

Willingness to Pay for GM Food among Thai Consumers and Students

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Abstract

This study aims to quantify and compare Thai consumers' and students' willingness to pay for GM food. One hundred and thirty participants joined the laboratory experiment, where the random nth-price auction was employed to elicit their demands. Specifically, subjects had to bid for three food items, under various labeling policies. Controversial issues from the current GM labeling regulation in Thailand namely, the mandatory labeling and the threshold levels, have been explored. The results find no statistical difference between students' and consumers' bids. In addition, both groups generally have negative attitude towards GM food, although students assign higher discount to GM food than consumers. As for the GM labeling policy, subjects do not significantly value GM-free label and do not view dissimilar threshold levels as different

Keywords: GMO Foods, Willingness to Pay, Student Subjects, Consumers,
Random nth-price Auction

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ความเต็มใจในการจ่ายอาหารจีเอ็มโอ ระหว่างผู้บริโภคและนักศึกษาไทย

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บทคัดย่อ

การศึกษานี้มีจุดประสงค์เพื่อประเมินและเปรียบเทียบความเต็มใจในการจ่ายของผู้บริโภคและนักศึกษาต่ออาหารจีเอ็มโอ ผู้เข้าร่วมการทดลองจำนวน 130 คน เข้าร่วมการประมูลแบบ Random nth-price เพื่อค้นหาอุปสงค์ของอาหารดังกล่าว ผู้เข้าร่วมการทดลองประมูลอาหาร 3 ชนิด ภายใต้ฉลากสินค้าที่มีรูปแบบแตกต่างกัน งานวิจัยนี้ครอบคลุมประเด็นเกี่ยวกับนโยบายฉลากอาหารจีเอ็มโอในประเทศไทย ได้แก่ การแสดงฉลากแบบบังคับและระดับของการปนเปื้อนจีเอ็มโอที่ต้องระบุไว้บนฉลาก ผลการทดลองไม่พบความแตกต่างทางสถิติระหว่างการประมูลของผู้บริโภคและนักศึกษา นอกจากนี้ ทั้งสองกลุ่มมีทัศนคติเชิงลบต่ออาหารจีเอ็มโอ โดยนักศึกษาจะมีความเต็มใจในการจ่ายอาหารจีเอ็มโอต่ำกว่าผู้บริโภค ในส่วนของนโยบายฉลากอาหารจีเอ็มโอนั้น ผลการศึกษาพบว่าผู้เข้าร่วมการทดลองไม่ได้ให้คุณค่าต่อฉลากปลอดจีเอ็มโอ อีกทั้งไม่พบความแตกต่างของความเต็มใจในการจ่ายระหว่างระดับต่าง ๆ ของการปนเปื้อนจีเอ็มโอ

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งานศึกษานี้ได้รับการสนับสนุนจากสำนักงานคณะกรรมการส่งเสริมวิทยาศาสตร์ วิจัย และนวัตกรรม (สกสว.) ความคิดเห็นจากงานวิจัยนี้มาจากผู้วิจัยแต่เพียงผู้เดียวโดยไม่มีส่วนเกี่ยวข้องกับ สกสว.

1) Introduction

The benefits and costs issues of genetically modified organisms (GMOs) are still open to debate, no final conclusion has yet been reached on this controversial topic. Nevertheless, the global area of genetically modified (GM) crops has seen a notable expansion from 1.7 million hectares in 1996 to over 179.7 million hectares in 2015 (James, 2015). This global area covered is made up of eight developed countries and twenty developing countries. Although the growth rate has been slowing down, emerging economies are expanding at a much faster pace than developed countries (James, 2015). One direct benefit of GM crops to those farmers is that it offers higher yields, as it raises the crops' tolerance towards pests, weeds, and diseases; and developments in the future could allow GM crops to survive "stress" or bad environmental conditions. Additionally, genetic engineering could help correct nutritional deficiencies in certain important food crops; golden rice which is enriched with vitamin A is a well-known example.

As for the demand side, consumers' attitudes towards GM food are not homogeneous across countries. Generally, Europeans appear to hold negative perceptions against GMO, relative to consumers in the U.S. (Hoban, 1998). Such unfavorable attitude is related to the safety, especially on consumers' health in the long run. In order to respond to consumers' concerns, regulators could impose certain constraints on import of GMO and/or food labeling policy.

