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Thai Consumer Willingness to Pay for Differing GM Labeling Policies: Comparisons across Time

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Abstract

Thailand has adopted a labeling policy on genetically modified (GM) food items since 2003 that if their ingredients are derived from soybean and corn, a mandatory label is required when their GM content reaches a 5% threshold level. However, critics disagree and demand a mandatory lower threshold requirement. The purpose of this research paper is to compare Thai consumers in 2009 and 2021 regarding their willingness to pay for GM food and quantify the premium for non-GM food. The demand-revealing mechanism used in this research is the experimental auction, specifically the random nth-price auction. One hundred and twenty-one participants took part in the experiment in both periods, in which they had to bid for food products affixed with newly constructed labels. Results show that Thai consumers do not strongly oppose GMOs, and the opposition appears to be weakening over time, as the average discount of GM food was 6.74% in 2009 and 3.08% in 2021. Thai consumers in 2009 did not view 1%, 5%, and higher percentages of GMO content differently. On the other hand, since they did not perceive a GM level of 5% as being GM-free food, the adoption of a 5% threshold level is supported until further research has been carried out on the cost implications. Consumers in 2021 appeared to be insensitive to the 5% threshold level and significantly assign the average premium of 10.94% to GM-free food. Nevertheless, market opportunities exist for GM food sellers if they clearly post GMO benefits on their labels.

Keywords: Genetic modification, Labeling, Willingness to pay, GM foods, Experimental auctions

JEL Classifications: O13, Q11, Q13, Q18

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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. On the consumption side, the major concern is food safety, specifically on the long-term unexpected health implications of consuming GM foods. Consumers' views on GM foods do vary from country to country. For example, GM foods are more acceptable to Americans than Europeans, since only 21% of Americans perceive GMOs as a serious food risk, compared to 28%, 30%, 38%, 39%, 48%, 49%, 57%, 60%, 62%, and 65% of consumers from Norway, Italy, France, the United Kingdom, the Netherlands, Spain, Germany, Austria, Portugal, and Sweden, respectively (Hoban, 1998). These countries' safety concerns are reflected in their regulations in the areas of import restrictions and labeling policies. Some countries actually require GMO labeling based on the consumer right to know, rather than on cost-benefit analysis, safety considerations, or scientific proof (Caswell, 2000; Carter, 2002).

Previous studies on GMO acceptance have mostly been conducted in the United States and Europe; very few have been conducted in developing countries. The scope of this study is to focus on consumers in Thailand, specifically with the purpose of quantifying how much Thai consumers are willing to pay for GM food, and what the premium would be for non-GM food. An earlier survey showed that GMO acceptance in Thailand is relatively higher than in other countries, as 72% of Thai consumers agree that the benefits of GMOs far outweigh the risks (Environics International, 2000). This percentage is actually higher than that of any country in Europe (which ranges from 22% to 55%), and ranks lower than only Indonesia's figure of 81% in Asia and the Pacific Rim region. A local survey of 305 Thai consumers in the Bangkok metropolitan area in 2005 revealed that only 26% would not purchase and consume GM food, whilst the rest might either buy or eat it (Foundation for Consumers, 2007).

In addition, this study attempts to analyze Thai consumers' responses to various GM labeling policies, including the one currently imposed by the Thai government. The Ministry of Public Health (MOPH) in Thailand, which is responsible for ensuring consumer safety in food consumption, has issued the "Announcement of the MOPH (No. 251) B.E. 2545 (2002)" regarding the presentation of GM food labeling. Its mandatory labeling policy disallows the use of labels stating "no GMO" or "GMO free." Coverage is restricted to twenty two food categories which contain the ingredients of soybean and corn, such as cooked soybean, soybean milk, popcorn, tofu, and corn starch. Specifically, if a food item has any DNA or protein derived from GM or genetic engineering of at least 5% of its top three ingredients, its label must clearly show the words "genetically modified" in the list of ingredients; for example, "chilled tofu made from genetically modified corn." Unfortunately, a previous survey revealed that although 80% of the respondents had some knowledge about GM plants or foods, only half of them knew about the GM food label policy, and 81% had never seen food with a GM content label (Foundation for Consumers, 2007). In addition, most consumers were not satisfied with the current regulation; 35% preferred the removal of the 5% threshold level, 31% would like to see a more visible label, and 30% did not wish the coverage to be limited only to soybeans and corn.

After the law's imposition, the Confederation of Consumers Organization, a non-governmental organization (NGO), claimed that there were no food items being displayed that had a GM label affixed to them (Thai Fund Foundation, 2003). Optimistically, this could have meant that Thailand was a GM-free country, or that producers had switched

to non-GM ingredients. However, Greenpeace cited the problem of weak enforcement and demanded that labels be attached that specify any food item containing at least 1% GMO of any ingredient (Greenpeace asks for, 2004). Greenpeace's shopper's guide to GMO-free food has been regularly updated and distributed to the public, with the sole purpose of informing consumers about the GM content of food sold in Thailand. However, Thailand's Food and Drug Administration does not share their views about the extent of GM food distribution in Thailand. Its survey and laboratory tests of 70 food item samples conducted during 2004 and 2005 came up with only 4 food items not displaying the labels correctly (FDA disagrees, 2005). In 2020, the MOPH circulated the new announcement's draft in order to seek public opinion on this issue. This draft proposed to cover all GM foods and animals but still retain the 5% threshold level (Thai PBS News, 2020).

