PUBLIC PERCEPTION OF THE ETHICAL ASPECTS OF CROSS-SPECIES GENE TRANSFERS IN ANIMALS

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Abstract: The purpose of this paper is to examine the ethical perception of modern biotechnology in general and several cross-species gene transfers in animals among the Malaysian public. Results from the survey on 434 stakeholders showed that the respondents did not perceived modern biotechnology as very threatening to the natural order of things and recognized the high promise that modern biotechnology could provide to society. However they also stressed that human does not have the absolute rights to modify living things and perceived modern biotechnology in general as moderately risky, have moderate confidence on biotechnology regulation and stressed the high need for proper labeling of modern biotechnology products. The stakeholders also claimed that they were not very familiar with the four biotechnology applications surveyed. Animal to animal gene transfers were perceived as more beneficial, less risky and more acceptable compared to the transfers of human or synthetic human genes into animals.

Keywords: Cross-species gene transfer, Ethical aspects, Malaysia, Modern biotechnology, Perception

INTRODUCTION

Man has always been very creative and has created various skills and sophisticated technologies in the name of development. Although new technologies hold great promises for the betterment of society but there have also been many controversies surrounding them. One of the most controversial technologies in the 21st century is modern biotechnology. In Malaysia, biotechnology has been identified as one of the five engine of growth that will transform Malaysia into a highly industrialized nation by 2020 [1]. Successful development and commercialization of modern biotechnology products in Malaysia depends greatly on their acceptance by the Malaysian public. In order to benefit from the usage of modern biotechnology techniques, their acceptance by the Malaysian consumers has to be addressed [2]. Sjoberg [3] argued that public reactions and attitudes to gene technology need to be seriously studied due to its impact on policies acceptance. Modern biotechnology is still considered as new and not very familiar by the lay people. On the other hand, the advancement in modern biotechnology has been so rapid in the past fifteen years making it the object of many doubts, fears, concerns, as well as being debated intensely worldwide on its safety to human health, the environment and the society [4]. The debate was often perceived as a conflict between the supporters of modern biotechnology who emphasized on its potential benefits and the opposition who claimed that genetic modification (GM) technology as tampering with nature [5].

Batalion [6] proposed that the central problem with GM technology is not just limited to its possible long term risks but the technology itself is seen as trying to "control" living nature based on mechanistic view. Most people have conscience and religious beliefs and many religious beliefs do not

allow unrestricted interference with life such as can happen with GM technology [7]. The rate of development in modern biotechnology has been very rapid which have bred anxiety of technological compulsion ('if we can do it, let's do it') before considering the propriety or ethical consideration of the developments [8].

Furedi [9] argued that risk perceptions at individual or societal level as realted to moral values. According to him, people were found to be willing to accept some level of risk, if a product was perceived as useful and was not objectionable morally. A study carried out by Eisendel [10] showed that the Candiand perceived moral acceptance as the strongest predictor of support for biotechnology compared to usefulness and perceived risk. Gaskell et al. [11] also found that moral acceptability act as a veto for the support of biotechnology among the Europeans. The US people [12] also used moral reasoning in their opinions towards six applications of biotechnology.

The moral or ethical concerns related to modern biotechnology can be categorized into two classes: intrinsic and extrinsic [13]. Extrinsic objection refers to the concerns regarding the possible concerns and risks of different application of biotechnology to human health, environment, economy and society [14]. The societal concerns include the need for labeling [15], patenting rights of the Scientists [16] while the economic concerns include denying the benefits of modern biotechnology to society, economy and the farmers [17], monopoly of modern biotechnology products market by giant companies [18].

On the other hand, intrinsic objection refers to the concerns on the process of modern biotechnology itself [13]. The technology has been perceived as unnatural, tempering with Nature and playing "God". Other researchers have claimed that GM biotechnology is seen as threatening the natural order of living things and argued whether human has the rights to modify living things for their benefits [17]. The intrinsic concerns may also include religious beliefs and principles held by people concerning the relationships between human beings and God [17]. Unrestricted interference with life such as GM technology are not allowed by many religions [7].

The objective of this paper is to assess the ethical perception of modern biotechnology in general and four examples of gene transfers in animals among the Malaysian public.

