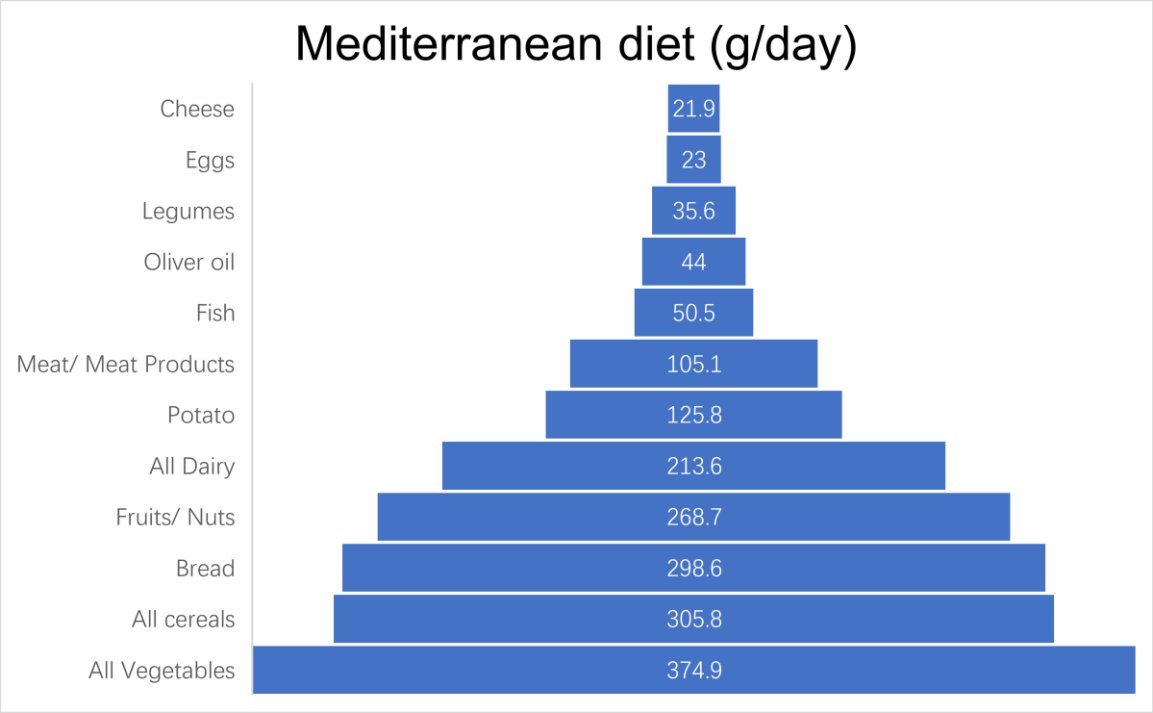

Figure 1-2 Mediterranean diets daily intake per person
Notes: Refer to Davis et al. (2015), and the value was the mean value of daily intake grams per day.

1.3.4 Dietary habit in China

The guidelines of sustainable diet in China are currently lacking. However, in 2016, the Chinese Nutrition Society issued the Dietary Guidelines for Chinese Residents, stating the Chinese government's dietary standards (C.N.S, 2016). Five of principles have been highlighted: 1) Eat a variety of foods, cereal-based; 2) Be active to maintain a healthy body weight; 3) Eat plenty of vegetables, fruits and soy products; 4)Eat a moderate amount of fish, poultry, eggs and lean meat; 5) Limit salt, cooking oil, added sugar and alcohol consumption. This dietary guideline is mainly aimed at health perspective rather than an environmental perspective.

The Chinese officials have set general recommended dietary standards and established a Chinese dietary pyramid that contains the recommended daily intake of several foods. Figure 1-3 shows that the Chinese diet is characterised by 1) a wide variety of foods and 2) a predominantly plant-based food. 3) Animal-based foods as a supplementary to the diet (C.N.S, 2016).

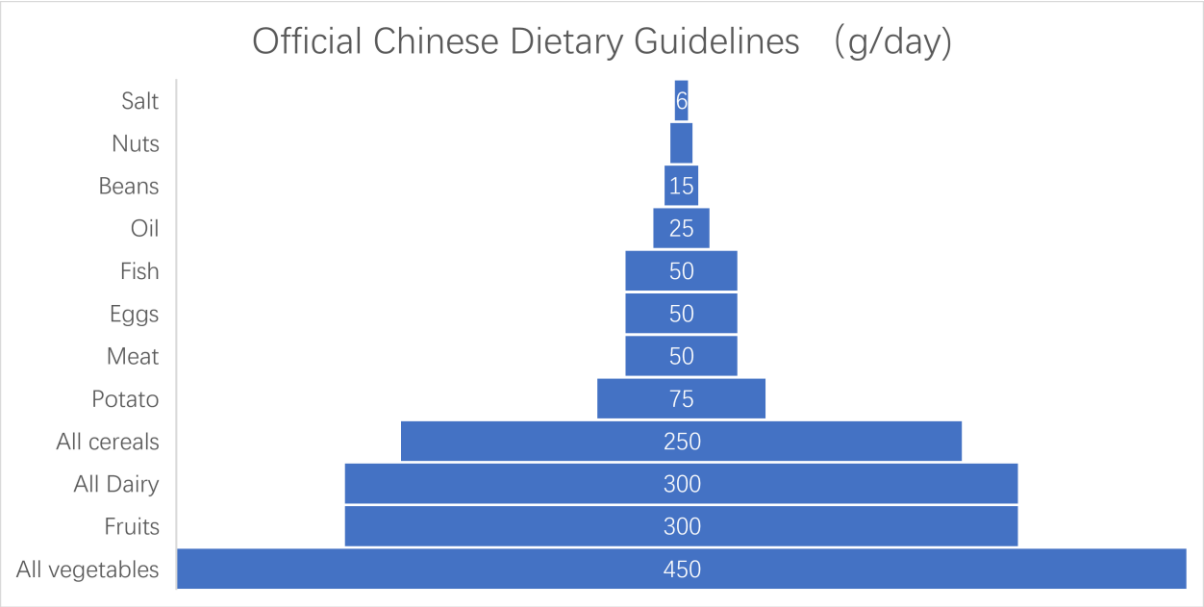

Figure 1-3 Official Chinese Dietary Guidelines daily intake per person

When comparing the recommended Chinese diet with the Mediterranean diet, apparent similarities can be seen. In particular, both diets ensure three principles: 1) a wide variety of food intake, 2) a plant-based food as the mainstay, and 3) an animal-based food as supplement.

Since the recommended Chinese dietary guideline is similar to Mediterranean diet, Chinese dietary guidelines can be considered as a sustainable approach. Additionally, it is worth noting that a healthy diet is not necessarily a sustainable diet. For example, fruit and vegetables

transported by plane would be considered healthy food but not typically a sustainable option (Burlingame and Dernini, 2012). Nevertheless, Chinese consumers tend to have a preference of having freshly produced food products, which are mainly produced locally or in surrounding areas.

However, this is the recommended dietary guideline, and it would be interesting to understand Chinese consumers' real consumption habit and how far it is from the recommended guideline. According to Food Supply, meat consumption has increased significantly globally since 2014 (FAOSTAT, 2021). As shown in Figure 1-4, the overall meat consumption in China has accounted for 27-28% of the world overall meat consumption, and Chinese meat consumption has also increased by 21% over the last decade. However, caution needs to be taken when interpreting such data, as criticism was received for the FAOSTAT in the Food Supply regarding the statistical approach used.

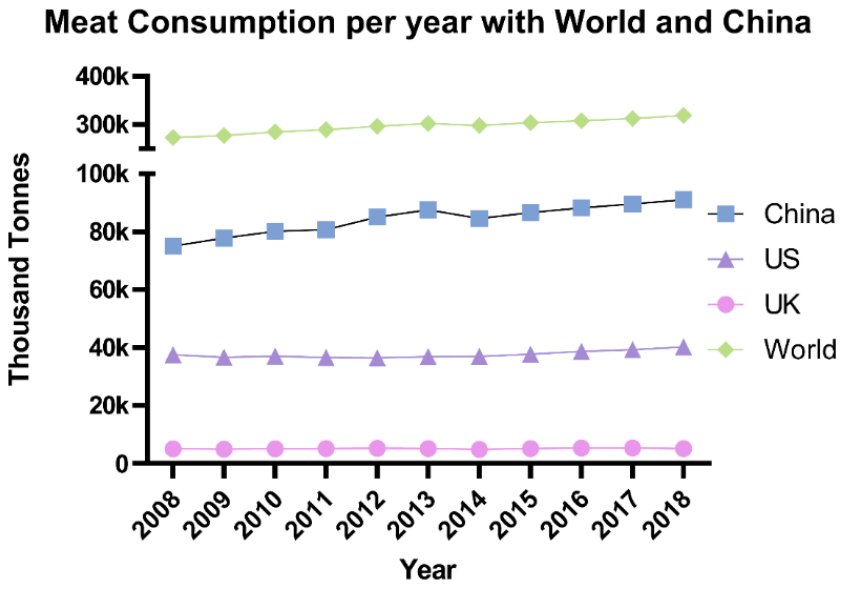

Figure 1-4 Meat consumption per year for World, United Kingdom, the United States and China, 2008-2018

Data refer from FAOSTAT (2021) new and old food supply quantity. Country: China, United States of America (US), United Kingdom of Great Britain and Northern Ireland (UK)

Figure 1-5 summarised Chinese food product consumption per capita in 2018 (FAOSTAT, 2021). The highest per capita quantity of food supply is vegetables, cereals and fruits. Most widely consumed food groups in China include pork, fish/seafood and milk products in meat and dairy consumption per capita. Overall the last decade, the per capita consumption of all food items increased significantly, with the highest increase of 44% for fruit, 16% for cereals and 28% for vegetables. There was also a significant increase in per capita consumption of meat, with the most significant increases in per capita consumption of mutton & goat meat (25%), followed by bovine meat (19%) and poultry meat (15%), and pork meat (13%). In addition, the per capita consumption of fish and seafood also increased by 27%. Interestingly, per capita consumption of other meat and milk products decreased by 9% and 18%, respectively.

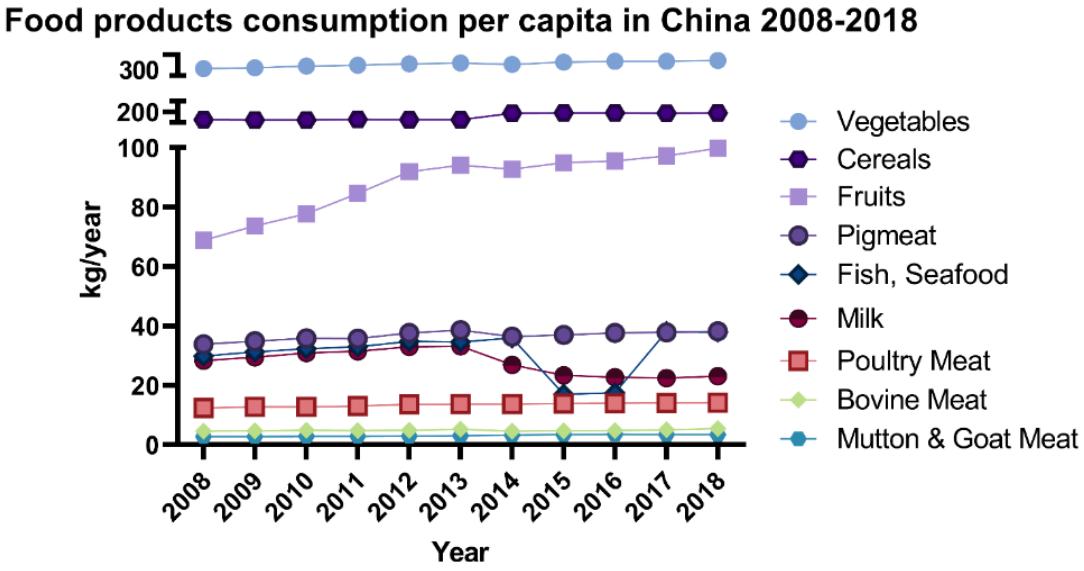

Figure 1-5 Food products consumption per capita in China across 2008-2018
Notes: Data refer from FAOSTAT (2021) new and old food supply quantity

1.4 Consumer willingness, intention and motivation to reduce meat and adopt meat substitutes, edible insects and cultured meat

Reducing meat consumption and adopting meat alternatives are commonly considered as effective approaches in order to adopt a sustainable diet. Meat substitutes are widely available on the market, with plant-based meat alternatives is commonly produced using protein extracted from plants, including wheat, soybean, legumes, oil seeds and fungi (Onwezen *et al.*, 2021). Due to the high protein content, edible insects are also promoted as meat alternatives. Cultured meat is the latest emerging meat alternative, providing similar sensory characteristics and nutritional value as conventional meat products whilst being environmentally sustainable (Bryant and Barnett, 2020). In order to understand Chinese consumers' attitude towards more sustainable meat consumption, three alternatives were meat substitutes, edible insects and cultured meat in present study.

As shown in Figure 1-6 a number of factors tend to influence meat-eating behaviour (Stoll-Kleemann and Schmidt, 2017). To better understand behavioural factors, including the intention to reduce meat and willingness to adopt meat substitutes, the current study used Theory of Planned Behaviour (TPB) measures with meat eater groups.

This section is divided into five main sections, including recent research findings and factors influencing Chinese consumers towards sustainable diets. Section 1.4.1 explores the impact of social-demographic on consumer acceptance of sustainable diets. Section 1.4.2 examines the influence of knowledge and skills on consumer acceptance of sustainable diets. Section 1.4.3 discuss meat attachment, which in Figure 1-6 is emotions & cognitive and values and attitude, but meat attachment is discussed separately in this study. Section 1.4.4 is about the theory of planned behaviour, where several key factors are socio-cultural factors and values & attitudes in the Stoll-Kleemann and Schmidt (2017) model. Section 1.4.5 is the influence of other factors on consumer adoption of sustainable diets, focusing on China's cultural and religious differences.

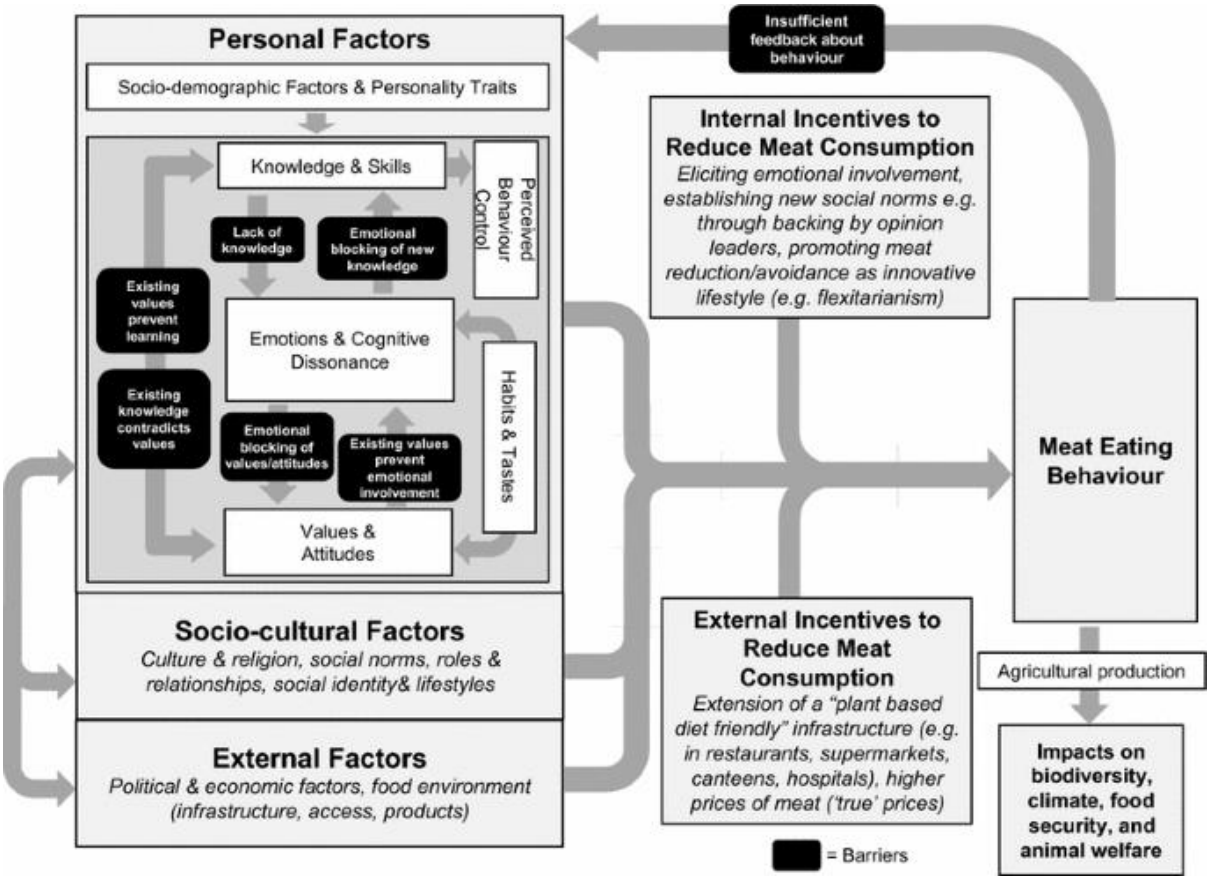

Figure 1-6 Model of factors that influence meat-eating behaviour (Based on Stoll-Kleemann and Schmidt (2017))

1.4.1 Socio-demographic factors

Previous studies have shown that socio-demographic factors could affect consumers' ability in adopting sustainable diets. For gender, females were found to be more willing to reduce meat consumption and adopt meat substitutes than males in China (Chan et al., 2017; Zhong, 2018) and Europe ((De Boer and Aiking, 2011; Graça, Calheiros and Oliveira, 2015; Hayley, Zinkiewicz and Hardiman, 2015; O'Keefe et al., 2016; Pfeiler and Egloff, 2018; Rothgerber, 2013; Schösler et al., 2015; Wozniak et al., 2020; Gómez-Luciano, Vriesekoop and Urbano, 2019; Melendrez-Ruiz et al., 2019)). Males were also found to consume significantly more

meat than females in China, however, opposite results were reported for Turkish male consumers (Schösler et al., 2015).

Some researchers have linked masculinity to willingness to reduce meat consumption (Rothgerber, 2013; Schösler et al., 2015; De Backer et al., 2020). Due to widely held stereotypes, meat is believed to provides men with strength and vitality (Love and Sulikowski, 2018). Interestingly, previous studies found males to be more willing to consume insect than females (Cicatiello et al., 2016; Grasso et al., 2019; Lammers, Ullmann and Fiebelkorn, 2019; Laureati et al., 2016; Orkusz et al., 2020; Schäufele, Albores and Hamm, 2019; Sogari, Menozzi and Mora, 2019).