Although there appears to be some consensus regarding the importance of labeling as a means of assisting consumers during their decision-making process, there are still variations in the approaches taken by various governments. Whether or not to choose voluntary or mandatory labeling is one of the first issues to be considered. Voluntary labeling allows food producers to decide whether they want to affix a GM or non-GM label. On the other hand, mandatory labeling requires a GM label if the product contains GM ingredients, or if it is derived from GM materials. The benefits and costs to both consumers and producers are weighed before the policy makers select which labeling policy to implement. Mandatory labeling may limit consumers' choices if producers shift to non-GM ingredients, and it could result in the disappearance of some GM food items from the shelves (Carter & Gruère, 2003). Voluntary labeling could generate net benefits when a small proportion of the population wants to know which products do not contain GMOs and would be willing to pay higher prices for them, whilst mandatory labeling may be more effective if most of the population demands this information (Caswell, 2000). Several countries in Asia are currently under a mandatory labeling policy, as shown below in Table 1.

Table 1: Mandatory Labeling Policies in Asia

China	South Korea
India	Sri Lanka
Indonesia	Taiwan
Japan	Thailand
Malaysia	Vietnam

Source: Center for Food Safety (2013)

In addition to the imposition of mandatory labeling or voluntary labeling, policy makers must make decisions on which ingredients or threshold levels to apply. Table 2 presents the different threshold levels selected by various countries. Another complication of GMO labeling lies in the extent of that coverage. Choices have to be made whether to include animal feed, meat, and products from animals fed with GM feed; food offered by restaurants; unpackaged food; and also, additives and flavorings (Gruère & Rao, 2007). For certain countries like Brazil and the European Union, all food products come under their coverage, whilst for other countries food items not on their "list" are excluded. An example of the latter is Japan's labeling policy which covers only eight crops and thirty three processed foods (The Law Library of Congress, 2014).

Table 2: Threshold Level and Coverage for Labeling GM Foods

Country	Threshold Level	Coverage
Japan	5%	Soy, corn, potato, canola, cotton seed, alfalfa, beet, papaya; and 33 processed foods
South Africa	5%	Food
South Korea	3%	Agricultural products, processed food, and animal feed
New Zealand	1%	Food
Brazil	1%	Food and animal feed
Russia	0.9%	Food
England	0.9%	Food and animal feed
European Union	0.9%	Food and animal feed
China	Unspecified	Soybean seeds, soybeans, soybean powder, soybean oil, and soybean meal; seed corn, corn, corn oil, and corn powder; planting seed of rape, rapeseed, rapeseed oil, rapeseed meal; cotton seed; and tomato seed, fresh tomatoes, and tomato paste

Source: The Law Library of Congress (2014)

Thailand is not a major producer of GM crops, nor does it have a reputation for advancements in this area. Consequently, GM crops sold in Thailand are usually imported. Genetic engineering research on its benefits to agricultural and industrial agricultural industries has been intensively conducted in Thailand over the past two decades. While several research projects aimed at improving certain crops' productivity have been extensively carried out in Thailand, limited research has been conducted on the demand side, specifically focusing on Thai consumers' perceptions of GM food. With only a few producers complying with the GM food label policy, it is not easy to estimate the demand for GM food using field data currently available. As a result, this study is based on the conventional lab experimental approach. One controversial issue involves the MOPH's requirement of GM food labeling at a threshold level of 5%, whilst Thai NGOs are demanding a 1% (or less) threshold level. It would be especially important to compare Thai consumers' valuation on GM food during the past decade, since there is no major amendment to the MOPH's announcement. As such, this research seeks to answer the questions whether Thai consumers' attitude towards GM food has changed and is different from that of other countries. The results would help policy makers to gain a better understanding of Thai consumers' viewpoints on this sensitive topic.

2. Willingness to pay for GM food

Several studies have been carried out on consumers' perceptions towards GM technology and GM foods and the determinants of such attitudes. Costa-Font, Gil, & Traill (2008) broke down these perceptions into three areas: risk and benefit perceptions; individual attributes and values; and knowledge of the product and process. Consumers in most European countries generally perceive GMO's benefits to be less than its risks, while American, Spanish, and Italian consumers believe otherwise. Socio-economic and demographic attributes, along with individual values such as environmentalism, conservationism, materialism, and equity can play an important role as well. As for the third dimension, additional considerations need to be taken into account, such as the difference between objective and subjective knowledge, the process of acquiring such knowledge, and the credibility of the sources of information.

Rather than focusing on attitudes and perceptions, many researchers have focused on consumers' valuations, purchasing intentions, and purchasing behavior. Research on the price premiums of GM-free food covering a diverse range of foods has been

conducted in many countries. Percentage premiums for non-GM foods range from as high as 784% in France to as low as a negative 67% in Canada (Lusk, Jamal, Kurlander, Roucan, & Taulman, 2005). However, most of the studies have concentrated on the United States and European countries. These exceptions are, for examples, Mucci & Hough (2003); Li, Curtis, McCluskey, & Wahl (2002); and McCluskey, Grimsrud, Ouchi, & Wahl (2003).

