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STUDIES IN HUMANS

Consumer knowledge and attitudes about genetically modified food products and labelling policy

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Abstract

The purpose of this study was to examine the relationship between consumer knowledge, attitudes and behaviours towards foods containing genetically modified organisms (GMOs) and the prevalence of GMO labelling in northern New Jersey supermarkets. This cross-sectional study surveyed 331 adults, New Jersey supermarket customers (mean age 26 years old, 79.8% women). The results show a strong, positive correlation between consumer attitudes towards foods not containing GMOs and purchasing behaviour (Pearson's $r = 0.701$, $p < 0.001$) with lesser correlations between knowledge and behaviour (Pearson's $r = 0.593$, $p < 0.001$) and knowledge and attitudes (Pearson's $r = 0.413$, $p < 0.001$). GMO labelling would assist consumers in making informed purchase decisions.

Keywords

Consumer behaviour, GM food, GMO, supermarkets

History

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Introduction

The U.S. Food and Drug Administration (2001) defines the term genetically modified organisms (aka GM or GMOs) as ''originally used by the molecular biology scientific community to denote a living organism that had been genetically modified by inserting a gene from an unrelated species''. Since genes from unrelated organisms are not naturally transferred, technology is needed to carry out this task. These new species of plants are referred to as ''transgenics'' (U.S. Food and Drug Administration, 2001). Organisations studying the presence of GMOs in America estimate that 75–80% of packaged or processed food items on supermarket shelves nationwide contain GMOs (Center for Food Safety: About GE Foods, 2014; Martin, 2013; Pew Initiative on Food and Biotechnology, 2005). One of the main reasons for the predominance of GM food products in the US marketplace is that the US cultivates the largest amount of GM crops in the world (GM crops: A story in numbers, 2013). In the US, a large number of processed foods accessible to consumers contain GMOs, ostensibly attributed to the higher level of national agricultural cultivation of GM commodities (GM crops: A story in numbers, 2013; Martin, 2013).

Although the FDA states that it supports manufacturers who choose to include truthful information on their labels regarding whether food products were created using genetic engineering, labelling remains voluntary in the US (U.S. Food and Drug Administration, 2013). Currently, the only organisation offering verified GM testing in North America is the Non-GMO Project, which places its ''Non-GMO Project VERIFIED'' seal on products that undergo voluntary testing and contain not more than 0.9% GM ingredients, which is the current threshold required within the European Union (EU) for GMO labelling (The Non-GMO Project, 2014). However, due to limited testing capabilities and the high likelihood of contamination, no products are scientifically guaranteed to be ''GMO-free'' (The Non-GMO Project, 2014; U.S. Food and Drug Administration, 2001). In addition to the specific labelling done by the Non-GMO Project, foods that are labelled as ''Organic'' by the United States Department of Agriculture (USDA) do not contain any ingredients produced by biotechnology, although the ''Organic'' label itself does not mention the absence of GM ingredients (U.S. Food and Drug Administration, 2001).

The literature has shown that consumers have both positive and negative perceptions of GM products that are offset by personal values and ethics. It has been argued that the acceptance of GM technology is greatly influenced by the values held by members of a particular society, including overall concerns about global food and food security, climate change and ethical beliefs. These values are affected by increasing environmental regulation and consumer engagement that in parallel increases risk and benefit associations of GM products (Frewer et al., 2013). Pre-dispositioned attitudes have been found to be the predictors of behavioural intention to purchase GM food products (Prati et al., 2012), while confounding findings for knowledge and attitudes have been reported for potential consumers (Huffman et al., 2007; Koivisto Hursti & Magnussen, 2003).

The extent that consumers view GM foods to be unnatural has been associated with acceptance of these products (Frewer et al., 2014), though this outlook has been shown to be dependent on product type and ethical purview. For example, Australians have been shown to have less positive attitudes towards food products engineered with genetically modified animals compared to genetically modified plants (Marques et al., 2014). This finding

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is affirmed by a recent meta-analysis of the literature (Frewer et al., 2013).