Age has been shown to be another factor associated with adopting sustainable diets. Most studies have found that young people are more likely to reduce meat consumption and adopt a plant-based diet (De Boer and Aiking, 2011; Pfeiler and Egloff, 2018; Elzerman et al., 2015; Jallinoja, Niva and Latvala, 2016). However, an opposite trend was observed in other studies, where older populations are more likely to adopt plant-based diets, which are believed to be health motivations (Chan et al., 2017; Graça, Calheiros and Oliveira, 2015).

Socioeconomic status, including education level, household income, and occupation, are also known to play a role. For example, highly educated consumers are shown to be more environmentally conscious (Birch, Skallerud and Paul, 2019; de Boer, Schösler and Boersema, 2013; Gómez-Luciano, Vriesekoop and Urbano, 2019; Grasso et al., 2019). Research showed

that consumers are more likely to embrace plant-based diets in urban areas (de Boer, Schösler and Boersema, 2013). Although, high meat consumption is not an indicator of prosperity or household wealth in Western countries (Stoll-Kleemann and Schmidt, 2017). In developing countries such as China, meat consumption is positively correlated with wealth levels, indicating that culture also interacts with sociodemographic status in consumers' ability to adopt a sustainable diet (Garnett and Wilkes, 2014). For Chinese consumers, a study found that younger Chinese participants had more positive attitudes towards cultured meat (Schösler et al., 2015).

1.4.2 Knowledge & skills

Knowledge and skills are prerequisites for determining behaviour (Stoll-Kleemann and Schmidt, 2017). Therefore, consumers' knowledge of sustainable diets can significantly affect the acceptance of sustainable diets. As shown in the previous literature, three types of knowledge influence consumer acceptance: 1) consumer knowledge of environmental benefits; 2) consumer knowledge of health benefits 3) consumer knowledge of food technology with alternative proteins (Stoll-Kleemann and Schmidt, 2017).

It was reported that the higher the consumer's meat consumption, the less they believed that reducing meat consumption would positively impact the environment. Garnett et al. (2015) confirmed a gap between the public's understanding of the role of meat in climate change and reality, with 83% of respondents agreeing that human activities negatively impact the

environment. However, only 30% of participants believe that meat is a significant contributor. In reality, 40% of climate change is due to agricultural activities (FAO, 2013). The findings suggest that consumers do not seem to be aware of the potential environmental benefits of reducing meat consumption or adopting plant-based diets (Myers and Pettigrew, 2018). Further, participants may underestimate the ecological impacts of meat production (Vanhonacker et al., 2013). Graham and Abrahamse (2017) found that providing information about the negative environmental impacts of meat to consumers would significantly increase consumer willingness to reduce meat consumption compared to an uninformed control group.

Secondly, the more health-conscious consumers were more likely to adopt a sustainable diet (Carfora, Caso and Conner, 2017). Health factors tend to outweigh environmental benefits or animal welfare factors in terms of incentives for adopting sustainable diets (Dibb and Fitzpatrick, 2014). Consumers have an inherent bias towards meat, as they believe meat is an essential element for maintaining health, and vegetarian diet is nutritionally inadequate (Dibb and Fitzpatrick, 2014; Stoll-Kleemann and Schmidt, 2017). In addition, Cordts, Nitzko and Spiller (2014) showed that when participants were asked to read an article about the adverse health effects of meat consumption, their willingness to reduce meat consumption was significantly higher than the control group.

1.4.3 Meat attachment

To measure consumer attachment to meat, the Meat attachment questionnaire was developed by Graça, Calheiros and Oliveira (2015). In Figure 1-6, Stoll-Kleemann and Schmidt (2017) categorised meat attachment as values and attitudes, and this study explores meat attachment separately.

In meat-eating behaviour, emotions can be thought of as consumers' responses when confronted with animal suffering. Kollmuss and Agyeman (2002) have formalised that the stronger a person's emotional response, the more likely they are to engage in a new behaviour. More specifically, it has been suggested that the emotional connection to meat may be a continuum, with aversion (i.e. negative emotions and rejection, associated with moral internalisation). On the other hand, attachment patterns may hinder consumption habits (Graça, Oliveira and Calheiros, 2015).

Graça, Oliveira and Calheiros (2015) noted that positive perceptions of meat could be summarised as meat attachment, which includes hedonism, affinity, entitlement, and dependence. Graça, Calheiros and Oliveira (2015) found that meat attachment implies a positive association with meat consumption, with high levels of meat consumption. Sixteen items of meat attachment scales were then developed with reliable explanatory power for meat consumption and consumers' willingness to reduce meat consumption. Many researchers have since used meat attachment scales and have demonstrated that meat attachment is significantly

and negatively associated with both meat consumption and intention to reduce meat consumption (Dowsett et al., 2018; Bryant et al., 2019; Wang and Scrimgeour, 2021; Lentz et al., 2018; Circus and Robison, 2019).

1.4.4 Theory of Planned Behaviour and personal norm

The Theory of Planned Behaviour (TPB) was developed by Ajzen (1991) to understand and predict behaviours. Three key factors (subjective norm, perceived behavioural control and personal norm) are included in this theory, which is further discussed in subsequent sections (Section 1.4.4.1, 1.4.4.2, 1.4.4.3).

1.4.4.1 Subjective norm

Subjective norm (SN) describes the perceived social influence to perform or not to perform the behaviour (Ajzen, 1991). Previous research has suggested that SN has a weak influence on the intention to reduce meat consumption (Lentz et al., 2018; Graça, Calheiros and Oliveira, 2015). In other words, this means that when individuals reduce meat consumption as behaviour they are minimally influenced by the views of others. The study here also includes a sample of Chinese consumers, and Wang and Scrimgeour (2021) also support the conclusion that SN limited effect on reducing meat consumption and adopting plant-based food.

1.4.4.2 Perceived behaviour control

For perceived behaviour control (PBC), Ajzen (1991) suggested in the theory of planned behaviour that 'perceived ease or difficulty of performing the behaviour" (p. 188). A more detailed description in the context of diet is the perceived difficulty and ease of following a sustainable diet. A previous study suggests that perceived behavioural control is a low predictor of explanatory power in explaining consumers' intention to reduce meat (Graça, Godinho and Truninger, 2019). Instead, factors such as lack of suitable meat substitutes and the lack of knowledge and skills to cook meat substitutes are essential factors that prevent consumers from adopting a plant-based diet (Hoek et al., 2017).

1.4.4.3 Personal norms

Schwartz (1973) proposed the definition of the personal norm (PN) as primarily, attach to the self-concept and experience as feelings of a moral obligation to perform a certain behaviour. Previous literature argued that personal norms somehow can be seen as internalised social norms (Thøgersen and Ölander, 2006). Studies have confirmed that PN positive influences consumers' environmental protection (pro-environmental). Individuals with higher PN values recognise environmental protection as a moral obligation (Bamberg and Möser, 2007; Doran and Larsen, 2016). The reason for exploring the PN in this study is that the relationship between PN on the intention of environmental protection has been verified. This study is expected to explore the effect of PN on the intention to reduce meat consumption. There has been limited

research investigating the effect of PN on the intention to reduce meat. In order to address this knowledge gap, the present study hypothesised that individuals - are more likely to reduce their meat consumption and adopt meat substitutes when they have higher PN values, as they are morally obliged to recognise the rightness of their behaviour.

1.4.5 Other factors

In Stoll-Kleemann and Schmidt (2017) model, there are many other factors that can be explored. However, due to sample size and time restriction, many factors were not explored in the current study, including food neophobia, ethical issues in the values, habits and sensory appeal, cultured social factors, religion, social norm, attitude and personality.

Many studies have mentioned that cultural differences significantly influence consumers' dietary behaviour. It has been proven that the Chinese food culture exists to consume meat substitutes such as tofu, soy and insects (Thavamani, Sferra and Sankararaman, 2020; Hartmann et al., 2015). Many cooking methods are available to cook meat substitutes, and there are also many vegetarian restaurants in China (Lu, 2014). Zhong (2018) has also confirmed that there is a history and culture of plant-based diets (vegetarianism) in China. For, research by Chen, Feng and Chen (2009) has shown although insect-eating cultures have historically emerged in Yunnan, these cultures have gradually disappeared in recent years. The desire to eat insects is highly affected by consumers' food neophobia status nowadays (Hartmann et al., 2015).

Religion can also affect consumers' attitudes toward meat consumption; although most Chinese consumers are non-religious (Lu, 2014), Buddhism was reported to have a 6.75% population. Buddhist teachings refer to 'Stop Killing', leading believers not to kill animals and not eat their meat. Thus, religion could be identified as one of the factors affecting meat consumption habits among Chinese consumers.

1.5 Research gap

The majority of current research exploring consumers intention to adopt sustainable diets were focused on Western consumers, and limited research has been conducted with Chinese consumers. Only two or three papers were published in English (Bryant *et al.*, 2019; Wang and Scrimgeour, 2021). Moreover, no previous research exploring this subject are has published in Chinese. China remains the most populous country in the world, and further understanding of Chinese consumers' intentions towards adopting sustainable diets could help promote sustainable diets in the future. As sustainable diets are primarily aimed at protecting the environment, the impact of consumers' environmental awareness on adopting sustainable diets is essential to understand. However, most research findings have still not linked environmental awareness to the willingness to adopt a sustainable diet. Meat attachment theory was initially designed to predict intentions to reduce meat consumption. A few studies to date have been conducted to predict intentions to adopt meat substitutes (plant-based food) (Bryant et al., 2019; Wang and Scrimgeour, 2021). Edible insects and cultured meat can also be considered as part

of a sustainable diet plan in the future. Therefore, it is worth investigating consumers' intention and motivation to adopt edible insects and cultured meat. In addition, previous studies have mainly investigated consumers' opinions rather than looking into different consumer segmentations. In this study, consumers' intention and motivations to reduce meat consumption and adopt meat substitutes were further explored across non-meat eaters and meat-eaters and among different meat-eater groups.

1.6 Aims

This study aimed to understand the behavioural intentions of Chinese consumers towards the adoption of a sustainable diet. This study utilised an online survey to explore whether the theory of planned behaviour, meat consumption, environmental awareness, meat attachment and food choice motivations influence consumers' willingness to reduce meat consumption and adopt three meat alternatives. Additionally, these factors were also explored between non-meat eaters and meat eaters as well as within meat eater groups (Low, Standard and High meat eaters). The more detailed sub-aims are shown as below:

- Investigating Chinese consumers' understanding of a sustainable diet and environmental awareness (Section 3.4 and 3.5)
    - Investigating the impact of Chinese consumers' meat intake on environmental awareness
- Understanding variation in willingness and motivations to reduce meat consumption (Section 3.6)

- Validating the use of the Meat Attachment Questionnaire (MAQ) and Theory of Planned Behaviour (TPB) as a tool for measuring consumer attitudes towards reduced meat consumption (Section 3.7)
  - Investigating the impact of consumers' meat intake on TPB elements towards reducing meat consumption intention
- Investigate motivations and willingness to adopt meat substitutes (Section 3.8), edible insects (Section 3.9) and cultured meat (Section 3.10).
  - Explore the impact of familiarity factors towards adopting edible insects and cultured meat intention.
  - Explore the differences in motivational factors when adopting the three meat alternatives (substitutes, edible insects and cultured meat) (Section 3.11).

Chapter 2 Material and Methods

2.1 Participants

Participants living in Shanghai, China were invited to complete the online survey. Shanghai - was chosen as the primary city for the investigation to be comparable to the educational level in the UK, which will be investigated in another study. To determine the sample size, statistical power analysis was performed with a confidence level of 95% and a margin of error of 5%. Therefore, a sample size of 540 has been determined as sufficient in order to achieve adequate statistical power.

Participants were recruited in three ways 1) through Chinese social media platforms (WeChat, QQ, Weibo) 2) Disseminate to Shanghai University (e.g. Shanghai Jiaotong University) 3) Disseminate through Survey recruitment Agency (Credamo, China). Finally, a total of 985 participants have completed the questionnaire for this study. To ensure the quality of the data, the inclusion criteria were 1) Age 18 years or older and living in Shanghai 2) The time required to answer the questionnaire was greater than 15 minutes in order to screen out participants who did not complete the questionnaire seriously (158 participants were screened out) 3) Mismatching meat consumption status, for example, when participants self-identified as vegetarians but reported detailed consumption of meat (49 participants were screened out). Therefore, 778 participants met the study criteria and included in this study.

2.2 Ethical Consideration

The University of Nottingham Medical School - Ethics Committee has approved this study (FMHS 154-0121); refer to Appendix 5.1. The questionnaire was pilot tested with Chinese consumers to remove errors, misinterpretations and duplications. Upon starting the survey, consumers were advised that they could withdraw at any time without any disadvantage to themselves, agreeing with the University ethics committee policy. Participant eligibility and consent to participate in the study were gained via an electronic consent form prior to completing any study procedures. If participants are eligible and have given their consent, they will proceed to the start of the survey, and the survey takes approximately 20-25 minutes to complete.

2.3 Questionnaire outline

The original questionnaire was written by Hannah Ford, PhD student in Sensory Science at the University of Nottingham, and was first piloted and distributed in the UK. The questionnaire was then translated into Chinese and back-translated into English to check the quality of translation. The questionnaire was split into five parts, as demonstrated in the flow diagram Figure 2-1. The detail of the questionnaire can be found in Appendix 5.2. All data from this study were analysed using SPSS 26 (IBM Corp, 2019). Online Surveys JISC (JISC, Bristol UK) was used to disseminate the survey online, and data were downloaded directly from JISC.

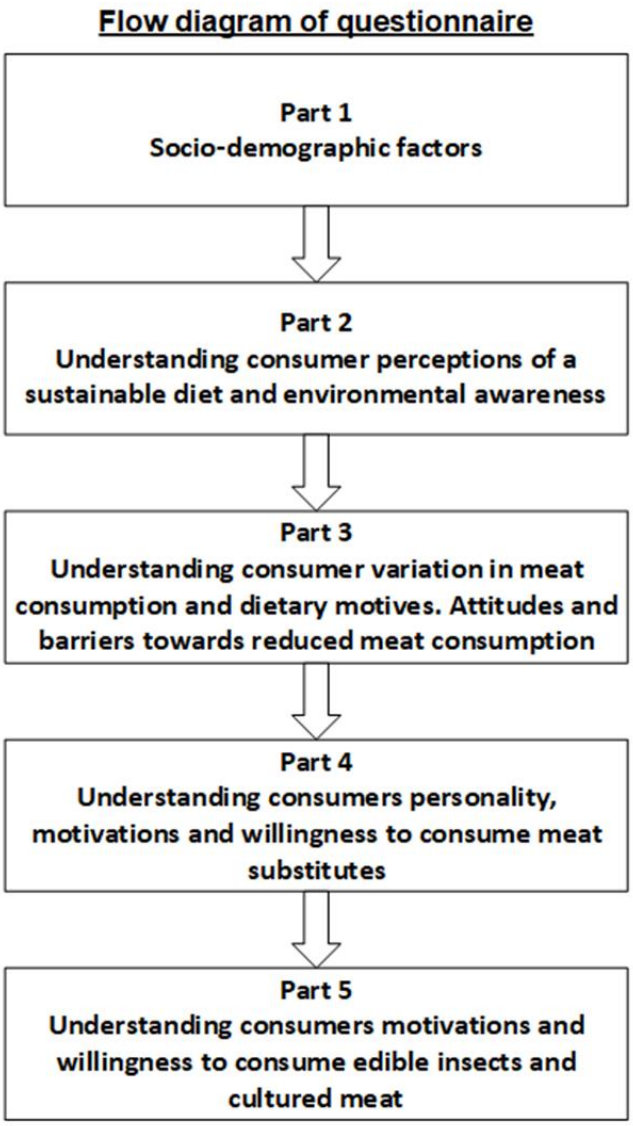

Figure 2-1Flow diagram of the questionnaire

2.3.1 Questionnaire Part 1 & analysis method

The first part of the questionnaire collected information regarding consumers' demographics, including where they live (whether they live in Shanghai or not), age, gender, ethnicity/race, religion, education, household income and family dynamics (number of adults and children) (Appendix 5.2 Q1 to Q9).

Before asking specific questions, the definitions of ‘meat’ and ‘meat substitutes’ were provided to avoid ambiguity around the terms. Meat is defined as *'refers to both red and white meat (e.g. beef, lamb, pork, chicken). Examples of meat from other animals can include turkey, goat, game birds, rabbits etc. Meat also includes unprocessed meat (e.g. chicken breast, steak) or processed meat (e.g. sausages, bacon, ham, salami, pates, canned meat, chicken nuggets etc)'*. For meat substitutes, the following definition was taken from Hoek et al. (2011) and adapted for present study: *‘It will read that meat substitutes' are protein-containing foods that are primarily vegetable-based and are often used to replace the function of meat as a meal component. Meat substitutes are frequently made up of pea protein, soya (tofu), mycoprotein (Quorn), jackfruit or animal-like proteins produced by yeast extract and are often designed to imitate meat in taste, texture and appearance. They can therefore take the form of burgers, sausages, chicken strips, ham slices etc. They are predominantly used in hot meals and can make up components of ready to eat meals'*.

For data analysis, frequency counts were mainly used to understand the distribution of the demographic information for this cohort.

2.3.2 Questionnaire Part 2 & analysis method

The second part of the questionnaire measures consumer environmental awareness of food behaviours and different food and consumer perception of a sustainable diet.

Consumers were asked to rate the environmental impact of a variety of behaviours and a range of foods using a 7-point scale ranging from 'Highly Negative' to 'Highly Positive'. Nine behaviours were selected based on a previous study that reported these behaviours as being of significant impact on the environment, as shown in Table 2-1 (Tobler, Visschers and Siegrist, 2011). The 12 different foods items as shown in Table 2-1 were selected based on the study conducted by Jungbluth, Tietje and Scholz (2000).

For data analysis, the environmental impact for both behaviours and foods was analysed similarly by summing and averaging all participants' responses and conducting a one-way ANOVA to compare the environmental impact across different food and behaviours. T-tests were applied to explore the differences between non-meat eaters and meat eaters in environmental impact for both behaviours and foods. One-way ANOVAs were applied to explore differences across consumer meat eaters groups for the environmental impact of both behaviours and foods.

Table 2-1 Environmental impact of food behaviour and different foods

Behaviour (Appendix 5.2 Q10)	Foods (Appendix 5.2 Q11)
Buying food products that contain less packaging	Beef
Eating more local food	Lamb
Avoiding food products that were transported by aeroplane	Chicken
Eating more seasonal fruits and vegetables	Pork
Eating more organic foods	Fish
Eating less meat	Prawns
Eating less dairy	Nuts
Eating more plant-based foods	Cheese
Eating more meat substitutes	Milk

	Eggs Seasonal vegetables Meat substitutes

In order to measure consumers' prioritisation of sustainability elements (social or environment), participants were asked to rate these elements on a 7-point Likert agreement scale from 'strongly disagree (1)' to 'strongly agree (7)' (Appendix 5.2 Q12). The environmental impact includes *carbon footprints, waste, recycling, biodiversity, land and water use etc*. The social impact elements included, *fair labour practices, animal welfare, health etc*. An independent T-test was applied to explore differences between environment and social perceptions. To further measure consumer awareness of both the environmental and health implications of meat production and consumption, consumers were asked to rate their agreement regarding the five statements (Appendix 5.2 Q13), four statements referring to environmental impact, and one statement referring to health impact. One-way ANOVA was applied to compare consumer responses to these five statements.