Value elicitation methodology can largely be divided into two categories; survey or experiment. While most of the existing studies on GM food valuation rely on the survey method, other researchers have employed demand-revealing mechanisms, the most popular of which is the experimental auction methodology, to elicit WTP. The auction methodology has several advantages over the others (Noussair, Robin, & Ruffieux, 2004). Firstly, all subjects use the same monetary value as a means of identifying their preferences. Secondly, there is a commitment to an actual purchase (or even consumption). Thirdly, the dominant strategy is for each subject to reveal his/her actual valuation. Fourthly, all of the product's characteristics, including its GM components, must be taken into consideration before submitting a bid. Table 3 provides a summary of GM food valuations using various experimental auctions.

Table 3: GM Food Valuations Using Experimental Auctions

	Auction Type	**Country**	**Sample**	**Product**	**Premium for Non-GM***
Buhr et al. (1993)	Vickrey	US	106 students	Pork sandwich	-15%
Lusk et al. (2001)	First-Price and Second-Price	US	50 students	Corn chips	14%
Noussair et al. (2002)	Vickrey	France	112 random subjects	Chocolate bar	43%
Huffman et al. (2003)	Random nth-Price	US	172 random subjects	Vegetable oil Tortilla chips Potato	18% 14% 14%
Wachenheim & VanWechel (2004)	Random nth-Price	US	112 students	Cookie Potato chips Muffin	10% 11% 14%
Noussair et al. (2004)	BDM	France	97 random subjects	Biscuits	75%
Rousu et al. (2004)	Random nth-Price	US	44 random subjects	Vegetable oil Tortilla chips Potato	8% 14% 10%
Kaneko & Chern (2005)	Vickrey	Japan	39 random subjects 28 students	Canola oil Natto	59% 79%
Jaeger & Harker (2005)	Fifth-Price	New Zealand	100 random subjects	Kiwifruit	61%
Lusk et al. (2006)	Fifth-Price	US England France	164 random subjects 108 random subjects 98 random subjects	Cookie	47% 160% 784%
Dannenberg et al. (2008)	Vickery	Germany	164 random subjects	Soybean oil Chocolate bar	89% 144%
Colson et al. (2011)	Random nth-Price	US	92 random subjects	Broccoli Tomato Potato	22% 29% 17%
Ramaswami et al. (2013)	BDM	India	64 students 50 teachers	Cookie	16%
Lacy & Huffman (2016)	Random nth-Price	US	102 random subjects	Potato Potato dice	-6% -17%

Note: * Premiums for non-GM items are from Dannenberg (2009), except Colson et al. (2011), Ramaswami et al. (2013) and Lacy & Huffman (2016). Premiums for non-GM in Colson et al. (2011), Ramaswani et al. (2013), and Lacy & Huffman (2016) are from comparisons between GM-free and GM food items.
Source: Authors 'compilation

The Vickrey auction, used to elicit WTP, is of particular interest to agricultural economists. Under the Vickrey second-price auction, participants simultaneously submit sealed bids for a product. The highest offer wins the auction but pays the next highest bid. Theoretically, there is an incentive to bid according to the true valuation in order to win the auction (Vickrey, 1961). Buhr, Hayes, Shogren, & Kliebenstein (1993) proposed the use of the split-valuation method in order to elicit the value of a good with uncertain attributes. Participants were first given a typical meat sandwich then asked to bid for a lean meat sandwich derived from genetically engineered growth enhancers. Winners were determined by the Vickrey auction and were required to consume the sandwich. The second-price auction, however, has its limitations, especially when inexperienced individuals do not fully understand the experimental procedure and consequently do not reveal their highest WTP (Lusk, Daniel, Mark, & Lusk, 2001). Under their procedure, participants initially received a bag of GM corn chips before bidding for GM-free corn chips under both first-price and second-price auction mechanisms. The results showed no statistically significant differences between both mechanisms. Most participants did not want to pay a premium for the GM-free snack, and only 20% of participants offered at least $0.25 per ounce in exchange for the GM-free snack.

Noussair, Robin, & Ruffieux (2002) focused their experiment on how consumers react to the GM food labels. The experiment relied on the same GM and non-GM products for all of the three rounds. The products were presented without their packages in the first round and with their original packages in the second round. In the last round, participants were implicitly required to read the labels which were projected on a large screen. Generally, the GM food labels did not affect consumers' WTP unless consumers were aware of the information on the labels. A more recent study by Dannenberg, Scatasta, & Sturm (2008), which relies on the Vickery 2nd price auction, examined important conditions for the creditability of the mandatory labeling policy.

Noussair, Robin, & Ruffieux (2004), in their experiment, added one round with 1% and 0.1% threshold levels of GM content and another round in which participants were provided with GMO information. The Becker-DeGroot-Marschak (BDM) mechanism, which is theoretically equivalent to a second-price auction, was employed instead of the Vickrey auction. Under this mechanism, the participant(s) who submitted bid(s) higher than the randomly drawn selling price won the food item(s). They found that consumers perceived 1% of GM content differently from typical GM foods, and the 0.1% threshold level was not considered by them to be GMO-free. (See also Ramaswami, Bansal, & Chakravarty (2013) for an experiment on Indian subjects, who generally revealed fewer negative attitudes towards GMOs than the French subjects in the previously mentioned experiment.)

