A PRELIMINARY STUDY OF THE EDIBILITY CHARACTERISTICS OF SOUTHEASTERN FINFISH

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A major problem in the marketing of seafood products is the large number of fish species with widely varying edibility characteristics. To better disseminate information on foodfish to consumers, therefore, Brand Group Inc. (under NMFS contract) developed a Model Identification Plan (2) for finfish relative to eight sensory attributes: odor, flakiness, coarseness, flavor, moisture, fat, firmness and color. This system was designed to inform the consumer about a fish species in regard to its edibility characteristics. The less-familiar species would be better incorporated into the marketplace through descriptions of edibility which could be compared with characteristics of more familiar species. We have attempted to evaluate the usefulness of the Brand Group system and to apply it to familiar and unfamiliar species of the Southeast region.

In this study, a previously trained taste panel evaluated the edibility characteristics of 16 different species of local (South Carolina) fresh finfish. Major objectives included: (i) determination of the precision and reproducibility of taste panel evaluation methods for each characteristic; (ii) determination of which of the eight proposed characteristics were relevant for our use; and (iii) determination of a grouping system for the species tested.

MATERIALS AND METHODS

Taste panel

Thirteen employees of the Charleston Laboratory were selected as panelists and trained for sensory evaluations. Each panelist was briefed by the panel leader as to the general nature of the study and the panelists were trained in order to familiarize them with test procedures and to improve their ability to identify and compare sensory attributes. Methods, scales, score sheets, and terminology to be used in the tests were discussed; training was through individual and group sessions in which various samples of products were evaluated and discussed. Principles of quantitative descriptive analysis as described by Stone, et al. (3) were employed.

Sample preparation

Samples, purchased locally, were examined for freshness. Sample selection was based on the availability of fresh local finfish at the time of the tests and many of the samples were reef-fish from the snapper-grouper fishery. The less familiar species were identified by an experienced marine biologist.

Two skinless fillets from each fish were placed skinned sides together in seal-a-meal boiling bags to be weighed, coded and refrigerated for at least 1-1/2 hours. Thermocouples were placed between pairs of unseasoned fillets and the open end of the bag was folded and clamped around the thermocouple lead. Temperatures were recorded before and during cooking using a Honeywell multipoint recorder. The bag was immersed in boiling water until the internal temperature reached 160^{0}F. The bag was removed and drained of free liquid and the samples were divided into approximately 1 oz. portions and placed into 4 oz. styrofoam cups and sealed with coded lids.

Sample presentation

The samples were given to panelists seated at booths in our special palatibility room. They were asked to evaluate each sample according to the guidelines posted in each booth.

Two characteristics described by Brand Group were eliminated from our panel evaluation form -- coarseness and fat content. It was found during panel training that coarseness was a difficult concept for the taste panel to relate to finfish and that fat content, which can be measured chemically, was not a clearly percieved attribute. Therefore, these two characteristics were eliminated from the sensory evaluation form.

All evaluations were made on the cooked flesh (the Brand Group Plan recommends a raw-odor evaluation). It was assumed that a consumers' evaluation of raw fish flesh would be misleading at a fish market where a mixture of strong odors is prevalent.

The edibility characteristics were rated by marking the appropriate boxes numbered 1 through 5 (integers only) on the basis of mild to strong odor, light to dark color, not flaky to flaky, soft to firm, mild to strong flavor and dry to very moist.

Statistical analyses

The Wilcoxon signed rank test and Kendall's correlation coefficient were used to statistically assess the edibility characteristics (3). Non-parametric statistics were used because the characteristic evaluations were discrete numbers and the data cannot be assumed to follow a normal distribution. The BMDP (1) cluster analysis program and a multidimensional scaling (MDS) program were also used to group the different species on the basis of similar edibility characteristics.

RESULTS AND DISCUSSION

Panel reliability

For a majority of the species reported in this paper, only one evaluation was made by the thirteen taste panelists. For red porgy (Pagrus sedecim) there were seven different taste tests and for black sea bass (Centropristis striata) five tests. The data were segregated into three groups: (i) sea bass tests, (ii) red porgy tests and (iii) the data for all other tests with the remaining 14 species. The standard deviation of each variable of each group was evaluated for each taste panelist. The median standard deviations for each characteristic for groups I and II were compared with those of group III using the Wilcoxon signed rank test of the BMDP3S non-parametric statistics package (1). The statistical results as tabulated in Table 1 show that the panelists were discriminating in their ratings. When $P \leq 0.05$ we accept the fact that the taste panel can discriminate one species from the others for that edibility characteristic. Only the odor evaluations and the flakiness evaluation for red porgy resulted in P greater than 0.05. In general, the P values are quite low.

