

Some Further Considerations in the Development of an Experimental Design for Sensory Evaluation of Fish Quality

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An experimental procedure along with a method of analysis to judge the suitability of an individual to be included in a taste panel is described. The procedure is based on comparison of the organoleptic scores assigned by the individual to pairs of fish samples whose qualities are known and a set of physical measurements of the same samples. Fisher's Exact Probability Test provides a criterion for the judgement.

A general problem faced by research workers specializing in fields demanding variables measured qualitatively, is the utilization of such data for analytical purposes. Coming to fishery technology, especially with regard to Hedonic Scales (Iyer *et al.*, 1969; Iyer, 1972; Govindan, 1974) the problem is how far it is justified to treat individual judgements as measurements on a ratio scale, or how far can we say that human judgement is as good as physical judgement (Thurstone, 1927). It is proposed here to make use of both physical and sensory scores for formation of sensory panel. For this purpose an experimental procedure along with a suitable method of analysis has been described in this communication. Correlation between sensory quality and objective measurement of it has been observed by Amerine *et al.* (1965).

Methods

Take two fishes of the same species, same age and weight. By organoleptic evaluation, they should be of different qualities and roughly one fish, say B, should be twice as fresh as fish A. Keep the fishes at low temperature, test them for quality by any of the quantitative methods, say, for example TMA and note down the values of each. Again keep the fishes at low temperature.

Select a person with normal health and willing to participate in the experiment. The person may be of either sex, but he/she should be familiar with the taste of fish. Psychometrics (Guilford, 1954) tells us that the time of judgement is very important in human

judgement. At the time at which the individual is assessing the fish about 3 hours should have been elapsed since he took his last food (Amerine *et al.*, 1965). He should be given a piece of his choice from fish B which is fresher; but he should not be told anything about the quality of fish. He should be asked to taste the fish; the temperature of the fish may be raised to the level desired by him.

After having tasted this fish, he has to report his findings with regard to the taste of the fish. At the end he should be asked to assign a number which according to him, based on his personal experience, may be assigned to this particular piece of fish. He may be told that the best fish he has ever tasted may be assigned a score of 5 and the worst fish he may have tasted may be assigned a score of 1. Based on this somewhat arbitrary classification, he may be asked to assign a score to the fish he has just now tasted. Then after about 15 minutes, in the same manner, a piece of fish A is offered and the score on this is noted. After giving an interval of 3 days to avoid the effects of fatigue, the experiment may be repeated.

Using the two sets of scores, the analysis to determine the suitability of the individual to be included in the panel of judges can be carried out by the Fisher Exact Probability Test (Siegel, 1956). For this purpose, a frequency table showing the number of times the quality of one fish is judged superior to that of the other can be formed as shown below. Ties are to be omitted.

	A	B	Total
Physical	f^{11}	f^{12}	$f^{1\cdot}$
Organoleptic	f^{21}	f^{22}	$f^{2\cdot}$
Total	$f^{\cdot 1}$	$f^{\cdot 2}$	$f^{\cdot\cdot}$

The frequencies under A refer to the number of times fish A is judged superior in quality to fish B and those under B, to the number of times fish B is judged superior to fish A.

The test can be carried out either by working out the exact probabilities for the occurrence of the given distribution and more extreme ones or by referring to tables provided by Finney (1948) and given in Siegel (1956). When the smallest frequency differs from zero more than one probability will have to be worked out, the number of probabilities to be worked out being one more than the smallest frequency.

Discussion

For illustration, an artificial data is presented in Table 1. The physical measurements

Table 1. The physical and organoleptic scores for fish samples A and B (Data for illustration)

	Physical		Organoleptic	
	A	B	A	B
1.	37	17	3	1
2.	16	8	1	4
3.	38	19	3	1
4.	68	34	2	4
5.	11	12	2	1
6.	10	15	3	1
7.	25	13	2	4
8.	35	17	5	4
9.	20	10	3	5
10.	50	25	4	2
11.	63	31	5	1
12.	20	10	4	2
13.	41	21	3	4
14.	55	27	4	2
15.	25	13	5	2
16.	20	10	4	3
17.	52	27	3	4
18.	30	15	2	3
19.	80	40	5	1

assigned to fish A are the number of *Pseudomonas* present, taken in a modified form from Karthiayani & Iyer (1975) purely for the purpose of illustration. The counts assigned to fish B are half of those for fish A in all but two cases, so that fish B is twice as fresh as fish A in almost 90% of the cases. Scores from 1 to 5 were randomly assigned to fish A and B to form the organoleptic scores. (A

Table 2. Frequency tables formed for Fisher's Exact Probability Test

	A	B	Total
Physical	2	17	19
Organoleptic	12	7	19
Total	14	24	38

The exact probabilities to be worked out correspond to the above and the two more extreme distributions given below:

1.	A	B	Total
Physical	1	18	19
Organoleptic	13	6	19
Total	14	24	38

2.	A	B	Total
Physical	0	19	19
Organoleptic	14	5	19
Total	14	24	38

case where the judge is not able to distinguish the difference in quality). As described under the experimental procedure, a higher organoleptic score is associated with better quality. Keeping this in mind the frequency table drawn from this data is shown in Table 2. The extreme distributions for which the probabilities are to be worked out are also given in the table. The three probabilities are

$$P_1 = \frac{19! 19! 14! 24!}{38! 2! 17! 12! 7!} = 0.000891,$$

$$P_2 = \frac{19! 19! 14! 24!}{38! 1! 18! 13! 6!} = 0.000053$$

$$\text{and } P_3 = \frac{19! 19! 14! 24!}{38! 0! 19! 14! 5!} = 0.000001$$

Thus, when there is no difference between the two types of judgement, the probability to obtain a distribution as extreme as or more extreme than the one obtained in the example is $P_1 + P_2 + P_3 = 0.000945$. This being less than the probability corresponding to the significant level, it is to be concluded that there is difference in the individual judgement compared to judgement on the basis of physical scores (as it should be in the present case). If the p-value is greater than that corresponding to the significance level, say, 0.05 or 0.01 at 5% or 1% level, then the individual is taken in the panel as there is good agreement with his judgement and the physical measurements. Thus the larger the p, the greater are the chances of inclusion of the judge in the panel. When a judge gives equal scores for both fish samples A and B (B is twice as fresh as A) in any trial, he is to be excluded from further trials. A similar procedure can be used for other fishery products as well.

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