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Opinions of Rural and Urban Consumers Toward Freshwater Prawns:

Results from 2003 and 2004 Surveys

FRESHWATER PRAWNS

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Executive Summary

This bulletin presents results from freshwater prawn mail surveys sent out in fall 2003 and winter 2004 to a rural locale (Starkville, Mississippi) and an urban locale (Germantown, Tennessee) to assess residents' knowledge, attitudes, opinions, and willingness-to-pay for freshwater prawns. Results confirmed that freshwater prawns are a new item to consumers with only 29% and 31% of the rural and urban respondents having consumed freshwater prawns. Only gender (female) and higher education were significant ($p<0.01$) explanatory variables for Starkville respondents' propensity to consume prawns, while in Germantown only gender (female) was a significant explanatory variable.

The primary reason both rural and urban consumers ate prawns was because they enjoyed the flavor. The other main reasons Starkville respondents ate prawns were price and availability of fresh product. Germantown respondents rated health/nutrition and variety in diet as the key reasons for consuming prawns after flavor. Higher income levels of Germantown respondents help explain these latter two reasons for consumption. For consumers and nonconsumers, the three principal reasons given for beginning or increasing prawn consumption were availability of quality products, price, and recipes. Because consumer and nonconsumer responses were identical, similar marketing methods could be used to target each group.

Starkville prawn consumers indicated that the limited availability of fresh products, price, and lack of preparation knowledge were the three principal reasons why prawns were not consumed more frequently. For Germantown consumers, price, limited availability of fresh products, and lack of preparation knowledge were the primary reasons prawns were not consumed more frequently. For nonconsumers in both locations, lack of familiarity with prawns was the most important reason for not consuming the product, followed by lack of fresh product availability and lack of preparation knowledge.

Respondents were asked to identify how often they consumed freshwater prawns; approximately 66% indicated they had never consumed freshwater prawns, and approximately 11% consumed prawns once annually. Model results indicate the frequent consumer of prawns has the following characteristics: older, non-Catholic, higher income, and of Asian ethnicity. Also, females were less likely to have consumed prawns than males, but females who did consume prawns consumed them more frequently than males. Respondents in both locales preferred to purchase freshwater prawns at grocery stores or restaurants rather than at other outlets.

Starkville respondents' willingness-to-pay for freshwater prawns was $7.02 per pound for all respondents, $8.11 per pound for prawn consumers, and $3.84 per pound for nonconsumers of prawns. Germantown respondents' willingness-to-pay was $8.39 per pound for all respondents, $9.21 per pound for prawn consumers, and $4.41 per pound for nonconsumers. Starkville responses suggest that the willingness-to-pay for prawn price was less than for marine shrimp and lobster, but not significantly. This finding indicates respondents do not differentiate between the shellfish products in terms of value. Germantown respondents were willing to pay a significantly lower price for prawn tails compared with lobster, but the price they were willing to pay for prawns was not significantly different from what they would pay for marine shrimp. Thus, Germantown prawn consumers do not differentiate between the value of marine shrimp and prawn products, indicating product acceptance and substitutability.

Opinions of Rural and Urban Consumers Toward Freshwater Prawns: Results from 2003 and 2004 Surveys

INTRODUCTION

This bulletin presents results from mail surveys sent out in fall 2003 and winter 2004 to residents of a rural locale (Starkville, Mississippi) and an urban locale (Germantown, Tennessee) to assess their knowledge, attitudes, and opinions toward freshwater prawns (*Macrobrachium rosenbergii*) (sometimes called freshwater shrimp or just prawns). Results from this survey should be useful in understanding how prawns are perceived, who buys them, and what attracts consumers to them. Within the survey, a set of questions posed hypothetical prices for prawns, marine shrimp, and lobster products from which a respondent would select which one he or she would buy. From these data, a specialized statistical test was used to assess consumer willingness-to-pay for prawns, marine shrimp, and lobster products. Prawn market share relative to shrimp and lobster products was also calculated. These results should be of interest and use to the U.S. freshwater prawn (FWP) industry, prawn producers, government agencies, and seafood retailers/marketers.

Freshwater prawns are native to the tropical Indo-Pacific region of the world, and freshwater prawn aquaculture is concentrated in mainland China and other Asian countries. Interest in freshwater prawn aquaculture has developed in regions with subtropical to temperate climates, such as North America and nontropical areas of China. From 1985 to 1995, global freshwater prawn production increased from 35 to 60 million pounds (Lutz 2002). In contrast, U.S. production of freshwater prawns has decreased substantially, from a high of 400,000 pounds in 1990-1991 to a low of 100,000 pounds in 2001, presumably due to the large quantities of shrimp imports (Figure 1). Most prawn production in the U.S. occurs in Mississippi (600 acres), Tennessee (200 acres), Kentucky (200 acres), and Alabama (60 acres), and a few farms are in Arkansas, Georgia, Illinois, Indiana, Louisiana, and Ohio (Dasgupta, in press).

Presently, the small U.S. FWP industry is at a crossroads. Technology is available to produce postlarvae and grow prawns to food size in a few months (D'Abramo et al., 2003). Research has been conducted on freezing FWP, and results have shown flavor quality to be stable for at least one year with individually quick frozen (IQF) methods (Silva et al., 1989). The Mississippi State University Department of Food Science has conducted FWP flavor tests with consumers and found their response to be very positive

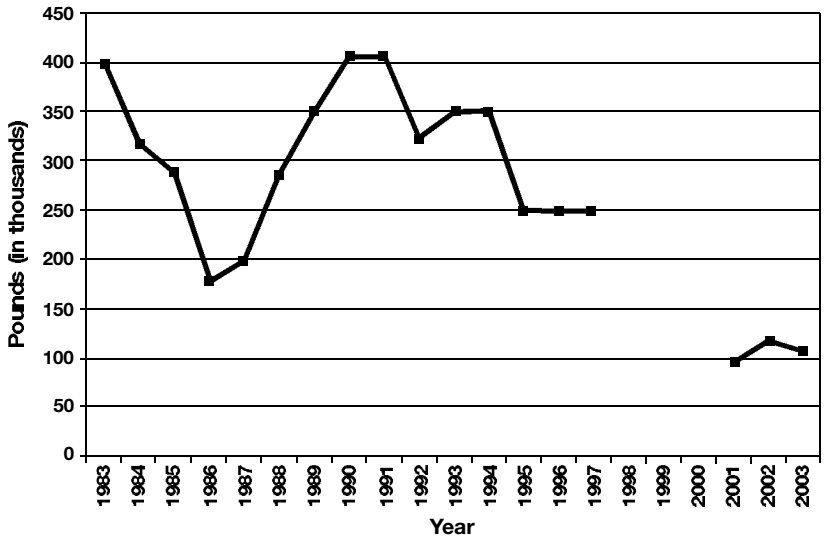

Figure 1. U.S. Freshwater Prawn Production Volume, 1983-2003. (Sources: FAO Fisheries Department, Fishery Information, FishStat Plus; MSU/Coastal Research and Extension Center, Alternative Freshwater Prawn Production Systems.)

toward its taste and texture attributes, suggesting that prawns are a potentially desirable product (Gallardo et al., 2004). A challenge facing the U.S. FWP industry is the difficulty in marketing low volumes of farm-raised prawns. Either too much time, energy, and money are used to supply many small orders, or not enough prawns are available to supply larger orders. As a result, profitable prawn enterprises are the exception rather than the rule.

Thus, the current problem is how to effectively market FWP when only small quantities of domestically produced prawns are available. Aggregation of prawn product is an essential component of this problem, but it is beyond the scope of this study. Therefore, this bulletin will focus on the marketing aspects of this problem. Presently, many producers sell prawn products directly from their freezers to individuals, grocery stores, and specialty meat markets and seafood shops. Other producers have their prawns individually quick frozen (IQF), packaged, and labeled by HACCP-approved seafood processors. The cost for these types of product distribution is high and inefficient for small producers. Successful marketing can increase product demand, resulting in the need for increased product quantity and production acreage. Prawn producers and marketers need information about how to price, market, and distribute their product.

