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# Young Generation's Preference for Plant-Based Meat Substitute Burger in Asia: Evidence from Taiwan

Yu-Hui Chen<sup>\*</sup>, Keh-Jinn Tey<sup>\*\*</sup>, and Shuay-Tsyr Ho<sup>\*\*\*</sup>

### Abstract

The rising trend of plant-based burger in the world market reflects the emerging awareness of ensuring food security while reducing carbon footprints to achieve environmental sustainability. Plant-based meat substitute is introduced to the market to satisfy the demand of those who are willing to reduce the meat consumption but refuse to compromise on the taste of meat. Burger patty mimicking the sensory attributes of beef patty is the primary product of plant-based burger. The purpose of this research is to examine how tasting experience would affect the preferences and willingness to pay by the young generation for plant-based meat substitute burger in Taiwan using discrete choice experiment. The experiment sessions are conducted on campus with the recruitment of undergraduates as participants. Our main results suggest that tasting experience can increase the young people's willingness to pay for plant-based burger. Young people show stronger preference for the plant-based meat substitute

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burger after the tasting experiment. Those who have a preference for plant-based meat substitute patty after the tasting experiment are more likely to be females who believe that plant-based meat substitute burger is healthier than beef counterparts. Young people remain to be price sensitive regardless of the tasting experiences. The potential negative effects from higher saturated fat in the food product might be ignored after the tasting, implying the meat substitute patty outweighs other nutritional concerns and play more critical role in determining the change in preferences among food substitutes. Retailers could consider tasting trials as one of their marketing strategies to raise the acceptance of plant-based meat substitutes by the young generation, while keeping the price at the affordable level for young generation across different age groups and occupations. Potential food policy implications can be targeted toward the retailing side to encourage more new customers who might not be interested in such meat substitute but would however alter their behavior when tasting events are available.

Keywords: Plant-based Meat Substitute, Discrete Choice Experiment, Willingness to Pay, Young Generation, Tasting Experience

JEL Classification: Q10, Q18, D12, C93

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## **I. Introduction**

Ensuring food security is a key priority for both developing and developed countries. The growing global population and global per capita income are increasing global food demand, especially the demand for livestock products (Alexandratos and Bruinsma, 2012). To meet the estimated food demand for the year 2050, current food production levels must increase by 25%–70% (Hunter et al., 2017). Such an increase, however, constitutes a major challenge for policymakers, who must maintain a food supply–demand balance while minimizing the adverse environmental effects of food production.

Global meat consumption per capita has increased by approximately 83% in the preceding 50 years (Sans and Combris, 2015). Because of the increase in meat demand over these 50 years, the production of animal products has become the primary purpose of agricultural land use, accounting for 65% of all land use change (Alexander et al., 2015). Approximately 14.5% of anthropogenic greenhouse gas emissions are generated by the livestock industry (Gerber et al., 2013). However, livestock accounts for only 18% and 37% of the world's calorie supply and protein supply, respectively (Ritchie and Roser, 2020). These numbers are low relative to the amounts of natural resources that are required to raise livestock and the levels of environmental pollution caused by livestock farming.

Reducing meat consumption by switching to a more plant-based diet can help mitigate the environmental effects of our daily food choices (Tilman and Clark, 2014; Stoll-Kleemann and

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Schmidt, 2017). Hallström et al. (2015) estimated that a transition to a vegan diet can reduce greenhouse gas emissions and land use demand by up to 55% and 60%, respectively. However, persuading people to change their current diets on the basis of environmental considerations can be a challenging task. The enjoyment of eating meat is a key barrier that deters people from transitioning to a plant-based diet (Fehér et al., 2020). Thus, meat substitutes must be introduced to encourage people to eat less meat. A meat substitute is defined as a food product that emulates the taste of traditional meat products, such as their appearance, taste, texture, and chemical characteristics (Malav et al., 2015). Plant-based meat substitutes, which are the most prevalent type of meat substitute, are mainly produced from proteins extracted from plants such as soybean and wheat (Bonny et al., 2015). The new generation of plant-based meat substitutes, which have been developed by meat substitute producers such as Beyond Burger and Impossible Burger and attempt to replicate the nutritional and gustatory attributes of beef patties (He et al., 2020), can serve as an alternative for meat eaters in place of meat. This development is crucial because beef products have the largest carbon footprint and require the most extensive land use among all livestock products (Röös et al., 2013).

The present study examined the preference for plant-based meat substitute burgers among young adults in an Asian society and how these consumers' willingness to pay (WTP) for meat substitutes was affected by factors that help mitigate negative environmental externalities, including product traits, tasting experiences, sociodemographic factors, purchase behaviors, and attitudes toward novel foods. The present study was motivated by two trends: The first trend pertains to the increasing demand for meat in Asian countries, where traditional diets are predominantly based on grains and vegetables; this trend is occurring because of the Westernization of Asian diets and the rapid economic growth of Asian countries (Nam et al., 2010). Notably, the primary consumers of fast food are young adults aged between 18 and 25 years (Nelson et al., 2008). The second trend relates to Taiwan being ranked third globally in terms of the proportion of its population who are vegetarians (approximately 13%; World Atlas, 2019). In addition, Taipei was ranked the most vegan-friendly city in Asia on the basis of the high number of restaurants in Taipei serving vegan meals (PETA Asia, 2022). Dishes that contain traditional plant-based meat substitutes, such as tofu and texturized vegetable protein,

are found on the menus of many vegetarian restaurants in Taiwan. By contrast, Beyond Burger and Impossible Burger are less common and less accessible for Taiwanese consumers. Therefore, the contribution of the present study is two-fold: First, this study explored the extent to which individuals in an Asian society, particularly young adults, accept plant-based food products. Second, the study examined multiple aspects in addition to how product attributes influence purchase intention. Specifically, a tasting experiment was conducted to clarify how the interactions among tasting experience, demographic and habitual variables, and knowledge level influence the acceptance of novel foods among consumers.