Consumer acceptance levels of GM food products have also been shown to moderate between perceived benefits, risks, attitudes to GM technology, trust in institutions and scientific knowledge, and pricing. Literature findings demonstrate that perceived benefits and risks play a significant role in shaping behavioural intentions towards GM food, contingent on attitudes towards GM technology. Risk perceptions of GM agri-products have been demonstrated to be greater in Europe than North America and Asia (Frewer et al., 2013). In particular, consumers in France and Germany have been shown to be reluctant to accept genetically modified foods (Bieberstein et al., 2013). Although consumers receive messages from highly varied sources about GMOs and possible benefits or costs, they do not view all sources as equally reliable; consumers tend to view university scientists and farmers as the most trustworthy, environmental organisations and government agencies as moderately trustworthy, and grocery stores and food manufacturers as the least trustworthy (Lang, 2013). However, even the most trusted sources report conflicting messages to consumers, resulting in varied public opinion. Positive attitudes towards GMO for food were significantly associated with higher trust in scientists and governments and with lower trust in watchdog agencies, such as environmental groups in Australia (Marques et al., 2014). However, consumers' attitudes towards food safety did not significantly influence the perceived risks of GM foods in an investigation conducted in Spain (Rodríguez-Entrena & Salazar-Ordóñez, 2013; Rodríguez-Entrena et al., 2013). On the other hand, research has also shown that risk perceptions, together with food safety concerns, are major determinants of consumer resistance to food technologies (Chen et al., 2013).

The heterogeneity of GM purchase intentions has been globally linked to university education, scientific knowledge (Frewer et al., 2013), and behavioural responses to innovation. Findings from the aforementioned investigation in Spain suggest that science literacy attributes may be more influential than knowledge in the conditioning of consumers' acceptance of GM food products (Rodríguez-Entrena & Salazar-Ordóñez, 2013). A study conducted in China found that consumers' decisions about purchasing GM foods are generally impacted by how information on these products is framed and presented. Though, the findings suggest that mandatory labelling may not be effective in the promotion of product reliability and consumer awareness (Zhao et al., 2013). However, a recent investigation in Canada demonstrated the effectiveness of information and prior knowledge of new food technologies on consumers' evaluation of food product innovations and purchase intentions, indicating that promotional and educational campaigns might be effective in offsetting food technology neophobia (Chen et al., 2013). The success of new food technologies appears to hinge on whether consumers perceive scientific progress as improvements in social welfare. However, the potential occurrence of a negative or positive incident in the GM food sector may strongly ferment public opinion towards or against these products (Frewer et al., 2014).

Gender differences and income levels have been found to be affective on consumers' perceptions of these products. One investigation found that while male consumers did not prioritise GMO products as one of their top concerns, females had stronger attitudes towards purchasing non-GM foods (Bellows et al., 2010). Investigators have also explored the financial aspects of GMO preferences and attitudes, specifically how income level influences attitudes towards GMOs, since it is widely believed that GMO foods are distributed more often to low-income populations. King (2003) conducted focus groups of low-income consumers in California and found that 80% of the participants initially were not knowledgeable about GMO products. After they were provided with information about these foods, the participants felt that scientifically altered crops could be unethical and unsafe. Furthermore, Nielsen et al. (2003) determined that high-income consumers do not have to consider price when deciding between GMO and non-GMO products; they have the ability to solely purchase non-GMO products. The willingness to pay a premium price for non-GMO foods reflects a negative attitude towards genetic modification, though that attitude may vary based on consumer priorities. In a study of American grocery shoppers, consumers who shopped in speciality grocery stores were willing to pay an average of 37 cents more for a ''Genetically modified free'' product, while consumers in a traditional store were only willing to pay an additional 18 cents (Batte et al., 2007). Within this speciality-store population, older customers, and women in particular, were willing to pay more money for non-GM food products, and although there was no strong correlation between individual income and willingness to pay for GM-free products, there was a strong correlation between income and willingness to pay for 70–100% Organic products (which are free of GM-ingredients) (Batte et al., 2007). The results from a study in Ireland indicate that a market for GM potatoes could exist within an appropriate price point (Thorne et al., 2014).

