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## Consumer attitudes and acceptability of catfish prepared in a lowat manner

Amanda Emad Al-Turk

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CONSUMER ATTITUDES AND ACCEPTABILITY OF CATFISH PREPARED IN  
A LOW-FAT MANNER

By

Amanda Emad Al-Turk

A Thesis  
Submitted to the Faculty of  
Mississippi State University  
In Partial Fulfillment of the Requirements  
for the Degree of Master of Science  
in Nutrition  
in the Department of Food Science, Nutrition, and Health Promotion

Mississippi State, Mississippi

May 2007

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A LOW-FAT MANNER

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PREPARED IN A LOW-FAT MANNER

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Consumption of farm-raised catfish in the United States has increased over the last few decades. However, consumers usually prefer it as a deep-fried product, especially in the southern United States. The objective of this cross-sectional study was to determine the acceptability of low-fat baked catfish using a Central Location Test. Subjects (n=137) tasted, compared, and evaluated samples of low-fat baked catfish and deep-fried catfish. Results indicated that the fried product was favored ( $p < 0.05$ ) over the baked product. The majority of subjects (93.4%) identified the baked product as the healthier choice. Most subjects (85.7%) indicated that catfish was an overall healthy food choice. Reasons for consuming catfish included taste (75.6%), convenience (15.1%), health reasons (7.6%), and cost (1.7%). The majority of subjects (63.8%) indicated that they normally consumed catfish as a deep-fried

product, but 91.9% indicated that they would be willing to consume catfish prepared in a low-fat manner.

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## CHAPTER I

### INTRODUCTION

Overweight and obesity rates are growing in epidemic proportions worldwide and within the United States. The World Health Organization estimates that there are more than 1 billion overweight adults, and that at least 300 million are obese (WHO, 2000). Currently, 66.3% of adults in the United States are considered overweight, 32.2% obese, and 4.8% extremely obese (Ogden et al., 2006). Being overweight or obese increases a person's risk for developing chronic diseases such as coronary artery disease, Type 2 Diabetes Mellitus, hypertension, hyperlipidemia, metabolic syndrome, and certain types of cancer (National Heart, Lung, and Blood Institute, 1998).

Consuming foods that are high in saturated and trans-fatty acids, such as many fried foods, have been linked to the leading causes of morbidity and mortality (Capps, Cleveland and Park, 2002), such as coronary heart disease and diabetes (Hu, Manson, and Willett, 2001). Dietary recommendations include reducing the intake of saturated and trans-fatty acids and replacing them with more heart healthy fats such as monounsaturated and polyunsaturated fatty acids (Hu, Manson, and Willett, 2001). Of particular interest to researchers has been the role of omega-3 and omega-6 fatty acids

in the reduction of cardiovascular disease. Since fish is a good source of polyunsaturated fatty acids, especially omega-3 fatty acids, the American Heart Association recommends eating at least two, three-ounce servings of fish per week. They also recommend grilling, baking or poaching fish instead of frying in order to achieve maximum health benefits (American Heart Association, n.d.).

Consuming farm-raised catfish, along with other positive lifestyle factors, has been shown to have many positive health benefits. Farm-raised catfish is low in kilocalories, total fat, saturated fat, and is a good source of lean protein. Although it does not contain high amounts of omega-3 fatty acids as some fattier fish, such as salmon, the same cardioprotective benefits are still produced. However, many people, especially in the southern region of the United States, traditionally consume catfish that has been deep-fried. The objective of the current study was to determine which preparation method of catfish consumers preferred as well as their willingness to consume catfish prepared in a low-fat manner.

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CHAPTER II  
CONSUMER ATTITUDES AND ACCEPTABILITY OF CATFISH PREPARED IN A  
LOW-FAT MANNER

**Abstract**

Consumption of farm-raised catfish in the United States has increased over the last few decades. However, consumers usually prefer it as a deep-fried product, especially in the southern United States. The objective of this cross-sectional study was to determine the acceptability of low-fat baked catfish using a Central Location Test. Subjects (n=137) tasted, compared, and evaluated samples of low-fat baked catfish and deep-fried catfish. Results indicated that the fried product was favored ( $p < 0.05$ ) over the baked product. The majority of subjects (93.4%) identified the baked product as the healthier choice. Most subjects (85.7%) indicated that catfish was an overall healthy food choice. Reasons for consuming catfish included taste (75.6%), convenience (15.1%), health reasons (7.6%), and cost (1.7%). The majority of subjects (63.8%) indicated that they normally consumed catfish as a deep-fried product, but 91.9% indicated that they would be willing to consume catfish prepared in a low-fat manner.

## **Introduction**

The consumption of farm-raised channel catfish has dramatically increased over the last few decades. The catfish industry in the United States began commercial production in the 1970's and has continued to expand. Nationally, per-capita consumption of catfish has increased from 0.32 kilogram (kg) in 1990 to 0.50 kg in 2004 (National Fisheries Institute, 2004). The state of Mississippi ranks second, behind Arkansas, in per-capita consumption of catfish (Dean, Hanson, and Murray, 2002). This increase may be partially attributed to statements issued by the American Heart Association (AHA) which recommend consumption of fish as part of a healthy diet (AHA, n.d).

Research has shown that the polyunsaturated fatty acids (PUFAs) in fish are responsible for reducing the risk of coronary heart disease. Bang, Dyerberg, and Nielsen (1971) first made the connection between omega-3 fatty acids and reduced risk of coronary heart disease in their classical nutrition study of Greenland Eskimos. They observed plasma lipid and lipoprotein levels to be much lower in the Eskimo population as compared to Westerners (Bang, Dyerberg and Nielsen, 1971). Further studies have shown the link between omega-3 fatty acids and reduced risk of sudden cardiac death (Albert et al., 1998), thrombosis (Akoh and Heansberger, 1991), and decreased blood pressure (Mozaffarian, Gottdiener, and Siscovick, 2006). In order to receive the maximum benefits of fish, the fish should be prepared in a low-fat manner, such as baking or grilling, instead of deep frying.

