

CHINESE CONSUMER PREFERENCES FOR AND  
ATTITUDES TOWARDS PECANS

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CHINESE CONSUMER PREFERENCES FOR AND  
ATTITUDES TOWARDS PECANS

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Abstract: Pecan is a wild nut tree and native to North America. The U.S. exports large amounts of pecans around the world every year, with more than a third of these exports going to China. Pecans are gaining greater acceptance in China both in production and consumption, but Americans know little about how Chinese view pecans and utilize them in Asian dishes. Producers should always seek to understand their consumers, yet little is known about pecan consumption in China. In this study, we focus on gauging the familiarity of Chinese participants with pecans (*Carya illinoensis*), how they are used, how they are perceived, and the key demographics that are correlated with pecan consumption. These objectives are achieved using an online survey of 1,000 residents of mainland China.

**Key words:** pecan, pecan consumption, exports to China, pecan consumption in China, nut consumption in China, ordered logit regression, weights.

## TABLE OF CONTENTS

Chapter	Page
I. INTRODUCTION.....	1
1.1 Background.....	1
1.2 Problem Statement.....	3
1.3 Objectives.....	3
1.4 Specific Definitions.....	3
II. REVIEW OF LITERATURE.....	5
2.1 Consumption of Tree Nuts in China.....	5
2.2 Distribution Channel of Nuts.....	6
2.3 Exports of U.S. Pecans.....	7
III. SURVEY AND RESPONDENTS.....	8
3.1 Survey Design.....	8
3.2 Respondents.....	10
3.3 Sample Balancing.....	12
IV. METHODS AND RESULTS.....	14
4.1 Objective 1: Ability to Identify Pecans Relative to Other Nuts.....	14
4.2 Objective 2: Influence of Demographic Variables on Pecan Consumption.....	15
4.3 Objective 3: Pecan Consumption Relative to Other Nuts.....	18
4.4 Objective 4: Attitudes towards Pecans.....	19
V. CONCLUSION.....	22
REFERENCES.....	24
APPENDICES.....	27

## LIST OF TABLES

Table	Page
3.1. STATISTICS OF INTERNET SURVEY SAMPLE BEFORE SAMPLE BALANCING AND THE SIXTH CHINESE DEMOGRAPHIC CENSUS (2010) .....	37
4.1. FACTORS INFLUENCING CHINESE CONSUMER PREFERENCE FOR PECANS .....	38
4.2. CHINESE CONSUMER CONSUMPTION FOR 13 TYPES OF NUTS .....	39

## LIST OF FIGURES

Figure	Page
2.1. THREE STATISTICS REGARDING NUT CONSUMPTION IN CHINA .....	27
2.3. TRENDS IN U.S. PECAN EXPORTS TO SELECT COUNTRIES .....	28
3.1. SURVEY QUESTION EXAMPLES .....	29
3.2. CHINA REGIONALIZATION .....	30
3.3. DISTRIBUTION OF TRIMMED WEIGHTS FROM SAMPLE BALANCING ALGORITHM.....	31
4.1.1. RESULTS OF NUT IDENTIFICATION QUIZ .....	32
4.1.2. RESULTS OF NUT IDENTIFICATION QUIZ (SHELLED).....	33
4.3. ORDINAL CHOICES RELATIVE TO FREQUENCY OF PECAN CONSUMPTION.....	34
4.4.1. CHINESE’S ATTITUDES, BELIEFS AND USES OF PECANS .....	35
4.4.2. FOUR TYPES OF PECAN PROVIDED IN THE SURVEY .....	36

## CHAPTER I

### INTRODUCTION

#### **1.1 Background**

The pecan (*Carya illinoensis*) is one of the top ten nuts in the world, possessing a high nutritional value and oil content. Pecan nuts confer high oxidation resistance, promote weight control, and help prevent cancer (Vadivel et al., 2012; Villarreal-Lozoya et al., 2007). Indigenous to Northeast America (Sparks, 2005), it was an important food source for many indigenous people, and now has a worldwide appeal. American pecan farmers are increasingly reliant on exports, especially to China, which imports more than a third of the U.S. pecan crop (Zhang, Peng, & Li, 2015).

Zhu, an associate professor at Jiangsu Academy of Agricultural Sciences (2018), claimed that pecan trees were first brought to China in the early 1900s and were planted mainly for timber and street trees in the first several years. In 2008 pecan planting once again became popular in China as more pecans were sold on the market. Before 2008, China consumed a considerable amount of walnuts, which are indigenous to North America and Persia, but few pecans. Consumption of pecans is said to have risen considerably in 2008 when a shortage of walnuts in China and a surplus of pecans in the U.S. induced Chinese consumers to substitute pecans for walnuts (Zhang et al., 2015). Pecans are now a well-known food in China, which is remarkable given that it was virtually unknown ten years prior.

Perhaps the first US pecan exporter to China was the Hudson Pecan Company. Frustrated with low domestic pecan prices, Randy Hudson sought to sell in China. He first attempted to work through official government and industry channels, but this proved fruitless because Chinese importers did not know what a pecan was. There was no Chinese word referring to pecans. Hickory, almonds, and cashews did have a place in both Chinese vernacular and in its stores, but pecans did not. The best indicator of pecan's absence from China was its absence from the Red Book, a document listing tariffs applied to Chinese imports. When he took some of his pecans to a trade show around 1999 and told Chinese attendees they were pecans, many tried to correct him and say they were actually hickory nuts. There was no evidence that anyone in China, save for those who have traveled abroad, had ever seen, eaten, or known of the pecan.

One Shanghai buyer at the show was particularly interested in importing pecans, but was more interested in a trade than a purchase, so Mr. Hudson agreed to trade one shipping container (39 m<sup>3</sup>) of pecans for a half container of walnuts. In hopes of acquiring a permanent buyer, Mr. Hudson sent only high quality pecans, those of the Desirable variety. The buyer apparently liked the pecans and found a market for them, for he purchased more, and with a persistent effort at Chinese trade shows by growers and the Southern United States Trade Association, Mr. Hudson and other growers now export large volumes of pecans to China (Hudson, 2017).

US pecans now have a permanent home in China. Of the 294 million lbs. of pecans produced in the 2017-18 marketing year (September 1, 2017 through August 31, 2018), on an in-shell basis, 38% were exported with 36% of those exports going to China (mainland and Hong Kong) specifically (APC, 2019; ERS, 2019). It is difficult to separate mainland China from Hong Kong because many exports go to mainland China through Hong Kong. China is a big potential market because of growing exports, increasing trade liberalization between the US and China, the prominence of nuts in the Chinese diet, and its high population.



## **1.2 Problem Statement**

Given that pecan consumption in China went from non-existent to millions of lbs. in just twenty years, and given its importance as a market for US pecans, it is worth exploring the state of pecan consumption in China. China is also a peculiar market, one of the few (along with Italy, Vietnam, and Mexico) to import more in-shell US pecans than shelled US pecans (APC, 2019), and so the characteristics of Chinese pecan demand deserves special attention. To what extent are pecans familiar food in different regions of China? How does pecan consumption compare to consumption of other nuts? What demographic factors are associated with higher pecan consumption? How do Chinese view the pecan in terms of healthfulness and other considerations? We explore these questions through an internet survey of over 900 Chinese citizens.

## **1.3 Objectives**

This is an exploratory survey, seeking to document the nature of pecan consumption in China to aid US exporters in understanding their market. The main questions asked are:

1. How well can Chinese citizens identify pictures of pecans relative to other popular nuts?
2. How does pecan consumption vary across demographic variables in China?
3. How frequently do Chinese citizens consume pecans relative to other popular nuts?
4. What are their general attitudes towards pecans in regards to healthfulness, how are pecans consumed, and other considerations?

## **1.4 Specific Definitions**

A few terms have specific definitions and are thus worthy of stating explicitly here.

Respondents—the first question of the survey asks whether the respondent is born and raised in China, and only those who answer yes are administered the survey. No attempt was made to verify citizenship, length of residence in China, or whether the person had traveled abroad. No data were collected on ethnic identity. Also, individuals above the age of 50 and below the age of 18 were excluded from the sample due to their low sample sizes, so the targeted ‘respondents’ only includes those between the age of 18 and 50. All respondents claim to be located in one of the mainland Chinese provinces, and thus do not include residents of Hong Kong, Taiwan, or Macao.

Weighted statistic—the demographics of the sample are not identical to those of China’s population. When a weighted statistic is employed that means the respondent’s observation was assigned a weight generated by a sample balancing mechanism to force the sample to behave as if the distribution of their age (among those 18 to 50), region, household size, and gender was identical to that of mainland China, as reported by the 2010 6th Chinese demographic census.

Nut—there is a botanical and a culinary definition of a nut, and this research uses the culinary definition. Botanically a nut is a seed, which does not naturally detach itself from its shell, so the fruit and the seed remain attached. Peanuts are actually legumes, and cashews are seeds that have separated from the tree fruit, so these are not botanical nuts. Many foods referred to in a culinary sense as a nut are botanically something else. However, in this study a food is referred to as a nut whenever the common vernacular dictates.

## CHAPTER II

### REVIEW OF LITERATURE

#### **2.1 Consumption of Tree Nuts in China**

Tree nuts are common snacks in China. Other popular snacks of the ‘nut’ variety (regardless of whether they are technically nuts in a botanical sense) on the lower end of the price spectrum include peanuts, melon seeds, chestnuts, and especially walnuts, which Chinese considered especially healthy for brain development (due to their physical resemblance to the brain). As China's wealth increased and consumers became more aware of the health benefits of more expensive tree nuts, they increasingly consumed almonds, cashews, chestnuts, pecans, macadamia nuts, pistachios, hazelnuts and pine nuts. These high-end nuts are especially suitable for family, travel, gifts, and holiday consumption. Nuts are a popular food in China and central to some of its eating traditions. For example, according to Lu and Hou (2017), which is the leading institute providing commercial reports based on big data, cooperating with Alibaba Group in China, Chinese consumers at the Spring Festival of 2017 increased their nut consumption considerably, to the point that nuts now occupy 45% of their food budgets (Ma, 2017).

Bosi Data Research Center (BDRC) (2018) reported that the market size of the Chinese dried fruit and nut industry was about 88 billion yuan in 2017, which increased by 20.88% based on 72.8 billion yuan in 2016. Figure 2.1 shows that from 2011 to 2018, the market size of the Chinese dried fruit and nut industry increased considerably. It was estimated that in 2020, the market size would be 119.5 billion yuan (BDRC, 2018; China Industry Information, 2019).

E-commerce is partly responsible for this rise. For instance, Alibaba is the largest e-commerce platform, and Tmall, which is a subsidiary of Alibaba Group, is the biggest retail site in China. CBNDData and Tmall released the "White Book of Consumer Insight Trends on Roasted Seeds and Nuts Industry in 2019" (Lu & Hou, 2019), whose statistics showed that Chinese nuts consumption accounts for 17% of leisure food sales in 2018, and was the second highest item in leisure food sales. From 2010 to 2017, the sale proportion of nuts in Chinese snack food industry has raised year by year (Figure 2.1).

## **2.2 Distribution Channel of Nuts**

The survey design began with qualitative, on-site data collection, where the author traveled to six cities in China, including Beijing, Xi 'an, Chongqing, Sichuan, Suzhou and Shanghai, to observe pecan consumption behavior. Casual observation found that many people frequently consume nuts. Among the most frequently observed nuts were peanuts, walnuts, almonds, cashews, chestnuts, pecans, macadamia nuts, pistachios, ginkgo nuts, hazelnuts, pine nuts, and lotus seeds. The elderly appear to prefer buying nuts in big supermarkets. However, younger Chinese appear to prefer online shopping.

China has two major e-commerce platforms: Taobao (Alibaba group) and JDcom. The most popular nut brands sold online are Three Squirrels, BE&CHEERY and BESTORE. On this trip, we found new shops selling tree nuts in downtown shopping centers, which are mainly dominated by shopping, catering and entertainment and experience heavy consumer traffic. Examples of such shops are Joy City, SKP, The Mixc, Wanda Squire, and Paradise Walk. There are nuts for sale in some restaurants. Especially in the provinces Xinjiang and Lanzhou, restaurants have been observed displaying nuts for sale at the front door. A few typical Chinese foods and dishes that contain nuts are dumplings with walnuts, *eight treasures* porridge with lotus seeds, walnuts, almonds, and chicken soups with walnuts and ginkgo nuts.

### **2.3 Exports of U.S. Pecans**

Nuts are thus a common food in China, and pecans seem to have a growing presence, with much of the pecan consumption stemming from imports from the US. However, China is now planting pecan trees and their domestic consumption is expected to grow. China refers to all pecans as ‘Bi Gen Guo’. According to Collins and Erickson (2010), Chinese buyers have historically preferred large pecans, but in recent years, smaller varieties are becoming more popular due to their perceived higher meat content per weight. Based on our own observations during trips to China, pecans are rarely used as a recipe ingredient, as are peanuts, cashews, walnuts, chestnuts. They instead prefer purchasing cracked but unshelled pecans, often flavored.

As early as 1901, China introduced the planting technology of pecans. However, pecan production is restricted by environmental factors, so China depends on mostly imports. In 2015, Chinese import tariffs for in shell and shelled pecan (HS 0802909040) dropped from 24 percent to 10 percent (USDA, 2015), reducing pecan prices for Chinese importers and increasing pecan prices for pecan exporters. From 2009 to 2017, Hong Kong was the top export market for U.S. in-shell pecans but for shelled pecans, Hong Kong and China imports are relatively low (Figure 2.3), testifying to our observation that Chinese prefer their pecans in-shell. While the US does not rely solely on China as an export market, China is its largest export market (Zhang et al., 2015) (when ‘China’ is said to include Hong Kong and imports more than a third of the U.S. pecan crop).