Although other countries have laws in place that require companies to label GM foods, labelling remains voluntary in the US, though there have been recent efforts to change this policy in individual municipalities (Carter, 2002; Vilojen & Marx, 2013). The FDA maintains that mandatory labelling potentially implies that GM food products are unhealthy and environmentally harmful, though this perception is currently unfounded (U.S. Food and Drug Administration, 2001). Scholarly opinion suggests that global warming actually necessitates the inclusion of GM products into the food system (Rotman, 2014). On the other hand, research has demonstrated that GM crops could potentially have negative effect on the environment by threatening biodiversity, creating a monoculture that would cause soil depletion and be problematic in the event of a plague, and increasing herbicide and pesticide use, leading to a prevalence of herbicide-resistant weeds and pesticide-resistant pests (Food and Water Watch, 2013; Owen & Zelaya, 2005; Pandey et al., 2010; van den Bergh & Holley, 2002). The FDA asserts that genetically modified foods are ''generally as nutritious'' as non-bioengineered versions (U.S. Food and Drug Administration, 2013), though more recent studies have drawn this assumption into question by asserting that organic produce, which is free of genetic engineering, may contain higher concentrations of antioxidants (Barański et al., 2014). While consumers place a great deal of credibility in FDA-sanctioned health claims about food products, many are in favour of GM labelling due to concerns about the environmental impact (Raab & Grobe, 2003; Roe & Teisl, 2007). Both the FDA's lack of support for a mandatory labelling policy and the aforementioned concerns about the impact of GMOs have the potential to influence consumer opinions towards these foods.

Unlike in the US, labelling of GM products is mandatory throughout the EU. All products which contain more than 0.9% genetically modified ingredients, packages must specify ''genetically modified'' or ''produced from genetically modified [name of the organism]'' on the list of ingredients, and items without packages must be located near a sign conveying those messages (European Commission – Health and Consumers, 2014; Regulation (EC) No 1830/2003) (Gruère et al., 2008). For an overall comparison of global GM regulations, Vigani & Olper (2013) created an index of GM-strictness (which ranges from 0 – non-restrictive to 1 – highly restrictive). The US received an index of 0.35 while the EU received an index of 0.69, which reflects a

more intense approval process, more thorough assessment of GM-risk, firm labelling policies, traceability of GMs, ensured coexistence of GM and non-GM products, and participation in international agreements regarding GM usage. Although certain European countries do rely on the production of GM foods, such as Spain, the complete ban of certain GM-foods in countries like Austria and Italy resulted in Europe's high GM index (Vigani & Olper, 2013). Alternatively, developing countries tended to have lower indexes, which reflect more lax GM regulation than the US, which may be a result of lower GM risk perception due to a lack of biosafety studies and awareness (Vigani & Olper, 2013).

The European resistance to modified foods reflects more uniform negative consumer attitudes, which may be a result of residual distrust in the food industry from the 1990s, when Europe suffered several food safety issues (including the spread of mad cow disease) and witnessed widespread media coverage of the possible risks of biotechnology (Finucane & Holup, 2005; Martin, 2013; Rollin et al., 2011). European distaste for GM products may also be an extension of their preference for small companies, rather than the massive international operations that typically produce GMs (Martin, 2013). Similar to consumers who wish to avoid GMs in the US, a higher willingness to pay for non-GM products is a luxury afforded by the relatively stable economic state of Western Europe, which allows consumers to pay slightly more to avoid GM-foods (Martin, 2013).

