Analyzing Willingness to Pay for Meat Substitutes:
Evidence from Experimental Auction for Hamburger Patty Products

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Abstract

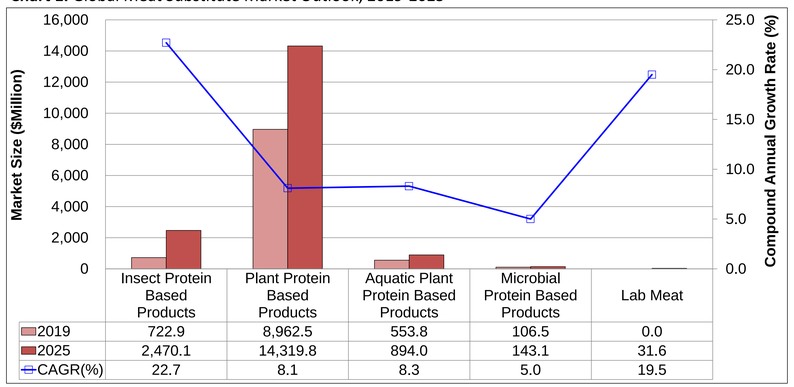
Despite of the boom of meat substitute market, there is lack of information on consumer side of the market. The lack of information is the background of question that arises as to whether the market for meat substitute can operate on its own and increase its size. This study aims to provide information on consumer acceptance of meat substitutes. To achieve this, we conducted an experimental auction by offering an opportunity to taste meat substitute products to Korean consumers. Then their willingness to pay (WTP) for each product were measured and which factor most affected the size of WTP was identified. The preliminary results show that, in all products, the higher the level of satisfaction with the taste, the higher the WTP. Also, both plant-based patties are positively affected by the information on health, and resources/environment. We also found that consumers who prefer meat consumption have lower WTP for both plant-based patties.

Motivation and Purpose of Research

[Unsustainable Meat Production and Meat Substitute Market Outlook]

- In 2010, livestock supply chains emitted an estimated total of 8.1 GT CO2-eq, and the livestock sector consumed 6 GT of feed material in dry matter, including one third of global cereal production.
- By replacing beef with plants in the US, only 10% of land, 4% of GHG emissions, and 6% of reactive nitrogen is required per person per year, compared to what the beef diet requires.
- Furthermore, the prospect that the global meat substitute market will grow significantly is predominant. The total size of meat substitute market is valued at an estimated $10,345.8 million in 2019, and it is expected to grow at a CAGR of 9.5% from 2019 to 2025 and reach $17,858.5 million by 2025. The plant protein-based products accounted for the largest share of the global meat substitute market.

Chart 1. Global Meat Substitute Market Outlook, 2019-2025



	Insect Protein Based Products	Plant Protein Based Products	Aquatic Plant Protein Based Products	Microbial Protein Based Products	Lab Meat
2019	722.9	8,962.5	553.8	106.5	0.0
2025	2,470.1	14,319.8	894.0	143.1	31.6
CAGR(%)	22.7	8.1	8.3	5.0	19.5

Source: Meticulous Research (2019), Alternative Protein Market by Stage/Type (Insect, Algae, Duckweed, Wheat, Corn, Mycoprotein, Mushrooms), Application, and Geography – Global Forecast to 2025.

[Research Purpose]

- Despite of the boom of the meat substitute market, there is lack of information on consumer side of the market. The lack of information is the background of question that arises as to whether the market for meat substitute can operate on its own and increase its size.
- In particular, the lack of information can be an obstacle for the growth of this market, because food industry may hesitate to enter the market and be uncertain about making investment decisions related to R&D and so on. Moreover, as the government is not sure about whether and how to promote the industry and market as well as whether the market really needs policy support, it will be demanding for the government to make policy decisions as well as to design effective policies and regulations.
- Hence, as the first stage of providing information on this market to the industry and government, this study examined consumer acceptance of meat substitutes.
- To achieve this purpose, we conducted an experimental auction by offering an opportunity to taste meat substitute products to Korean consumers and measured their willingness to pay for each product.
- In addition, we examined whether the level of information perceived by consumers could affect the level of WTP and which factors are influential.