The objective of the current study was to determine which method of preparation of catfish consumers preferred as well as their willingness to consume catfish prepared in a low-fat manner.

## Literature Review

### *Ictalurus punctatus*

The most common species of farm-raised channel catfish in the United States is *Ictalurus punctatus*, which is a member of the Ictaluridae family in the Siluriformes order. This species of fish is native to North America, and can be found naturally between the Rocky and Appalachian Mountains, and from the Hudson Bay drainage south to the Gulf of Mexico (Mississippi State University Extension Service, n.d.). They are cultured specifically for commercial production within the United States and abroad (Wellborn, 1988). This species of fish is well-suited for consumer consumption due to its mild flavor and lack of “fishy” odor (Van der Ploeg, 1991).

Farm-raised catfish are raised in a controlled environment, in clay-based ponds that have fresh water filtered and pumped by aquifers (The Catfish Institute, n.d.). The catfish are fed a specially formulated diet that is nutritionally complete, ensuring adequate growth, reproduction, and health. The feed is comprised of puffed, high-protein food pellets made of a mixture of soybeans, corn, wheat, vitamins, and minerals. Farm-raised catfish consume the pellets as they float to the top of the water’s surface, unlike bottom-feeding wild catfish. This contributes to an overall healthier and milder tasting fish (The Catfish Institute, n.d.). Farm raising catfish also produces a consistent, high quality product that is available year round (Hanson, Dean, and Spurlock, 2004).

Catfish harvesting begins once the fish reach approximately 18 months of age. At this point, they weigh an average of 0.45 to 0.68 kg, and are harvested in large weighted



nets known as seines (The Catfish Institute, n.d.). Complete processing of catfish then takes less than thirty minutes. The fish are kept alive until they are processed. They are cleaned, processed, and kept on ice or frozen to -40°F until they are sold (The Catfish Institute, n.d.).

### **Farm-raised Channel Catfish in Mississippi**

The catfish industry in Mississippi began in the late 1960's and has been a significant contributor to the state's economy. Most of the catfish were harvested by commercial fisherman in the area and sold at local markets. Mississippi farmers who were growing soybeans and cotton were looking to diversify, and the catfish industry began to emerge. In 1973, there were 8929 hectares of catfish ponds in Mississippi that were being used for food production and 1107 hectares of ponds for fingerling production. As of 2002, there were 40,863 hectares of water used for catfish harvesting (Dean, Hanson, and Murray, 2002). Approximately 20% of these ponds are located in Humphreys County, which has come to be known as "The Catfish Capital of the World" (USDA NASS, 2005). In 2001, farmers in Mississippi sold 173 million kg of farm-raised catfish to processing plants, accounting for approximately 64% of farm-raised catfish processed in the United States (Dean, Hanson, and Murray 2002). The United States National Agricultural Statistics Services (USDA NASS, 2005) reported that 58% of the total catfish producers in the United States were located in Mississippi.

Dean et al. (2001) reported that net sales of processed farm-raised catfish in the United States totaled \$669 million. The state of Mississippi accounted for more than half

of this revenue totaling \$435 million in 2001. These revenues have served to boost the economy of the rural Mississippi Delta region which has higher mortality rates on average than the nation as a whole due to chronic diseases such as heart disease, diabetes, and cancer (Pickle, Mungiole, Jones, and White, 1997).

Most of the catfish processing plants in Mississippi are located in the Delta Region from Tunica to Yazoo County, and in Noxubee and Kemper Counties in eastern Mississippi (Dean, Hanson, and Murray, 2002). The Catfish Institute (TCI), located in Belzoni, Mississippi, has developed stringent criteria for certifying U.S. farm-raised catfish processing plants. As of 2006, 10 out of the 15 plants certified by TCI are located in Mississippi (The Catfish Institute, n.d.). Approximately 3600 workers are employed in catfish processing plants across the state. Combined with the 3000 that are employed on catfish farms, and the 330 in feed mills, the catfish industry employs nearly 7000 Mississippians, with a total payroll that exceeds \$102 million (Dean, Hanson, and Murray 2002). The farm-raised catfish industry has had a tremendous impact on the economy and employment within the state of Mississippi.

Consumption of farm-raised catfish has increased hand-in-hand with the increase in production. In 1998, total consumption of farm-raised catfish in the United States was 128 million kg. National annual per capita consumption increased from 0.49 kg in 2000 to 0.52 kg in 2001 (Hanson, Dean, and Spurlock 2004). Mississippians were the second largest consumers of farm-raised catfish behind Arkansans, consuming 2.1 kg per capita, well above the national average (Dean, Hanson, and Murray 2002). Catfish consumption accounted for more than 20% of overall per capita consumption of fresh and frozen

finfish, and is ranked third in per capita consumption of fresh and frozen finfish after Alaskan pollock and salmon (Hanson, Dean, and Spurlock 2004). On the National Marine Fisheries Service Top Ten list, catfish has consistently ranked fifth since 1998. Moreover, marketing strategies such as the promotion of different cooking methods of catfish other than traditional deep frying as well as the health benefits of fish consumption are being evaluated to further increase the consumption of farm-raised catfish within the United States (Hanson, 2002).

