Consumer Attitudes Toward Genetic Modification and Other Possible Production Attributes for Chicken

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Today's consumers face foods whose production attributes they are often largely unfamiliar with and uncertain about. This study surveyed Delaware consumers about labeling, health risk concerns, and knowledge of five potential attributes for chicken: free-range, treated with antibiotics, irradiated, fed genetically modified (GM) feed, and GM chicken. Respondents were highly in favor of labeling all attributes, and perceived a high health risk from and had a low self-reported knowledge of many of the attributes. Gender, tobacco use, and label reading habits were significant factors in explaining the difference in responses. An analysis of survey comments further demonstrated the extent of consumer concerns.

The demand for chicken has greatly increased over the past twenty years, and it is now the second most consumed meat, after beef, in the U.S. Recently, new technologies have appeared that could be used in the raising and processing of chicken products and may in turn affect consumer attitudes. Primary among these new technologies has been the emergence of genetically modified (GM) crops, which are included in chicken feed. As genetic modification is applied to animal research, it is conceivable that a GM chicken itself could be developed in the future. These existing and potential broiler production attributes join other possibly controversial technologies such as irradiation or the use of antibiotics. A full understanding of consumer's attitudes and opinions regarding these attributes could be crucial in maintaining the present and future business of the chicken industry. The objective of this study was thus to determine consumer knowledge, labeling preference, and health-risk concerns for GM chicken, irradiated chicken meat, and chicken given antibiotics and GM feed. To balance these with an arguably non-controversial attribute, free-range-raised chicken was also included.

Background

Chicken's two primary feed ingredients, corn and soybeans, are among the top GM crops in the country. Adoption of both has risen greatly since they first became available to farmers in 1996, with 2003 shares of the total acreage at 41% for corn and 81% for soybeans (USDA - ERS 2003). Given the importance of these crops as feed, it is likely that most non-organic chickens are consuming such products at least to some degree. However, the use of neither GM crop requires labeling, and polls typically indicate little awareness of agricultural biotechnology on the part of average consumers (James 2004).

As of the time of this study, no GM animal had been approved for human consumption, although the potential clearly exists for the future. To date only limited attention has been paid to how consumers would react to such a product. As noted by Hossain and Onyango (2004), the literature that does exist suggests consumers are more concerned with genetic modification of animals than of plants. In one related effort considering both, Chern et al. (2002) examined consumer acceptance of GM salmon (a product awaiting approval) and GM-fed salmon. While they found strong support for labeling along with large willingness-to-pay to avoid both versions, their respondents were willing to pay more to avoid the former.

Irradiation of foods has been developed prior to the widespread application of genetic modification techniques. It consists of one of three methods—gamma rays, electron beams, or X-rays—to expose foods to ionizing radiation. The technique has been approved for various foods over the years to control insects, delay ripening, decontaminate spices, and reduce or control foodborne pathogens (Buzby and Morrison 1999). However, it has only been a little more than a decade since the U.S. approved use of irradiation for poultry products, and the process remains relatively little used in this area. The limited use of irradiation stems, in part, from a perceived lack of consumer

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acceptance. Nayga, Poghosyan, and Nichols (2004) suggest ways to market such food products to different segments of consumers.

While some studies such as those above have looked individually at some of the attributes explored here, fewer have looked at consumer attitudes and reactions to sets of attributes. Among the more recent and relevant to this study, Miles et al. (2004) looked at 1,092 UK consumers' attitudes towards 18 food-safety issues. Of the 18, they found that consumers tended to be most concerned with the potential hazards from the use of technology in food production. Among the top five concerns were two also covered in this study: the use of antibiotics,and GM foods. The results from Miles et al. showed gender and age to be significant indicators of concern for the issues, with females more concerned and younger consumers less concerned than were males or older consumers. In contrast with their hypothesis, however, the presence of children under the age of 19 in household did not significantly affect the level of concern.

Also focusing on a single product type, Cardello (2003) looked at 88 subjects' concerns about chocolate pudding using any of 20 different production technologies. The consumers listed two attributes that overlapped with this study, GM foods and irradiation, in their top three concerns. The gender difference also appeared strongly significant, with females expressing greater concerns across the technologies. These studies were particularly useful in designing the survey and models used in this research.