Although the second-price auction, theoretically, reveals demand, it may not fully engage bidders who value the product well below or well above the market-clearing price. These so-called off-margin bids may be insincere bids when bidders are guaranteed a loss or a win. The random nth-price auction is shown to be more effective with off-margin bidders because the market-clearing price is endogenously determined (Shogren, Margolis, Koo, & List, 2001). Once all the bids are submitted and ranked from highest to lowest, a random number (denoted by n) between 2 and the total number of bidders is selected. Winners are the (n-1) highest bidders who purchase the item at the n-highest bid price. Participants in the Wachenheim & VanWechel (2004) experiment were asked to bid for three food items under the random nth-price auction. Each of the three items was offered in two versions, one with a GM food label and the other showing no GM content. They concluded that participants read the labels and that there was a premium for non-GM food.

The Huffman, Shogren, Rousu, & Tegene (2003) experiment was also limited to three food items, each with two different labels; one was plain and the other one stated that "This product is made using genetic modification (GM)." The results indicated that most consumers preferred non-GM foods, as 60% of the participants offered lower bids for the GM-labeled food, and that the GM food label affected WTP at a discount of approximately 14%. Based on the same group of participants, Huffman, Rousu, Shogren, & Tegene (2007) showed that participants' prior beliefs and new information did affect WTP. The new information was divided into pro-biotechnology from the biotech industry, anti-biotechnology information from the environmental group, and information from third parties from independent groups, such as scientists and academics.

Each participant in the Rousu, Huffman, Shogren, & Tegene (2004) experiment bid for three food items under the random nth-price auction mechanism. Three types of labels were explored; the GM-free label, the 1% threshold label, and the 5% threshold label. Consumers discounted 1% and 5% GM content by 7% to 13%, relative to the GM-free food. However, there was no WTP difference between 1% and 5% threshold labels, which suggested that the 5% threshold could be a better choice if mandatory labeling is imposed. Colson, Huffman, & Rousu (2011) tested for WTP differences between transgenic and intragenic methods of GM engineering under the random nth-price auction. The transgenic method allows the transfer of genes across different species, whilst the intragenic method restricts the transfer of genes to only those within the species itself. The experimental results showed that consumers assigned higher WTP to intragenic food compared to transgenic food, depending on the type of information presented to participants. More recently, Lacy & Huffman (2016) adopted the random nth-price auction to search for the WTP for low-acrylamide and sulfite-free potato products among American consumers. Consumers' WTP was conditional on whether the information was based on the company or the environmental perspective.

The fifth-price auction incorporates the benefits of both the second-price auction which is effective for on-margin bids, and the random nth-price auction which works better for off-margin bids (Lusk et al., 2006). Subjects in Lusk et al. (2006) were given non-GM foods and asked to bid for GM foods. For each round of the auction, four of the lowest bidders purchased the GM foods at the fifth lowest bid. On average, US consumers' bids were significantly lower than bids from England and France. Also, in general, demographic attributes could not explain consumers' willingness to accept GM foods.

3. Experimental design

Similar to the studies by Huffman et al. (2003), Wachenheim & VanWechel (2004), Rousu et al. (2004), Colson et al. (2011), and Lacy & Huffman (2016), the experimental design was based on the random nth-price auction which works well with off-margin bidders. Off-margin bids are to be expected since Thai consumers rarely see GM foods on supermarket shelves. This conventional lab experiment took place at Mahidol University, Thailand. Seventy and fifty-one representative consumers participated in the 2009 and 2021 experiments, respectively. Each session required ten to twelve subjects and lasted for approximately two hours. Subjects were recruited through invitation posters, stating that the research project was about food items and was funded by the government. The persons who signed up were subsequently contacted and randomly assigned to an available session. This was done to prevent participants who knew each other from attending the same session. Representative consumers were not recruited through random sampling selection, nor did they demographically represent

Thai shoppers. Most of them were main shoppers for their households, as shown in Table 4 along with the profiles of other participants.

Table 4: Demographic Characteristics of Participants

Variable	Definition	2009 Mean (SD)	2021 Mean (SD)
Age	Age of participant	32.69 (5.64)	37.71 (7.14)
Male	Male = 1, Female = 0	0.27 (0.45)	0.22 (0.42)
Bachelor	Bachelor degree or higher = 1, Otherwise = 0	0.89 (0.32)	0.92 (0.27)
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	3.24 (0.81)	3.80 (0.60)

Source: Authors' calculations

After the subjects signed an informed consent form, each was given 500 Baht (equivalent to roughly US$ 15) as an endowment. While some previous studies endowed subjects with a product and asked them to bid for another "superior" product, the subjects in this experiment were endowed with money, similar to the actual market environment where money is a medium of exchange. Lusk, Feldkamp, & Schroeder. (2004) showed that subjects who were endowed with a good, bid differently from those who were endowed with money. Specifically, WTPs from those endowed with a good were less than those with money endowments in the random nth price auction. However, loss aversion could explain the differences in the subjects' bidding behaviors. On the other hand, Corrigan & Rousu (2006) suggested that subjects might feel obligated to the experimenter and bid higher in situations where the endowments were goods. As such, the WTPs' results could show bias, even after the loss aversion had been taken into consideration. In order to minimize the effects of loss aversion and "reciprocal obligation", this experiment chose to endow subjects with money.

Each subject was separately seated in a private cubicle in order to prevent them from observing the other participants' behavior, and all of them were asked to randomly select letter names in order to preserve their anonymity. The objective of the research project was stated, as well as an explanation of how the random nth-price auction worked. The subjects were told that the experiment consisted of eight rounds; two training rounds and six actual bidding rounds. The six actual bidding rounds differed in their labeling policies, but this information was not conveyed to the subjects. The sequence of the experimental sessions is shown in Table 5.