METHODOLOGY

Data for this study was collected by means of a survey carried out from early August 2009 to early February 2010. The multi-dimensional instruments to measure ethical aspects of modern biotechnology and applications used in this study were constructed based on the work of earlier researches [13, 14, 17, 19. 20, 21] and validated and in earlier study [22, 23]. All items were measured on 7 point Likert scales. The questionnaires were administered face to face to 434 adult respondents (age 18 years old and above) in the Klang Valley region. The respondents were stratified according to stakeholders' groups which consisted of eleven groups: producers, scientists, policy makers, NGOs, media, religious scholars, university students and consumers. Data analysis was carried out using SPSS version 14.0.

RESULTS AND DISCUSSION

Ethical Dimensions and reliability

An exploratory principal component factor analyses followed by varimax rotation were carried out to identify items best expressive of ethical dimensions. Seven factors with eigenvalues greater than one were extracted and were able to account for the majority of the variances in responses (66.7%) indicating this is a good instrument that can measure the general ethical aspects of modern biotechnology. Table 1 shows the results of principal component factor analyses using varimax rotation. This rotation yielded meaningful item groupings or dimensions with strong unambiguous loadings. All of the factor loading values were greater than 0.4, which can be considered as more significant as suggested by Hair et al.(22).

The first factor or dimension was interpreted as market monopoly by giant companies and developed countries, where five items strongly loaded on it. The second dimension with four items strongly loaded on it was labeled as general concerns. The third dimension clearly reflected the labeling aspects of biotechnology and was named as the need for proper and appropriate labeling, and four items strongly loaded on it as well. Five items were salient to the fourth factor which labeled as threatening the natural order of things. The fifth factor, which was made up of another five items represented general promise. Another three items reflected the sixth dimension, described as public confidence on government regulation related to modern biotechnology.

Table 1: Factor loadings and Cronbach's alpha values of general ethical aspects of modern biotechnology

Dimensions and items	Factor loading	α
Monopoly		0.84
Product market dominated by giant companies	0.80	
May cause economy divide	0.75	
Bring increase in bioterrorism	0.65	
Global market monopolized by developed countries	0.80	
Industry encouraged to patent their innovation	0.54	
General concern		0.85
Babies may become premature	0.87	
Increase human fatality	0.76	
Give rise to unknown diseases	0.80	
May cause the transfer of animal disease to human	0.75	
The need for labeling		0.86
Labelling is producer's responsibility	0.48	
Labelling to differentiate GM and non-GM products	0.86	
Labeling to give information	0.86	
Labelling important for allergic people	0.72	
Threaten natural order of things		0.78
Modification considered over the limit	0.71	
Cross the natural boundaries between different species	0.76	
Interfere with the living organism natural integrity	0.77	
Modern biotechnology considered as blasphemy	0.73	
Equal status between non-living and living organisms	0.50	
General promise		0.86
Enhance food quality	0.88	
Enhance Malaysian economy	0.80	
Useful to fight Third World hunger	0.80	
Patent needed to protect scientist IP rights	0.80	
Reward to cover developmental cost	0.62	
Confidence on regulation		0.75
Regulation adequate	0.76	
Efficient monitoring by Govt dept	0.80	
Adequate regulation on GMOs failure	0.83	
Human rights to modify living things		0.53
Human has the right to modify living thing	0.59	
If animal do not feel pain, human can modify their genetics makeup	0.76	
The use of animals is appropriate	0.76	

The items included whether the respondents agree that the regulation related to modern biotechnology and the regulatory action on experimental failure of genetically modified organisms is adequate in protecting the safety of Malaysian society and whether the government department involved in modern biotechnology regulation has monitored the safety of modern biotechnology products efficiently. The last three items were most salient to the seventh dimension related to whether human possess the rights to modify living things. Cronbach's coefficient was used to calculate the reliability of all dimensions. As Table 1 shows, the standardized alpha coefficients of all dimensions were acceptable (23).