### **Health Benefits of Fish Consumption**

As the number of overweight and obese individuals in the United States increases, it becomes vitally important for the catfish industry to market farm-raised catfish as part of a healthy, balanced diet. Many consumers, especially in the southern region of the United States, traditionally consume catfish that has been deep-fried; however, the consumption of fried foods has been shown to have adverse health effects. Conversely, baked, broiled, and blackened fish have many positive health associations. Along with other positive lifestyle factors, such as a healthy diet and exercise, the consumption of fish can aid in the prevention of certain chronic diseases. There are many health benefits associated with the intake of fish. Catfish naturally is a very healthy food choice that is low in calories, total fat, saturated fat, and cholesterol. The United States Department of Agriculture Nutrient Database reports the following nutrition composition per 100 grams of raw farm-raised channel catfish: 135 kilocalories, 7.59 g of total fat, 1.77 g of saturated fat, and 47 mg of cholesterol. Farm-raised channel catfish is also an excellent

source of lean protein, containing 15.55 g of protein per 100 g (USDA National Nutrient Database for Standard Reference, n.d.).

Many of the beneficial effects of fish consumption can be attributed to the high levels of polyunsaturated fatty acids (PUFA) in the fish. PUFAs can be divided into two categories, depending on the location of the first double bond. Omega-3 fatty acids have the first double bond on the third carbon molecule from the methyl end of the fatty acid, whereas omega-6 fatty acids have the first double bond located on the sixth carbon molecule. Omega-3 fatty acids have been shown to reduce the risk of heart disease, lower blood pressure and heart rate, as well as improve other risk factors for developing cardiovascular disease (Mozaffarian and Rimm, 2006). Docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA) are two omega-3 fatty acids. DHA is important for brain development and function for the fetus during pregnancy and in children during infancy (Mozaffarian and Rimm, 2006), and EPA has antiaggregatory effects that may help to prevent thrombosis and hemostasis (Akoh and Hearnberger, 1991). Linoleic acid is the most prevalent omega-6 fatty acid in humans, and has been shown to lower plasma cholesterol levels (Horrobin and Huang, 1987). Both omega-3 and omega-6 fatty acids have been linked to overall reductions in plasma fibrinogen concentrations as well (Radack, Deck, and Huster, 1990).

There is much variation in the data published concerning the fat content of farm-raised catfish. Fat content may be related to differences in diet, genetic variability, and season (Nettleton et al., 1990; Robinson, Li, and Oberle, 2001). Moreover, there are several differences in PUFA levels between farm-raised catfish and wild catfish

(Chanmugam, Boudreau, and Hwang, 1986). The United States Department of Agriculture Nutrient Database reports 0.16 g of omega-3 fatty acids and 0.21 g of omega-6 fatty acids per 100 g of farm-raised channel catfish. Nettleton et al. (1990) found similar results. They reported that the total omega-3 fatty acid composition was 2.5% of the total fatty acids, or 0.16 g per 100 g of farm-raised channel catfish. For channel catfish in the wild, the Nutrient Database reports 0.23 g of omega-3 and 0.23g of omega-6 fatty acids per 100 g. Chanmugan, Boudreau, and Hwang (1986) found total omega-6 PUFA levels to be higher in farm-raised channel catfish, whereas total PUFA levels, total omega-3 PUFA levels, and omega-3/omega-6 ratio to be higher in wild catfish. Although catfish is lower in omega-3 fatty acids than other fattier fish, such as salmon, a study by Tidwell et al. (1993) reported that the incorporation of both catfish and salmon into the diet lowered lipid levels in men. However, there was not a statistical difference in total cholesterol, LDL-C, HDL-C, and triglyceride levels between those who consumed catfish and those who consumed salmon.

Research has shown that the polyunsaturated fatty acids, especially omega-3 fatty acids, in fish may help decrease the risk of cardiovascular disease. The Tromso Study reported that consistent, long-term consumption of fish has beneficial effects on cardiovascular health such as lowering of total cholesterol and triglyceride levels (Bonaa, Bjerve, and Norday, 1992). A study conducted by Akoh and Hearnberger (1991) found a 66% increase in bleeding time and a 25% increase in blood clotting time, which may lower the risk for thrombosis, in subjects who were fed a controlled diet of farm-raised catfish.

Albert et al. (1998) found that men who ate at least 1 fish meal per week, defined as low to moderate fish intake, had a 52% lower risk of sudden cardiac death as compared to those who consumed fish less than once a month. Moreover, any intake of omega-3 fatty acids in fish, along with other positive lifestyle factors, was associated with a decreased risk of sudden cardiac death (Albert et al., 1998). Fish intake, when broiled or baked, has also been associated with lower heart rate, lower systolic, diastolic, and mean blood pressures, and lower stroke volume ratio (Mozaffarian, Gottdiener, and Siscovick, 2006). However, when fish were fried, there was not an association with heart rate, differences in blood pressure were less significant, and a lower cardiac output was observed. Fried fish intake was also positively associated with higher body mass index (BMI) and higher prevalence rates of diabetes and coronary heart disease (Mozaffarian, Gottdiener, and Siscovick, 2006). An additional study by Mozaffarian et al. (2003) reported positive associations between the intake of fried fish and new-onset of myocardial infarction, atrial fibrillation, and congestive heart failure. Both the National Health and Nutrition Examination Survey (NHANES) Epidemiological Follow-up Study and Nurses' Health Study showed a reduced risk for stroke as fish consumption increased (Kris-Etherton, Harris, and Appel, 2002).

Although fish consumption has been linked to reducing the risks of developing cardiovascular disease, there are possible risks associated with fish consumption. Many species of fish contain mercury which can affect the developing nervous system of infants (Torpy, Lynn, and Class, 2006). Farm-raised channel catfish is categorized jointly by the Food and Drug Administration (FDA) and the Environmental Protection

Agency (EPA) as a fish with “Lower Levels of Mercury.” They report a 0.05 ppm concentration of mercury in catfish (FDA b, 2001).

For women who may become pregnant, are pregnant, or are nursing mothers, and small children, the FDA and EPA recommend eating up to 12 ounces (an average of 2 fish meals) of fish per week that are lower in mercury, an amount that has been shown to still enable the consumer to receive the health benefits of the fish (FDA a, 2004). Other chemicals such as dioxins and polychlorinated biphenyls (PCBs) can accumulate in fish, but are present in very low levels in catfish, especially farm-raised catfish (Torpy, Lynn, and Class, 2006). Overall, the health benefits of catfish consumption far outweigh the potential risks.