## CHAPTER III

### SURVEY AND RESPONDENTS

#### **3.1 Survey Design**

The survey was administered in the Chinese (Mandarin) language, written by a Chinese native, who translated all descriptions of the survey here into English.

The survey instrument is divided into five parts (1) a nut identification quiz (2) questions regarding the frequency of pecan and other nut consumption (3) questions regarding how pecans are consumed (4) questions about attitudes towards pecans and (5) a set of demographic questions.

An example of the nut identification quiz is shown in Figure 3.1. The quiz concerns only six nuts: almonds, hazelnuts, hickory nuts, macadamia nuts, pecans, and walnuts. One quiz was conducted for nuts within the shell and another was conducted for nuts that have been shelled. Part A. of Figure 3.1 shows the question used to assess whether respondents could identify pecans for the in-shell quiz. Subjects are given a picture of the nut and asked to choose between the six possible nuts. Those six possible nuts remain the same for all six questions, so that each option will eventually be the correct answer in one of the six questions.

Thus, the identification quiz contains twelve total questions, six for in-shell nuts and six for shelled nuts. Respondents are first presented the six questions for in-shell nuts and then the six questions for shelled nuts. Within each quiz, both the order of the nuts and the order of the possible answers are randomized. Note that the type of shelled nuts consumed in China are often

different from those in the US. The most popular varieties may be different, and in China, the shells are often cracked whereas in the US this is rarely the case. To account for different possible pecan appearances, for the in-shell nuts, half the time the picture shows a typical un-cracked American pecan (as in Figure 3.1) and half the time it shows a typical cracked Chinese pecan (shown in Figure 4.1.1).

The second part of the survey concerns the frequency of nut consumption, both in an absolute sense and relative to other nuts. Respondents are asked how often they consume each of the following thirteen nuts: pecan, almond, walnut, macadamia, hazelnut, hickory, cashew, pine nuts, pistachio, chestnut, ginkgo, lotus seed, and peanut. The eight levels of consumption frequency are: never, once per year, twice per year, three to six times per year, seven to eleven times per year, monthly, weekly, daily. Part B of Figure 3.1 below shows the question used to elicit the frequency of pecan and other nuts consumption. The order of the thirteen nuts is randomized across surveys.

Pecans are frequently used as a recipe ingredient in the US, such as pecan pie, caramel-pecan pumpkin pull-apart, roasted vegetables with pecans, sweet potato gratin with pecans, green salad with pecans, and pecan flavor ice cream. It is not clear if pecans are used in this manner in China, or if they consume pecans exclusively as a direct snack. Thus, a survey question is provided eliciting this information, where we list five different forms of eating: raw and already shelled pecans; raw but not already shelled pecans; cooked, flavored, and shelled pecans; cooked and flavored but not shelled pecans; and a recipe or dish containing pecans. For each pecan type respondents are given the statement, "When you consume pecans, you tend to eat them as," and they were asked to select the appropriate response. Response options are: strongly disagree, disagree, somewhat disagree, neither agree nor disagree, somewhat agree, agree, strongly agree, and I do not eat pecans.

Respondents' attitudes towards pecans could have effects on their preference for and consumption of pecans. These attitudes are measured through a series of agree/disagree and true/false questions, eliciting the perceived relationship between pecans and weight loss, bone health, and other outcomes. A few questions also ask the respondent to compare pecans and walnuts in their healthiness, price, convenience, and the like. In all such questions, respondents are presented with either a positive or a negative statement. For instance, half are asked to answer true/false to the statement 'Eating pecans is good for bone health', while the other half are presented with the statement 'Eating pecans has no effect on bone health'. The combination of positive and negative statements should produce responses that are free of bias from positive / negative statements, such as acquiescence bias, where individuals prefer to agree with statements.

The final section of the survey contains a series of demographic questions, including the respondents' age, gender, region, family income, household size, members of children, and educational background. These questions are needed both for the sample balancing algorithm and to evaluate how pecan consumption varies across demographic profiles.

The appendices contain the actual survey administered, with Appendix A showing the instrument as it appeared to the respondents and Appendix B being the English translation.

### **3.2 Respondents**

We collected data from an online survey using respondents recruited by Survey Sampling International (SSI), who recruited a panel of subjects agreeing to take part in internet surveys in return for rewards like cash and airline miles. SSI was asked to only recruit individuals over the age of 18 currently living in mainland China. The sample was chosen to mimic the demographic profile of China to the greatest extent possible, but of course, with lower rates of internet use in China and non-response bias the sample is not (nor could any sample be) truly representative. The survey was administered during September of 2017, yielding 1,000 responses.



The demographics of the sample compared to population are shown in Table 1 and Figure 3.2. In some cases, in order to make statistics more representative of China, the sample statistics are modified by excluding certain respondents and/or the use of sample balancing. Any time sample balancing is used the statistics are reported as ‘weighted’.

Consider age. Likely due to greater information technology literacy among the youth, the average age in the sample is much younger than the population. The sample included so few individuals over the age of 50 that it was decided to exclude all observations from respondents over 50.

Although Table 1 shows the sample included 68 individuals above the age of 50, these respondents are not included in any statistical analysis. Any respondent under the age of 18 was also dropped, as they were not supposed to be included. Excluding these age categories reduces the sample size from 1,000 to 912. For the remaining categories, 18-30, 31-40, and 41-50, sample balancing was used to rectify any differences in the age distributions between the sample and the population. The sample is skewed towards large-sized households, but there was adequate representation in each category so that no respondent was excluded based on household size, and this bias was corrected through sample balancing.

Respondents were only taken from 29 provinces in the autonomous region of mainland China, encompassing most of China excluding Hong Kong, Taiwan, Tibet, and Macau. Henceforth ‘China’ refers only to mainland China. Sample balancing is used to reconcile the percent of the sample from each region with the population numbers, but to aid the sample balancing algorithm, the 29 provinces are reorganized into the six regions shown in Figure 3.2. The sample over-represents eastern and northern regions and underrepresents the others, and this is corrected for by sample balancing. Likewise, discrepancies in gender balances and household sizes are also corrected for by sample balancing, such that when a ‘weighted’ statistic is reported, each observation is assigned a weight generated from a sample balancing algorithm that causes the sample to mimic a sample that was representative in terms of gender, ages 18-50, household size,

and region. In this research, sample balancing did not account for education and income because the population data were not available, otherwise it prevented the sample-balancing algorithm from converging.

### 3.3 Sample Balancing

As mentioned previously, the sample demographics do not reflect the demographics of China as a whole, so sample balancing is used to make the sample more representative. To illustrate, let  $Northwest_i$  be an indicator variable that equals one if the respondent resides in the Northwest region and zero otherwise. As Figure 3.3 shows,  $N^{-1} \sum_{i=1}^N Northwest_i$  equals 0.03, whereas 7% of the Chinese population reside in the Northwest. A sample-balancing algorithm was used to calculate a weight for each individual,  $W_i$ , such that  $N^{-1} \sum_{i=1}^N W_i Northwest_i$  equals 0.07.

The values of  $W_i$  also ensure that the weighted sample distribution and the population distributions are equal for all other regions, all ages between 18 and 50, all household sizes, and both genders. The sample-balancing algorithm operates as follows. Let there be  $j$  demographic variables considered, and let  $j_L$  be the number of levels variable  $j$  can take. For instance, there are only two genders, so  $j_L$  for gender equals 2, whereas  $j_L$  for region equals 6 as there are six possible regions. Let  $D_{i,j,l}$  be an indicator variable that equals one if person  $i$ 's level of demographic variable  $j$  equals  $l$  ( $l = 1, \dots, L$ ) and zero otherwise. For example, if  $j = 2$  refers to gender and  $l = 1$  refers to females, then for person  $i$ ,  $D_{i,2,1}$  equals one if they are female and zero otherwise. Also, let  $P_{j,l}$  be the percent of the China population whose demographic variable  $j$  resides at level  $l$ . Following the previous example, if 51.19% of the China population is female then  $P_{2,1} = 0.5119$ .

The sample balancing algorithm used follows that of Ireland and Kullback (1968) and Lambert et al. (2014) and is described as

$$(1) \min_{W_i} \sum_{i=1}^N (W_i) \ln(W_i) \text{ subject to } \left( \sum_{i=1}^N (W_i) \right)^{-1} \left( \sum_{i=1}^N (W_i) D_{i,j,l} \right) = P_{j,l} \forall j, l$$

The algorithm was executed using Matlab's `fmincon` routine, and to prevent extreme weights from excessively increasing the variance of weighted statistics the weights were trimmed such that the maximum (minimum) weight was no more (less) than the 95th (5th) percentile. As mentioned previously, any time a statistic is reported as 'weighted' this indicates that the trimmed weights from the sample-balancing algorithm are used. There was considerable variation in the weights chosen by the algorithm, with almost half receiving a weight less than 0.1 and 12% with weights greater than 3, as shown below. Occasionally statistics are reported as both weighted and unweighted so that readers can inspect how sample balancing alters the results. In general, sample balancing had only small impacts on reported statistics.

## CHAPTER IV

### METHODS AND RESULTS

#### **4.1 Objective 1: Ability to Identify Pecans Relative to Other Nuts**

The first objective is to assess the ability of respondents to identify pictures of pecans relative to other popular nuts. Figure 4.1.1 shows the results for in-shelled nuts and Figure 4.1.2 shows results for shelled nuts. Recall that for in-shelled pecans, half of the respondents see a picture of pecans from the US and half see pecans collected from a food shop in China. The two figures show the actual photos used in the survey. Within each picture is the [unweighted] percent of survey respondents who correctly identify the nut, along with the weighted percentage. The figures suggest that weighted statistics differ little from their unweighted counterparts.

Respondents were able to identify unshelled walnuts and unshelled almonds best, with correct identification rates at 85% or above. They perform less well identifying pecans, with correct identification rates in the 40-62% range. These rates changed little when the unshelled pecans from the US were used relative to the unshelled pecans from China (the cracked pecans, on the right).

Familiarity with pecans dropped when comparing shelled nuts. Given that most Chinese purchase pecans unshelled, it is not surprising they performed better at identifying pecans in the shell than shelled. Of the in-shell nuts, pecans and macadamia nuts were less familiar to respondents than the other nuts, and walnuts are by far the most familiar. In the shelled nuts category pecans are the least familiar nut, with almonds and walnuts being the most familiar.

Part of the reason respondents are less able to identify pecans might be that pecans and hickory nuts resemble one another, whereas walnut, almond, and macadamia nuts are more distinct. Hickory nuts needed to be in the quiz, though, because they are a popular nut in China.

Though pecans are among the least familiar nuts, it is worth noting that half of respondents can identify pecans, even in a quiz where there were similar looking nuts, for example hickories and walnuts, suggesting that pecans have some level of familiarity in China.

#### **4.2 Objective 2: Influence of Demographic Variables on Pecan Consumption**

To analyze the influence of certain demographic variables on pecan consumption we create a statistical model relating demographic variables to their stated level of pecan consumption as indicated in section B of Figure 3.1. Each level of consumption is identified by the variable  $y_i$ , where 1 = never and 8 = daily. This variable is discrete, and a higher number indicates a greater level of consumption, so it is analyzed using an ordered logit model.

The model is specified such that  $y_i$  is influenced by gender (female dummy variable), age (age 31 to 40 and age 41 to 50 dummy variables), education (dummy variable for those with a bachelor's degree), income (I30k for those with household incomes between 30,000 and 100,000 yuan and I100k for those with incomes greater than 100,000 yuan), household size (H3 or 4 for those households with 3 or 4 people and H5 for those with 5 or more), number of children (C1 for those with one child and C2 for those with two or more), and region (R2 for those in the Northeast, R3 for those in East, R4 for those in Middle-south, R5 for those in Southwest, and R6 for those in Northwest).

The ordered logit model is specified as

$$(2) \quad \tilde{y}_i = x_i\beta + u_i = \beta_0 + \beta_1(\text{female}_i) + \beta_2\text{age31to40}_i + \beta_3\text{age41to50}_i + \beta_4\text{degree}_i + \\ \beta_5\text{I30k}_i + \beta_6\text{I100k}_i + \beta_7\text{H3or4}_i + \beta_8\text{H5}_i + \beta_9\text{C1}_i + \beta_{10}\text{C2}_i + \beta_{11}\text{R2}_i + \beta_{12}\text{R3}_i + \\ \beta_{13}\text{R4}_i + \beta_{14}\text{R5}_i + \beta_{15}\text{R6}_i + u_i$$

While the observed dependent variable is  $y_i$ , the model in (1) is stated in terms of a continuous, latent (*i.e.*, unobserved) variable  $\tilde{y}_i$ . Although  $\tilde{y}_i$  is unobserved, information about its value is manifested in the observed values for  $y_i$  relative to the values of  $\gamma_k$ , which are elements in the vector  $\bar{\gamma}$ . Specifically, if  $-\infty = \gamma_0 < \tilde{y}_i \leq \gamma_1$  then  $y_i = 1$ ; if  $\gamma_1 < \tilde{y}_i \leq \gamma_2$  then  $y_i = 2$ ; if  $\gamma_2 < \tilde{y}_i \leq \gamma_3$  then  $y_i = 3$ ; ... ; if  $\gamma_6 < \tilde{y}_i \leq \gamma_7$  then  $y_i = 7$ ; and if  $\gamma_7 < \tilde{y}_i \leq \gamma_8 = \infty$  then  $y_i = 8$ . The term  $u_i$  is a stochastic variable, so the probability  $y_i = k$  equals the probability that  $\gamma_{k-1} < \tilde{y}_i \leq \gamma_k = \gamma_{k-1} + x_i\beta + u_i \leq \gamma_k = \gamma_{k-1} + x_i\beta < u_i \leq \gamma_k - x_i\beta$ , which is written succinctly as  $P(y_i = k | x_i\beta, \bar{\gamma})$ .