Lastly, two additional questions aimed to capture whether consumers know anyone currently consuming a sustainable diet (Appendix 5.2 Q14) and if they know where to find information on sustainable diets (Appendix 5.2 Q15). A yes-no question format was used to capture this information, and frequency counts were used to analyse the data.

2.3.3 Questionnaire Part 3 & analysis method

Part three of the questionnaire collate consumption frequencies for a variety of meats (beef, lamb, chicken, pork, meat from other animals) as well as other foods (fish/seafood, dairy, meat substitutes). Consumption categories included in the questionnaire were as follows: 'Everyday (7)', '4-6 times per week (6)', '2-3 times per week (5)', 'Once per week (4)', '1-3 times per month (3)', 'Less than once per month (2)' and 'Do not consume (1)'. Omnivores, flexitarians were identified as meat eaters and vegan, vegetarian, pescatarian were identified as nonmeat eaters (Appendix 5.2 Q17). For nonmeat eaters, the questions in part 2 (Appendix 5.2 Q18 to Q23) were not answered.

In addition to classifying participants into meat eaters and non-meat eaters, an additional measure of classification was applied, which grouped the meat-eaters into three further categories – Low, Standard and Higher meat eater. Only omnivores and flexitarians' data were included when classifying meat eaters further. Total meat consumption was calculated by adding up the five types of meat consumption frequencies (Appendix 5.2 Q16). Quartile analysis was used to obtain the cut-off points of 25^{th}, 50^{th} and 75^{th}. For this study, low meat eaters have a sum meat consumption frequency value of less than 14 (below 25^{th}), and standard meat eaters are 15-18 (between 25^{th} to 75^{th}), and high meat eaters are greater than 19 (above 25^{th}).

Participants also received information regarding sustainability before asking their willingness to reduce meat consumption (Appendix 5.2 Q18) which was rated on a 7-point Likert scale from ‘Extremely unwilling’ to ‘Extremely willing’. The following statement was shown to participants - *'Global meat consumption is predicted to double by 2050. As a result, there is an increasing concern for meat to be produced sustainably by reducing the environmental impact and considering health, safety and quality concerns as well as animal and worker welfare rights'*. For those who were extremely unwilling, a further question was provided, asking to write down their reasons for being extremely unwilling to reduce meat consumption (Appendix 5.2 Q19). In Q18, frequency analysis was used. Q19 was limited to extremely unwilling respondents to reduce meat consumption, and the response was textual, so the analysis was done by summarising keywords using manually.

Three key components of the Theory of Planned Behaviour (TPB) were used to measure consumers' behavioural intentions towards sustainable diets, including perceived behavioural control, subjective norm, and personal norm (Ajzen, 1991).

The first element of the TPB is perceived behavioural control (PBC). PBC measures the consumers’ perception of control over performing the behaviour or not (Lentz *et al.*, 2018), which was measured using three item taken from Lentz *et al.* (2018) (Table 2-2). Subjective Norm (SN) defines beliefs about how others would perceive the behaviour if acted upon, which is measured by two statements (Berndsen and Pligt, 2004; Lentz et al., 2018). Personal Norm

(PN) measures individual obligations to follow sustainable diets (Wang and Scrimgeour, 2021), which is measured by one statement (Bamberg and Möser, 2007).

The questions were prefaced 'with regards to your current meat consumption habits, how much do you agree with the following statements….'. Scores ranged from 'strongly disagree' to 'strongly agree' and were measured on a 7-point Likert scale. The three PBC statements and two SN statements were analysed using Cronbach's Alpha (α) to test for reliability. Further analyses were conducted by averaging the three PBC statements and the two SN statements, respectively. A person's correlation test was applied to explore the association of the variables between personal norm and environmental awareness (Appendix 5.2 Q11). Additional ANOVAs were also applied to explore differences across consumers meat eaters groups.

Table 2-2 The Theory of Planned Behaviours (TPB) statements

	Statements (Appendix 5.2 Q20)
Perceived behavioural control (PBC)	I am confident I could change my habits if I wanted to
	Whether I change my habits is entirely up to me
	Changing my habits is not something that is under my control*
Subjective Norm (SN)	I eat meat to avoid disappointing someone who is trying to make me happy
	People who are important to me think I should consume meat
Personal Norm (PN)	I have made it one of my personal principles not to eat a lot of meat

*Notes: *Reverse coded item*

For the Meat Attachment Questionnaire (MAQ) (Appendix 5.2 Q21 and Q22), 16 statements converting five factors (hedonism, affinity, entitlement, dependence) were included, which were developed by Graça, Calheiros and Oliveira (2015) (Table 2-3). To ensure scale consistency and limit consumer confusion in the current study, a 7-point Likert scale was used,

ranging from 'strongly disagree' to 'strongly agree'. This is in alignment with a previous study by Lentz et al. (2018), who adapted the scale from its original 5-point to 7-point scale. Higher scores indicate higher attachments to meat.

For data analysis, Each group of statements was averaged to create subscale scores for five factors. Further, all 16 statements were averaged to create the meat attachment total score. After creating the subscales and the meat attachment scores, it was noted that higher scores mean higher attachment to meat. Cronbach's Alpha was also applied to check for scale reliability. When the Cronbach's Alpha for the five factors was greater than 0.8, exploratory factor analysis was run, and the method chosen was principal component analysis (PCA). As a prerequisite for PCA, the Kaiser-Meyer-Olkin (KMO) test needed to be greater than 0.6. MAQ has already been applied twice in China, so EFA would be a good way to accomplish the objectives of this study. The next analysis was to explore the association of the variables between MAQ using Pearson's correlation.

For data analysis, Cronbach's Alpha was applied to check for reliability. When the Cronbach's Alpha for the five factors was greater than 0.8, exploratory factor analysis was run, and the method chosen was principal component analysis (PCA). As a prerequisite for PCA, the Kaiser-Meyer-Olkin (KMO) test needed to be greater than 0.6. MAQ has already been applied twice in China, so EFA would be a good way to accomplish the objectives of this study. Each group of statements was averaged to create subscale scores for the five factors. All 16 statements were averaged to create the meat attachment total score. Pearson's correlation test was applied to

further explored the association of the variables between MAQ. Additional Pearson's correlations were also applied to explore the MAQ (Appendix 5.2 Q21-Q22) and TPB (Appendix 5.2 Q20) elements, willingness to reduce meat consumption (Appendix 5.2 Q18) and overall meat intake (Appendix 5.2 Q16).

Table 2-3 MAQ measurement and code name

Code	Factor and measurement items for the MAQ (Appendix 5.2 Q21-Q22)
HE	Hedonism
HE1	To eat meat is one of the good pleasures in life
HE2	I love meals with meat
HE3	I'm a big fan of meat
HE4	Nothing is comparable to a good steak
AF	Affinity
AF1*	I feel bad when I think of eating meat
AF2*	To eat meat is disrespectful towards life and the environment
AF3*	Meat reminds me of diseases
AF4*	By eating meat I'm reminded of the death and suffering of animals
EN	Entitlement
EN1	According to our position in the food chain, we have the right to eat meat
EN2	To eat meat is an unquestionable right of every person
EN3	Eating meat is a natural and undisputable practice
DE	Dependence
DE1	Meat is irreplaceable in my diet
DE2	I don't picture myself without eating meat regularly
DE3*	I would feel fine with a meatless diet
DE4	If I couldn't eat meat I would feel weak
DE5	If I was forced to stop eating meat I would feel sad

*Notes: *Reverse coded item*

The final part of this section addresses consumer motivations (health, convenience, sensory appeal, price, animal welfare, environmental benefit) towards reducing overall meat consumption to maintain a sustainable diet (Appendix 5.2 Q23) (Neff *et al.*, 2018). Scores ranged from 'Extremely unimportant (1)' to 'Extremely important (7)' and were measured using

a 7-point Likert scale. One-way ANOVA with different motivations as the factor was conducted, where a significant difference ($p<0.05$) was identified, either Fisher's Least Significant Difference (LSD) test or Game-Howell post-hoc test were conducted based on homogeneity of variances.

2.3.4 Questionnaire Part 4 & analysis method

Part four of the questionnaire explores consumer attitudes towards meat substitutes. The following statement was provided in order to measure willingness to use meat substitutes as a replacement to meat; 'The benefits of meat substitutes include a reduction in the amount of land and water used and the prevention of animal suffering. Just one '*Impossible burger' (a plant-based meat substitute product) is estimated to use 96% less land, 87% less water and 89% fewer greenhouse gas emissions compared to a burger made from cows (Impossible Foods, 2019)*'. Scores were measured on a 7-point Likert ranging scale from 'Extremely unwilling (1)' to 'Extremely willing (7)' (Appendix 5.2 Q24). For those who were extremely unwilling, further questions were presented, and they were asked to write down their reasons for being extremely unwilling to adopt meat substitutes (Appendix 5.2 Q25), and the response was textual, so the analysis was done by summarising keywords.

The same motives on the 7-point importance Likert scale given previously were listed to identify potential drivers for trying meat substitutes so that comparisons can be made between the motives for reducing meat and the motives for trying meat substitutes (Appendix 5.2 Q26).

One-way ANOVA with different motivations was conducted, where a significant difference ($p<0.05$) was identified, either Fisher's Least Significant Difference (LSD) test or Game-Howell posthoc test were conducted based on homogeneity of variances.

2.3.5 Questionnaire Part 5 & analysis method

Part five of the questionnaire investigate motivations and willingness to consume edible insects and cultured meat. Consumers were first asked if they had previously heard of entomophagy or edible insects (Appendix 5.2 Q27) and cultured meat (Appendix 5.2 Q32) and their consumption habits for edible insects (Appendix 5.2 Q28).

The following information was given to participants to introduce edible insects and cultured meat. For edible insects: *'With the population continuing to grow at a rapid rate, edible insects are increasingly being discussed as plausible alternative food sources. This is predominantly due to their nutritional benefits being high in protein and their pro-environmental impact which makes better use of land, water and produces less greenhouse gas emissions than most domestic breeding animal species'*. For cultured meat: *'Cultured meat, also known as in vitro or synthetic meat, is produced in a laboratory by extracting the stem cells from the muscle tissue of animals. The cells are fed and nurtured to multiply and create muscle tissue that is biologically the same as meat and therefore has the same taste and texture'*.

Based on this information, consumers were asked, 'how willing would you be to consider adopting edible insects (Appendix 5.2 Q29) and cultured meat (Appendix 5.2 Q33) into your future diet if products became more readily available?' Scores were collected on a 7-point Likert scale ranging from 'Extremely unwilling' to 'Extremely willing'. If participants answer 'Extremely unwilling', they will be asked for the reason(s) why and skip the next question as no motivational factors will influence their decision to consume edible insects (Appendix 5.2 Q30) and cultured meat (Appendix 5.2 Q34), and the response was textual, so the analysis was done by summarising keywords. The frequency analysis was used in Q29 and Q33 (Appendix 5.2). Independent T-test was applied to explore edible insect consumption habits (Appendix 5.2 Q28) whether they influence consumers' willingness to adopt edible insects (Appendix 5.2 Q29). Two additional One-way ANOVA was applied to explore whether previously heard edible insects (Appendix 5.2 Q27) and cultured meat (Appendix 5.2 Q33) influence consumers' willingness to adopt edible insects (Appendix 5.2 Q30) and cultured meat (Appendix 5.2 Q34).

A list of motivational factors excluded participants who were extremely unwilling to adopt edible insects (Appendix 5.2 Q31) and cultured meat (Appendix 5.2 Q35) was explored. These factors have been kept the same throughout the questionnaire to allow for comparisons to be made. One-way ANOVA with different motivations was conducted, where a significant difference ($p<0.05$) was identified, either Fisher's Least Significant Difference (LSD) test or Game-Howell post-hoc test were conducted based on homogeneity of variances.

Chapter 3 Results and Discussion

3.1 Results and Discussion outline

Section 3.2 summarises the demographic information of participants in this study. Section 3.3 describes the proportion of consumer meat eaters status. Section 3.4 describes consumers' perceptions of sustainable diets. Section 3.5 presents consumers' perception of environmental awareness for the nine behaviours and 12 food items and the impact of meat intake on environmental awareness. Section 3.6 explores the willingness and motivational reasons for reducing meat consumption. Section 3.7 discuss the results of the Meat attachment questionnaire and Theory of Planned Behaviour. Sections 3.8 to 3.10 describes willingness and motivational factors for accepting meat substitutes, edible insects and cultured meat. In Section 3.11, the motivational factors for adopting the three meat alternatives are compared.

3.2 Demographics information

In total, data for 778 Chinese consumers, aged over 18 years and live in Shanghai were included in this study. 51% of participants (n=393) were male, and 48% (n=373) were female (12 participants were not willing to share their gender in the survey). For the age of the participants, all participants were over 18 years old, with the majority of participants below the age of 35 years, 44% in the 25-34 years category, and 39% in the 18-24 years category. Participants aged 35-44 and 45-65 years old accounted for 12% and 5% respectively. The vast majority of participants were of Han ethnicity (98%). Meanwhile, most participants had no religious beliefs

(88%), with approximately 7% of participants being Buddhist. For the participant's education level, 72% of participants hold bachelor's degrees, and 14% of participants hold a postgraduate/ doctorate degree, and 10% of participants hold a three-year college degree. Regarding the participants' household income, 33% participants (n=257) had an annual income higher than 90,000 CNY, while 23% participants (n=174) had a household income of less than 50,000 CNY. Most of the participants (63%) had more than two adults living in their household, and 31% had more than four adults living in their household. Participants with no children in the household accounted for approximately 47% of the total number of participants, while 45% have one child in the household.

3.3 Meat eater classification

Based on the quartile analysis, of the total 778 participants, 178 participants (23%) were classified as low meat eaters (LME), 232 participants were classified as standard meat eaters (SME), representing 30% of the total participants; 27% of the participants were classified as high meat eaters (HME) with 207 participants in total. Additionally, there were 161 participants (20%) who were non meat eaters (NME). It’s interesting that approximately 20% of the survey participants were NME, however, it was suggested in previous research that meat-free eating habits are a minority culture in China (Mao et al., 2015). The reasons for the difference was currently unknown, however it could partly due to that the majority of participants in the current study were young and educated and dietary preference might have evolved greatly over the last

6 years in Shanghai. It would be interesting to further confirm this finding and explore the reasons behind such changes.

3.4 Awareness to sustainable diets

Surprisingly 67% of participants indicated that they knew someone who is consuming a sustainable diet. Interestingly, 58% of participants said they knew where to find information on sustainable diets.

China's internet is firewalled and isolated from Google (Bloomberg, 2018). Although there is sustainable diet information available on Chinese internet (Baidu), little information is published from Chinese government regarding its definition and guidance. However, as described in the introduction, the Chinese diet has a wide variety of plant-based foods, include all kinds of fresh vegetables, tofu and other soy products (Liu et al., 2021). The majority of consumers might have associated the sustainable diet with meat reduction increasing vegetable and fruit consumption. In China, the vegetarians represent 4 - 5% of the total population, with approximately over 50 million vegetarians in China (Li *et al.*, 2021), therefore, it is likely that Chinese consumers know someone around them that follow a plant-based diet which might be confused with sustainable diet. In the current study, 67% and 58% of consumers knew about the followers and information about sustainable diets, respectively, were believed to be those following a plant-based diet.

In the current study, participants rated environmental impact as a more important factor when following a sustainable diet [M=5.67, SD=1.22], which is significantly higher than social impact [M=5.28, SD=1.23], ($t(1554)=6.31$, $p<0.001$).

Regarding the five environmental awareness statements, one-way ANOVA analysis revealed a significant difference among the five statements ($F(4, 1941)=62.52$, $p<0.001$). The results showed that participants agreed most with the statement of *'high meat consumers are at a higher risk of developing type 2 diabetes, cardio-vascular disease (CVD), and certain types of cancer'* [M=5.56, SD=1.30], which were significantly higher than the other statements. Participants claimed somewhat agree with the two statements that *Meat production has a negative environmental impact through deforestation, biodiversity loss, soil and water pollution* [M=5.06, SD=1.34]; *When comparing different types of meat, red and processed meats have the greatest environmental impact* [M=5.11, SD=1.26]. The two statements had the significantly lowest agreement scores are: *meat consumption currently contributes to over half of food-related emissions* [M=4.62, SD=1.35]; *Dairy products are the second biggest contributor to food related emissions after red meat* [M=4.72, SD=1.20]. This data indicates that Chinese consumers are aware that meat had a negative impact on the environment, but the impact was not as strong as on health. Interestingly, Chinese consumers also have the lowest agreement scores on meat and dairy products have high emissions statements, indicating Chinese consumers are generally not fully aware of the GHG emissions that are produced by meat and dairy products.

In agreement with a previous study, consumers rated environmental factors as more important than social factors when considering a sustainable diet (Tobler, Visschers and Siegrist, 2011). The Guardian in 2016 claimed that China would aim to reduce its meat consumption by 50% by 2030 (Milman and Leavenworth, 2016). The Guardian also pointed out that China's dietary guidelines aim to reduce meat consumption by 40 - 75g per capita by 2030 and then calculated that the Chinese government proposed reducing meat consumption by 50% (Milman and Leavenworth, 2016). Chinese consumers generally have good awareness of environmental impact of meat production, however, they have limited knowledge regarding fair labour and animal welfare when considering making choices to their diet (Carnovale *et al.*, 2021).

It is also worth noting that the overweight rate in Shanghai is around 30% (Li, 2020). In China, about 34.3% of the Chinese population is overweight (Li, 2020). In particular, overweight and obesity, and diabetes rates rise every year (Li, 2020). This could be the reason that consumers in Shanghai, China, mostly believe that meat causes diseases such as obesity and CVD. In the dietary guidelines, the recommended per capita meat consumption is aimed at public health and not protecting the environment (C.N.S, 2016). Although the reason for promoting meat reduction is public health, if this can be achieved, it would also benefit the environment significantly. In this case, the CO_2 equivalent emissions of China's livestock sector can be estimated to reduce by 1 billion tonnes from the estimated 1.8 billion tonnes.