Studies that have reported the health benefits of fish consumption have led to recommendations to increase fish consumption. The American Heart Association recommends eating at least two servings of fish per week. A serving of fish is equal to approximately three ounces. They also recommend grilling, baking, or poaching fish instead of frying (AHA, n.d.). Grilled or baked fish is lower in kilocalories and contains less total fat and saturated fat than its fried counterpart. Catfish cooked with dry heat has approximately 152 kilocalories, 8.02 g of total fat, and 1.79 g of saturated fat per 100g, compared to 229 kilocalories, 13.33 g of total fat, and 3.29 g of saturated fat per 100 g of breaded, fried catfish (USDA National Nutrient Database, n.d.).

The FDA has issued a health claim regarding a reduced risk of coronary heart disease when foods are consumed that contain the omega-3 fatty acids DHA and EPA (FDA a, 2004) As more research supporting the health benefits of PUFAs have been

published, recommendations of EPA and DHA consumption have increased from 0.1- 0.2 g per day to 0.65 g per day (Kris-Etherton et al., 2000). The recommended ratio of omega-6 to omega-3 fatty acids is 2.3:1. As of 2000, intake of PUFAs contributed approximately 7% of total energy intake and 19-22% of energy intake from fat in the diets of American adults. Linoleic acid is the major PUFA consumed, accounting for 84-89% of total PUFA intake, whereas EPA and DHA only account for < 2% ( $\leq 0.2$  g per day) (Kris-Etherton et al., 2000). In order to achieve the recommendations for omega-3 fatty acids, in regards to grams per day as well as the omega-6:omega-3 ratio, EPA and DHA should be increased and omega-6 fatty acids should be decreased in the diet (Kris-Etherton, 2000).

### **Consumer Attitudes and Preferences Regarding Catfish**

As consumers become more aware of the health benefits of fish consumption, it is important to understand their attitudes and preferences concerning fish, especially for marketing purposes. In 1988, the Southern Regional Aquaculture Center conducted a marketing survey to determine consumer demographics, attitudes, perceptions, consumption and purchasing habits of farm-raised catfish (Engle, 1998). The survey reported demographic breakdown of catfish consumers as follows: more than 83% were Caucasian, 10% were African-American, and 5% were in other non-white categories, with Hispanics comprising the smallest percentage of consumption. Household income was also examined as an indicator of catfish consumption. The largest consumer group (20%) resided in the \$20,000 to \$30,000 income category, followed by 13% in the



\$50,000 and over category. Those households who reported incomes less than \$10,000 consumed the least amount of catfish.

Consumers' attitudes towards a certain product are a vital determinant in food consumption patterns. Attitude can be defined as a "psychological tendency that is expressed by evaluating a particular entity (e.g. a food product) with some degree of favor-disfavor, like-dislike, satisfaction-dissatisfaction, or good-bad polarity" (Eagley and Chaiken, 1993). When examining seafood in general, including fish, consumption is driven more by moral obligation and health involvement rather than taste and preference (Olsen, 2004). Kinnucan and Venkateswaran (1990) reported flavor and pond culture as the most important determinants of attitudes. However, a more recent study reported that flavor, followed by nutrition and no fishy odor were the most important factors influencing consumers' attitudes towards eating catfish (Hanson, 2002).

Although most consumers agree that fish is healthy, there is still much variation among groups in terms of fish consumption. In a 2000-2001 survey, the majority of catfish consumers were female (60.5%), and 59.8% were 50 years or older (House et al., 2003). This supports Olsen's hypothesis that "age is positively related to health involvement, which has a positive influence on seafood consumption behavior" (Olsen, 2003). Knowing consumer attitudes is important for marketing catfish as a healthy diet choice.

There are also many reasons cited for the consumption as well as non-consumption of catfish. House et al. (2003) reported that catfish consumers ate catfish for the following reasons: enjoyment of flavor (68%), health and nutrition (31%), and

addition of variety to diet (22%). Some of the reasons for not eating catfish more often included: price (22%), lack of fresh product availability (16%), lack of preparation knowledge (14%), and time-consuming preparation (13%). For those who did not eat catfish, the predominate reason for not consuming catfish was taste, followed by texture, smell, and lack of preparation knowledge (House et al., 2003).

## **Materials and Methods**

### **Data Collection**

Participants were verbally recruited for this study from patrons of the Perry Cafeteria at Mississippi State University. Approval for this study was obtained from the Institutional Review Board (IRB) at Mississippi State University (Appendix A) Informed consent was received from each participant (Appendix B). Each subject was given two samples of catfish to taste: a grilled product and a deep-fried product. All samples were Mississippi farm-raised catfish prepared by staff at the Perry Cafeteria. The samples were cooked to an internal temperature of 60°C and held in chafing dishes until sampling time. Participants were then asked to complete an acceptability test on the two samples (Appendix C) as well as a survey asking questions concerning eating habits and preferences of catfish (Appendix D).

### **Consumer Acceptability**

Consumer acceptability was evaluated using a Central Location Test on three separate occasions and at different meal times of the day. Consumers (n=50 each day) evaluated the two samples in the lobby of the Perry Cafeteria. Samples were assigned three digit random numbers and placed in five and a half ounce serving cups (Sweetheart Corporation, Owings Mills, MD). Consumers evaluated each sample using a hedonic scale ranging from 1 (dislike extremely) to 9 (like extremely). They were also questioned

as to which product they perceived to be the healthiest as well as likeliness of purchasing if the product had an added health benefit.

