

Original Article

Attitudes of agricultural scientists in Indonesia towards genetically modified foods*

Judhiastuty Februhartanty MSc¹, Tri Nisa Widyastuti MSc² and Dwi Nastiti Iswarawanti MSc¹

¹*Southeast Asian Ministers of Education Organization (SEAMEO), Tropical Medicine and Public Health (TROPMED), Regional Center for Community Nutrition (RCCN), University of Indonesia, Jakarta, Indonesia*

²*Currently affiliated with Research Triangle Institute (RTI) Indonesia based in South Sulawesi*

Conflicting arguments and partial truths on genetically modified (GM) foods have left confusion. Although studies of consumer acceptance of GM foods are numerous, the study of scientists is limited. Therefore, the main objective of this study was to assess the attitudes of scientists towards GM foods. The study was a cross sectional study. A total of 400 scientists (involved in at least one of teaching, research and consultancy) in the Bogor Agricultural Institute, Indonesia were selected randomly from its faculties of agriculture, veterinary, fishery, animal husbandry, forestry, agricultural technology, mathematics and science, and the post graduate department. Data collection was done by face-to-face interview using a structured questionnaire and self-administered questionnaire. The result showed that the majority (72.8%) of the respondents were favorably disposed towards GM foods, 14.8% were neutral, and only 12.5% were against them. The majority (78.3%) stated that they would try GM food if offered. Most (71%) reported that they were aware of the term "GM foods". Only half of the respondents felt that they had a basic understanding about GM foods. However, based on a knowledge test, 69.8% had a good knowledge score. Nearly 50% indicated that they were more exposed to news which supported GM foods. Over 90% said that there should be some form of labeling to distinguish food containing GM ingredients from non-GM foods. Attitudes were significantly associated with willingness to try GM foods if offered, restrictions on GM foods, and exposure to media reports about the pros and cons of GM foods.

Key Words: attitude, genetically modified foods, intention, knowledge, scientists, Bogor, Indonesia

Introduction

Biotechnology is a rapidly expanding discipline with various applications in the medical, agricultural and food sector. The use of genetic modification in food production is only one example, nevertheless a very important one. It offers new perspectives for product development, cost reduction and environmental protection.¹ Biotechnology in general and genetically modified (GM) food in particular has recently come to the forefront of public attention. Abundant questions are being asked about safety for human health and for the environment, ethics, free consumer choice, socio-economic and legal issues.²

Public support is especially low for biotechnology applications in the food sector.² Europeans show more concern and resistance towards GM food compared with other parts of the world.³ However, an understanding of European consumers' resistance would avoid their characterization as extremely anxious, emotional or even irrational about such foods.⁴ Proponents to GM foods argued that the techniques were safe. They claimed that the major innovation was that genes from very different organisms could be combined. For example, genes from fish, such as flounder, may make tomatoes stay ripe. However, this idea is still conceptual and has not yet worked in practice. The tomato did not have an inserted fish gene.⁵ Furthermore, the

opponents claimed that information about the safety of these products is not adequate.⁶ They were concerned that the product could trigger or introduce toxins and allergens.⁷⁻⁸

Consumer concerns seriously jeopardize the future market success of modern biotechnology products, including GM food products. Consequently, gaining insight into consumer beliefs, attitudes, and behavioral intentions concerning GM food is essential.² There are lessons to be learnt from studies of innovation adoption. First and foremost, for an innovation to be adopted enduringly, it must not only create value but also must deliver meaningful net benefits to all potential adopters.^{4,9}

Corresponding Author: Judhiastuty Februhartanty, SEAMEO-TROPMED RCCN, University of Indonesia, Campus of UI Salemba, Salemba Raya no. 6, Jakarta 10430, Indonesia. PO Box 3852, Jakarta INDONESIA 10038.