Although studies show that GMs are coming to the forefront of American consumers' minds, few studies explore the relationship between consumer knowledge, attitudes and behaviours towards GM food consumption and labelling of these food items on supermarket shelves. Because of this gap in the literature, the present study seeks to answer the following questions: (a) What is the relationship between consumer knowledge, attitudes, and behaviours toward GM food? and (b) What is the consumer attitude toward GM labelling in supermarkets?

Methods

A cross-sectional study design employing purposive sampling was used to conduct the research. Supermarket consumers were recruited via a personal online request. A total of 331 supermarket consumers consisting of Montclair State University, NJ, students, faculty and staff completed an online quantitative 25-question survey. The inclusion criteria for the consumer survey participants were as follows: participants had to be at least 18 years or older, live in New Jersey, and purchase food from New Jersey supermarkets. All participants had the opportunity to enter their e-mail address for a drawing to win a $25 Visa gift card.

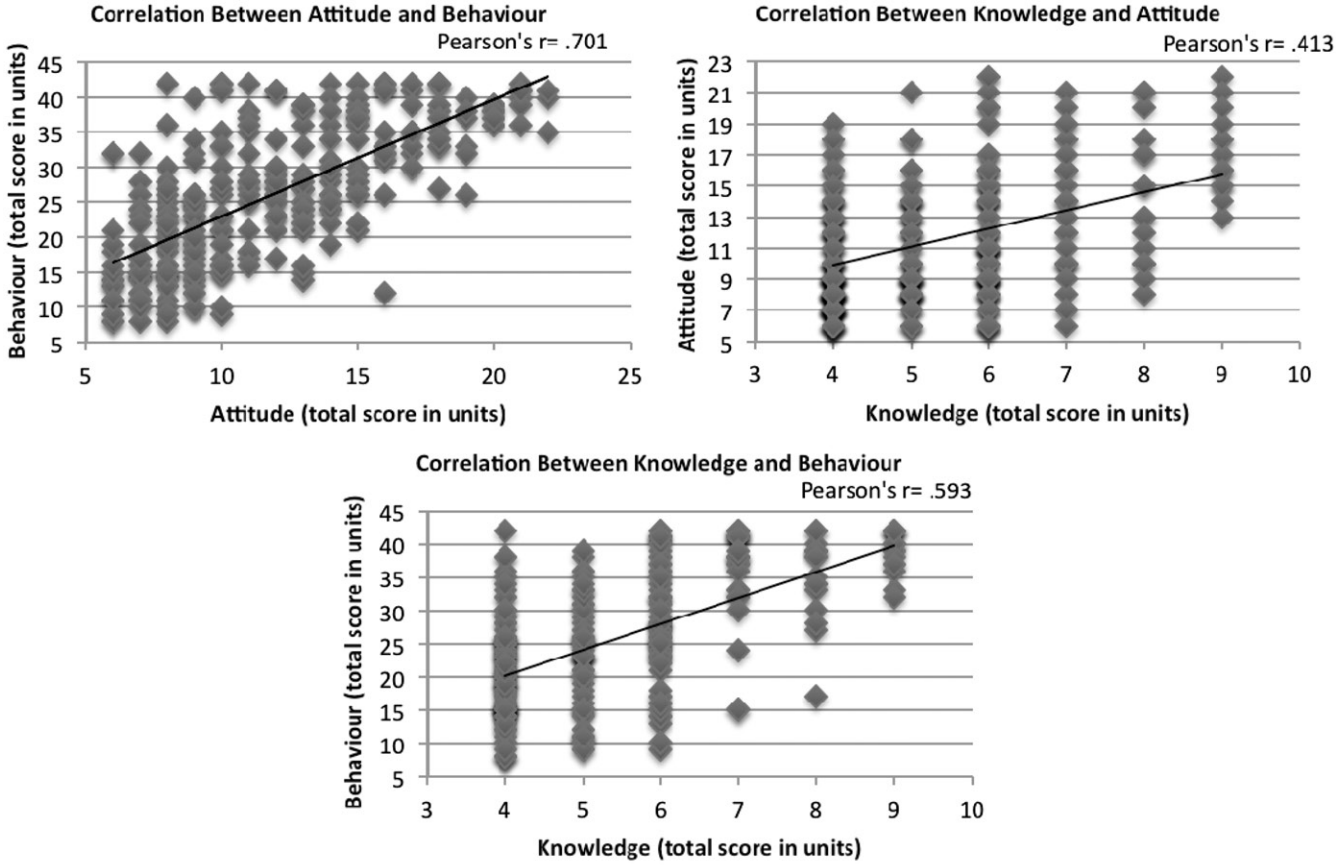
The survey contained 25 questions: 7 targeted demographics, 4 assessed knowledge of GM food products, 6 assessed attitudes towards GMs, and 8 assessed purchasing behaviour. Demographic questions included age, gender, residence, ethnicity, income, education and most frequented supermarket. Examples of knowledge questions included, ''I have heard of the term 'Genetically Modified Food' '', as well as a follow-up question asking for a definition of this term to assess comprehension. Other questions addressed awareness of GM foods in supermarkets and non-GM labelling on some products. Examples of attitude questions included, ''Price is more important than the presence of a non-GM food label when I make food purchasing decisions'', and ''I would prefer if food items in New Jersey supermarkets were labelled to distinguish between GM and non-GM products''. Other attitude questions addressed opinions about how labelling would impact food purchasing decisions and the effect of GM foods on health and the environment. Examples of behaviour questions included, ''I look for a non-GM label on foods that I purchase in New Jersey supermarkets'', and ''My belief about how eating GM foods impacts my health influences my food purchasing decisions''. Follow-up behaviour questions addressed frequency of purchasing foods with a non-GM label versus unlabelled foods. The majority of the responses were based on a 5-point Likert scale including options, such as ''All of the time'', ''most of the time'', ''some of the time'', ''rarely'' and ''never''. Consumers were also asked to name the supermarket where they most frequently shop, and the supermarkets were broken into level 1, level 2 and level 3 representing low-, moderate- and high-priced, respectively. The categorisation of these levels was determined from the average prices of goods as per prior research studies (Aggarwal et al., 2011; Drewnowski et al., 2012; Moudon et al., 2011).