### **Data Analysis**

Data were analyzed using SAS (version 9.1.2, 2005, SAS Institute Inc., NC, USA). Subjects (n=137) who completed all parts of the survey were included in the analysis. A randomized complete block design with three replications was used to determine if differences existed within each treatment among replications. A randomized complete block design using panelists as blocks was also used to determine if differences existed among the baked and catfish samples. When significant differences ( $p < 0.05$ ) occurred among treatments, the Least Significant Differences (LSD) Test was utilized to separate treatment means. Consumers were then clustered based on demographic information. The same statistical analysis was repeated within each demographic classification.

Agglomerate hierarchical clustering was performed using Ward's Method to cluster consumers together based on their preference and liking of catfish treatments. A dendrogram and a dissimilarity plot were used to determine how many clusters should be utilized to group together consumers. After this cluster analysis was performed, randomized complete block designs were utilized to determine differences ( $P < 0.05$ ) among treatments within each cluster. When significant differences occurred for a response ( $P < 0.05$ ) within each cluster, the Least Significant Distance Test was performed to separate treatment means.

## Results

This study investigated the attitudes and acceptability of consumers to consume catfish prepared in a low-fat manner (e.g. baked, broiled, or grilled) versus the traditional deep-fried manner. Of the 150 subjects that informed consent was obtained from, thirteen were excluded from the study due to incomplete surveys. The study sample was comprised of 137 subjects. The majority of subjects were Caucasian males between the ages of 18 and 29. Table 1 shows the demographic characteristics of the subjects.

Overall acceptability data for the study are shown in Table 2. The fried sample was preferred ( $p < 0.05$ ) significantly over the baked sample; however, the majority of subjects indicated that the baked sample was the healthiest. The fried and baked products were given mean acceptability scores of 8.1 and 7.6, respectively, on a 9-point hedonic scale with (1= dislike extremely, 5= neither like nor dislike, and 9= like extremely). Panelists indicated that both the fried and baked products would be purchased if there was an added health benefit, but one was not statistically favored over the other. These findings remain the same when analyzed according to gender (see Table 3).

Table 4 indicates that both Caucasians and African Americans preferred ( $p < 0.05$ ) the fried fish over the baked fish. The Hispanic subject, the Native Americans, and the Other group scored the fried fish slightly higher but it was not significant ( $p > 0.05$ ), whereas the Asian subjects ranked them the same.

When looking at preferences according to age (Table 5), there were no statistical differences in overall acceptability of the products, except in the youngest age group. The majority of subjects were between the ages of 18 and 29. The youngest group was the

only group who preferred ( $p < 0.05$ ) the fried fish over the baked fish. However, they were the only age group that perceived the baked fish to be healthier ( $p < 0.05$ ) than the fried fish. This could be due in part to the large sample size of the youngest age group.

Of the 137 subjects who were included in the sample, most consumed catfish monthly. No participants reported consuming catfish daily or never consuming catfish. Table 6 shows the catfish consumption habits of participants. The majority (72.4%) consumed catfish from a restaurant instead of preparing it at home (27.6%). Reasons for eating catfish included taste (75.6%), convenience (15.1%), health reasons (7.6%), and cost (1.7%). Although the majority (63.8%) of subjects normally ate deep-fried catfish, 91.9% of participants indicated that they would be willing (59.7% very likely and 32.2% somewhat likely) to consume catfish prepared in a low-fat manner. Over 36% of subjects were already eating catfish prepared in a low-fat manner such as baked (10.7%), blackened (13.2%), or grilled (12.3%). Only 3.2% of participants indicated that they would be very unlikely to eat catfish that was grilled, baked, or blackened. The majority (81.6%) of subjects indicated that catfish was a healthy food choice.

Table 7 shows acceptability scores according to different clusters of participants. Cluster 1 (7.3% of panelists) preferred ( $p < 0.05$ ) the fried fish sample. Cluster 2 (2.9% of consumers) preferred ( $p < 0.05$ ) the baked fish. Cluster 3 included 11.7% of the consumers, which preferred ( $p < 0.05$ ) the baked fish over the fried fish. Cluster 4 (7.3% of the panelists) liked neither the fried nor the baked fish. Cluster 5 (10.9% of consumers) preferred ( $p < 0.05$ ) the fried fish. Cluster 6, which comprised 12.4% of participants, preferred ( $p < 0.05$ ) the fried fish. Cluster 7 (20.4%) preferred ( $p < 0.05$ ) the baked

sample, and Cluster 8 (26.3%) preferred ( $p < 0.05$ ) the fried sample. These results reveal that overall, 57% of participants preferred fried catfish, over one-third (35%) preferred baked catfish, and 8% had no preference as to which preparation method was used.

Table 1. Demographics of Catfish Panelists

	<b>Percentages</b>
<b>Age</b>	
18-29 years	63.2%
30-49 years	18.4%
50+ years	18.4%
<b>Gender</b>	
Male	60.2%
Female	39.8%
<b>Ethnicity</b>	
Caucasian	76.0%
African-American	16.8%
Hispanic	0.8%
Asian/Island Pacific	1.6%
Native American	1.6%
Other	3.2%



Table 2. Mean Consumer Acceptability Scores of Fried and Baked Catfish

Treatment	Overall Acceptability <sup>1</sup>	Healthiest <sup>2</sup>	Health Benefits <sup>3</sup>
Fried	8.1 <sup>a</sup>	0.1 <sup>a</sup>	0.9 <sup>a</sup>
Baked	7.6 <sup>b</sup>	0.9 <sup>b</sup>	0.9 <sup>a</sup>
Standard Error	0.09	0.04	0.02

<sup>a-b</sup>Means with the same letter within each column are not significantly different ( $P > 0.05$ ).

<sup>1</sup> Hedonic scale was based on a 9-point scale (1= dislike extremely, 5= neither like nor dislike, and 9= like extremely);

each consumer tasted one catfish nugget for each treatment.