Experimental Design and Method

[Experimental Design]

- Experiment was conducted from August 21st to 23rd, 2019 in Seoul, Korea.
- A total of 8 auctions were held, and approximately 14~15 people participated in each auction.
- Three products were used for the experiment: 1) normal beef patty, 2) domestic plant-based patty, 3) imported plant-based patty.
- The auction consisted of three rounds, and additional information was provided for each round: 1) information on taste, 2) information on product ingredients and nutrition (health impact), 3) information on resource-saving and pollution-reducing impact of meat substitutes (resources and environment).
- We applied the **random *n*th price auction mechanism** and the **full bidding approach** – bidding simultaneously on multiple products. Therefore, each auction round had five steps: 1) each bidder received a bidding paper, 2) information on the products was provided, 3) each bidder submitted a bid, 4) each bid was rank-ordered from highest to lowest, 5) a random number was selected which is the ***n*** in the ***n*th price auction**.
- After all the three rounds ended, we randomly selected one product and one round, and sold the product to each of the ***n*-1 highest bidders** of the round at ***n*th price**.
- Before the real auction, we executed a practice auction with cereal bars in order to make participants better understand the auction system.

[Random Effect Panel Tobit Model]

- As the results from the experiment contain left-censored zero data (for WTPs), we applied **Random Effect Panel Tobit Model** to analyze the determinants of the WTP for the three products.

$$WTP_{it}^{*} = \alpha + \Sigma_{j=1}^{J}\beta_j X_{itj} + \epsilon_{it}$$

where $i = 1, 2, 3, ..., 115$, $t = 1, 2, 3$, $J =$ number of covariates

$$WTP_{it} = WTP_{it}^{*} \text{ when } WTP_{it}^{*} > 0$$

$$WTP_{it} = 0 \text{ when } WTP_{it}^{*} \leq 0$$

Preliminary Results and Discussions

Estimation is in progress, so these results are very preliminary!

- A total of 119 individuals participated in the experiment auction, but only 115 participants' data were used for the estimation due to reliability issue.
- In all products, the higher the satisfaction with the taste, the higher the WTP.
- Both plant-based patties are positively affected by the information on health, and resources/environment. The domestic product is more affected.
- However, individuals who prefer meat consumption have lower WTP for both plant-based patties.
- Future research will focus on elaborating the preliminary results and drawing market insights as well as policy implications.

Table 1. Estimation Results

Variables	Beef Patty		Domestic Plant-based Patty		Imported Plant-based Patty	
	Estimates	z-value	Estimates	z-value	Estimates	z-value
Intercept	1581.41	1.34	**3460.62*** **	**2.67**	**4431.64*** **	**3.28**
Age	8.75	0.64	-5.16	-0.36	-17.72	-1.19
Gender (male=1)	**353.55***	**1.72**	242.18	1.10	-31.01	-0.14
Marriage (married=1)	75.41	0.25	280.44	0.87	110.80	0.33
Family Size	-125.87	-1.36	40.34	0.41	99.20	0.98
Family Income (11 sections)	65.08	1.26	7.86	0.14	27.64	0.49
Education Level (5 sections)	-362.96	-1.58	-60.83	-0.25	-60.37	-0.24
Diseases (have=1)	87.90	0.20	**-858.55***	**-1.81**	-31.78	-0.06
Hamburger Preference (5-point scale)	97.63	0.62	77.36	0.48	-15.58	-0.09
Freq. of Hamburger Consumption (7-point scale)	109.74	1.06	-96.37	-0.88	-19.39	-0.17
Awareness of Meat Substitutes (5-point scale)	61.58	0.49	-62.53	-0.46	-124.98	-0.91
Meat Consumption Habit (4-point scale)	-219.01	-1.26	**-434.31** **	**-2.34**	**-464.50** **	**-2.43**
Satisfaction with the Product Taste (out of 100)	**32.30*** **	**5.73**	**23.85*** **	**3.71**	**18.68*** **	**3.46**
Health Effect (round2=1)	-72.19	-0.95	**268.26*** **	**2.78**	**162.61** **	**2.01**
Resources and the Environment Effect (round3=1)	-84.83	-1.11	**390.00*** **	**4.04**	**302.61*** **	**3.73**
# of Left-censored observations	2		0		0	
# of Uncensored observations	343		345		345	
Sigma U	943.31		976.22		1039.40	
Sigma e	577.55		732.13		614.39	
Log likelihood	-2795.87		-2871.28		-2834.62	

Note : *** p < .01, ** p < .05, * p < .1

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