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Genetic engineering and the public: Attitudes, beliefs, ethics and cows.

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ABSTRACT

A postal survey (n = 1682, margin of error 3%) used a hypothetical milk product with medical benefits produced by genetically engineered (GE) cows as a stimulus to examine New Zealanders' support and attitudes towards GE for food and medicine. Beliefs about proposed benefits of GE, ethical issues associated with GE, and ethical perceptions about the status and treatment of cows were canvassed. Ten times as many respondents totally opposed GE food as totally supported it. Medical applications (15.6%) received significantly more total support than GE food production (3.4%). A majority of respondents were prepared to support GE under some circumstances (medicine 61.8%, food 51.7%) - implying their need for case-by-case analysis. Respondents disagreed GE will: cure the world's major diseases, solve the world's food problems, improve the quality of animal lives, be environmentally benign, or that the spread of GE organisms can be controlled. GE did not fit with respondents' cultural and spiritual beliefs or basic principles. Although agreeing the instrumental use of cows by humans was acceptable, respondents strongly disagreed genetic modification of cows for human benefit was acceptable. Consistent significant differences were found between males and females on all the above issues.

Keywords: attitudes; outcome beliefs; genetic modification; food; medicine; ethics; cows.

INTRODUCTION

In New Zealand and around the world, researchers are genetically modifying crops and animals for food production and medical applications. The New Zealand Royal Commission on Genetic Modification (RCGM), considering genetic engineering (GE) and genetic modification (GM) equivalent, defined GM as: "the deletion, change or moving of genes within an organism, or the transfer of genes from one organism to another, or the modification of existing genes or the construction of new genes and their incorporation into any organism" (Royal Commission on Genetic Modification, 2001).

Proponents of GE believe it holds great potential to alleviate a number of the worlds' ills. They claim that the technology is safe and that it is crucial to New Zealand's economic and scientific development (Fletcher, 2001; Jordan, 2001). Opponents consider GE either intrinsically unethical (e.g., disrespectful to nature, usurps the role of God), too risky (e.g., benefits of adoption are uncertain, possibly dangerous to persons or environment), or unnecessary – safer, less-disturbing alternatives exist to achieve the desired ends (Straughan, 1995a, 1995b; Antoniou, 1996; Anon, 2000).

Local and international surveys report public opposition to GE (European Commission, 2000; Gamble– *et al.*, 2000). Reasons for this opposition include GE being considered unnatural, unwholesome, morally dubious and leading to negative consequences preventing happiness and inner harmony. Furthermore, it conflicted with values like responsibility for nature and responsibility for the welfare of other people (Bredahl, 2000). However, acceptance (or opposition) is complex – New Zealanders may be accepting of GE for medical technologies but not food (Royal Commission on Genetic Modification, 2001) as has been noted overseas (Frewer & Shepherd, 1995; Hamstra & Smink, 1996).

The success of any product depends on its market uptake, which in turn depends on how it is perceived (Bredahl, 2000). Attitudes, beliefs, and ethical perceptions are crucial to determining the likely uptake of GE technologies in New Zealand. In this study, as a stimulus for thought, we surveyed the public's general attitudes and beliefs about GE using a hypothetical milk product derived from genetically modified cows. Because the product was produced by genetically modifying cows, we considered it important to survey the public's ethical perceptions about the status and treatment of cows. The data are preliminary results from a larger project designed to develop a model for determining consumer attitudes to GE and of their intentions to purchase a specific GE milk product.

MATERIALS AND METHODS

The focus for the survey was a hypothetical milk product derived from genetically modified cows. The milk product provides extra resistance to the organisms that cause gastroenteritis. It was emphasized that this was a hypothetical product (no such product actually existed), no work was being done to produce such a product, and there are no genetically modified milk products currently available in New Zealand. The survey was constructed to measure the variables of interest determined from a literature review – variables reported in this paper are general attitudes to GE, beliefs about the consequences of GE, ethical considerations about GE and ethical considerations about cows.