<sup>2</sup>“Which product do you think is the healthiest?” Responses were coded (0= no; 1= yes)

<sup>3</sup>“Would you buy this product if it had an added health benefit?” Responses were coded (0= no; 1= yes)

Table 3. Mean Consumer Acceptability Scores of Fried and Baked Catfish According to Gender

Gender Treatment	Consumer Acceptability Scores		
	Overall Acceptability <sup>1</sup>	Healthiest <sup>2</sup>	Health Benefits <sup>3</sup>
<b>Male</b>			
Fried	7.9 <sup>a</sup>	0.2 <sup>a</sup>	0.9 <sup>a</sup>
Baked	7.5 <sup>b</sup>	0.8 <sup>b</sup>	0.8 <sup>a</sup>
Standard Error	0.14	0.06	0.04
<b>Female</b>			
Fried	8.3 <sup>a</sup>	0.1 <sup>a</sup>	0.9 <sup>a</sup>
Baked	7.6 <sup>b</sup>	0.9 <sup>b</sup>	0.9 <sup>a</sup>
Standard Error	0.12	0.06	0.04

<sup>a-b</sup>Means with the same letter within each column are not significantly different (P>0.05).

<sup>1</sup> Hedonic scale was based on a 9-point scale (1= dislike extremely, 5= neither like nor dislike, and 9= like extremely);

each consumer tasted one catfish nugget for each treatment.

<sup>2</sup>“Which product do you think is the healthiest?” Responses were coded (0= no; 1= yes)

<sup>3</sup>“Would you buy this product if it had an added health benefit?” Responses were coded (0= no; 1= yes)

Table 4. Mean Consumer Acceptability Scores of Fried and Baked Catfish According to Race

Treatment	Consumer Acceptability Scores <sup>1</sup>					
	Caucasian	African-American	Hispanic	Native American	Asian	Other
Fried	8.1 <sup>a</sup>	8.5 <sup>a</sup>	9.0 <sup>a</sup>	8.5 <sup>a</sup>	7.5 <sup>a</sup>	7.0 <sup>a</sup>
Baked	7.6 <sup>b</sup>	7.6 <sup>b</sup>	6.0 <sup>a</sup>	8.0 <sup>a</sup>	7.5 <sup>a</sup>	6.8 <sup>a</sup>
Standard Error	0.10	0.18	NA <sup>b</sup>	0.35	0.71	1.20

<sup>a-b</sup>Means with the same letter within each column are not significantly different ( $P > 0.05$ ).

<sup>1</sup> Hedonic scale was based on a 9-point scale (1= dislike extremely, 5= neither like nor dislike, and 9= like extremely); each consumer tasted one catfish nugget for each treatment.

Table 5. Mean Consumer Acceptability Scores of Fried and Baked Catfish According to Age

Age Group Treatment	Consumer Acceptability Scores		
	Overall Acceptability <sup>1</sup>	Healthiest <sup>2</sup>	Health Benefits <sup>3</sup>
18-29 years			
Fried	8.2 <sup>a</sup>	0.1 <sup>a</sup>	0.9 <sup>a</sup>
Baked	7.5 <sup>b</sup>	0.9 <sup>b</sup>	0.9 <sup>a</sup>
Standard Error	.10	.05	.03
30-49 years			
Fried	7.8 <sup>a</sup>	0.1 <sup>a</sup>	0.9 <sup>a</sup>
Baked	7.7 <sup>a</sup>	0.9 <sup>a</sup>	0.9 <sup>a</sup>
Standard Error	.22	.099	.07
50+ years			
Fried	8.0 <sup>a</sup>	0.3 <sup>a</sup>	0.9 <sup>a</sup>
Baked	7.8 <sup>a</sup>	0.7 <sup>a</sup>	0.9 <sup>a</sup>
Standard Error	.26	.13	.04

<sup>a-b</sup>Means with the same letter within each column are not significantly different (P>0.05).

<sup>1</sup> Hedonic scale was based on a 9-point scale (1= dislike extremely, 5= neither like nor dislike, and 9= like extremely);

each consumer tasted one catfish nugget for each treatment.

<sup>2</sup>“Which product do you think is the healthiest?” Responses were coded (0= no; 1= yes)

<sup>3</sup>“Would you buy this product if it had an added health benefit?” Responses were coded (0= no; 1= yes)

Table 6. Catfish Consumption Habits of Panelists

	<b>Mean Responses</b>
<b>How often do you eat catfish?</b>	
Weekly	24.2%
Monthly	52.4%
Rarely	23.4%
<b>Where do you usually eat catfish?</b>	
At home	27.6%
Restaurant	72.4%
<b>Reasons for Eating Catfish</b>	
Taste	75.6%
Cost	1.7%
Health Reasons	7.6%
Convenience	15.1%
<b>Usual Preparation Method</b>	
Deep-fried	63.8%
Baked	10.7%
Blackened	13.2%
Grilled	12.3%
<b>Willingness to consume catfish prepared in a low-fat manner</b>	
Very Likely	59.7%
Somewhat Likely	32.3%
Somewhat Unlikely	4.8%
Very Unlikely	3.2%
<b>Do you think catfish is a healthy food choice?</b>	
Yes	81.6%
No	6.4%
Not Sure	12.0%

Table 7. Mean Consumer Acceptability Scores of Baked and Fried Catfish According to Different Clusters of Segments Using a Hedonic Scale<sup>1</sup>

Cluster	Baked	Fried	Sample Size	Percentage of Panelists
Cluster 1	4.4 <sup>b</sup>	7.8 <sup>a</sup>	10	7.3%
Cluster 2	8.5 <sup>a</sup>	5.3 <sup>b</sup>	4	2.9%
Cluster 3	8.4 <sup>a</sup>	7.0 <sup>b</sup>	16	11.7%
Cluster 4	6.4 <sup>a</sup>	6.7 <sup>a</sup>	10	7.3%
Cluster 5	6.9 <sup>b</sup>	9.0 <sup>a</sup>	15	10.9%
Cluster 6	7.0 <sup>b</sup>	8.0 <sup>a</sup>	17	12.4%
Cluster 7	8.5 <sup>a</sup>	8.0 <sup>b</sup>	28	20.4%
Cluster 8	8.3 <sup>b</sup>	9.0 <sup>a</sup>	36	26.3%

<sup>a-b</sup>Means with the same letter within each column are not significantly different ( $P>0.05$ ).

