

Market Development for Cultured North Carolina Sturgeon Meat

Project 13-ST-02

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Market development for cultured Russian sturgeon meat in eastern and central North Carolina

John Selden Burke, Barry Nash
PO Box 28 Marshallberg NC 28553, U.S.A.
252-808-5837, jsb28553@gmail.com

Abstract

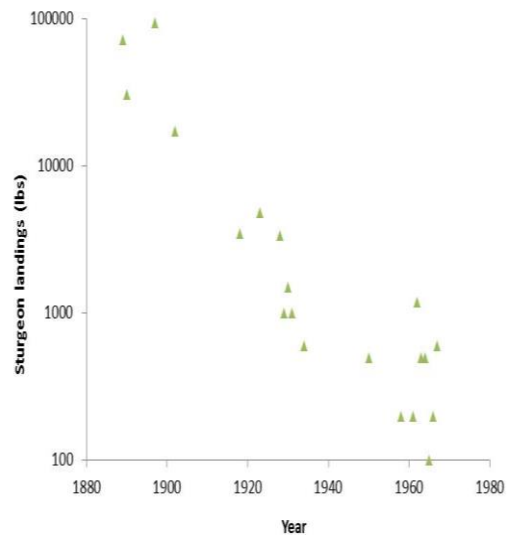
Consumer preferences for a variety of professionally prepared sturgeon dishes were profiled. Three sensory sessions were conducted in a fine-restaurant setting. During each session, participants from the local community were provided information on sturgeon biology and culture prior to evaluating the eating quality of a total of nine different culinary preparations. A minimum of one appetizer, a salad and an entree were sampled and scored on a Hedonic scale that ranged from “terrible” to “excellent.” Sturgeon dishes were consistently rated in the “good” to “excellent” range by both male and female participants. The sensory scores indicated baked and grilled preparations were preferred over steamed sturgeon and sturgeon meat that was flavored with relatively strong seasonings (teriyaki, blackened) were preferred over more delicately seasoned dishes.

Keywords: *Acipenser*; product introduction; market development; consumer preference

Introduction

Sturgeon are one of the most valuable of the fish families in the market because of the particularly high price consumers are willing to pay for their roe, better known as caviar. US sturgeon stocks were decimated by overfishing in the 19th century, and have not recovered, probably due to a combination of continued fishery mortalities, habitat destruction and pollution. The Atlantic and shortnose sturgeon are found in North Carolina coastal waters, and at the end of the 19th century there was still a fishery for them in the Cape Fear River (Fig. 1).

Figure 1. Sturgeon landings from the Cape Fear River 1880-1980.



Currently both North Carolina species are on the endangered species list. A consequence of the precarious condition of indigenous sturgeon populations is that this historically important commercial species is essentially unknown to consumers as fresh sturgeon has been unavailable for nearly 100 years.

Culturing sturgeon is economically feasible as some species grow rapidly in captive conditions. In addition to the high value of caviar derived from mature females, the quality of the meat of both sexes is highly valued in areas where it is available. The

commercial culture of domestic species, though technically feasible, is not an attractive option as their endangered status requires particularly tight regulation of any activity that potentially could impact wild populations. Also the international market recognizes Russian species as producers of the higher grades of caviar than our domestic species. Due to the internationally recognized quality of their roe, the Russian sturgeon (*Acipenser gueldenstadtii*), is currently cultured in North Carolina. The exotic status of the Russian sturgeon in the U.S. means that culture of the species is only permitted in indoor recirculated aquaculture systems, as this minimizes the possibility of their release to the wild. While this style of culture allows a high level of control of culture conditions, it is energetically costly compared to pond or natural raceway culture systems. In Russia, where commercial culture of this species is well developed, male sturgeon are harvested at two years and five to six pounds when their meat is considered best in terms of palatability. Females are not harvested until maturity (five to six years) as their roe makes caviar of particularly high quality (second only to that of the beluga sturgeon, *Huso huso*).