A set of research activities designed to provide the FWP industry with information to bridge the gap between costly marketing of low production volumes to more efficient marketing outlets was funded by the Mississippi Agricultural and Forestry Experiment Station. To bridge this gap, marketing research must determine consumer attitudes and opinions toward FWP and what price consumers are willing to pay for FWP products. For farm-raised FWP to effectively compete with other seafood, beef, and poultry products, a high-quality prawn product must be produced, processed, and presented to consumers to alter their present fish, shellfish, and meat-buying habits. To maintain or increase levels of demand for new products, markets need to be identified and evaluated, and marketing strategies must be developed.

The main goal of this research was to collect and distribute this basic knowledge for prawn producers, processors, and marketers to more effectively target consumer audiences. This study had three specific objectives: (1) to identify consumer characteristics that determine freshwater prawn consumption; (2) to examine consumer's willingness-to-pay for freshwater prawns and study how this intent compares with willingness-to-pay for marine shrimp and lobster products; and (3) to compare the market share of freshwater prawns with that of marine shrimp and lobster products.

BACKGROUND

Consumption of fish and shellfish products by Americans has increased since 2000 after a relatively flat consumption level during the 1990s (Figure 2). During this time, shellfish gained an increasingly greater proportion of the total amount of seafood consumed by Americans (Figure 3). Shellfish include several well-known marine animals, such as clams, crabs, lobsters, mussels, oysters, scallops, and shrimp. Marine shrimp are by far the preferred seafood consumed in the U.S. with consumption around 4 pounds per person per year, approximately one-fourth of the total fish and shellfish consumed (Figure 4). Freshwater shellfish products are not as popular, but crawfish is the most familiar to consumers. Freshwater prawns are not nearly as well-known as crawfish or marine shellfish products.

Earlier marketing studies found that consumers do not view FWP as a substitute for marine shrimp when the prawn product is widely known (Lacroix and Phillips 2000). However, when the prawn product is

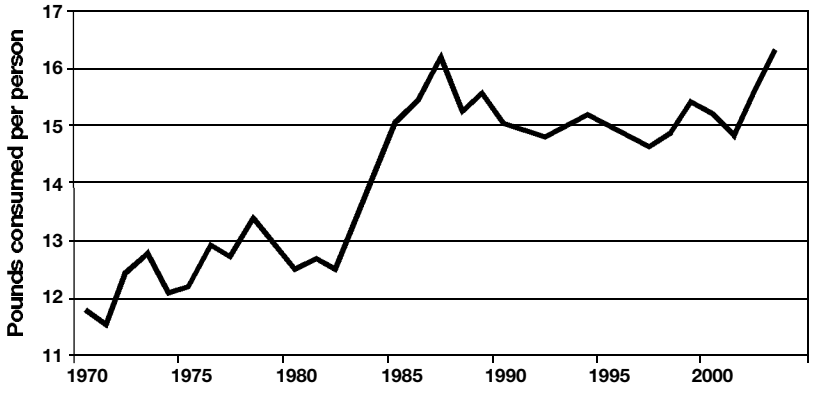

Figure 2. U.S. Per-Capita Consumption of Fish and Shellfish Products, 1970-2003. (Sources: USDOC/NOAA/NMFS, Fisheries of the United States, 2001; USDOC/NOAA/NMFS, Fisheries of the United States, 2003.)

less well-known, especially when the prawn product is marketed with head off, consumers often confuse the prawn and marine shrimp products. Substitution between prawns and shrimp could be a positive attribute because the rapid increase in U.S. per-capita consumption of marine shrimp may enable prawns to fit into the existing shrimp marketing channels (Lacroix and Phillips 2000). However, U.S. prawn producers do not produce enough quantity to take advantage of the economies of scale required to sufficiently lower production costs to accept a low shrimp commodity price and still make a profit (Posadas, personal communication, 2004). Thus, domestic FWP producers currently need to obtain a premium price for the low quantity of prawns they produce — i.e., a price higher than that received for the marine shrimp commodity — but presumably lower than that received for lobster products. However, for this situation to occur, the U.S. prawn product must have superior characteristics in the eyes of the consuming public, and it must be differentiated from prawns grown in Indo-Asian and Pacific countries, where prawns are native.

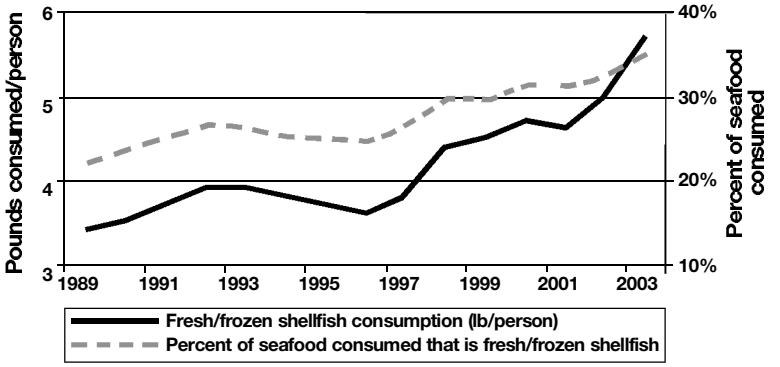

Figure 3. Per-Capita Fresh and Frozen Shellfish Consumption and Fresh and Frozen Shellfish Consumption as a Percent of Total Seafood Consumption in the United States, 1989-2003. (Sources: USDOC/NOAA/NMFS, Fisheries of the U.S., 2001; USDOC/NOAA/NMFS, Fisheries of the U.S., 2002; and USDOC/NOAA/NMFS, Fisheries of the U.S., 2003.)

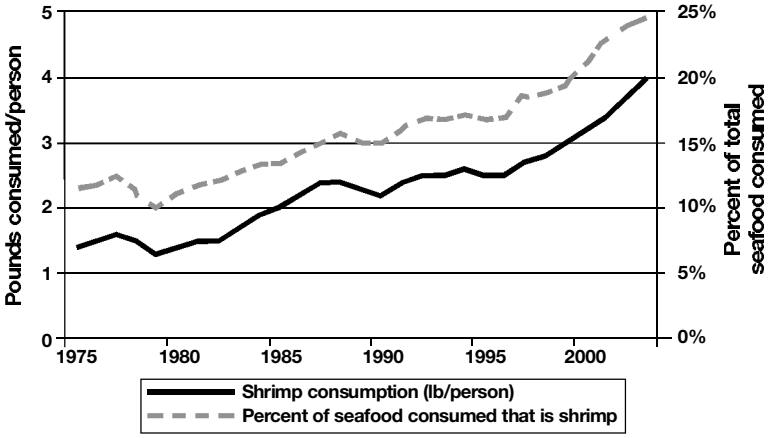

Figure 4. Per-Capita Shrimp Consumption and Shrimp Consumption as a Percent of Total Seafood Consumption in the United States, 1975-2003. (Sources: USDOC/NOAA/NMFS, Fisheries of the U.S., 2001; USDOC/NOAA/NMFS, Fisheries of the U.S., 2003.)

The advantages that U.S.-produced prawns may have over imported prawns are freshness and size. One hundred percent of Indo-Asian prawn exports must be frozen and shipped to the U.S., which may affect flavor and quality attributes. There are several possible characteristics that might increase the value of U.S.-grown prawns over imported prawn and marine shrimp products. First, the U.S.-grown prawn is a safe product produced in a sustainable production system because domestic, farm-raised products must be grown under strict U.S. government environmental regulations and be processed according to rigorous HACCP food safety regulations. Second, it is a fresh product that can be shipped as live, fresh (on ice), or IQF products; for fresh or IQF forms, prawns can be processed within minutes or hours of harvesting and delivered to U.S. consumers within days of harvest to meet consumer expectations for a fresh, high-quality product. Third, U.S.-grown prawns are uniquely sized products — in particular, the often rare jumbo-sized prawn product. Fourth, by marketing prawns as a unique U.S. product — a seasonal delicacy that niche consumers eagerly anticipate each year — producers could capitalize on the limited domestic supply. Thus, the results from this study that investigates consumers' opinions and attitudes toward value-added prawn features should benefit U.S. prawn producers, processors, and marketers.