College students were recruited to participate in tasting experiments conducted at a university campus. In a within-subject design setting, we performed a discrete choice experiment in which the stated preference technique was applied to estimate the preferences and WTP of young adults in Taiwan with respect to plant-based meat substitute burgers and to identify the types of consumers who are more likely to pay for such burgers. A multinomial logit (MNL) model and a random parameter logit (RPL) model were employed to examine preferences for meat substitutes on the basis of the key attributes used to distinguish conventional and plant-based burgers. A latent class model was employed to exemplify how the WTP for meat substitutes can be heterogeneous after considering the socioeconomic backgrounds of the participants.

## **II.** Literature Review

Various factors can affect consumer preferences and WTP for plant-based meat substitutes. First, price is a key factor that affects the intentions of consumers to purchase plant-based meat substitutes. Taste is another major factor that influences consumer preferences. Weinrich (2018) conducted focus group interviews with 43 individuals from Germany, France, and the Netherlands. That study discovered that the interviewees would consider purchasing plant-based meat substitutes only when such substitutes were priced

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similarly to conventional meat products. The interviewees from all three countries cited the taste of meat as their main reason for not switching to meat substitutes and for maintaining their current meat-eating habits. In a hypothetical choice experiment conducted in Canada that involved 533 respondents, the respondents who preferred plant-based burgers were less price sensitive than were those who preferred beef burgers (Slade, 2018).

In a study aimed at clarifying consumer preference for plant-based meat substitute patties in the United States (Van Loo et al., 2020), only 23% of the respondents were willing to purchase plant-based meat substitutes instead of farm-raised beef. Those who preferred plant-based meat substitutes tended to be younger and more highly educated relative to those who preferred farm-raised beef. A cross-national consumer survey was conducted in the United Kingdom and the Netherlands to examine and measure the acceptance of meat substitutes (Hoek et al., 2011). That survey revealed that unfamiliarity with meat substitutes and a negative perception toward the sensory attributes of meat substitutes were the key barriers that prevented people who had never or rarely consumed meat substitutes from accepting them.

Health is another pivotal criterion influencing purchase intention related to plant-based meat substitutes because it is a driving force for the development of such substitutes. Marette and Millet (2016) conducted an experiment involving 124 participants in France with the objective of examining the effects of health and environmental information on the WTP and quantity-related decisions of their participants with respect to both beef and soy patties. The researchers reported on the effects of disseminating information regarding the health benefits of soy products and the adverse effects of excessive red meat consumption on the WTP of participants with respect to soy patties. Siegrist and Hartmann (2019) studied a group of Swiss people and discovered that those who preferred to eat meat substitutes tended to exhibit higher health consciousness and eat less meat relative to those without this preference. In a choice experiment conducted by Apostolidis and McLeay (2016) in the United Kingdom, the 247 respondents who participated generally preferred minced meant with low fat content, which is a feature commonly associated with meat substitutes.

Sensory marketing is defined by Krishna (2012) as "marketing that engages the consumers' senses and affects their perception, judgment, and behavior." Because healthy food

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is often perceived as being less tasty than unhealthy food, multisensory marketing is often applied to enhance the taste perceptions of consumers (Raghunathan et al., 2006; Elder and Krishna, 2009).

Alemu and Olsen (2020) conducted a discrete choice experiment involving buns made with cricket flour with the objective of examining how tasting experience affects the WTP for a novel food product. The participants of this tasting experiment were willing to pay a higher price for the buns compared with those who had only completed a questionnaire without tasting the buns. Their findings suggested that the tasting experience could help increase the WTP for novel food among consumers. The contingent valuation method was applied by Boxall et al. (2007) to examine the effects of health and environmental information on the WTP for organic wheat bread among a group of participants; that study aimed to clarify how sensory taste–related information affected their responses to health and environmental information. Before the participants tasted the breads used in the experiment, their WTP for environmental information was higher than their WTP for health information. However, after the tasting experiment, their WTP for health information was approximately twice their WTP for environmental information. This finding may be attributed to the participants' expectation before the tasting experiment that healthy foods are less desirable compared with other similar products.

A discrete choice experiment was conducted by Chen et al. (2020) in Taiwan to investigate the willingness of Taiwanese consumers to pay for pure rice noodles. Specifically, a blind tasting experiment was conducted to test the ability of a group of Taiwanese participants to correctly distinguish pure rice noodles from other types of rice noodles with varying levels of rice content on the basis of the noodles' appearance and taste. The findings revealed that the participants preferred pure rice noodles both before and after the tasting experiment and that they were willing to pay a higher premium for pure rice noodles after the tasting experiment. In a choice experiment that was conducted to examine the WTP and preferences of U.S. consumers for multiple apple varieties (Yue and Tong, 2011), participants were presented with apples but blinded to their brands to prevent them from making decisions based on brand associations. This choice experiment was a tasting experiment conducted to examine the

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preferences and WTP of the participants in relation to the appearance and taste of apples. Notably, the participants preferred the SweeTango brand over other apple brands, and the WTP for this brand was also higher among both frequent and infrequent apple buyers.

# **III.** Methodology

Discrete choice experiment is one type of stated preference methods used to measure the willingness to pay for a good or service (Freeman III et al., 2014). Discrete choice experiment not only measures the mean WTP of a good or service but also the marginal WTP for each attributes (Hoyos, 2010). The estimated results of discrete choice experiment are also expected to replicate the real purchase situations (Lusk and Schroeder, 2004). Discrete choice experiment is based on Lancaster's consumer theory and random utility theory. People do not demand for the good itself but for the attributes of the good. The utility obtained from a good is the summation of utility derived from every attribute contained in the good (Lancaster, 1966). Thus, the respondent will select the alternative which maximizes utility from the choice set presented based on the random utility theory (McFadden, 1973).

