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Factors for a Socially Acceptable Gene Technology

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ABSTRACT

Public perceptions of biotechnology have received extensive attention in recent years in most Western countries such as Europe, USA and Canada but there have been limited similar surveys in developing countries. Most of the earlier studies used uni-dimensional or bi-dimensional instrument with multi-items or the most is four dimensions with single item. In this study, public attitude towards genetically modified food was based on multi-dimensions and multi-items instrument. Respondents were asked their attitude on genetically modified soybean that is already available in the Malaysian market. A survey was carried out on 440 respondents from various expert groups in the Klang Valley region. In order to detect the structure of attitude amongst the expert group in the Klang Valley region, structural equation modelling (SEM) using AMOS version 5.1 was carried out. Result of the survey has confirmed that attitude towards complex issues such as biotechnology should be seen as a multi-faceted/multidimensional process. The most important factors predicting encouragement of GM soybean are the specific application-linked perceptions about the benefits, acceptance of risk and moral concern while risk and familiarity are significant predictors of benefit and risk acceptance. Researchers, policy makers and industries interested in developing and marketing GM products in Malaysia should consider the various factors mentioned in this study in order to gain public approval.

ABSTRAK

Kebelakangan ini, persepsi masyarakat terhadap bioteknologi telah mendapat liputan yang meluas di negara barat seperti Eropah, USA dan Kanada tetapi masih lagi terhad di negara membangun. Kebanyakan kajian lepas telah menggunakan instrumen satu atau dua dimensi yang berbilang item atau pun instrumen empat dimensi dengan item tunggal. Dalam kajian ini, sikap masyarakat terhadap makanan terubahsuai secara genetik telah dinilai berdasarkan instrumen berbilang dimensi dan item. Kacang soya terubahsuai secara genetik yang telah berada di pasaran Malaysia telah dipilih untuk mewakili makanan terubahsuai secara genetik. Satu soal selidik telah dijalankan ke atas 440 responden yang terdiri daripada pelbagai golongan pakar di kawasan Lembah Klang. Analisis Model Persamaan Berstruktur (SEM) menggunakan perisian AMOS versi 5.1 telah dijalankan untuk melihat struktur

sikap terhadap kacang soya terubahsuai secara genetik. Hasil kajian telah mengesahkan bahawa sikap terhadap isu kompleks seperti makanan terubahsuai secara genetik patut dilihat sebagai daripada pelbagai sudut atau dimensi. Faktor terpenting dalam meramalkan sokongan terhadap kacang soya terubahsuai secara genetik adalah persepsi mengenai faedah, penerimaan risiko dan aspek moral makanan tersebut. Selain itu, faktor risiko dan 'familiarity' turut memberikan sumbangan yang signifikan. Para penyelidik, penggubal polisi dan industri yang berminat untuk membangunkan dan memasarkan produk terubahsuai secara genetik haruslah memberi perhatian yang serius terhadap faktor-faktor tadi bagai memastikan penerimaan masyarakat terhadap produk mereka.

INTRODUCTION

Biotechnology has been identified as one of the five core technologies that will accelerate Malaysia's transformation into a highly industrialized nation by 2020. R&D activities are categorized into seven sectors: namely plant, food, animal, molecular biology, medical, bio-pharmacy and industrial/environmental biotechnology (BIOTEK, 2002). Almost all researches in modern biotechnology in Malaysia are still at the experimental stage except for papaya, modified for delayed ripening, which are already undergoing contained field trial. Although modern biotechnology products developed by Malaysian researchers are not being commercialized yet, modern biotechnology products from other countries are slowly coming in. The only agricultural product/food already officially available in the Malaysian market is Glyphosate resistant soybean for human consumption. Besides soybean, four types of genetically modified corns meant for human food and animals' feed have been submitted by Monsanto to the Ministry of Science and Technology for market approval (Adib 2004). Another 26 biopharmaceuticals produced using modern biotechnology techniques were already registered with the Ministry of Health Malaysia (MOH) for use in this country. The list ranging from different types of insulin for the treatment of diabetes, growth hormones, drugs for the treatment of various kinds of cancers, hepatitis, infertility, autoimmune disorders, organ transplant and infectious diseases.

