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Market Opportunities for New Sauerkraut Products

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FORWARD AND JUSTIFICATION

Production and processing of head cabbage has a significant economic importance for New York State agriculture. New York produces about one-fourth of the total U.S. head cabbage output, with 79 percent destined to the fresh market. In the U.S., New York is the number one producer of fresh head cabbage (with a market share of 22 percent) and is number two, after Wisconsin, in the production of sauerkraut, with a market share of 39 percent (Lucier and Lin, 2002).

During the past decade (1991 to 2001), production of fresh head cabbage and sauerkraut in New York State increased 61 percent and 23 percent, respectively. During the same period, per capita consumption of fresh cabbage increased from 8.2 pounds to 8.8 pounds (an increase of 7.3 percent), while consumption of sauerkraut stayed stable at around 1.3 pounds (a decrease of between 2.2 to 2.3 pounds from the 1960s to '70s levels (USDA, 2004).

The consumption trends of fresh head cabbage and sauerkraut clearly reflect today's consumers' food preferences, which are strongly determined by an increasing desire and interest in both fresher and more complex and exciting food products. The incorporation of fresh cabbage to bagged salads is thought to be a major contributing factor to the observed increase in consumption of fresh head cabbage. On the other hand, sauerkraut sold and consumed today in the U.S. market is not that different from the sauerkraut made a hundred years ago and is appreciated mostly by older consumers and little by younger consumers.

Given both the economic importance of sauerkraut for the New York cabbage industry and the stagnated consumption in the U.S. market, and in an attempt to develop products that would be more appealing to today's consumers, Dr. John Roberts, a food scientist at Cornell University, developed several new sauerkraut formulations. These new sauerkraut products needed to be pre-selected for a market viability assessment before recommending their production and market introduction to processors in New York State.

Assessing the market viability of six new formulations is the main objective of this research project. It encompasses evaluations of consumer's acceptance of these new formulations, as an indicator of their market potential, and a more in-depth understanding of how U.S. consumers use and consume sauerkraut. Results from this study are keys in selecting which of the new formulations to produce and introduce to the market, as well as in developing adequate marketing and product-positioning strategies to ensure their success in the marketplace.

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SECTION I. INTRODUCTION

Production and processing of head cabbage has a significant economic importance for New York State agriculture. According to the New York Agricultural Statistics Service (2004), New York harvested 16,400 acres of head cabbage in 2001, with 84 percent of the production destined to the fresh market. New York produced \$48.6 million of cabbage for the fresh market in 2002, which accounted for 17 percent of the total U.S. fresh market cabbage output, and ranked second in the nation (behind California) for fresh market cabbage production. New York produced \$3.8 million and ranked number two, second only to Wisconsin, in the production of cabbage for sauerkraut, with a market share of 44 percent in 2001 (USDA, 2003).

Production of cabbage for fresh market in New York increased 61 percent over the decade between 1991 and 2001, and output of cabbage for sauerkraut in the state also increased 23 percent in the same period (Lucier and Lin, 2002). However, the increase in cabbage for sauerkraut production is mainly due to consolidation among U.S. processors which led to diminishing output in other producing states, such as Michigan, Ohio and Washington, and is not due to market demand growth.

Sauerkraut Consumption in the United States

Total cabbage consumption in 2001 in the United States was 3 billion pounds, of which about 88 percent was consumed fresh, while the rest was consumed as processed cabbage, mainly sauerkraut (Lucier and Lin, 2002). During the 1st decade (1991-2001), per capita consumption of fresh cabbage increased from 8.2 pounds to 8.8 pounds (an increase of 7.3 percent). On the other hand, per capita consumption of sauerkraut in the U.S. has exhibited a continuously declining trend since the 1960s and 1970s, from more than 2.0 pounds in the 1970s to as low as 1.0 lbs. in 1996. It stabilized at 1.3 pounds in recent years (USDA, 2003). The USDA *1994-1996 Continuing Survey of Food Intakes by Individuals* (1998) showed that 71 percent of fresh head cabbage is consumed at home. Most of the sauerkraut consumption (79 percent) takes place at home as well. Coleslaw accounts for most of the cabbage consumed away from home – more than half of coleslaw consumption (56 percent) occurred away from home, mostly at fast food outlets.

According to the Lucier and Lin report (2002), three-fourths of the total U.S. sauerkraut consumption is concentrated in the Midwest and in the East, with consumers in the South and West regions of the United States reporting light consumption of this product. They also pointed out that whites consume 91 percent of all sauerkraut while Asians and Hispanics consume very little. Additionally, sauerkraut consumption appears to be favored by consumers with the greatest financial means. Households identified as upper income in their study (3.5 times the poverty level) represented 39 percent of the U.S. population but consumed 43 percent of the total sauerkraut.

The Lucier and Lin report also indicated that men consume about 25 percent more cabbage (fresh and processed) per capita than women, and that, in proportion to their population shares,

both men and women over the age of 40 are strong consumers of cabbage in its different forms (fresh and processed). Moreover, except for coleslaw, men between 20 years and 39 years (16 percent of the population) favor cabbage (particularly sauerkraut), accounting for 30 percent of total cabbage consumption. By contrast, women in this age group tend to avoid cabbage in all forms. Consumers under 20 years are light cabbage consumers. While they account for nearly 30 percent of the U.S. population, they consume only 10 percent of all cabbage in this country.

The characteristics of sauerkraut consumption in the United States seem to indicate a preference for this product by consumers who were born and raised before the 1970s, when sauerkraut consumption was higher. On the other hand, it is not particularly liked by younger consumers who have been exposed to a wider array of food products and have developed an interest in innovative and exciting flavors, and who don't favor traditional products such as sauerkraut. The good news is that a significant portion of consumers do eat sauerkraut. According to a recent poll, paid for by the Great Lakes Kraut Company, two out of three Americans in the United States eat sauerkraut. The key to future industry growth is to expand consumer demand for the product. In their article, Lucier and Lin (2002) concluded that *"the success of the cabbage and sauerkraut industries may lie in expanding the range of product uses and also in the discovery and communication of product benefits."*

Development of New Sauerkraut Products at Cornell University

Consumption trends in the U.S. food market are strongly determined by today's consumer's desire for new and exciting flavors. This trend can be observed in almost all food categories including beverages, condiments, snacks, cheese, and produce. However, sauerkraut currently sold in the market is not that different from sauerkraut made in the past. Acknowledging this discrepancy, Dr. John Roberts, a food scientist at the New York State Agricultural Experiment Station at Cornell University in Geneva, New York, developed various new sauerkraut formulations for market testing.

Through the addition of savory ingredients such as onions, garlic, dill seed, green peppers, mustard seed, and jalapeño peppers to cabbage kraut, in different amounts and blends, new sauerkraut formulations were developed and screened for consumer acceptance through small sensory evaluation panels in Geneva, New York. These small-scale taste tests revealed the sauerkraut blends were well accepted, with many panelists preferring the blends to traditional sauerkraut. Six sauerkraut formulations were found to be the most favored among these panelists, including sauerkraut added with the following ingredients in concentrations indicated in parentheses: garlic (1%), onion (30%), dill seed (1%), jalapeño peppers (10%), green peppers (20%), and onions and jalapeño peppers (25% and 5%, respectively).

Due to the favorable acceptance identified through the preliminary taste tests, sauerkraut processors have shown interest in these new blends. The next phase needed in this research was to conduct a more wide-scale consumer acceptance evaluation to determine which sauerkraut blends would most likely be successful in the consumer market.

Objectives of the Study

The objectives of this study are to:

- Better understand consumer attitudes and behaviors with respect to sauerkraut and sauerkraut consumption.
- Identify the demographic characteristics of sauerkraut consumers.
- Explore consumer reactions to the concept of new sauerkraut formulations.
- Assess the market viability of three key new sauerkraut formulations.
- Derive recommendations for the introduction and marketing of these new formulations.

Organization of This Study

The study was conducted mostly through the collection of primary information, given that secondary information on sauerkraut consumption in the United States (that is, information available in publications or on the Internet) was very limited. Two approaches were employed in the collection of primary information in this study: a mail survey and a preference sensory evaluation test conducted with untrained panelists.

This report is divided in two parts. The first part corresponds to the results and recommendations derived from the mail survey administered to individuals in five U.S. cities. The second part corresponds to the results and recommendations of the sensory evaluation test conducted for the three new sauerkraut formulations which were identified as those with the highest market potential by the mail survey.

SECTION 2. EXPLORING SAUERKRAUT CONSUMPTION AND CONSUMER PREFERENCES -- THE MAIL SURVEY

Survey Design and Methodology

Given that consumption of sauerkraut is higher in the Midwest and in the East, five major cities and their suburbs in these areas of the United States were selected as targets of the mail survey for this study. These cities were New York (NY), Philadelphia (PA), Cincinnati (OH), Chicago (IL) and Detroit (MI).

The survey was divided into five major sections: general characteristics of sauerkraut consumption, characteristics of sauerkraut consumption at home, characteristics of sauerkraut consumption away from home, participants' interest in each of the six new sauerkraut formulations, and participants' demographic characteristics. The questionnaire is included in Appendix 1.

In July 2003, a letter was sent to all addresses selected for the survey to introduce the study, describe its objectives and announce the subsequent mailing of the actual survey. The questionnaire was mailed two weeks later along with a \$1 bill offered as a token of appreciation for participation. A total of 2,500 surveys were mailed, 500 per selected city. A postcard reminder was sent to the list four weeks after initial mailing of the questionnaire. The design of the questionnaire, as well as the mailing procedures, conformed to the Total Design Method (TDM) as established by Dillman (1978).

In all, 2,338 surveys were effectively delivered. The rest were returned due to incorrect addresses. A total of 863 responses were received, resulting in a response rate of 37 percent, relatively high by mail survey standards. Of the 863 returned surveys, 833 were deemed valid responses and were included in the results presented in this report. Most of the 30 surveys not included were excluded because they were received after the cut-off date for data analysis. Responses from the five cities were not statistically different. Therefore, the results of the following analysis represent all responses combined.