According to random utility model, it is assumed that the total utility of a person is made up from two components, which are observable deterministic part  $(V_{ij})$  and unobservable random part  $(\varepsilon_{ij})$ , as shown by the equation below:

$$U_{ij} = V_{ij} + \varepsilon_{ij} \tag{1}$$

Where  $U_{ij}$  represents the utility obtained by consumer i when product profile j is selected. The observable deterministic part  $(V_{ij})$  of the utility function can be assumed as the linear combination of the attribute  $x_{ij}$ :

$$U_{ij} = \sum_{k} \beta_k x_{ijk} + \varepsilon_{ij} \tag{2}$$

Where  $x_{ijk}$  is the attribute of product profile *j* selected by respondent *i* and  $\beta_k$  is the estimated coefficient of attribute *k*. When respondent *i* is able to choose product profile *j* instead of product profile *h*, the probability of respondent *i* choosing product profile *j* can be represented as:

$$Prob\left[(U_{ij} > U_{ih})\forall h \neq g\right] = Prob\left[(V_{ij} - V_{ih}) > (\varepsilon_{ih} - \varepsilon_{ij})\right]$$
(3)

$$Prob\left[\left(\sum_{k}\beta_{k}x_{ijk}-\sum_{k}\beta_{k}x_{ihk}\right)>\left(\varepsilon_{ih}-\varepsilon_{ij}\right)\right]$$
(4)

Multinomial logit model assumed preference homogeneity among respondents. The assumption of independence of irrelevant alternatives (IIA) must hold in order to use MNL model. Based on the IIA assumption, the relative probability of selecting a profile from two profiles in a choice set is independent of any additional profiles in the choice set. MNL analysis is widely used to analyse the results of choice experiment. The probability of respondent i choosing profile j is shown as the equation below:

$$Prob\left[(U_{ij} > U_{ih})\forall h \neq j\right] = \frac{e^{V_{ij}}}{\sum_{h=1}^{j} e^{V_{ih}}}$$
(5)

Maximum likelihood estimation would be used to estimate the values of the parameters when MNL model is applied. The likelihood function L and its log-likelihood function are represented as equation (6) and (7) below:

$$L = \prod_{i=1}^{I} \prod_{j=1}^{J} Prob(j)^{y_{ij}}$$
(6)

$$lnL = \prod_{i=1}^{I} \prod_{j=1}^{J} y_{ij} Prob(j)$$
<sup>(7)</sup>

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Where Prob(j) is the probability when profile j is chosen by respondent. The value of  $y_{ij}$  is based on the decision of respondent. It has a value of 1 when profile j is chosen by respondent i and it has a value of 0 when respondent i does not select profile j.

Random parameter logit model is applied when there are heterogeneous preferences across respondents (Greene et al., 2006). Validity of IIA assumption is not required for RPL model. Random parameter logit model is similar with multinomial logit model, the only differences is the value of  $\beta$  coefficient, as shown in the following equation:

$$U_{ij} = \sum_{k} \beta_{ik} x_{ijk} = \varepsilon_{ij}$$
(8)

As the preferences of respondents are heterogeneous, the value of  $\beta$  coefficient varies by the respondent. Although RPL model can be used to estimate the preferences of respondents when the preferences of respondents are heterogeneous, however, the effect of individual-specific characteristics on the probability of choosing profile cannot be identified (Boxall and Adamowicz, 2002).

The latent class model can then be used to separate the sample with heterogeneous preferences into n subsamples with homogeneous preferences based on the individual characteristics. The effect of individual characteristics factors among different groups can be examined by using latent class model. Assume  $Z_i$  is the individual characteristics variables, the utility of respondent i in group n can be represented by following equation:

$$U_{ij|n} = V_{ij|n}(Z_{j|n}) + \varepsilon_{ij|n}(Z_{j|n}), n = 1, 2, ..., N$$
(9)

The groups are usually separated by the information gathered from the survey, such as socioeconomic variables and purchasing behaviour. The probability of respondent i choosing profile j is shown below:

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$$\pi_{ij} = \sum_{n=1}^{N} \pi_{in} \cdot \pi_{ij|n} = \sum_{n=1}^{N} \left[ \frac{exp(a\lambda_n Z_i)}{\sum_{n=1}^{N} exp(a\lambda_n Z_i)} \right] \left[ \frac{exp(V_{ij|n}(Z_{j|n}))}{\sum_{c=1}^{C} exp(V_{ij|n}(Z_{c|n}))} \right]$$
(10)

where  $\pi_{in}$  is the probability of respondent *i* being distributed to group *n* and  $\pi_{ij|n}$  is the probability of profile *j* being selected by respondent *i* in the group *n*;  $\alpha$  is a scale parameter, usually standardized to 1 and  $\lambda_n$  is the estimated parameter for a specific group. To derive WTP, the marginal willingness to pay (MWTP) for each attributes can be estimated by following equation:

$$WTP_{attribute} = -\frac{dV/d \ attribute}{dV/d \ price} = -\frac{\beta_{attribute}}{\beta_{price}}$$
(11)

# **IV. Experimental Design**

To examine the preferences of young adults for plant-based meat substitute burgers, individuals aged 18–25 years who could access plant-based meat substitute burgers were selected as the target population for the present study. Because both beef burgers and plant-based meat substitute burgers were sold at a fast-food restaurant and a coffee shop located on the campus of National Taiwan University, college students were recruited from this university through social media, particularly Facebook. Before the tasting experiment was conducted, a pretest survey questionnaire was administered in early April 2021 to 11 students from National Taiwan University. The tasting experiment was conducted between April 26, 2021, and April 30, 2021. It comprised 10 sessions and involved 102 participants.