Data

Data was collected through a mail survey of Delaware residents conducted early in 2003. Delaware was selected because the broiler industry is very important to the state, so interest in responding to the survey therefore was expected to be high. The survey was sent to 1,000 randomly selected consumers in the state from a list purchased from USAData. Multiple stages were used, following Dillman (2000), to maximize the response rate. To begin, a pre-postcard was sent announcing the survey and informing future respondents that it would contain a gift as a token of appreciation. A few days later the first complete mailing was sent including a cover letter, the survey instrument, a sheet describing the attributes, a stamped return envelope, and a one-dollar bill.[1] The next week a postcard reminder was sent. In the last stage, a second complete mailing was sent to all who had not replied.

The survey itself was a booklet divided into three sections. The first section contained questions on consumers' knowledge of and health-risk and labeling concerns about the attributes of interest. The next section examined consumers' chicken-purchasing interests and frequency of consumption. The last section collected demographic information from the respondents. The final page was reserved for comments. An accompanying attribute-description sheet was used to be sure respondents understood the concepts and could compare the information with their prior understanding. The single page contained explanations of each of the relevant attributes and technologies: fed GM crops, chicken meat irradiation, antibiotics use, free-range, and GM chicken. Descriptions were constructed to be factual and neutral to avoid the introduction of bias, with no mention of controversial aspects. The GM-chicken option was clearly labeled as being hypothetical and described as having been altered to improve production, with no direct benefits to consumers. Respondents were requested to read the attribute-description sheet first.

A total of 498 completed questionnaires were received. After accounting for those initially returned as non-deliverable, the overall response rate was 50.3%. Table 1 shows demographic information and variable definitions for the sample. Respondents tended to be slightly more educated, had higher incomes, and were less racially diverse than the average indicated by state census figures. This was not considered a major concern, however, because all categories were sufficiently represented to use as regressors in the models.

Table 2 displays the definitions, means, and standard deviations for the three categories of dependent variables. For the first category, labeling, the simple statistics reveal a strong desire for labeling of all five attributes. While the highest percentage of respondents wanted labeling of GM chickens, this was not significantly greater than for the other attributes. For health-risk concerns, respondents were asked to use a five-point rating system from 1 (no risk), to 5 (high risk). Respondents indicated that they believed free-range chicken had low health

[1] The survey instrument and attribute sheet are available from the authors upon request.

Table 1. Demographics of Survey Respondents.

Variable	Description	Mean	Std. dev.
Age	Age, in years	50.2697	14.7827
Income	Income, in thousands	71.8910	38.1314
Female	1 if female, 0 otherwise	0.4617	0.4992
White	1 if white, non hispanic, 0 otherwise	0.8840	0.3206
SomeCollege	1 if had some college, 0 otherwise	0.2700	0.4445
College	1 if had college education, 0 otherwise	0.2563	0.4371
PostGrad	1 if had post-graduate education, 0 otherwise	0.1854	0.3890
Children	1 if children under 18 in household, 0 otherwise	0.3903	0.4884
PrimeShop	1 if primary shopper, 0 otherwise	0.7449	0.4365
Tobacco	1 if uses tobacco products, 0 otherwise	0.1922	0.3945
Poultry	1 if has worked in poultry industry, 0 otherwise	0.0791	0.2702
ReadLabel	Tendency to read food labels, from 1 = never to 4 = always	2.8015	0.9722

risk, GM feed had some health risk, and the other three characteristics carried high health risks. Lastly, respondents were requested to rate their knowledge of the attributes, prior to the survey, on a five-point scale with 1 being no knowledge. These results quickly indicated that consumers tend not to be familiar with these attributes. Only for free-range was the mean higher than the midpoint of the scale. Respondents had particularly low knowledge of GM feed and, as would be expected, the hypothetical GM chicken.