Tel: +62-21-31930205; Fax: +62-21-3913933

Email: jfebruhartanty@seameo-rccn.org

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The majority of studies on GM foods focused on determining consumer perception on the issue.^{2,4,6,10-12} Even for consumers in Asia including Indonesia, the majority were unaware of food biotechnology.¹³ However, majority of their attitudes was positive and wanted to know more about the biotechnology.¹⁴

Scientists are themselves a consumer group. However compared to general consumers, scientists are more knowledgeable about GM foods. Many studies have covered the consumer's acceptance or refusal to GM foods but limited ones include scientists as the study subjects. It is very interesting to know more about scientists' attitudes to GM foods since they are also expected to be able to provide explanation and information to other consumers about GM products. Besides, they are also expected to provide information for decision maker with regards to policy related to GM products. Furthermore, they are also the first group to react if any unsafe GM food is entering the market. Indirectly, they help all consumers to be protected.

This study aims to assess the attitudes of scientists (i.e. whether they agree or disagree) about GM foods, and associated matters.

Materials and methods

Subjects

Biotechnology has a close connection with agriculture. Therefore, for this study, the Bogor Agricultural Institute was chosen since it plays a role as a center of excellence in the Asia Pacific region, through science and technology with agriculture as the main competency. Subjects were scientists from the Bogor Agricultural Institute. Scientists were defined as the ones who involve in one or more activities covering teaching, research and consultancy. They were either academic staff or final stage research degree candidates. They must have at least heard or read about GM foods. The subjects were from the faculties of agriculture, veterinary, fishery, animal husbandry, forestry, agricultural technology, mathematics and science, as well as from the post graduate department and recruited randomly.

Permission and other administrative requirements for conducting the study were obtained from the relevant institutions. Ethical clearance was obtained from the Human Ethics Committee of Faculty of Medicine at the University of Indonesia. Prior to the study, the respondents were informed about the purpose of the study and requested to give written consent to participate in this study. Identity of all respondents was held in confidence.

Methods

The study was cross sectional, because it aimed to assess the proportion of scientists with particular views about GM foods. The estimation of required sample size was calculated based on the estimated proportional responses.¹⁵ Since the proportion of scientists in Indonesia who might have positive or negative attitudes was unknown, the authors used 50% for the expected proportion to obtain the biggest minimum sample size. Using this proportion, with a 10% anticipated precision and confidence level of 95%, it was determined that the sample size would be 384 respondents and this was rounded up to

400. The respondents were drawn randomly from eight faculties proportionally based on the total number of scientists available in each faculty.

The questionnaire was a 2-part questionnaire. The first part, conducted through interview, contained three sections: screening questions, demographic information, and questions about attitude, perceived intention, perceived awareness, perceived knowledge and media exposure. Respondents were also asked to fill in a self-administered questionnaire to assess their knowledge about GM foods. Scores were summed and classified as good knowledge (total score was $\geq 70\%$) or poor knowledge (total score was less than 70%).

This survey was undertaken from February to March 2003 at the Bogor Agricultural Institute in Bogor, West Java, Indonesia. Subjects could refuse to take part in the study. Enumerators were trained and questionnaires pre-tested.

Data analysis

SPSS for Windows version 11.0 (SPSS Inc., Chicago, IL) was used. Frequency distribution was used for descriptive analyses and Chi-square, Fisher Exact and Kolmogorov Smirnov tests were used to assess the association. Level of significance was determined when the p value was less than 0.05.

Principal component analysis or factor analysis was employed to check the internal validity for the task at hand for the questionnaire part 2 which was special questionnaire to assess their knowledge.¹⁶ For questionnaire part 1, factor analysis was also carried out to know the most important information or question in a composite variable (i.e. perceived intention, perceived awareness, knowledge, and media exposure). Every composite variable was tested using factor analysis, and the question which had the highest anti image value (a) was considered to be the most reflective question in that group of questions.¹⁶

Results

Table 1 shows that most respondents were from the faculty of agriculture. This faculty is the oldest in the Bogor