Currently two North Carolina businesses, Marshallberg Farm and La Paz Farm are culturing Russian sturgeon in indoor re-circulated aquaculture systems. Originally, business success for cultured Russian sturgeon depended solely on the production of caviar, a luxury product for which there is a worldwide demand. Global economic uncertainty and increased competition from overseas farms, however, is expected to reduce wholesale caviar prices. This will make sturgeon meat, now viewed as a marginally valuable byproduct of caviar production, much more critical to the economic viability of domestic sturgeon culture.

Fresh sturgeon meat possesses the sensory characteristics of many of the highly prized marine species caught in North Carolina waters. Preliminary experimentation by a professional chef (Tim Coyne of Bistro-by-the-Sea, Morehead City) showed the quality of sturgeon meat is comparable to the sensory characteristics of popular marine species, like grouper and snapper, that have limited availability along the North Carolina coast. These species are becoming increasingly difficult to source as a result of stricter fisheries regulations. Consistency in supply is important to both wholesale and retail buyers, so cultured sturgeon would be a consistent source of marine protein for consumers who are eating more seafood for its health benefits. In discussions with Carteret County restaurant chefs, they expressed their belief the desirable sensory characteristics of sturgeon could make it a viable alternative to marine species that are inconsistently available. Because a market for fresh sturgeon has not existed on the east coast of the U.S. since the early 20th century, consumers have not had opportunities to experience the wide range of cuisine that can be prepared from sturgeon meat. Given consumer's unfamiliarity with sturgeon, market research was required to determine how best to prepare it to suit consumers' palates. Our project was an attempt to introduce a panel of volunteers to a variety of sturgeon dishes and evaluate their preferences.

The goals of our project were:

- 1) Increase public awareness of the high quality of cultured sturgeon meat to stimulate demand.

- 2) Develop a variety of recipes suitable for preparation in fine restaurants.
- 3) Document consumer preferences for different cooking methods and flavor profiles.

2. Materials and Methods

2.1 Sturgeon recipes

Executive chef Tim Coyne of Bistro-by-the-Sea Restaurant in Morehead City developed three different recipes for each of three product categories: a) appetizers; b) salads; and c) entrees. Six cooking methods were evaluated: baked, broasted (deep-frying under pressure) chargrilled, sautéed, cold-smoked, hot-smoked and steamed.

The culinary preparations were:

Sensory Session 1: September 16, 2013

Appetizer: Sautéed sturgeon, grilled asparagus, and red pepper and chives wrapped in bacon.

Salad: Steamed sturgeon in a Bibb lettuce cup with arugula, cucumbers, water chestnuts, and artesian greens garnished with a spear of radish, black olive and cherry tomato.

Entrée: Chargrilled sturgeon, marinated in a Teriyaki glaze over Asian slaw (Julienne red cabbage, carrots, red bell peppers, toasted sesame seeds, sesame seed oil and rice wine vinegar). Entrée was served with a wonton cracker and a light Wasabi spread topping.

Sensory Session 2: October 14, 2013

Appetizer: Steamed sturgeon with ginger dipping sauce. Item was garnished with pickled ginger.

Salad: Sturgeon salad (baked sturgeon, mayonnaise, grapes, and toasted almonds) with toast points.

Entrée: Broasted tempura sturgeon and broasted potatoes with malt vinegar and remoulade, served in a basket.

Sensory Session 3: November 4, 2014

Appetizer: 1) Cold-smoked sturgeon; 2) Hot-smoked sturgeon

Salad: Chargrilled blackened sturgeon over Asian slaw.

Entrée: Chargrilled sturgeon steak with roasted Brussels sprouts & carrots.

2.2 Panelists, sampling and data collection

Restaurant manager Libby Eaton of Bistro-by-the-Sea and Barry Nash of North Carolina Sea Grant recruited up to 60 panelists to participate in three sensory sessions. Ms. Eaton recruited participants from a list of customers she maintains when scheduling special events at her restaurant. Mr. Nash recruited participants from staff at the North Carolina State University Center for Marine Sciences & Technology, the North Carolina Division of Marine Fisheries, the National Oceanic and Atmospheric Administration's Beaufort laboratory, and the North Carolina Aquarium at Pine Knoll Shores.