Models and Hypotheses

Fifteen models were run in total, one for each of the five attributes for each of the three categories. For the five models involving labeling, where the choice was dichotomous, the binary logit model was used. The remaining models, where the dependent variables took on ordered values from 1 to 5, were estimated using the cumulative, or ordered, logit model. All models were estimated using SAS. The descending option was used, so that the independent variables predict the probability of being in a higher category (Allison 1999). The set of independent variables was the same across all models, with a simplified general form expressed as

$$\begin{aligned} y_i = {} & \beta_0 + \beta_1 \text{Age}_i + \beta_2 \text{Income}_i + \beta_3 \text{Female}_i \\ & + \beta_5 \text{White}_i + \beta_6 \text{SomeCollege}_i + \beta_7 \text{College}_i \\ & + \beta_8 \text{PostGrad}_i + \beta_9 \text{Children}_i + \beta_{10} \text{PrimeShop}_i \\ & + \beta_{11} \text{Tobacco}_i + \beta_{12} \text{Poultry}_i + \beta_{13} \text{ReadLabel}_i + \varepsilon_i, \end{aligned} \tag{1}$$

where y_i represents one of the fifteen possible dependent variables as in Table 2, ε_i is normally distributed with mean 0 and standard deviation σ, and the independent variables are as defined in Table 1. For the cumulative logit models, four intercepts—one less than the number of categories of the dependent variable—were calculated. As with typical intercepts however, they are of little substantive interest (Allison 1999).

A remaining issue in the model specification was the concern over possible interactions among the independent variables. The specific concern was that some of the demographic variables might be endogenous. In such instances, the resulting model coefficients would be biased, and an alternative methodology would be required for analysis. The demographic variables were tested for each model using the two-stage process outlined in Wooldridge (2003). No evidence of endogeneity for the variables was discovered in any instance, verifying the appropriateness of the methods used.

From the literature discussed above, it was hy-

Table 2. Definition and Statistics for the Dependent Variables.

Category	Attribute	Definitions	Mean	Std. dev.
Labeling				
	GM fed	1 if consumer wants GM fed chicken products labeled, 0 otherwise	0.7597	0.4277
	GM chicken	1 if consumer wants GM chicken products labeled, 0 otherwise	0.8078	0.3945
	Free-range	1 if consumer wants free-range chicken products labeled, 0 otherwise	0.7483	0.4345
	Irradiated	1 if consumer wants irradiated chicken products labeled, 0 otherwise	0.7918	0.4065
	Antibiotics	1 if consumer wants products from chickens treated with antibiotics labeled, 0 otherwise	0.7941	0.4049
Health risk concerns				
	GM fed	Scale from 1 = no health risk from GM fed chickens to 5 = high risk	2.9741	1.2271
	GM chicken	Scale from 1 = no health risk from GM chickens to 5 = high risk	3.4031	1.2665
	FreerRange	Scale from 1 = no health risk from free-range chickens to 5 = high risk	2.1757	1.1198
	Irradiated	Scale from 1 = no health risk from irradiated chickens to 5 = high risk	3.2040	1.2662
	Antibiotics	Scale from 1 = no health risk from chickens treated with antibiotics to 5 = high risk	3.1289	1.1808
Knowledge				
	GM fed	Scale from 1 = no knowledge of GM fed chickens to 5 = very familiar	1.9937	1.1789
	GM chicken	Scale from 1 = no knowledge of GM chickens to 5 = very familiar	1.7405	1.1152
	Free-range	Scale from 1 = no knowledge of free-range chickens to 5 = very familiar	2.7449	1.5057
	Irradiated	Scale from 1 = no knowledge of irradiated chickens to 5 = very familiar	2.0840	1.2415
	Antibiotics	Scale from 1 = no knowledge of chickens treated with antibiotics to 5 = very familiar	2.4377	1.3216

pothesized that young respondents would be less concerned than older respondents about possible health effects from the technologies and thus also less likely to desire labeling. However, because younger consumers appear to be more accepting of GM technology (Hossain et al. 2003) they may be more knowledgeable about these and the other modern techniques. Gender was another category where most of the hypotheses were clear. For both labeling and health it was anticipated that females would be more in favor and more concerned, respectively, across the attributes. As noted in Gaskell et al. (2004), studies have typically found females to be less supportive of technologies and more concerned with the risks. While they further suggested females are generally less knowledgeable, no initial hypotheses were made in this regard. For race, no hypotheses were made for any of the models. While Hossain et al. (2003) found higher acceptance of GM foods among whites, the issue has received little attention in the literature and is of interest for more examination. For income, while well-considered in past studies, no specific hypotheses were formulated because reported results had been mixed.