Survey Results

1. Characteristics of Sauerkraut Consumption

This part of the mail survey included questions aimed at identifying whether participants are sauerkraut consumers or not and, if so, the characteristics of their consumption of sauerkraut. The first question was "have you had sauerkraut in the past 12 months?" Participants were classified as "consumers" or as "non-consumers" of sauerkraut based on their response to this question. Those who responded "yes" were classified as sauerkraut "consumers" and were asked to indicate where they usually eat sauerkraut – at home or away from home. Those who replied "no" to this question were classified as "non-consumers" and were asked to indicate why they had not consumed sauerkraut during the 12 months prior to the survey.

1.1 Consumers and Non-Consumers of Sauerkraut

In all, 72 percent of survey participants were classified as sauerkraut “consumers”, of which female and male consumers were about equal (50 percent and 49 percent, respectively). The rest of the participants (28 percent) were classified as “non-consumers” of sauerkraut, and the distribution between genders among non-consumers was also about equal – both 49 percent (Table 1).

Table 1. Survey Participants by Consumption Category and Gender

	All	Females	Males	Unidentified
	<i>Number (percentage)</i>			
Consumers	601 (100%)	302 (50%)	293 (49%)	6 (1%)
Non-consumers	232 (100%)	114 (49%)	114 (49%)	4 (2%)
All Participants	833 (100%)	416 (50%)	407 (49%)	10 (1%)

As shown in Table 2, sauerkraut consumers tend to be older than non-consumers, with 56 percent of consumers being 51 years and older, compared to 44 percent of non-consumers. Conversely, non-consumers tend to concentrate in the younger age groups, with 22 percent being 34 years or less in age, compared to 13 percent of consumers and 15 percent of all survey participants. These results confirm the USDA survey’s findings cited earlier indicating that, in proportion to their population shares, both men and women over the age of 40 are strong consumers of sauerkraut (Lucier and Lin, 2002).

With respect to income levels, results from this survey don’t coincide with the findings of the USDA survey cited in the introduction of this section (Continuous Food Intake Survey by USDA). According to the USDA food intake survey, sauerkraut consumption is more concentrated in the higher income groups. In fact, in the present survey 49 percent of sauerkraut consumers 52 percent of non-consumers have income levels of \$50,000 or above; additionally, the share of consumers and non-consumers in the two lower income groups (under \$50,000) are very similar.

Table 2. Sauerkraut Consumer Distribution by Age and Income

	All Participants	Consumers	Non-Consumers
	<i>Percent of respondents</i>		
Age group			
18 – 34 yrs	15%	13%	22%
35 – 50 yrs	32%	31%	34%
51 – 66 yrs	29%	31%	24%
66 yrs+	24%	25%	20%
Income level			
<\$25,000	14%	14%	15%
\$25,001-\$50,000	27%	27%	28%
\$50,001-\$75,000	22%	24%	18%
\$75,001+	28%	25%	34%
No response	9%	10%	5%

In order to explore the relationship between country of origin and sauerkraut consumption, survey participants were asked to indicate “the region of the world that you and your family (parents or grandparents) associate most strongly with your original nationality”. They were also asked to indicate the specific country of origin. The fact that 40 percent of participants indicated their origin was North America (most often the United States) indicates that, unless all of these individuals were Native Americans, many participants didn’t understand clearly how to reply to this question or didn’t answer according to the instructions provided.

Even though 55 percent of consumers identified their origins were in Europe (mostly in countries such as Germany, Italy, England, Ireland, Poland and Czechoslovakia), 32 percent of non-consumers also identified the same countries as their place of origin (Table 3). On the other hand, participation of individuals from the other nine regions of origin explored in the survey, including South America, Central America, the Caribbean, Africa, Middle East, Far East, Asia, Oceania, and “Other”, was very low. Obviously, these results make it very difficult to derive any conclusions on the effect of country/region of origin on the consumption of sauerkraut or on the market potential for sauerkraut among consumers with ethnic origins in places different from Europe (i.e., Hispanics, Asians, etc.).

Table 3. Distribution of Survey Participants, by Origin

Origin	All Participants	Consumers	Non-Consumers
	<i>Percent of respondents</i>		
North America	40%	38%	45%
South America	1%	0%	2%
Central America	1%	1%	0%
The Caribbean	2%	1%	3%
Europe	49%	55%	32%
Africa	2%	1%	7%
Middle East	0%	0%	1%
Far East	0%	0%	1%
Asia	3%	1%	7%
Oceania	0%	0%	0%
Other	1%	1%	1%
No Response	1%	2%	1%

1.2 Sauerkraut Consumers: Usual Place Where Sauerkraut is Consumed

The results from the mail survey do confirm the findings of the USDA survey relative to consumption of sauerkraut taking place mostly at home in the United States. In fact, 60 percent of sauerkraut consumers reported they usually eat sauerkraut at home, while 23 percent indicated they usually eat it away from home, and 17 percent said they usually eat sauerkraut both at home and away from home (Table 4).

More female consumers usually consume sauerkraut at home (64 percent) than males (56 percent), while consumption away from home is higher among males (27 percent) than among females (20 percent), possibly as a result of males attending sports events (where sauerkraut with hot dogs is a common food option) more frequently than females. The percentage of consumers

who reported usually eat sauerkraut in both places is basically the same for females and males: 16 percent and 17 percent, respectively (Table 4).

Table 4. Sauerkraut Consumers - Place Where Sauerkraut is Usually Consumed

	At Home	Away from Home	Both
	<i>Percent of respondents</i>		
All participants	60%	23%	17%
Females	64%	20%	16%
Males	56%	27%	17%

1.3 Non-Consumers: Reasons for Not Consuming Sauerkraut

Survey participants who had not eaten sauerkraut during the 12 months prior to the survey were classified as “non-consumers.” This group of participants was asked to indicate their reasons for not consuming sauerkraut. They were offered a range of options from disliking or avoiding fermented and pickled foods, including cabbage and derived products, to no consumption due to lack of exposure to or unawareness of the product. The list included: “I never eat fermented/pickled foods”, “I don’t like/never eat cabbage or derived products”, “I don’t like sauerkraut”, “I haven’t had a chance to eat it”, “I don’t know” and “Other”. When answering “other”, respondents were asked to specify their responses. Respondents were instructed to check all the options that applied.

Half of non-consumers (50 percent) reported they had not eaten sauerkraut because they don’t like it, 10 percent reported they never eat fermented or pickled foods, and 8 percent indicated they don’t like or never eat cabbage products. These results mean that these individuals clearly are not suitable target markets for either traditional or new sauerkraut formulations. On the other hand, 32 percent of non-consumers indicated they “haven’t had a chance to eat it,” and 13 percent said that they “don’t know” why they had not eaten it. Given that these individuals didn’t indicate rejection for the product, they could constitute a potential target market for sauerkraut and the new formulations if wider exposure and availability of sauerkraut products were ensured. Reasons cited by non-consumers who checked the option “other” included: diet restrictions (mainly related to sodium restrictions), health-related problems (heartburn, indigestion, etc.), and dislike or lack of interests of other members in the household.

2. Characteristics of Sauerkraut Consumption at Home

In order to identify the characteristics of sauerkraut consumption at home, consumers were asked to indicate the frequency of consumption, the types of foods with which they usually eat sauerkraut, and whether the sauerkraut they consume at home is mainly home-made or bought at a store. Results on these questions are presented below and are based on the number of consumers who indicated “at home” as the place where they usually consume sauerkraut; it does not include those who checked both “at home” and “away from home”.

2.1 Frequency of Consumption

To determine frequency of consumption at home, respondents were presented with the following options: “once a week or more often”, “about every other week”, “about once a month”, “less than once a month”, and “only on special occasions (such as a holiday or family celebration)”. Results indicate that frequency of consumption of sauerkraut is very low. Only 4 percent of consumers eat sauerkraut “once a week or more often”, and just another 5 percent eat it “about every other week”. Furthermore, 24 percent indicated they eat it “about once a month”, 35 percent reported a frequency of “less than once a month” and 17 percent eat it “only on special occasions”. In summary, 76 percent of consumers who usually eat sauerkraut at home do it once a month or less frequently!

2.2 Types of Foods Usually Eaten with Sauerkraut at Home

There doesn't seem to be a particularly key type of food with which these consumers eat sauerkraut at home. The options provided to respondents included: “regular meals”, “traditional family recipes”, “dishes cooked on special occasions”, and “other types of foods.” When the answer was “other types of foods”, they were asked to specify the food. Respondents were asked to check all the options that applied.

Results indicated that 34 percent of these consumers usually eat sauerkraut at home with regular meals, 32 percent eat it with traditional family recipes, 29 percent eat sauerkraut with dishes cooked on special occasions, and 26 percent have it with “other types of foods”. Among the other types of foods most often cited were: hot dogs (33 percent), pork - ribs, loin, chops, etc. (31 percent), sausages (16 percent), kielbasa/polish sausage(16 percent), bratwurst (10 percent), Reuben sandwich (9 percent), and mashed potatoes (5 percent). Other foods cited less frequently were pierogis, chicken, salad, and corned beef.

2.3 Source of Sauerkraut Consumed at Home

To establish the source of the sauerkraut consumed at home, these consumers were asked the question - “Is the sauerkraut consumed at home mainly home-made, or is it bought at a store?” A total of 76 percent of these sauerkraut consumers reported that the sauerkraut eaten at home is mainly bought at a store. This represents a key marketing opportunity for the sale of the new sauerkraut formulations through retail stores!

3. Characteristics of Sauerkraut Consumption Away from Home

In order to explore the characteristics of consumption of sauerkraut away from home, consumers who indicated they “usually” eat sauerkraut away from home (23 percent of all sauerkraut consumers) were asked to indicate the types of food outlets where they eat it, as well as the types of foods with which they usually have it.