<sup>1</sup> Hedonic scale was based on a 9-point scale (1= dislike extremely, 5= neither like nor dislike, and 9= like extremely); each consumer tasted one catfish nugget for each treatment.

## Discussion

The escalating obesity epidemic in the United States is alarming. As more research continues to be conducted on the relationship between obesity and the increased risk of developing chronic disease, nutrition recommendations have changed to reflect new findings. Nutrition experts recommend the incorporation of heart healthy fats, such as monounsaturated and polyunsaturated fats, into the diet instead of unhealthier fats such as saturated and trans-fatty acids. Furthermore, omega-3 and omega-6 fatty acids are also being encouraged due to their cardioprotective effects. Since fish is an excellent source of these polyunsaturated fats, the American Heart Association recommends eating two servings of fish weekly (AHA, n.d.). In order to receive the maximal nutritional effects of fish, the fish should be prepared in a low-fat manner, such as baked, blackened, or grilled, instead of the traditional deep-fried method. This study examined which preparation methods consumers preferred, as well as their willingness to eat catfish prepared in such a manner.

Although the fried sample in this study was favored over the baked sample, subjects gave the baked fish a mean acceptability score of 7.6, which falls between “like moderately” and “like very much.” Even though about half (57%) preferred fried catfish, 35% of subjects preferred the baked catfish over the fried sample. Subjects were knowledgeable of the fact that baked catfish is healthier than deep-fried catfish. The majority (91.9%) of participants indicated that they would be willing (59.7% very likely and 32.2% somewhat likely) to consume catfish prepared in a low-fat manner.

In this study, subjects reported taste (75.6%), followed by convenience (15.1%), health reasons (7.6%), and cost (1.7%) as determinants of fish consumption. House et al. (2003) reported taste (68%) as the predominate factor influencing food choice, followed by nutrition (31%) and addition of variety to diet (22%). Both studies found taste to be the overwhelming deciding factor in catfish consumption. Kinnucan and Venkateswaran (1990) also reported similar results, whereas Olsen (2004) believed fish consumption to be driven more by moral obligation and health involvement rather than taste and preference. However, in this study, even though the majority of participants indicated that the baked product was healthier than the fried product, 63.8% of participants usually consumed catfish that was deep-fried. This implies taste, not health, was the top factor influencing food choice.

Differences across demographic groups also existed. Both the Caucasian and African American groups significantly preferred the fried fish over the baked fish, whereas there were no significant differences among other groups. This may be due to the small sample size in all groups except the Caucasian and African American groups. When examining age, the youngest group was the only group to significantly prefer the fried fish, even though they were the only age group to perceive the baked fish to be significantly healthier than the fried fish. Again, this may be due to small sample size in all groups except the youngest group.

There were some limitations to this study including limited diversity within the sample. The sample was comprised mainly of caucasian males between the ages of 18 and 29. Many population groups were underrepresented. Also, since testing occurred on



three separate occasions and at different meal times, there may have been some variation in the products due to human error. Testing of samples in a controlled environment would decrease this variability.

Even though catfish consumption has increased, further research should be conducted to determine exactly why fried fish is preferred over baked fish as well as ways to encourage consumers to consume catfish prepared in a low-fat manner. Marketing strategies should be aimed at highlighting the health benefits of fish as well as ways to prepare fish in a low-fat manner. As consumers become more aware of these benefits, they will be more likely to consume catfish that has been prepared in a low-fat manner.

## **Conclusion**

Farm-raised catfish is a healthy diet choice since baked, blackened, or grilled catfish is low in kilocalories, total fat, saturated fat, and a good source of lean protein. Results from this study indicate that consumers are willing to eat catfish prepared in both a low-fat or traditional deep-fried method. Marketing strategies should be aimed at ways to incorporate baked, blackened, or grilled fish into the diet, as well as increasing awareness of the health benefits of fish prepared in a low-fat manner. These benefits include risk reduction of cardiovascular disease, including myocardial infarction, congestive heart failure, stroke, and atrial fibrillation. For these reasons, organizations such as the American Heart Association have issued recommendations to increase fish consumption (AHA, n.d.). Two fish servings per week are recommended to produce the aforementioned cardioprotective effects. Consuming fish prepared in a low-fat manner as part of a healthy diet may also be a key player in the reduction of obesity rates. Further research needs to be conducted concerning the relationship between fish consumption and healthy body weight.

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APPENDIX A  
IRB APPROVAL LETTER



August 3, 2006

Amanda Al-Turk  
209 Clements Avenue  
Starkville, MS 39759

RE: IRB Study #06-198: Consumer Attitudes and Acceptability of Catfish Prepared in a Low-Fat Manner

Dear Ms. Al-Turk:

The above referenced project was reviewed and approved via administrative review on 8/3/2006 in accordance with 45 CFR 46.101(b)(6). Continuing review is not necessary for this project. However, any modification to the project must be reviewed and approved by the IRB prior to implementation. Any failure to adhere to the approved protocol could result in suspension or termination of your project. The IRB reserves the right, at anytime during the project period, to observe you and the additional researchers on this project.

Please refer to your IRB number (#06-198) when contacting our office regarding this application.

Thank you for your cooperation and good luck to you in conducting this research project. If you have questions or concerns, please contact me at [jmiller@research.msstate.edu](mailto:jmiller@research.msstate.edu) or 325-5220.

Sincerely,

A handwritten signature in black ink that reads "Jonathan E. Miller".