The data from the surveys was uploaded into IBM SPSS Statistics for Windows, Version 20.0 (IBM Corp. Released 2011; IBM SPSS Statistics for Windows, Version 20.0; IBM Corp., Armonk, NY). Demographic data were analysed for frequency and percentages of each category through the generation of tables and graphs. Age was regrouped into ranges, and responses for supermarkets most frequented were reclassified as level 1, level 2 or level 3 supermarkets to improve analysis. The responses to the remaining questions were coded with a number indicating a response, most frequently from 1 to 5 since the majority of the questions were based on the 5-point Likert scale. For example,

Table 1. Consumer demographic data.

Total participants, $n = 331$	Frequency	Percentage (%)
Age range ($n = 321$, Mean age $= 26 \pm 9.043$)		
18–22	160	49.1
23–29	98	30.1
30–39	35	10.7
40–49	19	5.8
50–59	12	3.7
60–69	2	0.6
Gender ($n = 326$)		
Male	66	20.2
Female	260	79.8
Ethnicity ($n = 322$)		
Black or African-American, non-Hispanic	18	5.6
Hispanic or Latino	41	12.7
White, non-Hispanic	226	70.2
Asian	22	6.8
Other	15	4.7
Income ($n = 327$)		
$0–$25 000	84	25.7
$25 001–$50 000	54	16.5
$50 001–$75 000	67	20.5
$75 001–$100 000	62	19.0
$100 001	60	18.3
Education ($n = 329$)		
High School Diploma	124	37.7
Associate's Degree	50	15.2
Bachelor's Degree	107	32.5
Master's Degree	41	12.5
Doctoral Degree	7	2.1
Supermarket most frequented by classification* ($n = 325$)		
Level 1	35	10.8
Level 2	79	24.3
Level 3	187	57.5
Other	24	7.4

*Supermarkets were categorised as level 1, 2 or 3 based on price. Level 1 supermarkets are high-priced, level 2 supermarkets are moderately-priced, and level 3 supermarkets are low-priced. Pricing strata were determined by current supermarket prices. Consumers in the ''other'' category shop primarily at locations that could not be categorised, such as farmer's markets or small local food stores.



