METHODS OF SENSORY EVALUATION OF QUALITY AND APPLICATION OF STATISTICAL METHODS IN SENSORY EVALUATION PROBLEMS WITH SPECIAL REFERENCE TO FISHERY PRODUCTS

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INTRODUCTION

Sensory evaluation is still the most reliable method for evaluation of the freshness of raw and processed fishery products. Sophisticated methods like Intelectron Fish Tester, cell fragility technique and chemical and bacterioligical methods like estimation of trimethylamine, hypoxanthine, carbonyl compounds, volatile acid and total bacterial count have no doubt been developed for accessing the spoilage in fish products. However, they are of very limited use as none of these methods is a complete test by itself. Further, the reproducibility and dependability of these methods are known to be upset by icing and other types of preservation employed. The quality of raw and processed fishery products depend on several factors like physiological conditions at the time of capture, morphological differences, rigor mortis, species, rate of icing and subsequent storage conditions. In ice storage, some of the flavour bearing components which otherwise would have been measured objectively might leach out and protein denaturation could take place. Also, fishery products are having their own characteristic flavour and aroma which are mostly complex in nature, which vary with species and type of treatment applied and which none of these objective methods so far developed can singly bring out successfully. More than the complex nature of the flavour and odour characteristics of the fishery products, new techniques of preparation and processing like artificial dehydration, canning under different media, freezing and rating of the speciality products will make the problem more complicated. Hence the existing methods of sensory evluation of quality and the use of statistical techniques need consideration in evaluating the quality of raw and processed fishery products.

Methods or tests used in sensory evaluation:

Quite a good number of tests are used in sensory evaluation of qualities of foods and beverages. These tests are broadly classified under four heads as difference tests, preference tests, despriptive tests and sensitivity tests. Difference tests are used in situations where we are interested in finding whether a particular food item is different from a standard or existing one. Descriptive tests are more of flavour profile type. The flavour profile method provides a way for the evaluation of flavour by an analytical descriptive procedure. It concerns with the different types and intensity of aroma and flavour factors. This type of analysis are used in the development, improvement and control of a product as well as to detect trouble shooting points. Preferenc tests are usally used for getting an idea about the preference of a particular food item. Consumer's reaction about the acceptability of a food item also comes under this group.

Senstitivity tests include stimulus, difference and terminal thereshould tests as well as dilution tests. These types of tests are generally used for evaluating the odour and flavour of specific characteristics of foods and beverages.

Different methods of sensory evaluation which receive frequent references are single sample, paired comparison, duotrio, dual standard, multiple comparison, triangle, rank order and scalar scoring test. Single sample test is usually used where food items having an after taste or flavour carry over. Here only one sample is presented at a time for evaluation. Though it is easy to conduct but statistically it is consonsidered to be less efficient. In paired comparison test the panel members are given a reference sample first followed by unknown samples for comparison. The panel member's task is to state whether the unknown sample is different from the reference sample or not. A slightly different forms of paired comparison test are the duo-trio and dual standard tests. In duo-trio method the panel members are first given a reference sample A followed by two samples as unknown. The panel members' task is to say which of the two belonged to A. In multiple comparison method, judges are given a number of samples at a time and asked to select the sample which showed marked difference in the group. In the triangular method each panel member is given three samples of which two are identical. They are asked to select the odd sample out of the three. In rank order test the panel members are given a number of coded samples at a time and asked to rank them according to the intensity of a particular characteristic. Some times three or more samples are provided to judges in a random order at a time and asked to score or rate the samples according to a pre-determined scale. This method is called scalar scoring method. Depending upon the type of problem on hand a particular method can be selected.

Statistical methods in sensory evaluation problem:

Since sensory evaluation methods are to a great extent psycho-physical in nature, statistical methods are quite often used in the design, analysis and interpretation of data pertaining to experiments on sensory evaluation of foods and beverages. Simpler as well as more sophisticated statistical methods are used frequently depending upon the type of problem. Binomial distribution, 't' distribution, analysis of variance technique, sequential analysis, fractional replication, technique of confounding, incomplete block designs and Chi-square statistic are used in the design and analyisis of experiments. The purpose of statistical analysis is to bring out significant differences when they exist after accounting for chance causes. The chance probability of detecting a difference in paired comparison, duo-trio and dual standard are $\frac{1}{2}$ each while in triangular test it is $\frac{1}{3}$. In multiple comparison the chance probability is still less depending on the number of test samples. Binomial distribution and Chi-square statistic are quite often used for analysing data where paired comparison, duo-trio, dual standard and triangular methods are used. Wald's sequential method of analysis are used to determine the average number of triangular tests to be conducted for selecting judges having a specified ability to detect flavour differences. Analysis of variance technique is used for analysing data on scalar scoring tests. Analysis of variance tables are prepared under the assumptions that scores are normaly and independently distributed, treatment effects and environmental effects are additive and the error variances are homogeneous. Some times the scores obtained from a taste panel data may not satisfy these assumptions. Taste fatigue and taste adaption often make

deviations from these assumptions. Taste fatigue arises whenever too many samples are presented at a time for evaluation. In such cases balanced incomplete block designs can be successfully used. Where ranking method was adopted, rapid mehod of rank analysis can be applied.