The error term  $u_i$  is assumed to follow the logistic distribution, whose cumulative distribution function is  $F(u_i) = (e^{u_i}) / (1 + e^{u_i})$ , and so the probability  $P(y_i = k | x_i\beta, \bar{\gamma})$  equals the probability  $\gamma_{k-1} + x_i\beta < u_i \leq \gamma_k + x_i\beta$ , which is calculated as

$$(3) \quad F(u_i) = \left[ (e^{\gamma_k - x_i\beta}) / (1 + e^{\gamma_k - x_i\beta}) \right] - \left[ (e^{\gamma_{k-1} - x_i\beta}) / (1 + e^{\gamma_{k-1} - x_i\beta}) \right]$$

Given this probability, the likelihood (LF) and log-likelihood function (LLF) for  $N$  observations can be written as follows, where  $I[y_i = k]$  is an indicator function that equals one if  $y_i = k$  and zero otherwise. The parameters in the  $\beta, \bar{\gamma}$  are then estimated by maximizing the functions.

$$(4) \quad \max_{\beta, \bar{\gamma}} LF = \prod_{i=1}^N \prod_{k=1}^8 [P(y_i = k | x_i\beta, \bar{\gamma})]^{I[y_i=k]}$$

$$(5) \quad \max_{\beta, \bar{\gamma}} LLF = \sum_{i=1}^N \sum_{k=1}^8 I[y_i = k] \ln[P(y_i = k | x_i\beta, \bar{\gamma})]$$

To illustrate how the parameter estimates are used to predict values of  $y_i$ , suppose that we acquire the parameter estimates for  $\bar{\gamma}$  shown in Table 2. For any individual  $i$  their predicted value

of  $\tilde{y}_i$  is estimated as  $E(x_i\beta + u_i) = x_i\hat{\beta}$  as  $E(u_i) = 0$ , where  $\hat{\beta}$  is the estimate of  $\beta$ . Once the value of  $\tilde{y}_i$  is acquired the estimate of  $y_i$  is obtained by comparing  $\tilde{y}_i$  to the values in  $\bar{y}$  (Katchova, 2013; Peel, et al., 1998). For example, if  $\tilde{y}_i$  equals 0, it resides between the parameters -0.64 and 0.15, signifying that  $y_i$  probably equals 2 (once per year), as demonstrated in Figure 4.3.1.

Table 4.1 displays the results from the ordered-logit model, which includes the coefficients and p-values of all variables and 912 respondents. The greater the value of each coefficient, the more pecans are consumed. Using a significance level of 5%, neither household size nor region appear to influence pecan consumption. Household size might have no effect because the dependent variable measures consumption at the individual, not household level. The insignificance of the regional variables shows that although most pecans consumed in China enter as imports in the eastern and southeastern coast, those pecans are being distributed evenly through all six regions.

The estimates suggest that females eat more pecans than males, and younger Chinese eat more pecans than their parents do. Higher income individuals consume more pecans, and those with a college degree consume more than those without.

Regarding number of children, if an individual has just one child they eat more pecans than an individual who has two or two more children. However, an individual with no child consumes less than an individual with children. Pecans are among the more expensive nuts, so perhaps children with two or more children to feed and thus greater food expenses save money by relying on cheaper nuts. Why those without a child consume less is not clear, and might be due to individual-specific factors associated with people who choose not to have children.

Overall, gender, age, education, number of children, and income have a statistically detectable effect on the level of pecan consumption among Chinese, but region does not have effect.

Therefore, while pecan consumption does vary across demographic profiles within a region,

individuals within the same demographic profile but located in different regions have roughly the same consumption levels.

### 4.3 Objective 3: Pecan Consumption Relative to Other Nuts

An ordered-logit model similar to that used in Objective 2 is employed to analyze how the frequency of pecan consumption compares to consumption of other nuts. The model is specified such that the latent variable for nut consumption,  $\tilde{y}_i$ , is influenced not by demographics but by whether the nut is a pecan, almond, walnut, macadamia, hazelnut, hickory, cashew, pine nuts, pistachio, chestnut, ginkgo, lotus seed, or peanut.

$$(6) \quad \tilde{y}_i = x_i\beta + u_i = \beta_0 + \beta_1 \text{pecan} + \beta_2 \text{almond} + \beta_3 \text{walnut} + \beta_4 \text{macadamia} + \beta_5 \text{hazelnut} + \beta_6 \text{hickory} + \beta_7 \text{cashew} + \beta_8 \text{pine nuts} + \beta_9 \text{pistachio} + \beta_{10} \text{chestnut} + \beta_{11} \text{ginkgo} + \beta_{12} \text{lotus seed} + u_i$$

In (6), pecan is a dummy variable that equals one if the nut being considered is a pecan and equals zero otherwise, almond is a dummy variable for almonds, and so on. To encourage the model to better represent nut consumption across all six regions, a weighted likelihood function is used, where each term in the log-likelihood function is weighted by  $W_i$ , the weighting parameter as generated by the sample-balancing algorithm. In the log-likelihood function below,  $j$  refers to the 13 nuts,  $i$  refers to the individuals, and  $k$  refers to each of the 8 possible levels of nut consumption.

$$(7) \quad \max_{\beta, \bar{\gamma}} LLF = \sum_{j=1}^{13} \sum_{i=1}^N \sum_{k=1}^8 W_i I[y_i = k] \ln[P(y_i = k | x_i\beta, \bar{\gamma})]$$

Table 4.2 displays the estimation results. As before, a larger coefficient means the more frequently the nuts are eaten. Peanuts serve as the baseline, and so have a coefficient normalized to zero. All coefficients are significant and negative, indicating that peanuts are the most widely consumed nut. Walnuts have the smallest coefficient in absolute value, so it is the second most



consumed nut. Pecans ranked eleventh among those thirteen nuts, indicating that it is among the least consumed nuts in China. Note that statistical significance only denotes the nut's consumption relative to peanuts. The coefficients for pecans and macadamia nuts, for instance, may or may not be statistically different.

To test whether the consumption of other nuts are statistically different from pecans, the model is re-estimated normalizing the coefficient for pecans, instead of peanuts, to zero. When this is performed, the following nuts have consumption levels that are not statistically different from pecans at the 5% level: macadamia nuts, hazelnuts, pine nuts, hickory nuts and lotus seeds. Thus, almonds, walnuts, cashews, pistachios, chestnuts, and peanuts are eaten more frequently than pecans, while ginkgo nuts are eaten less frequently.

While pecans have found a strong market in China, these estimates show that many other nuts have higher consumption levels. However pecans are nevertheless consumed at the same or higher level than some traditional Chinese nuts like lotus seeds and ginkgo.

#### **4.4 Objective 4: Attitudes towards Pecans**

The last objective concerns how respondents tend to consume pecans and their general attitudes towards pecans, such as its healthiness, ease of eating, and the like.

First, consider how pecans are consumed. In this question, we provide five ways pecans, which can be consumed and asked the extent to which they consume them in that way. The results shown in Figure 4.4.1 are weighted and exclude those who do not consume pecans. Results show that respondents prefer cooked and flavored pecans to raw pecans. To our surprise, as we had not witnessed much of it in China, pecans play a role in many people's recipes. It was already mentioned that China imports more in-shell pecans than shelled pecans. It is thus not surprising that Figure 4.4.1 shows respondents prefer in-shell to shelled pecans, suggesting the appearance of an in-shell pecan is aesthetically pleasing and that they enjoy cracking pecans themselves. This

is supported by the fact that they report pecans to be easy to crack and eat. Figure 4.4.1 also shows that they consider pecans tasty, healthy, a weight loss aid, but they do consider pecans to be expensive.

Figure 4.4.1 provides some additional information on the perceived health benefits of pecans. In general, pecans are considered healthy in manifold ways, though respondents are less confident about their ability to reduce diabetes. There are many scientific reasons for believing pecans to be healthy, but there is no reason to believe it reduces hair loss. A hair loss question was asked anyway as a way to gauge the extent to which they would agree with any possible benefit from pecans. Roughly, 40% of respondents indicated they did believe pecans would reduce hair loss, suggesting much of the perceived benefits of pecans are based on a general positive attitude towards pecans and not on specific health studies.

Next, we consider the respondents attitudes towards pecans by comparing them to walnuts. Walnuts are pecans' biggest competitor in China, and have similarities in attributes and appearance. Both pecan and walnut belong to *Juglandaceae* plant family (Hal. 2000), for instance. Planting area and yield of walnuts in China is higher than those in any other country and it was previously shown that walnuts are consumed more than any other nut besides peanuts. In 2017, China consumed 1.045 million tons of walnuts, more than any other country and accounting for around 48 percent of world consumption. In the same year, China produced 1.89 million tons of walnuts, accounting for around 47 percent of global production. Moreover, the walnut has a long history of being produced and consumed in China, and so perceptions of the pecan relative to walnuts will play a major role in determining future Chinese consumption of pecans (Zhang et al. 2015).

Figure 4.4.1 shows that more than 60% respondents said that pecans were better than walnuts for losing weight, providing a favorable taste, and being easy to crack and eat. However, most

respondents believed walnuts to be superior in terms of physical and mental health, as well as price.

Next we evaluated how the shape and size of a pecan might influence its anticipated flavor. We designed 4 idealistic types of pecan to show to respondents; 82% of respondents believed the tall and skinny pecan would taste better than the short and fat pecan, while 70% of respondents said that they preferred big pecans to small ones (Figure 4.4.2).

## CHAPTER V

### CONCLUSION

This study used an online survey of over 900 respondents to explore the role of pecans in Chinese food consumption. We found that pecans are less familiar to Chinese consumers than nuts like walnuts or almonds, but that most can at least recognize it in a picture, suggesting it has a prominent place in Chinese food. Compared to walnuts and almonds, two popular nuts in China, pecans are consumed less frequently. However, pecan consumption is roughly equivalent to consumption of a number of other nuts, like lotus seeds, hickory nuts, and macadamia nuts. Chinese people prefer to purchase pecans in the shell and remove the shells themselves. Chinese females' consumption of pecans is higher than males', and older respondents tend to consume less pecans than their younger counterparts. Pecan consumption rises with education and income. If a family has only one child, they will consume more pecans than their counterparts. Pecan consumption seems to be similar across all regions.

This survey was conducted with the intention of helping the US pecan industry better understand an important export market—China—so what did we learn? A few highlights are as follows. First, pecan consumption is roughly the same across regions in China, so producers should not expect greater exports to result from better access to regional markets in China. Second, the young, educated, and wealthy consume pecans at a higher rate, so one would expect pecan consumption in China to rise over time. Third, while half of respondents consume pecans at least three times a year, suggesting pecans have found a home in the Chinese diet, pecan consumption is considerably lower than that of other nuts, like cashews, almonds, and especially walnuts. This

is because pecans are thought to be particularly expensive, though better tasting nuts, at least compared to walnuts. Finally, Chinese consumers generally have a favorable opinion of pecans, believing them to be healthy, and unlike the US, Chinese consumers prefer the pecans to be cooked and flavored.

In general, respondents could be further educated about nutrition and specifically about the nutritional benefits of pecans, which will lead to higher consumption. Additional research is needed to better understand what their current tree nut nutrition knowledge is, and examine the preferences surrounding their tree nut and pecan purchases.