3.5 Perceived environmental impact for behaviours and foods

3.5.1 Perceived environmental impact for behaviours

When exploring consumer understanding of the environmental impact of the nine behaviours, as shown in Figure 3-1, consumers agree that all these behaviours positively impact on the environment, but to a different degree. One-way ANOVA followed by post hoc test ($F(8, 2913)=57.27$, $p<0.001$) found that consumers perceived '*eating more seasonal fruits*' as having the highest positive environmental impact (approaching moderately positive impact on the scale) than any other statements (Figure 3-1). '*Eating more organic, plant-based, and local foods and buying food products containing less packaging*' were rated as having a slightly positive environmental impact than the other statements. In addition, consumers perceived that *eating less meat*, *avoiding food products transported by aeroplanes,* and *eating less dairy* have significantly lower positive environmental impacts and than the other behaviours.

According to Jungbluth, Tietje and Scholz (2000), the two highest environmental impact behaviours were the rejection of air-freighted products and the preference for organic products for the consumers. Both reducing meat consumption and increasing vegetable purchases had positive impact on the environment, but less than the environmental impact of refusing air freight products. The environmental impact of packaging was not very important as described in the Jungbluth, Tietje and Scholz (2000)'s study. However, Jungbluth, Tietje and Scholz (2000)'s study was conducted two decades ago, and the results are likely to be different nowadays. In another study, Swiss consumers expressed that excessive packaging had the most

significant environmental impact, followed by eating more local food and avoiding food transport. Lastly, eating more vegetables and fruit in season and organic food, and especially less meat, had the least environmental impact (Tobler, Visschers and Siegrist, 2011). It was suggested that the high environmental impact for over-packed and organic food identified by Swiss consumers could be due to Swiss media campaigns.

Interestingly, in all three studies, reducing meat was rated as having relatively low positive environmental impact. In theory, a sustainable diet aims to reduce meat consumption by increasing the consumption of vegetables and fruits. However, consumers perceive consuming more vegetables and fruits as having a more positive environmental impact, but not for reducing their meat consumption. In other words, it may imply that consumers are more willing to increase their vegetables and fruits intake but less willing to reduce their meat consumption.

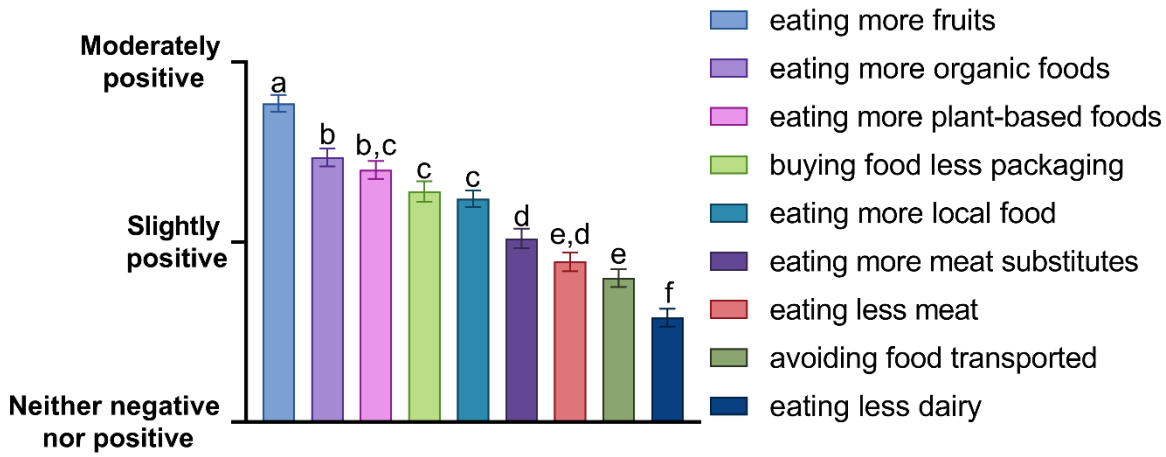

Figure 3-1 Perceived environmental impact for behaviours

Notes: According to Games-Howell test, values with different letters are significantly different ($p<0.05$). Results are mean ± SEM values. N=778

When exploring the relationships between the nine food behaviours and the intention to reduce meat consumption, all nine behaviours are positively associated with the intention to reduce meat consumption (Table 3-1). In another word, when consumers have higher environmental awareness to the listed food behaviours, they have a higher intention to reduce their meat consumption. In addition, all nine behaviours are positively associated with each other, indicating that consumers' environmental awareness of these behaviours is closely linked.

The behaviours that are mostly associated with the intention to reduce meat are: eating more plant-based foods, meat substitutes and eating less meat. In other words, this indicates that when thinking of reducing meat consumption, consumers are more likely to adopt the approaches eating less meat and substituting for other meat substitutes rather than eating fruits and organic foods or buying food with less packaging.

Table 3-1 The correlations between intention to reduce meat consumption with perceived environmental impact for behaviour

	1	2	3	4	5	6	7	8	9
Intention to reduce meat consumption	1								
Buying food less packaging	.199**	1							
Eating more local food	.194**	.512**	1						
Avoiding food transported	.258**	.504**	.525**	1					
Eating more fruits	.247**	.415**	.619**	.466**	1				
Eating more organic foods	.271**	.378**	.501**	.416**	.647**	1			
Eating less meat	.312**	.414**	.450**	.513**	.407**	.450**	1		
Eating less dairy	.245**	.337**	.366**	.449**	.319**	.331**	.690**	1	
Eating more plant-based foods	.390**	.448**	.513**	.490**	.584**	.619**	.583**	.499**	1
Eating more meat substitutes	.352**	.451**	.434**	.471**	.383**	.468**	.584**	.542**	.656**

*Notes: ** mean correlation is significant at the 0.01 level (2-tailed) in Pearson correlation tests. The No.1 intent to reduce meat consumption is to respond to willing reduce meat consumption (N=617). The No.2 to 9 were the Perceived environmental impact for behaviours (N=778)*

3.5.1.1 Non-meat eaters vs Meat eaters

As shown in Table 3-2, non-meat eaters (NME) rated all nine food behaviours, apart from eating more fruits, as having a significantly more positive environmental impact than meat eaters (ME) ($p<0.001$). This indicates NME have an overall higher environmental awareness than ME. However, eating more fruits is the only statement that was not significant. It suggests that regardless of meat-eating status, consumers have similar environmental awareness to fruit consumption.

Jungbluth, Tietje and Scholz (2000) reported that reducing meat and dairy products and avoiding transport are the food behaviours that have the most positive environmental impact. However, results in the current study suggest that both ME and NME rank eating less meat and dairy and avoiding food transported by aeroplane as having a lower positive environmental impact than other statements. Interestingly, even for NME, who have better environmental awareness, could underestimate the environmental impact of meat and dairy consumption in comparison to other food behaviours. This finding is novel, as no studies have explored the differences in environmental awareness between NME and ME before. The behavioural intentions of non-meat eaters consumers and meat eater consumers show significant differences in the present results, which is in line with the expectations of the results.

Table 3-2 Perceived environmental impacts for behaviours – NME vs ME

	Meat Eaters	Nonmeat Eaters	t-value	p-value
Buying food less packaging	5.13[a]±1.62	5.84 [b]±1.37	t(288)=-5.6	<0.001
Eating more local food	5.15 [a]±1.31	5.57 [b]±1.18	t(270)=-3.8	<0.001
Avoiding food transported	4.73 [a]±1.39	5.07 [b]±1.27	t(268)=-2.9	<0.001
Eating more fruits	5.76 [a]±1.36	5.81 [a]±1.24	t(270)=-0.48	0.632
Eating more organic foods	5.39 [a]±1.42	5.77 [b]±1.22	t(268)=-2.9	<0.001
Eating less meat	4.7 [a]±1.39	5.65 [b]±1.37	t(268)=-2.9	<0.001
Eating less dairy	4.42 [a]±1.36	5.21 [b]±1.21	t(268)=-2.9	<0.001
Eating more plant-based foods	5.27 [a]±1.4	5.9 [b]±1.24	t(268)=-2.9	<0.001
Eating more meat substitutes	4.81 [a]±1.53	5.84 [b]±1.23	t(268)=-2.9	<0.001

Notes: According to the independent T-test, values in the same row with different letters are significantly different ($p<0.05$). Results are mean ± standard deviation values. N=778, ME=617, NME=161.

3.5.1.2 Comparison within Meat eaters groups

As shown in Table 3-3, no significant differences were found among meat eater groups for all food behaviours apart from eating less meat ($p>0.05$). This result indicates that the overall environmental awareness among the three meat eaters groups are similar. Interestingly, LME considered eating less meat as having a significantly higher positive environmental impact than HME ($F(2, 614)=0.40$, $p =0.046$), whereas SME was not significantly different to either LME and HME (Table 3-3). In another word, the less meat they consume, a higher environmental impact was associated with eating less meat.

As discussed above, NME were more environmentally conscious than ME (Table 3-2). However, further exploration of environmental awareness among meat eaters revealed that meat intake did not affect their overall environmental awareness.

Table 3-3 Environmental impact of food behaviours among Meat Rating status

	Low Meat Eater	Standard Meat Eater	High Meat Eater	p-value
Buying food less packaging	5.04[a]±1.7	5.21[a]±1.57	5.12[a]±1.59	0.582
Eating more local food	5.17[a]±1.39	5.09 [a]±1.28	5.2 [a]±1.27	0.668
Avoiding food transported	4.87 [a]±1.52	4.63 [a]±1.36	4.72 [a]±1.3	0.217
Eating more fruits	5.75 [a]±1.42	5.76 [a]±1.36	5.77 [a]±1.32	0.994
Eating more organic foods	5.45 [a]±1.45	5.37 [a]±1.43	5.38 [a]±1.4	0.824
Eating less meat	4.9 [a]±1.45	4.67 [a, b]±1.34	4.55 [b]±1.36	0.046
Eating less dairy	4.46 [a]±1.43	4.41 [a]±1.33	4.39 [a]±1.34	0.863
Eating more plant-based foods	5.31 [a]±1.52	5.33 [a]±1.33	5.17 [a]±1.38	0.450
Eating more meat substitutes	4.88 [a]±1.61	4.76 [a]±1.46	4.79 [a]±1.54	0.713

Notes: Values in the same row with different letters are significantly different ($p<0.05$) according to LSD. All the data sets follow the Homogeneity of Variances. Results are mean ± standard deviation values. N=617, LME=178, SME=232, HME=207

3.5.2 Perceived environmental impact for food items

For environmental awareness of the listed food, ANOVA analysis revealed that consumers agree that beef, lamb, chicken, pork, fish, and prawn have a more negative environmental impact than other food items [$F(11, 3672)=233$, $p<0.001$] (Figure 3-2). Participants agreed that beef, lamb and pork have a higher negative environmental impact than chicken, fish and prawns. Interestingly, participants could not differentiate the environmental impact between pork, beef and lamb. Participants agreed that cheeses only had a little negative environmental impact on the environment and nuts, milk and eggs had a slightly positive environmental impact. Participants indicated that seasonal vegetables and meat substitutes had a moderately positive impact on the environment.

The findings in this study suggest that Chinese consumers generally have good awareness to environmental impact of a range of food items, however, there were still lack of critical environmental knowledge within the meat section (Figure 3-2). Consumers categorised all meat and seafood as having a slightly negative impact on the environment. According to Poore and Nemecek (2018), beef (99.48 kg CO_2 eq) produce the most greenhouse gas emissions per kilogram, which is the most environmentally impactful meat, followed by lamb (39.72 kg CO_2 eq), seafood (prawns 26.87 kg CO_2 eq), cheeses (23.88 kg CO_2 eq), pork (12.31 kg CO_2 eq), chicken (9.87 kg CO_2 eq), eggs (4.67 kg CO_2 eq), tofu (treat as meat substitutes, 3.16 kg CO_2 eq), nuts and vegetables (0.43 kg CO_2 eq). There are great differences among the GHG produced by different types of meat, however, consumers in China do not seem to be aware of

such differences. It's interestingly to highlight that prawn is actually produce more GHG than some meat (e.g. pork and chicken), however, the findings in the current study suggested that Chinese consumers consider Prawn has slightly positive environmental impact.

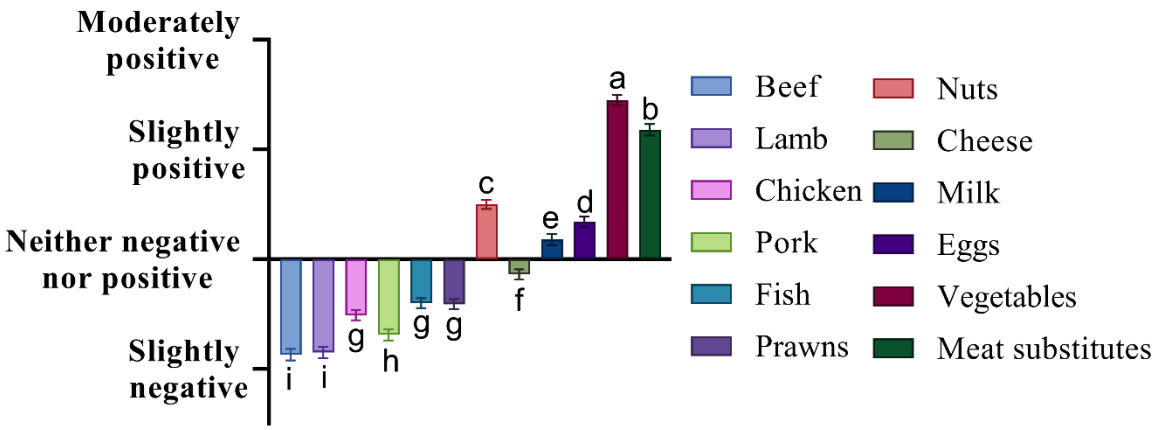

Figure 3-2 Perceived environmental impact for foods
Notes: Different letters within each category indicate significant differences at p<0.05. According to the Games-Howell test, which results are mean±SEM values. N=778.

3.5.2.1 Non-meat eaters vs Meat eaters

Regarding consumer awareness of different foods, in general, NME rated all types of meat as having a significantly higher negative environmental impact than ME ($p<0.05$) (Figure 3-3).

Interestingly, NME rated nuts, seasonal vegetables and meat substitutes as having a significantly higher positive environmental impact than ME, indicating NME believed that these types of food had a more positive impact than ME ($p<0.05$). In addition, cheese, milk were not significantly different between ME and NME ($p>0.05$), and the ratings are close to

neither positive or negative on the scale, indicating both ME and NME have netural views on these food items.

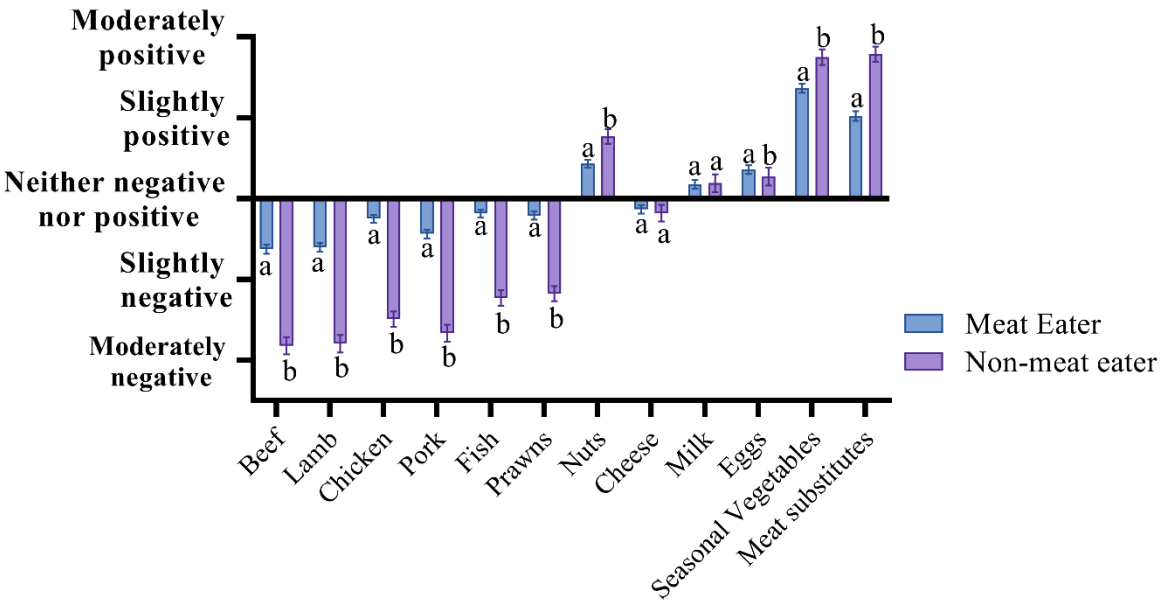

Figure 3-3 Perceived environmental impact for foods – Non-meat eater vs Meat eater
Notes: According to the independent T-test, values within each category with different letters are significantly different ($p<0.05$). Results are mean ±SEM values. N=778, ME=617, NME=161.

3.5.2.2 Comparison within Meat Eater Groups

As shown in Figure 3-4, the HME rated all meats and seafood as having a significantly lower negative environmental impact than the LME and SME ($p<0.05$). In other words, HME consumes a lot more meat than LME and SME because they believe meat do not impact negatively on the environment.

HME also rated seasonal vegetables as having a lower positive environmental impact than LME and SME [$F(2, 614)=2.34$, $p<0.05$]. No significant differences for nuts, cheeses, milk and

meat substitutes among meat eaters groups were found, indicating that the environmental impact of these foods was similar among meat eaters groups ($p>0.05$).

As mentioned above, whether to eat meat or not is closely associated with an individual's environmental awareness (Figure 3-3). The results in Figure 3-4 showed that meat eaters (classified by their meat intake) showed differences in environmental awareness to some meats and seafoods. Therefore, consumers' environmental awareness could play a role in consumers' meat intake or vice versa. It is likely that the greater environmental awareness to meats and seafood contributed to the lower meat consumption in low meat eaters.

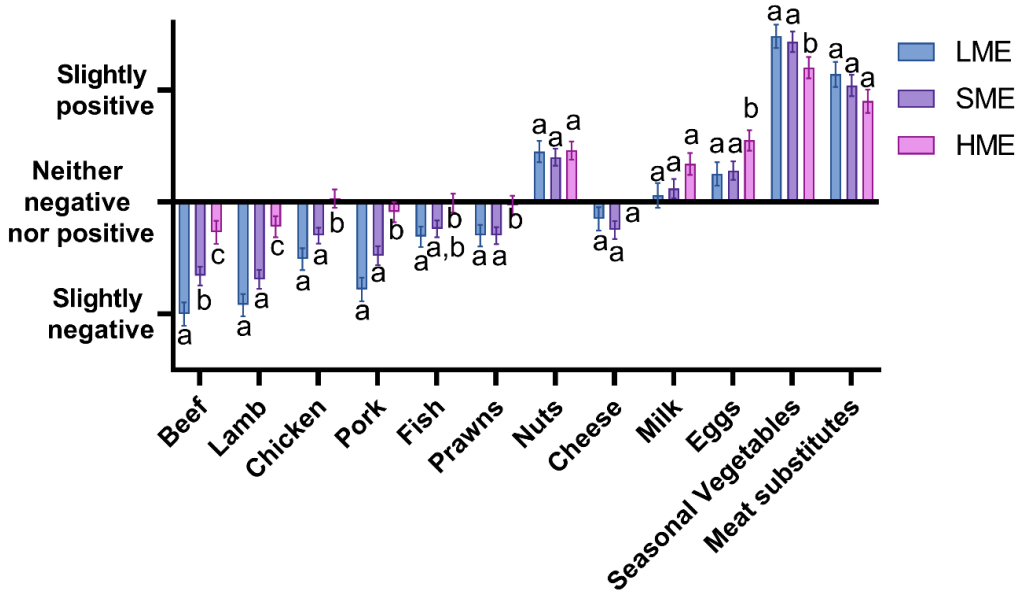

Figure 3-4 Environmental awareness of foods in LME, SME and HME

Notes: Different letters within each category indicate a significant difference at $p<0.05$. According to LSD or Games-Howell test, which results are mean ±SEM values. N=617, LME=178, SME=232, HME=207.