Demographic information was collected on all participants during the first sensory session. At each session, panelists were served a three-ounce portion of an appetizer, three ounces of a salad, and three ounces of an entrée. They were instructed to cleanse their pallets with unsalted crackers and filtered water (served at room temperature) before sampling each course. Panelists were provided ballots (see Appendix A) to rate the flavor, texture, aroma and appearance of each item according to a Hedonic scale where 1 = *Terrible*; 2 = *Very Poor*; 3 = *Poor*; 4 = *Fair*, 5 = *Good*; 6 = *Very Good* and 7 = *Excellent*. The actual flavor profiles were not shared with the participants. Individuals were encouraged to express their likes and dislikes about each item in the “comments” section of the ballot. A discussion was held after each course to encourage panelists to articulate what they most favored about each item and what they believed needed to be improved. Finally, participants were asked to choose from among three options the most reasonable price point for each item.

2.3 Data Analysis

Data was entered in an Excel spread sheet and means were calculated for all rated factors and price points. The means were used to graphically infer preferences for each of the different recipes over the duration of the project. After each session, investigators met with the chef to discuss trends suggested by the results. Recipes that showed potential as value-added products for commercial distribution were converted into formulations so interested processors could consider offering sturgeon-based foods to retail or wholesale accounts.

One goal of this project was to educate likely consumers about the sturgeon species and the two North Carolina businesses that produce cultured sturgeon. During the first sensory session, Dr. John Burke provided a 20-minute talk on the biology of sturgeon and its history. At the second sensory session, sales representative Ms. Elizabeth Wall gave an overview of La Paz Farm in Lenoir. At the third session, facilities manager Brian Redburn provided an overview of Marshallberg Farm in Smyrna. The presentations were delivered prior to the sensory evaluations.

3. Results

3.1 Panelists

A total of 56 individuals (30 females and 26 males) participated in this project. Ages represented were: 20s-5; 30s-5, 40s-5, 50s-27, over 60-14. Forty out of 56 have 4 years of college. Forty-eight of the 56 eat out once a week or more, and of those, 37 select chef-driven restaurants. Thirty-six of the 56 spend \$15 - 30 on dinner, 34 of whom purchase wine. Approximately half of the group (23) watch cooking shows.

3.2 Trial 1.

In Trial 1, three different cooking styles were compared. Initially responses of male and female panalists was examined separately. Mean scores for flavor showed close agreement between male and female panelists (Figure 2a) so in subsequent analysis their scores were pooled . The lowest flavor scores were received for the steamed sturgeon which was the foundation for the salad.

Though low, these scores averaged above 5 or “good” on the Hedonic Scale – the minimum threshold for consumer acceptance. The sautéed appetizer was rated around 6 or “very good,” while the chargrilled entrée was rated approximately midway between “very good” and “excellent”. Examination of mean scores for all the sensory qualities evaluated by panalists, shows that ranking of dishes was consistent with the exception of appearance, where the appetizer scored high (Fig. 2b).

Figure 2a. Comparison of mean scores for flavor of sturgeon dishes by sex of the taster. Three sturgeon dishes cooked in different ways were scored by panalists in trial 1.

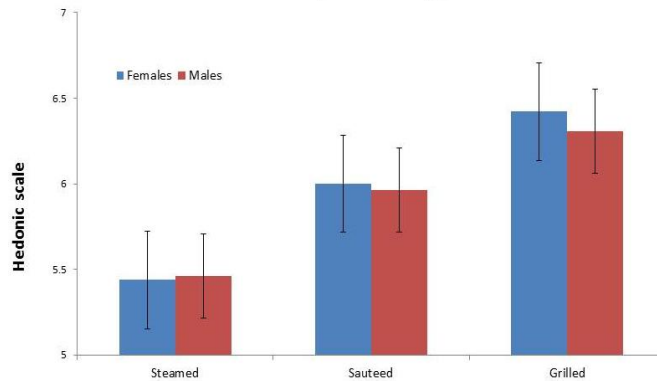
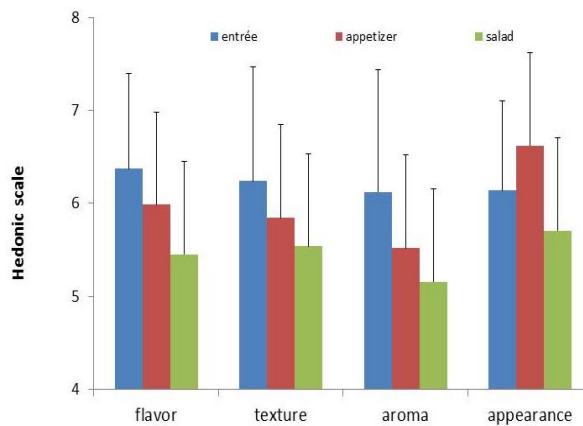