Labeling of GM food is a means to provide consumers with additional information, so they could make a better decision. Countries, however, do not agree on the standard of GM labeling policy, and several debatable issues have been raised on such policy. The first issue is related to the choice between mandatory or voluntary labeling. Mandatory labeling requires a disclosure of GM information when food items are derived from GMO, while food producers could willingly choose to post GM or non-GM information under voluntary labeling. Mandatory labeling could be socially desirable if majority of consumers in a country demands such information, although this policy could drive certain GM food out of the market and leave consumers with fewer product choices (Caswell, 2000; Carter & Gruère, 2003). Several countries in Asia such as China, India, Indonesia, Japan, Malaysia, South Korea, Sri Lanka, Taiwan, Thailand, and Vietnam are currently under the mandatory labeling policy (Center for Food Safety, 2013). There have been a few exceptions, one of these being the Philippines (Aguiba, 2013). The next issue is related to the application of threshold levels. Since a food item could contain several ingredients which are derived from various sources; it may not be feasible, if not impossible, to scientifically verify the GM contamination. As a result, regulators do not generally set the threshold level to

be 0%; rather, allowing a certain proportion or threshold of GM mixture. A lower threshold level undoubtedly means higher cost of verification on the producer's side. While Japan and South Africa adopt the 5% threshold level, similar to Thailand; others choose smaller thresholds (The Law Library of Congress, 2014). As New Zealand and Brazil employ the 1% threshold level; the threshold level adopted by Russia, England, and European Union is 0.9%.

Countries do not necessarily require all food products to be under the GM labeling policy. Regulators could decide to include only the ones which possess higher probabilities of GMO contamination and/or are important to consumers' demand. South Africa, New Zealand, and Russia's regulations cover all food items, while animal feed is added in Brazil, England, and the European Union's coverage (The Law Library of Congress, 2014). In Japan, 8 crops and 33 processed foods are included, while other agricultural products are excluded. As for China, the coverage comprises of soybeans, corn, rape, and tomatoes.

Previous studies on GM food have not been dedicated to emerging economies like Thailand, partly because Thailand has not been a major supplier of GM crops in the world. Nevertheless, the research on this area has been carried out during the past decades. Current experiments by government agencies and in universities' laboratories are focused on crops with high economic value such as papaya, rice, chili peppers, tomatoes, pineapples, yard long beans, cotton, and orchids (Rerkasem, 2005). On December 25, 2007, the cabinet approved experiments on GM plants only if they were conducted on the government's test field, after applying strict containment measures (Cabinet blocks GM, 2007). Certain crops with export potential such as rice are omitted from the field trial. Nevertheless, over the past decades, there have been many reports of GMO contamination in open fields, such as GM cotton in Loei province in 1999, GM papaya in Khon Kaen province and other provinces in 2004, and GM maize in Phitsanulok province in 2007 (Greenpeace, 2007). In 2010, cases involving GM cotton, GM papaya, GM maize, GM chili, and GM soybean were reported in eight provinces across Thailand (Danger of new GMO, 2010). As a result, several NGOs are trying to persuade the Thai government to reverse its decision to allow open field experiments. However, despite these criticisms from NGOs, the Department of Agricultural under the Ministry of Agriculture and Cooperatives has conducted a feasibility study on the commercialization of GM crops (Vipoosanapat, 2014).

Although Thailand's supply of GM crops is limited; Thai consumers could still be exposed to GMO, as Thailand has imported such crops from other countries instead of relying on its own production. As a result, this study chooses to focus on the demand side of GM food in Thailand. Specifically, the study employs the experimental auction in quantifying GM food's willingness to pay (WTP). Previous studies that derive WTP of GM food through the experimental approach have recruited consumers and students as subjects, and provided policy recommendations. Since questions have been raised regarding the ability to generalize the results from students to the general population; this study relies on both students and consumers, so their WTPs can be compared and analyzed.

Since the auction is conducted in Thailand, the current GM labeling policy has to be tested. In 2002, Thailand's Ministry of Public Health (MOPH) has issued an announcement regarding the GM food labeling. It is a mandatory labeling, which implies that GM-free producers cannot voluntarily post such sign on their products. The announcement covers only 22 food items which have soybean or corn as their main ingredients. The threshold level is set at 5%, and is applied only to the top three ingredients. The MOPH has initiated the revision of the announcement in 2020, with the plan to expand the coverage to all types of food and animal; still, non-governmental organizations (NGOs) has requested for a lower threshold level (Thai PBS News, 2020).