The objective of the training rounds was to familiarize subjects with the random nth-price auction. In the first training round, each subject was presented with a food item and a bidding sheet. They were given sufficient time to examine, and eventually bid for the product. All bids were collected and written on the board, ranked from the highest to the lowest bid. A number was randomly drawn from a clear plastic box, and the market-clearing price was pointed out, following which all the winning bids were circled on the board. The subjects were then allowed to ask questions regarding the auction procedure. The second training round involved the same practice, but the subjects had to bid for three different products simultaneously. A random number was drawn and applied to all three products, and the winners were determined on the same basis as in the first training round. The subjects were again encouraged to ask questions until they clearly understood how the auction worked.

Table 5: Sequence of The Experimental Session

Round	Explanation
Training Round 1	Auction for one food item
Training Round 2	Auction for three food items
Actual Round 1	Auction for three food items with actual ingredients labels [Showing no information about GMO]
Actual Round 2	Auction for three food items with GM labels [Additional label statement "Made from genetically modified corn (or soybean)"]
Actual Round 3	Auction for three food items with 5% GM threshold level labels [Additional label statement "Up to 5% of corn (or soybean) could be genetically modified"]
Actual Round 4	Auction for three food items with 1% GM threshold level labels [Additional label statement "Up to 1% of corn (or soybean) could be genetically modified"]
Actual Round 5	Auction for three food items with GM-free labels [Additional label statement "Certified to be free of any genetically modified ingredient"]
Actual Round 6	Auction for three food items with GM labels containing additional nutritional value [Additional label statement "Made from genetically modified corn (or soybean) to raise vitamin A enrichment"]

Source: Authors's compilation.

The subjects were reminded that the experiment consisted of six actual rounds, but only one round would be binding. This was to discourage the subjects from lowering their bidding amounts in an attempt to win more than one food item or one round (Rousu et al., 2004). Both the binding round and the binding nth price were selected at the end of the sixth actual round. The first actual round began with the examination of three food items, after which subjects placed separate bids for each of them. The round ended when sealed bids for all three products were collected simultaneously. Actual rounds two to six followed the same procedure, except with different labeling policies. It should be noted that the experiment was conducted under a within-subject design, in which all participants were required to complete all actual rounds. Nevertheless, the subjects did not complete all six rounds in the same order as presented in Table 5; depending on the session, six labeling policies were randomly chosen to avoid any potential bias.

All of the food items used in the experiment, except in the first training round, were re-packaged with newly constructed labels. This was to remove both the branding and packaging effects from the decision making. The compulsory Food and Drug Administration (FDA)'s approval sign was also not shown on the label. Plain white labels were posted on the package's front with the product's name, ingredients, net weight, and expiry date printed on them using a suitably visible font size. Three food items used in the actual rounds included popcorn, corn cereal, and soybean oil since the existing MOPH's regulations are limited only to soybean and maize ingredients. Three products were chosen with the expectation that one of the three would be of interest to each of the subjects (Huffman et al., 2003; Noussair et al., 2004; Rousu et al., 2004). Figure 1 shows the first-round labels that were attached to the three products, whilst labels for rounds two to six are shown in Table 5. Vitamin A was hypothetically added, according to the label statement in the sixth round, since its additional nutritional value was expected to be understood by the subjects.

Figure 1: Labels for Actual Round 1

Popcorn Ingredients: Corn 67% Soybean oil 27% Salt 3% Net weight: 84 grams Best consumed before [Actual expiry date]	**Cereal** Ingredients: Corn 88% Sugar 7% Malt extract 3% Minerals 1.9% Vitamins 0.09% Iron 0.01% Net weight: 150 grams Best consumed before [Actual expiry date]	**Soybean Oil** Ingredients: Soybean 100% Net weight: 1 liter Best consumed before [Actual expiry date]

Source: Authors's compilation.

After which, the binding round, the binding random nth price, and the winners were publicly announced. Those who did not win were dismissed, whilst the winners exchanged money for the food items. Immediate consumption of the food items by the winners was not required since it was expected that those participants were shoppers who regularly made similar purchasing decisions (Huffman et al., 2003).

Harrison, Harstad, & Rustrom (2004) raised three concerns when employing experimental methodology in eliciting WTPs in the laboratory. The issue of "affiliated belief about field substitutes" could occur when subjects adjust their beliefs after having observed other subjects' revealed valuations, particularly in a repeated game with the same product, whilst the "affiliated belief about characteristics" issue arises when subjects are not familiar with the products and use other subjects' behaviors as reference. This study followed Harrison et al. (2004)'s suggestion by avoiding repeated bidding of the same products in all rounds and requiring subjects to submit their bids simultaneously. In addition, the subjects' bidding behaviors and the winners were not announced until all actual rounds were completed. The issue of "field-price censoring" occurs when the same products can be found in the actual marketplace, which imposes a limit on how much the subjects would be willing to bid. This issue was harder to control in this experiment but was not expected to be severe since direct comparisons with actual counterpart products in the market could not be made directly. All the food items employed in this experiment were available in the actual marketplace, varying in quality and price; for example, international and national brands carried price premiums of approximately 10% above the house brands. It should be noted that the experimenter had re-packaged all the food items in order to negate the brand and packaging effects.