Figure 2b. Mean scores for flavor, texture, aroma and appearance of an appetizer (sauteed sturgeon), entrée (char grilled sturgeon teryaki) and salad (steamed sturgeon in a bib lettuce cup with artisan greens and water chestnuts garnished with radish with mayonnaise, grapes, toasted almonds .

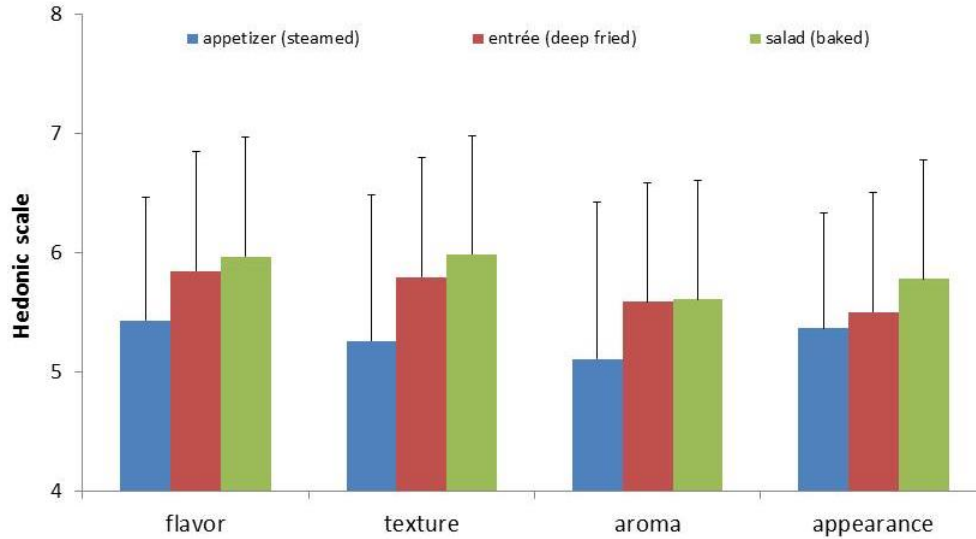


3.2 Trial 2.

In Trial 2, three different cooking styles were again compared. Two new cooking styles were evaluated by the panelists – the sturgeon entrée was deep fried and the sturgeon in the salad was baked. Steamed sturgeon was again served this time in the appetizer. Mean scores for all sensory parameters for each preparation were correlated as lowest scores for all sensory parameters were received for the steamed preparation and highest for the baked sturgeon, the foundation for the salad (Figure 3). The entrée, whose

sturgeon was deep fried, received mean marks slightly below the baked preparation, Though scores for the steamed sturgeon were lowest again, they did average above 5 or “good.” Both the deep fried and baked sturgeon were rated around 6 or “very good”..

Figure 3. Trial 2 mean scores for flavor texture aroma and appearance of an appetizer (steamed sturgeon with ginger dipping sauce), entrée (deep fried sturgeon) and salad (baked, flaked sturgeon with mayonnaise, grapes, toasted almonds and peppers).