DATA AND PROCEDURES

Data were obtained through a mail survey sent to an urban locale (Germantown, Tennessee) and a rural locale (Starkville, Mississippi) during fall 2003 and winter 2004. The survey consisted of questions that focused on consumer knowledge about FWP, their attitudes and opinions toward FWP products, and their willingness-to-pay for this product (Appendix I). These two locales were chosen because a stark contrast in demographics was desired to see what differences urban and rural residents might have in their view toward FWP (U.S. Census). There were population differences: Starkville had a population of 22,037 people in a county of 42,902 people, and Germantown had 37,281 people in a county of 897,472 people. There were age differences: Starkville median age was 25, and Germantown median age was 41. There were differences in education: Starkville had 85% of the populace with a high school degree or higher, and Germantown had a 98% level. Starkville had 46% of its populace with a bachelor's degree or higher compared with Germantown's 60%. There was a per-capita income difference: Starkville had a $16,272 income compared with Germantown's $44,021. Probably the most contrasting difference was the median income: Starkville's was $22,590, and Germantown's was $94,609. Additionally, it was deemed relevant to treat the Catholic faith separately from broader religious categories when asking about FWP consumption because it has been seen that demand for catfish increases around the spring Catholic Lent season (House et al., 2003).

To ascertain people's willingness-to-pay for FWP products, a hypothetical purchasing context (conjoint analysis methodology) was designed into the survey. Product-pricing scenarios for the three seafood species (FWP, marine shrimp, and lobster) were combined to produce a set of 25 different pricing com-

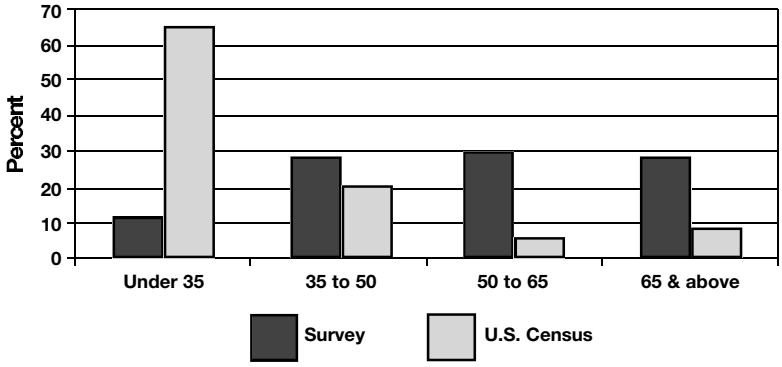

Figure 5. Comparison of Age Categories of Survey Respondents and those from 2000 U.S. Census Results (U.S. Census Bureau) for Starkville.

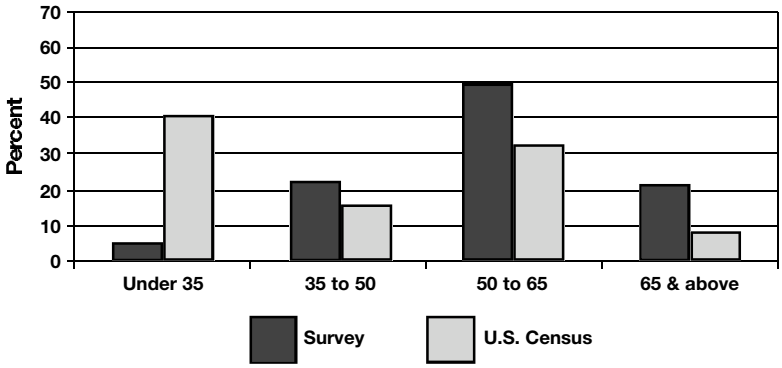

Figure 6. Comparison of Age Categories of Survey Respondents and those from 2000 U.S. Census Results (U.S. Census Bureau) for Germantown.

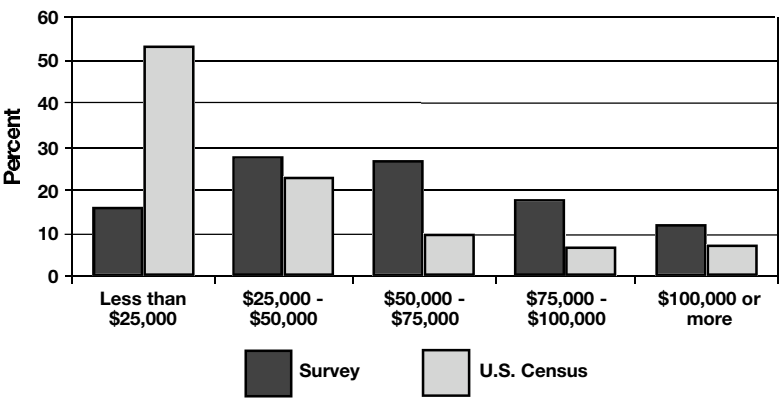

Figure 7. Household Income Comparison of Survey Respondents and 2000 U.S. Census Results (U.S. Census Bureau) for Starkville.

binations using a fractional factorial design to maximize design efficiency and minimize cross-attribute correlation. The 25 scenarios were randomly divided into two groups to prevent respondent fatigue. The first group had 12 scenarios that were included in version 1 of the survey, and the other group had 13 scenarios that were included in version 2 of the survey.

Of the 1,000 surveys sent to Starkville, 305 surveys were returned as undeliverable, and 131 usable, completed surveys were returned; thus, 18.8% of the surveys were used in the analysis. Of the 2,000 surveys sent to Germantown, 91 surveys were returned as undeliverable, and 523 usable, completed surveys (27.5%) were returned and used in the analysis. In most cases, analyses were conducted by region; however, some questions were analyzed using a combined data set, resulting in a bias toward Germantown survey responses.

Approximately 90% of the Starkville respondents were distributed into three age groups, "between 35 and 50," "between 50 and 65," and "older than 65" (Figure 5). Survey respondents in Starkville were older than the mean Starkville population, according to the 2000 U.S. Census. Approximately 29% of the survey respondents were older than 65 years, whereas the 2000 U.S. Census reported approximately 9% of the population in this age range in Starkville. However, results showed that people under 35 years old were least likely to respond to the survey (12%). The 2000 U.S. Census suggests that 65% of the population is under 35 in Starkville.

For the Germantown respondents' age distribution, approximately 50% of the respondents were between 50 and 65 years old (Figure 6). Germantown survey respondents also tended to be older than the population average. Approximately 23% of the respondents were over 65 years old, whereas the 2000 U.S. Census indicates that approximately 9% of the Germantown population falls within that age range.

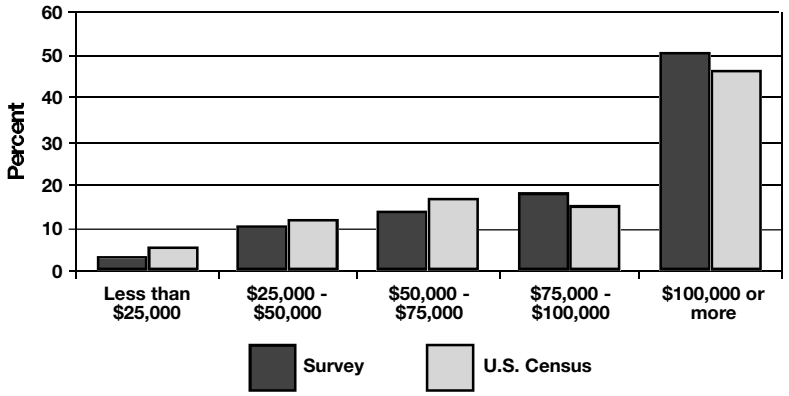

Figure 8. Household Income Comparison of Survey Respondents and 2000 U.S. Census Results (U.S. Census Bureau) for Germantown.

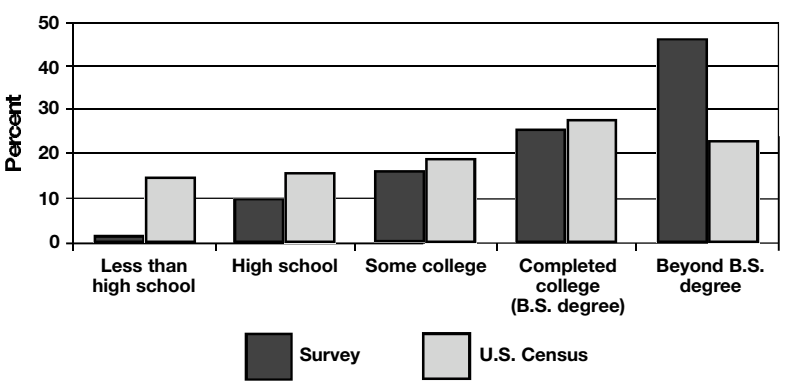

Figure 9. Level of Education Comparison of Survey Respondents and 2000 U.S. Census Results (U.S. Census Bureau) for Starkville.