Jonathan E. Miller  
IRB Administrator

cc: William Mikel

**Office of Regulatory Compliance**

P. O. Box 6223 • 8A Mergari Street • Mailstop 9563 • Mississippi State, MS 39762 • (662) 325-3294 • FAX (662) 325-8776



APPENDIX B  
CONSENT FORM

**Catfish Panel Consent Form**

**Title of Study: Consumer Attitudes and Acceptability of Catfish Prepared in a Low-Fat Manner**

**Study Site:** Mississippi State University Perry Cafeteria

**Name of Researcher(s) & University affiliation:**

Amanda Al-Turk, Mississippi State University Graduate Student  
Benjy Mikel, Professor and Head of Food Science, Nutrition & Health Promotion Department

**What is the purpose of this research project?**

The purpose of this research project is to determine which preparation methods of catfish consumers prefer as well as their willingness to eat catfish prepared in a low-fat manner.

**How will the research be conducted?**

The research will be conducted in two parts:

1. You will be given two samples of catfish prepared in different manners: one low-fat preparation method (grilled) and one high-fat method (deep fried) will be used. You will then be asked to do an acceptance test (SEE ATTACHED ACCEPTANCE TEST).
2. A survey will be given to you asking questions regarding your catfish eating habits as well as your attitude towards catfish as a healthy diet choice (SEE ATTACHED SURVEY).

**Are there any risks or discomforts to me because of my participation?** No

**Does participation in this research provide any benefits to others or myself?** We hope that results of this study will show that eating catfish prepared in a low-fat manner can be part of a healthy diet and that more people will choose catfish prepared in a low-fat manner instead of the traditional deep fried method.

**What are alternative procedures or courses of treatment that might be advantageous to me?** n/a

**Will this information be kept confidential?**

Yes, this information will be kept confidential. Names will only be attached to consent forms, which will be stored in a locked file cabinet in the Department of Food Science, Nutrition, and Health Promotion. These files will be retained for three years and then destroyed. Also, please note that these records will be held by a state entity and therefore are subject to disclosure if required by law

**Who do I contact with research questions?** If you should have any questions about this research project, please feel free to contact Dr. Benjy Mikel at 662-325-5508. For additional information regarding your rights as a research subject, please feel free to contact the MSU Regulatory Compliance Office at 662-325-5220.

**What do I do if I am injured at a result of this research?**

In addition to reporting an injury to Dr. Benjy Mikel at 662-325-5508 and to the Regulatory Compliance Office (662-325-5220), you may be able to obtain limited compensation from the State of Mississippi if the injury was caused by the negligent act of a state employee where the damage is a result of an act for which payment may be made under §11-46-1, et seq. Mississippi Code Annotated 1972. To obtain a claim form, contact the University Police Department at *MSU UNIVERSITY POLICE DEPARTMENT, Stone Building, Mississippi State, MS 39762, (662) 325-2121.*

**What if I do not want to participate?**

Please understand that your **participation is voluntary**, your **refusal to participate will involve no penalty or loss** of benefits to which you are otherwise entitled, and you **may discontinue your participation** at any time without penalty or loss of benefits.

You will be given a copy of this form for your records.

**THANK YOU FOR YOUR PARTICIPATION!**

\_\_\_\_\_  
Participant Signature

\_\_\_\_\_  
Date

\_\_\_\_\_  
Investigator Signature

\_\_\_\_\_  
Date

APPENDIX C

ACCEPTANCE TEST OF BAKED AND FRIED CATFISH SAMPLES

## CATFISH SURVEY

I am conducting research for my Master's thesis regarding consumer attitudes regarding catfish. Please taste the following two samples of catfish and answer the questions that follow. Your help is greatly appreciated!

**Product: Catfish**

Please rate catfish as follows:

Please taste each of the two (2) samples starting with the sample number on the left and continuing to the right.

Please expectorate the sample and rinse your mouth with water between samples.

Rate each sample for overall acceptability and place a check mark indicating your level of acceptability.

**OVERALL ACCEPTABILITY (LIKING)**

433	561	
		Like extremely
		Like very much
		Like moderately
		Like slightly
		Neither like nor dislike
		Dislike slightly
		Dislike moderately
		Dislike very much
		Dislike extremely

**WHICH PRODUCT DO YOU THINK IS THE HEALTHIEST?**

433	561

**WOULD YOU BUY THIS PRODUCT IF IT HAD AN ADDED HEALTH BENEFIT?**

433	
Yes	
No	

**WOULD YOU BUY THIS PRODUCT IF IT HAD AN ADDED HEALTH BENEFIT?**

561	
Yes	
No	

APPENDIX D

SURVEY

**Please read the following questions and indicate your response by placing a checkmark in the blank next to the appropriate response.**

1. How often do you eat catfish?

Daily     Weekly     Monthly     Rarely     Never  
(skip to Question 5)

2. Do you most often eat catfish that has been prepared at home or from a restaurant?

At home     Restaurant

3. Please check your main reason for eating catfish.

I like the taste.  
 The cost is reasonable.  
 It's a healthy food choice  
 It's readily available and convenient.

4. When you eat catfish, how do you prefer it to be prepared?

Deep-fried     Baked     Blackened     Grilled  
Other (please describe) \_\_\_\_\_

5. Please indicate your willingness to consume catfish prepared in a low-fat manner, such as grilled, baked or blackened?

Very likely  
 Somewhat likely  
 Neither Likely nor Unlikely  
 Somewhat Unlikely  
 Very Unlikely

6. Overall, do you think that catfish is a healthy food choice?

Yes     No     Not Sure

The following questions are asked for categorical purposes only:

7. What is your age group?

18 – 29     30 – 49     50 or older

8. What is your gender?

Male     Female

9. What is your ethnicity?

Caucasian     African-American     Hispanic  
 Asian/ Island Pacific     Native American     Other