3.1 Types of Food Outlets Where Sauerkraut is Consumed

Sauerkraut consumers in this study were asked to “indicate the type(s) of food outlet(s) where you eat sauerkraut away from home”. The options provided for food outlets included: “fast food outlets”, “sit-in restaurants”, “food outlet at sports events”, “food outlets at special events (i.e., fair, festival)”, and “other types of food outlets.” When answering “other types of food outlets”, respondents were asked to specify the types of food outlets. They were asked to check all options that applied.

The types of outlets most often cited were: “food outlets at special events (i.e., fairs or festivals)”, reported by 56 percent of respondents in this group; “sit-in restaurants” (51 percent); and “fast-food outlets (i.e., sandwich/hot dog outlets)”, reported by 49 percent. “Sports event food outlets” (33 percent) and “other types of food outlets” (15 percent) were less frequently cited. The “other types of food outlets” cited by respondents included park concessions, bars, hot dog stands, cafeterias at work, October or fall festival parties and German restaurants, among others.

3.2 Types of Foods with Which Sauerkraut is Consumed

In order to determine the types of foods with which sauerkraut is consumed away from home, these consumers were asked to indicate the types of foods with which they eat sauerkraut when eating it away from home. They were again instructed to check all the options that applied. The options presented to respondents included: “as an ingredient on sandwiches (i.e., Reuben or others)”, “as a condiment on hot dogs”, “as a side dish to meat entrees”, and “with other types of foods” (where they were asked to specify the type of food).

Results indicate that, when consumed away from home, sauerkraut is mostly eaten as a condiment on hot dogs (reported by 62 percent of respondents in this group), as an ingredient on sandwiches (i.e., Reuben or others) (58 percent) and as a side dish to meat entrees (45 percent). Only 13 percent of these consumers indicated that they eat sauerkraut away from home with “other types of foods”, and the other types of foods cited included: different types of sausages (bratwurst, polish-smoked and Italian, among others), pork, Polish and German dishes, appetizers and salads.

4. Consumer Interests in the New Sauerkraut Formulations

In order to explore the market potential for the six new sauerkraut formulations developed at Cornell’s Geneva Experimental Station, all survey participants were asked to indicate the degree of interest they would have in eating each of these products if available commercially. A 4-point scale was used in this case, where 1 = very interested, 2 = interested, 3 = somewhat interested, and 4 = not interested. The six sauerkraut formulations are sauerkraut with garlic, sauerkraut with onion, sauerkraut with dill seed, sauerkraut with jalapeño peppers, sauerkraut with green peppers, and sauerkraut with onions and jalapeño peppers. The goal is to identify the three new formulations which generate the most interests among survey participants for further testing through a sensory evaluation panel.

Based on the highest percentage of consumers who indicated being “interested” or “very interested”, the three formulations with the greatest market interests were sauerkraut with onion (47 percent), sauerkraut with garlic (38 percent), and sauerkraut with dill (27 percent). Less sauerkraut consumers expressed the same degree of interest for sauerkraut with green peppers (20 percent), sauerkraut with jalapeño peppers (16 percent), and sauerkraut with onions and jalapeño peppers (15 percent) (Table 5).

When analyzed by gender, slightly more female sauerkraut consumers (50 percent) were “interested” or “very interested” in sauerkraut with onion compared to male consumers (45 percent), while slightly more male sauerkraut consumers were “interested” or “very interested” in sauerkraut with garlic (42 percent) compared to female consumers (35 percent). Almost the same percentage of female (28 percent) and male (25 percent) sauerkraut consumers were “interested” or “very interested” in sauerkraut with dill. Moreover, while most non-consumers indicated no interest in any of the new sauerkraut formulations (i.e., they circled “4 = not interested” in the 4-point scale), 16 percent of survey respondents in the non-consumer group indicated being “interested” or “very interested” in sauerkraut with onion, 18 percent in sauerkraut with garlic, and 8 percent in sauerkraut with dill. Therefore, sauerkraut with onion, sauerkraut with garlic, and sauerkraut, therefore, were selected to be the three new formulations tested through the sensory evaluation panel.

Table 5. Sauerkraut Consumers’ Interest in the New Sauerkraut Formulations, by Gender

	Sauerkraut with:					
	Garlic	Onion	Dill	Jalapeño Peppers	Green Peppers	Onion & Jalapeño Peppers
	<i>Percent of respondents</i>					
Very interested						
All	19%	24%	11%	6%	6%	6%
Females	17%	26%	13%	5%	7%	3%
Males	21%	22%	9%	9%	5%	7%
Interested						
All	19%	23%	16%	10%	14%	9%
Females	18%	24%	15%	6%	11%	6%
Males	21%	23%	16%	13%	18%	12%
Somewhat interested						
All	21%	20%	21%	13%	18%	12%
Females	22%	18%	22%	12%	16%	11%
Males	20%	22%	21%	15%	19%	14%
Not interested						
All	30%	24%	37%	52%	43%	54%
Females	31%	26%	38%	58%	48%	61%
Males	29%	23%	37%	47%	40%	48%
No response						
All	11%	9%	15%	19%	19%	19%
Females	12%	6%	12%	19%	18%	19%
Males	9%	10%	17%	16%	18%	19%

Summaries of the Mail Survey Results and Recommendations

1. Summaries

According to the mail survey, almost three out of every four individuals surveyed are sauerkraut consumers. Contrary to the findings of the USDA survey on gender distribution of sauerkraut consumers, results from this survey indicate that the proportions of females and males who are sauerkraut consumers vs. non-sauerkraut consumers are similar. Results of this survey disagree with the USDA survey findings on a higher sauerkraut consumption among higher income consumers. In this survey, no such effect was evident. This survey's results do confirm that consumers of sauerkraut are concentrated in the older age groups.

Most of the individuals identified as non-consumers of sauerkraut are not a target market for sauerkraut products. Those who indicated aversion to fermented, pickled, sauerkraut, or cabbage derived products will not be persuaded to try the new products. Identification of the effect of an individual's country or area of origin on consumption or non-consumption of sauerkraut was not possible through this survey.

Consumption frequency of sauerkraut is very low among sauerkraut consumers. Most of them consume sauerkraut only once a month or less often. There doesn't seem to be a particularly "key" type of food with which sauerkraut is consumed at home. Some mentioned consuming it in salads, which might be an interesting new application to promote. Since most sauerkraut consumed at home was bought at a store, retail stores would be an adequate marketing channel for the new sauerkraut formulations.

Special events (fairs and festivals), sit-in restaurants, and hot dog outlets are the outlets where more consumers eat sauerkraut away from home. Bars were mentioned by a few but might be an interesting venue to promote it's consumption. Different types of sausages, pork, Reuben sandwiches, and Polish/German dishes are the typical types of foods with which sauerkraut is commonly eaten away from home. Appetizers and salads, mentioned by a few, constitute interesting applications to explore/promote.

The three new sauerkraut formulations with the highest market potential (i.e., with the highest percentages of consumers "interested" and "very interested") to be tested through a sensory evaluation are: sauerkraut with garlic, sauerkraut with onion, and sauerkraut with dill.

2. Recommendations for the Sensory Evaluation

The demographic characteristics of sauerkraut consumers who indicated being "interested" or "very interested" in the three selected sauerkraut formulations (sauerkraut with garlic, sauerkraut with onion, and sauerkraut with dill) were used to design the profile of individuals to participate in the sensory evaluation panel (Table 6).

Percentages reported in Table 6 indicate that interest in these three new formulations among sauerkraut consumers is very homogeneous across the different categories explored (gender, age,

income, and origin). This implies that the sensory evaluation panel did not need to be specifically defined in terms of age, income level, or origin for the results to be representative. It is very important, however, that panelists be sauerkraut consumers, given that most non-consumers don't have much interest in the new formulations, according to the survey results.

Additionally, it is worth exploring in more depth the acceptance of these three new sauerkraut formulations among younger consumers (under 34 years of age) through this panel, particularly given that they constitute a key target market that these new formulations aimed at. On the basis of these findings, it was recommended that the ideal sensory evaluation panel should be divided in two age groups of equal size, with a cut-off age of 34 years, and that each group should compose of an equal number of males and females.

Table 6. Demographic Characteristics of Sauerkraut Consumers Who Were “Interested” or “Very Interested” in the Three New Sauerkraut Formulations Selected for Sensory Evaluation

	Sauerkraut w/Garlic	Sauerkraut w/Onion	Sauerkraut w/Dill
	<i>Percent of respondents</i>		
Gender			
Females	35	50	28
Males	42	45	25
Age			
18 - 34 yrs	45	47	21
35 - 50 yrs	46	52	24
51 - 66 yrs	37	47	32
66 yrs+	27	44	26
Income			
<\$25,000	35	51	23
\$25,001-\$50,000	38	48	26
\$50,001-\$75,000	48	51	30
\$75,001+	34	42	24
Origin			
North America	39	44	23
Europe	37	50	29
Others	30	44	21

SECTION 3. THE SENSORY EVALUATION STUDY

Design of the Sensory Evaluation Study

Based on the results of the mail survey, the three sauerkraut formulations showing the highest degrees of interest among sauerkraut consumers were selected to be tested through the Sensory Evaluation Panel for tasting. The three formulations were: sauerkraut with onion, sauerkraut with garlic, and sauerkraut with dill. Plain sauerkraut was included as a reference sample in the evaluation.

The test was conducted on October 23rd, 2003 at the Sensory Evaluation Laboratory in the Department of Food Science at Cornell University, Ithaca, New York. Individuals were invited to participate and were offered \$5 and an additional treat (candy) as an incentive to participate. Requirements to participate were to be over 18 years of age and to have eaten sauerkraut at least once in the past year. The goal for the Sensory Evaluation Response test was set at 80 panelists, of which, half were to be under 34 years old and half over 34 years old with an equal proportion of males and females.

Participants in the preference test were asked to taste each sample on its own and to rate overall acceptability, appearance, and flavor, using a 9-point hedonic scale. After tasting each of the samples individually, panelists were allowed to taste it with a piece of frankfurter and were asked a few additional questions including: purchase intention, image of sauerkraut, frequency of consumption, and potential effect of health claims on their consumption of sauerkraut.