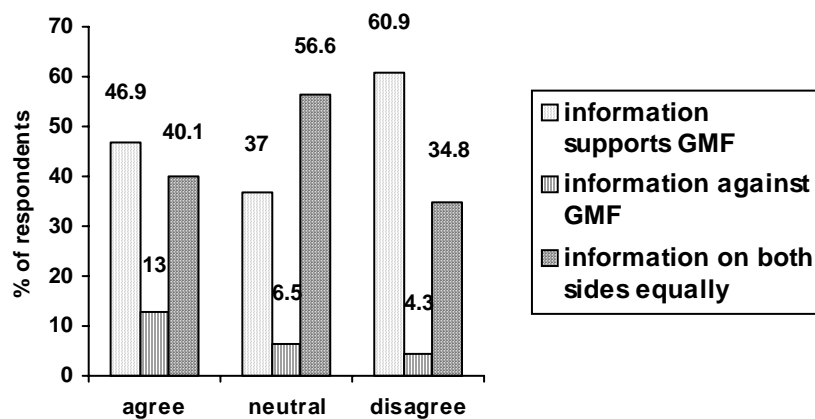
Table 1. Characteristics of the respondents (%)

Variables	Frequency (n=400)
Faculty	
Agriculture	27.0
Veterinary	7.0
Fishery	13.5
Animal husbandry	9.0
Forestry	9.8
Agricultural technology	12.8
Math and science	16.0
Post graduate	5.0
Level of education	
Undergraduate	32.8
Postgraduate	67.2
Sex	
Male	53.5
Female	46.5
Age	
18 – 29 years old	47.2
30 – 39 years old	21.0
40 – 49 years old	21.0
50 – 59 years old	6.8
more than 60 years old	4.0

Table 2. Chi-square analysis (p values) of relationship between factors

	Overall attitude	Willingness to try	Restriction	Knowledge score	Basic understanding	Media exposure
Willingness to try	0.000*	-	-	-	-	-
Restriction	0.011*	0.000*	-	-	-	-
Knowledge score	0.141	0.003*	0.126	-	-	-
Basic understanding	0.266	0.191	0.192	0.000*	-	-
Media exposure	0.048*	0.005*	0.033*	0.711	0.513	-
Educational background	0.799	0.011*	0.944	0.143	0.869	0.647

* Significant different ($p < 0.05$)

**Figure 1.** Association between overall attitude and media exposure

Agricultural Institute and has the largest faculty. A higher proportion of them were with postgraduate degrees. The gender distribution was about equal. Almost 50% of respondents were young scientists aged 18-29 years.

Overall, 73% of those surveyed indicated that they supported GM food developments, 15% were neutral, and only 12% were opposed.

Based on factor analysis, the variable reflecting perceived intention was *willing to try* (i.e. willingness to try if they were offered some GM foods, $\alpha = 0.923$). The variable reflecting perceived awareness was *restriction* (i.e. whether they would apply any restrictions to GM food consumption, $\alpha = 0.693$). The variable reflecting perceived knowledge was *basic understanding* (i.e. whether they had a basic understanding of GM foods, $\alpha = 0.707$). The variable reflecting media exposure was *media exposure* (i.e. the kind of arguments about GM foods they knew from the media, $\alpha = 0.585$).

Based on the above factor analysis, when respondents were asked if they would try GM foods at the time of interview, 78% said that they would, 17% said that they would not, while the rest could not decide. When asked about restrictions to consumption of GM foods, almost 2/3 answered "yes". When they were asked to rate their understanding on GM foods, 49% reckoned they had a basic understanding. With the self-administered questionnaire to assess their knowledge about GM foods, 70% of them were categorized as having a good knowledge score. The majority of respondents (47%) stated that they were more exposed to news which supported GM foods and 11% to news which opposed GM foods.

Table 2 reports the results of two-way cross tabulations of the dependent variable (i.e. attitude) with independent variables (i.e. willingness to try, restriction, knowledge score, basic understanding, media exposure, and educational level) using the Chi-square test. Attitude was significantly associated with willingness to try, restriction, and media exposure. Willingness to try was significantly associated with restriction, knowledge score, media exposure, and education level. Restriction was related to media exposure. Basic understanding and knowledge score were associated.

The association between attitude and willingness to try shows that 90% of those who supported GM foods were willing to try the products. Interestingly, among those who were neutral or against GM foods, over 50% were also willing to try any such products.

Association between attitude and restriction in consuming GM foods reveals that 90% of those who were against GM foods admitted to have restriction. However, a high proportion of respondents who agreed or were neutral towards GM foods also had restriction (69% and 73% respectively).