3.6 Willingness and motivation of reducing meat consumption

When asking participants whether they are now trying to reduce their meat consumption, 64% of participants (omnivore and flexitarian only, n=617) stated they had made an effort to reduce their meat consumption after giving participants sustainability information and explored whether they were willing to reduce meat consumption in the next year for sustainability or environmental reasons. Seventy per cent of participants were willing to reduce their own meat consumption, with 13% natural and 11% participants remaining slightly unwilling. 2% of participants expressed an attitude of extremely unwillingness to reduce meat consumption. Some of their comments were shown as below:

'I have money, like to eat meat, and can't get enough vegetables and fruits. – no reason, just love to eat meat'
'Meat Alternatives taste bad and have different nutritional values. – because meat taste and supply nutritional values'
'I don't think the environmental impact of meat consumption is that great, the numbers look alarming but it's nothing compared to the waste and so on. Instead of making me suffer every day by not eating meat for the environment's sake, I should just manage the waste first. – believe meat consumption not significantly impact the environment.'

The comments received by participants suggests that consumers might just love eating meat and enjoy the taste and flavour of it, which could link to their high meat attachment. It has shown that hedonism and attachment to meat can prevent consumers from reducing meat consumption (Graça, Calheiros and Oliveira, 2015). Some participants also highlighted the impact of food waste, which they believed could be much higher than the environmental impact of food; thus if they were to change their behaviour, then they would tackle food waste first.

When the participants were asked to indicate their motivation for reducing their meat consumption, a significant difference among different motivational factors was observed ($p<0.05$). ANOVA analysis followed by post-hoc test showed that food safety [M=6.00, SD=1.00] was rated as the highest motivation factor, followed by health [M=5.62, SD=1.19] and environmental benefits [M=5.56, SD=1.24]. The factors of convenience [M=5.00, SD=1.00], sensory appeal [M=5.17, SD=1.16], the price [M=5.06, SD=1.24] and animal welfare [M=4.87, SD=1.37] were significantly lower than food safety, health and environment. In addition, sensory appeal and price were significantly higher than animal welfare in motivating consumers to reduce their meat consumption, as shown in Figure 3-5.

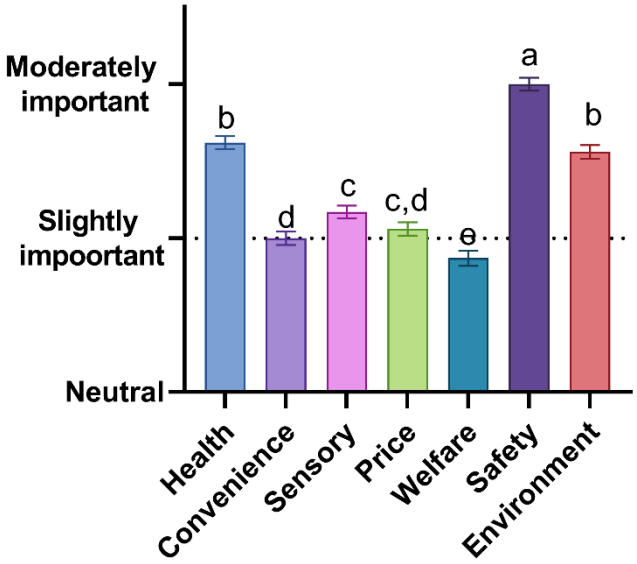

Figure 3-5 Motivation for reducing meat consumption
Notes: According to the Games-Howell test, different letters within each category indicate a significantly different ($p<0.05$). Results are mean±SEM values. $F(6, 2416)=88.22$, $p<0.001$. N=778

Interestingly, a previous study by Lentz et al. (2018) in New Zealand identified price as the strongest motivation for reducing consumers' meat consumption, followed by health, taste, and animal welfare. The least important motivation was environmental factors (Lentz et al., 2018).

Food safety was rated as the top one factor when considering meat reduction for Chinese consumers in the current study, whereas New Zealand consumers rated cost as the top factor. This could be due to the fact that Chinese consumers are generally more concerned about food safety, and the food safety scandals have influenced their views over the last decade. There are a range of scandals that were reported in China, including, the pork scandal, involved dealers buying dead pork, further processing it in illegal workshops and selling on the market (Luo, 2016); the lamb scandal was similar, involved using rat and fox meat mixed with lamb (The Ministry of Public Security, 2013). In the last decade, there were many reported food safety scandals in China and Chinese government has established Consumer right day (15th March every year) to protect consumers from these scandals, therefore, it's not surprising to see food safety was identified as highest motivator, as Chinese consumers would always put food safety when making food and dietary choices (CN315, 2020). Both health and environment were rated as the second most important factors, demonstrating that Chinese consumers, similar to Western consumers, are motivated by the positive health effects of reducing meat consumption. As discussed above, Chinese consumers have a good awareness of the environment, and they were also motivated by environmental factors when considering reducing their meat intake. However, in some studies conducted in Western countries, ranked environmental factor as the

last incentive to reduce meat consumption, which is surprising (Lentz et al., 2018; Graça, Calheiros and Oliveira, 2015).

Animal welfare was the least motivational factor. Only 30% of Chinese farmers had heard of animal welfare in 2013 (You et al., 2014). There are limited information about animal welfare available from the current Chinese website, which is not surprising that consumers are unaware of animal welfare. The findings here suggest that when promoting meat reduction strategies in China, the official authorities should prioritise food safety, health and environment factors to encourage consumers to reduce their meat consumption and consider meat alternatives.

3.7 Meat attachment questionnaire (MAQ) & Theory of Planned Behaviour (TPB) elements

3.7.1 Meat attachment questionnaire (MAQ)

The Meat attachment questionnaire (MAQ) was first published by Graça, Calheiros and Oliveira (2015), and there have been several studies that have repeatedly validated the MAQ scale in different population samples.

In the current study, a principal axis factor analysis was conducted on the 16 items with varimax with Kaiser normalisation. The Kaiser-Meyer-Olkin (KMO) measure certified the sampling adequacy for the analysis, the KMO=0.94. Four factors had eigenvalues over Kaiser's criterion of 1 and, in combination, explained 71.87%.

Table 3-4 shows the factors loadings after rotation. The items that cluster on the same factor suggest that factor 1 represents hedonism, factor 2 represents affinity, factor 3 represents entitlement and factor 4 is represent dependence.

Table 3-4 MAQ Principal component analysis results

	Component [a,b,c,d,e,f]			
	1	2	3	4
	Hedonism	Affinity	Entitlement	Dependence
Hedonism				
HE1	0.773	0.217	0.250	0.303
HE2	0.793	0.211	0.229	0.252
HE3	0.769	0.195	0.264	0.309
HE4	0.584	0.148	0.376	0.374
Affinity				
AF1-R	0.290	0.710	-0.105	0.042
AF2-R	0.054	0.797	0.292	0.150
AF3-R	0.173	0.744	0.163	0.050
AF4-R	0.186	0.784	0.193	0.136
Entitlement				
EN1	0.294	0.097	0.783	0.115
EN2	0.253	0.158	0.794	0.191
EN3	0.423	0.306	0.681	0.115
Dependence				
DE1	0.759	0.217	0.279	0.296
DE2	0.634	0.278	0.272	0.245
DE3-R	0.275	0.361	-0.001	0.702
DE4	0.338	-0.021	0.228	0.769
DE5	0.363	0.081	0.194	0.737

a. Extraction Method: Principal Component Analysis.
b. Rotation Method: Varimax with Kaiser Normalization.
c. Bolded font coefficients absolute value higher than 0.5
d. Fix number of factors to extract: 4
e. Reverse questions in the initial questionnaire, recode completed
f. KMO value equal 0.940

The hedonism, affinity, entitlement, dependence, and meat attachment all had high reliability as Cronbach's α are greater than 0.8 (Table 3-5). Therefore, indicating that MAQ scales have good reliability in this sample of Chinese consumers. As shown in Table 3-5, significant correlations were observed among hedonism, affinity, entitlement, dependence and meat attachment, indicating these dimensions are significantly associated with each other.

To compare current results with previously published results. Table 3-6 summarised average scores across studies conducted in different countries, including Germany (Graça, Calheiros and Oliveira, 2015); New Zealand (Lentz et al., 2018); New Zealand and Chinese (Wang and Scrimgeour, 2021); and USA, India and China (Bryant et al., 2019). It is worth noting that Graça, Calheiros and Oliveira (2015) and Bryant et al. (2019)'s studies used 5 point scales, so their data was converted to 7-point for the purpose of comparison between different studies.

Table 3-5 Meat Attachment Questionnaire reliabilities, means, standard deviations and correlations

MAQ scale and subscales	Cronbach's Alpha	Mean±SD	1	2	3	4	5
1. Hedonism	0.91	4.54±1.3	1				
2. Affinity	0.82	4.93±1.14	.487**	1			
3. Entitlement	0.83	4.60±1.2	.674**	.447**	1		
4. Dependence	0.85	4.20±1.19	.832**	.473**	.606**	1	
5. Meat Attachment	0.93	4.54±1.01	.914**	.712**	.787**	.902**	1

Notes: ** mean correlation is significant at the 0.01 level (2-tailed) in the Pearson correlation test.

In general, the scores for meat attachment, hedonism, affinity, entitlement, and dependence were lower for Chinese consumers than in Germany, New Zealand, and USA consumers (As

illustrated in Table 3-6). This indicates that Chinese consumers have a lower attachment to meat than consumers in Western countries, indicating there is a variation in consumer meat attachment and intake across different countries. China has a long food history of eating plant-based food (Zhong, 2018). It is possible that food culture history could potentially influence the habits of Chinese consumers and their attitudes towards meat. Majority of Chinese consumers have beliefs that consuming plant-based food is beneficial to their health, therefore, Chinese consumers may become less attached to meat from a health benefits perspective.

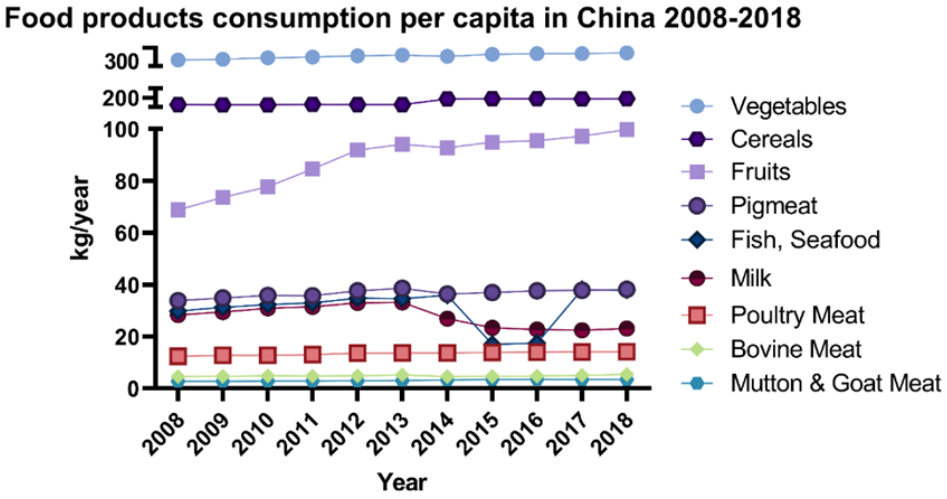

Figure 3-6 Food products consumption per capita in China across 2008-2018 – same as Figure 1-5

Notes: Data refer from FAOSTAT (2021) new and old food supply quantity

Zhong (2018) also argued that Chinese consumers' principles of tolerance and friendliness towards nature have further led to the Chinese being less inclined to eat meat and hunt animals. The results in Figure 3-6 confirm that the main diet of Chinese consumers nowadays is mainly a plant-based diet, with meat serving as a small part of their daily meals. In the context of this dietary pattern, it could also explain the lower attachment of Chinese consumers to meat.

Table 3-6 The MAQ scales and subscales comparison with three studies

MAQ scales and subscales	Current study	Graça, Calheiros and Oliveira (2015)	Lentz et al. (2018)	Bryant et al. (2019)		
Country Population	China	German	New Zealand	China	USA	India
1. Hedonism	4.54±1.3	5.2±1.41	5.10±1.4	N/A	N/A	N/A
2. Affinity	4.93±1.14	5.6±1.44	5.20±1.5	N/A	N/A	N/A
3. Entitlement	4.60±1.2	5.04±1.48	4.80±1.4	N/A	N/A	N/A
4. Dependence	4.20±1.19	4.49±1.62	4.20±1.40	N/A	N/A	N/A
5.Meat Attachment	4.54±1.01	5.06±1.31	4.80±1.20	5.18±0.75	5.26±1.13	4.59±1.09

*Notes: Results are mean ± standard deviation values. N/A means that this data was not reported in the study. Graça, Calheiros and Oliveira (2015)'s and Bryant et al. (2019)'s study used a 5-point scale in Table 3-6 reported the 7-point scale by estimation. The estimation method was the original data * 1.4. Wang and Scrimgeour (2021)'s study did not provide the MAQ data.*

As shown in Table 3-7, total meat attachment score and scores for MAQ subscales have a significant negative correlation with willingness to reduce meat and meat intake ($p<0.05$). This finding agrees with Lentz et al. (2018)'s results that consumers who have higher attachment to meat, they are less willingness to reduce their meat consumption. For the relationship between meat intake and MAQ, this study also supports Lentz et al. (2018) and Graça, Calheiros and Oliveira (2015)'s finding where higher meat intake is associated with greater attachment to meat and hedonism, affinity, entitlement, and dependence. This means that when individuals consume high levels of meat, they become more attached to the meat, or vice versa.

Table 3-7 Pearson correlations for MAQ with TPB components and meat intake.

	Willing to reduce meat consumption	1	2	3	4	5	6	7	8
1. PN	.535**	1	-	-	-	-	-	-	-
2. PBC	.490**	.386**	1	-	-	-	-	-	-
3. SN	-.085*	0.041	-.082*	1	-	-	-	-	-
4. Hedonism	-.551**	-.523**	-.338**	.112**	1	-	-	-	-
5. Affinity	-.382**	-.475**	-.192**	-.161**	.487**	1	-	-	-
6. Entitlement	-.422**	-.303**	-.161**	.183**	.674**	.447**	1	-	-
7. Dependence	-.590**	-.525**	-.411**	.126**	.832**	.473**	.606**	1	-
8. Meat Attachment	-.595**	-.562**	-.349**	0.077	.914**	.712**	.787**	.902**	1
9. Meat Intake	-.285**	-.242**	-.171**	.133**	.426**	.162**	.276**	.371**	.380**

*Notes: * p<0.05, ** p<0.01 in Pearson correlation test. SN is the subjective norm, PBC is perceived behaviour control, PN is the personal norm. The meat intake is summarised into five types of meat consumption.*

3.7.2 Theory of Planned Behaviour (TPB) element

For TPB, the correlations between the three factors (SN, PBC and PN) with MAQ are shown in Table 3-7 (As above). SN was significant positive correlated with hedonism, entitlement, dependence and meat intake, and significant negative correlated with affinity (<0.05). There wasn't a significant correlation between the total meat attachment score and SN (p>0.05). This is similar to the finding reported in previous studies (Lentz et al., 2018; Graça, Calheiros and Oliveira, 2015), where no significant correlation with meat attachment indicates that other people's options do not seem to influence an individual's attachment to meat (Table 3-7). PBC was significant negative correlated with total attachment score and sub-scale scores, which disagrees with Lentz et al. (2018) finding. The data in the current study indicate that the higher the level of perceived behavioural control in reducing meat consumption, the more likely they are less attached to the meat for Chinese consumers (Table 3-7).

PN was found to be significantly negatively correlated with meat attachment and sub-scales (Table 3-7). This finding is in agreement with Wang and Scrimgeour (2021) studies have confirmed that the PN positively correlated with willingness to adopt a plant-based diet, while the willingness negatively correlated with MAQ. Therefore, the PN should be negatively correlated with MAQ in Wang and Scrimgeour (2021) study. Meanwhile, PN were reported to be positively correlated with environmental awareness in Bamberg and Möser (2007). The current study also supports the finding that PN and environmental awareness are positively associated (Table 3-8). The findings here suggest that more Chinese consumers agree that reducing meat consumption is the right thing to do, the less likely they are attached to meat.

Table 3-8 Pearson correlations for Personal norm with environment awareness

	Personal Norm (PN)
Buying food with less packaging	.112**
Eating more local food	.156**
Avoiding food transported	.213**
Eating more fruits	.126**
Eating more organic foods	.224**
Eating less meat	.264**
Eating less dairy	.189**
Eating more plant-based foods	.311**
Eating more meat substitutes	.289**

*Notes: ** $p<0.01$ in Pearson correlation test.*

Interestingly, MAQ is negatively correlated with willingness to reduce meat consumption (Table 3-7), whereas positive correlations were found for PBC and PN. This indicates that Chinese consumers are more likely to reduce their meat consumption when they have higher behavioural control and the more they perceive it to be the right thing to do.

3.7.2.1 Comparison within Meat eaters groups

According to Table 3-9, there are significant differences among meat eaters groups for PN [$F(2, 614)=14.81$, $P<0.001$], PBC [$F(2,614)=5.72$, $p<0.001$] and SN [$F(2,614)=5.66$, $p<0.001$). It was found that LME has significantly higher scores than HME for PBC and PN. However, the LME has significantly lower SN scores than SME and HME. In contrast, SME was not significantly different to either LME or HME for PBC and SN.

This result suggests that consumers with lower meat intakes are more likely to have higher perceived control over reducing meat consumption and perceive that it is right to reduce meat consumption. LME indicated the lowest scores in SN than SME and HME, suggesting that LME was significantly less influenced by the opinions of others in reducing meat consumption than SME and HME.