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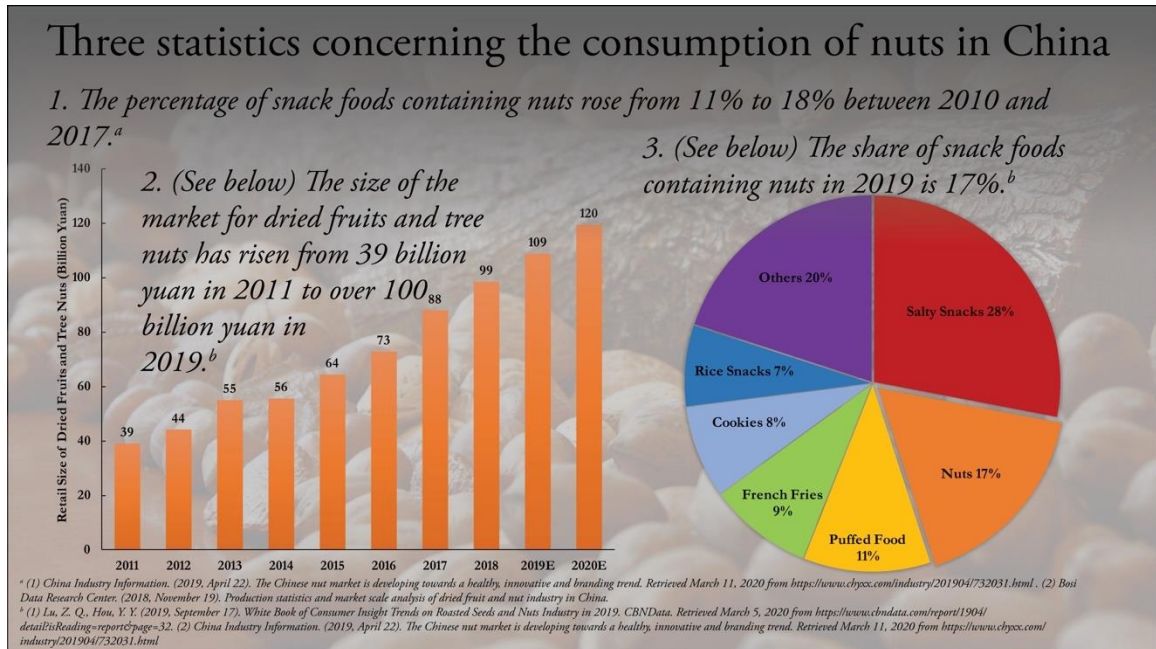
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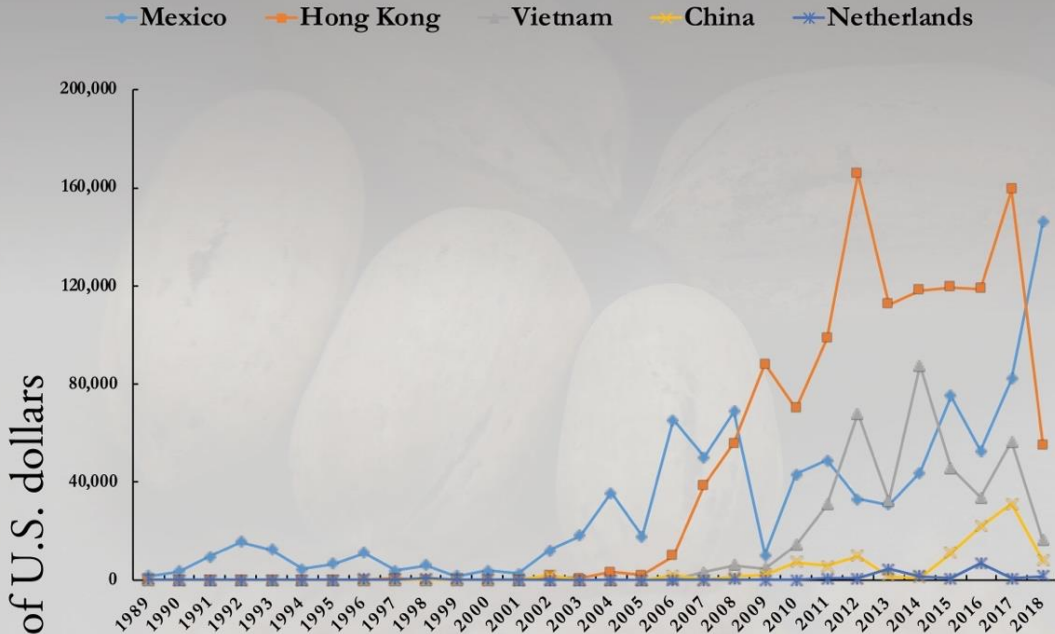
## APPENDICES



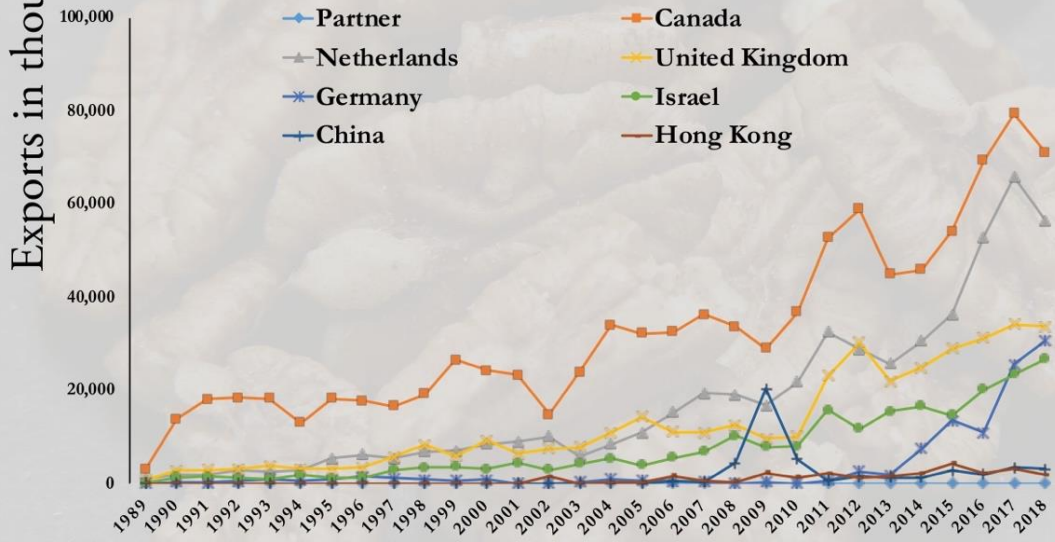
**Figure 2.1.** Three Statistics Regarding Nut Consumption in China

# U.S. Pecan Exports to Major Export Markets

## U.S. In-Shell Pecan Exports



## U.S. Shelled Pecan Exports



Source: USDA Foreign Agricultural Service.

**Figure 2.3.** Trends in U.S. Pecan Exports to Select Countries

# Illustration of survey questions used, as they appeared on the survey instrument

**A: Example of question used for Objective 1:**  
respondents' ability to identify pecans relative to other nuts



Try to identify the type of nut shown in the picture above.

- Hickory
- Macadamia
- Pecan
- Almond
- Hazelnut
- Walnut

Order of the options were randomized across surveys. Similar questions were presented each of the six nuts, and the order in which the nut pictures were presented were also randomized.

Questions were presented using both shelled and shelled nuts.

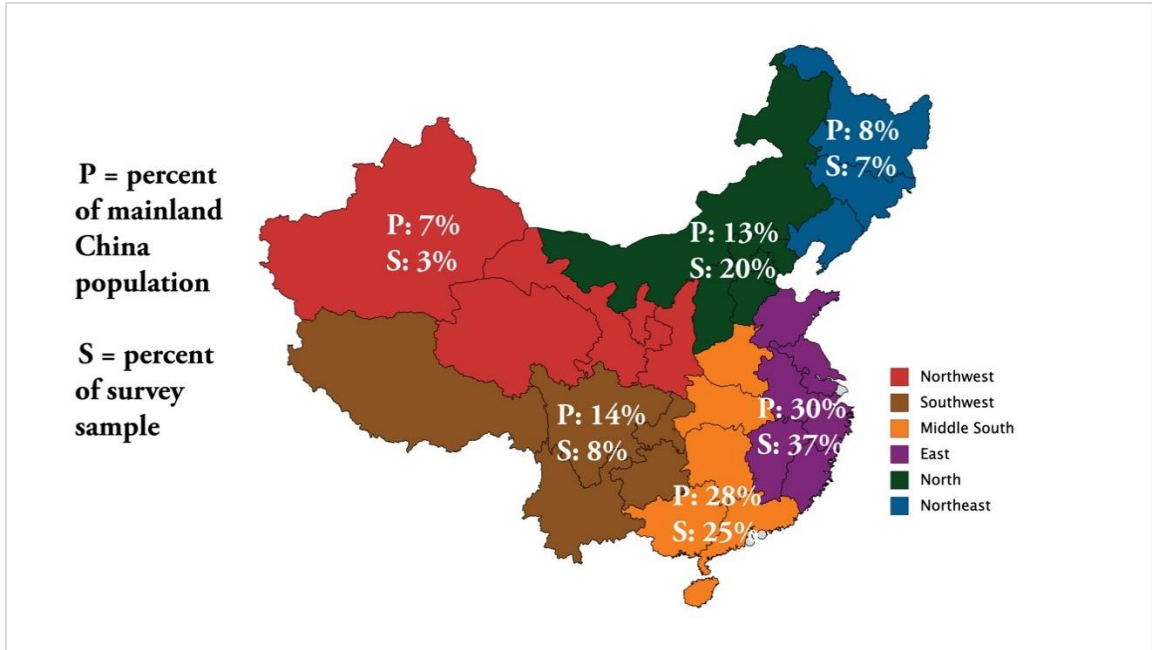
**B: Example of question used for Objectives 2 and 3:**  
**Impact of demographics on pecan consumption and pecan consumption levels relative to other nuts**

How often do you consume each of the following nuts?

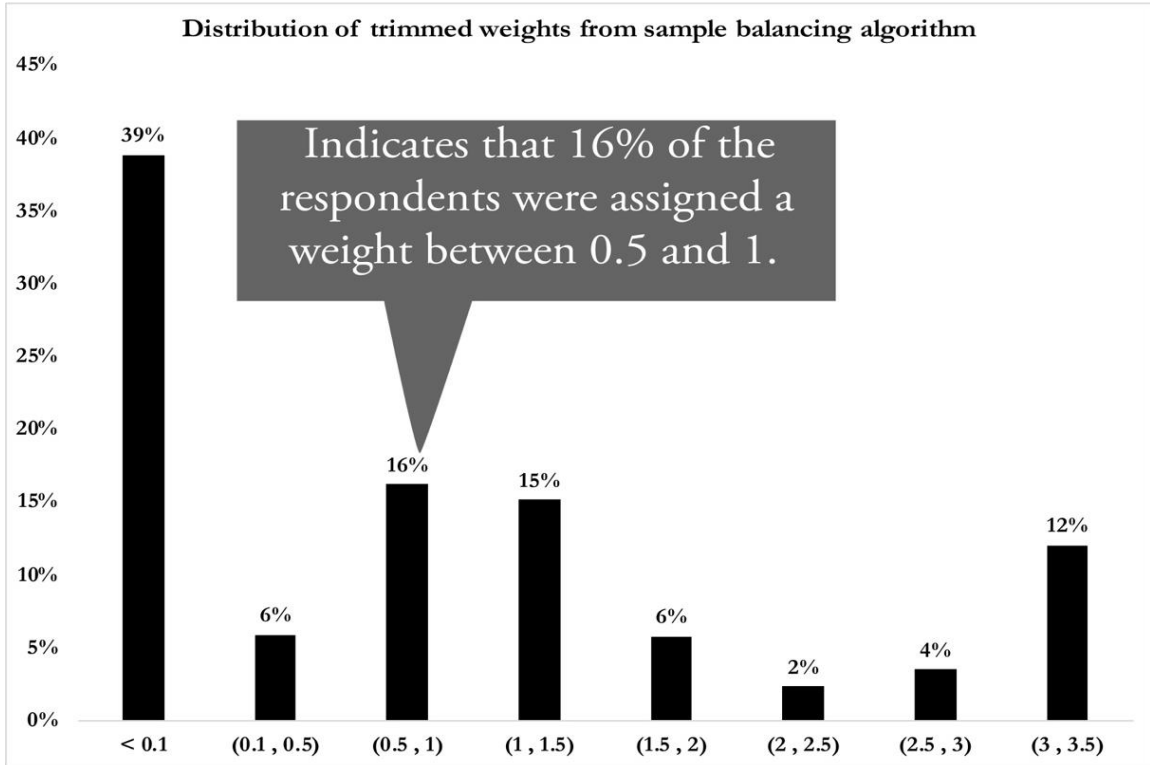
	Never	Once per year	Twice per year	3-6 times per year	7-11 times per year	Monthly	Weekly	Daily
Lotus seed	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Cashew	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Pecan	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ginkbo	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Chestnut	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Almond	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Walnut	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Hickory	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Pine Nuts	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Hazelnut	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Pistachio	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Macadamia	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Peanut	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Order of the nuts were randomized across surveys.

**Figure 3.1.** Survey Question Examples



**Figure 3.2.** Sample versus Population Statistics by Region



**Figure 3.3.** Trimmed Weights Calculated From Sample Balancing Algorithm



## Percent of Survey Respondents Who Correctly Identified (In-Shell) Nut Type From a Picture



**Pecan: 62%**  
**57% (adjusted)**  
(How they often appear in the U.S.)



**Pecan: 61%**  
**60% (adjusted)**  
(How they often appear in China)



**Hickory: 66%**  
**63% (adjusted)**



**Almond: 73%**  
**70% (adjusted)**



**Macadamia: 61%**  
**58% (adjusted)**

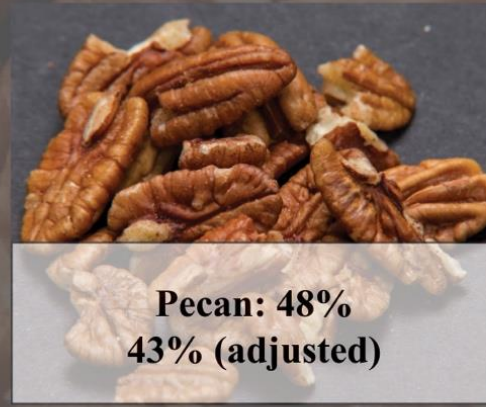


**Walnut: 95%**  
**96% (adjusted)**

Notes: Results of an internet survey of 929 Chinese residents between 18 and 65 years of age. Respondents were presented with the nut pictures above and asked to identify the nut type from a list. The adjusted percentages are calculated using sample balancing to make the sample more representative of the Chinese population.