Correlations between characteristics

The mean values of the six edibility characteristics- odor, color, flakiness, firmness, flavor and moisture were evaluated for the 16 species of local finfish. Sensory characteristic profiles for four of the species are shown in Figure 1. The profiles are drawn as connected lines for better visual comprehension; no serial relationship is intended. The red porgy and vermilion snapper (Rhomboplites aurorubens) have similar profiles except for the lighter color of the red porgy. The longspine squirrelfish (Holocentrus rufus) was firm but scored low in flakiness. The American shad (Alosa sapidissima) shows a dark color and a soft texture (low firmness). The Kendall's correlation coefficients between the means of the six variables for all species were calculated and are shown in Table 2. These correlation coefficients were used to test if the variables were independent. At the 0.05 level of significance, the independent hypothesis is rejected if the absolute value of the correlation coefficient is larger than 0.34375. Based on this test, odor, color, flakiness and flavor failed to be independent from each other. Firmness and moisture were (negatively) correlated with each other but no other pairs of variables failed the test for independence.

Grouping of species

The mean values for each species were standardized such that each variable has a mean of zero and a standard deviation of one. The Euclidean distances between species, calculated by the standardized means of the six variables (dimensions), were analyzed with a cluster analysis computer program to determine logical groupings of the species (Figure 2). Dissimilarities between groups of fish are indicated by the distance at which they are joined. Red porgy and vermilion snapper form the first similar group at a distance of 1.13 units.

Grouping of species by the results of cluster analysis is based upon the analyst's judgment. Based on our judgment, the fish were divided into four groups. Group 1 consists of knobbed porgy, gag, vermilion snapper, red porgy, gray triggerfish, short bigeye, scamp, black sea bass and blackfin snapper. Group 2 consists of American shad, blue angelfish, black drum and white grunt. Group 3 consists of longspine porgy and longspine squirrelfish. Group 4 consists solely of red drum, but this species should be eliminated since the sample had been frozen and it was a large fish. Smaller red drum have been reported to have much better edibility characteristics and the smaller size would be more likely encountered commercially.

A multidimensional scaling (MDS) program developed by Bell Laboratories was used to measure the dissimilarities between the 16 species. Based on the standardized means the procedure provides each species with a point in an Euclidean space. We used MDS to study our dissimilarity data with 1-, 2-, 3- and 4-dimensional spaces. Figure 3 is the final configuration plot of the 16 points on the two-dimensional space. Each letter on the MDS plot represents a species. If two letters are relatively close together, then the corresponding species are relatively similar.

Based on our study of the two-dimensional MDS plot, and with some considerations of the other dimensions, we divided the fish into four groups. Comparing these groups with the previous grouping based on cluster analysis, we find that the present group 1 contains black drum and white grunt which previously were members of group 2.

CONCLUSION

There was a relatively large variability in panel ratings of odor and some difficulty with flakiness for the repeated samples of red porgy but valid differences in profiles between species were defined. Odor was eliminated as a characteristic for future work because of its variability and negative character. Grouping of the species on the basis of edibility characteristics was accomplished through computer programs. A majority of the species fell into one group with desirable edibility characteristics (mild flavor, light color, moderate firmness and flakiness).

Although there is inherent variability in taste panel results and variations within some fish species due to size and season, the concept of evaluating and recording edibility characteristics promises to benefit consumers of seafoods and to improve the marketability of underutilized species.

REFERENCES

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3. Stone, H., J. Sidel, S. Oliver, A. Woolsey and R. Singleton. 1974. Sensory evaluation by quantitative descriptive analysis. Food Technol. 28(II):24-34.

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	GROUP I Sea Bass	GROUP II Red Porgy
Odor	0.068	0.079
Color	0.008	0.017
Flakiness	0.006	0.136
Firmness	0.014	0.003
Flavor	0.002	0.003
Moisture	0.021	0.042

Table 1. P- Values from Wilcoxon signed rank test for differences between medians of standard deviations. Groups I and II versus Group III consisting of all other species.