Primary taste test:

As a preliminary to the constitution of a taste panel primary taste testing are generally conducted. The primary taste test is intended to screen members who are sensitive to basic tastes. Solutions of Sodium chloride, Hydrochloric acid, Sucrose, Sodium Carbonate and Quinine Sulphate are some of the solutions generally used to represent the basic tastes viz. saltiness, acidity (sourness), sweetness, alkalinity and bitterness respectively. The same basic principles have been applied for selecting a panel for evaluation of quality of fishery products. The concentration of the solutions used were Sodium Chloride - 0.5%; Hydrochloric acid -0.25% Sucrose - 1%, Sodium Carbonate - 0.25%, and Quinine Sulphate - 0.05%. Each of these solutions were further diluted to give four samples of varying concentrations as 0%, 25%, 50% and 100% of the prepared solutions. These solutions were arranged in random order and supplied to the entire Institutional members. A score sheet was used for assessing the taste of the solutions used and arranging them in their increasing order of concentrations. Those who scored 80% and above were considered successfull. The following Table (Table I) gives the number of identifications in the different solutions by the members.

TABLE I DETAILS OF IDENTIFICATION BY INSTITUTIONAL MEMBERS IN DIFFERENT SOLUTIONS

	Sugar	*Alkaline*	*Acid*	*Salt*	*Quinine*
All correct	16	27	34	24	34
One mistake	22	14	17	21	13

Constitution of a taste panel for frozen and canned shrimp:—

Krishna Iyer et. al. (1969) described certain methods they have tried in the laboratory of Central Institute of Fisheries Technology, Cochin, for constituting a taste panel for frozen and canned shrimp. The authors have tried three methods of panel selection viz. Scalar scoring method, Range and deviation method and Triangular method. Out of these three methods tried, they were of opinion that, triangular method was more suitable for panel formation of such fishery products. According to them the fist two methods were not quite successful, the former because of the presence of a highly significant interaction meansquare resulting from the characteristic complex flavour stimuli of the product, taste fatigue and taste adaption and the latter because of the high total deviation (Table II, III, IV & V).

Descriptive numerical scoring system:

Numerical scoring system were frequently used for evaluating or rating the quality of fishery products. Hedonic scale was prepared in the past for this purpose. The hedonic scale contains expressions of the form "like very much", "like", "neither like nor dislike", "dislike", "dislike very much". These expressions

were given corresponding numerical scorings $+2, +1, 0, -1, -2$ respectively for the purpose of statistical treatment, Torry Research Station, Aberdeen, had developed a descriptive numerical scoring system for the ice-stored, smoked and frozen characteristics of white fish such as cod for judging the colour, odour (raw and cooked), texture and flavour of the product. Such a descriptive numerical scoring system would provide a more uniform rating of these products by the panel members.

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TABLE II. RESULTS OF SCALAR SCORING TEST–ANALYSTS OF VARIANCE TABLE FOR FLAVOUR SCORES

Source of Variation	SS	DF	MS
Total	93.0893	125	
Bet. samples	2.7143	2	1.3572*
Bet. panel members	38.5893	13	2.9684*
Samples X panel members	21.2857	26	0.8187**
Error	30.5000	84	0.3631

* denotes significance at 5% level

** denote significance at 1% level

TABLE III RESULTS OF RANGE AND DEVIATION METHOD
(Flavour scores)

Panel members	Range of sum	Sum of ranges	Range of sum / Range of sum	Sum of deviations
1	4	1	4.00 (Sig)	4
2	2	5	0.40 (N.S)	8
3	2	5	0.40 (,,)	6
4	4	3	1.33 ,,	7
5	4	3	1.33 ,,	8
6	3	4	0.75 ,,	8
7	4	4	1.00 ,,	4
8	5	2	2.40 (Sig)	2
9	0	6	0.00 (N. S.)	8
10	3	4	0.75 ,,	6
11	2	3	0.67 ,,	7
12	2	5	0.40 ,,	6
13	3	3	1.00 ,,	10
14	4	4	1.00 ,,	4

Sig. Significant at 5% level
N. S. not significant.

TABLE IV SELECTION OF PANEL MEMBERS USING TRIANGULAR METHOD FOR CANNED PRAWNS

Panel members	No. of times odd samples were detected correctly	No. of times good saroples were detected
1	5	5
2	5	6
3	5	5
4	5	5
5	6	6
6	6	6

TABLF V SELECTION OF PANEL MEMBRS USING TRIANGULAR METHOD FOR FROZEN PRAWNS

Panel members	No. of time odd samples were detected correctly	No. of times good samples were detected
1	5	5
2	5	5
3	5	5
4	6	6
5	5	5
6	6	6