Characteristics of the Panel

As shown in Table 7, the composition of the Sensory Evaluation panel didn't match exactly the characteristics of the ideal panel recommended, but they were close enough to consider it satisfactory for the intended purposes. A total of 81 individuals participated in the evaluation. Of these, 45 were females and 36 were males. A total of 43 panelists were under 34 years of age with 21 females and 22 males, and 38 were 34 years and older, of which, 24 were females and 14 were males.

Among the 43 panelists who were under 34 years old, there was a higher concentration of younger panelists, with 31 being between 18 and 25 years old. Similarly, among the 38 panelists aged 34 years or older, there were 23 panelists in the age range 34 to 50 years old, while 15 were 51 years or older. Moreover, no panelists were 60 years or older. Therefore, results from this test would tend to reflect to a larger extent the perceptions of the "younger" panelists in each age subgroup, which was a particular interest in this project.

Table 7. Characteristics of the Sensory Evaluation Panelists, by Age and Gender

Age	Total	Female	Male
	<i>Number</i>		
All participants	81	45	36
18 – 25 yrs	31	17	14
26 – 33 yrs	12	4	8
34 – 50 yrs	23	15	8
51 yrs and older	15	9	6

Statistical Analysis of the Data

The panelists rated overall acceptability, appearance, and flavor of the four samples (three sauerkraut formulations and one plain sauerkraut) presented to them on a 9-point hedonic scale, which included the following categories:

- 1 = dislike extremely
- 2 = dislike very much
- 3 = dislike moderately
- 4 = dislike slightly
- 5 = neither like nor dislike
- 6 = like slightly
- 7 = like moderately
- 8 = like very much
- 9 = like extremely

Given the specific interest of identifying preferences in different age groups, the ratings are reported here for three groups: “all” panelists, panelists “under 34 years old” and panelists “34 years and older.” Each of the additional questions presented to panelists in this test used a specific scale, which is explained at the beginning of the corresponding section.

Mean ratings for overall acceptability, appearance, and flavor were obtained for each of the four samples in each of the three groups. ANOVA (analysis of variance) was used to determine statistical significance of the mean (average) ratings. A *p* value under 0.05 indicates there is a significant difference between the samples at the 5% level (or 95% confidence level). If a significant difference was identified, the Tukey’s pair-wise comparison test was used to determine where the differences lay. The percentage distribution of panelists’ ratings and a summary of the statistical analysis of the mean ratings for each sample in each group are reported in the following sections.

Sensory Evaluation Panel Results

1. Overall Acceptability

The percentage distribution of the ratings for overall acceptability for each of the four samples in the three groups analyzed is presented in Table 8. The results show that the highest percentage of ratings lay between a rating of 6 (like slightly) and a rating of 9 (like extremely), indicating that the majority of the participants liked the three new sauerkraut formulations, as well as the plain sauerkraut.

Table 8. Ratings for Overall Acceptability of Sauerkraut Samples – Percentage Distribution

Sample	Age group	Rating*								
		1	2	3	4	5	6	7	8	9
		<i>(Percent of respondents)</i>								
Plain sauerkraut	All	-	3.7	4.9	6.2	4.9	17.3	43.2	18.5	1.2
	<34 yrs	-	2.3	7.0	2.3	2.3	18.6	51.2	16.3	-
	34 yrs+	-	5.3	2.6	7.9	7.9	15.8	36.8	21.1	2.6
Sauerkraut with onion	All	2.5	11.1	12.4	17.3	2.5	17.3	19.8	16.1	1.2
	<34 yrs	-	9.3	11.6	14.0	4.7	18.6	20.9	20.9	-
	34 yrs+	5.3	13.2	10.5	21.1	-	15.8	21.1	10.5	2.6
Sauerkraut with garlic	All	-	-	6.2	6.2	4.9	23.5	35.8	19.8	3.7
	<34 yrs	-	-	7.0	9.3	7.0	11.6	39.5	20.9	4.7
	34 yrs+	-	-	5.3	2.6	2.6	36.8	31.6	18.4	2.6
Sauerkraut with dill	All	-	4.9	8.6	14.8	6.2	9.9	27.2	17.3	11.1
	<34 yrs	-	2.3	2.3	16.3	9.3	11.6	27.9	16.3	14.0
	34 yrs+	-	7.9	15.8	13.2	2.6	7.9	23.7	21.1	7.9

*1 = Dislike extremely; 9 = like extremely.

Table 9 further summarizes the percentage of panelists in each group who assigned a rating between 6 (like slightly) and 9 (like extremely) to each of the samples, as well as the percentage of panelists who liked them significantly, that is, those that gave the sample a rating of either 8 (like very much) or 9 (like extremely). Plain sauerkraut and sauerkraut with garlic received the highest percentage of ratings (between 6 and 9) across the three age groups (76.3 percent to 86.1 percent and 76.7 percent to 89.4 percent, respectively) followed by sauerkraut with dill (60.6 percent to 69.8 percent), and sauerkraut with onion (50 percent to 60.4 percent). These results could indicate a general order of preference for the samples in the test among panelists.

However, when looking at the percentages of panelists who liked these samples significantly (provided ratings of 8 or 9), this order of preference is different. In this case, sauerkraut with dill had the highest percentages of panelists liking it “very much” or “extremely” (28.4 percent to 30.3 percent), followed by sauerkraut with garlic (21 percent to 25.6 percent), sauerkraut with onion (13.1 percent to 20.9 percent), and lastly by plain sauerkraut (16.3 percent to 23.7 percent). These results reflect a wide variability of the ratings assigned by panelists to the sauerkraut with

dill and the sauerkraut with garlic have (as indicated by their higher standard deviations). These results imply that younger panelists (under 34 years old) are more likely to find these two flavors highly appealing.

Table 9. Overall Acceptability -- Distribution among Panelists Who Liked the Samples, by Age Group

Sample/Group	Liked Sample:	
	Slightly to Extremely (ratings 6 to 9)	Very Much to Extremely (ratings 8 and 9)
	<i>Percent of respondents</i>	
Plain sauerkraut		
All	80.2	19.7
<34 yrs	86.1	16.3
34 yrs+	76.3	23.7
Sauerkraut with onion		
All	54.4	17.3
<34 yrs	60.4	20.9
34 yrs+	50.0	13.1
Sauerkraut with garlic		
All	82.8	23.5
<34 yrs	76.7	25.6
34 yrs+	89.4	21.0
Sauerkraut with dill		
All	65.5	28.4
<34 yrs	69.8	30.3
34 yrs+	60.6	29.0

Results of the statistical analyses of these ratings, summarized in Table 10, provide additional insights into the results obtained for the four samples in the three panelists' groups. The mean ratings obtained for overall acceptability of the four samples are high by most standards in sensory evaluation panels using the 9-point hedonic scale. Except for sauerkraut with dill in the 34 yrs+ group, which had a mean rating of 5.82, the mean ratings for the plain sauerkraut, sauerkraut with garlic, and sauerkraut with dill ranked between 6 (like slightly) and 7 (like moderately) in all three groups. The standard deviations (in parenthesis under the mean ratings) show that the degree of variation of these ratings was very similar for plain sauerkraut and for sauerkraut with garlic, while it was consistently higher for the sauerkraut with dill. Sauerkraut with onion was rated lower than the other three samples in all groups and exhibited a higher standard deviation too.

The ANOVA test of these mean ratings was used to establish the statistical significance of the four samples in the three groups at the 5% level (95% confidence level) when the *p* value was below 0.05 (Table 10). When analyzing the data for "all" panelists, Tukey's test results (indicated by the letter to the right of the mean rating) show that sauerkraut with onion (which was rated lower) is significantly different from the other three samples at the 5% level. Plain

sauerkraut and the two other new formulations (sauerkraut with garlic and sauerkraut with dill), however, were not significantly different from each other -- they all have the same letter “a” to the right of the mean rating.

When breaking down the data into the two age groups of interest, the statistical analyses on the mean ratings for the under 34 years group and in the 34 yrs+ group show that the sauerkraut with onion, while rated lower than sauerkraut with dill, plain sauerkraut, and sauerkraut with garlic, was not significantly different from sauerkraut with dill. This means that panelists by age groups could not express a difference between the sauerkraut with onion and the sauerkraut with dill, their overall acceptability for these two was equal. Additionally, plain sauerkraut, sauerkraut with garlic, and sauerkraut with dill were not significantly different from each other for overall acceptability in any of the three groups. It indicated that there is no statistical evidence of differences in their overall acceptability.

Table 10. Statistical Analysis of Overall Acceptability Ratings of Sauerkraut Samples, by Age Group

	No. of Respondents	p Value	Mean Ratings			
			Plain S.	S. with Onion	S. with Garlic	S. with Dill
All	81	0.0000	6.37a	5.25b	6.51a	6.14a
Standard Deviation			(1.58)	(2.16)	(1.45)	(2.05)
<34 yrs	43	0.0184	6.47a	5.58b	6.49a	6.44ab
Standard Deviation			(1.45)	(2.03)	(1.59)	(1.84)
34 yrs+	38	0.0025	6.34a	4.97b	6.53a	5.82ab
Standard Deviation			(1.70)	(2.27)	(1.29)	(2.26)

2. Appearance

The percentage distribution of the ratings for the appearance of the four samples in the three groups is presented in Table 11. As was the case for overall acceptability, the results show that the highest percentage of ratings lay between 6 (like slightly) and 9 (like extremely), which indicates that the majority of the panelists liked the appearance of the three new sauerkraut formulations and that for the plain sauerkraut.