The advancement in modern biotechnology have been so rapid in the past ten years, it has been the object of an intense and divisive debate in advanced countries. Sagar et al. (2000) suggest that a major factor in the emergence of controversies surrounding biotechnology has been the neglect of the needs, interests and concerns of the primary stakeholders – the commoners. Public perceptions, understanding and acceptance of GMOs can both promote and hamper commercial introduction and

adoption of new technologies (Kamaldeen & Powell, 2000). Various studies have shown that consumer acceptance of modern biotechnology tend to be conditional and dependent on several factors.

Public acceptance can be understood as the combined attitude of individuals on certain political issues, such as those arising from technological innovations (Aerni 1999). An individual's attitude towards a new technology depends on his (or her) perception of its risks and benefits, his socially communicated values and trusts in institutions representing these technologies. Other studies also concluded that the public's main concerns about biotechnology are primarily driven by ethical, value and safety concerns (Einsiedel 1997). Gaskel et al. (2000) used four dimensions of attitude: perceived use, risks, moral acceptability and encouragement to model patterns of European public response to biotechnology.

The studies of public attitude towards biotechnology have many similarities with risk perception studies where the concept of 'risk' and 'attitude towards complex issues' such as biotechnology should be seen as a multi-faceted/multidimensional construct. The key variables of risk perception research are the perceived magnitude of risk or dread, risk acceptance, familiarity with the hazard and lately the factor benefit has gained much interests (Rohrmann 1999). It is the purpose of this paper to analyze the structure of attitude amongst the expert group in the Klang Valley region in Malaysia.

METHODS

Survey Data Collection

This is one of the first in-depth study on attitude towards modern biotechnology in Malaysia. The people in the Klang Valley region were chosen as the targeted population as it is the centre of country's economic and social development (numerous existing universities and R&D institutions, biotechnology related industries) besides the respondents in this region meet the requirement of diverse background stated in the model. The respondents (n=440) were adult representatives (age 18 years old and above) from various interest or stakeholders groups including producers, scientists, policy makers, NGOs, media, politicians and religious experts. The questionnaires were administered face to face to the respondents.

Instrument

The multi-dimensional attitude towards biotechnology instrument used in this study was self-constructed based on earlier researches (Latifah et al. 2004). The instrument incorporated six dimensions of attitude towards

genetically modified soybean (resistant to herbicide): perceived benefits, perceived risks, encouragement, familiarity, moral concerns and risk acceptance.

Perceived benefit scale (α=0.83) comprised of five items: benefit to Malaysian society, enhance quality of product, enhance quality of life, enhance Malaysian economy and benefits exceed risks. Each item was measured on a 7-point scale, ranging from 1(not useful at al for item 1/ strongly disagree for the other items) to 7 (very useful for item 1/ strongly agree for the other items). A higher score indicates higher perceived benefit.

The measure for perceived risk (α=0.85) was obtained by using five items: feelings of anxiety, harm to health, long term effect, catastrophic potential and overall risk magnitude. Each item was measured on a 7-point scale, ranging from 1(not worried at al for the first four items/ no harm at al for the last item) to 7 (very worried for the first four items/very harmful for the last item). A higher score indicates higher perceived risk.

Encouragement (α=0.90) was measured by four items: more rigorous research and development, should be commercialized, should be given monetary support by government and overall encouragement. Each item was measured on a 7-point scale, ranging from 1 (strongly disagree) to 7 (strongly agree). A higher score indicates higher encouragement.

Familiarity (α=0.68) comprised of four items: easy to know, easy judgment, effect known and controllability. Each item was measured on a 7-point scale, ranging from 1(not easy at al for the first two items/ strongly disagree for the remaining two items) to 7 (very easy for the first two items/ strongly agree for the other items). A higher score indicates greater familiarity.

Moral concern (α=0.85) was assessed by asking the respondent three questions related to whether the application threaten natural order of things, likened as 'play God" and regarded as co modifying life. Each item was measured on a 7-point scale, ranging from 1 (strongly disagree) to 7 (strongly agree). A higher score indicates higher moral concern.