Despite the findings of Miles et al. (2004), the presence of children in the household was believed to lead consumers to be more in favor of labeling and more mindful of, and thus concerned about, any potential health risks. It was also conceivable that for the same reasons parents may have taken the effort to be more knowledgeable. Three levels of education were entered into the model. Higher education was hypothesized to be associated with more knowledge about the attributes. The desire for labeling was also expected to increase with education, based on the idea that these consumers would usually be interested in having more rather than less information. The main question would be the relationship between education and health risk. For many technologies it has been argued both ways: either more education means better understanding and less concern, or better understanding leads to more concern.

Two variables regarding shopper behavior were included in the model. Both of these—the consumer being the primary shopper and being a consistent label reader—were expected to cause more interest in labels. For the latter, this was thought to also imply more knowledge and, perhaps, higher health concerns. With the former, no expectations were formed beyond label considerations.

Finally, two other variables were included that are not often considered. First, tobacco use was added to try to capture consumers who are, perhaps, more accepting of taking health risks and thus hypothesized to be less interested in labeling of the attributes and less concerned about health risks. No hypotheses were made regarding knowledge, in a way similar to variables discussed earlier. Second, given the noted importance of the broiler industry in the state, a variable was added indicating consumer involvement with the industry. The hypotheses were that such consumers would be less inclined to favor labeling, less concerned about health risks, and more knowledgeable of the attributes.

Results and Discussion

Results from the labeling regressions for each of the five attributes appear in Table 3. Quickly evident were two interesting and consistent findings. First, females were significantly more in favor of labeling each attribute at the 5% level, except for irradiation, where they were more in favor at the 10% level. This was in line with expectations, and seems to reflect the higher level of concern seen in similar studies. The second consistent finding was that users of tobacco products were significantly less interested in labeling at the 5% level for GM-fed chickens and GM chickens and at the 10% level for free-range chickens and irradiated chicken meat. Tobacco use was not significant in the model for antibiotic use, although the expected negative sign was maintained. The results were as expected and suggest that tobacco use should be considered in other studies as a way to capture the risk tolerance of respondents.

Only two other variables were statistically significant in any of the models. For irradiated chicken, non-whites were more interested in labeling. It was uncertain why this would be the case, particularly because similar relationships were not evident in the other categories. Finally, for chickens treated with antibiotics, the higher-frequency label readers were more interested in labeling than were infrequent label readers. While this was expected, the lack of the significance of this variable for the other attributes was a surprise. The outcome could, perhaps, be accounted for by considering again the evidence in Table 2, where the majority of subjects were interested in labeling each of the attributes.

Table 3. Binary Logit Regression Results for Labeling Support.

	Attribute									
	GM feed		GM chicken		Free-range		Irradiated		Antibiotics	
Parameter	Estimate	p Value	Estimate	p Value	Estimate	p Value	Estimate	p Value	Estimate	p Value
Intercept	0.8572	0.3736	0.8247	0.4643	0.1543	0.8748	0.0058	0.9955	-0.9998	0.3561
Age	0.0078	0.4938	0.0073	0.5727	0.0013	0.9077	0.0050	0.6878	0.0135	0.2650
Income	-0.0030	0.4976	0.0041	0.4459	0.0002	0.9597	-0.0030	0.5434	0.0061	0.2305
Female	1.0413	0.0024	0.9910	0.0173	1.0863	0.0014	0.7112	0.0558	1.1974	0.0027
White	0.5587	0.1932	0.3335	0.5200	0.1027	0.8291	1.0713	0.0164	0.3017	0.5588
SomeCollege	-0.4718	0.2893	-0.5116	0.3062	-0.4010	0.3268	-0.2020	0.6526	-0.1989	0.6750
College	0.0828	0.8651	0.3998	0.5015	0.2678	0.5674	0.6652	0.2054	0.1520	0.7753
PostGrad	-0.5271	0.2869	-0.6099	0.2830	-0.0587	0.9020	0.2298	0.6676	-0.4192	0.4253
Children	-0.0196	0.9530	0.0224	0.9552	0.3751	0.2735	0.4194	0.2645	0.4359	0.2594
PrimeShop	-0.5073	0.1733	-0.1800	0.6734	-0.4968	0.1735	-0.2295	0.5734	-0.4184	0.3030
Tobacco	-0.7018	0.0347	-0.9417	0.0132	-0.5636	0.0883	-0.6431	0.0743	-0.2674	0.4828
Poultry	0.0172	0.9749	-0.1618	0.7864	-0.3276	0.5046	-0.1361	0.8050	0.0319	0.9576
ReadLabel	0.1666	0.2984	0.1908	0.3231	0.4543	0.0062	0.2429	0.1758	0.5326	0.0064

