

Research Article

# Survey Research on the Influencing Factors of Upcycled Food in China

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## Abstract

Upcycled food is an emerging food in China. This article uses a questionnaire survey to conduct an online mode on the influencing factors, development prospects, health, waste and environmental protection of upcycled food among three groups that are students, staff, and retirees. The results showed that the tendencies of the three surveys on the acceptance, development prospects, waste and environmental protection of upcycled food were basically consistent, with employees being the highest, followed by students, and retirees being the lowest, and it is indicated that employees are the most interested in the development prospects of the upcycled food. According to the research on the impact of upcycled food on health, retired people are the highest, followed by employees, and students are the lowest. It is possible that retired people are older, frail, and have weakened body functions, so they pay more attention to the impact of food on health. In the survey of six factors that influence factors of upcycled food are nutrition, taste, price, food safety, packaging, and famous food brands, the evaluation of factors affecting upcycled food is different at different age groups. Generally speaking, the evaluations of employees and retired people in China are relatively similar. They put food safety first, followed by nutrition. Food safety still occupies a very important position in the hearts of the older people, and their evaluation of packaging is the last one, followed by the brand of food, it is shown that older people are more pragmatic about food consumption. Compared with the evaluations of employees and retired people, the difference in evaluations of students is relatively large. Students believe that price is the most important, followed by nutrition, and food safety is ranked last. In recent years, some food safety incidents have it also keeps happening, but overall the food safety situation in China is getting better. In addition to nutrition, students, employees and retirees all have the same evaluation of food brands, and they all rank second to last, which shows that people are more pragmatic in their food consumption. These survey results provide a reference for the development and promotion of upcycled food in China to a certain extent.

## Keywords

Upcycled Foods, Subjective Evaluation, Food Safety, Influencing Factor

## 1. Introduction

By 2050, the population will reach 9.1 billion in the earth, and it will be an increase of 34% from today. Nearly all of this population growth will occur in developing countries. Urbanization will continue to accelerate, with approximately

70% of the world population living in cities [1]. Income levels will be many times what they are now. To feed this larger, more urbanized, and wealthier population, food production must increase by 70% [2]. Therefore, some peo-

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**Received:** 1 March 2024; **Accepted:** 1 April 2024; **Published:** 12 April 2024



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ple think of the recycling of waste food [3, 4]. Upcycled foods use ingredients that otherwise would not have gone to human consumption, are procured and produced using verifiable supply chains, and have a positive impact on the environment [5, 6]. Upcycled foods are made from ingredients that would otherwise have ended up in any food waste destination. Upcycled foods are value-added products for human consumption [7, 8]. Focusing on the food safety issues of waste food recycling, Fei Wei established an optimization model for relevant stakeholders including food manufacturers and waste food collectors under different conditions of independence and as a community of interests, and analyzed the prices of newly produced food and the price of recycled food and corresponding profit and influencing factors [9]. Moshtaghian et al. investigated preferences for nutritional, environmental and food safety characteristics of upcycled foods according to age groups and assessed the association between age and the importance of these characteristics in the Swedish population [10]. The environmental benefits and food safety aspects of upcycled foods can be considered in product development and marketing to promote acceptance of these foods across all age groups. Since the nutritional attributes of upcycled foods are less important than their environmental attributes and food safety characteristics, strategies should be adopted to educate people about the ideal nutritional characteristics to enable them to choose healthy upcycled foods. Regarding nutritional and environmental properties, in 2020, Coderoni et al. conducted a study on the acceptability of upcycled foods [11]. In 2021, Coderoni et al. conducted a study on the perception of the safety of upcycled food and found that food neophobia and food technology neophobia would have a negative impact on the purchase intention of upcycled food [12]. In 2022, Yilmaz investigated the willingness of consumers in Turkey to buy upcycled food [13]. In 2023, Moshtaghian studied the selection motivation of upcycled foods and its relationship with consumer hesitation [14]. It can be seen that there are many studies on upcycled food in European countries, but there is less research on upcycled food in China.