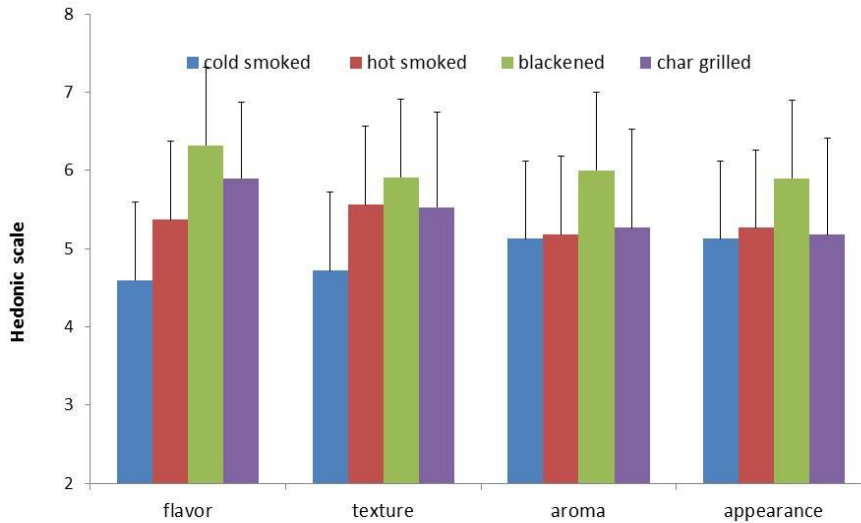


3.3 Trial 3.

In Trial 3, four different cooking styles were compared. Two new cooking styles were tested – a cold- and hot- smoked sturgeon were compared side by side as an appetizer. The entrée consisted of lightly seasoned chargrilled sturgeon and the salad’s principal ingredient was sautéed, blackened sturgeon. The chargrilled-sturgeon entrée and the hot-smoked appetizer received mean marks higher than the cold-smoked preparation but lower than the blackened preparation (Figure 4). Flavor and texture scores for the cold smoked appetizer were the lowest, averaging below “good” but above “fair”. Scores for evaluated for the chargrilled and blackened preparation averaged “good” to “very good.”

aroma and appearance of the cold smoked preparation and for all sensory parameters

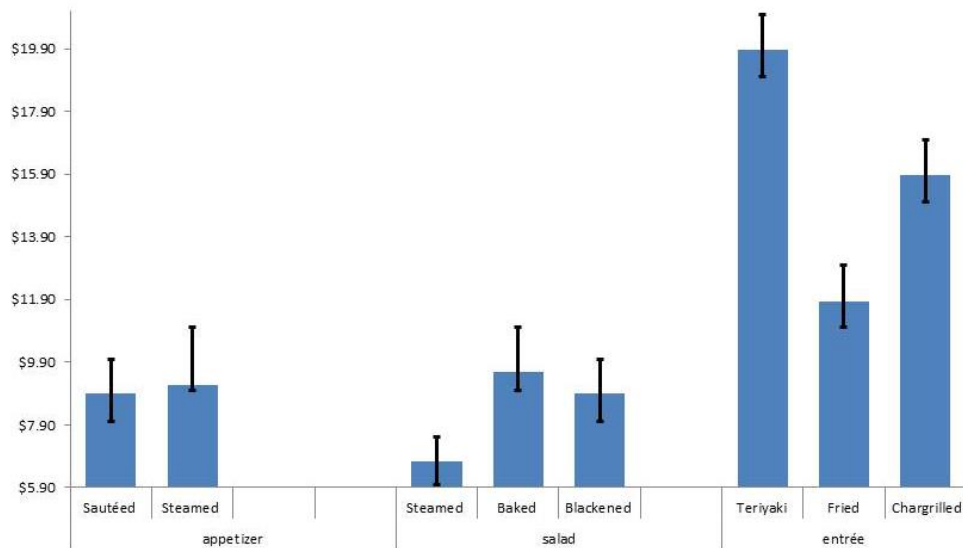
Figure 4, Trial 3 mean scores for flavor, texture, aroma and appearance of two appetizers (a cold and a hot smoked sturgeon), an entrée (char grilled sturgeon) and a salad (blackened sturgeon on a bed of Asian slaw).



3.4 Price point data

Despite the relatively high mean sensory scores, participants appeared unwilling to pay a premium price for sturgeon. On average, the participants generally selected a price

Mean price that taste trial participants would consider paying for sturgeon dishes. The bar represents the range in price that participants were allowed to chose from.



approximating the midpoint of the range. A clear exception to this generality was evident in the case of the steamed appetizer which was judged of low value (Fig. 5)

4. Discussion

4.1 Characterization of Panelists

The responses to our demographic survey showed our panelists were generally older than 50 and many had college educations. Based on the number of panelists who eat out regularly and the number who watch cooking shows, the group appeared to be relatively sophisticated in terms of culinary matters. Comments made on the participant survey forms were quite uniform. All but 12 panelists described the fish using two of these three descriptors: “firm,” “mild” or “not fishy.” Other comments by panelists included: “sturgeon went well with sauces,” “sturgeon by itself was bland – had very little taste,” and “sturgeon took on flavors very well.”