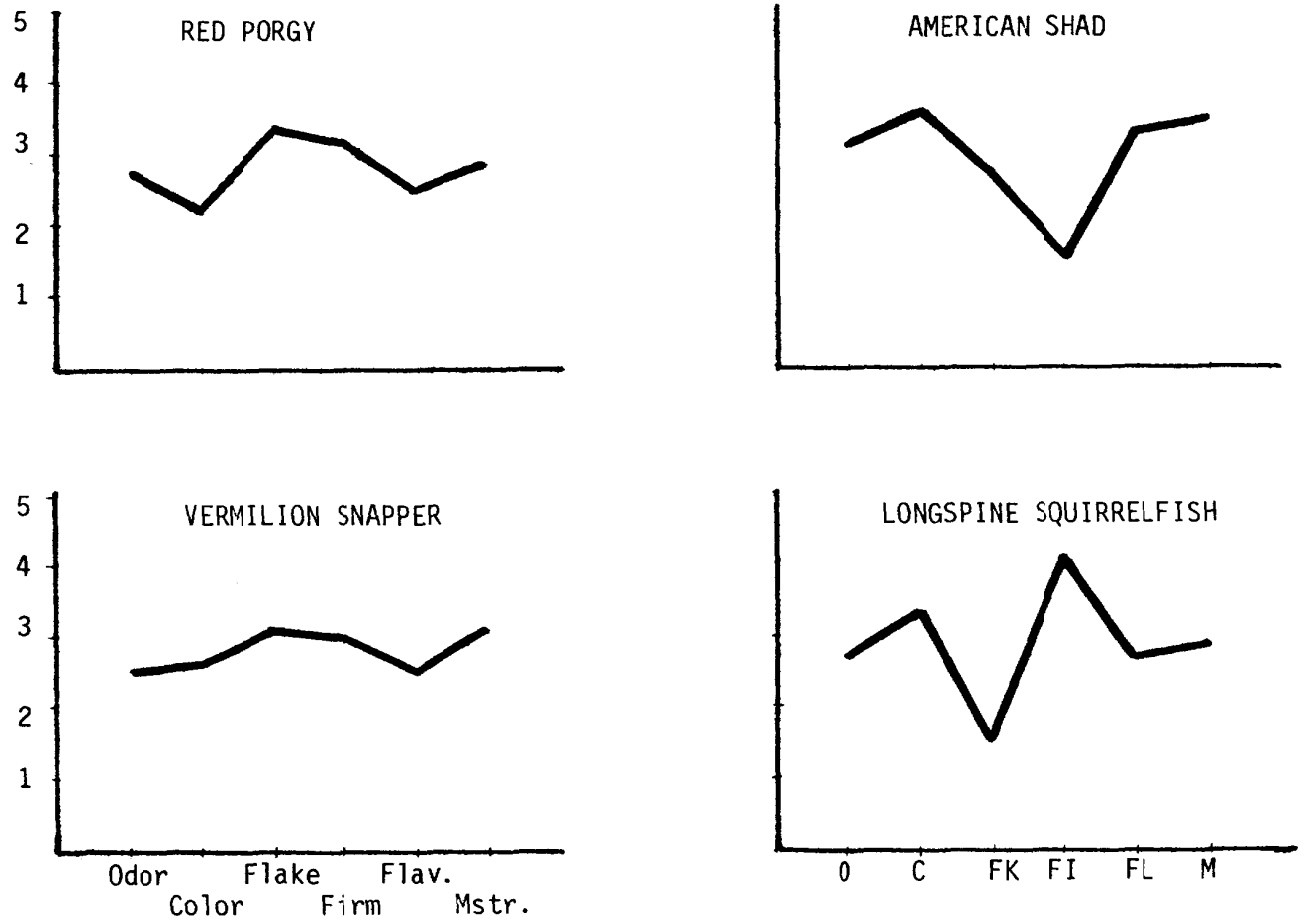


Figure 1. Edibility profiles for selected species.

	Odor	Color	Flakiness	Firmness	Flavor	Moisture
Odor	1					
Color	0.4503	1				
Flakiness	−0.3933	−0.4874	1			
Firmness	0.1097	0.3390	−0.1186	1		
Flavor	0.5378	0.5317	−0.5317	0.1277	1	
Moisture	0.1667	−0.251	−0.0921	−0.3798	0.1849	1

Table 2. Kendall's Correlation Coefficients Determined by the Mean Values.