2) Literature Review

In order to estimate WTP, researchers have mainly relied on either surveys or experimental auctions. Relative to laboratory experiments, surveys could be conducted with larger samples and potentially lower costs (per sample). The experimental auction, on the other hand, is incentive compatible; since samples or subjects are endowed with money (or products) and required to purchase or exchange the product. The auction mechanism could also be designed to motivate participants to reveal their true demands.

Experiments have traditionally depended on student samples for the purpose of testing economic theories. University students are more convenient to recruit and incur lower costs to researchers, but could raise skepticisms when the results have to be generalized and serve as policy recommendations. Earlier studies on induced valuation show mixed results between students and nonstudents. Maguire et al. (2003) conducted telephone and in-person surveys on both students and adults in Atlanta, the U.S., regarding their WTPs to the public good; and

found consistent behaviors between both groups. Mjelde et al. (2016)'s study asked for WTP for transportation attributes in order to serve elders in Texas, the U.S. Although both groups' behaviors were generally comparable, students' average WTPs were dissimilar to general population. Hsu and Shiue (2008)'s study on WTP for non-pirated software in Taiwan indicated that students and general consumers did not share the same pattern. Under the experimental auction approach, Dyer et al. (1989) recruited both students and executives from construction companies to participate in the first-price auction. Both groups ended up committing to the winner's curse, and there was no statistical difference between their bids.

Lusk et al. (2005)'s meta-analysis on GM food valuation found no statistical difference between students' and nonstudents' estimates. Nevertheless, the meta-analysis was derived from 25 studies; which employed different elicitation methods namely, survey, interview, and experiment. As presented in Table 1, past studies on GM food valuation under the experimental auction have used either students or consumers as subjects; exceptions being the studies by Kaneko and Chern (2005) and Bansal et al. (2013). Kaneko and Chern (2005)'s subjects were 28 students and 39 nonstudents from Japan, whilst Bansal et al. (2013) invited 64 students and 50 teachers from India to participate in their auction. Depositario et al. (2009) were the first to search for inconsistency between students' and nonstudents' bidding behaviors for GM food. Under the fifth-price auction, all subjects from Philippines submitted bids for a bag of golden rice. The bidding results indicated that although students had lower average WTP than nonstudents, statistical tests did not confirm such difference.

Table 1: Student and consumer subjects in experimental auction of GM food

Students	Consumers
Buhr et al. (1993) – U.S.	Huffman et al. (2003) – U.S.
Lusk et al. (2001) – U.S.	Rousu et al. (2004) – U.S.
Wachenheim & VanWechel (2004) – U.S.	Colson et al. (2011) – U.S.
	Lacy & Huffman (2016) – U.S.
	Lusk et al. (2006) – U.S., England, and France
	Noussair et al. (2002) - France
	Noussair et al. (2004) - France
	Dannenberg et al. (2008) - Germany
	Jaeger & Harker (2005) – New Zealand

Experimental auctions of GM food which relied on student subjects were all conducted in the U.S., as shown in Table 1. Buhr et al. (1993)'e experiment involved 106 students in the U.S. Students were endowed with a sandwich, and asked to bid for a GM sandwich. Under the Vickery auction; subjects were motivated to reveal their true valuations since the highest bidder won the product, but paid the price of the second-highest bidder. Interestingly, the GM food's average bid was higher than non-GM. Lusk et al. (2001) also recruited U.S. students to join the first-price and the second-price auctions, in order to bid for corn chips. Although GM corn chips received an average discount of 14%, most subjects were not willing to pay higher for GM-free food.

The random nth-price auction was adopted in the Wachenheim and VanWechel (2004)'s experiment on 112 students from the U.S. Subjects had to bid for cookies, potato chips, and muffin; which were presented with GM and GM-free labels. On average, GMO received discounts between 10% and 14%. This auction technique has been proven to be effective against off-bidders, or those who have considerably lower (or higher) valuations (Shogren et al., 2001). These off-bidders may not actively participate in the bidding process when the winners are restricted to one or a few highest bidders. The random nth-price auction allows any bidder to win, depending on the randomly drawn number n , which ranges from 2 to the number of participants. Those who bid higher than the n th-bidder's price win the auction.

As for studies that relied on consumer subjects, both Huffman et al. (2003)'s and Rousu et al. (2004)'s experiments recruited U.S. consumers to participate in the random nth-price bidding for three food products. Most subjects in Huffman et al. (2003)'s study submitted lower bids for the GM label, with average discounts between 14% and 18%, conditional on the food items. Rousu et al. (2004) explored the differences between the 5% threshold, the 1% threshold, and the GM-free labels. Although consumers lowered their WTPs on GMO, they perceived the 5% and the 1% contents as no difference.