Having the large majority in agreement may have removed the potential for other variables to have a statistically measurable affect.

Table 4 shows the cumulative regression results for the five health-risk-concern models. The results from the free-range chicken model were considered first as it was expected few consumers would express concern over this attribute and thus the findings would differ from the remaining models. Two groups believed there was less health risk from free range chicken: white consumers, at the 5% level compared to other races, and those with a post-graduate education, at the 10% level compared to those with high school or lower education. The result for education could be expected, while the reasoning for the racial difference was again uncertain.

Turning to the other four attribute models, race was not statistically significant. The primary finding was that females consistently had higher health-risk concerns at the 5% level, except for GM chicken (10% level). This was as hypothesized and seems to suggest food marketers must do much more to convince women of the safety of these techniques. Additional research should also be conducted to better understand why these gender differences exist. Label readers also were significantly more concerned about risks, although only at the 10% level for irradiated chicken, again as anticipated. Higher education did tend to weakly reduce health-risk concerns, with significance levels around 10%, for GM-fed and irradiated chickens. This could be slight evidence for the argument that more-educated consumers are less concerned about new, technical in nature attributes than are less-educated consumers.

Age had the hypothesized negative sign and was significant at the 5% level for irradiated chicken and at 10% for GM chicken. The result suggested younger consumers may be more accepting of newer, controversial techniques than are older respondents. The results of the other variables were not as strong as expected. In particular, the signs for tobacco use, primary shoppers, and consumers with children had the expected signs in all models but were insignificant.

Results from the five cumulative-regression models for knowledge of the attributes appear in Table 5. Here, GM chicken results should be considered different from the rest of the models because GM chickens were not an actual product available in the marketplace. Due to the hypothetical nature of the product described in the survey package, significant differences were not anticipated. One difference was discovered though, with label readers claiming more knowledge at the 5% level. The result may reflect respondents' opinion that they have an overall better understanding of the technology and the food system than do infrequent label readers.

Label readers also claimed significantly higher knowledge in the models of the other attributes. Four other variables also had consistent and significant effects across the remaining models. First, gender again was demonstrated as a key characteristic, with females expressing lower knowledge of each of the other attributes, although only at 10% for antibiotics. While consistent with the expectations of Gaskell et al. (2004), this could relate to a desire for additional information, especially regarding health risks, rather than their truly being less informed than males. Those with a post-graduate education claimed significantly higher knowledge than did those with high school or lower education as suspected (10% for GM fed), but college-educated consumers did not. The two other results escaped a straightforward explanation: those with higher incomes showed higher knowledge, while tobacco users showed less knowledge.

The remaining variables added little to the model results. For example, those involved in the poultry industry only had significantly higher knowledge of free-range chicken. Race only mattered at the 10% level in a lower expressed knowledge of irradiated chicken on the part of white consumers. Age, being the primary shopper, and having children were not statistically significant in any model.