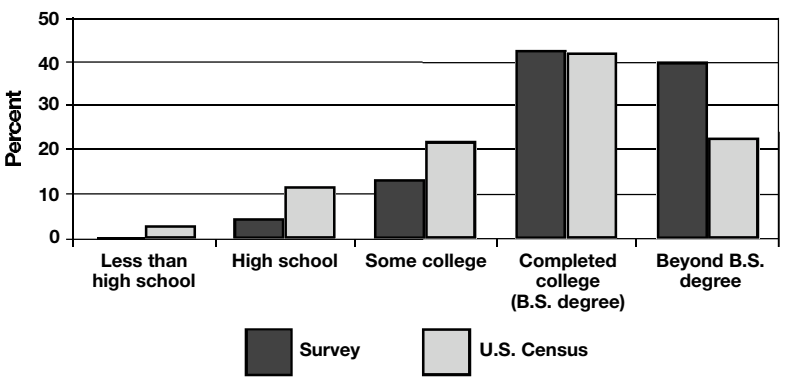

Figure 10. Level of Education Comparison of Survey Respondents and 2000 U.S. Census Results (U.S. Census Bureau) for Germantown.

Average income proportions for Starkville respondents were more evenly distributed than those for respondents from Germantown. Germantown respondents' incomes were more representative of their respective locale. Approximately 27% of the Starkville respondents' income was between $25,000 and $50,000, almost equivalent to the 23% reported by the 2000 U.S. Census for the same income range in that community. According to that census, the income of approximately 50% of the Starkville population was less than $25,000, whereas only 16% of the survey respondents in Starkville reported this income level (Figure 7). Results for Germantown indicated that the population average income and the survey respondents' average income were very similar (Figure 8).

Respondents with education beyond a bachelor's degree returned a disproportionately larger number of surveys than would be expected according to the 2000 U.S. Census. Approximately 46% and 40% of the Starkville and Germantown respondents, respectively, had education beyond a bachelor's degree. Conversely, the 2000 U.S. Census indicated that 23% and 22% of the respective residents have that level of education (Figures 9 and 10). With the exception of the "Beyond B.S." category, the education levels of respondents in both regions were closely aligned.

Generally, survey respondents were Caucasian, with 79% of the Starkville respondents and 95% of the Germantown respondents reporting this ethnicity. Results were similar to those reported by the 2000 U.S. Census, where the Caucasian population was approximately 65% and 93%, respectively.

RESULTS

Freshwater Prawn Consumer Demographics

Demographics of freshwater prawn consumers and nonconsumers are summarized in Table 1. Results confirmed the presumption that freshwater prawns are a novel product to American consumers. Only 29% of the Starkville respondents had consumed freshwater prawns. Similarly, of the 505 Germantown respondents (18 respondents did not respond to the FWP consumption question), only 31% had consumed prawns.

A logistic regression model was estimated to determine those consumer characteristics that would indicate a tendency to consume freshwater prawns. Gender (female) and higher education were significant ($p<0.01$) explanatory variables for Starkville respondents, indicating that individuals with either of these characteristics would have a greater tendency than individuals without these characteristics to consume FWP (Table 2). For the Germantown respondents, only gender (female) was a significant explanatory variable. The negative sign of the gender coefficient indicates that females were less likely than males to have consumed prawns. When data from the Starkville and Germantown surveys were combined, only gender was a significant explanatory variable (Table 2).

Likelihood of Consumption

Results indicated that a large group of respondents would potentially consume freshwater prawns in the future (Table 3). Ninety-three percent of respondents who had already consumed prawns stated that they would consume prawns again. In addition, a high percentage (83%) of respondents who had never eaten FWP indicated that they would consider trying the product.

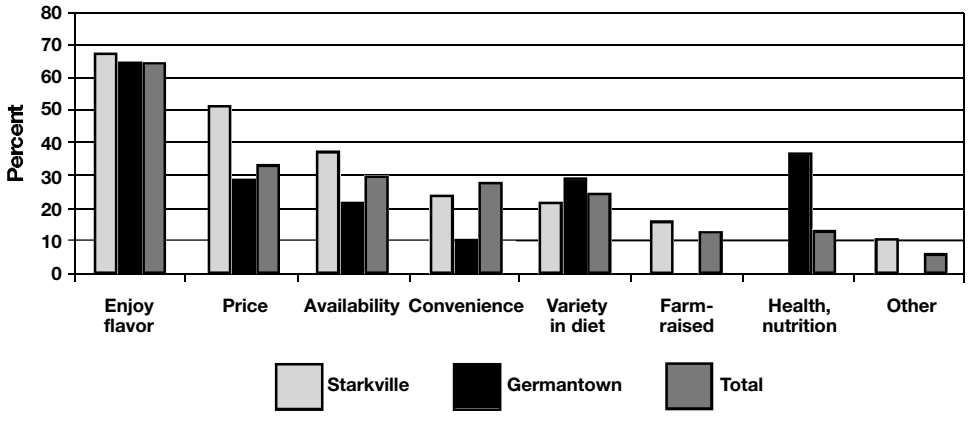

Figure 11. Categories of Greatest Response (as a percent of total respondents) to Reasons Why Freshwater Prawns Are Consumed.

Table 1. Summary of demographics comparing consumers of freshwater prawns with nonconsumers in the two study areas.

Demographic	Starkville (%)			Germantown (%)		
	Nonconsumers N=92	Consumers N=37	Total N=129	Nonconsumers N=350	Consumers N=155	Total N=505
	71.32	28.68	100.00	68.63	31.37	100.00
Age of respondent						
Under 35	10.84	14.29	11.86	2.95	7.74	4.76
Between 35 and 50	27.71	28.57	28.82	22.12	24.52	22.78
Between 50 and 65	31.33	31.43	30.51	51.92	44.51	49.48
Older than 65	30.12	25.71	28.81	23.01	23.23	22.98
Gender						
Percent male	55.68	78.38	62.40	60.85	64.38	61.71
Household income						
Less than $25,000	19.77	7.89	16.13	4.19	2.76	3.83
$25,000 - $50,000	27.91	26.32	27.42	9.68	13.10	10.81
$50,000 - $75,000	31.40	15.79	26.61	15.16	17.24	15.54
$75,000 - $100,000	13.95	26.32	17.74	18.06	21.38	19.14
$100,000 or more	6.98	23.68	12.10	52.90	45.52	50.68
Education						
Less than high school	1.11	2.63	1.56	0.28	0.63	0.40
High school	10.00	10.53	10.16	4.51	3.14	4.18
Some college	25.56	18.42	16.41	19.16	22.64	12.75
Completed college (B.S. degree)	22.22	10.53	25.78	34.65	35.22	42.63
Beyond B.S. degree	41.11	57.89	46.09	41.41	38.36	40.04
Ethnicity						
Caucasian	81.61	73.68	79.20	96.24	92.86	95.09
African American	10.34	13.16	11.20	0.87	1.30	1.02
Native American	3.45	0.00	2.40	0.29	1.30	0.61
Asian	1.15	7.89	3.20	0.29	1.30	2.04
Hispanic	0.00	5.26	1.60	1.73	2.60	0.61
Other	3.45	0.01	2.40	0.58	0.64	0.61
Religion						
Non-Catholic	75.28	68.42	73.23	77.03	70.32	75.61
Catholic	12.36	15.79	13.39	14.53	20.65	16.39
Other	12.36	15.79	13.38	9.05	8.42	7.98

Reasons For or Against Consumption

Respondents who had previously consumed freshwater prawns were asked to provide reasons for their prawn consumption. Sixty-five percent of the 192 freshwater prawn consumers (Starkville N=37 and Germantown N=155) who responded to this question stated enjoyment of flavor to be the principal reason (Figure 11). The survey population with a lower percentage of high-income families (Starkville) chose price, followed by availability of fresh products, as their second and third reasons for consuming FWP. As expected, high-income consumers in the Germantown locale did not indicate price as a principal reason but stated health/nutrition and variety in diet as the number two and three principal reasons. No Germantown respondents chose farm-raised aspects of prawn production as a primary reason for consuming FWP, while no Starkville respondents identified health and nutrition as the primary reason.