4.2 Variability in Sensory Scores

Scores for the sturgeon dishes indicate this species will be readily accepted as an appetizer, salad or entre in any fine restaurant setting. With the exception of the cold smoked sturgeon appetizer, all preparations scored above “good.” Four of the nine dishes scored approximated or exceeded “very good”.

While participants found all the sturgeon preparations very palatable, they responded least favorably to dishes that were steamed. Lowest scores in both the first and second trial were for sturgeon dishes prepared by steaming and included the preparation with the overall lowest score. While a variety of factors likely contribute to this result, the flavor of sturgeon meat was less affected by steaming than by other cooking techniques. The most common cooking method for fish in North Carolina is deep frying, which provides a product less recognizable as fish than steaming. The inference that consumers in Carteret County prefer their sturgeon have a robust or strong flavor profile was supported by the results in Trial 3, as the smoked sturgeon appetizers, which were mildly flavored compared to the blackened and baked dishes, received lower scores.

Our results also suggest that sturgeon dishes prepared with strong flavor profiles appear to be favored over more delicately flavored dishes. This was true in all three of the trials. In Trial 1, the preferred dish had a teriyaki glaze. In the second trial, the sturgeon salad was preferred over deep fried and steamed preparations. In Trial 3, the blackened, chargrilled preparation was preferred over smoked and simply chargrilled sturgeon.

5. Impact and Benefits

Our results indicate that sturgeon dishes will be well received by restaurant patrons in North Carolina. With the sole exception of the cold-smoked sturgeon, all of the preparations tested were rated “good” or better. The responses provided by participants and the observations of the researchers indicate sturgeon provides an eating quality comparable to popular wild-caught species that are inconsistently available in Carteret County markets. Cultured sturgeon should provide a dependable supply of high-quality marine protein to regional restaurants at a comparable cost. Bistro-by-the-Sea Restaurant began offering sturgeon from Marshallberg Farm this fall.

One item that may have potential as a commercially processable, value-added product is the sturgeon salad, which was served in Trial 2. The recipe was converted into a formulation (see Appendix C), though additional ingredients would be required to maintain its keeping quality during refrigerated storage (Nash, 2010). Brightwater Seafood, a subsidiary of Inland Seafood with a distribution center in Charlotte, manufactures a line of refrigerated seafood spreads and salads for the grocery trade. The sturgeon salad would fit in Brightwater’s retail line provided Marshallberg and La Paz Farms could meet the company’s volume requirements.

6. Extension of Results

The results of this research will be posted on Marinersmenu.org, a website and blog supported by North Carolina Sea Grant to educate consumers on how to ascertain the quality and safely handle, cook and store North Carolina seafood at home. The team decided a website, rather than a North Carolina Blueprint publication, would be a better means to communicate our results and educate consumers, chefs and retailers about sturgeon because the content could be revised over time. The management of Marshallberg and La Paz Farms agreed a special section should be established on Mariner’s Menu to highlight the biology of sturgeon and general information on culturing it. Also included will be background information on both companies, their contact information, and the recipes listed in Appendix A. Marinersmenu.org will inform consumers and chefs about the superior eating quality of cultured sturgeon and show both how to prepare sturgeon at home or in a restaurant. Elizabeth Wall, the sales representative at La Paz, intends to rely on this site to promote sturgeon to her restaurant clientele.

7. Students

There were no students involved in this project.

Acknowledgements

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References

Nash, Barry. 2010. Ready-to-Sell: Developing Value-Added Seafood Products. North Carolina Sea Grant, UNC-SG-BP-10-10.