Colson et al. (2011)'s and Lacy and Huffman (2016)'s random nth-price experiments used random subjects from the U.S. In Colson et al. (2001)'s study, 92 subjects submitted their bids for three agricultural products namely, broccoli, tomato, and potato. Premiums for non-GM products were between 17% and 29%. Interestingly, U.S. consumers in Lacy and Huffman (2016)'s study gave higher prices to GM potato and potato dice by 6% and 17%, respectively; although their WTPs were depending on the information source.

Lusk et al. (2006) studied WTP for GM food among consumer subjects from three countries namely, the U.S., England, and France. Consumers' WTPs were derived from the fifth-price auction. Both Noussair et al. (2002)'s and Noussair et al. (2004)'s studies focused on French consumers. Noussair et al. (2002) welcomed 112 subjects to participate in the Vickery auction for GM chocolate bars. The researchers presented the labels on the projected screen, in order to raise subjects' awareness. Such awareness was effective, since consumers gave an average of 43% premium to non-GM food. Noussair et al. (2004) investigated consumers' WTP for the smaller threshold level, specifically the 0.1% level. The auction mechanism was the Becker-DeGroot-Marschak (BDM), in which winners were the ones who bid higher than the randomly picked price. Subjects from France did not view the 0.1% GM content as equally as GM-free.

Other than consumers from the U.S. and France; in Dannenberg et al. (2008)'s experiment, 164 German participants bid for soybean oil and chocolate bar under the Vickery auction. On average, subjects assigned price premiums to GM-free soybean oil and chocolate bar of 89% and 144%, respectively. The experiment which was conducted in Asia Pacific included Jaeger and Harker (2005) who adopted the fifth-price auction to study WTP for GM food among New Zealand consumers. The researchers estimated Kiwifruit's WTP based on bids by 100 random subjects.

3) Experimental Methodology

The experiment which was conducted in one classroom of Mahidol University, Thailand; was participated by 60 students and 70 consumers. All participants were solicited through posters which were publicized around the campus and on social media. Participants were informed merely that the experiment was related to food; neither the GM labeling information nor the auction methodology was stated. There were 13 sessions, since each session needed 10 participants. However, participants were not allowed to select their own session; instead, participants were contacted and assigned the session by the experimenter, so those who knew each other were not placed in the same session. Table 2 presents demographic profiles of both groups of participants.

Table 2: Demographic characteristics of participants

Variable	Definition	All	Students	Consumers
		Mean (SD)	Mean (SD)	Mean (SD)
Age	Age of participant	27.10 (7.41)	20.58 (1.61)	32.69 (5.64)
Male	Male = 1, Female = 0	0.29 (0.46)	0.32 (0.47)	0.27 (0.45)
Bachelor	Bachelor degree or higher = 1, Otherwise = 0	0.48 (0.50)	0.00 (0.00)	0.89 (0.32)
Income	Below Baht 5,000 = 1; Baht 5,000 – 9,999 = 2; Baht 10,000 – 24,999 = 3; Baht 25,000 – 49,999 = 4; Baht 50,000 – 99,999 = 5; Baht 100,000 and higher = 6	2.74 (0.97)	2.15 (0.80)	3.24 (0.81)
Student	Student = 1, Consumer = 0	0.46 (0.50)	N/A	N/A
Household	Number of members in participant's household	4.66 (1.46)	4.62 (0.88)	4.70 (1.81)
Children	Children in household = 1, Otherwise = 0	0.44 (0.50)	0.42 (0.50)	0.46 (0.50)
Shopper	Main shopper =1, Otherwise = 0	0.36 (0.48)	0.10 (0.30)	0.59 (0.50)

After participants had read the information sheet and signed the consent form, the experimenter paid each participant with 500 Baht cash. The experimenter could choose to endow subjects with either cash or product, which could influence how subjects behave in the auction (Lusk et al., 2004). Product endowment could cause subjects to feel obligated to the experimenter; thus, bidding higher. Additionally, subjects' unwillingness to lose the possessed product may be stronger, compared to when the endowment is money. Thus, these "reciprocal obligation" and "loss aversion" bias can be reduced when money is awarded instead (Corrigan & Rousu, 2006).