The association between attitude and media exposure indicates that more of the respondents who were against GM foods were exposed to media with arguments which supported GM foods than those who agreed or were neutral about the issue (Fig 1).

The association between the willingness to try and to apply restrictions to GM food consumption shows that 93% of respondents who would not consume of GM foods were those who would apply restrictions.

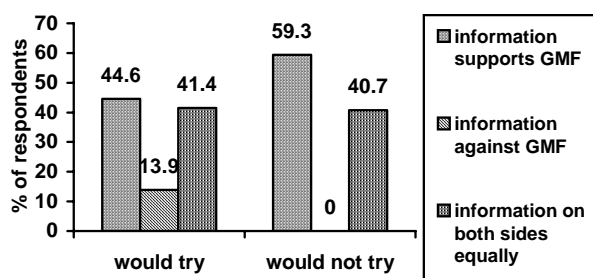


Figure 2. Association between willingness to try and media exposure

Interestingly, 67% of respondents who would try the foods would also restrict.

When “willingness to try” was associated with knowledge score, it was found that those who “would like to try” (74%) had a good knowledge score than those who “would not like to try” (55%).

Association between “willingness to try” and “media exposure” reveals that respondents who would not try GM foods if they were offered were actually more exposed to media presenting arguments which supported GM foods (Fig 2).

Association between willingness to try and educational level tells us that the highest proportion of those who said “would not try if offered GM foods” had a doctoral degree level (60%).

A higher proportion of respondents preferred restrictions, had heard arguments from the media which supported GM foods.

The association between knowledge score about GM foods and basic understanding of GM foods perceived by the respondents, reveals that more respondents who considered they had no basic understanding (66%) were in fact categorized as having a good knowledge score.

Discussion

Interestingly, among those who disagree with GM foods, the majority would try them including consumers in Asia.¹⁴ However, in the present study of scientists, the declined intention to buy was not necessarily affected by potential advantages of GM foods such as better taste or fresher, higher nutritional value in term of more vitamins or less saturated fats, or by affordability if 10% cheaper than conventionally produced food. These may be responses coloured by economic status or considerations.

Most respondents wanted restrictions in the market place for GM foods. The most common restrictions envisaged were on the basis of:

- possible health side effects (long or short term, unknown effects, allergic reactions, toxicity, genetic effects) (72%)
- unclear information (6%)
- religious restrictions (*halal* or not) (3%)

Most scientists (84%) believed their peers to be capable to assess the benefits and risks of GM foods. Most of them (72%) disagreed that the likely risks of GM foods are greater than the benefits.

This finding is a little bit different with a survey that was conducted by Asian Food Information Council (AFIC)

in 2001 among consumers in Asia, which found that around two-thirds sought no restrictions to GM foods.¹⁴

Over 90% of respondents felt that there should be a form of labelling to distinguish food containing GM ingredients from non-GM ingredients. This is not surprising since there are still no regulations about this matter in Indonesia. However, the European Union has passed legislation requiring a label for all foods containing more than 1% of GM ingredients.¹⁷

The overall attitude of respondents was not related to knowledge about GM food. Those who disagreed with GM foods felt there were more disadvantages than advantages. A study by Zechendorf³ found consumer acceptance depends on people’s socio-cultural attitudes as well as knowledge about the benefits of biotechnology. People tend to choose based on perceived advantages or disadvantage. A review of studies among consumers in the developing world concluded that the generally positive perception towards GM foods in developing nations stems from the sense of more urgent need in terms of food availability and nutritional content.¹⁸

The most common perceived advantages of GM foods in this present study were (using their own words) improved eating quality (66%), increased choice (45%), and improved nutritional value (39%). The most common disadvantages perceived were (using their own words) unknown long-term effects (85%), potential allergic reaction (23%), and lack of known safety (23%).

When the scientists were asked, whether they had eaten any foods that contain GM ingredients, the majority of them (62%) said “yes”. Indeed, GM products are available in the Indonesian market as stated by the Indonesian daily newspaper *Kompas* on December 18, 2002.