As shown in Table 12, like the overall acceptance ratings, the appearance of plain sauerkraut and sauerkraut with garlic received the highest percentages of ratings between 6 and 9 across the three panelists’ groups (73.7 percent to 86.1 percent and 81.4 percent to 81.6 percent, respectively). In this case, however, ratings for these samples are followed by sauerkraut with onion (76.7 percent to 78.9 percent, and sauerkraut with dill received the lowest percentage of ratings between 6 and 9 in all three panelist groups (62.7 percent to 68.5 percent). This result indicates that the panelists found the appearance of sauerkraut with dill somewhat less appealing, compared to the appearance of the other samples.

Moreover, 41.9 percent to 42.1 percent of panelists rated the appearance of plain sauerkraut a rating of 8 or 9. This is significantly higher than the other three samples. It shows that a higher number of panelists liked the appearance of the plain sauerkraut the best. This indicates that in the consumer’s opinion the addition of garlic, onion, and dill to sauerkraut somewhat detracts from the appearance of the final product.

Table 11. Percentage Distribution of Appearance Ratings for the Sauerkraut Samples

Sample	Age group	Rating*								
		1	2	3	4	5	6	7	8	9
<i>Percent of respondents</i>										
Plain sauerkraut	All	-	-	1.2	6.2	12.4	12.4	25.9	37.0	4.9
	<34 yrs	-	-	2.3	2.3	9.3	16.3	27.9	34.9	7.0
	34 yrs+	-	-		10.5	15.8	7.9	23.7	39.5	2.6
Sauerkraut with onion	All	-	-	2.5	3.7	16.1	13.6	40.7	22.2	1.2
	<34 yrs	-	-	4.7	7.0	11.6	11.6	41.9	23.3	
	34 yrs+	-	-			21.1	13.2	42.1	21.1	2.6
Sauerkraut with garlic	All	-	-	1.2	6.2	11.1	19.8	38.3	21.0	2.5
	<34 yrs	-	-		9.3	9.3	25.6	30.2	23.3	2.3
	34 yrs+	-	-	2.6	2.6	13.2	10.5	47.4	21.1	2.6
Sauerkraut with dill	All	-	3.7	13.6	12.4	4.9	12.4	29.6	16.1	7.4
	<34 yrs	-	4.7	16.3	14.0	2.3	11.6	23.3	18.6	9.3
	34 yrs+	-	2.6	10.5	10.5	7.9	10.5	39.5	13.2	5.3

* 1 = Dislike extremely; 9 = like extremely.

The results of the statistical analyses of the appearance ratings are summarized in Table 13. The mean ratings for plain sauerkraut, sauerkraut with onion, and sauerkraut with garlic are all between 6 (like slightly) and 7 (like moderately) and exhibit a similar degree of variation, as indicated by the values of their standard deviations. The mean rating for the appearance of sauerkraut with dill is consistently lower, and it also has a higher degree of variation, as reflected by the value of standard deviation.

The ANOVA test of these mean ratings established the statistical significance of the four samples at the 5% level (95% confidence level) as indicated by a *p* value below 0.05 for “all” panelists and for the “under 34 yrs” group, but not for the “34 yrs+” group (Table 13). Tukey’s test results for the first two groups (indicated by the letter to the right of the mean rating) indicate that for “all” panelists the appearance of sauerkraut with dill (which is rated lower) is significantly different from the appearance of the other three samples at the 5% level. The mean ratings for plain sauerkraut and the two new formulations (onion and garlic), however, were not significantly different from each other (they all have the same letter “a” to the right of the mean rating), which means that panelists liked their appearance equally. Furthermore, the test indicated that there is no significant difference in the appearance of sauerkraut with garlic and sauerkraut with dill for panelists who were under 34 years old.

These results confirm that the addition of dill does have a negative impact on the appearance of the sauerkraut formulation, while the addition of onion and garlic don't, a factor that should be seriously considered by product developers before introducing sauerkraut with dill to the market.

Table 12. Appearance Ratings -- Distribution of Panelists Who Liked the Samples, by Age

Sample/Group	Liked Sample:	
	Slightly to Extremely (ratings 6 – 9)	Very Much to Extremely (ratings 8 and 9)
<i>Percent of respondents</i>		
Plain sauerkraut		
All	80.2	41.9
<34 yrs	86.1	41.9
34 yrs+	73.7	42.1
Sauerkraut with onion		
All	77.7	23.4
<34 yrs	76.7	23.3
34 yrs+	78.9	23.7
Sauerkraut with garlic		
All	81.5	23.5
<34 yrs	81.4	25.6
34 yrs+	81.6	23.7
Sauerkraut with dill		
All	65.4	23.5
<34 yrs	62.7	27.9
34 yrs+	68.5	18.5

Table 13. Statistical Analysis of Sauerkraut Samples' Appearance Ratings, by Age Group

	No.	p Value	Mean Ratings			
			Plain Sauerkraut	Sauerkraut with Onion	Sauerkraut with Garlic	Sauerkraut with Dill
All	81	0.0011	6.86a	6.58a	6.60a	5.99b
Stand. Deviation			(1.39)	(1.27)	(1.25)	(2.00)
<34 yrs	43	0.0075	6.98a	6.49a	6.56ab	5.91b
Stand. Deviation			(1.34)	(1.40)	(1.28)	(2.17)
34 yrs+	38	0.1658	6.74	6.71	6.71	6.11
Stand. Deviation			(1.46)	(1.11)	(1.25)	(1.83)

3. Flavor

Table 14 summarizes the percentage distribution of the ratings for the flavor of each of the four sauerkraut samples in the three age groups. Once again, the highest percentages of panelists' ratings ranked between 6 (like slightly) and 9 (like extremely). It indicates that the majority of the participants liked the flavor of the three new formulations and the plain sauerkraut samples presented to them.

Table 15 shows that for flavor the percentage of panelists that assigned a rating between 6 (like slightly) and 9 (like extremely) in the three groups was higher for sauerkraut with garlic (76.8 percent to 86.8 percent), followed by plain sauerkraut (73.7 percent to 79.1 percent), and then by sauerkraut with dill (65.9 percent to 76.7 percent). Sauerkraut with onion had the lowest percentages of panelists rating it between 6 and 9 in all three groups (39.5 percent to 55.8 percent).

The percentage of panelists who liked the flavor of each of these samples significantly – those who rated the samples 8 (like very much) or 9 (like extremely) -- was higher for sauerkraut with dill (31.6 percent to 37.2 percent), followed by plain sauerkraut (23.3 percent to 28.9 percent), and by sauerkraut with garlic (21 percent to 28 percent). Sauerkraut with onion had the lowest percentage of such high ratings for flavor (13.2 percent to 18.2 percent).

Table 14. Percentage Distribution of Ratings for Flavor, by Age Group

Sample	Age Group	Ratings*								
		1	2	3	4	5	6	7	8	9
		<i>(Percent of respondents)</i>								
Plain sauerkraut	All	-	4.9	2.5	12.4	4.9	17.3	32.1	24.7	1.2
	<34 yrs	-	4.7	2.3	7.0	7.0	18.6	37.2	23.3	-
	34 yrs+	-	5.3	2.6	15.8	2.6	15.8	29.0	26.3	2.6
Sauerkraut with onion	All	7.4	13.6	12.4	18.5	1.2	16.1	14.8	16.1	-
	<34 yrs	9.3	9.3	7.0	18.6	-	18.6	18.6	18.6	-
	34 yrs+	5.3	18.4	15.8	18.4	2.6	15.8	10.5	13.2	-
Sauerkraut with garlic	All	-	2.5	4.9	9.9	1.2	28.4	29.6	19.8	3.7
	<34 yrs	-	2.3	7.0	11.6	2.3	20.9	27.9	23.3	4.7
	34 yrs+	-	2.6	2.6	7.9	-	36.8	29.0	18.4	2.6
Sauerkraut with dill	All	1.2	12.4	6.2	8.6	-	12.4	25.9	23.5	9.9
	<34 yrs	-	7.0	4.7	11.6	-	11.6	27.9	25.6	11.6
	34 yrs+	2.6	18.4	7.9	5.3	-	13.2	21.1	23.7	7.9

* 1 = Dislike extremely; 9 = like extremely.

Table 15. Flavor -- Distribution of Panelists Who Liked the Samples, by Age Group

Sample/Group	Liked Samples:	
	Slightly to Extremely (ratings 6 – 9)	Very Much to Extremely (ratings 8 and 9)
	%	%
Plain sauerkraut		
All	75.3	25.9
<34 yrs	79.1	23.3
34 yrs+	73.7	28.9
Sauerkraut with onion		
All	47.0	16.1
<34 yrs	55.8	18.6
34 yrs+	39.5	13.2
Sauerkraut with garlic		
All	81.5	23.5
<34 yrs	76.8	28.0
34 yrs+	86.8	21.0
Sauerkraut with dill		
All	71.7	33.4
<34 yrs	76.7	37.2
34 yrs+	65.9	31.6

Except for sauerkraut with dill in the 34 yrs+ group, which had a mean rating of 5.71, the mean ratings for the plain sauerkraut, the sauerkraut with garlic, and the sauerkraut with dill ranked between 6 (like slightly) and 7 (like moderately) in the three groups (Table 16). The standard deviations (in parentheses under the mean ratings) show that the degree of variation of the mean ratings was very similar for plain sauerkraut and for sauerkraut with garlic, while it was consistently higher for the sauerkraut with dill. The sauerkraut with onion was rated consistently lower than the other three samples in all groups and also exhibited a higher standard deviation.

The ANOVA test established the statistical significance of the mean ratings for the flavor of the four samples, in the three groups, at the 5% level (95% confidence level) as indicated by a *p* value under 0.05 (Table 16). Tukey’s test results (as indicated by the letter to the right of the mean rating) show that for “all” panelists and for the “under 34 yrs” group, the flavor of the sauerkraut with onion (which was rated lower) is significantly different from the flavor of the other three samples at the 5% level. However, the flavor of plain sauerkraut and the other two new formulations (garlic and dill) was not significantly different from each other (they all have the same letter “a” to the right of the mean rating), which means that panelists in these two groups liked them equally.