4. Results

4.1 WTP and Acceptance of GM Food

Since no sellers have declared that their products contain GMOs in Thailand, it is safe to assume that Thai consumers generally perceive the food items with actual labels to have no GMO content. Through the auction mechanism, the results reported here represent the demand of representative Thai consumers. As presented in Table 6, it appears that Thai consumers did not generally have strong negative attitude towards GM foods in 2009 and 2021 as their WTPs for GM food in 2009 and 2021 were 6.74% and 3.08% lower than regular foods. Among the three food items, cereal receives the steepest discount of 8.91% in 2009 and 5.19% in 2021. It should be pointed out that percentage discounts are calculated from all participants' WTPs; if only decreasing bids are considered, such discounts would be considerably larger. Only a few consumers

completely rejected GM foods as the percentage of subjects whose bid was zero equated to 6.67% in 2009 and decreased to only 1.96% in 2021; both numbers were substantially lower than the 22% in the Noussair et al. study in 2002, and the 35% in the Noussair et al. study in 2004, which were based on French consumers.

Table 6**:** Comparisons Between Bids for Actual Labels and GM Labels

	2009			**2021**		
	Popcorn	**Cereal**	**Oil**	**Popcorn**	**Cereal**	**Oil**
Average bid for an "Actual label" [Standard deviation]	21.97 [12.57]	31.91 [17.09]	32.06 [10.95]	31.90 [25.63]	38.55 [25.26]	39.75 [14.22]
Average bid for a "GM label" [Standard deviation]	20.64 [13.90]	29.07 [17.53]	30.37 [11.46]	31.88 [26.49]	36.55 [23.35]	38.16 [15.48]
Percentage bidding zero for a GM label	7.14%	7.14%	5.71%	1.96%	1.96%	1.96%
Percentage discount for a GM label	-6.05%	-8.91%	-5.26%	-0.06%	-5.19%	-4.00%

Note: Average bid for ALL products is not shown since popcorn, cereal, and oil have different market prices.
Source: Authors' calculations

Table 7 presents the comparisons between WTPs for actual and GM-free labels. Since consumers' attitudes towards the existing actual labeling are believed to be indifferent to the GM-free label, increasing bids for the GM-free label imply that consumers are willing to pay for confirmation that the product has no GMO content. In all, Thai consumers would welcome this information and be willing to raise their bids for GM-free foods by an average of 3.48% and 10.94% in 2009 and 2021, respectively, which is considered to be in the same range as in the US. Popcorn carried the largest premium of 4.68% in 2009 and 12.54% in 2021. With a GM-free label, the complete rejection rate almost disappears. It should be emphasized that percentage premiums for GM-free label are larger, if only increasing bids are included.

Table 7**:** Comparisons Between Bids for Actual Labels and GM-free Labels

	2009			**2021**		
	Popcorn	**Cereal**	**Oil**	**Popcorn**	**Cereal**	**Oil**
Average bid for an "GM-free label" [Standard deviation]	23.00 [12.74]	33.01 [17.17]	32.80 [11.67]	35.90 [25.75]	42.27 [28.84]	43.96 [20.27]
Percentage bidding zero for a GM-free label	1.43%	1.43%	1.43%	1.96%	0.00%	0.00%
Percentage premium for a GM-free label	4.68%	3.45%	2.32%	12.54%	9.66%	10.61%

Note: Average bid for ALL products is not shown since popcorn, cereal, and oil have different market prices.
Source: Authors' calculations

Table 8 presents bidding results when additional nutritional value is added to the GM food items. The bidding results reveal some interesting implications, as consumers' acceptance clearly improves. Consumers in 2009 gave GM food enriched with vitamin A an average premium of only 0.62%, or nearly the same price as the actual label case, whilst the average percentage premium went up markedly to 22.31% in 2021. Value-added GM foods have completely eliminated the negative attitude among consumers. Opportunities exist for GM food producers if GMO benefits are conveyed directly to consumers although other GMO benefits are not explored here.

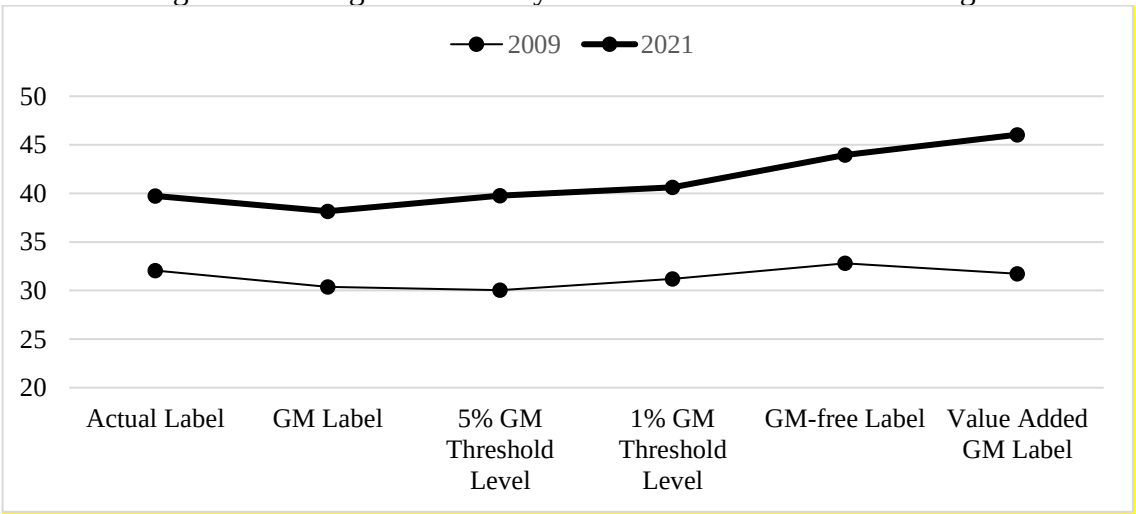
Table 8**:** Comparisons Between Bids for Actual Labels and GM-free Labels