Each variable was defined by specific sets of items (questions or statements). The order of the items was randomized so that items measuring a specific variable were intermixed with items measuring other variables. Most items consisted of statements with which the respondent was asked to agree or disagree. The scale was not numerically anchored; respondents were asked to put a mark on a line composed of 20 dashes at the point that best represented their opinion. The researchers gave a numerical value between 1 (strongly agree) and 20

(strongly disagree) to the responses based on the location of the respondent's mark. The scale was anchored at either end with 'Strongly agree' at one end and 'Strongly disagree' at the other end. At the midpoint was the anchor: 'Neutral'. To one side of the scale respondents could tick a box if they judged the question to be not applicable to themselves or if they did not know. Two questions requiring categorical responses were asked regarding respondents level of support for GE.

The survey was distributed by post (March – June 2001) to a random sample of 3000 New Zealanders over the age of 18 years, stratified according to income and region. Analysis of the data was completed using Excel, Genstat and SAS. Descriptive statistics (percentages, means, standard deviations and standard error of means) were calculated. Two-tailed t-tests were used to test the non-directional hypotheses that level of agreement to variable statements differed significantly from the neutral mid-point (10.5) of the scale. Observed differences in the data between male and female mean responses indicated

the value of conducting *post hoc* two-tailed t-tests to test the non-directional hypotheses that male and female mean responses differed significantly. Contingency table Chi Squared tests were used to test the significance of differences between responses in the categorical questions.

RESULTS
Sample characteristics

A total of 1682 usable surveys were received, giving a margin of error of 3% with a 95% confidence interval and a response rate of 56%. Nearly 53% (n = 885) of respondents were female, 47% (n =786) respondents were male and 0.7% (n =11) did not report gender. About 85% (n = 1427) classified themselves as NZ European, while 5.4% (n = 90) identified as Maori, and the remaining 9% were either composed of other ethnic minorities or did not report their ethnicity.

TABLE 1: Respondents' support for food production and medical applications of GE by gender and total sample

GE application	% Totally supportive		% Circumstantial support		% Totally opposed		% Don't know	
	Total	Male / female	Total	Male / female	Total	Male / female	Total	Male / female
Food Production	3.4	5.9 / 1.1	51.7	58.5 / 46.0	36.0	29.1 / 42.1	8.2	6.1 / 9.9
Medical applications	15.6	23.4 / 8.0	61.8	60.1 / 63.4	13.6	11.5 / 15.5	8.4	5.0 / 11.6

Notes: n = 1682, 95% confidence interval margin of error ± 3%

TABLE 2: Respondents' mean ± SD agreement with beliefs regarding consequences of GE technologies in general by total sample and gender.

Beliefs about the consequences of GE	Total Sample	Male	Female
Genetically engineered products are environmentally friendly	14.7 ± 4.9***	13.7 ± 5.1***	15.6 ± 4.5***
The spread of genetically modified organisms can be controlled	15.5 ± 5.0***	14.9 ± 5.0***	16.1 ± 4.9***
Genetic engineering technology will solve the world's food problems	13.2 ± 5.9***	12.3 ± 5.9***	14.1 ± 5.7***
Genetic engineering will cure the world's major diseases	13.0 ± 5.6***	11.9 ± 5.8***	14.0 ± 5.2***
Genetic engineering will improve the quality of animal lives	14.5 ± 4.9***	13.5 ± 5.0***	15.6 ± 4.5***

Note: Significance (2-tailed t-test) indicates difference of mean from neutral mid-point (10.5) of scale
Scale: 1 = Strongly agree, 10-11 = Neutral, 20 = Strongly disagree
*** = P<0.001

TABLE 3: Respondents' mean ± SD agreement with ethical statements regarding GE technologies in general by total sample and gender.