The statistical analysis of the mean ratings of flavor in the 34 years+ group indicate that the flavor of sauerkraut with onion, while rated lower than the flavor of sauerkraut with dill, plain sauerkraut, and sauerkraut with garlic, was not significantly different from the flavor of sauerkraut with dill. As is the case for the other two groups, panelists in this group liked equally

the flavor of plain sauerkraut, sauerkraut with garlic, and sauerkraut with dill, as indicated by the fact that they are not significantly different from each other according to Tukey’s test.

Table 16. Statistical Analysis of Flavor Ratings, by Age Group

	No.	p Value	Mean Ratings			
			Plain Sauerkraut	Sauerkraut with Onion	Sauerkraut with Garlic	Sauerkraut with Dill
All	81	0.0000	6.28a	4.80b	6.35a	6.11a
Standard Deviation			(1.71)	(2.30)	(1.61)	(2.31)
<34 yrs	43	0.0023	6.37a	5.14b	6.33a	6.49a
Standard Deviation			(1.59)	(2.35)	(1.76)	(2.05)
34 yrs+	38	0.0003	6.26a	4.50b	6.39a	5.71ab
Standard Deviation			(1.83)	(2.23)	(1.46)	(2.55)

Results of Additional Questions Presented to Panelists

1. Purchase Intention

To measure purchase intention, after panelists had tasted each sample both on its own as well as with a piece of frankfurter, they were asked “how likely would it be for you to purchase from a store or to order at a food outlet each of the four samples”. They were asked to respond using a 4-point likelihood scale where 1 corresponds to “very likely”, 2 to “somewhat likely”, 3 to “somewhat unlikely” and 4 to “very unlikely”.

Table 17 summarizes the percentage distribution of panelists’ purchase intention responses for each of the four sauerkraut samples in all three age groups. According to the results among the groups, sauerkraut with dill has the highest percentage of panelists who would “very likely” purchase it or order it from a store or food outlet (32.6 percent to 34.2 percent). Plain sauerkraut is favored by panelists in the “34 yrs+” group (42.1 percent would likely purchase/order it), while in the “under 34 years” group, sauerkraut with onion and sauerkraut with garlic have the highest percentage of panelists who would “very likely” purchase/order them (with 23.3 percent each).

Another way to look at these results is summarized in Table 18. In this table the percentages for “very likely” and “somewhat likely” were grouped together and reported under “Likely” to indicate the percentage of panelists in each group that would likely purchase/order each of the samples. Similarly, the percentages for “somewhat unlikely” and “very unlikely” were added together and reported under “Unlikely” to reflect the percentage of panelists in each group who would not purchase/order these products.

Table 18 shows that, while over 60 percent of panelists in the three groups would “likely” purchase/order sauerkraut with dill (60.5 percent to 69.8 percent), sauerkraut with garlic (60.3

percent to 65.2 percent), and plain sauerkraut (73.7 percent to 86.5 percent), over 50 percent of panelists indicated it would be “unlikely” that they would purchase/order sauerkraut with onion (51.1 percent to 57.1 percent). Moreover, in all four samples, younger panelists, those in the “under 34 years” group, had the highest percentages for “likely” purchase/order, with plain sauerkraut at the top (86.5 percent), followed by sauerkraut with dill (69.8 percent), sauerkraut with garlic (65.2 percent) and, at the low end, sauerkraut with onion (48.9 percent).

These results indicate first that sauerkraut with onion would probably not succeed in the market and, second, that the other two flavors (dill and garlic) as well as the plain sauerkraut would be more successful among younger consumers (under 34 years).

Table 17. Percentage Distribution of Panelists’ Purchase Intentions

Sample/Group	Purchase is:			
	1 Very Likely	2 Somewhat Likely	3 Somewhat Unlikely	4 Very Unlikely
	<i>Percent Responses</i>			
Plain sauerkraut				
All	28.4	45.7	16.1	9.9
<34 yrs	16.3	60.5	20.9	2.3
34 yrs+	42.1	31.6	7.9	18.4
Sauerkraut with onion				
All	16.1	28.4	23.5	32.1
<34 yrs	23.3	25.6	25.6	25.6
34 yrs+	7.9	34.2	18.4	39.5
Sauerkraut with garlic				
All	19.8	43.2	22.2	14.8
<34 yrs	23.3	41.9	20.9	14.0
34 yrs+	18.4	42.1	23.7	15.8
Sauerkraut with dill				
All	33.3	32.1	13.6	21.0
<34 yrs	32.6	37.2	14.0	16.3
34 yrs+	34.2	26.3	13.2	26.3

Table 18. Percentage Distribution for Panelists' Purchase Intentions

Sample/Group	Purchase is:	
	Likely*	Unlikely**
<i>Percent of respondents</i>		
Plain sauerkraut		
All	74.1	25.9
<34yrs	86.5	13.5
34 yrs+	73.7	26.3
Sauerkraut with onion		
All	44.5	55.5
<34yrs	48.9	51.1
34 yrs+	42.1	57.1
Sauerkraut with garlic		
All	63.0	37
<34yrs	65.2	34.8
34 yrs+	60.3	39.7
Sauerkraut with dill		
All	65.4	34.6
<34yrs	69.8	30.2
34 yrs+	60.5	39.5

*Includes percentages for "very likely" and "somewhat likely".

**Includes percentages for "very unlikely" and "somewhat unlikely".

2. Frequency of Consumption

To identify the frequency of consumption of sauerkraut among the panelists, they were asked "on average, how often do you eat sauerkraut?" The options provided for response in this case were the same as used in the mail survey of in this study and included: "once per week or more often", "about every other week", "about once a month", "less than once a month" and "only on special occasions".

As illustrated in Table 19, sauerkraut consumption is infrequent. Most of the panelists in the three different groups eat sauerkraut less than once a month (39.5% - 44.7%), followed by those who eat it about once a month (23.7% - 32.6%) and by those who eat it only on special occasions (15.8% - 20.9%).

Altogether, 90.1% of "all" panelists consume sauerkraut once a month or less often (Table 19). This result is even higher than the percentage of sauerkraut consumers in the mail survey who consume sauerkraut once a month or less often. Therefore, promoting an increase in consumption frequency should be a key marketing strategy to pursue in order to increase volume sales of sauerkraut in its different forms.

Table 19. Frequency of Consumption of Sauerkraut

Sample/Group	1 Once per Week or More Often	2 About Every Other Week	3 About Once a Month	4 Less than Once a Month	5 Only on Special Occasions*
	<i>Percent</i>				
All	-	9.9	29.6	42.0	18.5
<34 yrs	-	7.0	32.6	39.5	20.9
34 yrs+	-	15.8	23.7	44.7	15.8

* Holidays or special celebrations.

3. Potential Influence of Health Claims on Consumption

Through many recent studies of cabbage and products derived from it, such as sauerkraut, cabbage has been found to be effective in protecting against diseases such as cancer. To identify the likely influence of such health claims on increasing consumption of sauerkraut, panelists were asked “how likely would you be to increase your current consumption of sauerkraut on the basis of these health claims?” They were asked to respond using a 4-point likelihood scale, where 1 corresponds to “very likely”, 2 to “somewhat likely”, 3 to “somewhat unlikely” and 4 to “very unlikely”. Table 20 summarizes the percentage distribution of panelists’ responses in the three groups.

Almost a quarter of all panelists (22.2%) indicated they would “very likely” increase their consumption of sauerkraut on the basis of these health claims. Furthermore, the percentage of panelists in the “34 years+” group that would “very likely” increase their consumption of sauerkraut on this basis (29%) is much higher than the percentage of panelists in the “under 34 yrs” group (16.3%) who responded in this way.

Interestingly, almost three-quarters (71.1% - 76.8%) of panelists in the different groups would “very likely” or “somewhat likely” increase their consumption of sauerkraut on the basis of these health claims. These results indicate that wider advertising and promotion of sauerkraut’s health benefits among consumers would be key in increasing sauerkraut consumption.

Table 20. Potential Influence of Health Claims on Increasing Sauerkraut Consumption

Age Group	1 Very Likely	2 Somewhat Likely	3 Somewhat Unlikely	4 Very Unlikely
All	22.2	51.9	17.3	8.6
<34 yrs	16.3	60.5	16.3	7.0
34 yrs+	29.0	42.1	18.4	10.5

4. Image of Sauerkraut

To identify panelists’ perceptions of the new sauerkraut products, they were asked to indicate: “what kind of image do the new sauerkraut flavors have for you?” The response options provided included: “exciting new flavor”, “interesting”, “not that different from plain sauerkraut”, “boring” and “other”. Table 21 summarizes the percentage distribution for panelists’ responses in the three age groups.

Results on the image of these new formulations are very promising from the point of view of marketing, as the majority of panelists in the three different groups (52.6% - 76.7%) indicated the new flavors have an “interesting” image for them. Furthermore, it is among the younger consumers (under 34 years) where more panelists find these new flavors interesting (76.7%), a promising result for the new products. Older panelists (34 yrs+) seem to be slightly more conservative as 26.3% of them indicated that the new formulations were “not that different from the plain sauerkraut”. When choosing the option “other”, panelists were asked to specify their response. Unfortunately, all of the panelists who chose this option provided comments on the flavor and on whether they liked/disliked the samples but not on the “image” as such.

Table 21. Sauerkraut Image, by Age Group

Age Group	1 Exciting New Flavor	2 Interesting	3 Not that Different from Plain Sauerkraut	4 Boring	5 Other
	<i>Percent</i>				
All	7.4	65.4	17.8	1.2	8.6
<34 yrs	7.0	76.7	9.3	-	7.0
34 yrs+	7.9	52.6	26.3	2.6	10.5

Summaries and Recommendations from the Sensory Evaluation Panel

1. Summary of Results

- Two of the three new sauerkraut formulations, sauerkraut with garlic and sauerkraut with dill, were acceptable for most of the panelists in the three age groups. Sauerkraut with onion was consistently rated lower in all three age groups for acceptance and flavor (Figures 1, 2 and 3). The much lower ratings consistently assigned by panelists in the three age groups to sauerkraut with onion could indicate an unfavorable market perspectives of this sauerkraut formulation. Therefore, sauerkraut with onion is less likely to succeed if introduced to the market, as compared to the sauerkraut with garlic and sauerkraut with dill formulations are.
- On the other hand, slightly lower ratings were given by panelists in all three age groups to the appearance of sauerkraut with dill than to the other three samepls(Figures1, 2 and 3). This was slightly more marked in the less than 34 yrs old group. These results warrant

further consideration by product developers of the factors that affect the appearance of this sauerkraut formulation before its introduction to the market.