For TPB results, LME has lower meat intake could be due to the resources and ability (PBC) to implement reducing meat consumption and convinced reducing meat consumption is the right action (PN). Moreover, LME are less affected by other people's views in reducing meat consumption, so their SN values are significantly lower than SME and HME.

Table 3-9 TPB scores in Low Meat Eater, Standard Meat Eater and High Meat Eater

	Low Meat Eater	Standard Meat Eater	High Meat Eater
Personal Norm (PN)	4.4 [a]±1.62	3.78 [b]±1.6	3.52 [b]±1.62
Perceived Behavioural Control (PBC)	5.24 [a]±1.06	5.07 [a,b]±1	4.9 [b]±0.93
Subjective Norm (SN)	3.38 [a]±1.13	3.51 [a,b]±1.08	3.76 [b]±1.15

Notes: According to the LSD test, values in the row with different letters are significantly different ($p<0.05$). Results are mean ± standard deviation values. N= 617, Low Meat Eater (LME)=178, Standard Meat Eater (SME)=232, High Meat Eater (HME)=207.

3.8 Willingness, motivation for adopting meat substitutes

When participants (n=617, only omnivore and flexitarian were included) were asked about their willingness of adopting meat substitutes as a replacement to meat in the next year 64% of the participants were willing to adopt meat substitutes. 4% of participants expressed they are extremely unwilling to adopt meat substitutes. 16 of them felt that the sensory appeal of meat substitutes was not good enough, especially compared to real meat. Six participants love meat, and they could be classified as unwilling to adopt meat substitutes because of hedonic reasons. Three participants thought that meat substitutes were unsafe because of the additives in meat substitutes. One participant was reluctant to adopt meat substitutes because meat substitutes were too expensive. One citation from each reason were selected and demonstrated as below:

Food additives and the safety of food – food safe reason
There is no substitute for the taste and nutrition of meat – sensory appeal reason
Enjoy meat and moderate intake of meat contributes to good health – the hedonic reason

Bryant et al. (2019) reported a similar percentage of Chinese consumers that expressed willingness to buy plant-based meats (62.4%). However, they also explored consumers in US and India, and found that only 32.9% of consumers in the US and 62.8% of consumers in India indicated they were very or extremely likely to buy plant-based meat. The research indicates a

huge cross-cultural variation in consumer willingness and acceptability to plant based food, and future research would be needed to explore this further.

Similar to the motivation of meat reduction's findings, food safety [M=6.10, SD=1.13] was cited as the first motivating factor for adopting meat substitutes. Secondly, environmental benefit [M=5.68, SD=1.24], health benefit [M=5.72, SD=1.19] were statistically higher than the sensory appeal [M=5.43, SD=1.15], convenience [M=5.31, SD=1.12] and price [M=5.22, SD=1.26], participants considered these factors to have a slightly important effect on motivated adoption of meat substitutes. Animal welfare [M=4.97, SD=1.34] was the least motivation factor among all factors, $F(6, 2416)=74.8$, $p<0.001$ (As Figure 3-7).

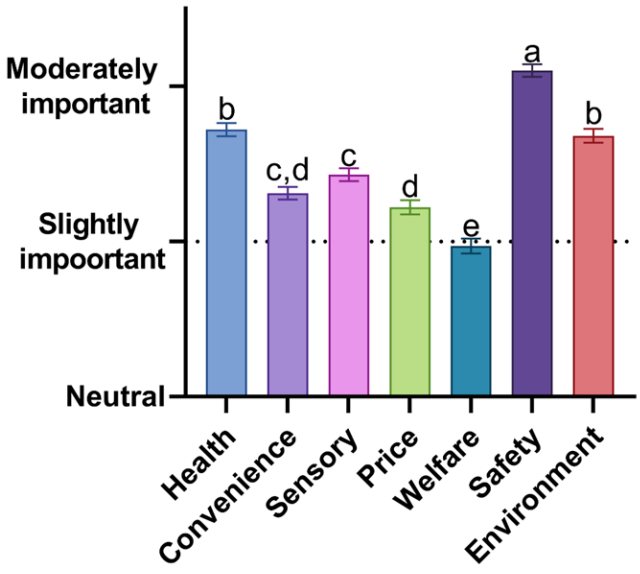

Figure 3-7 Motivation for adopting meat substitutes

Notes: According to the Games-Howell test, different letters within each category indicate a significantly different ($p<0.05$). Results are mean±SEM values. N=778

Chinese consumers' acceptance of meat substitutes is as expected, as China has a long history of consuming plant-based products (Yao, 2007). Meat substitutes are usually available in China as a plant-based product, usually in a snack or dish made from soy products, and are very common in supermarkets. The most popular plant-based snack in China is 'spicy strips', which use soy or flour as ingredients, are processed using various food additives and are generally spicy in flavour. However, the media has exposed this popular plant-based product in China as having food safety issues involving potential unsafe food additives (Liu, Mutukumira and Chen, 2019). This might explain why food safety is consistently cited as the top 1 factor when considering reducing meat consumption and adopting meat substitutes.

Meat substitute’s snacks in China are fairly low in price, and when food companies were reported to have food safety issues, consumers could be very concerned about the food safety of meat substitutes. The environmental and health factors on consumer incentives to adopt meat substitutes can be understood as consumers understanding that meat substitutes have health and environmental benefits when substituting meat consumption. Similarly, animal welfare is the least motivating factor for consumers to adopt meat substitutes. Because there is relatively little information about animal welfare in China and consumers are not fully aware of animal welfare, which makes animal welfare the least incentive for meat substitutes adoption.

3.9 Willingness, motivation for adopting edible insects

Interestingly 79% of the participants had heard of edible insects. 62% of the participants indicated they had never tried edible insects before, and 23% had tried edible insects on a single occasion. Participants who had tried edible insects on a few occasions accounted for 13% of the total. Only 2% of participants regularly consumed edible insects. Chinese consumers were actually aware of edible insects, as 79% of participants had heard of it, but familiarity was low, as only 36% of participants had eaten it once or more.

The tradition of eating edible insects as a dish exists in China, and this kind of edible insects diet is usually found in Yunnan Province, China (Feng et al., 2018). There was no evidence of the edible insects as a traditional food in Shanghai (China), which explains the low incidence of edible insects consumption experience.

30% of participants are willing to adopt edible insects, and 57% of participants are unwilling. In total, 23% (n=182) participants were extremely unwilling to consider adopting edible insects. They mainly expressed their concerns as being scared, disgusted, afraid, horrible, hated discomfort towards edible insects. Moreover, a few participants also expressed that they believe that edible insects would have unknown bacteria or pathogens, making them think that edible insects are unsafe. Moreover, the reason was the fear of food safety issues with insects. Other consumers in the study similarly cited food neophobia and aversion as the main reasons that prevented consumers from accepting edible insects. The reasons for Chinese consumers'

unwillingness to adopt edible insects are similar to those given in the Onwezen et al. (2021) literature review study. It would be interesting to conduct future studies to explore how food neophobia, disgust affect consumer acceptability to edible insects for Chinese consumers.

This study further explored the relationship between individuals' knowledge of edible insects and their willingness to adopt them. The results of the t-tests revealed that when consumers had heard of edible insects [M=3.47, SD=1.82], they were significantly more likely to adopt edible insects than others who had not heard of edible insects [M=2.69, SD=1.44, $t(322)=5.8$, $p<0.001$]. Exploring consumers' familiarity with edible insects and willingness to accept edible insects. An ANOVA was conducted to find that consumers who tried edible insects frequently and regularly [M=5.64, SD=1.29] and those who tried it a few occasions [M=5.21, SD=1.15] were significantly more willing to adopt edible insects than those who tried it once [M=3.86, SD=1.52] and those who had never tried it [M=2.65, SD=1.57, $F(3, 774)=101$, $p<0.001$]. This supports Hartmann et al. (2015) finding that familiarity is one of the key factors affect consumers' willingness to accept edible insects.

Onwezen et al. (2021) research also supported this view that consumers are biased influenced by the foods that they are familiar with. Research suggest that this dietary tradition of edible insects only appears in Yunnan Province and the southern region of China, indicating there were culture differences within China (Durst et al., 2010; Chen, Feng and Chen, 2009). Majority of participants have heard of edible insects in this study, indicating the regional insect eating habit have increased national familiarity to edible insects. However, only 36% of them

had eaten it once or more, suggesting more studies would be needed to understand barriers behind edible insects eating in order to promote edible insect as a sustainable meat alternatives.

Participants (n=596, excluding extremely unwilling to adopt edible insects) were asked about seven potential factors that motivate them to adopt edible insects. As shown in Figure 3-8, Participants rated food safety [M=6.21, SD=1.06] as the first motivating factor and was significantly higher than other factors. The environmental benefit [M=5.74, SD=1.19], sensory appeal [M=5.61, SD=1.21] and health benefit [M=5.49, SD=1.31] were also rated as important motivators and the least important motivator is insect welfare [M=4.67, SD=1.46], $F(6, 1894)=106.17$, $p<0.001$.

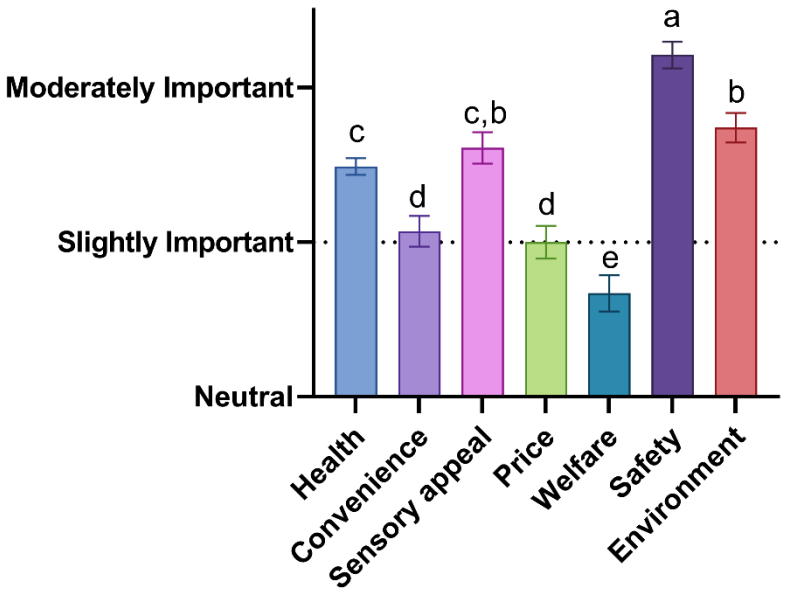

Figure 3-8 Motivation for adopting edible insects
Notes: According to the Games-Howell test, different letters within each category indicate a significantly different ($p<0.05$). Results are mean±SEM values. N=596

Chinese consumers are still very concerned about food safety, environmental benefits and health benefits for edible insects. Consumers may be concerned that insects may contain unknown bacteria, which could lead to food safety issues. The food safety in the acceptance of edible insects by consumers is also shown in other studies (Orkusz et al., 2020). Misconceptions about food safety can be attributed to consumers' lack of knowledge about edible insects. It is worth noting that consumers cited sensory appeal, environmental impact and health as secondary incentives to adopt edible insects. The sensory properties of edible insects were indicated as an important factor, as some insects are known to have distinct flavours that could be unpleasant. Thus, when promoting edible insects to consumers, the processing methods to improve the sensory characteristics of edible insects can be critical. A previous study also found that consumers expect edible insects to have a good and acceptable sensory appeal (Onwezen et al., 2021).

3.10 Willingness, motivation for adopting cultured meat

57% of participants claimed they know what cultured meat means; interestingly, 40% of participants agree that they don't know what cultured meat means and 3% of participants indicated they have never heard of cultured meat. When participants read the definition of cultured meat. 65% of the participants were willing to adopt cultured meat in the next year, 18% had neutural views. Of those who expressed extremely unwillingness, most of which were because cultured meat was not similar to real meat. The majority of these reasons were because

the sensory appeal of cultured meat was not the same as the real meat, and some participants indicated that cultured meat might have food safety issues.

Individuals' knowledge of cultured meat and their willingness to adopt cultured meat was further explored. The results of the ANOVA found those who have heard of cultured meat consumers were significantly more willing to adopt cultured meat [M=5.31, SD=1.40] than those who did not know the meaning of cultured meat [M=4.42, SD=1.27]. Consumers who had heard of cultured meat were both significantly more likely to adopt cultured meat than those who had not heard cultured meat [M=2.81, SD=1.55, $F(2, 775)=70.3$, $p<0.001$].

In the current study, a higher percentage of consumers (65%) were willing to accept cultured meat in comparison to Western countries (approximately 50%) (Bryant et al., 2019; Liu et al., 2021). Cultured meat is a novel food, and this study used '人造肉' as a translation term; it is worth noting that the linguistic equivalence may affect Chinese consumers. In English, cultured meat also has many equivalents, such as lab-grown meat, clean meat, artificial meat, vitro-meat. The translation of these different words in Chinese varies; in the second translator review, '人造肉' was considered to be the most consistent with the meaning of cultured meat. However, this translation also has the meaning of including meat substitutes in Chinese. Although this study provides a definition of cultured meat in order to prevent misunderstandings caused by linguistic equivalence, the misunderstanding may still happened. The misunderstandings arising from linguistic equivalence can lead to increased familiarity with cultured meat among consumers, as they are likely to interpret cultured meat as meat substitutes. The reasons given

by Chinese consumers for being unwilling to try cultured meat are similar to the previous studies, with the sensory appeal being the main reason and food safety being the next important reason (unnatural) (Liu et al., 2021). In Western consumers, the perception of cultured meat as unnatural is also one of the most common reasons reported by consumers, followed by food safety and the expectation of sensory food (Bryant and Barnett, 2020). Concerns about food safety have also been shown in studies to be related to unnaturalness and scientific uncertainty (Siegrist, Sütterlin and Hartmann, 2018).

Chinese consumers' knowledge of cultured meat is at an acceptable level, with 57% of consumers knowing what cultured meat means, but in contrast, 40% of consumers do not know the exact definition and meaning of cultured meat. In agreement with previous studies, consumer familiarity with cultured meat significantly influences consumer acceptance of cultured meat (Liu et al., 2021; Bryant et al., 2019). In general, Chinese consumers do not seem familiar with cultured meat, and cultured meat is still an unfamiliar term to most Chinese consumers. The unfamiliarity of cultured meat also contributes to consumers being unwilling to try cultured meat; Liu et al. (2021) also support this hypothesis. The results are expected, as cultured meat is still at development stage and only appears on social media and news, not available on the market yet. Therefore, a lower familiarity and acceptance is expected.

Consumers cited environmental benefit [M=6.16, SD=1.13] as the first incentive to eat or try cultured meat, significantly higher from other factors, followed by food safety [M=5.71, SD=1.26], health [M=5.64, SD=1.24] and sensory appeal [M=5.56, SD=1.14], which were

very close to being moderately important for motivating them to try or eat cultured meat (Figure 3-9). In addition, convenience [M=5.25, SD=1.19], the price [M=5.25, SD=1.40] and animal welfare [M=5.07, SD=1.40], participants generally considered it more than slightly important to motivate them to eat or try cultured meat, $F(6, 2416)=71.81$, $p<0.001$.

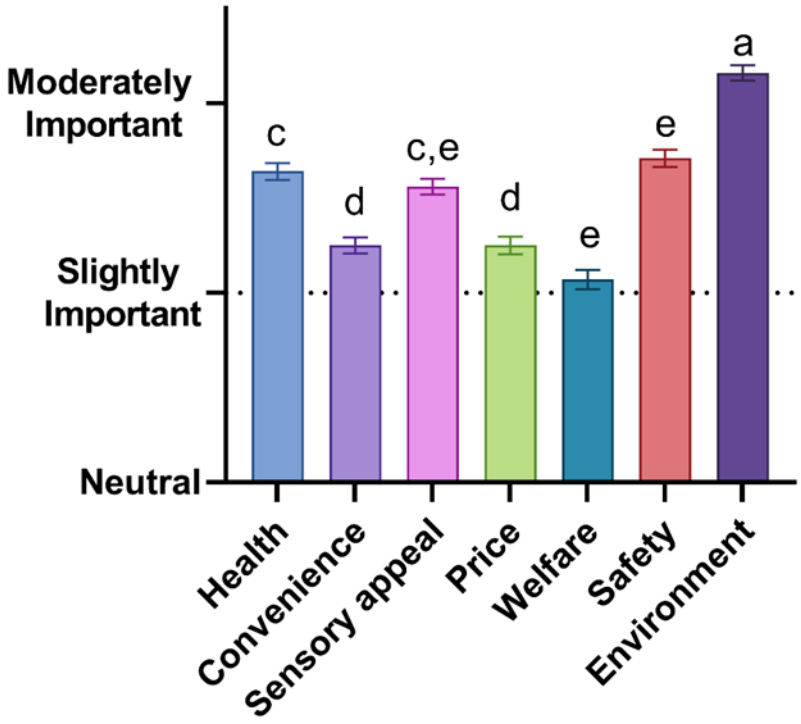

Figure 3-9 Motivation for adopting cultured meat
Notes: According to the Games-Howell test, different letters within each category indicate a significantly different ($p<0.05$). Results are mean±SEM values. N=778.

The environmental benefit is the prior factor in motivating consumers to adopt cultured meat, which is interesting, whereas food safety is the prior factor for edible insects and meat substitutes. This could be due to the fact that consumers are more familiar with meat substitutes and edible insects and less familiar with cultured meat. Thus, they would rely on the

information given to them regarding cultured meat more heavily, which has the information that culture meat can reduce the production of greenhouse gases and create a new source of proteins that can help feed the growing world population. A previous study found that giving participants information regarding sustainability can increase consumer acceptability of certain products (Bryant and Barnett, 2020). Thus the culture meat information provided to participants might influence consumers motivation in adopting cultured meat. Other studies have also confirmed that consumers are aware of the environmental benefits of cultured meat across different consumer groups (Bryant and Barnett, 2018; Circus and Robison, 2019). This suggests that when promoting cultured meat product in the future, environmental benefits associated with it should be promoted to increase consumer acceptance. The sensory appeal and health benefits are found to be the second most important motivating factor. Although cultured meat is still at the laboratory stage and has not reached the market yet, consumers have a high expectation of the sensory properties of cultured meat even consumers never tried this novel product before. This suggests that cultured meat would need to optimise its sensory properties to increase consumer acceptance when launching the products.

Mancini and Antonioli (2019) have shown that consumers are likely to be cautious about the food safety of cultured meat. Zhang, Li and Bai (2020) suggest that Chinese consumers are very concerned about the food safety of cultured meat. The establishment of government regulations on the safety of cultured meat will likely drive consumer acceptance of the cultured meat. Bryant and Barnett (2018) confirmed that the consumer recognised the potential health benefits of cultured meat, such as reduced meat fat content. The current study also agrees that

Chinese consumers perceive health benefits as the third most important incentive to adopt cultured meat. Animal welfare remains the least motivating factor for consumers. Unlike other studies, Western consumers generally strongly agree that animal welfare is a significant incentive (lower than environmental benefits factors) for them to adopt cultured meat, such as avoiding animal suffering and death (Bryant and Barnett, 2020). As mentioned earlier, Chinese consumers have less knowledge of animal welfare compared to Western consumers.