Ethical perception	Total sample	Male	Female
Using genetic engineering fits with my cultural and spiritual beliefs	15.0 ± 5.1***	13.5 ± 5.4***	16.2 ± 4.4***
Using genetic engineering fits with my basic principles	14.8 ± 5.3***	13.3 ± 5.6***	16.1 ± 4.5***
Using GE is acceptable to me even if it causes harm to animals	17.4 ± 3.9***	16.7 ± 4.4***	18.1 ± 3.2***
Using GE is acceptable to me even if causes harm to the environment	18.3 ± 2.9***	17.9 ± 3.3***	18.6 ± 2.4***
Using GE is acceptable to me even if it causes harm to people	18.7 ± 2.8***	18.5 ± 3.1***	19.0 ± 2.4***
Using GE is acceptable to me if it provides food for the hungry people of the world	10.6 ± 6.3NS	9.7 ± 6.4***	11.3 ± 6.2***

Note: Significance (2-tailed t-test) indicates difference of mean from neutral mid-point (10.5) of scale
Scale: 1 = Strongly agree, 10-11 = Neutral, 20 = Strongly disagree
*** = P<0.001

TABLE 4: Respondents' mean ± SD ethical perceptions regarding the status and treatment of cows by total sample and gender.

Ethical perception	Total sample	Male	Female
I primarily value cows for their potential use by humans	7.1 ± 4.9***	6.3 ± 4.4***	7.8 ± 5.2***
Cows have the same rights as humans	11.8 ± 6.2***	13.2 ± 5.8***	10.7 ± 6.2NS
It is acceptable for humans to eat cows and their by-products	4.7 ± 4.0***	4.2 ± 3.6***	5.2 ± 4.2***
It is acceptable to genetically modify cows for the benefit of humans	14.0 ± 6.0***	12.6 ± 6.2***	15.3 ± 5.4***
Cows think, have feelings, and feel pain in a similar way to humans	8.1 ± 5.6***	8.7 ± 5.6***	7.6 ± 5.5***
Human welfare should take precedence over the welfare of cows	8.1 ± 6.2***	7.5 ± 5.9***	8.7 ± 6.5***

Note: Significance (2-tailed t-test) indicates difference of mean from neutral mid-point (10.5) of scale
Scale: 1 = Strongly agree, 10-11 = Neutral, 20 = Strongly disagree
*** = P<0.001

General attitudes and support for GE

More people totally opposed GE (food 36%, medicine 13.6%) than totally supported it (food 3.4%, medicine 15.6%). However, a large middle group was prepared to support GE food (51.7%) or GE medicine (63.4%) in some circumstances. Significantly more support was shown for medical applications than for food production (P<0.001), indicating that respondents distinguished strongly between these two applications of GE (Table 1).

While ethnicity had no effect on total support for GE for food or medicine, significantly more Maori (P<0.01) and females (P<0.001) were totally opposed than NZ Europeans or males respectively.

Beliefs about the general consequences of GE technology

Most people did not believe that often-proposed benefits of GE would eventuate or that the environmental effects would be benign (Table 2). Women were consistently and significantly (P<0.001) more sceptical than men.

Ethical perceptions regarding GE technologies generally

Most respondents indicated that GE did not fit well with their cultural and spiritual beliefs or with their basic principles (Table 3).

Acceptance of GE was less likely when it involved harm to animals, the environment or people. Overall, respondents were neutral towards acceptance of GE if it provided food for the hungry people of the world, with males accepting and females rejecting. Significant differences (P<0.001) existed between male and female perceptions for all statements in Table 3.

Ethical perceptions regarding the status and treatment of cows

Respondents strongly considered it acceptable to eat cows and their by-products and that human welfare should take precedence over the welfare of cows. Although they agreed that cows think, have feelings and feel pain in a similar way to humans, they did not agree that cows have the same rights as humans. Even though they strongly valued cows primarily for their usefulness to humans, respondents did not consider it acceptable to genetically modify cows for human benefit (Table 4). Male and female responses were significantly different (P<0.001) for all of the items in Table 4.