- Accordingly, the purchase intention results were favorable for sauerkraut with garlic and sauerkraut with dill (in spite of the somewhat objectionable appearance) but not for sauerkraut with onion.
- Younger panelists (those under 34 years) exhibited a higher degree of enthusiasm towards the new sauerkraut formulations than the older panelists (34 years and older). The new formulations were perceived as “interesting” by most of the panelists and, particularly, among the younger group (under 34 years old)
- Current frequency of consumption of sauerkraut is very low, which implies that strategies to promote and boost its consumption should be identified and implemented. Results from the sensory evaluation panel indicate that promoting the health benefits of sauerkraut would likely increase its consumption among consumers of all ages, particularly among the older crowd (34 years and older).

Figure 1. Ratings for Overall Acceptability, Appearance, and Flavor for the Four Sauerkraut Formulations among All Panelists

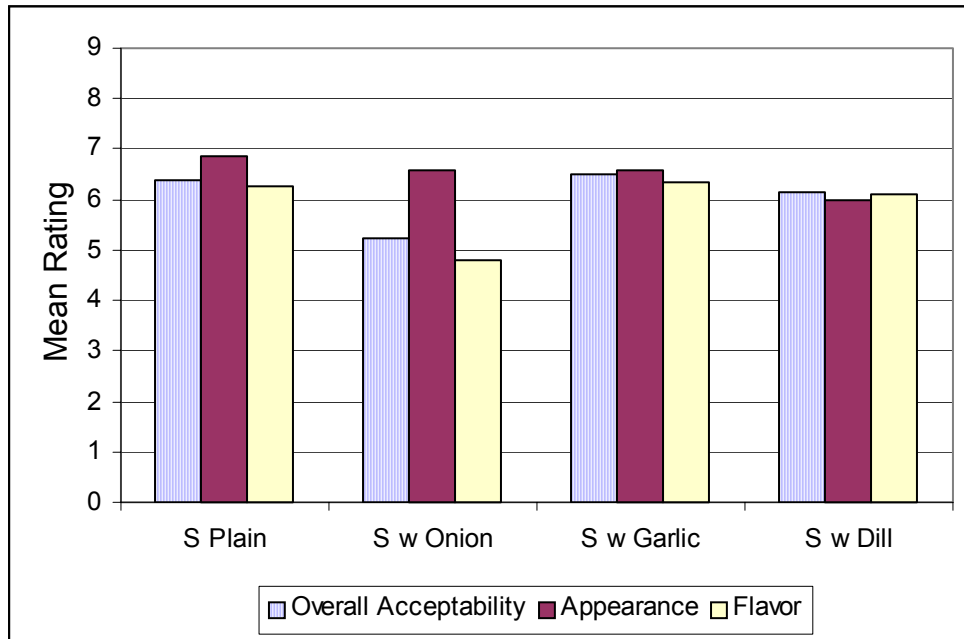


Figure 2. Ratings for Overall Acceptability, Appearance, and Flavor for the Four Sauerkraut Formulations among Panelists Under 34 Years Old

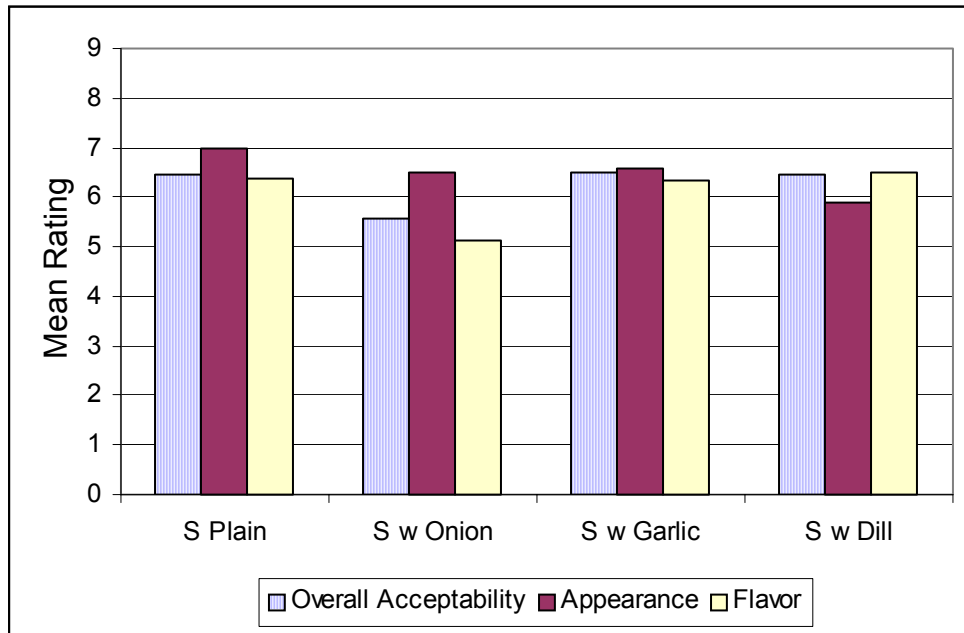
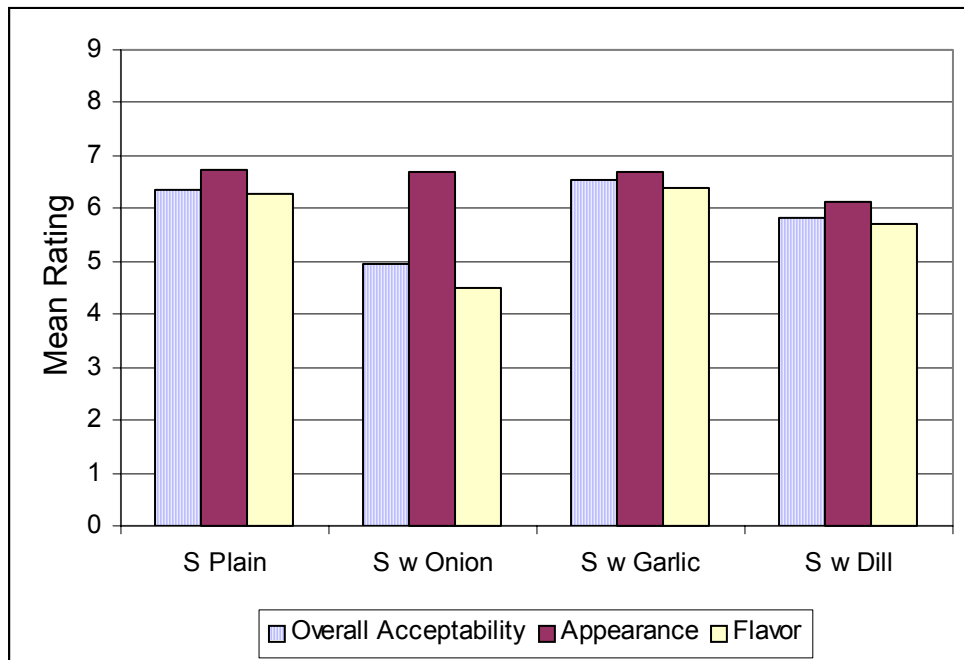


Figure 3. Ratings for Overall Acceptability, Appearance, and Flavor for the Four Sauerkraut Formulations among Panelists 34 Years and Older



2. Recommendations

On the basis of the sensory panel evaluation results, the following actions are recommended with respect to the three new sauerkraut formulations tested:

- Among the three new formulations, sauerkraut with garlic has the highest potential to succeed in the market and should be introduced to the market first.
- Before introducing sauerkraut with dill to the market, processors need to explore ways to reduce the “objectionable” appearance of the product.
- Sauerkraut with onion is least likely to succeed in the market. Results from sensory evaluation showed that this new formulation was not particularly well accepted by the majority of the panelists.
- Promotion of the new flavors should focus primarily on younger consumers (under 34 years old). It will be advantageous to widely promote the health benefits of sauerkraut and new ways of using the products when marketing the new sauerkraut formulations.
- Retail stores are an appropriate outlet for introducing these new products. Adequate marketing strategies need to be developed for this marketing channel. Moreover, the new sauerkraut products should also be made more widely available in the different types of foodservice outlets, including bars.
- It highly recommended to explore additional ways to promote an increase in sauerkraut consumption, such as in new applications (for example, as an ingredient in salads and appetizers).

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APPENDIX 1

Sauerkraut Consumption Study

July 2003

This study is sponsored by

Cornell University

**Department of Applied Economics and Management in Ithaca, New York
and
Department of Food Science and Technology in Geneva, New York**

- **All responses to this survey are anonymous and strictly confidential.**
- You must be 18 years or older to complete this survey.
- If you are not 18 years or older, we would appreciate it if you could pass the survey on to someone who meets this requirement among either relatives or friends.

Please place a checkmark \checkmark in the space provided to indicate your response to each of the questions below.