Measure for risk acceptance (α=0.87) comprised of three items: accept risk if it can boost Malaysian economy, societal risk acceptance and risk minimal in comparison with other risks. Each item was measured on a 7-point scale, ranging from 1(not willing at al for the first item/ not acceptable for the second and strongly disagree for the last item) to 7 (very willing for the first item/very acceptable for the second item and strongly agree for the last item). A higher score indicates higher risk acceptance.

Statistical Analysis

Initially reliability tests and confirmatory factor analysis were carried out using SPSS version 12.0 to assess the consistency and uni-dimensionality of the constructs. Then correlational analyses were carried out at a bivariate level followed by structural equation modelling (SEM) analyses using AMOS version 5.1 to test the interrelationships among all variables which correlated at the bivariate level (Brathwaite &Ahmed 2004)

RESULTS AND DISCUSSIONS

Confirmatory Factor Analysis

Confirmatory factor analysis (CFA) was carried using SPSS version 12.0 to assess the construct validity. CFA yielded six factors with eigenvalues greater than 1.0, with all items having a loading of 0.35 and above (Table 1). The loadings were considered very significant (Hair et al. 1992).

Table 1. Confirmatory factor analysis of the attitude items

Item	Factor Loadings					
	Factor 1: Encouragement	Factor 2: Perceived Risks	Factor 3: Perceived Benefits	Factor 4: Moral Concern	Factor 5: Risk Acceptance	Factor 6: Familiarity
1. Should be given monetary support by govt.	0.86					
2. Overall encouragement	0.80					
3. More rigorous R&D research	0.77					
4. Should be commercialized	0.76					
5. Concern of harm to health		0.85				
6. Long term effect		0.84				
7. Catastrophic potential		0.83				
8. Feelings of anxiety		0.79				
9. Overall risk magnitude		0.35				
10. Benefit to Malaysian society			0.72			
11.Enhance Malaysian economy			0.69			
12. Enhance quality of life.	0.39		0.69			

Cont….

Cont…..

13. Enhance quality of food.	0.41		0.68			
14. Benefits exceed risks			0.59			
15. 'Play god'				0.86		
16. Commodify life.				0.85		
17. Threaten natural order of things				0.78		
18. Willingness to accept some risks					0.82	
19. Risk acceptance by Malaysian society					0.81	
20. Comparison with other risk					0.69	
21. Easy judgment						0.82
22. Easy to know/identify						0.77
23. Effect known						0.76
24. Controllability						0.43

Note: Only factor loadings greater than or equal to 0.35 were recorded for ease of ease of interpretation.

Correlational Analysis

In order to examine the relationships among the dimensions of attitude towards genetically modified soybean (GM soybean) at a bivariate level, Pearson correlations were carried out. From Table 2, it can be seen that there are significant correlations between the dimensions of attitude towards GM soybean. Familiarity was found to be positively correlated to

Table 2. Correlation coefficients between attitude dimensions towards modern biotechnology constructs

Attitude Dimension	Familiarity	Moral concerns	Risk	Benefit	Risk acceptance	Encouragement
Familiarity	-	-0.15**	-0.03(ns)	0.22**	0.20**	0.25**
Moral concerns		-	0.32**	-0.35**	-0.36**	-0.43**
Risk			-	-0.42**	-0.48**	-0.40**
Risk acceptance				-	-	0.57**
Benefit					-	0.58**

**$p < 0.01$

benefit, risk acceptance and encouragement of GM soybean while moral concerns and risk aspects of GM soybean were positively correlated to

each other but were negatively correlated to all other dimensions of attitude. The remaining two dimensions: benefit and risk acceptance were found to be positively correlated with each other and also with encouragement.

Structural Equation Modelling (SEM)

In order to understand interrelationships between all constructs which was impossible at the bivariate level, SEM was carried out. Figure 1 shows the final structural model using AMOS version 5.0 with maximum likelihood estimation. The fit indexes indicated a good fit for this model, with χ^2/df ratio of 2.20 and RMSEA value of 0.05. (Kline 1998, Browne & Cudeck 1993).