Survey respondents were asked to provide the reasons for either lack of prawn consumption or infrequent con-

Table 2. Demographic characteristics and their explanatory power on predicting the tendency to consume freshwater prawns.[1]

Demographic variable	Freshwater prawn consumption		
	Starkville	Germantown	Combined locales
Intercept	0.5660	0.6403	0.1553
Age	-0.0178	-0.0124	-0.0098
Gender (Female)	-0.9334*	-0.3842*	-0.4556*
Education	-1.5422*	0.2953	-0.1264
Religion	-0.0251	-0.3134	-0.1648
Income	1.9×10^{-5}	-6.47×10^{-6}	0.68×10^{-6}
Ethnicity	1.7956	-0.2608	0.6435

[1]This table is to display, which variables are significant in predicting consumption of freshwater prawns and not the magnitude of one variable compared to another. For example, a -0.9 for gender and a -1.5 for education does not mean that education has a greater or lesser impact on prawn consumption. The values in the above table were obtained using mathematical models. For more information about the use of these models see Gallardo (2004). [*= Statistical significant ($p<0.01$)]

sumption (Figure 12). The most noticeable result was the high number of nonconsumers who were unfamiliar with prawns. More than 70% of respondents from Starkville, and more than 60% from Germantown were unfamiliar with the product. Lack of fresh product availability and lack of preparation knowledge were the second and third reasons given by nonconsumers. Consumers of prawns in Starkville indicated that the limited availability of fresh products, price, and lack of preparation knowledge were the three principal reasons why prawns were not consumed more frequently. Although Germantown consumers represented a higher income level, price was the primary reason prawns were not consumed more frequently, followed by limited availability of fresh products and lack of preparation knowledge.

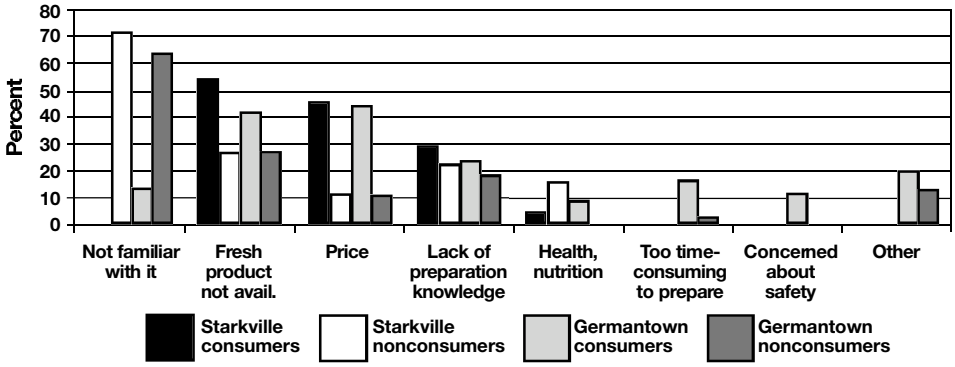

Figure 12. Categories of Greatest Response (as a Percent of Total Respondents) to Reasons Why Freshwater Prawns Are Not Consumed or Not Consumed More Frequently.

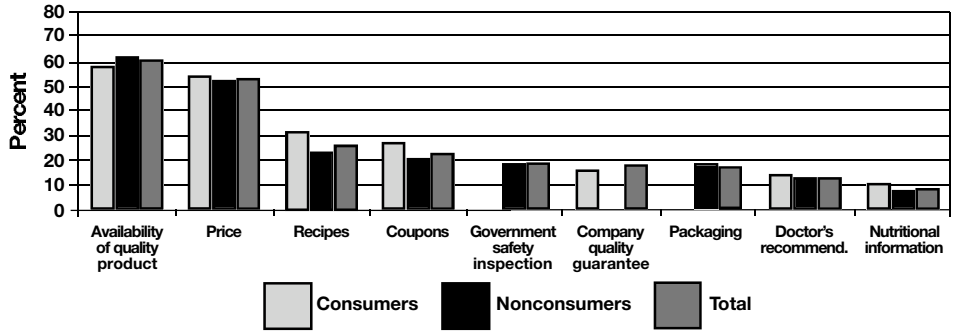

Figure 13. Factors That Respondents in Starkville and Germantown Indicated Would Increase Consumption of Freshwater Prawns.

Increasing Consumption

Freshwater prawn consumers and nonconsumers were also asked to identify conditions that might favor an increase in their consumption or that might influence them to start consuming prawns (Figure 13). Responses from consumers and nonconsumers were quite similar, suggesting that similar marketing methods could be used to entice nonconsumers and consumers to consume more prawns. For consumers and nonconsumers, the three principal reasons given for beginning or increasing prawn consumption were availability of quality products, price, and recipes. The reason, "knowing the production process," was not considered important by either market group.

Table 3. Respondents' likelihood of continued consumption or consideration of beginning to consume freshwater prawns.

	Number of respondents	Percent
Freshwater prawn consumers		
Would consume prawns again	187	93
Would not consume prawns again	14	7
Total	**201**	**100**
Nonconsumers of freshwater prawns		
Would consider consuming prawns	336	83
Would not consider consuming prawns	69	17
Total	**405**	**100**

Frequency of Shellfish Consumption

Respondents were asked to provide information about how often they consumed freshwater prawns, marine shrimp, and lobster. Approximately 66% of all respondents indicated they had never consumed freshwater prawns, and approximately 11% consumed prawns once annually. Approximately 60% of all respondents indicated they consumed marine shrimp between once a month and once every three months. Sixty-three percent of all respondents indi-

cated that they had never consumed lobster or consumed it once per year. A Poisson model was used to determine those variables that were significant in determining the frequency of FWP consumption. Results are summarized in Table 4.

Results presented in Table 4 provide us with characteristics of the most likely buyers of the freshwater prawn products. Older people tended to consume prawns more frequently. Also, although females were less likely than males to have consumed prawn (Table 2), females who did consume prawns, consumed them more frequently than males. Catholics consumed prawns less frequently than non-Catholic groups. Also, people with higher incomes consumed prawns more frequently. Relative to ethnicity, Asian groups consumed prawns more frequently than other ethnic groups.

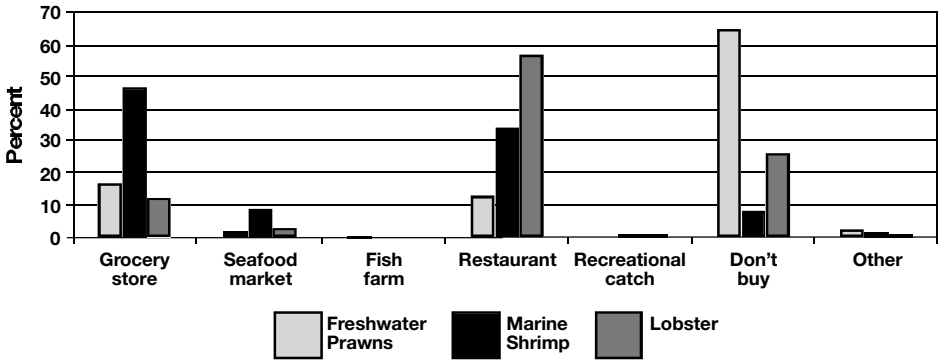

Figure 14. Shellfish Purchase Locations for Starkville and Germantown Buyers.