About half (48%) of respondents felt that they had heard more pro arguments on GM foods, 42 % had heard both sides equally and 11% had heard more contra arguments on GM foods. Figure 1 shows that those who disagreed with GM food were more exposed to information which supported GM foods. This is amazing, considering that over 90% of them using mass media as source of information to find scientific issues including topics related to GM foods. It has been recognized that mass media play an important role in influencing social issues, and GM foods topic is one of them.^{17, 19-21} The mass media helps to shape consumer views by bringing attention to GM food issues.²¹ However, in this present study, the supportive media information on GM foods seemed to have made the respondents more cautious and more critical.

Almost all scientists (98%) said that information about GM foods should be made available in the mass media (TV, radio, newspaper, magazines, internet), followed by public places (supermarket, pharmacy, doctor’s clinic, school/college) at 44%, 40% of respondents felt that information should come from Government/Department of Health, and 39% of respondents felt that information should be available on the product label.

Educational level was not associated with overall attitude. The same is the situation among consumers in Ireland and the United States.¹² This is probably due to an indirect association with the idea through higher educa-

tional level and an associated willingness to try, then later with overall attitude.

The majority of respondents would try GM foods if they were offered. Most said that the idea to clearly label GM foods was excellent. In studies about consumer acceptance, most asked that the regulatory authority requires labels on GM foods.^{12, 17}

Educated people hold their principal/opinion much more strongly. This is shown in Figure 2. Even if they did not know of negative arguments against GM foods, they may not try GM foods. Even when respondents had heard more pro arguments for GM foods from the media, they still had reservations. This was probably because they wanted to be more careful, as scientists, as found by Verdurme et al.² where public support is especially low for biotechnology applications in the food sector, with its health implications.

Where scientists felt that they had no basic understanding, in fact, they had a good knowledge score on GM foods. They were probably being modest or they did not have enough confidence to state that they had the basic understanding. Another reason may be cultural and some reluctance to tell the truth.

An active role of scientists and other relevant parties can be expected in persuading governments about the need for food labelling regulations in regard to research findings about biotechnology in general and GM foods in particular. A recent example of a grassroots action to develop public awareness about labelling of GM foods provided is the website www.thecampaign.com. Further study is needed to address labelling issues as they affect scientists and consumers.

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Judhiastuty Februhartanty MSc¹, Tri Nisa Widyastuti MSc² and Dwi Nastiti Iswarawanti MSc¹

¹*Southeast Asian Ministers of Education Organization (SEAMEO), Tropical Medicine and Public Health (TROPMED), Regional Center for Community Nutrition (RCCN), University of Indonesia, Jakarta, Indonesia*

²*Currently affiliated with Research Triangle Institute (RTI) Indonesia based in South Sulawesi*

印尼農業科學家對基因改造食品的態度

針對基因改造(GM)食品矛盾的論點及部分的真相已經逐漸釐清。雖然研究消費者對 GM 食品的接受度研究很多，但針對科學家所做的研究仍然有限。因此，本研究主要的目的為評估科學家對於 GM 食品的看法。本研究是一個橫斷性研究。隨機選取自印尼 Bogor 農業研究所的農業、獸醫、水產、畜牧、森林、農業技術、數學及科學系所與博士後研究單位，共有 400 名科學家(每個系所至少有一名教學、研究與顧問人員參與)參與研究。面對面訪談，以自填式的結構問卷收集資料。結果顯示大部分的受訪者(72.8%)傾向贊同 GM 食品、14.8%持中立立場，只有 12.5%反對。大部分受試者(78.3%)表示如果提供的話，他們願意嘗試 GM 食品。大部分(71%)自陳他們知道 GM 食品的意涵。只有一半的受訪者認為他們對 GM 食品有基本的了解。然而，根據認知測驗，69.8%有良好的認知分數。將近 50%指出他們接觸到較多支持 GM 食品的新聞。超過 90%的受訪者認為非 GM 食品應該有一些標示，以區別是否為 GM 食品。對 GM 食品的態度與嘗試的意願、GM 食品的規定、接觸到傳播媒體對 GM 食品正反面的報告有顯著的相關。

關鍵字：態度、基因改造食品、介入、認知、科學家、Bogor、印尼。