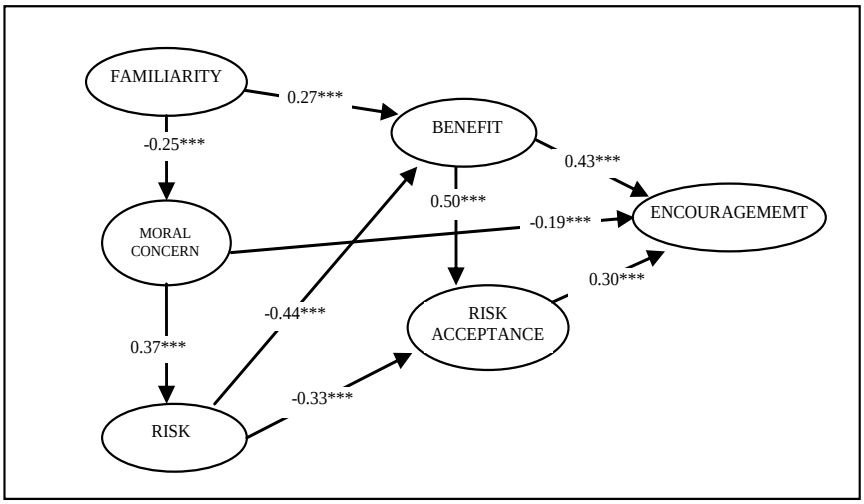

Figure 1. Structural Equation Model showing interrelationships amongst relevant variables.
Notes: Standardized estimates are presented. ***p < 0.001

Interrelationship between attitude dimensions

As can be seen in Figure 1, the six dimensions of attitude towards GM soybean are interrelated. Benefit (β=0.43, p<0.001) and risk acceptance (β=0.30, p<0.001) are strongly associated with encouragement of GM soybean while benefit also have strong positive relationship with risk acceptance (β=0.50, p<0.001). The findings in this study are supported by some of the earlier study on public perception towards modern biotechnology. Data from the fourth Eurobarometer survey (Gaskell et al 2000) suggested that perceived benefit was found to be a pre-condition for Europeans support towards seven applications of biotechnology. The

role of the benefit factor can be seen clearly in our SEM model. It is an important moderating factor for perceived risk in order for the risk to be accepted. Even though GM soybean is seen as having some risks but if the benefit is clear to the consumers, the risk become acceptable and the application will be encouraged.

Risk shows a strong negative relationship with benefit (β=-0.50, $p<0.001$) and also has significant negative association with risk acceptance (β=-0.33, $p<0.001$) (Figure 1). Earlier researches have suggested an inverse relationship between risk and benefit (Alhakami & Slovic 1994, Gaskell et al 2000). If the perceived risks are very severe, no amount of benefit are liable to make the risk acceptable (Hansen et al 2003, Rowe 2004).

Moral concern shows significant relationship with risk (β=0.37, $p<0.001$) and also a direct negative relationship with encouragement (β=-0.19, $p<0.001$). If the biotechnology application has high moral concern, it will also accentuate the perceived risk. Gaskel et al (2000) suggested that the moral aspects of modern biotechnology applications appeared to act as a veto for the support of biotechnology applications. Even though the application may have clear benefit, but if it is seen as having high moral concerns, it will not be encouraged.

Familiarity is another important dimension in risk perception studies (Rowe 2004). It has significant positive effect on benefit (β=0.27, $p<0.001$) (Figure 1) but negative relationship with moral concerns. The more familiar the biotechnology product, more benefit is associated with it but the opposite applies to moral concerns.

CONCLUSION

As can be seen from the results from SEM results in Figure 1 which has been discussed in section 3.0, attitude toward genetically modified food such as GM soybean is a complex issue which involved the interplay between many factors. This study has confirmed that attitude towards complex issues such as GM food should be seen as a multi-faceted/multidimensional process. The most important factors predicting encouragement of GM soybean are the specific application-linked perceptions about the benefits, acceptance of risk and moral concern while risk and familiarity are significant predictors of benefit and risk acceptance. Researchers, policy makers and industries interested in developing and marketing GM products in Malaysia should consider the various factors mentioned in this study in order to gain public approval.

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