Table 2 displays the specific ethical dimensions of transgenic animal. Four factors with eigenvalues greater than one were extracted and were able to account for the majority of the variances in the responses indicating that this is a good instrument that can measure the ethical aspects of transgenic animal. Varimax rotation yielded strong unambiguous loadings with factor loading values greater than 0.4. The first dimension representing familiarity consists of four items (Table 2). Five items related to specific risks of GM animal labeled as perceived risks while another three items which are strongly loaded on the third dimension was interpreted as denying the benefits of transgenic animal to the society and country. The fourth dimension with five items reflected the ethical acceptance of transgenic animal. As Table 2 shows, the standardized alpha coefficients of all dimensions were acceptable (23).

Ethical perception of modern biotechnology

Stakeholders' perception towards ethical aspects of modern biotechnology generally were analyzed based on seven dimensions: threatening natural order of living thing, general concerns, human rights to modify living thing, the needs for labeling, general concerns, monopoly by giant companies and developed countries and control on biotechnology regulation. Overall, the Klang Valley public perceived modern biotechnology as not very threatening to the natural order of things (mean score 3.76) and recognized the high promise that modern biotechnology could provide to society (mean score 5.31)(Table 3). However they also stressed that human does not have the absolute rights to modify living things (mean score 3.55), perceived modern biotechnology as having moderately concerns (mean score 4.59) and expressed high degree of concerns that the global market of modern

biotechnology is being monopolized by the big companies and the developed countries with a high mean score of 5.05. The respondents exhibited only moderate confidence on government regulations (mean score 4.09) and expressed high level of need for the proper labeling of modern biotechnology products (mean score of 5.70).

Ethical perception of cross-species gene transfers

Perceptions towards four types of cross-species gene transfers in animals were analyzed based on four dimensions: familiarity, perceived risks, denying benefits if it is not developed and ethical acceptance. The four types of gene transfers surveyed are: the transfer of *Chinook* salmon's growth gene into *Atlantic* salmon to enhance faster growth, the transfer of cow's albumin gene into chicken egg to enrich its protein content, the transfer of human mammary gene into sheep to produce mother's milk and the transfer of synthetic human mammary gene into sheep to produce mother's milk (Table 4).
The respondents claimed that they were not very familiar with all types of transgenic animals (mean score below the mid-point value of 4.0) (Table 2). This finding is not surprising as modern biotechnology has been associated with being 'novel' and 'complex' with only moderate level of awareness and knowledge among the public [24], no mandatory labelling of modern biotechnology products in Malaysia and limited periodic coverage on modern biotechnology issues in the Malaysian general mass-media. This situation is not unique to Malaysians. The public in the United Kingdom was also found to have low familiarity with GM foods [25].

Gene transfers in animals were not perceived as very beneficial by the respondents (mean score below the mid-point value of 4.0). Comparing across different type of gene transfers, the benefits of animal to animal gene transfers were perceived as being more denied if the applications were not carried out compared to the transfer of human or synthetic human genes into animals. The most beneficial application was attributed to the transfer of *Chinook* salmon's growth gene into *Atlantic* salmon which involved same species gene transfer (fish to fish) followed by the transfer of cow's albumin gene into hen to enrich the protein content in the chicken eggs (different species gene transfer). The transfer of human genes into animals was ranked as the least beneficial. It looks like the Malaysian respondents were sensitive of the usage of human genes in food. Even in the case whereby the human mammary gene

was synthetically made, its usage in food was still not favoured (Table 2)

Table 2: Factor loadings and Cronbach's alpha values of ethical aspects of GM animals

Dimensions and items	Factor loading	α
Familiarity		0.79
Easy to judge	0.83	
Easy to know	0.77	
Effect well known	0.79	
Information adequate	0.72	
Perceived Risks		0.78
Threaten natural order of things	0.64	
Playing God	0.73	
Reduce status of living things to machines	0.75	
Extinction of original species	0.64	
Ecosystem imbalane	0.64	
Worry to consume	0.60	
Denying benefits		0.79
Improvement of Malaysian society denied	0.67	
Improvement of farmer's life denied	0.70	
Boost of country's economy denied	0.74	
Usefulness to fight third world hunger denied	0.68	
Ethical acceptance		0.84
More intensive development	0.80	
More financial support from govt	0.80	
Should be encouraged	0.77	
Should be commercialized	0.76	
Risk minimal compared to other dangers	0.46	