The session lasted for approximately two hours. During the whole process, the experiment was conducted with complete anonymity, since subjects randomly drew their own letter names and revelation of actual names was strictly prohibited. The experimenter explained the random

nth-price auction process, including examples. Subjects were also informed that the experiment entailed two practice rounds and six actual rounds. In the first practice round, subjects were presented with one food item. After subjects had submitted their bids, the experimenter wrote all the bids on the board, ranking from highest to the lowest. Then, the n number (from one to ten) was randomly drawn from a clear box, and the winners (letter names) were publicly announced without actual exchange of money for the food item. The second practice round followed the same practice, but with three food items. At the end of each practice round, participants could ask questions regarding the auction procedure.

Subjects were reminded that only one of the six actual rounds was the binding round, and the determination of such round was random and announced at the end of the experiment. This implied that only the winners of the binding round would have to exchange money for the food items. This was implemented to prevent earlier rounds' winners from losing their motivation in bidding for later rounds, due to insufficient endowment to cover all products in all rounds. In each of the six actual rounds, the experimenter presented the three food items to all participants to examine. Consistent with previous studies, three products were preferred with the expectation that participants would be interested in bidding at least one product. Popcorn, corn cereal, and soybean oil were chosen in the actual rounds, since the existing MOPH's announcement on GM labeling covers only corn and soybean ingredients. Participants wrote their bids for all the three food items in the paper sheet. Each round ended when all sealed bids were collected concurrently.

The six actual rounds were directed under the same procedure, but with different labeling policies. In order to eliminate the brand effect from the experiment, all food items had to be re-packaged with plain white labels. Comparisons across rounds could be possible when only labeling policies were adjusted. The actual label presented only the weights, ingredients, and expiration dates of the products. The GM label contained the additional "made from genetically modified corn (or soybean)" statement. The 5% GM threshold level label and the 1% GM threshold level label specifically stated the "up to 5% of corn (or soybean) could be genetically modified" statement and the "up to 1% of corn (or soybean) could be genetically modified" statement, respectively. The GM label with nutritional value indicated the "made from genetically modified corn (or soybean) to raise vitamin A enrichment" statement, similar to the golden rice. Lastly, the GM-free label enclosed the additional "certified to be free of any genetically modified ingredient" statement. It should be pointed out that different sessions were

carried out with different sequences of these six actual rounds, in order to minimize any possible bias from certain sequential arrangement.

Questionnaires were distributed at the end of the experiment (rather than at the beginning) to ensure that subjects did not have advanced knowledge that the experiment was about GMO. In addition to demographic characteristics, the questionnaire asked subjects for their shopping behavior, and their knowledge and perceptions about GM food. A simple risk attitude test which could generate additional compensation was also conducted. Although subjects in the experiment did not represent all Thai shoppers, statistics from Table 3 show that they often read food labels, and most agreed on the importance of the GM content food labels. The Thai subjects admitted that even if they did not have much knowledge about GMO, they did not have a positive attitude towards GMO, and some perceived GM food as risky. This is different from Chinese consumers who tend to have favorable opinions about GMO, and view GM food as having little or no risk, which affects their WTP (Li et al., 2002). Note that each subject's perception towards GMO and his/her general risk attitude do not move in the same direction, showing a correlation of -0.116.

Table 3: Definitions and summary statistics of attitudinal variables

Variable	Definition	All	Students	Consumers
		Mean (SD)	Mean (SD)	Mean (SD)
Safety	Importance of food safety versus food price	7.26	7.65	6.93
	[Scale from 1 to 10; Food price most important = 1, Food safety most important = 10]	(2.70)	(2.26)	(3.01)
Nutrition	Importance of food nutrition	7.40	7.18	7.59
	[Scale from 1 to 10; Not important = 1, Most important = 10]	(2.54)	(2.30)	(2.73)
Label_Read	Frequency of reading food labels	3.98	3.82	4.11
	[Always = 5, Often = 4, Sometimes = 3, Rarely = 2, Never = 1]	(0.95)	(0.83)	(1.03)
Label_GM	Importance of GM labels	2.77	2.75	2.79
	[3 = Very important, 2 = Little important, 1 = Not important]	(0.55)	(0.54)	(0.56)
Knowledge	Self-reported knowledge about biotechnology	1.78	1.78	1.77
	[High knowledge = 3, Some knowledge = 2, No knowledge = 1]	(0.49)	(0.52)	(0.46)
Opinion*	Opinion about the use of biotechnology	1.80	1.89	1.72
	[Favorable opinion = 3, Neutral opinion = 2, Negative opinion = 1]	(0.74)	(0.70)	(0.78)
Risk_GM*	Risk perception associated with GM food	2.33	2.24	2.43
	[High risk = 3, Little risk = 2, No risk = 1]	(0.62)	(0.66)	(0.61)
Risk_Attitude**	Risk attitude of participant	5.12	5.08	5.14
	[Scale from 0 to 9; Risk loving = 0, Risk averse = 9]	(2.52)	(1.97)	(2.93)

Source: Attitudinal variables are adapted from Li et al. (2002)

Note: The "Don't know" choices have been excluded from the summary of statistics.