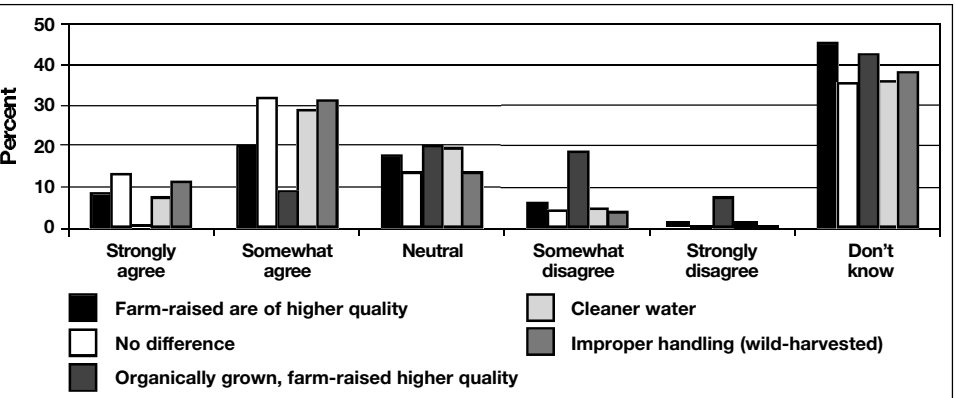

Figure 15. Combined Opinion of Starkville and Germantown Respondents (percent of total) toward Farm-Raised and Wild-Harvested Shellfish Products.

Shellfish Purchase Location

Respondents preferred to purchase freshwater prawns at grocery stores or restaurants than at other locations (Figure 14). They also generally purchased marine shrimp at grocery stores and restaurants. Fewer than 10% of respondents purchased shellfish at seafood markets. Finally, the majority of respondents indicated that either lobster was purchased almost exclusively at restaurants or was not purchased. Only 12% of respondents purchased lobster at grocery stores. Results suggest that restaurants are the principal place of purchase for "delicacy products" such as lobsters, whereas consumers choose restaurants and other outlets to purchase shrimp and prawn products.

Table 4. Demographic variables explanatory power on frequency of prawn consumption.[1]

Demographic variable	Coefficient
Age	0.00732*
Gender – Female	0.29804*
Education	-0.01041
Religion – Catholic	-0.49550*
Income	0.00004*
Ethnicity – Asian	1.97466*

[1]This model allows the user to determine the likelihood that a demographic will frequently consume FWP. For example, Asians are almost twice (1.9 times) as likely to frequently eat prawns than non-Asians. Also, non-Catholics (since it is negative) are about 0.5 times as likely to frequently have prawns in a meal than Catholics. However, do not compare the magnitudes between variables. For more information about this model, see Gallardo (2004). [*=Statistical significant (p<0.01)]

Farm-Raised Seafood

Respondents were asked for their opinions — strongly agree to strongly disagree or don't know — about farm-raised versus wild-harvested fish and seafood products (see Appendix I, question 6 for a listing of the statements respondents were provided to answer this question). Results are summarized in Figure 15. The majority of respondents offered no definitive opinion ("Don't Know") about their preference for

Table 5. Comparison of Starkville respondents' willingness-to-pay estimates for three shellfish products.[1]

Seafood Product	Willingness-to-pay amount ($)		
	Total	Nonconsumers	Consumers
Large freshwater prawn Tails (23-45 units/lb)	7.02*a* [6.76 - 7.27]	3.84*a* [3.64 - 4.02]	8.11*a* [7.73 - 8.48]
Large marine shrimp tails (23-45 units/lb)	7.50*a* [7.27 - 7.73]	4.19*a* [4.02 - 4.35]	8.38*a* [8.00 - 8.79]
Lobster (1 lb)	7.48*a* [7.10 - 7.73]	4.19*a* [3.99 - 4.38]	8.34*a* [7.92 - 8.77]

[1]Numbers inside brackets represent the 95% confidence interval around the mean. Values with different letters (a) within a column among shellfish products are significantly different at the p<0.05 level; same letters represent no significant difference.

farm-raised versus wild-harvested fish and seafood products. However, for those who did respond in one of the agreement categories, a greater response occurred in the "Strongly Agree" and "Somewhat Agree" categories than in the "Strongly Disagree" and "Somewhat Disagree" categories. This trend suggested that there is a generally positive attitude toward farm-raised fish and shellfish products. Respondents somewhat agreed that the quality of farm-raised fish and shellfish products is higher than that of wild-harvested products, that farm-raised shellfish are harvested from cleaner waters, and that wild-harvested fish and shellfish products are more likely subject to improper handling. Also, respondents somewhat agreed that organically grown, farm-raised shellfish have quality and safety advantages over wild harvest shellfish.

Willingness-to-Pay

As part of the survey, respondents were presented with hypothetical pricing scenarios and were asked whether they would purchase one pound of either freshwater prawn tails or marine shrimp tails, or lobster, with each shellfish product having a different price (Appendix I, question 8). The collected responses were used to estimate a willingness-to-pay indicator. First, responses were used to estimate a conditional logit model (see Gallardo, 2004, for estimation details) that was used to develop predicted willingness-to-pay and 95% confidence intervals for both locations. Tables 5 and 6 summarize the willingness-to-pay results for Starkville and Germantown respondents, respectively. The summary also includes a division by prawn consumer and nonconsumer categories.

Starkville respondents' willingness-to-pay for freshwater prawns was not lower than that for marine shrimp or lobster (Table 5). Also, willingness-to-pay for lobster was not statistically different from that of marine shrimp. Results indicate that people in Starkville do not price-differentiate among prawn tails, marine shrimp tails, or lobster products. This finding could have a positive or a negative implication for a new product, such as freshwater prawns. Consumers are willing to buy the new product; however, consumers are not prepared to pay a premium price for the new product. Another important point to consider is that individuals who had previously consumed prawn were willing to pay twice as much for this product as people who had never consumed prawn.

Freshwater prawn willingness-to-pay estimates for Germantown respondents were significantly lower than amounts for marine shrimp tails and lobster, and willingness-to-pay for shrimp was significantly lower than amounts for lobster (Table 6). Nonconsumers in Germantown were willing to pay a significantly lower

Table 6. Comparison of Germantown respondents' willingness-to-pay estimates for three shellfish products.[1]

Seafood Product	Willingness-to-pay amount ($)		
	Total	Nonconsumers	Consumers
Large freshwater prawn tails (23-45 units/lb)	8.39*a* [8.23 - 8.54]	4.41*a* [4.32 - 4.50]	9.21*a* [8.98 - 9.45]
Large marine shrimp tails (23-45 units/lb)	8.99*b* [8.85 - 9.14]	4.98*b* [4.91 - 5.06]	9.31*a* [9.09 - 9.54]
Lobster (1 lb)	9.29*c* [9.14 - 9.44]	5.03*b* [4.96 - 5.12]	9.89*b* [9.67 - 10.12]

[1]Numbers inside brackets represent the 95% confidence interval around the mean. Values with different letters (a,b,c) within a column (among shellfish products) are significantly different at the p<0.05 level; same letters represent no significant difference.

Table 7. Comparison of willingness-to-pay estimates from Starkville and Germantown respondents after using an equivalent scaling factor.

Seafood product	Willingness-to-Pay	
	Starkville	Germantown
Large freshwater prawn tails (23-45 units/lb)	5.86*ax* [5.65 - 6.06]	8.39*ay* [8.23 - 8.54]
Large marine shrimp (23-45 units/lb)	6.27*bx* [6.08 - 6.46]	8.99*by* [8.84 - 9.15]
Lobster (1 lb)	6.26*abx* [6.04 - 6.47]	9.29*by* [9.13 - 9.45]

[1]Numbers inside brackets represent the 95% confidence interval around the mean. Values with different letters (a, b) within a column (products) are significantly different ($p<0.05$); values with different letters (x, y) within a row (locales) are significantly different ($p<0.05$).

price for prawn tails in comparison to marine shrimp tails or lobster, but they were willing to pay a similar price for either marine shrimp or lobster. Prawn consumers in Germantown stated that they would not pay a different price for prawn tails relative to marine shrimp tails. Therefore, Germantown prawn consumers do not differentiate between marine shrimp and prawn products, indicating prawn acceptance and substitutability. However, prawn consumers in Germantown had a significantly higher willingness-to-pay amount for lobsters than for prawns (i.e., they were willing to pay a premium price for lobster products).