Examination of Respondent Comments

The above understanding of consumer attitudes was complemented by an examination of comments provided on the survey instruments. Seventy-two respondents included detailed comments, revealing some major trends. A large portion of these (18 of 72) dealt with the use of antibiotics and irradiation. Several respondents were of the opinion that the use of antibiotics in chicken production may lead to antimicrobial resistance, and the vast majority were against the usage of antibiotics. Comments about irradiation revealed uncertainty about the food-safety practice and resulted in mixed emotions on

Table 4. Cumulative Logit Regression Results for Health Risk Concerns.

	Attribute									
	GM feed		GM chicken		Free-range		Irradiated		Antibiotics	
Parameter	Estimate	p Value	Estimate	p Value	Estimate	p Value	Estimate	p Value	Estimate	p Value
Intercept 5	-1.6175	0.0152	-1.0646	0.1063	-2.8737	0.0001	-0.5827	0.3772	-2.7970	0.0001
Intercept 4	-0.4639	0.4813	0.0661	0.9197	-1.4761	0.0282	0.4520	0.4927	-1.5472	0.0195
Intercept 3	1.0013	0.1294	1.4212	0.0316	0.0454	0.9457	1.8826	0.0047	-0.0613	0.9256
Intercept 2	2.3644	0.0004	2.4953	0.0002	1.1855	0.0766	3.2318	0.0001	1.6123	0.0166
Age	-0.0059	0.4519	-0.0153	0.0535	0.0033	0.6767	-0.0176	0.0260	-0.0093	0.2388
Income	-0.0046	0.1148	-0.0020	0.4998	0.0011	0.6975	-0.0058	0.0443	0.0013	0.6587
Female	0.6587	0.0031	0.3782	0.0867	0.2661	0.2330	0.9967	0.0001	0.4538	0.0404
White	-0.4384	0.1602	-0.0621	0.8421	-1.1589	0.0003	-0.2643	0.3998	0.0822	0.7921
SomeCollege	-0.0768	0.7882	-0.0046	0.9872	-0.0465	0.8714	-0.5077	0.0777	0.1479	0.6048
College	-0.5656	0.0604	-0.2738	0.3640	0.0069	0.9819	-0.4845	0.1079	-0.2840	0.3439
PostGrad	-0.5406	0.1021	-0.4212	0.2000	-0.5958	0.0769	-0.5921	0.0719	-0.2560	0.4356
Children	0.1544	0.4966	0.2023	0.3777	0.1850	0.4231	0.0597	0.7930	0.2306	0.3114
PrimeShop	0.0488	0.8489	0.1559	0.5413	0.0449	0.8640	0.0530	0.8366	0.3844	0.1352
Tobacco	-0.3564	0.1492	-0.3960	0.1050	-0.0611	0.8061	-0.0656	0.7885	-0.1966	0.4222
Poultry	-0.1541	0.6827	-0.1261	0.7336	-0.2043	0.5972	0.2528	0.5041	0.3183	0.3994
ReadLabel	0.2396	0.0225	0.2592	0.0134	0.0397	0.7065	0.1774	0.0900	0.2740	0.0091

Table 5. Cumulative Logit Regression Results for Knowledge of the Attributes.