Additionally, respondents were asked whether the hypothetical milk product would be more acceptable if it was produced by GE cows using introduced: existing cow genes (mean 9.1, P<0.001); mouse genes (mean 17.6, P<0.001); human genes (mean = 16.9, P<0.001), or synthetic genes (15.9, P<0.001).

DISCUSSION

New Zealanders are strongly wary of GE-food production. Ten times as many people totally opposed as totally supported it. The totally opposed group are likely to maintain opposition to GE-food production irrespective of demonstrable benefits. They have intrinsic (spiritual, ethical, emotional) objections to the technology that positive consequences are unlikely to alter. However, approximately 52% would support GE food production and 62% would support medical applications in some circumstances, indicating for this group that acceptability of GE is a matter for case-by-case decision on the basis of beneficial consequences. This partial acceptance is reflected in the greater support for medical applications of GE and confirms the results of earlier studies (Frewer & Shepherd, 1995; Hamstra & Smink, 1996; Royal Commission on Genetic Modification, 2001). Perceived harmful consequences are highly likely to make conditional accepters reject GE technology.

Echoing results by Gamble *et al.* (2000), females were more likely than males to be averse to GE for food production. Additionally, our study shows this is also true regarding GE medicines. While Maori were more likely than NZ Europeans to be averse to GE technology for both food and medicine, our sample of Maori (4.5%) was disproportionately smaller than their proportion of the New Zealand population (14.5%), questioning any such conclusions.

Respondents were sceptical that some of the possible proposed benefits (e.g., solving the world's food problems, curing the world's major diseases, and improving the quality of animal lives) would result from the use of GE technology. Respondents strongly disagreed that GE technology was environmentally safe. By making unsubstantiated claims, perceived by the public to be of dubious truth, proponents of GE are likely to reduce their perceived trustworthiness as a source of information regarding GE. Public perceptions of deceitfulness regarding the benefits of GE are likely to generalise to suspicion about the motives for the development of GE technology.

GE technology did not fit well with peoples' cultural and spiritual beliefs or with their basic principles, indicating that the majority of respondents had ethical concerns regarding GE. These concerns were very strong given the possibility of harm to animals, the environment or humans. GE was very unacceptable under any of these circumstances. The perception of harmful consequences associated with GE has a strong effect on making GE unacceptable. The conditional-accepters group is only likely to be accepting of GE if the benefits to be gained out-weigh possible harms and any intrinsic cultural, spiritual, and ethical reservations that they hold about the technology.

Even when the proposed consequence was strongly positive (i.e., providing food for the hungry people of the world), the use of GE still only received a neutral response to its acceptability; males slightly agreeing and females slightly disagreeing that it was acceptable. In general, males took a more consequentialist (teleological) approach (the ends justify the means) than did females, who took a more principled (deontological) approach (the means are against my principles and, therefore, prohibited irrespective of any potential beneficial ends). Social psychologists have suggested that this is a gender difference in the way ethical problems are approached (Indick *et al.,* 2000).

Respondents primarily valued cows instrumentally – that is, for their use to humans (in general, this attitude to cows was held less strongly by females than males). However, it is important to note that respondents strongly rejected the idea that it is alright to genetically modify cows for human benefit. Respondents strongly disagreed that the hypothetical milk product would be more acceptable to them if either mouse, human or synthetic genes were introduced to the GE cows in order to produce the product. However, they agreed the product would be more acceptable if only existing cow genes were used. This suggests a greater public aversion to the development of transgenic cows than to the manipulation of existing genes of the species. It is possible that the public's perception regarding the ethical status and treatment of other high mammals (e.g., horses, monkeys, dolphins, dogs, pigs) will be similar to these finding for cows. However, further research would be necessary to verify this hypothesis.