Upcycled food is an emerging food product that appeals to people in terms of food production as well as the environment. But people are more concerned about the quality of this food. Food quality refers to the degree to which the inherent characteristics of a food meet the requirements, including its appearance, character, specifications, quantity, quality, packaging, and safety and hygiene. Food quality control refers to the first implementation of food production hygiene standards, which is a good production management system that ensures high safety of food in the food production safety process. Food process quality control is based on the food supply chain, focusing on each link and the factors that affect each link, controlling the influencing factors, and ensuring the quality of food. Studying the quality control of food processes can reduce or eliminate food safety hazards, prevent problems before they occur, avoid or minimize food safety issues, and

reassure consumers [15]. Food flavor is a comprehensive response generated by multiple sensory receptors in the brain, generally including taste and odor. It can make quick and intuitive preliminary judgments on the quality and other characteristics of food. Food flavor plays a leading role in determining the market value of food and consumer satisfaction. With the continuous improvement of social productivity and people dietary requirements in daily life, people demand for food flavor quality has also increased. Therefore, research on food flavor quality has become an important direction in food science in recent years [16]. At the same time consumers are concerned about the traceability of ingredients and legislation. Therefore, if upcycled food enters the Chinese market in the near future, will the source of the raw materials be safe enough? Is the production process transparent enough? How can citizens improve their understanding of the emerging foods? About a series of issues such as whether the legislation on emerging foods can be sufficiently improved are inevitable issues for upcycled foods to enter and become popular in the Chinese market. Understanding the environmental, social and economic impacts of discarded food can help food producers, policymakers, funders and academics recognize the best uses for such food.

Since people in China have relatively little understanding of upcycled food, this article uses a questionnaire survey to investigate upcycled food among three types of people that are school students, staff, and retirees. In order to obtain people's attitudes towards upcycled food in China, the conduct research mainly focuses on the understanding of upcycled food, acceptance, influencing factors, development prospects, food safety and environment.

## 2. Survey Questionnaire Design

In order to gain a deeper understanding of China's awareness, acceptance, influencing factors, development prospects, food safety and environment of upcycled food, a survey was conducted on upcycled food among students, employees, and retirees. In order to take care of the privacy of the investigators, only the interviewers were asked to fill in their gender and stage that is student, working, or retired during the survey. The purpose is to investigate how much Chinese consumers pay attention to production raw materials, because the biggest difference between upcycled foods and traditional similar foods is the selection of raw materials. Have Chinese people been exposed to or heard of upcycled food before? If upcycled food is introduced into the Chinese market, how should consumers choose upcycled food based on nutrition, taste, price, food safety, packaging, and food brand reputation? After a preliminary understanding of upcycled food, consumers are optimistic about the development prospects of upcycled food, and the impact of upcycled food on their health has also been covered in the survey. The questionnaire was conducted using the Questionnaire Star online survey method, through classmates, parents' colleagues, etc.

### 3. Design Results and Discussion

#### 3.1. Investigation Background

Firstly, personnel situation. A total of 170 people participated in the questionnaire survey, including 109 students, accounting for 64% of the total number of people surveyed, 41 employees, accounting for 24% of the total number of people surveyed, and 20 retirees, accounting for 12% of the total number of people surveyed. The male and female percentages of students, employees, and retirees surveyed are shown in Table 1. The male and female percentages of students are 77% and 23% respectively, and male are about three times as many as female. The male and female percentages of employees are 37% and 63%, and women are about twice as many as men. The percentages of men and women among retirees are 40% and 60% respectively, and women are 1.5 times as many as men.

**Table 1.** Male to female ratio.

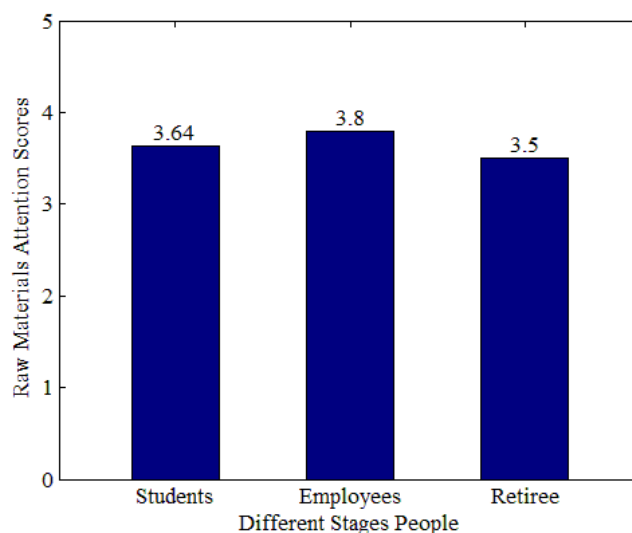
Items	Students (%)	Employees (%)	Retirees (%)
male	77	37	40
female	23	63	60

Secondly, understanding the situation of upcycled food. The percentages of the surveyed students, employees, and retired people who know about upcycled food are shown in Table 2. The proportions of students who know about upcycled food are 37% and 63% respectively, indicating that the students know about upcycling. The number of people who understand recycled food is slightly more than one-third of the total surveyed, and the proportions of employees and retirees who know about recycled food are 27% and 73% respectively, indicating that the number of employees and retirees who know about recycled food Less than one-third of the total survey population. Generally speaking, it shows that Chinese people are less aware of upcycled food. Students are slightly more aware than employees and retirees, while employees and retirees are equally aware of it.