The survey was divided into five parts. The first part collected personal information about the participants. The second part assessed the participants' burger consumption and purchasing behaviors. The third part pertained to the participants' attitudes toward plant-based meat

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substitute burgers. In the fourth part, three choice sets were presented to the participants. Finally, in the fifth part, another three choice sets were presented. The participants were instructed to complete the fourth and fifth parts of the survey before starting and after completing the tasting experiment, respectively.

Burgers were selected as the primary object of evaluation in the present study because most new-generation plant-based meat substitutes are sold in the form of burger patties (He et al., 2020). Four attributes were investigated in the present study, namely the type of patty and the price, juiciness, and saturated fat per serving of a patty. Type of patty was the primary attribute of interest because the patty is an essential component of a burger and also the primary format in which new-generation plant-based meat substitutes are sold. Most plant-based meat substitute patties available on the market have been developed to replicate the sensory attributes of beef patties. Therefore, for the type-of-patty attribute in the present study, burgers were classified as beef burgers or plant-based meat substitute burgers.

Price is a key criterion in food-purchasing decisions (Steenhuis et al., 2011). The price attribute of the burgers used in the present study was divided into NT\$70, NT\$110, and NT\$150 on the basis of the burgers' actual prices. Taste is another major factor that influences the meal preferences of young adults (Livingstone et al., 2020). In one study, the juiciness of beef patties was rated more highly than was the flavor of beef patties (Carpenter et al., 2001). Given the lack of research regarding the extent to which consumers accept the juiciness of plant-based meat substitute patties, juiciness was selected as an attribute for evaluation in the present study; specifically, burgers were classified as either juicy or normal on the basis of their juiciness.

Health is also a major criterion affecting food-purchasing decisions (Rosenblatt et al., 2018), and the intake of saturated fat is associated with the risk of cardiovascular disease (Siri-Tarino et al., 2010). Thus, saturated fat was selected as the health-related attribute of the burgers used in the present study. The weight of a patty sold on the market is typically 113 g. As an attribute, the saturated fat per serving of the beef and plant-based meat substitute patties used in the present study was determined by checking their nutritional labels; for this attribute, each patty was assigned a value of 5.5, 8, or 10.5 g.

The attributes, attribute levels, number of attribute levels, and basic profiles are presented in Table 1. On the basis of these attributes and attribute results, the full factorial design enabled 36 (2 × 3 × 2 × 3) product profiles to be generated. A total of 595( $C_2^{35}$ ) choice sets would be produced if each choice set was designed to comprise a single basic product profile and two alternative product profiles. Although including a no-choice option in a choice set is recommended, such an option should be replaced with a basic or status quo product profile if a new and unfamiliar product is the object of evaluation (Dhar and Simonson, 2003; Parker and Schrift, 2011). An orthogonal design was developed using SPSS 22.0 software to reduce the number of product profiles, and six distinct product profiles (Table 2) were retained after all infeasible profiles (e.g., plant-based meat substitute patties priced at NT\$70) were removed. A total of 10( $C_2^5$ ) choice sets were generated on the basis of the retained product profiles. Ultimately, nine choice sets were selected and used in the present study. A sample choice set is presented in Table 3. Three choice sets were assigned to each questionnaire. Therefore, three versions of a questionnaire were administered in the present experiment.

Attribute	Level	Number of Levels	Basic Profile
Type of Patty	Beef Plant-Based Meat Substitute	2	Beef
Price (NTD)	70 110 150	3	70
Juiciness	Normal Juicy	2	Normal
Saturated Fat (per serving of patty)	5.5g 8g 10.5g	3	8

Table 1. Attributes, Attribute Levels, Number of Attribute Levels and Basic Profile

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Profile	Type of Patty	Price (NT\$)	Juiciness	Saturated Fat (per serving of patty)
Basic	Beef	70	Normal	8g
1	Plant	110	Juicy	8g
2	Beef	70	Juicy	10.5g
3	Beef	110	Juicy	10.5g
4	Plant	110	Normal	5.5g
5	Plant	150	Juicy	5.5g

Table 2. Product Profiles of Burgers

Table 3. The choice set designed for experiment

Attribute/Profile	Basic	Profile 1	Profile 2
Type of Patty	Beef	Plant-Based Meat Substitute	Beef
Price (NTD)	70	110	70
Juiciness	Normal	Juicy	Juicy
Saturated Fat (per serving of patty)	8 g	8g	10.5g
Which one to buy?			

## V. Results

### A. Descriptive Statistics

The socioeconomic profiles of the participants are presented in Table 4. The study sample comprised 49 individuals aged 18–21 years (48%) and 53 individuals aged 22–25 years (52%). The average age of the study participants was 21.70 years; 57 (55.9%) participants were male, and 45 (44.1%) were female. Regarding educational level, most of the participants were undergraduate students (83.3% of the study sample). Regarding monthly income, the most prevalent wage bracket was NT\$8,001–NT\$11,000 per month (32 participants; 31.4%), and the average monthly income of the study participants was NT\$11,500. Regarding monthly food expenses, the most prevalent spending bracket was NT\$6,001–NT\$8,000 per month (38 participants; 37.3%), and the average monthly food expense of the study participants was NT\$6,657.