To make the Starkville and Germantown willingness-to-pay estimates comparable, the data sets were adjusted because different pricing scenarios were presented at each location. Starkville responses were multiplied by a factor estimated using a nested logit model. Willingness-to-pay for freshwater prawn tails was significantly lower than that for marine shrimp tails and lobster when considering the Germantown and scaled Starkville responses (Table 7). For all three shellfish products, Starkville respondents' willingness-to-pay decreased, when scaled to the Germantown responses, and was significantly lower than Germantown respondents' willingness-to-pay. These results are meaningful only for grocery store management decisions that require comparisons between the two regions. Individual grocery store pricing decisions would not be based upon combined or scaled willingness-to-pay values but would focus on willingness-to-pay values derived from each individual locale (i.e., values found in Tables 5 and Table 6).

Predicted Market Share

Predicted market share for freshwater prawns in the Starkville and Germantown locales are summarized in Table 8. As expected, freshwater prawn tails had a lower market share than marine shrimp tails or lobster because it is a new product. However, the prawn market share was noteworthy because it was being compared with two established and accepted shellfish products. Respondents in Starkville assigned a higher market share to marine shrimp tails, while respondents in Germantown assigned approximately the same market share to lobster and marine shrimp tails (34.87% versus 34.07%).

Table 8. Estimated market share of three fresh shellfish products in a rural locale (Starkville) and an urban locale (Germantown).

Starkville (%)			Germantown (%)		
Prawn tails	Marine shrimp tails	Lobster	Prawn tails	Marine shrimp tails	Lobster
22.28	42.67	35.05	31.06	34.07	34.87

CONCLUSIONS

In general, consumers were not willing to pay a premium price for freshwater prawns, but they did express an equal behavior toward marine shrimp and freshwater prawns. According to the results obtained from the conjoint analysis experiment, Starkville and Germantown respondents accepted prawns and would pay a price equal to that for marine shrimp. One way to differentiate the prawn product from the marine shrimp product would be to use advertising campaigns that familiarize consumers with the unique taste and texture of the prawn product. In-store cooking and taste-testing promotions could be implemented to increase sales. Additionally, as evidenced from the results of the survey, marketing efforts should focus on the flavor attributes of the freshwater prawn.

Most nonconsumers of prawns were not familiar with the product, and this inhibited them from buying prawns. Lack of product availability and lack of preparation knowledge were the other two principal reasons given for not consuming prawns. The three principal reasons that would lead nonconsumers to begin eating prawns were availability of quality products, price, and recipes. These were the same reasons given by prawn consumers when asked what it would take to increase their consumption of prawns. Because consumer and nonconsumer responses were the same, similar marketing methods could be targeted toward both groups to increase prawn consumption.

Larger quantities of freshwater prawns are more likely to be sold in more populated, higher income urban locations than in less populated, lower income rural locations. In addition, the higher income population in the urban location appeared to be willing to pay a significantly higher price for FWP than the lower income population in the rural location. Therefore, although shipping costs to locations that are further away from the prawn facility would increase costs, targeting higher income urban locations may provide greater profit potential.

The study could have been improved if more diverse geographical locations characterized by higher populations and higher income levels had been surveyed. These surveys were conducted in connection with an in-store grocery prawn pricing experiment, so these locales were necessary to complement the data collected in the grocery store. Finally, the study showed that grocery stores and restaurants were the preferred outlets for purchase of shellfish products. Therefore, it would be insightful to the freshwater prawn industry to conduct freshwater prawn demand studies at a range of grocery stores and restaurants throughout the United States.

REFERENCES

D'Abramo, L.R., C.L. Ohs, M.W. Fondren, J.A. Steeby, and B. Posadas. 2003. "Culture of Freshwater Prawns in Temperate Climates: Management Practices and Economics." Mississippi Agricultural and Forestry Experiment Station (MAFES) Bulletin 1138, Mississippi State University; pp.23.

Dasgupta, S. "Economics of Freshwater Prawn Farming in the United States." Southern Regional Aquaculture Center, Mississippi State University, in press.

FAO Fisheries Department, Fishery Information, Data and Statistics Unit. 2000. FISHSTAT Plus: Universal software for fishery statistical time series. Version 2.3.

Gallardo, R.K. 2004. "Comparison of Revealed and Stated Preferences for a New Shellfish Product: the Case of Freshwater Prawns." M.S. Thesis, Department of Agricultural Economics, Mississippi State University, Mississippi; pp. 161.

Gallardo, R.K., P.C. Coggins, and M.A. Hattaway. 2004. "Consumer Evaluation of Freshwater Prawns." Book of Abstracts from The International Food Technology Annual Meeting and Food Expo, Las Vegas, NV; pp. 195.

House, L., T. Hanson, S. Sureshwaran, and H. Selassie. 2003. "Opinions of U.S. Consumers About Farm-Raised Catfish: Results of a 2000-2001 Survey." Mississippi Agricultural and Forestry Experiment Station (MAFES) Bulletin 1134, Mississippi State University; pp. 18.

Lacroix, D., and H. Phillips. 2000. "Marketing and Preparation for Consumption." Article published in the book: Freshwater Prawn Culture, The farming of *Macrobrachim rosenbergii*. M. B. New and W. C. Valenti (Eds.). Blackwell Science, Ltd., Oxford. pp. 345-368.

Lutz, G. 2002. "Freshwater Prawns: Old Ideas Open New Horizons." *Aquaculture Magazine*. 28(5): 23-34.

Mississippi State University, Coastal Research and Extension Center, Alternative Freshwater Prawn Production Systems. www.msstate.edu/dept/crec/aquafwp.html

Silva, J., J. Hearnsberger, R. Hagan, and G. Ammerman. 1989. "A Summary of Processing Research on Freshwater Prawns at Mississippi State University, 1984-1988." Mississippi Agricultural and Forestry Experiment Station (MAFES) Bulletin 961, Mississippi State University; pp. 20.

U.S. Census Bureau. United States Census 2000. http://www.census.gov

U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fishery Service. 2002. "Fisheries of the United States, 2001." Current Fishery Statistics No. 2001. Silver Springs, MD, September 2002. www.st.nmfs.gov/st1/fus/fus01/

U.S. Department of Commerce, National Oceanic Atmospheric Administration, National Marine Fishery Service. 2003. "Fisheries of the United States, 2002." Current Fishery Statistics No. 2002. Silver Spring, MD, September 2003. www.st.nmfs.gov/st1/fus/current/index.html

U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fishery Service. 2004. "Fisheries of the United States, 2003." Current Fishery Statistics No. 2003. Silver Springs, MD, October 2004. www.st.nmfs.gov/st1/fus/fus03/index.html

APPENDIX I. MAIL SURVEY INSTRUMENT

2003 FRESHWATER PRAWN MARKETING SURVEY

Conducted by:
Dr. Hanson, Dr. Hudson and Ms. Gallardo
Mississippi State University
Department of Agricultural Economics

NOTICE: Any information reported below is strictly confidential. This data will be used only by persons engaged in this survey, and will not be disclosed or released to others for any purpose.

This research is supported by grants from the USDA ARS Alternative Crops and Value Added Products and Mississippi State University's Special Research Initiative programs. This survey was reviewed by Mississippi State University's Institutional Review Board of the Regulatory Compliance Office, IRB # 03-227.

2003 FRESHWATER PRAWN MARKETING SURVEY

Directions: Please have the household member that usually decides what food you purchase at the grocery store fill out this survey. For this survey please use the following definition for **shellfish:** an aquatic animal with a shell, such as a marine shrimp, freshwater prawn, lobster, crawfish or crab. Thank you in advance for taking the time to fill out this survey.

1. Have you ever consumed freshwater prawns? Check one. YES ____ NO ____
   - If YES, would you consume it again? YES ____ NO ____
   - If NO, would you consider consuming freshwater prawns? YES ____ NO ____

2. If you consume freshwater prawns, please rank your top 3 reasons by putting a "1", "2" or "3" next to the appropriate reason. If you do not eat freshwater prawns, check the "Do NOT Eat Freshwater Prawns" space and go to the next question.

____ Enjoy flavor	____ Convenience
____ Health/Nutrition	____ Product safety
____ Traditional/Habit	____ Religion
____ Price	____ Variety in diet
____ Availability	____ Know how to prepare
____ Farm raised	____ Allergic to marine seafood
____ Other (specify)	____ Do NOT Eat Freshwater Prawns

3. If you **do not** eat or **do not like** freshwater prawns, please indicate why by ranking your top 3 reasons with a "1", "2" or "3" next to the appropriate reasons.