Table 3: General ethical perceptions of modern biotechnology

Ethical dimensions	Mean score ± std dev.	
Threatening the natural order of things	3.76 ± 1.14	Moderate
Risks to human health	4.59 ± 1.11	Moderate
Human rights to modify living things	3.55 ± 1.18	Moderate
Monopoly by giant companies and developed countries	5.05 ± 1.02	High
The need for proper and appropriate labeling	5.70 ± 1.20	High
Perceived benefits	5.31 ± 1.17	High
Confidence on government regulation towards GMO	4.09 ± 1.11	Moderate

*1-2.99: low, 3.00-5.00: moderate, 5.01-7.00: high

Table 4: Ethical perception of cross-species gene transfers

Ethical dimension	Overall mean score			
	The transfer of *Chinook* salmon's growth gene into *Atlantic* salmon	The transfer of cow's albumin gene into chicken egg	The transfer of human mammary gene into sheep	The transfer of synthetic human mammary gene into sheep
Familiarity	3.25[1]	3.16[2]	3.08[4]	3.12[3]
Denying benefit	3.90[1]	3.87[2]	3.68[4]	3.69[3]
Perceived risk	4.02[4]	4.21[3]	4.53[2]	4.62[1]
Ethical acceptance	4.48[1]	4.24[2]	3.58[4]	3.65[3]

[1,2,3,4] ranking

All type of gene transfers in animals surveyed was perceived as risky (mean score above the mid-point value of 4.0). The highest risk was associated with the transfer of synthetic human mammary gene into sheep to produce mother's milk followed by the non-synthetic version. The same species gene transfer (fish to fish) was perceived as less risky followed by the cow's gene into hen.

The pattern of ethical acceptance follows the beneficial ranking but opposite the risk ranking. Animal to animal gene transfers were found to be more acceptable ethically (mean scores below the mid-point value of 4.0) compared to human or synthetic human gene transfers to animal (mean scores above the mid-point value of 4.0). This pattern can be explained by the balancing relationship between the benefits of the application to consumers and the involvement of inter-species gene transfers. Benefit has been found to be inversely related to perceived risks while moral concern was positively related to risks [26]. If the application has clear benefits to consumers and does not involve interspecies gene transfers, the risks aspects will be perceived as lower and vice-versa. In the 1993 International Bioethics Survey [27], cross species gene transfers (animal-plant and human-animal) also garnered much lower support in all countries. Gaskell et al. [11] also noted that moral acceptability appeared to act as a veto. If the moral concern is high, the risk associated with the modern biotechnology application is also perceived as high. These can be seen across the applications. All the applications surveyed have potential benefits to the consumers but if the ethical acceptance was low, the applications would be perceived as less beneficial and more risky.

CONCLUSION

Overall the respondents did not perceived modern biotechnology as very threatening to the natural order of things and recognized the high promise that modern biotechnology could provide to society. However they also stressed that human does not have the absolute rights to modify living things and perceived modern biotechnology in general as moderately risky, have moderate confidence on biotechnology regulation and stressed the high need for proper labeling of modern biotechnology products. The stakeholders also claimed that they were not very familiar with the four biotechnology applications surveyed. The low level of familiarity also indicates the need for more dialogues, forums and more balanced information in the media to be made available to the public. Animal to animal gene transfers were perceived as more beneficial, less risky and more acceptable ethically compared to the transfers of human or synthetic human genes into animals. The use of human genes in food is considered not acceptable ethically. It is suggested that the scientists and industries should be more careful in the selection of gene sources and assess the benefit, risk and moral aspects of any new biotechnology applications/products before embarking on R&D and commercialization to avoid the loss of huge amount of financial and labour investments if the products turn out to unacceptable to consumers. It is also recommended that the related government regulatory bodies in Malaysia to be more visible and responsible in setting the direction and pace of development to prevent questionable or premature commercialization of biotechnology applications/products. Labeling of modern biotechnology products is also recommended to increase consumers' confidence on the products besides the need to make available scientific evidence on the safety of modern biotechnology products by independent researchers.

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