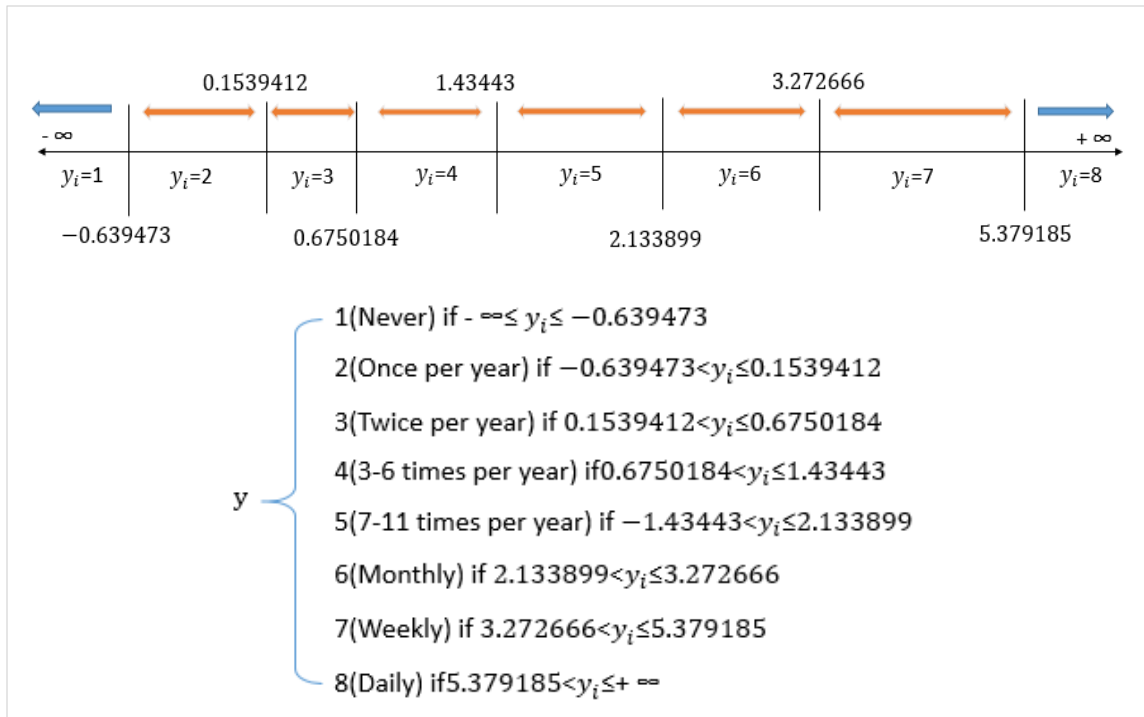
**Figure 4.1.1.** Results of Nut Identification Quiz (In-Shell)

## Percent of Survey Respondents Who Correctly Identified (Shelled) Nut Type From a Picture



Notes: Results of an internet survey of 929 Chinese residents between 18 and 65 years of age. Respondents were presented with the nut pictures above and asked to identify the nut type from a list. The adjusted percentages are calculated using sample balancing to make the sample more representative of the Chinese population.

**Figure 4.1.2.** Results of Nut Identification Quiz (Shelled)



**Figure 4.2.** Ordinal choices relative to frequency of pecan consumption.



# Attitudes, beliefs, and uses of pecans

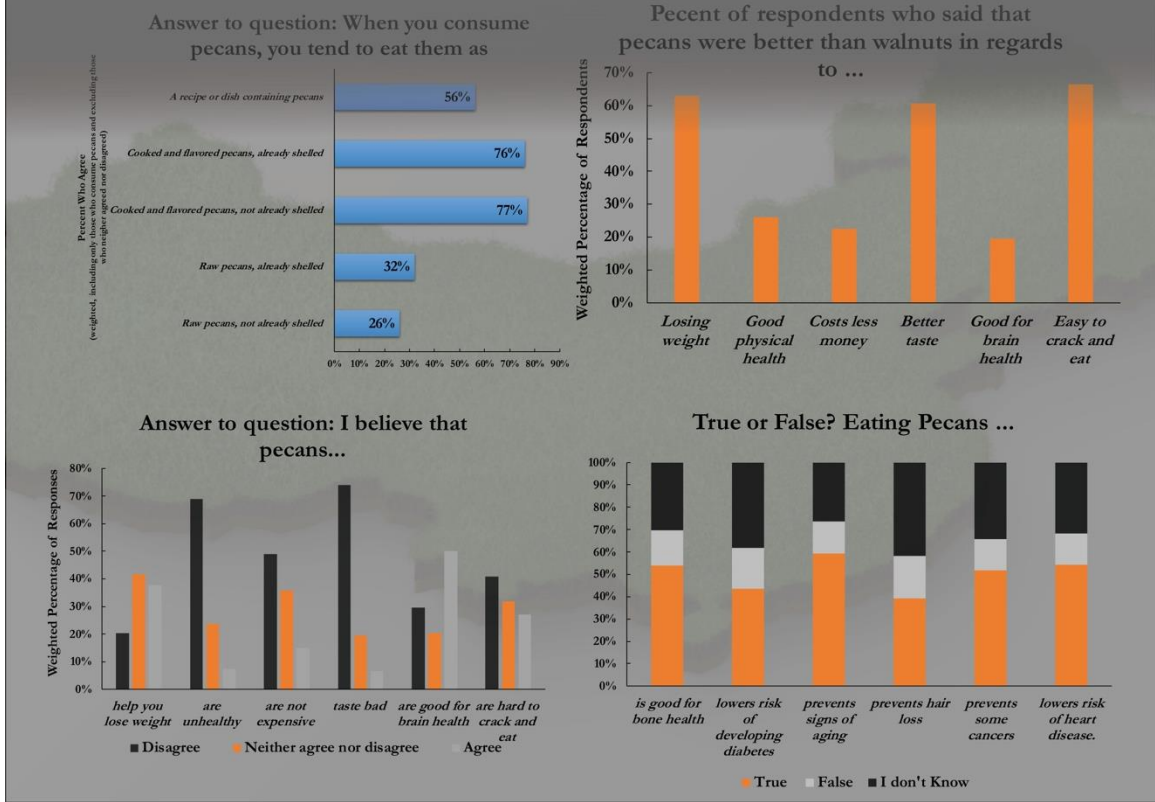
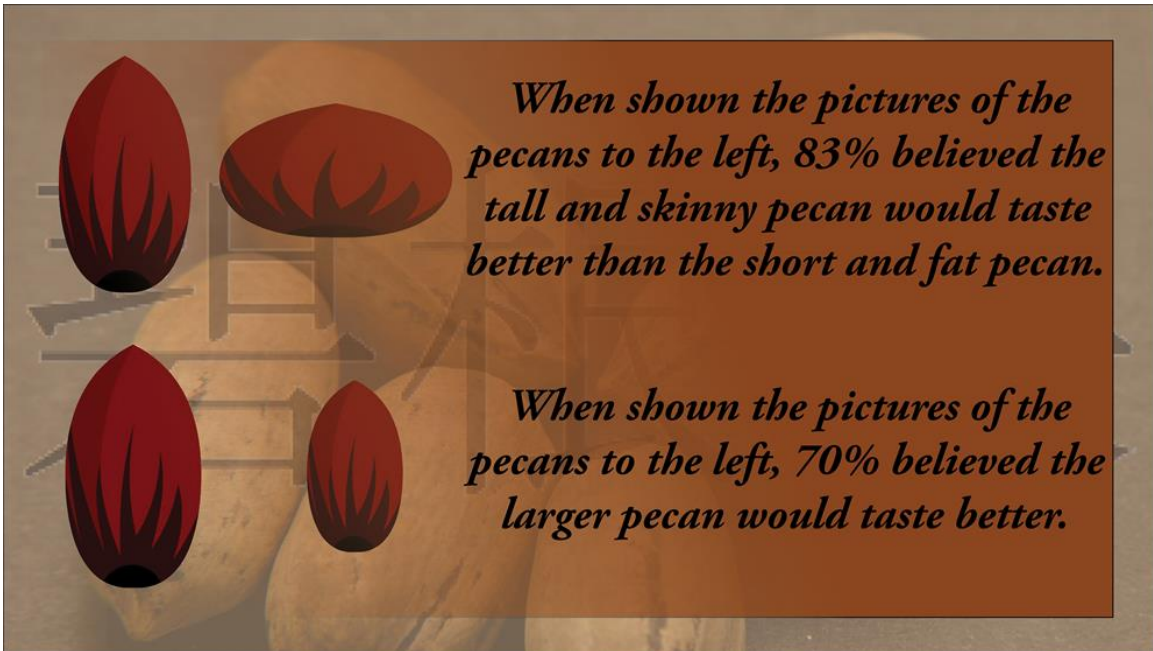


Figure 4.4.1. Ordinal choices relative to frequency of pecan consumption.



*When shown the pictures of the pecans to the left, 83% believed the tall and skinny pecan would taste better than the short and fat pecan.*

*When shown the pictures of the pecans to the left, 70% believed the larger pecan would taste better.*

**Figure 4.4.2.** Four types of pecan provided in the survey.

**Table 3.1. Statistics of internet survey sample before sample balancing and the sixth Chinese demographic census (2010).**

Attributes	Internet survey sample before sample balancing (N=1,000)		The 6th Chinese demographic census (2010)	
	No.	%	No.	%
<b>Gender</b>				
Male	510.00	51.00%	682,329,104	51.19%
Female	490.00	49.00%	650,481,765	48.81%
<b>Age</b>				
Under 18	3.00	0.30%	278,912,995	20.93%
18-30	415.00	41.50%	289,653,479	21.73%
31-40	349.00	34.90%	223,633,012	16.78%
41-50	165.00	16.50%	217,048,306	16.29%
51-65	60.00	6.00%	213,709,330	16.03%
Above 65	8.00	0.80%	109,853,747	8.24%
<b>Highest Education</b>				
Junior College degree	244.00	24.40%	68,610,519	5.15%
Graduate degree	68.00	6.80%	4,138,585	0.31%
Primary school diploma	1.00	0.10%	357,211,733	26.80%
Middle school diploma	10.00	1.00%	518,176,222	38.88%
High school diploma	74.00	7.40%	186,646,865	14.00%
Bachelor's degree	603.00	60.30%	45,625,793	3.42%
<b>Income</b>				
under 10000	28.00	2.80%	NA	NA
10000-30000	96.00	9.60%	NA	NA
30000-50000	62.00	6.20%	NA	NA
50000-70000	84.00	8.40%	NA	NA
70000-90000	141.00	14.10%	NA	NA
90000-100000	115.00	11.50%	NA	NA
Above 100000	453.00	45.30%	NA	NA
Na	21.00	2.10%	NA	NA
<b>Household Size</b>				
1 person	34.00	3.40%	58,396,327	14.56%
2 people	101.00	10.10%	97,947,686	24.42%
3 people	551.00	55.10%	107,978,654	26.92%
4 people	171.00	17.10%	70,598,493	17.60%
5 people	107.00	10.70%	40,332,512	10.06%
6 and above 6	36.00	3.60%	25,819,306	6.43%

*Note: The survey was conducted 20–26 September, 2017. Respondents were potential Chinese pecan consumers aged above 18 years.*

**Table 4.1. Factors Influencing Chinese Consumer Preference for Pecans**

Variable	Estimate	<i>P</i> -value
<b>Gender</b>		
Female	0.4227	0.000
<b>Age</b>		
Age 31-40	-0.4040	0.004
Age 41-50	-0.5262	0.004
<b>Education</b>		
bachelor and above bachelor's degree	0.7521	0.000
<b>Family income</b>		
30 thousands yuan < a ≤ 100 thousands yuan	0.4085	0.037
Above 100 thousands yuan	0.8270	0.000
<b>Number in household</b>		
3 or 4 people	-0.1190	0.583
5 and above 5	-0.2782	0.919
<b>Number of children</b>		
1 child	0.7687	0.000
2 and 2 more children	0.3312	0.182
<b>Region</b>		
Northeast China	-0.1364	0.614
East China and	0.1545	0.350
Middle-of-south China	-0.1248	0.483
Southwest China	0.0680	0.778
Middle-of-south China	-0.0692	0.864
Northwest China	-----	
<b>Vector <math>\bar{\gamma}</math></b>		
$\gamma_1$	0.639	
$\gamma_2$	0.154	
$\gamma_3$	0.675	
$\gamma_4$	1.434	
$\gamma_5$	2.133	
$\gamma_6$	3.272	
$\gamma_7$	5.379	
Sample size	912	

*Note: The survey was conducted 20–26 September, 2017. Respondents were potential Chinese pecan consumers aged from 18 to 50 years.*

**Table 4.2. Chinese Consumer Consumption for 13 Types of Nuts**

Variable	Estimate	<i>P-value</i>
Pecan	-2.105	0.000
Almond	-1.415	0.000
Walnut	-0.527	0.000
Macadamia	-2.143	0.000
Hazelnut	-1.981	0.000
Hickory	-1.843	0.000
Cashew	-1.683	0.000
Pine nuts	-1.919	0.000
Pistachio	-1.451	0.000
Chestnut	-1.447	0.000
Ginkgo	-2.546	0.000
Lotus seed	-1.915	0.000
Peanuts	0.000	-----
<b>Vector <math>\bar{\gamma}</math></b>		
$\gamma_1$	-4.190	
$\gamma_2$	-3.069	
$\gamma_3$	-2.539	
$\gamma_4$	-1.831	
$\gamma_5$	-1.196	
$\gamma_6$	-0.149	
$\gamma_7$	1.906	
<b>Sample size</b>	929	

*Note: The survey was conducted 20–26 September, 2017. Respondents were potential Chinese pecan consumers aged from 18 to 50 years.*