*Total scores are the sum of all responses to the knowledge, attitude, and behaviour survey questions, respectively. A low score indicated more knowledge, more positive attitude toward non-GMO foods, and more frequent non-GM food purchasing.

Figure 1. Correlation analysis of knowledge, attitude and behaviour.*.

a response of ''All of the time'' was entered as ''1'', ''Most of the time'' was entered as ''2'' ''Some of the time'' was entered as ''3'', ''Rarely'' was entered as ''4'' and ''Never'' was entered as ''5''. The questions were sorted as knowledge, attitude or behaviour, and new variables with these titles were created. The knowledge variable was equal to the sum of the responses to the knowledge questions. The attitude variable was equal to the sum of the responses to the attitude questions, and the behaviour variable was equal to the sum of the responses to the behaviour questions. Since the numbering system gave a ''1'' for the most knowledge, most positive attitude towards non-GM foods, and most frequent purchasing behaviour of non-GM foods, a lower score indicated more knowledge, a more positive attitude towards non-GM foods, and more frequent purchasing behaviour of non-GMO foods. Conversely, a high score indicated less knowledge of GM food products, a more positive attitude toward GM-containing foods, and more frequent purchasing behaviour of GM-containing foods.

Once the knowledge, attitude and behaviour variables were created, a correlation analysis was conducted to determine the relationship between them and the significance of the relationship. The correlation analysis generated values for Pearson's *r*, with a result close to 1 or −1 indicating a strong relationship, while a positive number indicates a positive relationship and a negative result indicates an inverse relationship. Additionally, an alpha value of 0.05 used, meaning that *p* values less than 0.05 indicate statistical significance. Montclair State University Institutional Review Board (IRB) approved the research protocol.

Results

Of the 331 consumer participants, the majority, or 89.9%, were between 18 and 39 years of age. The average age was 26 ± 9.043 years old, 79.8% were female, and 70.2% were White. There was a fairly even distribution of income among the participants with 25.7% making \$0–\$25 000, 16.5% making \$25 001–\$50 000, 20.5% making \$50 001–\$75 000, 19.0% making \$75 001–\$100 000, and 18.3% making over \$100 001. For highest degree received in education, 37.7% had a high school diploma, 15.2% had an Associate's degree, 32.5% had a Bachelor's degree, 12.5% had a Master's degree, and 2.1% had a Doctoral degree. Table 1 shows an in-depth breakdown of the demographic results for consumer participants.

Figure 1 shows the percentage breakdown of participants shopping at these categories of supermarkets, including some that shop at other locations, such as farmer's markets and independent stores, which were not classified as level 1, 2 or 3. The percentage of participants shopping at each level of supermarket declines with an increase in price level; a total of 57.5% of the participants shopped at level 3 supermarkets, 24.3% shopped at level 2 supermarkets, and 10.8% shopped at level 1 supermarkets.

A correlation analysis revealed a Pearson's *r* of 0.413 between knowledge and attitude, which indicates only a slightly weak to moderate relationship between these variables. Pearson's *r* for knowledge and behaviour was 0.593, or moderate to slightly strong. The analysis also revealed a fairly strong relationship between attitude and behaviour with a Pearson's *r* of 0.701. All of

Table 2. Correlation analysis of consumer demographic variables with knowledge, attitude and behaviour.