**Table 2.** Knowledge about upcycled food.

Items	Students (%)	Employees (%)	Retirees (%)
Yes	37	27	27
No	63	73	73

#### 3.2. Concerns about Raw Materials for Food Production

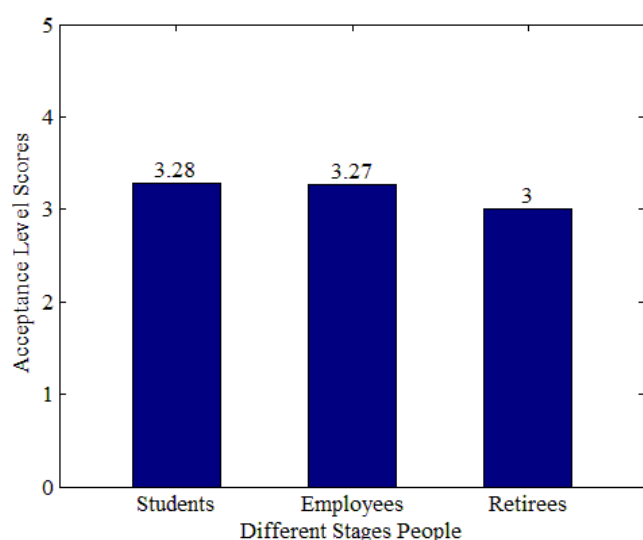


**Figure 1.** Concerns about raw materials for food production.

The results of the survey questionnaire on the concern about food production raw materials were divided into 5, 4, 3, and 2 respectively, including almost always, often, occasionally, and almost never, using the surveyed students, employees, and retired people. The percentage of answers for almost always, often paying attention, occasionally paying attention, and almost never paying attention was calculated. The results are shown in Figure 1. From the figure, it can be seen that employees have the highest score, followed by students, and finally retired people.

#### 3.3. Acceptance of Upcycled Food

The results of the survey questionnaire on the acceptance of upcycled food were assigned 5, 4, 3, and 2 score for complete acceptance, acceptance, non-acceptance, and retention respectively. The percentage of answers by the assigned score is multiplied using the surveyed students, employees, and retirees, and the summation results are shown in Figure 2. From the figure, it can be seen that the scores of students and employees are almost the same, with the highest scores, and the scores of retired people are slightly lower. After all, upcycled food is a new thing, and it is easier for younger students or employees who are more exposed to new knowledge and technologies in the world to accept it.



**Figure 2.** Acceptance of upcycled food.

### 3.4. Evaluation of the Importance of Influencing Factors

The factors that influence the investigation of upcycled food include nutrition, taste, price, food safety, packaging, and FFB. Scores are assigned to five aspects that very important, important, average, unimportant, and uncertain, respectively are 5, 4, 3, 2, 1. For students, employees, and retired people, the survey percentages are calculated based on the six factors of nutrition, taste, price, food safety, packaging, and well-known food brands. The percentage of answers by the assigned score is multiplied, and the summation results are as follows as shown in Table 3. It can be seen from the table that for the factor of nutrition, employees have the highest score, followed by students, and finally retired people. This may indicate that employees work the hardest and pay the most attention to nutrition. In terms of the degree of hard work, employees have the highest score, and it seems to verify this. For the factor of taste, employees have the highest score, followed by students, and finally retirees, which may mean that employees work the hardest and pay the most attention to taste. For the factor of price, employees and students have the same score, and retirees have the least, which shows that employees and students are at the stage when they spend a lot of money and have tight money; for the factor of food safety, employees have the highest score, followed by retired people, and finally students, which may mean that employees have the most exposure to information, the most exposure to food safety information, and a deeper understanding. Regarding the factor of packaging, students have the highest score, followed by employees, and finally retired people, it may mean that students are younger and pay more attention to appearance. For the factor of well-known food brands, employees have the highest score, followed by students, and finally retired people. Employees have the most access to information, and they have the highest score for well-known food brands with knowing the most information. For students, the scores for the six factors of nutrition, taste, price, food safety,