3.11 Comparing motivation factors for adopting three meat alternatives

Environment, food safety, and health are among the three most important motivations for adopting the three meat alternatives, following by sensory appeal, convenience, and price. However, animal/ insect welfare emerged as the lowest motivation to adopt the three meat alternatives. Firstly, environmental incentives for consumers to adopt cultured meat were significantly higher than those for meat substitutes and edible insects [$F(2, 1403)=34.76$, $p<0.001$], indicating consumers were more motivated by environmental factor when considering adopting cultured meat. While conversely, food safety factors were significantly less important as incentives for cultured meat than edible insects and meat substitutes [$F(2, 1378)=38.89$, $p<0.001$]. Consumers' health incentives to adopt meat substitutes was significantly more important than adopting edible insects [$F(2, 1364)=5.7$, $p=0.003$]. The three motivation factors of convenience [$F(2, 2419)=7.4$, $p=0.001$], price [$F(2, 2149)=7.1$, $p=0.001$], and welfare [$F(2, 1368)=13.11$, $p<0.001$] that motivate consumers to adopt meat substitute and cultured meat were equally important but significantly more important than edible insects. For

the sensory motivation, the adoption of edible insects and cultured meat were equally important but significantly more important than meat substitute [F(2, 1359)=4.38, p=0.013] (Figure 3-10). The findings here indicate that although consumers were motivated by similar factors, the degree of motivations can be different across different meat alternatives. For example, consumers were more motivated by environmental factor, whereas food safety is less important for cultured meat, whereas food safety remains the most significant factor for adopting edible insects and meat substitutes.

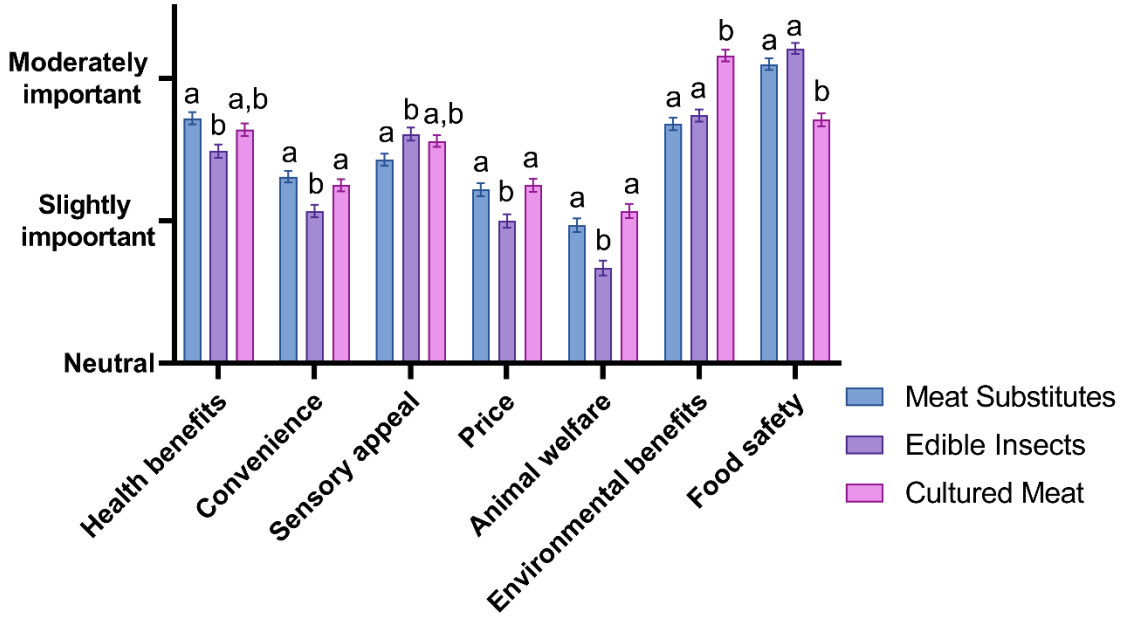

Figure 3-10 Motivation factor for adopting meat substitutes, edible insects and cultured meat

Notes: Different letters within each category indicate a significant difference at p<0.05. According to LSD and Games-Howell test. The dataset convenience and price follow the Homogeneity of Variances, used ANOVA and LSD to determine the differences. Other datasets used welch and Games-Howell tests to determine the differences. Results are mean ±SEM values.

Liu et al. (2021) and Onwezen et al. (2021) found that environmental benefits were the strongest motivating factor in adopting meat substitutes, edible insects, and cultured meat, whereas for the current study, although environmental benefits are also rated very high for all three types of food, food safety were rated as highest for edible insects and meat substitutes, indicating the motivational factor can be different across different countries.

In this study, consumers unanimously agreed that food safety was the first incentive to adopt meat alternatives and edible insects, indicating, Chinese consumers care about and value food safety factors. The issue of food safety has been discussed before, such as meat substitutes already have food safety issues in China, and the edible insects' consumers believe that it may contain unknown bacteria. Food safety issues with meat substitutes and edible insects already exist in the Chinese consumers' memory and intuition. Chinese consumers are not familiar with cultured meat, especially as it is still a concept and consumers were not able to purchase it on the market. Therefore, consumers are generally lack of knowledge for food safety issues in cultured meat.

The health benefits, convenience, price and animal welfare were rated lower, whereas sensory appeal than meat substitutes and culture meat, indicating the sensory properties of edible insects are an important motivator, and consumers may not be aware of the health benefit convenience, price and animal welfare of consuming edible insects in comparison to the other two foods.

Chapter 4 Conclusion

4.1 Main finding

As described in the introduction section, China does not have any official recommendations or guidelines for a sustainable diet. The official and widely available Chinese dietary guidelines are similar to a sustainable diet structure discussed in this thesis, although the Chinese dietary guidelines are aimed at consumers' health rather than the environmental perspective. Although there is limited information on sustainable diets, the results in Section 3.4 suggest that the majority of Chinese consumers are aware of sustainable diets. Since a sustainable diet aims to reduce the environmental impact in comparison to conventional meat based diet, it is therefore necessary to investigate the environmental awareness of the consumers. Section 3.5 shows that Chinese consumers' environmental awareness is within an acceptable range, which provides a positive basis for promoting sustainable diets in the future to reduce the environmental impact. Chinese consumers are likely to be more willing to increase their vegetables and fruits intake but less willing to reduce their meat intake as their knowledge of the environmental impact on meat and dairy production seems lacking (Section 3.5.1 and 3.5.2). This study also found that consumers with higher environmental awareness are more likely to reduce their meat consumption (Section 3.5.1).

Interestingly, the results of the current study showed that non-meat eaters had a higher level of environmental awareness of both food behaviours and food items than meat eaters (Section 3.5.1 and 3.5.2), suggesting environmental awareness could be one of the motivating factors

determining whether consumers would eat meat or not. However, there were no significant differences among the three meat eaters groups (Low, Standard and High meat eaters) for environmental awareness of food behaviours. The results suggested that participants' decision to consume meat was not related to the awareness of the behavioural impact on the environment. However, considering environmental awareness of different foods, High Meat Eaters believed that meat less negatively impacted the environment, whereas, Low Meat Eaters were more aware of the negative environmental impact pf meat and therefore was consuming less meat and more willing to reduce their meat consumption (Section 3.5.1 and 3.5.2).

In the current study, the majority of consumers indicated that they are willing to reduce their meat consumption. The three factors that motivate consumers most to reduce meat consumption were food safety, environmental and health benefits, while the factor that least motivates consumers is animal welfare (Section 3.6).

As shown in Section 3.7.1, the results relating to meat attachment confirmed that Chinese consumers have a lower meat attachment compared to some Western countries discussed in the previous studies. Those consumers who have been found to have higher attachment to meat, were also consume more meat. In addition, it has been identified that these high meat attachment consumers are more unwilling to reduce their meat consumption. The results of the present study suggest that the meat attachment theory is also applicable to Chinese consumers and can be used to explain the willingness to reduce meat consumption. In Section 3.7.2, it can be seen that low meat attachment consumers are likely to have higher behavioural control and

personal norm in relation to reducing meat consumption. However, the subjective norm does not affect consumers' meat attachment.

As shown in Section 3.8, Chinese consumers are also highly willing to adopt meat substitutes due to their high familiarity. This study also found that consumers who are willing to reduce their meat consumption are also more likely to adopt meat substitutes. We have further confirmed that the two key factors influencing consumer unwillingness to adopt meat substitutes attachment to meat and food safety. Over the last decade, China had several scandals relating to food safety, and it is therefore, unsurprising that food safety was cited as the first incentive for consumers to adopt meat substitutes. The following highest motivating factors to adopt such substitutes and are health and environmental factors.

As seen in Section 3.9, Chinese consumers are not very willing to adopt edible insects, most notably because of their fear and aversion to insects. As suggested by the results of the present study, food neophilia explains Chinese consumers' intention to adopt edible insects. This study further found that consumers who were more familiar with edible insects were more likely to adopt edible insects. Consumers still ranked food safety as the strongest incentive to adopt edible insects because of the perception of unknown bacteria in insects. Consumers ranked sensory appeal as the second most motivating factor, indicating that consumers expect a good sensory experience when eating insects.

In Section 3.10, Chinese consumers were willing to accept cultured meat, similar to those willing to accept meat substitutes. This study suggests that linguistic equivalence is likely to have led participants to interpret cultured meat as meat substitutes, leading to a high willingness to accept cultured meat and high familiarity with it. The strongest reasons for participants to adopt cultured meat were environmental benefits, followed by food safety and sensory appeal, suggesting the environmental benefits can be used as primary information when promoting cultured meat in the future.

There are three key findings of this study. The first is the addition of environmental awareness to the theory of measuring consumer willingness to adopt sustainable diets. Since the starting point of a sustainable diet is to protect the global environment, results have shown that consumers with high environmental awareness are more likely to adopt sustainable diets. It would be helpful to further enrich the current theory by measuring the effect of environmental awareness on the willingness to adopt sustainable diets. A further step is to explore and compare consumers' motivational reasons for adopting the three sustainable meat alternatives. The different motivational reasons for different meat alternatives also have significant implications for guiding policy development.

The final key finding is that this study investigates Chinese consumers' willingness to adopt a sustainable diet while exploring the three theories: Meat Attachment, Theory of Planned Behaviour, and Food Motivated. The present study initially found that cultural differences lead Chinese consumers to behave differently from Western consumers in adopting sustainable diets.

The meat attachment results found that the Chinese consumers were significantly lower than Western consumers. Moreover, Chinese consumers were also shown similar behaviour in adopting meat alternatives with Western consumers; for example, Chinese consumers also felt the edible insects were disgusted and unwilling to adopt edible insects as a diet.

4.2 Limitations

This study also explored the factor of personality in the questionnaire, as consumers' personality traits may influence their eating habits. In a previous study, the personality factor significantly correlated with meat intake among German consumers; for example, extroverted consumers eat more of each type of meat and had higher overall meat consumption (Pfeiler and Egloff, 2018). However, in present study, the 15 items scale of personality was applied for Chinese consumers for the first time because of linguistic equivalence. There were some misunderstandings of the questions, as some terms are not applicable to Chinese participants or these terms are not widely used. The factor analysis revealed some misunderstanding of the questions, so the personality results were not presented in the current thesis.

In previous studies, gender differences were evident, with males generally having higher attachment to meat consumption than females, and with masculinity explaining the gender differences. However, due to the sample size and sampling method of this study (convenience sampling), which has a random nature and may result in a sample that is not representative of the overall population of Shanghai (China), therefore, the impact of demographic information

was not further explored. In particular, as consumption habits vary across different regions in China, the results of this study cannot be generalised to Chinese consumers' intentions towards sustainable diets.

In Section 3.5, the relationship between meat intake and environmental awareness in the meat eaters group is unclear. This study did not explore emotional factors, such as aversion to meat in reducing meat consumption (Section 3.6) and fear of novel foods (food neophobia) in adopting edible insects and cultured meat (Section 3.9 and 3.10). Previous studies identified emotional factors as a potential important determinant of consumer acceptance of sustainable diets (Onwezen et al., 2021).

4.3 Future works

This study is the first of its kind to explore Chinese consumers' intention for adopting sustainable diets. This study is prospective in the fact that most of the research samples are Western consumers, however China has the most extensive consumer base in the world, yet only a small number of studies focusing on Chinese participants have been conducted. The current study results yielded several interesting findings, showing a significant need for future research in order to compare the attitudes towards sustainable eating across different countries and cultures.

Some factors are not discussed in this thesis, such as personality, demographic factors such as gender, age factors. Demographic factors are not reported because of the limitations of convenience sampling, so that future research could use stratified sampling methods on a representative sample. China has a tradition of eating plant-based food, which is different from Western dietary traditions. Therefore, the impact of this dietary tradition on consumer acceptance of sustainable diets across different cultures would be interesting to explore in future studies.

In future work, the measurement of the emotional factor of consumers will be explored. The previous research has demonstrated that consumers' emotions towards meat may be a continuum in which one end refers to disgust, while the others show meat attachment (Graça, Calheiros and Oliveira, 2015). In future studies, it is necessary to further validate consumers' emotions towards meat among Chinese consumers. As mentioned in the previous limitations, consumers' emotions towards novel foods (edible insects and cultured meat) also need further investigation and the food neophobia scale could be conducted for future research.

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Chapter 5 Appendix

5.1 Ethics approval

University of Nottingham
UK | CHINA | MALAYSIA

Faculty of Medicine & Health Sciences
Research Ethics Committee
Faculty Hub
Room E41, E Floor, Medical School
Queen's Medical Centre Campus
Nottingham University Hospitals
Nottingham, NG7 2UH
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17 February 2021

Yuchen Zhang
MRes Sensory Science Student
Division of Food, Nutrition and Dietetics
School of Biosciences
University of Nottingham
Sutton Bonington Campus
Loughborough, Leicestershire
LE12 5RD

Dear Yuchen Zhang

Ethics Reference No: FMHS 154-0121 **– please always quote**	
Study Title: Understanding Chinese consumer attitudes and behaviour regarding sustainable diets: Intention to reduce meat consumption and adopt sustainable protein alternatives.	
Chief Investigator/Supervisor: Dr Qian Yang, Assistant Professor in Sensory and Consumer Sciences, School of Biosciences	
Lead Investigators/student: Yuchen Zhang, Master of Research in Sensory and Consumer Science, School of Biosciences	
Other Key investigators: Hannah Ford, PhD in Sensory and Consumer Science, University of Nottingham, University of Adelaide Partnership, Dr Rebecca Ford, Associate Professor in Sensory and Consumer Science, School of Biosciences	
Proposed Start Date: 01.02.2021	**Proposed End Date:** 31.10.2021

Thank you for submitting the above application was considered at the meeting held on 22 January 2021 and the following documents were received:

- FMHS REC Application form and supporting documents version 4.0: 13/01/2021

These have been reviewed and are satisfactory and the project has been given a favourable opinion.

A favourable opinion has been given on the understanding that:

1. The protocol agreed is followed and the Committee is informed of any changes using a notice of amendment form (please request a form).
2. The Chair is informed of any serious or unexpected event.
3. An End of Project Progress Report is completed and returned when the study has finished (Please request a form).

Yours sincerely

Dr John Williams, Associate Professor in Anaesthesia and Pain Medicine
Chair, Faculty of Medicine & Health Sciences Research Ethics Committee

5.2 Questionnaire detail

Welcome to this online Sustainable Dietary Survey
We would like to invite you to take part in a research study. Before you decide, it is important for you to understand why the research is being done and what it will involve for you.

What is the purpose of the research?
The need to start consuming more sustainable food and beverage products is imperative if we want a more sustainable food secure future. Broad media coverage has progressively reported the impending threats of climate change and population growth to our society, where there is a need to shift current consumer behaviour towards a more sustainable lifestyle. Adopting a more sustainable diet is seen as one solution in tackling these global challenges.
The purpose of this study is to investigate preferences and attitudes towards sustainable diets and acceptance of substitutes and protein alternatives between different dietary groups.

Why have I been invited to take part?
You have been invited to take part in this research because you have shown an interest in taking part to assess preferences and attitudes towards sustainable diets and acceptance of substitutes and protein alternatives between different dietary groups. In addition, you are an **adult** (18+) currently living in **Shanghai**, **China**.

Do I have to take part?
No. It is up to you to decide if you want to take part in this research. If you do decide to take part, you will need to agree that you have read this information sheet and consented to take part in the study. However, you would still be free to withdraw from the study at any time, without giving a reason and without any negative consequences. This would not affect your legal rights.

What will happen to me if I take part?
If you do decide to take part and click on the survey link, you will be asked to complete an online consent form and then answer a short survey that should take approximately 20-25 minutes to complete.

Your involvement is completely voluntary but any completed questions you submit will be used in the study. Data produced from the survey is anonymous, however once you have submitted your survey, we will not be able to remove your answers from the analysis.

You can complete the questionnaire from either your laptop, tablet or mobile device. You are strongly advised to complete the questionnaire in one sitting, however if you do close the web browser you can return to the questionnaire by clicking on the survey link on the same device and continue where you left off.

Expenses and payments

We are very grateful to you for considering to take part in this study and as a thank you, upon competition of the questionnaire, you will have the option to submit your email address, Wechat and QQ number to be entered into a prize draw for the chance to win 200CNY (20GBP) by Alipay transfer.

Are there any risks in taking part?
The researchers have not identified any risks associated with this study.

Are there any benefits in taking part?
We cannot promise the study will help you, but the information we get from this study may help us to understand consumer preferences and attitudes towards sustainable diets and acceptance of substitutes and protein alternatives between different dietary groups. Your participation will help us to identify potential strategies in addressing public health and environmental issues whilst being informative to the food industry when developing sustainable products.

What will happen if I don't want to carry on with the study?
Even after you have agreed to the consent form, you are free to withdraw from the study at any time without giving any reason and without your legal rights being affected. Any personal data will be destroyed. If you withdraw we will no longer collect any information about you or from you but we will keep the anonymous research data that has already been collected and stored as we are not allowed to tamper with study records. This information may have already been used in some analyses and may still be used in the final study analyses. To safeguard your rights, we will not use any personally identifiable information.

Who has reviewed this study?
All research involving people is looked at by an independent group of people, called a Research Ethics Committee, to protect your interests. This study has been reviewed and given favourable opinion by the Faculty of Medicine and Health Sciences Research Ethics Committee (Reference number: FMHS 154-0121).

Who is organising and funding the research?
This research is being organised by Dr Qian Yang and Dr Rebecca Ford of the University of Nottingham and is being funded by the University of Nottingham.