The risk attitude test was a simplified version of the Holt and Laury (2002)'s test, which consisted of 9 decision rows, each with 2 options: A and B. Option A in all rows was the 25 Baht payoff with certainty; whilst Option B's payoffs were either 50 Baht or 0 Baht, depending on the results of the 10-sided dice rolling. Higher chances of winning 50 Baht increased in latter rows. For example, the first row of option B stated that if the dice rolling turned out to be number zero (10% chance), the payoff is 50 Baht, while other numbers (90% chance) meant no additional compensation was given. For the second row, when the numbers zero and one occurred, 50 Baht would be awarded. In the last row, there was a 90% chance of winning 50

Baht, and a 10% chance of winning nothing. The expected outcomes of options A and B were the same in the fifth row. Risk lovers were expected to choose option B since the very first row, and would be assigned the scale of “0” in the Risk Attitude variable. On the other hand, a very risk averse subject could choose option A in all rows, and would be assigned the scale of “9”. Subjects were informed that only one row was randomly selected for the actual payment. For a review of other procedures to elicit risk attitude, see Harrison and Ruström (2008).

4) Experimental Results

Students and consumers display different average bids in the GM labeling experiment in Thailand. Generally, consumers submitted lower bids than students, except in the case of soybean oil where bids from both groups were not vastly different. For students, the average bid for food products with actual labels is the highest, even when compared to the GM-free and value added GM labels. As for consumers, GM-free food receives the highest valuation, followed by GM food with additional nutrition (for popcorn and cereal) or the actual label (for vegetable oil). Tables 4 to 6 present comparisons of bids from students and consumers for popcorn, corn cereal, and soybean oil, respectively.

Table 4: Comparisons between bids from students and consumers for popcorn

	Students	Discount (-) Premium (+)	Consumers	Discount (-) Premium (+)
Average bid for an “Actual label” in Baht	29.10	N/A	21.97	N/A
Average bid for a “GM label” in Baht	24.85	-14.60%	20.64	-6.05%
Average bid for a “GM-free label” in Baht	27.73	-4.70%	23.00	+4.68%
Average bid for a “5% GM threshold label” in Baht	25.40	-12.71%	20.37	-7.28%
Average bid for a “1% GM threshold label” in Baht	24.72	-15.06%	21.33	-2.93%
Average bid for a “Value added GM label” in Baht	27.27	-6.30%	22.51	+2.47%

Note: % discounts or premiums are compared to actual label

Table 5: Comparisons between bids from students and consumers for cereal

	Students	Discount (-) Premium (+)	Consumers	Discount (-) Premium (+)
Average bid for an "Actual label" in Baht	38.17	N/A	31.87	N/A
Average bid for a "GM label" in Baht	34.60	-9.34%	29.03	-8.92%
Average bid for a "GM-free label" in Baht	37.47	-1.83%	32.97	+3.45%
Average bid for a "5% GM threshold label" in Baht	34.20	-10.39%	29.96	-6.01%
Average bid for a "1% GM threshold label" in Baht	33.95	-11.05%	29.36	-7.89%
Average bid for a "Value added GM label" in Baht	37.10	-2.79%	32.00	+0.40%

Note: % discounts or premiums are compared to actual label

Table 6: Comparisons between bids from students and consumers for oil

	Students	Discount (-) Premium (+)	Consumers	Discount (-) Premium (+)
Average bid for an "Actual label" in Baht	34.12	N/A	32.06	N/A
Average bid for a "GM label" in Baht	29.28	-14.17%	30.37	-5.26%
Average bid for a "GM-free label" in Baht	33.87	-0.73%	32.80	+2.32%
Average bid for a "5% GM threshold label" in Baht	31.15	-8.70%	30.04	-6.28%
Average bid for a "1% GM threshold label" in Baht	30.93	-9.33%	31.20	-2.67%
Average bid for a "Value added GM label" in Baht	31.78	-6.84%	31.74	-0.98%

Note: % discounts or premiums are compared to actual label

Although both groups assign discounts to GM food for all threshold levels, students appear to have a more unfavorable attitude towards GM food, as evidenced by steeper discounts for all GM food items. In case of popcorn, for example, students' average bids for GM label, 5% GM threshold level, and 1% threshold level are less than the actual label by more than 10%,

while consumers' average bids for such labels are in the range of 3% to 7%. Nevertheless, based on the t-tests' results displayed on Table 7; there are no statistical differences among these three GM labels, for both consumers and students.