# Appendix A. Survey Instrument for Final Chinese's' Preferences for Pecan, Chinese version

Survey Flow Chinese's' Preferences for Pecan, Chinese version

Zoom Out Zoom In  
 Show Flow IDs

The screenshot displays a survey flow editor interface. At the top, there are navigation buttons for 'Zoom Out' and 'Zoom In', and a checkbox for 'Show Flow IDs'. The main area shows a sequence of survey elements:

- Show Block: 介绍 (1 Question)** with options: Add Below, Move, Duplicate, Delete.
- Randomizer** (purple box) with options: Randomly present (1), Evenly Present Elements, Add Below, Move, Duplicate, Collapse, Delete.
- Show Block: 坚果图片识别 V1 (11 Questions)** with options: Add Below, Move, Duplicate, Delete.
- Show Block: 坚果图片识别 V2 (11 Questions)** with options: Add Below, Move, Duplicate, Delete.
- + Add a New Element Here**
- Show Block: 频率 (1 Question)** with options: Add Below, Move, Duplicate, Delete.
- Randomizer** (purple box) with options: Randomly present (1), Evenly Present Elements, Add Below, Move, Duplicate, Collapse, Delete.
- Show Block: 健康1 (3 Questions)** with options: Add Below, Move, Duplicate, Delete.
- Show Block: 健康2 (3 Questions)** with options: Add Below, Move, Duplicate, Delete.
- + Add a New Element Here**
- Randomizer** (purple box) with options: Randomly present (1), Evenly Present Elements, Add Below, Move, Duplicate, Collapse, Delete.
- Show Block: 价格1 (3 Questions)** with options: Add Below, Move, Duplicate, Delete.
- Show Block: 价格2 (3 Questions)** with options: Add Below, Move, Duplicate, Delete.
- + Add a New Element Here**

Below this sequence is a list of additional survey blocks:

- Show Block: 碧根果的吃法 (1 Question)
- Show Block: 坚果的益处 (1 Question)
- Show Block: 碧根果长短偏好 (2 Questions)
- Show Block: 碧根果大小偏好 (2 Questions)
- Show Block: 其他坚果问题 (4 Questions)
- Show Block: 健康1 (3 Questions)
- Show Block: 健康2 (3 Questions)
- Show Block: 价格1 (3 Questions)
- Show Block: 价格2 (3 Questions)
- Show Block: 个人信息 (9 Questions)
- End of Survey** (red box) with options: Move, Duplicate, Customize, Delete.
- Show Block: u (3 Questions)

At the bottom, there is a '+ Add a New Element Here' button.

## 介绍

Q215 您好!

欢迎参加美国俄克拉荷马州立大学的一项问卷调查。我们正在对中国人进行一项有关他们对食物喜好的调查问卷。问卷只需要 5 - 10 分钟就可以完成，调查结果仅用于学术研究。

此调查中，我们并不要求您的姓名或联系方式，所以您的答案是完全匿名的。

本次调查本着自愿原则，您也可以随时终止此调查。

如果您有任何问题想联系这项研究的主要负责人，请联系贝利诺伍德教

授 [bailey.norwood@okstate.edu](mailto:bailey.norwood@okstate.edu)

如果您有任何问题想联系这项调查的批准监督机构，请联系机构审查委员会

[irb@okstate.edu](mailto:irb@okstate.edu).

End of Block

---

## Native

Q235 请问您是否在中国出生并长大?

- 是 (1)
- 不是 (2)

End of Block

---

## 坚果区分 V1

Q66 以下图片展示了一些不同种类的坚果。

请您辨别出来，并在以下选项中选出。（如果您不确定结果请尽可能猜测。）



Q26 请指出以上坚果是什么。

- 碧根果 (1)
- 杏仁 (6)
- 核桃 (8)
- 夏威夷果 (12)
- 榛子 (13)
- 小核桃 (山核桃) (14)





Q27 请指出以上坚果是什么。

- 碧根果 (1)
- 杏仁 (2)
- 核桃 (3)
- 夏威夷果 (4)
- 榛子 (5)
- 小核桃 (山核桃) (6)



Q28 请指出以上坚果是什么。

- 碧根果 (1)
- 杏仁 (2)
- 核桃 (3)
- 夏威夷果 (4)
- 榛子 (5)
- 小核桃 (山核桃) (6)



Q51 请指出以上坚果是什么。

- 碧根果 (1)
- 杏仁 (2)
- 核桃 (3)
- 夏威夷果 (4)
- 榛子 (5)
- 小核桃 (山核桃) (6)



Q52 请指出以上坚果是什么。

- 碧根果 (1)
- 杏仁 (2)
- 核桃 (3)
- 夏威夷果 (4)
- 榛子 (5)
- 小核桃 (山核桃) (6)

End of Block

## 坚果区分 V2

Q99 以下图片展示了一些不同种类的坚果。

请您辨别出来，并在以下选项中选出。（如果您不确定结果请尽可能猜测。）

---



Q100 请指出以上坚果是什么。

- 碧根果 (1)
- 杏仁 (6)
- 核桃 (8)
- 夏威夷果 (12)
- 榛子 (13)
- 小核桃（山核桃） (14)



Q101 请指出以上坚果是什么。

- 碧根果 (1)
  - 杏仁 (2)
  - 核桃 (3)
  - 夏威夷果 (4)
  - 榛子 (5)
  - 小核桃 (山核桃) (6)
-





Q102 请指出以上坚果是什么。

- 碧根果 (1)
  - 杏仁 (2)
  - 核桃 (3)
  - 夏威夷果 (4)
  - 榛子 (5)
  - 小核桃 (山核桃) (6)
-



Q103 请指出以上坚果是什么。

- 碧根果 (1)
  - 杏仁 (2)
  - 核桃 (3)
  - 夏威夷果 (4)
  - 榛子 (5)
  - 小核桃 (山核桃) (6)
-





Q104 请指出以上坚果是什么。

- 碧根果 (1)
- 杏仁 (2)
- 核桃 (3)
- 夏威夷果 (4)
- 榛子 (5)
- 小核桃 (山核桃) (6)

End of Block

---

坚果去壳

Q166 以下图片展示了一些不同种类的坚果。

请您辨别出来，并在以下选项中选出。（如果您不确定结果请尽可能猜测。）



Q169 请指出以上坚果是什么。

- 碧根果 (1)
- 杏仁 (2)
- 核桃 (3)
- 夏威夷果 (4)
- 榛子 (5)
- 小核桃（山核桃）(6)



Q167 请指出以上坚果是什么。

- 碧根果 (1)
- 杏仁 (2)
- 核桃 (3)
- 夏威夷果 (4)
- 榛子 (5)
- 小核桃 (山核桃) (6)



Q121 请指出以上坚果是什么。

- 碧根果 (1)
- 杏仁 (2)
- 核桃 (3)
- 夏威夷果 (4)
- 榛子 (5)
- 小核桃 (山核桃) (6)



Q168 请指出以上坚果是什么。

- 碧根果 (1)
- 杏仁 (2)
- 核桃 (3)
- 夏威夷果 (4)
- 榛子 (5)
- 小核桃 (山核桃) (6)






Q124 请指出以上坚果是什么。

- 碧根果 (1)
- 杏仁 (2)
- 核桃 (3)
- 夏威夷果 (4)
- 榛子 (5)
- 小核桃 (山核桃) (6)

---


End of Block

## 频率

Q137 您吃以下坚果的频率是什么? 

	没吃过 (1)	一年一 次 (2)	半年一 次 (3)	一年 3-6 次 (4)	一年 7-11 次 (5)	一月一 次 (6)	一周一 次 (7)	一天一 次 (8)
碧根果 (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
杏仁 (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
核桃 (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
夏威夷 果 (4)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
榛子 (5)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
小核桃 (山核 桃) (6)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
腰果 (7)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
松子 (8)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
开心果 (9)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
栗子 (10)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
白果 (11)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
莲子 (12)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
花生 (13)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

碧根果的吃法

Q30 当你在吃碧根果时，你倾向吃 


	非常不赞同 (1)	不赞同 (2)	有点不赞同 (6)	中立 (7)	有点赞同 (9)	赞同 (10)	非常赞同 (11)	我不吃碧根果 (12)
生的，带壳的碧根果 (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
生的，去壳的碧根果 (6)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
加工过的，有味道 的，带壳的碧根果 (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
加工过的，有味道 的，去壳的碧根果 (4)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
含有碧根果的食品或 菜肴 (5)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

坚果比较 1



Q145 您认为碧根果 

	非常不赞同 (1)	不赞同 (4)	不赞同 (5)	中立 (7)	有点赞同 (6)	赞同 (8)	非常赞同 (9)
帮助您减肥 (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
不健康 (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
价格不贵 (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
味道差 (4)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
有助于大脑健康 (5)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
很难剥开来吃 (6)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Q149 请根据以下条件选出你认为更好的是碧根果还是核桃。 

	碧根果 (1)	核桃 (4)
有助于减肥 (1)	<input type="radio"/>	<input type="radio"/>
有助于身体健康 (3)	<input type="radio"/>	<input type="radio"/>
价格更便宜 (4)	<input type="radio"/>	<input type="radio"/>
味道更好 (5)	<input type="radio"/>	<input type="radio"/>
有助于大脑健康 (6)	<input type="radio"/>	<input type="radio"/>
容易剥开来吃 (7)	<input type="radio"/>	<input type="radio"/>


End of Block

---

## 坚果比较 2

Q231 您认为碧根果 

	非常不赞同 (1)	不赞同 (4)	有点不赞同 (5)	中立 (7)	有点赞同 (6)	赞同 (8)	非常赞同 (9)
导致您发胖 (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
健康 (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
价格贵 (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
味道好 (4)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
对大脑健康有害 (5)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
容易剥开来吃 (6)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Q232 请根据以下条件选出你认为更好的是碧根果还是核桃。 

	碧根果 (1)	核桃 (4)
有助于减肥 (1)	<input type="radio"/>	<input type="radio"/>
有助于身体健康 (3)	<input type="radio"/>	<input type="radio"/>
价格更便宜 (4)	<input type="radio"/>	<input type="radio"/>
味道更好 (5)	<input type="radio"/>	<input type="radio"/>
有助于大脑健康 (6)	<input type="radio"/>	<input type="radio"/>
容易剥开来吃 (7)	<input type="radio"/>	<input type="radio"/>

End of Block

---

## 判断正误

Q42 请根据您的认识，判断以下陈述正误。



	正确 (1)	错误 (4)	不知道 (5)
常吃碧根果对骨骼健康有益。(12)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
常吃碧根果有助于降低患糖尿病的风险。(7)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
常吃碧根果能够抗衰老。(17)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
常吃碧根果不能解决脱发问题。(18)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
常吃碧根果不能预防一些癌症。(9)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
常吃碧根果不能降低患心脏病的风险。(6)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Q214 请根据你的认识，判断以下陈述正误。



	正确 (1)	错误 (4)	不知道 (5)
常吃碧根果对改善骨骼健康没影响。(12)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
常吃碧根果不能降低患糖尿病的风险。(7)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
常吃碧根果不能抗衰老。(17)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
常吃碧根果能解决脱发问题。(18)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
常吃碧根果能预防一些癌症。(9)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
常吃碧根果有助于降低患心脏病的风险。(6)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

End of Block

长短偏好

Q78 基于以下图片中碧根果的形状，您会觉得哪一个味道更好？

- 碧根果 A (1)
- 碧根果 B (2)

Pecan A

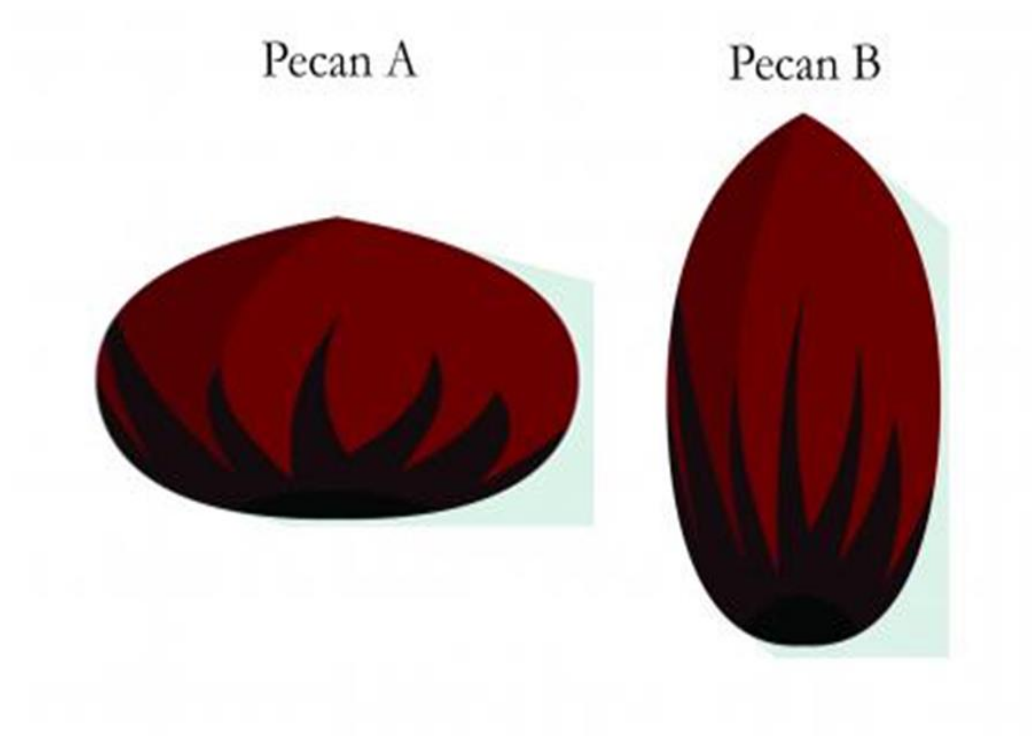


Pecan B



Q79 基于以下图片中碧根果的形状，您会觉得哪一个味道更好？

- 碧根果 A (1)
- 碧根果 B (2)



---

End of Block



## 大小偏好

Q80 基于以下图片中碧根果的大小，您会觉得哪一个味道更好？

- 碧根果 A (1)
- 碧根果 B (2)

Pecan A



Pecan B



Q81 基于以下图片中碧根果的大小，您会觉得哪一个味道更好？

- 碧根果 A (1)
- 碧根果 B (2)

Pecan A




Pecan B



---

End of Block


## 坚果

Q93 请选择您通常购买碧根果的地点。（多选） 

- 超市 (1)
  - 网上 (2)
  - 副食店, 便利店 (3)
  - 我没有买过碧更果 (5)
  - 其他 (4) \_\_\_\_\_
- 

Q233 每个月你平均大概花多少钱购买碧根果?