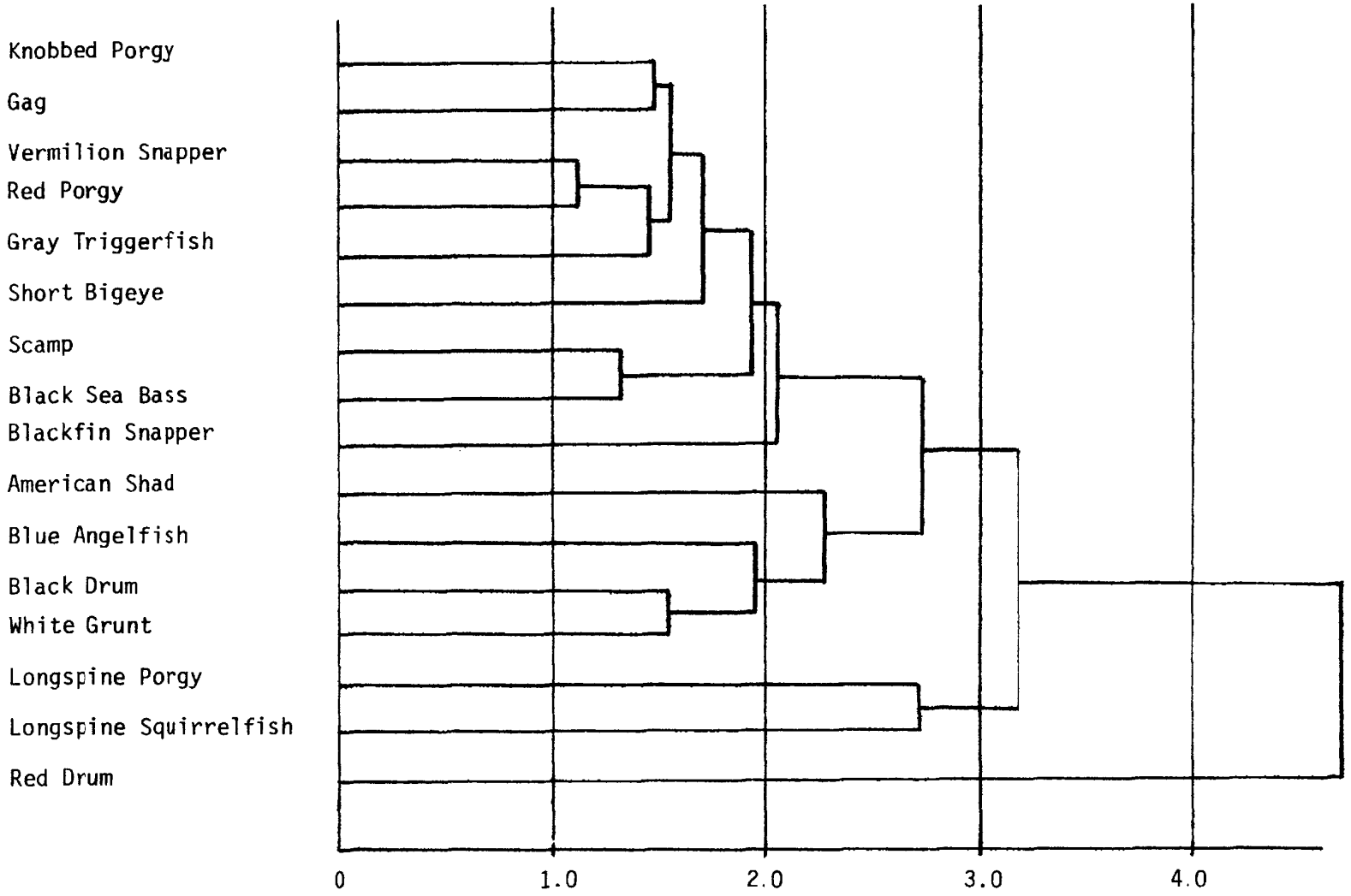
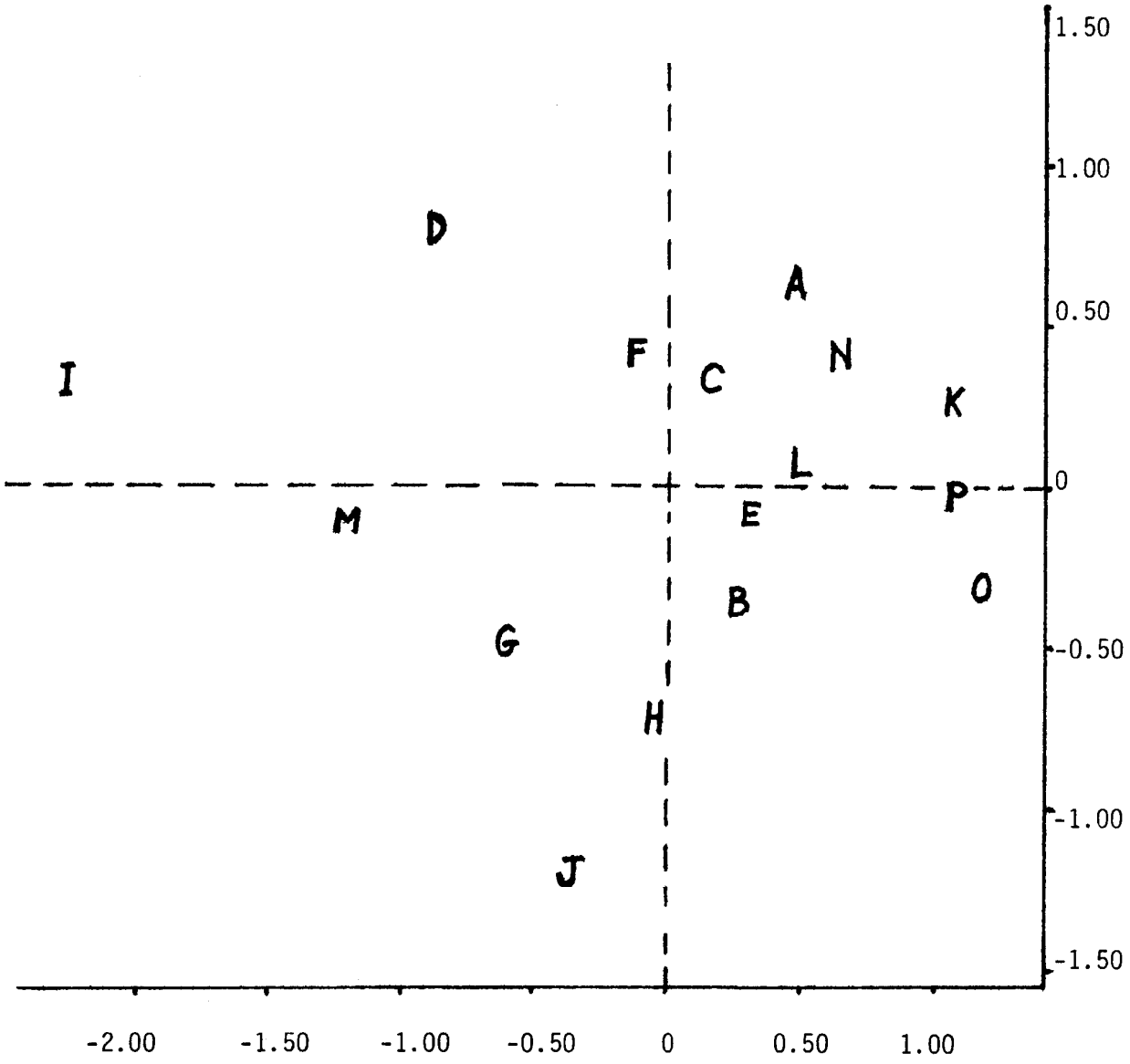


Figure 2. Cluster Analysis of 16 Southeastern Species.



A - Knobbed Porgy
B - White Grunt
C - Gray Triggerfish
D - Long Spine Squirrelfish
E - Vermilion Snapper
F - Short Bigeye
G - Blue Angelfish
H - Black Drum
I - Red Drum
J - American Shad
K - Black Sea Bass
L - Red Porgy
M - Longspine Porgy
N - Gag
O - Scamp
P - Blackfin Snapper

Figure 3. Grouping of Fish Species by Multidimensional Scaling (MDS) - 2 - Dimensional Plot.