Effect coding was applied to preserve the orthogonal design developed in the present study (Lusk et al., 2001). Five variables were established on the basis of the aforementioned four attributes. The intercept was defined as ASC. The attribute variables comprised type of patty (PATTY), juiciness (JUICY), saturated fat per serving of patty (FAT) and price of a burger (PRICE). The socioeconomic variable, purchasing behavior variable, and several attitudinal variables were created for application in a latent class analysis. The socioeconomic variable was gender (GENDER), and the purchasing behavior variable was the average amount spent on a burger (BURGER). The belief that plant-based meat substitute burgers are healthier than beef burgers (HEALTH) and the belief that it is reasonable for plant-based meat substitute burgers to be priced more highly than beef burgers (HPRICE) were selected as the attitudinal variables. Definitions of all the variables used in the present study are presented in Table 5.

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Category	Item	Frequency (Person)	Percentage (%)
	18-21	49	48
Age	22-25	53	52
	Average (years)	21.70	
	Male	57	55.9
Gender	Female	45	44.1
	Total	102	100
	Undergraduate	85	83.3
Education	Postgraduate	17	16.7
	Average (years)	16.33	
	5,000 and below	3	2.9
	5,001-8,000	21	20.6
	8,001-11,000	32	31.4
Monthly Income	11,001-14,000	19	18.6
wonuny income	14,001-17,000	11	10.8
	17,001-20,000	7	6.9
	20,001 and above	9	8.8
	Average (NTD)	11,500	
	4,000 and below	9	8.8
	4,001-6,000	31	30.4
Monthly Food	6,001-8,000	38	37.3
Expense	8,001-10,000	18	17.6
	10,001 and above	6	5.9
	Average (NTD) <sup>3</sup>	6,657	
Sample Size		102	

Table 4. Socioeconomic Profiles of Participants

Note: Average years of education is calculated according to the following school years: 16 years for undergraduate and 18 years for postgraduate. The middle value of each class is used to calculate the average monthly income: NT\$5,000 NTD and below is assumed as NT\$5,000, NT\$20,001 and above is assumed as NT\$20,001, NT\$5,001-8,000 is assumed as NT\$6,500 and so on. The middle value of each class is used to calculate the average monthly food expense: NT\$4,000 and below is assumed as NT\$4,000, NT\$10,001 and above is assumed as NT\$10,001, NT\$4,001-6,000 is assumed as NT\$5,000 and so on.

Variable	Definition	Coding
Attribute level	ls	
ASC	Intercept term	1 = basic profile was chosen;
PATTY	Type of patty	0 = profile #1 or #2 was chosen 1 = plant-based meat substitute; 0 = beef
JUICY	Juiciness	1 = juicy; 0 = normal
FAT	Saturated fat (per serving of patty)	Continuous variable: three levels of
PRICE	Price levels	5.5, 8, 10.5g per serving of patty Continuous variable: three levels of 70, 110, 150 NTD per burger
Socioeconomi	c variable	
GENDER	Gender	1 = male; 0 = female
Variable of pu	rchasing behaviour	
BURGER	Average spending on a burger	1 = more than NT\$110; 0 = NT\$110 and below
Attitudinal var	riables	
HEALTH	Plant-based meat substitute burger is healthier than beef burger	1 = yes; 0 = no
HPRICE	It is reasonable for the price of plant-based meat substitute burger higher than beef burger	1 = yes; 0 = no

Table 5. Definition of Variables in the Choice Experiment

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On the basis of the definitions of the variables, the utility of each respondent i when product profile j is chosen could be expressed as follows:

$$U_{ii} = ASC + \beta_1(PATTY_{ii}) + \beta_2(JUICY_{ii}) + \beta_3(FAT_{ii}) + \beta_4(PRICE_{ii}) + \varepsilon_{ii}$$
(12)

where  $U_{ij}$  represents the total utility obtained by respondent *i*, ASC is the constant term, and the parameters of each attribute are estimated using maximum likelihood estimation.

### B. Multinomial Logit Model (MNL)

Hausman test proposed by Hausman and McFadden (1984) is conducted to check the validity of the IIA assumption. The estimation results of the MNL model for both pre- and post-experiment conditions using NLOGIT version 5 are shown in Table 6. In the pre-experiment, the coefficient of ASC is negative and significant, indicating that the participants are inclined to choose the alternative profile instead of basic profile. The price coefficient is negative and significant, suggesting that the utility of participant increases in response to decreases in price of burger. For the post-experiment, the coefficient of PATTY becomes significant and positive, indicating that the plant-based meat substitute patty is preferred by the participants after the tasting experiment.

### C. Random Parameter Logit Model (RPL)

The RPL model was estimated using NLOGIT version 5 so that maximum likelihood estimations could be performed; this estimation process involved the use of 500 replications of Halton draws (Train, 2000). Table 7 lists the results estimated by the RPL model under the preand post-experiment conditions. The estimation results of the RPL and MNL models differed from each other before the tasting experiment was conducted, and none of the variables were statistically significant in the RPL model. After the tasting experiment was completed, the results of the RPL model were consistent with those of the MNL model. The coefficient for PRICE was negative and significant, indicating that the participants preferred burgers with a lower price to those with a higher price. In the RPL model, the positive coefficient for PATTY indicated that the participants preferred plant-based meat substitute patties to beef patties after they completed the tasting experiment. The nonsignificant estimation results for the JUICY and FAT coefficients were consistent with the findings of Slade (2018), who reported that the intention of Canadian consumers to purchase plant-based meat substitutes was unaffected by their taste and health benefits.