   If you **do** eat freshwater prawns indicate your top 3 reasons for **why you do not eat more** with a "1", "2" or "3" next to the appropriate reasons.

____ Price	____ Don't like smell
____ Fresh products not available	____ Don't like taste
____ Custom	____ Traumatic past experience with shellfish products
____ Religion	____ Concerned about product safety
____ Lack of preparation knowledge	____ Allergy
____ Too time consuming to prepare	____ Vegetarian
____ Not familiar with it	____ Health and/or nutrition
____ Don't like texture	____ Other

4. How often do you eat the following shellfish products? Please indicate your consumption frequency by placing an "X" in the box most representing your habits; do this for each shellfish product below.

	Daily	4 – 6 times per week	2 – 3 times per week	1 time per week	Once a month	Once every 3 months	Once every 6 months	Once a year	Never
Freshwater prawns									
Marine shrimp									
Lobster									
Crayfish									
Crab									

5. Where do you **most** frequently purchase the following shellfish products? Place an "X" in ONE box for each shellfish product.

	Grocery Store	Seafood Market	Fish Farm	Restaurant	Recreational Catch	Don't buy	Other (specify)
Freshwater prawn							
Marine shrimp							
Lobster							
Crayfish							
Crab							

6. Please indicate your opinion about the following statements by placing an "X" in the respective box that most represents your opinion toward the statement.

	Level of Agreement					
Farm-raised shellfish products are of higher quality than wild-harvested shellfish products.	Strongly agree	Somewhat agree	Neutral	Somewhat disagree	Strongly disagree	Don't know
Farm-raised shellfish products are harvested from cleaner waters than wild-harvested products.	Strongly agree	Somewhat agree	Neutral	Somewhat disagree	Strongly disagree	Don't know
There is no quality difference between farm-raised and wild-harvested shellfish products.	Strongly agree	Somewhat agree	Neutral	Somewhat disagree	Strongly disagree	Don't know
Wild-harvested shellfish products are more likely to suffer from improper handling and storage after harvest than farm-raised shellfish products.	Strongly agree	Somewhat agree	Neutral	Somewhat disagree	Strongly disagree	Don't know
"Organically grown" farm-raised shellfish products have considerable quality and safety advantages compared to wild-harvested shellfish products.	Strongly agree	Somewhat agree	Neutral	Somewhat disagree	Strongly disagree	Don't know

7. What would increase your consumption of freshwater prawns or what would make you want to try freshwater prawns if you have never eaten them before? Please indicate your preference by ranking your top 3 reasons with a "1", "2" or "3" next to the appropriate reasons.

Item	**Rank (1, 2, or 3)**
Recipes	
Coupons	
Company safety/quality guarantee	
Nutritional information	
Doctor's recommendation (diet program)	
Packaging (microwavable/convenience)	
Availability of quality products	
Information on production process	
Government safety inspection	
Price	

8. Assume that you are presented with the following pricing scenarios for the described shellfish products in a grocery store setting. Each scenario asks whether you would buy ONE of the products given the stated prices for each product. Prices for farm-raised freshwater prawns, wild-caught marine shrimp and wild-caught marine lobster are stated in dollars per pound. The weight of each product described is one pound with between 23 and 45 prawns or shrimp per pound and one one-pound lobster tail. All products are in the shell and have been de-headed.

   For each scenario indicate your purchasing choice by putting an "X" in the "I would purchase:" row under the product and price of your choosing. If you would not purchase any of the products at stated prices, put an "X" in the box below the "None" column.

Scenario 1

Attribute	Farm- raised Freshwater Prawn Count: 23-45	Wild-caught Marine Shrimp Count: 23-45	Wild-caught Marine Lobster	None
Price	$5.99 / lb	$7.99 / lb	$14.99 / lb	
I would purchase:				

Scenario 2

Attribute	Farm- raised Freshwater Prawn Count: 23-45	Wild-caught Marine Shrimp Count: 23-45	Wild-caught Marine Lobster	None
Price	$5.99 / lb	$11.99 / lb	$10.99 / lb	
I would purchase				

Scenario 3

Attribute	Farm- raised Freshwater Prawn Count: 23-45	Wild-caught Marine Shrimp Count: 23-45	Wild-caught Marine Lobster	None
Price	$7.99 / lb	$5.99 / lb	$14.99 / lb	
I would purchase				

Scenario 4

Attribute	Farm- raised Freshwater Prawn Count: 23-45	Wild-caught Marine Shrimp Count: 23-45	Wild-caught Marine Lobster	None
Price	$7.99 / lb	$9.99 / lb	$10.99 / lb	
I would purchase				

Scenario 5

Attribute	Farm- raised Freshwater Prawn Count: 23-45	Wild-caught Marine Shrimp Count: 23-45	Wild-caught Marine Lobster	None
Price	$7.99 / lb	$13.99 / lb	$6.99 / lb	
I would purchase				

Scenario 6

Attribute	Farm- raised Freshwater Prawn Count: 23-45	Wild-caught Marine Shrimp Count: 23-45	Wild-caught Marine Lobster	None
Price	$9.99 / lb	$7.99 / lb	$12.99 / lb	
I would purchase				

Scenario 7

Attribute	Farm- raised Freshwater Prawn Count: 23-45	Wild-caught Marine Shrimp Count: 23-45	Wild-caught Marine Lobster	None
Price	$9.99 / lb	$11.99 / lb	$8.99 / lb	
I would purchase				

Scenario 8

Attribute	Farm- raised Freshwater Prawn Count: 23-45	Wild-caught Marine Shrimp Count: 23-45	Wild-caught Marine Lobster	None
Price	$11.99 / lb	$5.99 / lb	$14.99 / lb	
I would purchase				

Scenario 9

Attribute	Farm- raised Freshwater Prawn Count: 23-45	Wild-caught Marine Shrimp Count: 23-45	Wild-caught Marine Lobster	None
Price	$11.99 / lb	$9.99 / lb	$10.99 / lb	
I would purchase				

Scenario 10

Attribute	Farm- raised Freshwater Prawn Count: 23-45	Wild-caught Marine Shrimp Count: 23-45	Wild-caught Marine Lobster	None
Price	$11.99 / lb	$13.99 / lb	$6.99 / lb	
I would purchase				

Scenario 11

Attribute	Farm- raised Freshwater Prawn Count: 23-45	Wild-caught Marine Shrimp Count: 23-45	Wild-caught Marine Lobster	None
Price	$13.99 / lb	$7.99 / lb	$12.99 / lb	
I would purchase				

Scenario 12

Attribute	Farm- raised Freshwater Prawn Count: 23-45	Wild-caught Marine Shrimp Count: 23-45	Wild-caught Marine Lobster	None
Price	$13.99 / lb	$11.99 / lb	$8.99 / lb	
I would purchase				

Demographic Information

9. What is the closest you have ever lived (all prior residences) to a coastal area? Check one.

____ Within 0-10 miles ____ 50-100 miles
____ 10-50 miles ____ > 100 miles

10. In what year you were born? _____

11. What is your gender? Check one. Male ____ Female ____

12. Please indicate the number of household members in each age group, including yourself.

____ 0-10 yrs. ____ 11-20 yrs. ____ 21-40 yrs.
____ 41-60 yrs. ____ 61 yrs. or above

13. What is the highest level of education you have achieved?

____ Less than high school
____ High school diploma or GED
____ Some college
____ Completed 2-year college degree
____ Completed 4-year degree (B.A. or B.S.)
____ Education beyond B.A. or B.S.

14. Please indicate your religious affiliation. Check one.

____ Catholic
____ Buddhist
____ Other
____ Jewish
____ Hindu
____ Muslim
____ Christian (Non-Catholic)

15. Please indicate your annual household income. Check one.

____ 0 - $25,000
____ $25,000 - $50,000
____ $50,000 - $75,000
____ $75,000 - $100,000
____ More than $100,000

16. Which of the following groups represents your ethnic background?

____ Black/African American
____ Native American
____ Hispanic
____ Caucasian
____ Asian or Pacific Islander
____ Other

You are now finished with the survey.

We would like to thank you for your time in completing this survey.

Please return the survey in the enclosed postage paid envelope.

If you have any questions about the survey, please contact Dr. Hanson or Ms. Gallardo at (662) 325-4990.

Mississippi State University

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