Appendix A: Scoring Ballot

| PRODUCT SCORE SHEET | | | | |
|---|------------|--|------------|------------|
| NAME: _____ | | PRODUCT CODE | | |
| DATE: _____ | | A04 (Sturgeon Appetizer) S04 (Sturgeon Salad) E04 (Sturgeon Entrée) | | |
| SCORE FOR: | | A04 | S04 | E04 |
| 7 = Excellent 6 = Very Good 5 = Good 4 = Fair 3 = Poor 2 = Very Poor 1 = Terrible | FLAVOR | | | |
| | TEXTURE | | | |
| | AROMA | | | |
| | APPEARANCE | | | |
| PUT YOUR COMMENTS HERE | | | | |
| A04: | | | | |
| S04: | | | | |
| E04: | | | | |
| SUGGESTED PRICE | | | | |
| <i>(Please circle one for each item)</i> | | | | |
| A04 & B04: | | | | |
| Prices for these items undecided | | | | |
| S04: | | | | |
| 1) \$7.95 2) \$8.95 3) \$9.95 | | | | |
| E04: | | | | |
| 1) \$14.95 2) \$15.95 3) \$16.95 | | | | |

Appendix B: Recipes

Trial 1: September 16, 2013

Appetizer: Two ounces sautéed sturgeon wrapped in (1/2) strip of bacon, (1) grilled asparagus spear, and (2) Julienne red pepper strips and (1) chive leaf.



Salad: Two ounces steamed sturgeon in a Bibb lettuce cup (3 leaves) with (2) sprigs of arugula, (3) slices of cucumber, (2) slices of water chestnuts, and (1/2 oz.) artesian greens garnished with (1) radish, (1) black olive and (2) cherry tomatoes on a wooden spear.



Entrée: Six ounces chargrilled sturgeon, marinated in a (1/4 cup) Teriyaki glaze over Asian slaw, served with a wonton cracker and a light Wasabi spread topping.



Trial 2: October 14, 2013

Appetizer: Two ounces steamed sturgeon with two ounces ginger dipping sauce. Garnished with pickled ginger.



Salad: Three ounces sturgeon salad with (4) toast points [Sturgeon salad – two ounces baked sturgeon, (1/4 cup) Hellmann’s mayonnaise, (6) grapes cut in halves, (1/4 cup) shaved, toasted almonds].



Entrée: Broasted tempura: six ounces sturgeon and (2) broasted red potatoes cut in half with malt vinegar and remoulade, served in a basket. Note: Broasting is *deep-frying* food under pressure. Heat oil to 350 degrees. Cut red skin potatoes in half. Broast for 5 minutes or until golden brown. Coat six ounces sturgeon strips in tempura batter and broast for 4 minutes or until golden brown.



Trial 3: November 4, 2014

Appetizer: 1) Two ounces cold-smoked sturgeon; and 2) two ounces hot-smoked sturgeon. Marinate sturgeon in salt brine for 24 hours before smoking. [Salt Brine: (3) cups water, (1/2) cup kosher salt, (1/4) cup black pepper, (4 tablespoons) red crushed pepper, (1) sprig of Dill weed, (1) sprig of fresh thyme].

Cold-smoke process: 150 degrees for 4 hours.

Hot-smoke process: 180 degrees for 2 hours.



Salad: Chargrilled (1200⁰ F degree sear for less than 1 minute each side). Two ounces sturgeon (lightly coat front & back of sturgeon filet w/ blackened seasonings). Place over (1) cup of Asian slaw.



Asian slaw ingredients – (1/2 cup each) Julienne red cabbage, carrots, red bell peppers, (1/4 c) toasted sesame seeds, (2 tablespoons) sesame seed oil and (1/4 cup) rice wine

vinegar. Heat oil in pan until smoking. Add sesame seeds to toast. Set aside and cool. Add rice wine vinegar. Mix vegetables and vinegar.

Entrée: Six ounces chargrilled sturgeon steak (1200⁰ F degree grill for 3-4 minutes each side) with roasted Brussels sprouts & carrots. Blanche (1/2 cup) each Brussels sprouts and carrot slices then drain. Toss with (3 tablespoons) olive oil, pinch of kosher salt and cracked black peppercorns. Roast in 450 degree oven for 12-15 minutes.



Appendix C: Value-Added Formulation for Sturgeon Salad

| Ingredient | Formula Percentage |
|------------------|--------------------|
| Mayonnaise | 33 |
| Steamed sturgeon | 32 |
| Halved grapes | 26 |
| Shaved almonds | 9 |