 Table 6.
 Multinomial Logit Model Estimation Results for Pre- and Post-Experiment

 Conditions

Attributo	Pre-Expe	eriment	Post-Expe	eriment
Allibule	Coefficient	s.e.	Coefficient	s.e.
ASC	-0.83879**	0.33314	-0.32960	0.32305
PATTY	0.15227	0.24407	0.56320**	0.22123
JUICY	0.15589	0.22568	0.12254	0.20843
FAT	-0.00883	0.17849	0.18834	0.16321
PRICE	-0.03731***	0.00753	-0.02680***	0.00735
Sample size	306		306	
Log likelihood	-295.35567		-305.77075	
Pseudo $R^2$	0.1162		0.0871	

Note: \*\*\* *P* < 0.01, \*\* *P* < 0.05, \* *P* < 0.10.

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Attributo	Pre-Expe	eriment	Post-Exp	eriment
Allindule	Coefficient	s.e.	Coefficient	s.e.
ASC	-4.48619	8.26759	-0.21374	3.69976
PATTY	1.27898	2.50523	6.81982**	2.87992
JUICY	3.00225	4.85677	1.07850	2.18363
FAT	-0.85268	1.88006	2.60374	2.06922
PRICE	-0.30876	0.47782	-0.26097***	0.09257
Sample size	306		306	
Log likelihood	-292.08449		-301.21150	
Pseudo $R^2$	0.1312		0.1040	

Table 7. Random Parameter Logit Model Estimation Results for Pre- and Post-Experiment Conditions

Note: \*\*\* *P* < 0.01, \*\* *P* < 0.05, \* *P* < 0.10.

### D. Latent Class Model (LCM)

The socioeconomic, purchasing behaviour and attitudinal variables in Table 5 are used to explain class memberships. The estimation results of the latent class model for pre- and post-experiment conditions using NLOGIT version 5 are shown in Table 8 and Table 9 respectively. In the pre-experiment condition, Class 1 comprises 49.7% of the samples while Class 2 consists of 50.3% of the samples. Only the attitudinal variable HPRICE is statistically significant among socioeconomic, purchasing behaviour and attitudinal variables. The coefficient of HPRICE is negative and it indicates that the members of Class 1 think that it is unreasonable for the price of plant-based meat substitute burger higher than beef burger.

After the tasting experiment, Class 1 consists of 58.5% of the samples while class 2 comprises 41.5% of the samples. As the significance of variable GENDER and HEALTH imply, Class 1 is characterized by male consumers who don't think plant-based meat substitute

burger is healthier than beef burger. Since the coefficient of PRICE in Class 1 is negative and significant, the Class 1 members tend to purchase the burger with cheaper price. Class 2 is characterized by female consumers who believe plant-based meat substitute burger is healthier than beef burger. The members of Class 2 prefer to consume plant-based meat substitute burger after the tasting experiment as the coefficient of PATTY shows to be positive and significant.

Attributo	Clas	s 1	Class	s 2
Allindule	Coefficient	s.e.	Coefficient	s.e.
ASC	-1.09243*	0.59660	-1.21976**	0.57765
PATTY	5.20528	115.8774	0.43010	0.36885
JUICY	4.98165	283.3866	-0.03955	0.36862
FAT	-4.12728	226.7095	0.33424	0.24570
PRICE	-0.56876	12.93066	-0.01210	0.01218
Coefficient estimates of class 1 re	lative to class 2			
Constant Term	0.98053	0.76927		
GENDER	-0.16423	0.55982		
BURGER	-1.01595	0.81507		
HEALTH	-0.27468	0.63208		
HPRICE	-1.11018*	0.60100		
Sample proportion	0.497		0.503	
Sample size	306			
AIC/N	1.896			
Log likelihood	-275.05714			
Pseudo $R^2$	0.182			

Table 8. Latent Class Model Estimation Results for Pre-Experiment Condition

Note: \*\*\* *P* < 0.01, \*\* *P* < 0.05, \* *P* < 0.10.

Attributo	Class	1	Class	2
Allinbule	Coefficient	s.e.	Coefficient	s.e.
ASC	-0.65764	0.63172	0.26023	0.57139
PATTY	14.6988	585943.0	1.08925***	0.39269
JUICY	-14.1262	585943.0	0.11160	0.41570
FAT	11.8062	468754.4	0.06910	0.38895
PRICE	-0.04352***	0.01313	-0.01993	0.01890
Coefficient estimates of class 1	relative to class 2			
Constant Term	2.22916	2.13956		
GENDER	1.79830**	0.79326		
BURGER	-1.18946	1.07353		
HEALTH	-2.88250**	1.37776		
HPRICE	-1.95519	1.47241		
Sample proportion	0.585		0.415	
Sample size	306			
AIC/N	1.909			
Log likelihood	-277.00885			
Pseudo $R^2$	0.176			

Table 9. Latent Class Model Estimation Results for Post-Experiment Condition

Note: \*\*\* *P* < 0.01, \*\* *P* < 0.05, \* *P* < 0.10.

Table 10 shows the differences in WTP for attributes before and after the tasting experiment. Regarding the type of patty, the WTP for beef patty is NT\$-4.14 before the tasting experiment and it decreases to NT\$-26.05 after the tasting experiment. The WTP for plant-based meat substitute patty is NT\$4.14 before the tasting experiment and it increases to NT\$26.05 after the tasting experiment. Regarding the juiciness, the WTP for normal level of juiciness is NT\$-9.75 before the tasting experiment and it increases to NT\$-4.24 after the tasting experiment. While the WTP for juicy burger is NT\$9.75 before the tasting experiment

and it decreases to NT\$4.24 after the tasting experiment. Regarding the saturated fat per serving of patty, the WTP for 5.5g of saturated fat is NT\$-14.63 before the tasting experiment and it increases to NT\$56.17 after the tasting experiment. The WTP for 8g of saturated fat is NT\$-21.28 before the tasting experiment and it increases to NT\$81.70 after the tasting experiment. The WTP for 10.5g of saturated fat is NT\$-27.93 before the tasting experiment and it increases to NT\$107.23 after the tasting experiment.