packaging, and well-known food brands are highest. Price is the highest, followed by nutritional factors, then packaging and taste. Packaging and taste are very close, ranking last is food safety. For employees, the highest score among the six factors is food safety, followed by nutritional factors, then taste, and the last one is packaging. For retired people, the highest score among the six factors is food safety, followed by nutritional factors, then price, and the last one is packaging. Different age groups have different evaluations of the influencing factors of upcycled food. Generally speaking, employees and retired people have similar evaluations. They put food safety first, followed by nutrition, which shows that food safety is the importance of status in the minds of most people. As living standards continue to improve in China and food becomes more and more abundant, satisfying nutrition is no longer the most prominent contradiction, but the evaluation of packaging is the last, followed by the brand of food., as the richness of food products in our country increases, market competition becomes more intense, the age increases and the experience is rich, employees and retirees become more pragmatic, packaging and branding are external factors for food. Compared with the evaluations of employees and retired people, the difference in evaluations of students is relatively large. Students think price is the most important, followed by nutrition, which shows that students born after 2000 are not the most lacking in nutrition, and students have no income, so they are most sensitive to price; and students put their evaluation of food safety last, although in recent years, small food safety incidents have continued to occur. After all, the major food safety incidents in China occurred too far away from them, or in other words the major food safety incidents in China, such as the Melamine-tainted Milk Powder incident in 2008, were not remembered by students because they were not born or were too young. This also shows that food safety situation has been getting better in recent years In China. In addition to nutrition, students, employees, and retirees all have the same evaluation of FFB, and they are all ranked second to last. This shows that people are more pragmatic about food consumption, and are no longer like the reform and opening up in the 1980s. In the early days, a new type of food could occupy the vast market by relying on one or two stars to become a food brand in China.

**Table 3.** Evaluation of the importance of influencing factors.

items	students	Employees	Retirees
Nutrition	4.24	4.66	3.95
Taste	4.09	4.54	3.65
Price	4.28	4.27	3.75
Food safety	3.33	4.93	4.2
Package	4.1	3.85	3.05
FFB	3.85	4.02	3.3

### 3.5. Development Prospects of Upcycled Food

The results of the survey questionnaire on the acceptance of upcycled food were assigned as 5, 4, 3, 2, and 1 respectively for those who are completely optimistic, optimistic, average, not optimistic, and unsure. The percentage of answers by the assigned score is multiplied, and the summation results are shown in Figure 3. From the figure, it can be seen that employees are the highest, followed by students, and retirees are the lowest. This is also in line with expectations. Employees are strong and knowledgeable, which can help them better understand the benefits of upgrading and rebuilding food. Due to their youth, students are more optimistic about new things, while retirees see more disadvantages in upgrading and rebuilding food.

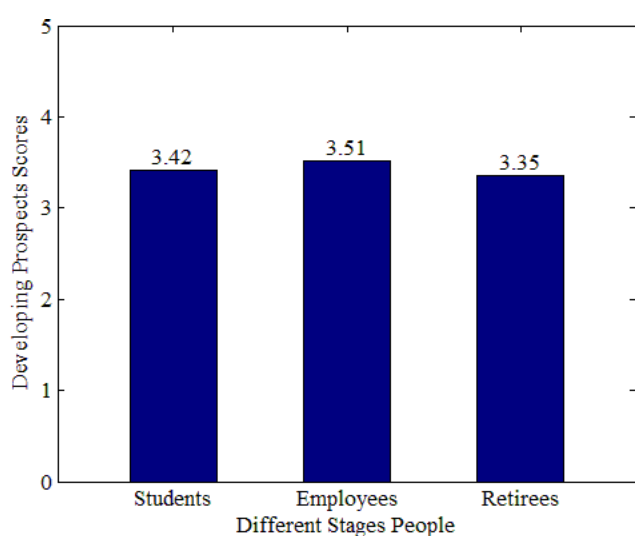


Figure 3. Prospects for the development of upcycled products.

### 3.6. Research on the Impact of Upcycled Food on Health

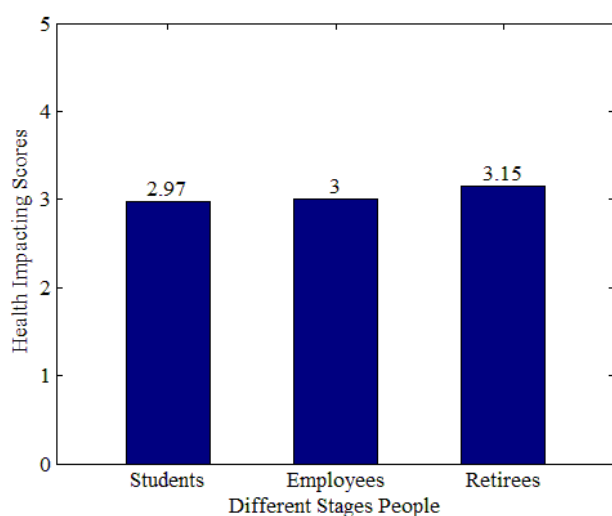


Figure 4. Research on the impact of upcycled food on health.