Compared to other GM labels, enhanced GM food receives a higher acceptance level from both consumers and students. Relative to students, consumers perceive this value-added GM food as equally (or even more) favorable to the actual label products. In case of popcorn, for example, the average bid for the value-added GM label is 2.47% higher than the actual label, although still slightly lower than the GM-free food. Statistical tests confirm that both consumers and students give higher valuations to all GM food with additional nutritional value.

Table 7: P-values from one-sided t-Tests for different labeling policies

	Popcorn	Cereal	Oil
	Students	Students	Students
	Consumers	Consumers	Consumers
Difference between the average bid for an "Actual label" and a "GM label"	0.0036** 0.0944*	0.0580* 0.0130**	0.0210** 0.0653*
Difference between the average bid for a "Actual label" and a "GM-free label"	0.0725* 0.1165	0.2840 0.1525	0.4354 0.1565
Difference between the average bid for a "5% GM threshold label" and a "GM label"	0.3787 0.3399	0.4369 0.1322	0.1130 0.3359
Difference between the average bid for a "1% GM threshold label" and a "GM label"	0.4747 0.1871	0.4086 0.3658	0.2091 0.1499
Difference between the average bid for an "GM label" and a "Value added GM label"	0.0187** 0.0170**	0.0564* 0.0238**	0.0793* 0.0795*

Note: ** P-value < 0.05 * P-value < 0.10

As presented in Table 8, results from independent-samples t-tests show that bidding behaviors of students and consumers are not statistically different, except when they bid for popcorn and cereal, and only for the actual label.

Table 8: P-values from two-sided t-tests comparisons between students and consumers

	Popcorn	Cereal	Oil
“Actual label”	0.0187**	0.0796*	0.5622
“GM label”	0.1911	0.1431	0.7472
“GM-free label”	0.1075	0.2252	0.7222
“5% GM threshold label”	0.2531	0.1694	0.9369
“1% GM threshold label”	0.1098	0.2004	0.7629
“Value added GM label”	0.1539	0.2004	0.9911

Note: ** P-value < 0.05 * P-value < 0.10

If bidding zero represents a complete rejection of GM food, a few students and consumers submitted zero bids for GMO, as presented in Table 9. Generally, consumers have less unfavorable opinion against GM food, as three to five of them bid zero for GM, 1% threshold, and 5% threshold labels. Take popcorn for example, only 5 out of 70 consumers, or 7.14%, always reject GM food regardless of the contamination level. As for students, GM vegetable oil has the highest rejection rate, compared to popcorn and cereal. In addition, for all three food items, the GM label carries the higher rejection rate, relative to both 5% and 1% threshold levels.

Table 9: Percentage bidding zero

	Popcorn			Cereal			Oil		
	GM	1%	5%	GM	1%	5%	GM	1%	5%
Students	10.00%	6.67%	6.67%	13.33%	10.00%	6.67%	20.00%	13.33%	13.33%
Consumers	7.14%	7.14%	7.14%	7.14%	5.71%	5.71%	5.71%	7.14%	4.29%

Previous experimental studies found no strong evidence of a relationship between GMO aversion and demographic variables (Lusk et al., 2001; Huffman et al., 2003; and Noussair et al., 2004). For this study, WTP for GM food which are based on bids from actual round 2 are regressed against demographic and attitudinal variables. Results from popcorn, cereal,

and vegetable oil are reported separately in Table 10, since the three products could have different perceived market prices. The results show that no single variable significantly influences GMO demand for all three products. Contrary to the findings of Lusk et al. (2006), older consumers seem to be more hostile towards GMO in the area of vegetable oil. Thai males' acceptance of GM food is less than that of females, which is inconsistent with previous studies where female GMO acceptance is usually lower than that of males (Costa-Font et al., 2008). Interestingly, households with children place higher premiums on GM popcorn and vegetable oil. In addition, income level is directly related to higher bids for GMO, in the case of popcorn. Other demographic characteristics, such as level of education and number of members in a household, cannot explain GM food's acceptance. Regression results confirm the earlier statistical tests that students do not bid differently than consumer subjects.