	Attribute									
	GM feed		GM chicken		Free-range		Irradiated		Antibiotics	
Parameter	Estimate	p Value	Estimate	p Value	Estimate	p Value	Estimate	p Value	Estimate	p Value
Intercept 5	-4.3053	0.0001	-4.4113	0.0001	-3.7378	0.0001	-4.4783	0.0001	-3.5951	0.0001
Intercept 4	-2.7799	0.0001	-3.0609	0.0001	-2.7199	0.0001	-3.3317	0.0001	-2.4082	0.0004
Intercept 3	-1.6516	0.0176	-2.0984	0.0044	-1.7715	0.0087	-2.2156	0.0015	-0.9964	0.1360
Intercept 2	-0.6700	0.3319	-1.2681	0.0824	-1.1997	0.0742	-1.2660	0.0662	-0.3317	0.6189
Age	-0.0056	0.5048	-0.0036	0.6887	0.0094	0.2421	0.0108	0.1934	-0.0031	0.6986
Income	0.0067	0.0276	0.0043	0.1804	0.0083	0.0047	0.0072	0.0169	0.0055	0.0637
Female	-0.5278	0.0224	0.0227	0.9257	-0.4483	0.0421	-0.4344	0.0562	-0.4656	0.0362
White	-0.0987	0.7651	-0.1682	0.6218	-0.0210	0.9476	-0.5894	0.0668	-0.0917	0.7723
SomeCollege	0.0055	0.9858	0.0591	0.8572	0.3267	0.2643	0.2471	0.4188	0.3788	0.1938
College	0.0578	0.8588	-0.0277	0.9362	0.3178	0.3042	0.1690	0.5999	-0.0600	0.8462
PostGrad	0.6030	0.0793	0.5287	0.1481	0.7918	0.0175	0.7394	0.0310	0.7762	0.0208
Children	0.0447	0.8517	0.0741	0.7694	-0.1893	0.4119	-0.0819	0.7311	0.1047	0.6500
PrimeShop	0.0030	0.9908	-0.0990	0.7251	0.2101	0.4110	0.1746	0.5076	-0.0647	0.8001
Tobacco	-0.5906	0.0287	-0.3316	0.2430	-0.7610	0.0028	-0.5349	0.0433	-0.4986	0.0495
Poultry	0.5402	0.1674	0.2362	0.5779	1.1210	0.0035	0.0770	0.8452	-0.0375	0.9240
ReadLabel	0.2532	0.0209	0.2735	0.0180	0.2486	0.0182	0.2863	0.0082	0.2990	0.0049

the subject. Respondents were split on acceptance, with some expressing concerns over possible health threats and others noting it is a useful tool for food safety and increasing shelf life. Ultimately, the impression was that few understood how the irradiation process worked and the long-term health effects from consumption.

Another area of controversy was GM-fed chicken and GM chickens. Fourteen individual comments directed towards this issue that were shared by respondents. Several indicated a lack of understanding of GM technology. Three respondents suggested they would be open to purchasing GM chicken if it was proven to be safe and without long-term detrimental health effects. However, eight respondents had strong reactions that "manipulating" food was wrong for both health and religious reasons, and stated they would not purchase such a product.

There were mixed feelings amongst many in terms of combined issues. For instance, one respondent wrote, "I'm not opposed to irradiating meat because I believe it has no residual negative effect on the meat. I am most opposed to the excessive use of antibiotics in chickens and eggs." Another comment of interest was, "I would not support food irradiation or GM chickens. I am somewhat neutral about GM feed and free-range chickens. I do support antibiotics." Such comments were unexpected. The expected pattern had been that if a respondent was against one form of intervention in chicken production, then that person likely would be against other modifications as well.

Seven respondents suggested that they would be more open to purchasing foods that have been irradiated or were GM if these foods were shown to have FDA approval and were labeled. The participants were concerned with the wholesomeness of food and felt that if there were any health risks with what they were eating, that food should be labeled as such. Labeling appeared to be a growing area of importance for many consumers, as many of them would like to be more aware of how their food has been produced.

After reviewing the comments, labeling appears to be of great importance when marketing chicken. Understanding if chicken has been raised conventionally with antibiotics, is GM, or if the product has been irradiated could significantly alter consumer's purchasing decisions. A label showing FDA approval that the chicken has been proven safe could mean the difference between a consumer purchasing the chicken or leaving it on the shelf.

Conclusion

The results of the survey show that consumers, especially women, were highly in favor of labeling all discussed attributes. Only users of tobacco products seemed less interested. Labeling, though, creates its own set of issues in terms of the costs involved and how those costs would be distributed. These costs can be difficult to determine and depend on many other factors such as the need for testing and certification programs. It appears clear that at least some of the associated costs would be felt by the consumers. Thus how strong consumers' desire for labeling would be at higher prices for the food products remains an area for future research.

Perceived health risks were highest for GM and irradiated chicken, with label readers and women among the most concerned. The former group also felt more knowledgeable about all the attributes as compared to the latter. It appears, therefore, that knowledge alone of these attributes does not necessarily increase or alleviate consumer concerns. Comments returned further highlighted many of these issues. Together, the results suggest much more would need to be done to have consumers accept these products. In particular, introduction of a GM chicken would likely require a substantial education effort and, perhaps most importantly, assurances of safety.

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