Since RPL model can estimate the WTP of each participant for every attribute levels, the *t*-test can be used to examine whether there exists statistically significant difference between WTP of each participant for every attribute levels before and after the tasting experiment. The results for each attribute levels are significant at 1%. The increase in WTP for plant-based meat substitute patty after the tasting trials shows that young generation in Taiwan is willing to pay a higher price for plant-based meat substitute burger after they taste the plant-based meat substitute burger. Although the juicy burger is preferred both before and after the tasting experiment, the WTP for juicy burger decreases after the tasting experiment. A huge increase in WTP for saturated fat after the tasting experiment demonstrates that the participants ignore the negative health effects of burger after the tasting experiment.

	WTP	WTP	Difforonco	Dvoluo
Attribute Level	Pre-Experiment	Post-Experiment		r-value
	(A)	(B)	(B) - (A)	
Type of Patty				
Beef	-4.14	-26.05	-21.91	< 0.001
Plant-Based Meat Substitute	4.14	26.05	21.91	< 0.001
Juiciness				
Normal	-9.75	-4.24	5.51	< 0.001
Juicy	9.75	4.24	-5.51	< 0.001
Saturated Fat				
5.5g	-14.63	56.17	70.80	< 0.001
8g	-21.28	81.70	102.98	< 0.001
10.5g	-27.93	107.23	135.16	< 0.001

Table 10. WTP Estimation Using the RPL Model

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The WTP estimation by socioeconomic profile, purchasing behaviour and attitudes before and after the tasting experiment are shown in Table 11. The pre-experiment results in the second panel suggest that the difference between WTP of male and female consumers for saturated fat per serving of patty is significant. The WTP of female consumers for saturated fat per serving of patty is lower than that by male consumers. The young generation that believe plant-based meat substitute burger is healthier than beef burger are willing to pay a premium for plant-based meat substitute patty and their WTP for saturated fat per serving of patty are lower than the counterpart.

In the post-experiment, the WTP of female consumers for plant-based meat substitute patty are higher than male consumers. Consistent with the results of pre-experiment condition, the WTP of female consumers for saturated fat per serving of patty are lower than male consumers. The WTP of the young people in Taiwan that believe plant-based meat substitute burger is healthier than beef burger for plant-based meat substitute patty are higher but their WTP for saturated fat per serving of patty are lower than the counterpart. The WTP of consumers who think it is reasonable for the price of plant-based meat substitute burger higher than beef burger for plant-based meat substitute patty are higher than the counterpart.

# **VI.** Conclusion

Replacing the meat in our daily meals with plant-based meat substitute can be one of the solutions to mitigate the environmental impacts of meat production. Due to the fact that the main product of new generation plant-based meat substitutes is burger patty, it is worthwhile to study the preferences of young generation since they are the main targeted customers by fast food chains. Discrete choice experiment with tasting trials is conducted to measure the preferences and WTP for plant-based meat substitute burgers among the young generation in Taiwan.

			Post-	experiment				Pre-6	experiment		
- - - -	į	Type (	of Patty	й	aturated Fat		Type	of Patty	Se	aturated Fa	t
Grouping Criteria	Obs	Beef	Plant-Based Meat Substitute	5.5g	89	10.5g	Beef	Plant-Based Meat Substitute	5.5g	8g	10.5g
Socioeconomic profile			00001000								
Male	57	-25.27*	25.27*	70.33***	102.3***	134.26***	-4.14	4.14	-9.92*	-14.42*	-18.93*
Female	45	-27.03*	27.03*	38.23***	55.61***	72.98***	-4.15	4.15	-20.6*	-29.96*	-39.32*
Purchasing behaviour Spend > NT\$110 on a	15	-26.57	26.57	56.6	82.33	108.06	-4.15	4.15	-17.72	-25.77	-33.82
Spend < NT\$110 on a burger	87	-25.95	25.95	56.09	81.59	107.09	-4.14	4.14	-14.1	-20.5	-26.91
Attitude											
Plant-based meat substitute burger is	50	-27.15**	27.15**	46.12**	67.08**	88.04**	-4.15**	4.15**	-19.77*	-28.75*	-37.74*
healthier than beef burger Plant-based meat											
substitute burger is not healthier than beef burger	52	-24.99**	24.99**	65.83**	95.76**	125.68**	-4.14**	4.14**	-9.69*	-14.09*	-18.49*
It is reasonable for the price of plant-based meat substitute burger higher	57	-27.15**	27.15**	53.54	77.87	102.21	-4.15	4.15	-18.6	-27.06	-35.51
It is not reasonable for the											
price of plam-based meat substitute burger higher than beef burger	45	-24.65**	24.65**	59.5	86.54	113.59	-4.14	4.14	9.6-	-13.96	-18.32
Note: *** <i>P</i> -value <	: 0.01,	** <i>P</i> -valı	te < 0.05, <i>* l</i>	<i>p</i> -value <	0.10. Ob	s. means r	number of	<sup>c</sup> participants	s. The ind	lependen	t
samples <i>t</i> -test	is con	nducted to	investigate v	whether th	nere is a d	lifference	between t	the WTP of a	different	groups.	

Table 11. WTP Estimation by Socioeconomic Profile. Purchasing Behaviour and Attitudes

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Before the tasting experiment, price is the only concern facing Taiwanese consumers in burger purchases. The negative coefficient of price in this study is consistent with the estimation results of previous studies; the utility of American and British consumers increased when the price of meat and meat substitutes decreased (Apostolidis and McLeay, 2016; Van Loo et al., 2020). Plant-based meat substitute patty is preferred by the young generation in Taiwan after the tasting experiment. The estimation results of LCM reveal that the young female believing plant-based meat substitute burger is healthier than beef burger do prefer to consume plant-based meat substitute burger after tasting. This is consistent with the previous findings that Canadian and Swiss female consumers have shown stronger preferences for plant-based meat substitutes (Slade, 2018; Siegrist and Hartmann, 2019).