- ¥0 (1)
  - ¥1-100 (2)
  - ¥101-200 (3)
  - ¥200 以上 (4)
- 

Q94 如果碧根果的价格和核桃一样, 您更偏向购买哪种? 

- 碧根果 (1)
  - 核桃 (2)
  - 都不买 (3)
-

Q14 您曾经购买碧根果当做礼物送亲朋好友吗? 

- 有过 (1)
- 没有 (2)

---

Q170 请选择以下哪个描述更符合您的坚果消费观。(多选)

- 因为坚果健康, 所以我吃坚果 (1)
- 因为坚果好吃, 所以我吃坚果 (2)
- 因为坚果方便, 所以我吃坚果 (7)
- 因为坚果便宜, 所以我吃坚果 (5)
- 我不吃坚果 (4)

---

Q171 对比您平时消费的坚果量, 以下情况中, 您坚果消费量的变化是?

	比平时少 (1)	和平时一样 (2)	平时的两倍 (3)	平时的三倍 (4)	平时的四倍或者更多 (5)
春节 (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
坚果成熟季 (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Q234 您通常一天中什么时候吃坚果？

- 早餐 (1)
- 午餐 (2)
- 晚餐 (5)
- 两餐之间，当零食吃 (3)
- 晚上，当零食吃 (4)
- 我从不吃坚果 (6)

---

End of Block

---

## 个人信息

Q111 您的性别？

- 男 (1)
- 女 (2)

---

Q2 您的年龄所在范围？

- 小于 18 岁 (1)
  - 18-30 (2)
  - 31-40 (3)
  - 41-50 (4)
  - 51-65 (5)
  - 大于 65 岁 (7)
-

Q3 您的学历程度?

- 未上过学 (1)
  - 小学 (6)
  - 初中 (7)
  - 普通高中 (8)
  - 中职 (3)
  - 大学专科 (4)
  - 大学本科 (13)
  - 研究生 (5)
- 

Q4 您家庭税前年收入?

- 低于 ¥10000 (1)
  - ¥10000-30000 (9)
  - ¥30000-50000 (2)
  - ¥50000-70000 (3)
  - ¥70000-900000 (4)
  - ¥90000-100000 (5)
  - 高于 ¥100000 (7)
  - 我不知道/拒绝回答 (8)
-

Q5 您当前居住在那个地区？

- (1)
- 安徽省 (3)
- 福建省 (17)
- 甘肃省 (20)
- 广东省 (19)
- 贵州省 (21)
- 海南省 (22)
- 河北省 (12)
- 黑龙江省 (9)
- 河南省 (13)
- 湖北省 (6)
- 湖南省 (7)
- 江苏省 (4)
- 江西省 (5)
- 吉林省 (10)
- 辽宁省 (11)
- 青海省 (23)
- 山东省 (16)
- 陕西省 (14)
- 山西省 (15)
- 四川省 (8)

- 台湾省 (34)
- 云南省 (36)
- 浙江省 (2)
- 北京 (28)
- 重庆 (30)
- 上海 (29)
- 天津 (31)
- 内蒙古自治区 (26)
- 广西壮族自治区 (18)
- 宁夏回族自治区 (27)
- 西藏自治区 (24)
- 新疆维吾尔自治区 (25)
- 香港特别行政区 (32)
- 澳门特别行政区 (33)
- 其他 (35)



Q6 您家庭有几口人（包括你自己和所有在你家里居住的成员）？

- 1 (独居) (1)
  - 2 (2)
  - 3 (3)
  - 4 (4)
  - 5 (5)
  - 6 或以上 (6)
- 

Q8 您家里有几个孩子？

- 0 (1)
  - 1 (2)
  - 2 (3)
  - 3 (4)
  - 4 (5)
  - 5 或以上 (6)
- 

Q114 您是家里主要负责采购食物的人吗？

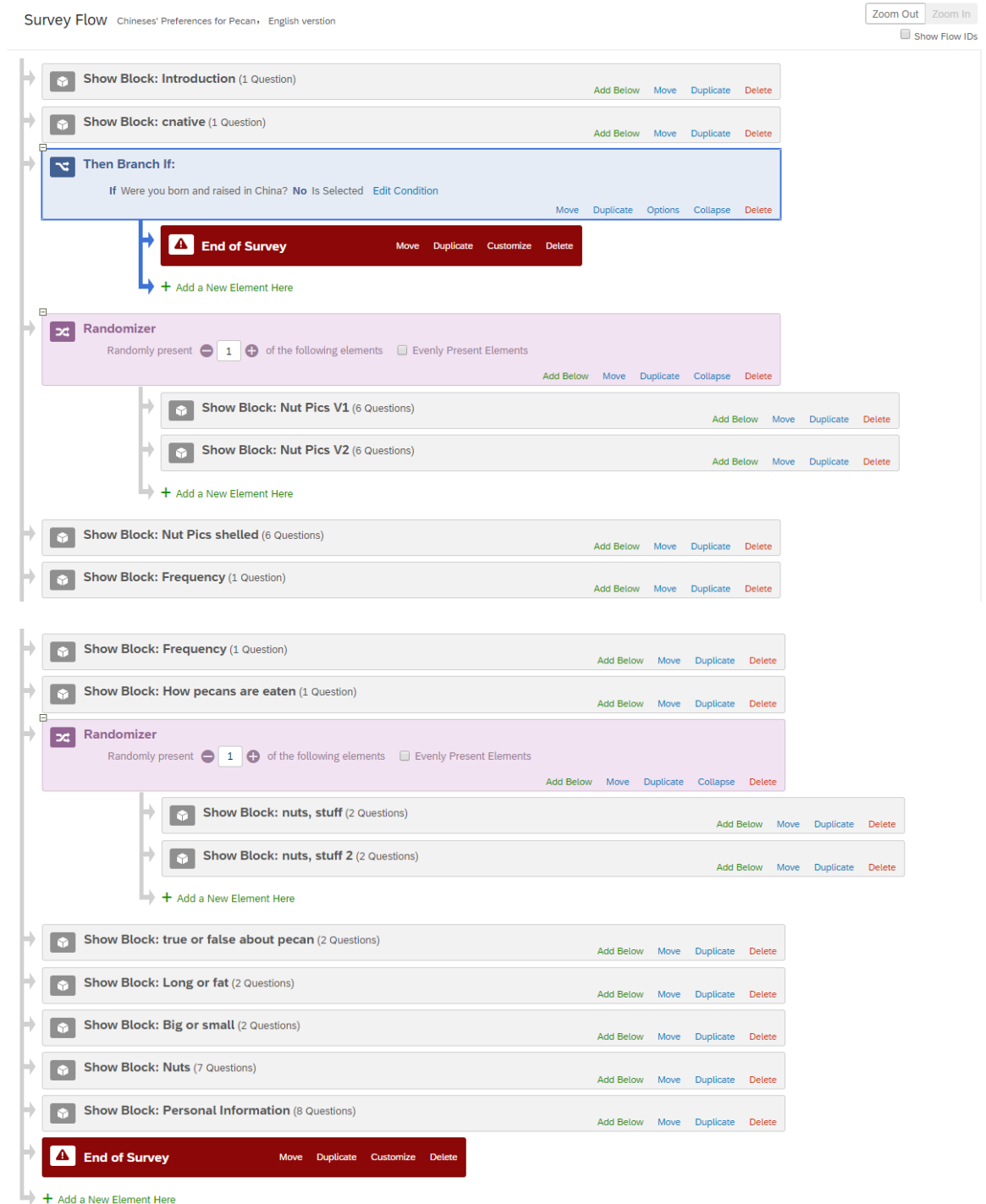
- 几乎是我 (1)
- 几乎是其他人 (2)
- 采购任务家庭成员均分 (3)

---

End of Block

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# Appendix B. Survey Instrument of Chinese Consumers' Preferences for Pecan, English version



## **Introduction**

Q215

Greetings from Oklahoma State University, a college in the United States of America. We are conducting a survey of people living in China regarding their preferences for food. The survey should only take 5-10 minutes to complete, and your responses are only used for academic research. At no point in this survey do we ask for your name or contact information, so your answers are completely anonymous. Your participation in this survey is, of course, voluntary, and you may cease your participation at any point. If you wish to contact the principle investigator of this research, please contact Professor Bailey Norwood at [bailey.norwood@okstate.edu](mailto:bailey.norwood@okstate.edu).

If you wish to contact the university office approving and monitoring all research, please contact the Institutional Review Board at [irb@okstate.edu](mailto:irb@okstate.edu).

End of Block

---

## **Native**

Q235 Were you born and raised in China?

- Yes (1)
- No (2)

End of Block

---

## **Nut Pics V1**

Q66 The following questions will present you with pictures of various nuts with the shell.

Please select the identity of the nut from the list provided. (If you are unsure of the nut's identity just make your best judgment.)

---



Q26 Try to identify the type of nut shown in the picture above.

- Pecan (1)
- Almond (6)
- Walnut (8)
- Macadamia (12)
- Hazelnut (13)
- Hickory (14)

Carry Forward All Choices - Displayed & Hidden from "Try to identify the type of nut shown in the picture above. "



Q27 Try to identify the type of nut shown in the picture above.

- Pecan (1)
- Almond (2)
- Walnut (3)
- Macadamia (4)
- Hazelnut (5)
- Hickory (6)

Carry Forward All Choices - Displayed & Hidden from "Try to identify the type of nut shown in the picture above. "



Q28 Try to identify the type of nut shown in the picture above.

- Pecan (1 = 1)
- Almond (2 = 6)
- Walnut (3 = 8)
- Macadamia (4 = 12)
- Hazelnut (5 = 13)
- Hickory (6 = 14)

Carry Forward All Choices - Displayed & Hidden from "Try to identify the type of nut shown in the picture above. "



Q51 Try to identify the type of nut shown in the picture above.

- Pecan (1 = 1)
- Almond (2 =6)
- Walnut (3 = 8)
- Macadamia (4 = 12)
- Hazelnut (5 = 13)
- Hickory (6 = 14)

Carry Forward All Choices - Displayed & Hidden from "Try to identify the type of nut shown in the picture above. "



Q52 Try to identify the type of nut shown in the picture above.

- Pecan (1 = 1)
- Almond (2 = 6)
- Walnut (3 = 8)
- Macadamia (4 = 12)
- Hazelnut (5 = 13)
- Hickory (6 = 14)

---

End of Block



## Nut Pics V2

Q99 The following questions will present you with pictures of various nuts with the shell.

Please select the identity of the nut from the list provided. (If you are unsure of the nut's identity just make your best judgment.)

---



Q100 Try to identify the type of nut shown in the picture above.

- Pecan (1)
- Almond (6)
- Walnut (8)
- Macadamia (12)
- Hazelnut (13)
- Hickory (14)

*Carry Forward All Choices - Displayed & Hidden from "Try to identify the type of nut shown in the picture above."*



Q101 Try to identify the type of nut shown in the picture above.

- Pecan (1)
- Almond (2)
- Walnut (3)
- Macadamia (4)
- Hazelnut (5)
- Hickory (6)

*Carry Forward All Choices - Displayed & Hidden from "Try to identify the type of nut shown in the picture above."*



Q102 Try to identify the type of nut shown in the picture above.

- Pecan (1)
- Almond (2)
- Walnut (3)
- Macadamia (4)
- Hazelnut (5)
- Hickory (6)

Carry Forward All Choices - Displayed & Hidden from "Try to identify the type of nut shown in the picture above."



Q103 Try to identify the type of nut shown in the picture above.

- Pecan (1)
- Almond (2)
- Walnut (3)
- Macadamia (4)
- Hazelnut (5)
- Hickory (6)

Carry Forward All Choices - Displayed & Hidden from "Try to identify the type of nut shown in the picture above."



Q104 Try to identify the type of nut shown in the picture above.

- Pecan (1)
- Almond (2)
- Walnut (3)
- Macadamia (4)
- Hazelnut (5)
- Hickory (6)

---

End of Block

### Nut Pics shelled

Q166 The following questions will present you with pictures of various nuts with the shell.

Please select the identity of the nut from the list provided. (If you are unsure of the nut's identity just make your best judgment.)

---



Q169 Try to identify the type of nut shown in the picture above.