Section 1. Sauerkraut Consumption

1. Have you had any sauerkraut in the past 12 months?

YES (*Skip to question No. 3*) NO (*Continue with question No. 2*)

2. If you haven't had sauerkraut during the past 12 months, please tell us why. Check **ALL** applicable options.

- I never eat fermented/pickled foods
 I don't like/never eat cabbage or derived products
 I don't like sauerkraut
 I haven't had a chance to eat it
 I don't know
 Other (please specify)
-

(Please skip to Section 4, question No. 9)

3. Where do you **usually** eat sauerkraut?

- At home (*Continue with Section 2, questions 4-6*)
 Away from home (*Skip to Section 3, questions 7-8*)

Section 2. At-Home Sauerkraut Consumption

4. How often do you eat sauerkraut at home? Check **only ONE option that best reflects your consumption frequency.**

- | | |
|---|---|
| <input type="checkbox"/> Once a week, or more often | <input type="checkbox"/> Less than once a month |
| <input type="checkbox"/> About every other week
celebration) | <input type="checkbox"/> Only on special occasions (such as a holiday or family
celebration) |
| | <input type="checkbox"/> About once a month |

5. Do you **usually** eat sauerkraut (Check **ALL** that apply)

- | | |
|--|--|
| <input type="checkbox"/> With regular meals | <input type="checkbox"/> With dishes cooked on special occasions |
| <input type="checkbox"/> With traditional family recipes | <input type="checkbox"/> With other types of foods (<i>please specify</i>) |
-

6. Is the sauerkraut you eat at home **mainly** home-made or is it bought at a store?
 Home-made Bought at a store

(Please proceed to Section 4, question No. 9)

Section 3. Away-from-Home Sauerkraut Consumption

7. If you usually eat sauerkraut away from home, please indicate the type(s) of food outlet(s) where you eat it. *Check ALL options that apply.*

- | | |
|--|---|
| <input type="checkbox"/> Fast food outlet (<i>i.e., sandwich/hot dog outlet</i>) | <input type="checkbox"/> Food outlet at a special event (<i>i.e., a fair or festival</i>) |
| <input type="checkbox"/> Sit-in restaurant | <input type="checkbox"/> Other types of food outlets (<i>please specify</i>) |
| <input type="checkbox"/> Sports event food outlet | |
-

8. With what type of foods do you eat sauerkraut when eating it away from home? *Check ALL options that apply.*

- | | |
|--|---|
| <input type="checkbox"/> As an ingredient on sandwiches (<i>i.e., Rye or others</i>) | <input type="checkbox"/> As a side dish to meat entrees |
| <input type="checkbox"/> As a condiment on hot dogs | <input type="checkbox"/> With other types of food (<i>please specify</i>) |
-

(Please proceed to Section 4, question No. 9)

Section 4. New Product Interests

9. Please indicate the degree of interest you would have in eating the new types of sauerkraut listed below if they were available commercially. *Please circle the number that reflects your response.*

	Very interested	Interested	Somewhat interested	Not interested
Sauerkraut with garlic	1	2	3	4
Sauerkraut with onion	1	2	3	4
Sauerkraut with dill seed	1	2	3	4
Sauerkraut with jalapeño peppers	1	2	3	4
Sauerkraut with green peppers	1	2	3	4
Sauerkraut with onions & jalapeño peppers	1	2	3	4
Sauerkraut with onions & green peppers	1	2	3	4

(Please proceed to Section 5, questions 10-13)

Section 5. Demographic Information

10. Gender. Please indicate your gender.

- Female Male

11. Age. Please check the category below that reflects your current age.

- Between 18 years and 34 years
 Between 35 years and 50 years
 Between 51 years and 66 years
 Over 66 years

12. Income. Please check the income range below where your current annual household income lies

- Under \$25,000
- Between \$25,001 and \$50,000
- Between \$50,001 and \$75,000
- \$75,001 and over

13. Ethnic origin. Please indicate the region of the world that you and your family (parents or grandparents) associate most strongly with your original nationality.

- | | |
|--|---|
| <input type="checkbox"/> North America | <input type="checkbox"/> Middle East |
| <input type="checkbox"/> South America | <input type="checkbox"/> Far East |
| <input type="checkbox"/> Central America | <input type="checkbox"/> Asia |
| <input type="checkbox"/> The Caribbean | <input type="checkbox"/> Oceania |
| <input type="checkbox"/> Europe | <input type="checkbox"/> Other (<i>please specify</i>): _____ |
| <input type="checkbox"/> Africa | |

Please indicate the name of the country of origin

Country: _____

Thank you for taking the time to complete this survey!

Please mail your completed survey back to us in the enclosed self-addressed envelope.

Otherwise please mail it back to:

Dr. Wen-fei Uva, Department of Applied Economics and Management
456 Warren Hall
Cornell University
Ithaca, NY 14853

APPENDIX 2

Sensory Evaluation of New Sauerkraut Flavors Questionnaire

Part A – Preference Test

- **Plain sauerkraut**

Please evaluate this sample and indicate how much you like or dislike each attribute by choosing the appropriate phrase in the corresponding scale.

Overall Acceptability

Dislike Extremely	Dislike very much	Dislike moderately	Dislike slightly	Neither Like/Dislike	Like slightly	Like moderately	Like very much	Like extremely
1	2	3	4	5	6	7	8	9

Appearance

Dislike Extremely	Dislike very much	Dislike moderately	Dislike slightly	Neither Like/Dislike	Like slightly	Like moderately	Like very much	Like extremely
1	2	3	4	5	6	7	8	9

Flavor

Dislike Extremely	Dislike very much	Dislike moderately	Dislike slightly	Neither Like/Dislike	Like slightly	Like moderately	Like very much	Like extremely
1	2	3	4	5	6	7	8	9

*You may now eat the sample with a piece of frankfurter.
Cleanse palate: please drink water and/or eat a cracker now*

- **Sauerkraut with onion**

Please evaluate this sample and indicate how much you like or dislike each attribute by choosing the appropriate phrase in the corresponding scale.

Overall Acceptability

Dislike Extremely	Dislike very much	Dislike moderately	Dislike slightly	Neither Like/Dislike	Like slightly	Like moderately	Like very much	Like extremely
1	2	3	4	5	6	7	8	9

Appearance

Dislike Extremely	Dislike very much	Dislike moderately	Dislike slightly	Neither Like/Dislike	Like slightly	Like moderately	Like very much	Like extremely
1	2	3	4	5	6	7	8	9

Flavor

Dislike Extremely	Dislike very much	Dislike moderately	Dislike slightly	Neither Like/Dislike	Like slightly	Like moderately	Like very much	Like extremely
1	2	3	4	5	6	7	8	9

*You may now eat the sample with a piece of frankfurter.
Cleanse palate: please drink water and/or eat a cracker now*

- **Sauerkraut with garlic**

Please evaluate this sample and indicate how much you like or dislike each attribute by choosing the appropriate phrase in the corresponding scale.

Overall Acceptability

Dislike Extremely	Dislike very much	Dislike moderately	Dislike slightly	Neither Like/Dislike	Like slightly	Like moderately	Like very much	Like extremely
1	2	3	4	5	6	7	8	9

Appearance

Dislike Extremely	Dislike very much	Dislike moderately	Dislike slightly	Neither Like/Dislike	Like slightly	Like moderately	Like very much	Like extremely
1	2	3	4	5	6	7	8	9

Flavor

Dislike Extremely	Dislike very much	Dislike moderately	Dislike slightly	Neither Like/Dislike	Like slightly	Like moderately	Like very much	Like extremely
1	2	3	4	5	6	7	8	9

*You may now eat the sample with a piece of frankfurter.
Cleanse palate: please drink water and/or eat a cracker now*

- **Sauerkraut with dill**

Please evaluate this sample and indicate how much you like or dislike each attribute by choosing the appropriate phrase in the corresponding scale.

Overall Acceptability

Dislike Extremely	Dislike very much	Dislike moderately	Dislike slightly	Neither Like/Dislike	Like slightly	Like moderately	Like very much	Like extremely
1	2	3	4	5	6	7	8	9

Appearance

Dislike Extremely	Dislike very much	Dislike moderately	Dislike slightly	Neither Like/Dislike	Like slightly	Like moderately	Like very much	Like extremely
1	2	3	4	5	6	7	8	9

Flavor

Dislike Extremely	Dislike very much	Dislike moderately	Dislike slightly	Neither Like/Dislike	Like slightly	Like moderately	Like very much	Like extremely
1	2	3	4	5	6	7	8	9

Part B – Additional Questions

- **Purchase intention**

Based on the samples that you have just tasted, how likely would you be to purchase from a store or to order at a food outlet, each of the new sauerkraut flavors? (*please check one*)

Sauerkraut with onions	Very Likely	Somewhat Likely	Somewhat Unlikely	Very Unlikely
Sauerkraut with garlic	Very Likely	Somewhat Likely	Somewhat Unlikely	Very Unlikely
Sauerkraut with dill	Very Likely	Somewhat Likely	Somewhat Unlikely	Very Unlikely

- **Consumption frequency**

On average, how often do you eat sauerkraut? (*please check only the option that best reflects your consumption frequency*)

- Once a week or more often
- About every other week
- About once a month
- Less than once a month
- Only on special occasions (i.e., holidays or family celebrations)

- **Influence of health claims on consumption**

Through many recent studies cabbage and products derived from it, such as sauerkraut, have been found to be very effective in protecting from diseases such as cancer. How likely would you be to increase your current consumption of sauerkraut on the basis of these health claims? (*please check your response*)

- | | | | |
|--------------------------------------|--|--|--|
| <input type="checkbox"/> Very Likely | <input type="checkbox"/> Somewhat Likely | <input type="checkbox"/> Somewhat Unlikely | <input type="checkbox"/> Very Unlikely |
|--------------------------------------|--|--|--|

- **Sauerkraut image**

For you, what kind of image do the new sauerkraut flavors have? (*please check one*)

- Exciting new flavor
- Interesting
- Not that different from the plain sauerkraut
- Boring
- Other (*please specify*) _____

What is your present age? _____ years

Please indicate your gender (*please check your response*)

- Female Male

OTHER A.E.M. STAFF PAPERS

SP No	Title	Fee (if applicable)	Author(s)
2004-01	Medicaid, County Property Levies, and Property Tax Levies on New York Farmland		Bills, N.
2003-04	A Brief Overview of Mozambique's Rural Development and the Role of US Assistance		Kyle, S.
2003-03	Political and Economic Prospects for Mozambique and Angola		Kyle, S.
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