	Knowledge	Attitude	Behaviour	Supermarket classification	County in NJ	Ethnicity	Income	Education	Gender	Age range
Knowledge										
Pearson correlation	1	0.413**	0.593**	0.195**	0.093	−0.051	0.076	0.151**	0.026	−0.120*
Sig. (2-tailed)		0.000	0.000	0.001	0.103	0.371	0.178	0.007	0.648	0.034
N	316	309	304	312	311	309	314	316	314	313
Attitude										
Pearson correlation	0.413**	1	0.701**	0.124*	0.099	0.047	−0.009	0.036	−0.103	−0.024
Sig. (2-tailed)	0.000		0.000	0.027	0.078	0.406	0.874	0.515	0.066	0.663
N	309	322	312	319	317	315	320	322	320	320
Behaviour										
Pearson correlation	0.593**	0.701**	1	0.192**	0.080	0.037	−0.066	0.121*	−0.085	−0.056
Sig. (2-tailed)	0.000	0.000		0.001	0.161	0.513	0.246	0.032	0.132	0.320
N	304	312	317	313	310	309	314	316	313	313
Supermarket classification										
Pearson correlation	0.169**	0.150**	0.179**	1	0.045	−0.001	−0.092	−0.014	0.031	0.094
Sig. (2-tailed)	0.003	0.007	0.001		0.422	0.984	0.098	0.797	0.575	0.092
N	312	319	313	325	319	319	323	325	322	322
County in NJ										
Pearson correlation	0.093	0.099	0.080	0.033	1	−0.025	−0.082	0.110*	0.053	−0.144*
Sig. (2-tailed)	0.103	0.078	0.161	0.558		0.653	0.142	0.048	0.341	0.010
N	311	317	310	319	323	316	321	323	321	321
Ethnicity										
Pearson correlation	−0.051	0.047	0.037	−0.073	−0.025	1	−0.058	−0.020	−0.009	0.040
Sig. (2-tailed)	0.371	0.406	0.513	0.192	0.653		0.300	0.716	0.874	0.478
N	309	315	309	319	316	322	321	322	319	319
Income										
Pearson correlation	0.076	−0.009	−0.066	−0.006	−0.082	−0.058	1	0.120*	−0.001	−0.220**
Sig. (2-tailed)	0.178	0.874	0.246	0.915	0.142	0.300		0.030	0.982	0.000
N	314	320	314	323	321	321	327	327	324	324
Education										
Pearson correlation	0.151**	0.036	0.121*	0.055	0.110*	−0.020	0.120*	1	−0.023	−0.628**
Sig. (2-tailed)	0.007	0.515	0.032	0.324	0.048	0.716	0.030		0.684	0.000
N	316	322	316	325	323	322	327	329	326	326
Gender										
Pearson correlation	0.026	−0.103	−0.085	0.020	0.053	−0.009	−0.001	−0.023	1	0.012
Sig. (2-tailed)	0.648	0.066	0.132	0.725	0.341	0.874	0.982	0.684		0.827
N	314	320	313	322	321	319	324	326	326	324
Age range										
Pearson correlation	−0.120*	−0.024	−0.056	0.007	−0.144*	0.040	−0.220**	−0.628**	0.012	1
Sig. (2-tailed)	0.034	0.663	0.320	0.901	0.010	0.478	0.000	0.000	0.827	
N	313	320	313	322	321	319	324	326	324	326

**Correlation is significant at the 0.01 level (2-tailed).
*Correlation is significant at the 0.05 level (2-tailed).

these results were significant with p values less than 0.05. Since Pearson's r values were all positive, this means that as knowledge of GMs increased, positive attitudes towards non-GM-containing foods increased, or purchasing behaviour of non-GM-containing foods increased. However, based on the correlation analysis, this positive relationship is strong for attitude and behaviour, moderate to fairly strong for knowledge and behaviour, and only slightly weak to moderate for knowledge and attitude. Figure 1 shows a graphical depiction of the correlations.