While none of the fast food restaurant chains in Taiwan offers plant-based meat substitute burger at the time of conducting this study, the only coffee shop chain that offers plant-based meat substitute burger is Dante Coffee. However, there is only around one eighth of the young people usually purchase burger from coffee shop chain based on the survey of this study. As most of the young people usually purchase burger from fast food restaurant chain, the producers of plant-based meat substitutes can collaborate with fast food restaurant chain to offer the plant-based meat substitute burger with a reasonable price.

While Impossible Burger is currently not available in Taiwan, the products of Beyond Meat are now available and can be purchased through different channels in Taiwan. As online retailer Momo Com Inc is the sole agent of Beyond Meat in Taiwan, consumers can purchase Beyond Burger from their e-commerce platform (Taipei Times, 2019). Also, the products of Beyond Meat can be purchased from the supermarkets such as RT-Mart, Costco and Carrefour. Starbucks Taiwan has launched three vegetarian foods that used the products of Beyond Meat, which are Beyond Meat Bolognese Penne, Beyond Meat Sausage Sandwich and Beyond Meatball Sandwich since September 2020 (Yang, 2020).

The effect of tasting experience on WTP for plant-based meat substitute burger by the young generation in Taiwan shows its efficacy and potential in broadening the commercial market. To encourage more young people shifting toward a more sustainable food consumption behaviour, plant-based meat substitutes companies may use tasting trials as a marketing

strategy to promote the plant-based meat substitutes. For example, they can sponsor plant-based meat substitute burgers to the event organized by college students as a marketing strategy exemplifying corporate social responsibility. Also, the producers of plant-based meat substitute are encouraged to target female consumers first when they do the advertising program. This is because young female consumers have a stronger preference for plant-based meat substitute compared to male consumers. Our result on price effect also suggests that the burger with a lower price is preferred by the young generation both before and after the tasting experiments. Most of the young people spend less than NT\$110 on a burger on average, while the plant-based meat substitute burgers available in the market are sold at more than NT\$110. It is recommended that the retailers of plant-based meat substitutes lower the price of plant-based meat substitute patties to make the plant-based alternatives more affordable and competitive.

Policy and marketing implications that can be extended from our results are two-fold. First, government may use tax incentives to alter the retailers' producing and marketing decisions, driving down the supply of conventional burger. However, this policy tool may backfire (Van Loo et al. 2020). Or the government may consider using nudge via educational or promotional campaigns to change both retailer and consumer behaviour without imposing any financial gains/losses. Second, the role of information in determining preference varies by socio-economic characteristics (Tonsor et al., 2022). Retailers should develop consumer segmentation to maximize profits and treat it as a strategy to survive the transition period to gain great market share by building trust. Second, the demand for plant-based burger is sensitive to price change and plant-based burger could be weak substitute for conventional burgers (Tonsor et al., 2022). These two observations imply that to induce higher demand for plant-based burger, the pricing strategy should focus on the plant-based proteins and meat lovers might be more responsive to altering consumption habit whenever the price of plant-based alternative changes.

Some limitations do exist in this study. The sample size of this study is relatively small and the sample is limit to the college students in one of the prestigious universities in Taiwan. Our estimation results may not represent entire young generation in Taiwan particularly those

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enrolling in different regions and different universities from the very specific one selected in this study where there are usually more resources and social capital for them to show greater tendency toward accepting new products as well as those without college education. Therefore, future research should be conducted with larger sample size, greater age range, a variety of occupations among the young generation (including but not limited to students), and wider geography of residency. In addition, both local and foreign brands of plant-based meat substitutes are available in Taiwan market. Current research has shown that brands matter in the sales of regular meat products, but not the plant-based ones (Van loo et al., 2000). Further research may consider including origin of brands as one attribute determining preferences to examine the brand effects.

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# 亞洲年輕人對植物肉漢堡之偏好— 以臺灣爲例

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### 摘要

近年來環境永續利用意識興起,人們希望在確保糧食安全同時也能降低碳足跡,這 趨勢使得植物肉消費意願在全球逐漸提升。目前在市場上推出的植物肉主要是作為肉類 替代品,其中仿牛肉餅口感與口味的植物肉漢堡即是主要品項之一。本研究目的是以年 輕族群為研究對象,利用問卷調查及離散選擇試驗法,透過實際品嚐體驗分析影響臺灣 年輕族群對植物肉漢堡的偏好因素與其願付價格。研究結果顯示,品嚐經驗將增加年輕 族群購買植物肉漢堡的意願;實際品嚐後,年輕族群對植物肉漢堡將更偏好,尤其是多 數相信植物肉漢堡較一般牛肉漢堡更健康女性消費族群;無論品嚐經驗如何,年輕族群 仍對價格敏感;品嚐後,食物中高飽和脂肪的潛在負面影響可能被忽略,意味著植物肉 漢堡的重要性勝過脂肪的營養考量,且在食品替代選擇上扮演重要角色。零售商可藉由 舉辦「試吃」的行銷策略,以提高消費者對植物肉的接受度,並將價格維持在年輕族群 可接受的水準。或許從零售業者開始,鼓勵其開發更多對初始對植物性肉類不感興趣但

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在提供品嚐體驗後改變其消費的新客戶,作為改變糧食政策的一個方式。

關鍵詞:植物肉、離散選擇試驗法、願付價格、年輕族群、品嚐經驗 JEL 分類代號:Q10,Q18,D12,C93