- Almond (1)
- Hazelnut (2)
- Walnut (3)
- Macadamia (4)
- Hickory (5)
- Pecan (6)





Q167 Try to identify the type of nut shown in the picture above.

- Pecan (1)
- Almond (2)
- Walnut (3)
- Macadamia (4)
- Hazelnut (5)
- Hickory (6)



Q121 Try to identify the type of nut shown in the picture above.

- Almond (1)
- Hazelnut (2)
- Walnut (3)
- Macadamia (4)
- Hickory (5)
- Pecan (6)





Q168 Try to identify the type of nut shown in the picture above.

- Pecan (1)
- Almond (2)
- Walnut (3)
- Macadamia (4)
- Hazelnut (5)
- Hickory (6)




Q124 Try to identify the type of nut shown in the picture above.

- Pecan (1)
- Almond (2)
- Walnut (3)
- Macadamia (4)
- Hazelnut (5)
- Hickory (6)

---

End of Block

**Frequency**


Q137 How often do you consume each of the following nuts? 

	Never (1)	Once per year (2)	Twice per year (3)	3-6 times per year (4)	7-11 times per year (5)	Monthly (6)	Weekly (7)	Daily (8)
Pecan (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Almond (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Walnut (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Macadamia (4)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Hazelnut (5)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Hickory (6)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Cashew (7)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Pine Nuts (8)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Pistachio (9)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Chestnut (10)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ginkbo (11)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Lotus seed (12)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Peanut (13)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

End of Block

---

**How pecans are eaten**

Q30 When you consume pecans, you tend to eat them as 

	Strongly disagree (41)	Disagree (42)	Somewhat disagree (43)	Neither agree nor disagree (44)	Somewhat agree (45)	Agree (46)	Strongly agree (47)	I DO NOT EAT PECANS (48)
raw pecans, already shelled (1) <was actually not shelled in china survey>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
raw pecans, not already shelled <was actually shelled in china survey> (6)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
cooked and flavored pecans, already shelled <was actually not shelled in china survey> (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

cooked  
and  
flavored  
pecans,  
not  
already  
shelled  
<was  
actually  
shelled  
in china  
survey>  
(4)

A recipe  
or dish  
containin  
g pecans  
(5)

End of Block

---

**Nuts, stuff 1**

Q230 You believe that pecans

	Strongly disagree (18)	Disagree (19)	Somewhat disagree (20)	Neither agree nor disagree (21)	Somewhat agree (22)	Agree (23)	Strongly agree (24)
help you lose weight (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
are unhealthy (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
are not expensive (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
taste bad (4)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
are good for brain health (5)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
are hard to crack and eat (6)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Q235 Please indicate whether pecans or walnuts are better according to the following criteria.

*<on the actual Chinese version the pecan was listed first and given #1 and walnut was listed second and given #2, so no variation between this question and the other one>*

	Walnut (1)	Pecan (2)
Losing weight (1)	<input type="radio"/>	<input type="radio"/>
Good physical health (2)	<input type="radio"/>	<input type="radio"/>
Costs less money (3)	<input type="radio"/>	<input type="radio"/>
Better taste (4)	<input type="radio"/>	<input type="radio"/>
Good for brain health (5)	<input type="radio"/>	<input type="radio"/>
Easy to crack and eat (6)	<input type="radio"/>	<input type="radio"/>

End of Block

---



**Nuts, stuff 2**

Q232 I believe that pecans

	Strongly disagree (18)	Disagree (19)	Somewhat disagree (20)	Neither agree nor disagree (21)	Somewhat agree (22)	Agree (23)	Strongly agree (24)
cause you to gain weight (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
are healthy (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
are expensive (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
taste good (4)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
are bad for brain health (5)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
are easy to crack and eat (6)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Q233 Please indicate whether pecans or walnuts are better according to the following criteria.

	Pecan (1)	Walnut (2)
Losing weight (1)	<input type="radio"/>	<input type="radio"/>
Good physical health (2)	<input type="radio"/>	<input type="radio"/>
Costs less money (3)	<input type="radio"/>	<input type="radio"/>
Better taste (4)	<input type="radio"/>	<input type="radio"/>
Good for brain health (5)	<input type="radio"/>	<input type="radio"/>
Easy to crack and eat (6)	<input type="radio"/>	<input type="radio"/>

---


End of Block

### True or false about pecan

Q42 According to your cognition, please judge the following statements.



	True (1)	False (4)	I DON'T KNOW (5)
Eating pecans is good for bone health. (12)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Eating pecans helps to lower one's risk of developing diabetes. (7)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Pecans can prevent the occurrence of signs of aging. (17)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Eating pecans has no effect on hair loss. (18)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Eating pecans cannot prevent some cancers. (9)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Eating pecans cannot lower one's risk of developing heart disease. (6)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Q214 According to your cognition, please judge the following statements. 

	True (1)	False (4)	I DON'T KNOW (8)
Eating pecans has no effect on bone health. (12)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Eating pecans cannot lower one's risk of developing diabetes. (7)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Pecans can't prevent the occurrence of signs of aging. (17)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Eating pecans prevents hair loss. (18)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Eating pecans prevents some cancers. (9)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Eating pecans helps to lower one's risk of developing heart disease. (6)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

End of Block

---

**Long or fat**

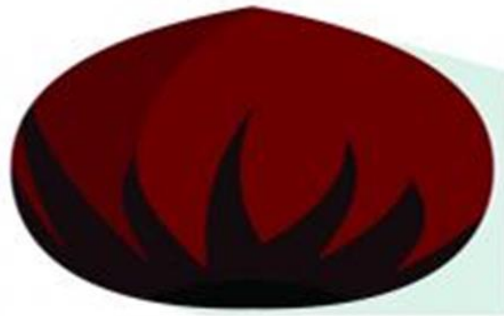
Q78 Which of the following pecans would taste better, based on their shapes?

- Pecan A (1)
- Pecan B (2)

Pecan A



Pecan B



Q79 Which of the following pecans would taste better, based on their shapes?

- Pecan A (1)
- Pecan B (2)

Pecan A



Pecan B



---

End of Block

**Big or small**

Q80 Which of the following pecans would taste better, based on their sizes?

- Pecan A (1)
- Pecan B (2)

Pecan A



Pecan B



Q81 Which of the following pecans would taste better, based on their sizes?

- Pecan A (1)
- Pecan B (2)

Pecan A



Pecan B




---


End of Block




## Nuts

Q93 Please check locations where you purchase pecans. (Multiple Answer) 

- Supermarket (1)
  - Internet (2)
  - Snack shop (3)
  - None: I do not purchase pecans (5)
  - Other (4) \_\_\_\_\_
- 

Q94 Approximately how much money, on average, do you spend on pecans each month? 

- 0 (1)
  - ¥1-¥100 (2)
  - ¥101-¥200 (4)
  - above ¥200 (5)
- 


Q238 If pecans and walnuts were the same price, which would you prefer to purchase? 

- Pecans (1)
  - Walnuts (2)
  - I do not purchase pecans or walnuts (3)
-

Q14 Have you ever purchased pecans as a gift for someone else?

- Yes (1)
  - No (2)
- 

Q170 Select the one option below that best describes your consumption of tree nuts. (Multiple

Answer) 

- I consume tree nuts because they are healthy (1)
  - I consume tree nuts because they are tasty (2)
  - I consume tree nuts because they are inexpensive (5)
  - I do not consume tree nuts (4)
- 

Q242 Compared to your usual amount of tree nut consumption, how does your consumption of tree nuts change during the following events?

	Less than usual (1)	About the same amount (2)	Twice as much as usual (3)	Three times as much (4)	Four times as much, or more (5)
During Spring Festival (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
When the nuts are in season (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

---

Q240 At what time of day do you usually consume tree nuts?

- In the morning, with breakfast (1)
- At lunchtime (2)
- In the afternoon/evening, with dinner (3)
- Between meals, as a snack (58)
- At night, as a snack (62)
- I rarely or never consume tree nuts (59)

---

End of Block

---

### **Personal Information**

Q111 What is your gender?

- Male (1)
- Female (2)

---

Q2 What is your age?

- Under 18 years old (1)
  - 18-30 (2)
  - 31-40 (3)
  - 41-50 (4)
  - 51-60 (5)
  - 61-65 (6)
  - Above 65 years old (7)
-

Q3 What is your highest level of education?

- Unschooled (1)
  - Primary school diploma (7)
  - Middle school diploma (8)
  - High school diploma (2)
  - Vocational school diploma (6)
  - Junior college degree (3)
  - Bachelor's degree (4)
  - Graduate degree (5)
- 

Q4 What is your annual household income before taxes (income from all earners in your household)?

- Under ¥10000 (1)
  - ¥10000-30000 (2)
  - ¥30000-50000 (3)
  - ¥50000-70000 (4)
  - ¥70000-90000 (5)
  - ¥90000-100000 (6)
  - Above ¥100000 (7)
  - Don't know / refuse to answer (8)
-

Q5 In what region do you currently live?

- -- (1)
- Anhui Province (3)
- Fujian Province (17)
- Gansu Province (20)
- Guangdong Province (19)
- Guizhou Province (21)
- Hainan Province (22)
- Hebei Province (12)
- Heilongjiang Province (9)
- Henan Province (13)
- Hubei Province (6)
- Hunan Province (7)
- Jiangsu Province (4)
- Jiangxi Province (5)
- Jilin Province (10)
- Liaoning Province (11)
- Qinghai Province (23)
- Shandong Province (16)
- Shaanxi Province (14)
- Shanxi Province (15)
- Sichuan Province (8)
- Taiwan Province (34)
- Yunnan Province (36)

- Zhejiang Province (2)
- Beijing (28)
- Chongqing (30)
- Shanghai (29)
- Tianjin (31)
- Inner Mongolia Autonomous Region (26)
- Guangxi Autonomous Region (18)
- Ningxia Hui Autonomous Region (27)
- Tibet Autonomous Region (24)
- Xinjiang Uyghur Autonomous Region (25)
- Hong Kong Special Administrative Region (32)
- Macau Special Administrative Region (33)
- Other (35)

Q6 How many people reside in your household (including yourself and all ages)?

- 1 (I live alone) (1)
  - 2 (2)
  - 3 (3)
  - 4 (4)
  - 5 (5)
  - 6 or more (6)
- 

Q8 How many children currently live in your household?

- 0 (1)
  - 1 (2)
  - 2 (3)
  - 3 (4)
  - 4 (5)
  - 5 or more (6)
- 

Q114 Who is responsible for purchasing food for your household?

- Mostly me (1)
- Mostly others (2)
- The responsibility is shared between me and others (3)

---

End of Block

---

## Oklahoma State University Institutional Review Board

Date: Thursday, September 14, 2017  
IRB Application No AG1738  
Proposal Title: Awareness of and attitudes towards pecans in China

Reviewed and Exempt  
Processed as:

**Status Recommended by Reviewer(s): Approved Protocol Expires: 9/13/2020**

Principal  
Investigator(s):  
F. Bailey Norwood  
426 Ag Hall  
Stillwater, OK 74078

---

The IRB application referenced above has been approved. It is the judgment of the reviewers that the rights and welfare of individuals who may be asked to participate in this study will be respected, and that the research will be conducted in a manner consistent with the IRB requirements as outlined in section 45 CFR 46.

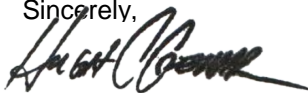
The final versions of any printed recruitment, consent and assent documents bearing the IRB approval stamp are attached to this letter. These are the versions that must be used during the study.

As Principal Investigator, it is your responsibility to do the following:

1. Conduct this study exactly as it has been approved. Any modifications to the research protocol must be submitted with the appropriate signatures for IRB approval. Protocol modifications requiring approval may include changes to the title, PI advisor, funding status or sponsor, subject population composition or size, recruitment, inclusion/exclusion criteria, research site, research procedures and consent/assent process or forms.
2. Submit a request for continuation if the study extends beyond the approval period. This continuation must receive IRB review and approval before the research can continue.
3. Report any adverse events to the IRB Chair promptly. Adverse events are those which are unanticipated and impact the subjects during the course of the research; and
4. Notify the IRB office in writing when your research project is complete.

Please note that approved protocols are subject to monitoring by the IRB and that the IRB office has the authority to inspect research records associated with this protocol at any time. If you have questions about the IRB procedures or need any assistance from the Board, please contact Dawnett Watkins 219 Scott Hall (phone: 405-744-5700, dawnett.watkins@okstate.edu).

Sincerely,



Hugh Crethar, Chair  
Institutional Review Board



VITA

CHUN DU

Candidate for the Degree of

Master of Science

Thesis: CHINESE CONSUMER PREFERENCES FOR AND ATTITUDES  
TOWARDS PECANS

Major Field: AGRICULTURAL ECONOMICS

Biographical:

Education:

Completed the requirements for the Master of Science in Agricultural Economics at Oklahoma State University, Stillwater, Oklahoma in May, 2020.

Completed the requirements for the Bachelor of Science in Agribusiness at Oklahoma State University, Stillwater, Oklahoma in December, 2016.

Completed the requirements for the Bachelor of Science in Agribusiness at China Agriculture University, Beijing, China in June, 2017.

Experience:

Research Assistant at Department of Agricultural Economics at Oklahoma State University.

Teaching Assistant in Study Abroad Course at Department of Agricultural Economics at Oklahoma State University.

Teaching Assistant in Chemistry Lab Course at Department of International College of Beijing at China Agriculture University.