Table 10. Results from regression models

	Popcorn	Cereal	Oil
Age	-0.376 (-0.644)	-0.974 (-1.419)	-1.053* (-1.729)
Male	-10.997** (-2.050)	-11.530* (-1.828)	-8.562 (-1.531)
Bachelor	-6.363 (-0.509)	-14.934 (-1.015)	-15.440 (-1.184)
Income	5.589* (1.744)	4.468 (1.186)	0.223 (0.067)
Student	4.133 (0.287)	-8.817 (-0.520)	-21.087 (-1.402)
Household	-2.173 (-1.176)	-2.377 (-1.094)	-1.495 (-0.776)
Children	8.767* (1.929)	7.495 (1.402)	9.776** (2.063)
Shopper	-0.821 (-0.141)	4.770 (0.695)	2.112 (0.347)
Safety	-2.968** (-2.338)	-1.544 (-1.034)	-1.093 (-0.826)
Nutrition	2.658**	0.890	-1.099

	Popcorn	Cereal	Oil
	(2.035)	(0.580)	(-0.807)
Label_Read	3.048 (1.165)	0.755 (0.245)	2.260 (0.829)
Label_GM	5.778 (1.315)	4.364 (0.844)	4.831 (1.054)
Knowledge	-2.418 (-0.490)	-7.797 (-1.344)	-3.221 (-0.626)
Opinion	-0.669 (-0.205)	-0.441 (-0.115)	0.916 (0.269)
Risk_GM	-3.024 (-0.763)	-0.385 (-0.082)	-0.738 (-0.178)
Risk_Attitude	-0.453 (-0.447)	0.341 (0.286)	0.359 (0.340)
N	93	93	93

Note: Definitions and descriptive statistics of variables are presented in Table 2 and Table 3. Numbers in parentheses are t-statistics. ** P-value < 0.05 * P-value < 0.10

As for attitudinal variables, only attitudes about food safety and food nutrition have an impact on GM food acceptance. For popcorn, participants who view food safety as more important than food price are against GMO, whilst those who consider food's nutritional value prior to consumption are in favor of GM food. Unexpectedly, participants who have negative opinions about the use of biotechnology and perceive GM food as having high risks do not place a lower valuation on GMO. Consumers and students who profess to have strong knowledge about biotechnology neither accept nor reject GM food. In addition, for most participants who frequently read food labels and view GM labeling as necessary, these factors do not determine their WTP. Lastly, an individual's risk attitude does not significantly affect his/her GMO preference.

5) Conclusion

The results from the experiment show that Thai consumers and students have unfavorable opinions against GM food. Both groups' willingness to pay for GMO is lower than regular food. Since there is no statistical difference between WTPs for actual labels and GM-free labels, the voluntary labeling policy may not evidently benefit GM-free food producers. Additionally, when there are no significant differences among the GM label, the 5% threshold level, and

the 1% threshold level; the current requirement of 5% threshold level could be socially appealing due to its lower cost on the producers' side. In addition, both consumers and students have welcomed GM food with added nutritional benefit, as its WTP is significantly higher than GM food; and could be even higher than regular food items.

Although consumers generally submitted lower bids than students, there is no statistical difference between consumers' and students' WTPs; thus, comparisons among previous studies which rely on different groups of subjects are possible. Additionally, this implies that researchers could employ both groups as subjects in their experimental auction. In order to save costs of running experiments, students could be invited to participate in similar experiments for the purpose of monitoring Thai consumers' behaviors over time.

No definite conclusions can be drawn regarding demographic and attitudinal factors that influence demand for GM food, since consumers react differently to different GM food items. Interestingly, certain results contradict those of previous studies. For example, Thai females seem to have less negative attitudes towards GMO than males, and households with children are not entirely against GM food. From the survey, participants in this study generally realize the importance of GM labeling, and perceive GMO negatively. However, the results from regression models do not confirm such results; even participants who have negative opinions about biotechnology and view GMO as risky, do not statistically reject GM food.

One of the limitations of the study is the focus on subjects in Bangkok and surrounding provinces; therefore, further studies on subjects from other parts of Thailand are required to confirm the results. Consequently, generalizability and policy adjustment are recommended only when more samples are included. Future researches could also focus on other types of food or other benefits of GMO, which are sensitive to consumers.

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