What if something goes wrong?
If you have a concern about any aspect of this project, please speak to the researcher Yuchen Zhang or the Principal Investigators Dr Qian Yang or Dr Rebecca Ford, who will do their best to answer your query. The researcher should acknowledge your concern within 10 working days and give you an indication of how she intends to deal with it.

If you remain unhappy and wish to complain formally, you can do this by contacting the FMHS Research Ethics Committee Administrator, Faculty Hub, Medicine and Health Sciences, E41,

E Floor, Medical School, Queen's Medical Centre Campus, Nottingham University Hospitals, Nottingham, NG7 2UH or via E-mail: FMHS-ResearchEthics@nottingham.ac.uk.
Please quote ref no: FMHS 154-0121.

Contact Details
If you would like to discuss the research with someone beforehand (or if you have questions afterwards), please contact:
Yuchen Zhang, MRes student
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CONSENT FORM

In order to check your eligibility and consent to participate in this study please read through the below consent form statements. If you are eligible and give your consent, you will proceed to the start of the survey which should take approximately 20-25 minutes to complete.

1	I confirm that I have read and understood the participant information sheet and I understand all information about the online survey.
2	I confirm that I am **18** years and/ or older and currently live in **Shanghai, China**.
3	I understand that my participation is voluntary and that I am free to withdraw at any time by simply exiting the survey, without giving any reason. I understand that should I withdraw then the information collected so far cannot be erased and that this information may still be used in the project analysis.
4	I understand that relevant sections of data collected in the survey may be looked at by the authorised individuals from the University of Nottingham, the research group and regulatory authorities where it is relevant to my taking part in this survey. I give permission for these individuals to have access to these records and collect, store, analyse and publish information obtained from my participation in this survey.
5	I agree that data collected in the online survey may be used for academic publication and conference presentations after anonymisation.
6	I understand that information about me recorded during the study will be made anonymous before it is stored. It will be uploaded into a secure database on a computer kept in a secure place in accordance with the General Data Protection Regulation (GDPR). Data will be kept for 7 years after the study has ended and then destroyed.
7	I understand that cookies, personal data stored by my Web browser, are not used in this survey. However, as an online participant in this research, there is always the minimal risk of intrusion by outside agents and therefore the possibility of being identified.
8	I agree that the research data collected about me may be stored and used in possible future research during and after 7 years and shared with other researchers including those working outside the University.

Question 0 Q0

☐ **YES:** I confirm that I have read and understood the consent form statements and I voluntarily consent to take part in this online survey [Continue to start of survey]

☐ **NO:** I do not give my consent to take part in this online survey [automatically taken to exit survey]

START OF SURVEY

SECTION 1: DEMOGRAPHICS

Please answer the following demographic questions. We respect your privacy, so all information is confidential and anonymised.

Question 1 Q1

Do you live in Shanghai? [ONLY ONE OPTION CAN BE SELECTED]

- Yes
- No [if selected automatically exit survey]

Question 2 Q2

What is your age?

- Less than 18 [if selected automatically exit survey]
- 18 – 24 years
- 25 – 34 years
- 35 – 44 years
- 45 – 54 years
- 55 – 65 years
- 65 + years
- Prefer not to say

Question 3 Q3

What gender do you identify as? [ONLY ONE OPTION CAN BE SELECTED]

- Male
- Female
- Other
- Prefer not to say

Question 4 Q4

Which ethnicity/ race do you identify with? [ONLY ONE OPTION CAN BE SELECTED]

- Han ethnicity
- Other race, ethnicity or origin, please specify:
- Prefer not to say

Question 5 Q5

Which religion do you agree with? [ONLY ONE OPTION CAN BE SELECTED]

- No religious belief
- Buddhism
- Taoism
- Islam
- Catholicism
- Christianity
- Other religions
- Prefer not to say

Question 6 Q6

What is your highest completed level of education? [ONLY ONE OPTION CAN BE SELECTED]

- No qualification
- Some secondary school
- Technical/ trade/ diploma/ vocational training
- Completed University graduate (Bachelor's degree)
- Completed Postgraduate/ Doctorate degree
- Prefer not to say

Question 7 Q7

What is your estimated household income? [ONLY ONE OPTION CAN BE SELECTED]

- <6500 CNY (722GBP)
- 6,500 - 15,000 CNY (722 – 1666 GBP)
- 15,000 - 30,000 CNY (1666 – 3333 GBP)
- 30,000 - 45,000 CNY (3333 GBP – 5000 GBP)
- 45,000 – 60,000 CNY (5000 – 6666 GBP)
- ＞60,000CNY (6666GBP)
- Prefer not to say

Question 8 Q8

How many adults (aged 18 and over) currently live in your household including you?

Question 9 Q9

How many children (younger than 18) currently live in your household?

INFORMATION
The next sections of the survey will mention meat and meat substitutes. To avoid any ambiguity please refer to the following definitions.
Meat refers to both red and white meat (e.g. beef, lamb, pork, chicken). Examples of meat from other animals can include turkey, goat, game birds, rabbit etc. Meat also includes unprocessed meat (e.g. chicken breast, steak etc) or processed meat (e.g. sausages, bacon, ham, salami, pates, canned meat, chicken nuggets etc).
Meat substitutes are products that are protein-containing foods that are primarily vegetable based and are frequently used to replace the function of meat as a meal component. Meat substitutes are often made up of pea protein, soya (tofu), mycoprotein (Quorn), jackfruit or animal-like proteins produced by yeast extract and are often designed to imitate meat in taste, texture and appearance. They can therefore take the form of burgers, sausages, chicken strips, ham slices etc . They are predominantly used in hot meals and can make up components of ready meals.
SECTION 2
This section will explore your perceptions of a sustainable diet.

Question 10 Q10
What impact do you believe the following behaviours have on the environment?

	Highly negative	Moderately negative	Slightly negative	Neither negative nor positive	Slightly positive	Moderately positive	Highly positive
Buying food products that contain less packaging	○	○	○	○	○	○	○
Eating more local food	○	○	○	○	○	○	○
Avoiding food products that were transported by aeroplane	○	○	○	○	○	○	○
Eating more seasonal fruits and vegetables	○	○	○	○	○	○	○

Eating more organic foods	○	○	○	○	○	○	○
Eating less meat	○	○	○	○	○	○	○
Eating less dairy	○	○	○	○	○	○	○
Eating more plant-based foods	○	○	○	○	○	○	○
Eating more meat substitutes	○	○	○	○	○	○	○

Question 11 Q11

What impact do you believe the consumption of the following foods have on the environment?

	Highly negative	Moderately negative	Slightly negative	Neither negative nor positive	Slightly positive	Moderately positive	Highly positive
Beef	○	○	○	○	○	○	○
Lamb	○	○	○	○	○	○	○
Chicken	○	○	○	○	○	○	○
Pork	○	○	○	○	○	○	○
Fish	○	○	○	○	○	○	○
Prawns	○	○	○	○	○	○	○
Nuts	○	○	○	○	○	○	○
Cheese	○	○	○	○	○	○	○
Milk	○	○	○	○	○	○	○
Eggs	○	○	○	○	○	○	○
Seasonal Vegetables	○	○	○	○	○	○	○
Legumes/ pulses	○	○	○	○	○	○	○
Meat substitutes	○	○	○	○	○	○	○

Question 12 Q12

Reasons behind selecting a sustainable diet could include both environmental and social elements. Please indicate your level of agreement or disagreement with the following statements.

When opting to adopt a sustainable diet, my key priority is…

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
The environmental impact (carbon footprints, waste, recycling, biodiversity, land and water use etc)							
The social impact (fair labour practices, animal welfare, health etc)							

Question 13 Q13

Please rate your agreement with the following statements. There are no right or wrong answers, we are just seeking your opinion on each of the statements, so please answer as honestly as possible.

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
Meat consumption currently contributes to over half of food related emissions	○	○	○	○	○	○	○

When comparing different types of meat, red and processed meats have the greatest environmental impact	○	○	○	○	○	○	○
Meat production has a negative environmental impact through deforestation, biodiversity loss, soil and water pollution	○	○	○	○	○	○	○
High meat consumers are at a higher risk of developing type 2 diabetes, cardio-vascular disease (CVD) and certain types of cancer	○	○	○	○	○	○	○
Dairy products are the second biggest contributor to food related emissions after red meat	○	○	○	○	○	○	○

Question 14 Q14

Do you know of anyone currently consuming a sustainable diet?

- ○ Yes
- ○ No

Question 15 Q15

Would you know where to find information on sustainable diets?

- Yes
- No

SECTION 3

This section will explore your consumption habits and dietary motives.

Question 16 Q16

Please select the option below which best represents your consumption habits in the last 12 months.

If a food item is not part of your diet, please select 'do not consume'. Please select more info to remind yourself of the definition for meat substitutes. More info [drop down definition for meat substitutes].

	Do not consume	Less than once per month	1-3 times per month	Once per week	2-3 times per week	4-6 times per week	Everyday
Beef	○	○	○	○	○	○	○
Lamb	○	○	○	○	○	○	○
Chicken	○	○	○	○	○	○	○
Pork	○	○	○	○	○	○	○
Meat from other animals	○	○	○	○	○	○	○
Fish/ Seafood	○	○	○	○	○	○	○
Dairy	○	○	○	○	○	○	○
Meat substitutes	○	○	○	○	○	○	○
Legumes/ pulses e.g. beans, lentils, peas	○	○	○	○	○	○	○

Question 17 Q17

When thinking about the food and beverages you consume, please select the statement that best describes your food preferences. [ONLY 1 OPTION CAN BE SELECTED]

- **Omnivore** (I eat meat from animals, dairy products, seafood and fish) [go to Question 18]
- **Pescatarian** (I don't eat meat from animals, but I do eat dairy products, seafood and fish) [go to Question 25]
- **Vegetarian** (I don't eat meat from animals, seafood and fish) [go to Question 25]
- **Vegan** (I eat no animal products including dairy products, eggs, seafood, fish and meat) [go to Question 25]
- **Flexitarian** (I have a primarily vegetarian diet but occasionally eat meat, dairy, fish and seafood) [go to Question 18]

Question 18 Q18

Based on this information, how willing are you to reduce your meat consumption in the next year for sustainability or environmental reasons? [show only to meat-eaters].

- Extremely unwilling [go to Question 19]

- Moderately unwilling [go to Question 20]
- Slightly unwilling [go to Question 20]
- Neutral [go to Question 20]
- Slightly willing [go to Question 20]
- Moderately willing [go to Question 20]
- Extremely willing [go to Question 20]

Question 19 Q19

Please specify your reason(s) for being extremely unwilling to reduce your meat consumption in the next year. [go to Question 20]

Question 20 Q20

With regards to your current meat consumption habits, please rate your agreement with the following statements. There are no right or wrong answers we are just seeking your opinion on each of the statements, so please answer as honestly as possible. [show only to meat-eaters].

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
I am confident I could change my habits if I wanted to	○	○	○	○	○	○	○
Whether I change my habits is entirely up to me	○	○	○	○	○	○	○
Changing my habits is not something that is under my control	○	○	○	○	○	○	○
I have made it one of my personal principles not to eat a lot of meat	○	○	○	○	○	○	○
People who are important to me think I should consume meat	○	○	○	○	○	○	○

I eat meat to avoid disappointing someone who is trying to make me happy	○	○	○	○	○	○	○

Question 21 Q21

Please rate your agreement with the following statements. [show only to meat-eaters]. [STATEMENTS ARE BLOCKED INTO 2 GROUPS OF 8 STATEMENTS]

BLOCK 1

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
To eat meat is one of the good pleasures in life	○	○	○	○	○	○	○
Meat is irreplaceable in my diet	○	○	○	○	○	○	○
According to our position in the food chain, we have the right to eat meat	○	○	○	○	○	○	○
I feel bad when I think of eating meat	○	○	○	○	○	○	○
I love meals with meat	○	○	○	○	○	○	○
To eat meat is disrespectful towards life and the environment	○	○	○	○	○	○	○
To eat meat is an unquestionable right of every person	○	○	○	○	○	○	○
I'm a big fan of meat	○	○	○	○	○	○	○

Question 22 Q22

Please rate your agreement with the following statements. [show only to meat-eaters].

BLOCK 2

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
Eating meat is a natural and undisputable practice	○	○	○	○	○	○	○
I don't picture myself without eating meat regularly	○	○	○	○	○	○	○
I would feel fine with a meatless diet	○	○	○	○	○	○	○
If I couldn't eat meat I would feel weak	○	○	○	○	○	○	○
If I was forced to stop eating meat I would feel sad	○	○	○	○	○	○	○
Meat reminds me of diseases	○	○	○	○	○	○	○
By eating meat I'm reminded of the death and suffering of animals	○	○	○	○	○	○	○
Nothing is comparable to a good steak	○	○	○	○	○	○	○

Question 23 Q23

How important are the following factors in your decision to reduce your overall meat consumption to maintain a sustainable diet? [show only to meat eaters].

	Extremely unimportant	Moderately unimportant	Slightly unimportant	Neutral	Slightly Important	Moderately Important	Extremely Important
Health benefits	○	○	○	○	○	○	○

Convenience (availability, easy to prepare)	○	○	○	○	○	○	○
Sensory appeal (taste,smell,appearance,texture)	○	○	○	○	○	○	○
Price	○	○	○	○	○	○	○
Animal welfare	○	○	○	○	○	○	○
Food safety	○	○	○	○	○	○	○
Environmental benefits	○	○	○	○	○	○	○
Other, please specify:							

SECTION 4: MEAT SUBSTITUTES

This section will explore your attitudes towards meat substitutes.

The benefits of meat substitutes include a reduction in the amount of land and water used and the prevention of animal suffering. The production of just one 'Impossible burger' (a plant-based meat substitute product) is estimated to use 96% less land, 87% less water and 89% fewer green-house gas emissions compared to a burger made from cows (Impossible Foods, 2019).

Question 24 Q24

Based on this information, how willing are you to consider using meat substitutes as a replacement to meat in the next year? [show only to meat eaters]

- ○ Extremely unwilling [go to Question 25]
- ○ Moderately unwilling [go to Question 26]
- ○ Slightly unwilling [go to Question 26]
- ○ Neutral [go to Question 26]
- ○ Slightly willing [go to Question 26]
- ○ Moderately willing [go to Question 26]
- ○ Extremely willing [go to Question 26]

Question 25 Q25

Please specify your reason(s) for being extremely unwilling to consider using meat substitutes as a replacement to meat in the next year. [go to Question 26]

Question 26 Q26

How important are the following factors in motivating you to eat and or try meat substitutes?

	Extremely unimportant	Moderately unimportant	Slightly unimportant	Neutral	Slightly Important	Moderately Important	Extremely Important
Health benefits	○	○	○	○	○	○	○
Convenience	○	○	○	○	○	○	○
Sensory appeal (taste,smell, appearance,texture)	○	○	○	○	○	○	○
Price	○	○	○	○	○	○	○
Animal welfare	○	○	○	○	○	○	○
Food safety	○	○	○	○	○	○	○

Environmental benefits	○	○	○	○	○	○	○
Other, please specify:							

SECTION 5: EDIBLE INSECTS & CULTURED MEAT

You are doing very well, this is the final section!

We are briefly going to ask you about your thoughts and opinions on edible insects and cultured meat.

Question 27 Q27

Have you previously heard of entomophagy or edible insects?

- ○ Yes
- ○ No

Question 28 Q28

Please select the option below which best represents your consumption habits for edible insects.

- ○ I have never tried edible insects in any form
- ○ I have tried edible insects on a single occasion
- ○ I have tried edible insects on a few occasions
- ○ I eat edible insects regularly

With the population continuing to grow at a rapid rate, edible insects are increasingly being discussed as plausible alternative protein sources. This is predominantly due to their nutritional benefits being high in protein and their pro environmental impact which makes better use of land, water and produces less green-house gas emissions than most domestic breeding animal species.

Question 29 Q29

Based on this information, how willing are you to consider adopting edible insects into your future diet if products become more readily available? [If answered extremely unwilling, go to question….]

- ○ Extremely unwilling [go to Question 30]
- ○ Moderately unwilling [go to Question 31]
- ○ Slightly unwilling [go to Question 31]
- ○ Neutral [go to Question 31]
- ○ Slightly willing [go to Question 31]
- ○ Moderately willing [go to Question 31]
- ○ Extremely willing [go to Question 31]

Question 30 Q30

Please specify your reason(s) for being extremely unwilling to adopt edible insects into your future diet. [go to Question 31]

Question 31 Q31

How important are the following factors in motivating you to eat and or try edible insects?

	Extremely unimportant	Moderately unimportant	Slightly unimportant	Neutral	Slightly Important	Moderately Important	Extremely Important
Health benefits	○	○	○	○	○	○	○
Convenience	○	○	○	○	○	○	○
Sensory appeal (taste,smell,appearance,texture)	○	○	○	○	○	○	○
Price	○	○	○	○	○	○	○
Insect welfare	○	○	○	○	○	○	○
Food safety	○	○	○	○	○	○	○
Environmental benefits	○	○	○	○	○	○	○
Other, please specify:							

Question 32 Q32

Have you previously heard of cultured meat?

- ○ Yes, and I know what it means
- ○ Yes, but I don't know what it means
- ○ No, I have never heard of cultured meat

Cultured meat, also known as in vitro or synthetic meat, is produced in a laboratory by extracting the stem cells from the muscle tissue of animals. The cells are fed and nurtured in order to multiply and create muscle tissue which is biologically the same as meat and therefore has the same taste and texture.

The benefits of cultured meat include reduced animal suffering, reduced production of greenhouse gasses and the creation of a new source of proteins with the potential of feeding the growing world population (Post, 2012).

Question 33 Q33

Based on this information, how willing are you to consider adopting cultured meat into your future diet if products become more readily available?

- ○ Extremely unwilling [go to Question 34]

- Moderately unwilling [go to Question 35]
- Slightly unwilling [go to Question 35]
- Neutral [go to Question 35]
- Slightly willing [go to Question 35]
- Moderately willing [go to Question 35]
- Extremely willing [go to Question 35]

Question 34 Q34

Please specify your reason(s) for being extremely unwilling to adopt cultured meat into your future diet [go to end of survey]

Question 35 Q35

How important are the following factors in motivating you to eat and or try cultured meat?

	Extremely unimportant	Moderately unimportant	Slightly unimportant	Neutral	Slightly Important	Moderately Important	Extremely Important
Health benefits	○	○	○	○	○	○	○
Convenience	○	○	○	○	○	○	○
Sensory appeal (taste, smell, appearance, texture)	○	○	○	○	○	○	○
Price	○	○	○	○	○	○	○
Animal welfare	○	○	○	○	○	○	○
Environmental benefits	○	○	○	○	○	○	○
Food safety	○	○	○	○	○	○	○
Other, please specify							

You have now completed the survey! Thank you for your participation and patience.
Click 'finish' to exit the survey.
If you have any questions, comments, concerns or inquiries, please do not hesitate to drop the survey co-ordinator an email: stxyz53@nottingham.ac.uk