	2009			2021		
	Popcorn	**Cereal**	**Oil**	**Popcorn**	**Cereal**	**Oil**
Average bid for an "Value added GM label" [Standard deviation]	22.51 [15.70]	32.03 [21.02]	31.74 [13.38]	40.78 [30.69]	47.51 [31.04]	46.04 [20.71]
Percentage bidding zero for a value added GM label	5.71%	5.71%	5.71%	1.96%	1.96%	1.96%
Percentage premium for a value added GM label	2.47%	0.36%	-0.98%	27.84%	23.25%	15.84%

Note: Average bid for ALL products is not shown since popcorn, cereal, and oil have different market prices.
Source: Authors' calculations

Comparisons of different labeling policies' average bids for soybean oil are presented in Figure 2; the other two food items follow similar patterns. For both 2009 and 2021, GM labels received the worst response, whilst GM-free food is valued higher than the actual label [showing no GMO information]. The major difference between consumers in 2009 and 2021 was on the nutritionally enhanced GM foods. In 2009, this value-added GM labels had better acceptance levels relative to GM foods, but the average bid was still below GM-free or even actual labels. But in 2021, it received the highest premium, even surpassing the GM-free labels.

Figure 2: Average Bids for Soybean Oil from Different Labeling Policies



Source: Authors's compilation.

Table 9 displays the results from the pooled variance one-sided t-test. Statistically, Thai consumers in 2009 placed lower bids for GM foods than they did on foods with actual labels and the GM-free labels. However, consumers do not place significantly higher premiums on GM-free labels when compared with the existing actual labels. This confirms the earlier assumption that Thai consumers regard the actual labels as having no GMO content. As such, if sellers voluntarily post GM-free labels, presumably incurring additional costs, proving this is true, consumers are not willing to pay more than they would for actual labeled products. On the other hand, consumers in 2021 did not perceive GM and actual labels differently, and were willing to pay higher for GM-free information. In addition, opportunities exist for sellers who sell GM foods with added benefits labels, as evidenced by the fact that consumers placed significantly

higher bids on value added GM labels than they did on GM labels in both 2009 and 2021, whereas GM foods with added nutrition labels receive higher WTPs compared to those with actual labels in 2021.

Table 9**:** P-values from One-Sided t-Tests for Different Labeling Policies

Difference between	**2009**			**2021**		
	Popcorn	**Cereal**	**Oil**	**Popcorn**	**Cereal**	**Oil**
"Actual label" and "GM label"	0.094	0.013	0.065	0.494	0.102	0.100
"Actual label" and "GM-free label"	0.117	0.152	0.156	0.014	0.017	0.015
"GM label" and "GM-free label"	0.032	0.004	0.016	0.041	0.006	0.005
"GM label" and "Value added GM label"	0.017	0.024	0.079	0.000	0.000	0.000
"Actual label" and "Value added GM label"	0.303	0.463	0.399	0.000	0.000	0.000

Source: Authors' calculations

4.2 Threshold levels

Figure 2 shows that the GM label, the 5% GM threshold label, and the 1% GM threshold level label receive lower bids than the actual label in 2009. But in 2021, WTPs for the 1% GM content turned out to be slightly higher than the actual label. As expected, a lower percentage of GM content received a higher WTP, and a 1% GM threshold level's average bid was still lower than the GM-free label. Compared to the actual label, percentage discounts increased according to the level of GM content, namely 4.51% for the 1% threshold level and 6.49% for the 5% threshold level in 2009, as shown in Table 10. The 2021 results also followed this pattern but with smaller discounts. It should be pointed out that in Rousu et al. study in 2004, consumers' WTP for 5% GM content was 6.38% to 9.09% lower than non-GM foods, and the range that consumers discounted the 1% threshold was between 8.49% and 18.12%.

Table 10 also shows the percentages of consumers' bidding zero which was 5.71% for the 1% threshold, and 6.67% for the 5% threshold level in 2009. If consumers' acceptance is measured by non-zero bids, consumers in 2021 clearly submitted higher non-zero bids as compared to 2009. The percentage of participants in the Noussair et al. (2004) study who submitted zero bids for the 1% threshold level was 10.7%, higher than this study's results.