Of particular note is the consistent finding of a moderate but highly significant difference between males and females in attitudes, beliefs about the consequences, and ethical values regarding GE. The direction of this difference is such that generally, females are more resistant than males to acceptance of GE, less likely to believe promised benefits will eventuate, have greater intrinsic ethical concerns about GE, perceive greater risk associated with the technology and show greater compassion and concern for cows. As noted earlier, for any product to be successful there must be a consumer market. The question of which gender predominantly does the grocery shopping in New Zealand may, therefore, be relevant to the degree of uptake of GE foods.

If proponents of GE wish to increase public acceptance, their research agendas must be seen to be addressing the issues that concern the public. They must not downplay or ridicule public fears as irrational and emotional. The perception of honesty is essential for gaining trust; potential benefits should not be exaggerated. The motives for introducing a technology as powerful and potentially far reaching as GE, but as yet, new and unknown, must be seen to be for the public good rather than for corporate or producer profit. The cautious introduction of products with attributes of benefit to the public will be more conducive to long-term public acceptance. Initial emphasis should be on medical applications rather than food production. Evidence must be produced that the technology (or a specific product) will be of benefit to consumers (rather than developers, producers and marketers), and that it is as at least as safe for humans, animals and the environment as conventional alternatives. Such evidence, presented for a specific product may increase its public acceptance, particularly amongst the large group of conditional accepters.

ACKNOWLEDGEMENTS

REFERENCES

Anon 2000: Genetically engineered food safety problems. *Physicians and Scientists for Responsible Application of Science and Technology.* (Retrieved 12 July, 2000, from the World Wide Web: http://www.psrast.org/indexeng.htm)

Antoniou, M. 1996: Genetic pollution. *Nutritional therapy today, December 1996. 6:* 8-11.

Bredahl, L. 2000: Determinants of consumer attitudes and purchase intentions with regard to genetically modified foods - results of a cross-national survey. *Working paper No. 69.* (Retrieved August, 2001 from MAPP Web site:http://www.mapp.hha.dk/WPpdf/wp69.pdf) The Aarhus School of Business.

European Commission: 2000: The Europeans and biotechnology (Eurobarometer 52.1). Brussels: European Commission.

Fletcher, R. 2001: Support for the Royal Commission. *Food technology in New Zealand, 36:* 3-4.

Frewer, L. J.; Shepherd, R. 1995: Ethical concerns and risk perceptions associated with different applications of genetic engineering: Interrelationships with the perceived need for regulation of the technology. *Agriculture and human values, 12*: 48-57.

Gamble, J.; Muggleston, S.; Hedderley, D.; Parminter, T.; Richardson-Harmen, N. 2000: Genetic engineering: The public's point of view. *(HortResearch client report No. 2000/249).* Auckland: HortResearch.

Hamstra, A. M.; Smink, C. 1996; Consumers and biotechnology in the Netherlands. *British food journal, 98*: 34-38.

Indick, W.; Kim, J.; Oelberger, B.; Semino, L. 2000: Gender differences in moral judgement: Is non-consequential reasoning a factor? *Current research in social psychology, 5*: 285-298.

Jordan, B. R. 2001: Gene technologies and food safety. New Zealand Institute of Agricultural Science and New Zealand Society for Horticultural Science "Gene Technologies Workshop", Lincoln University, Canterbury, New Zealand.

Genetically engineered food safety problems. (Retrieved 12 July, 2000, from the World Wide Web: http://www.psrast.org/indexeng.htm)

Royal Commission on Genetic Modification. 2001: Report of the Royal Commission on Genetic Modification. Wellington: Royal Commission on Genetic Modification.

Straughan, R. 1995a: Ethics, morality and crop biotechnology. 1. Intrinsic concerns. *Outlook on agriculture, 24*: 187-192.

Straughan, R. 1995b: Ethics, morality and crop biotechnology. 2. Extrinsic concerns about consequences. *Outlook on agriculture, 24*: 233-240.