Further analysis was conducted to determine any significant, strong relationships between the demographic variables and knowledge, attitude and behaviour. The analysis indicated that all demographic variables had very weak relationships with knowledge, attitude and behaviour. These results were only significant for the relationships between age range and knowledge, education and knowledge, and supermarket classification and knowledge, attitude and behaviour. Of primary interest is that income level, geographic location and education did not correlate with knowledge, attitude and behaviour. Furthermore, income, education and geographic location did not correlate with the classification of supermarket most frequented by consumers. Table 2 highlights these findings.

Discussion

Comparison with findings from other studies

Previous researchers have looked at consumer knowledge, attitudes and behaviour regarding GMs, with variable findings. Prati et al. (2012) found similar results to the current study using the Theory of Planned Behaviour as a model. They found attitudes towards GM foods to be the most significant predictor of behavioural intention. Conversely, Lusk et al. (2002) concluded that consumers are more willing to accept GM foods if they impart some type of benefit as there is a strong correlation between attitude and behaviour when it comes to purchasing intention. However, this does not necessarily mean that consumers will consistently purchase or reject GM foods. Rather, in the present research, we found that attitudes towards GM foods do not always correlate with purchasing behaviour. Another study focused on the correlation between knowledge and attitude towards GM-containing foods by splitting consumers into two groups: one group with a high level of knowledge of GM foods and one group with a low level of knowledge of GM foods. The results showed that consumers with a higher level of knowledge regarding GM-containing foods had more positive attitudes for

these foods (Koivisto Hursti & Magnussen, 2003). Conversely, findings by Huffman et al. (2007) demonstrated that consumers with greater knowledge of GM-containing foods have more negative attitudes towards such foods. The current study found slight to moderate correlations between knowledge and attitudes among participants.

Limitations

It is important to note a few limitations to this study. First of all, the results are only applicable to consumers in New Jersey and cannot be generalised to other locations. Also, the sample of consumers included were college students, staff and faculty. Because of this, it is possible that the participants in this sample have had more education and exposure to the topic of GM foods than the general public. This could impact the results if this study were replicated for a different population. This study also examines behaviours related to GM products in general, although previous literature suggests that consumer opinion of GM foods may differ by subcategory. Šorgo et al. (2012) found that GM-plants and microorganisms that had enhanced medicinal qualities were valued as more acceptable than modified animals or non-medicinal plant foods. Although this study did examine whether GM labels impact consumer purchasing of different food products (dairy, fresh produce, convenience foods, meat, fish and poultry), future studies should examine how varying attitudes towards specific varieties of GM-plants and animals impact purchasing behaviour.

Conclusions

Overall, this study provides new insight into consumer knowledge, attitudes and behaviours as well as the level of knowledge of customer service representatives regarding GM foods. The findings of this study show that there is a strong, positive correlation between New Jersey supermarket consumer attitudes towards GM foods and purchasing behaviour. As positive attitudes towards non-GM foods increase, purchasing behaviour of non-GM foods increases. However, although the relationships were all positive, the relationship between knowledge and attitudes and knowledge and behaviour were not very strong. Since this study surveyed only New Jersey consumers, it cannot be generalised nationwide. In light of a recent bill in New Jersey that would require food companies to label GM foods, the results of this study provide insight into the current status of consumer purchasing behaviours in New Jersey supermarkets. If this bill becomes a law, it is possible that consumers with negative attitudes towards GM foods would more easily be able to choose GM-free foods due to the presence of labelling. This may cause these consumers to purchase even more GM-free foods. Additionally, for those consumers who are unaware of GM foods, the presence of a label may motivate them to gain more knowledge and awareness. It is possible that their current attitudes towards GM foods would change, which could, in turn, alter their purchasing behaviour. Because of this, labelling of GM foods should be in place. Additionally, some consumer's attitudes and behaviours were influenced by beliefs about the environmental impact of GMOs. However, very few studies exist to determine the long-term impact of GMO production on the environment. Future studies should examine environmental effects of GMOs.

Declaration of interest

There is no conflict of interest in this study. Funding was not needed to carry out the research, and the authors have no affiliation with any supermarkets involved in this study.

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