Table 10**:** Comparisons between bids for actual labels and different GM threshold labels

	2009			**2021**		
	Popcorn	**Cereal**	**Oil**	**Popcorn**	**Cereal**	**Oil**
Average bid for a "5% GM label" [Standard deviation]	20.37 [13.58]	30.03 [18.53]	30.04 [12.00]	31.17 [23.04]	37.71 [25.33]	39.78 [16.63]
Percentage bidding zero for a "5% GM label"	7.14%	5.71%	7.14%	1.96%	0.00%	0.00%
Percentage discount/premium for a "5% GM label"	-7.28%	-5.91%	-6.28%	-2.28%	-2.19%	0.10%
Average bid for a "1% GM label" [Standard deviation]	21.33 [14.17]	29.39 [17.48]	31.20 [11.86]	32.08 [23.14]	38.69 [26.68]	40.61 [17.62]
Percentage bidding zero for a "1% GM label"	7.14%	5.71%	4.29%	1.96%	1.96%	0.00%
Percentage discount/premium for a "1% GM label"	-2.93%	-7.92%	-2.67%	0.55%	0.36%	2.17%

Note: Average bid for ALL products is not shown since popcorn, cereal, and oil have different market prices.
Source: Authors' calculations

As can be seen in Table 11, GM foods with 1% and 5% threshold levels did not receive higher premiums over GM foods without any stated thresholds for both 2009 and

2021. In 2009, consumers bid the 5% GM labels lower than the 1% GM and the actual labels. Since there is no statistical difference between the 1% GMO content and actual labels (except for cereal), it appears that consumers in 2009 were sensitive to the 5% GMO content more than the 1% content. With such behavior, the 5% threshold level employed by Thailand policy makers since 2003 has met the 2009 consumers' concern. Thai consumers in 2021, however, no longer viewed food with the 5% GMO content as negative as in 2009. The 2021 consumers did not assign lower WTPs to food with 5% threshold, compared to the 1% threshold and regular food. Based on the cost-benefit comparison, when WTP for a 5% GM threshold level and WTP for a 1% threshold level are not perceived differently, a 5% GMO labeling requirement which incurs lower cost of certification would be more advantageous to producers and could be socially desirable.

Table 11**:** P-values from one-sided t-Tests for different GM threshold levels.

Difference between	**2009**			**2021**		
	Popcorn	**Cereal**	**Oil**	**Popcorn**	**Cereal**	**Oil**
"5% GM label" and "GM label"	0.340	0.125	0.336	0.466	0.087	0.040
"1% GM label" and "GM label"	0.187	0.371	0.150	0.321	0.083	0.048
"5% GM label" and "1% GM label"	0.096	0.143	0.042	0.145	0.148	0.166
"5% GM label" and "Actual label"	0.063	0.060	0.047	0.466	0.263	0.488
"1% GM label" and "Actual label"	0.247	0.015	0.202	0.314	0.459	0.262

Source: Authors' calculations

5. Conclusion and implications

Consistent with previous survey results conducted in Thailand, the results from this study show that many Thai consumers did not seem to have strong feelings against GM food in 2009, and the negative attitude continued to be weaker in 2021. If bidding zero signals a complete rejection decision, the percentages of 6.66% in 2009 and 1.96% in 2021 reported in this experiment are lower than experiments conducted on French or even US subjects (see Noussair et al., 2002; Huffman et al., 2003; and Noussair et al., 2004). The average discount when consumers notice GM labels was 6.74% in 2009, and subsequently decreased to 3.08% in 2021. This figure is considered to be in the same range as US consumers, who generally do not have an unfavorable opinion of GMO, unlike the Europeans whose opinions are more unfavorable.

Experimental results show that Thai consumers in 2009 and 2021 regarded 1%, 5%, and higher percentage of GM content indifferently. In terms of cost/benefit comparisons, a mandatory 5% threshold choice could be superior to a 1% threshold since it is less costly to sellers (Rousu et al., 2004). Additionally, the results from this study show that consumers in 2009 did not generally perceive 1% impurity differently from regular food. As segregation costs for the 5% GMO content are expected to be more expensive than the 1% content, the 5% threshold level seems to be more socially desirable than the 1% threshold level.

In 2021, Thai consumers did not prefer a 1% threshold level over a 5% threshold level but prefer a 0% threshold level (or GMO-free). As for the GM-free food sellers, statistical tests show that Thai consumers in 2009 did not view the existing food labels and GM-free food labels differently which implies that there would be no premium for GM-free food sellers who voluntarily post a GM-free statement as well. This preference changed in 2021 as consumers were willing to assign the average premium of 10.94% for GMO-free foods. A more detailed cost analysis is required to determine whether WTP for GMO-free food is sufficiently greater than the associated costs. In addition, GM-free food sellers must also take into account traceability, testing, and segregation costs, and how much of these costs can be passed on to the consumers. Nevertheless, with such

change in consumers' preference over time, a voluntary labeling policy could also be an option for policy makers.

This does not mean that GM sellers have limited opportunities since GMO foods with added benefits is overwhelmingly welcomed by Thai consumers. In 2009, consumers noticed such benefits on the label and were willing to pay higher, though not as high as the GM-free food labels. But in 2021, consumers raised their bids for GM food with added benefits even further and were willing to pay an average premium of 22.31% over regular food. The limitation of this paper is that its focus is only on the nutritional benefits of GM foods which directly affect consumers' health. Other benefits such as shelf-life extension are not explored here.

Future research should be carried out on other aspects of GM food labeling policies, namely how consumers react to different labeling statements, how producers are required to verify GMOs, and whether there is a difference between third-party certification and self-certification. As for Thailand, other crops which are not subject to the current regulations but are crucial to daily consumption such as rice, papaya, and chili peppers should also be studied. Although the sample size employed by this research is rather small, and some may argue that the findings cannot be generalized to cover the entirety of Thai consumers, the results certainly serve as preliminary evidence and have important policy implications. Further research needs to be conducted on Thai consumers using a larger and more representative sample.

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