The results of the survey questionnaire on the acceptance of upcycled food were assigned as 5, 4, 3, 2, and 1 for completely safe, safe, average, unsafe, and uncertain respectively. The percentage of answers by the assigned score is multiplied, and the summation results are shown in Figure 4. From the figure, it can be seen that the retirees have the highest number, followed by employees, and the lowest is the student. The retirees are the oldest, frail and physically weak, and pay more attention to the impact of food on health.

### 3.7. Research on the Impact of Upcycled Food on Waste and Environmental Protection

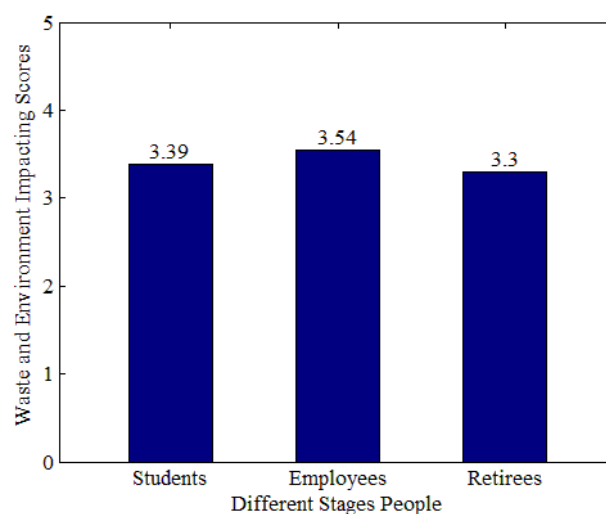


Figure 5. Research on the impact of upcycled food on health.

The results of the survey questionnaire on the acceptance of upcycled food were assigned as 5, 4, 3, 2, and 1 respectively for very large, large, average, insignificant, and uncertain. The percentage of answers by the assigned score is multiplied, and the summation results are shown in Figure 5. From the figure, it can be seen that employees are the highest, followed by students, retired people, and probably working. As employees are more exposed to information and understand the most advanced technologies, the future of upcycled food will be more sensitive to the role played by waste and environmental protection.

## 4. Conclusions

- (1) In the survey on the acceptance of upcycled food, students and employees scored almost the same, with the highest scores, while retirees had slightly lower scores. Upcycled food is a new thing after all, and younger students may be new to new knowledge about the world. Employees who are more exposed to technology are more likely to accept it. The early promotion of upgrading food in this way can start with students and employees, and the effect may be better.



- (2) In the investigation of six factors including nutrition, taste, price, food safety, packaging, and FFB, there are differences in the evaluation of the influencing factors of upcycled food in different age groups. Overall, the evaluations of employees and retirees in China are relatively close. They prioritize food safety first, followed by nutrition, and the evaluation of packaging is the last. Compared to the evaluations of employees and retirees, there is a significant difference in evaluations among students, who believe that price is the most important, followed by nutrition. In addition to nutrition, the evaluation of food brands by students, employees and retirees is uniform, all placed in the second to last position, and it is indicated that in China consumption of food is more pragmatic. It is no longer in the early 1980s when a new type of food relied on one or two celebrities to create a food brand, which can occupy the vast food market in China for a long time. Therefore, there are three suggestions for upgrading food in China. Firstly, if developing an upgraded food, food safety must be given top priority. Secondly, when developing upgrading food products, it is important to be pragmatic. While ensuring food safety, attention should be paid to nutrition and taste, and packaging should not be taken too seriously. Finally, if developing an upgraded food for students, the price must be given high priority.
- (3) According to the survey on the development prospects of upcycled food, employees are the highest, followed by students, and retirees are the lowest, indicating that employees are the most optimistic about upcycled food. According to the research on the impact of upcycled food on health, retired people are the highest, followed by employees, and students are the lowest. Therefore, it is recommended that when developing new upgraded foods in China, consumers should first consider office workers, which is easier to promote.

## Abbreviations

FFB: Famous Food Brands

## Author Contributions

Bozan Zhao is the sole author. The author read and approved the final manuscript.

## Acknowledgments

Thanks to the online mini program of Questionnaire Star on the WeChat platform, which counts the number of people, answers to questions, and calculates the percentage of each answer saving a lot of energy. At the same time, I would like to express my gratitude to my classmates, parents, their colleagues, and everyone who filled out the questionnaire.

## Funding

This research was financially supported by University Student Innovation of Tianjin and Entrepreneurship Project.

## Conflicts of Interest

The authors declare no conflicts of interest.

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