Development of Guidelines for the Preparation and Handling of Sensory Samples in the Scotch Whisky Industry

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ABSTRACT

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Sensory panels are used widely in the Scotch Whisky industry in a range of applications. Sensory data can play a key role in monitoring product quality or advancing flavour understanding. Therefore, the quality of this data must be high. Standard procedures for sensory evaluation outline requirements for experimental design, selection and training of panellists, and sensory room design. However, there are certain aspects of sample preparation and handling, specific to the assessment of whisky, which are not covered by these standards. This paper describes a programme of research aimed at examining these factors and their potential impact on sample condition. The results of this study have been collated, to produce guidelines for the preparation and handling of sensory samples in the Scotch Whisky industry. Following these guidelines should aid in the optimisation of sensory data quality.

Key words: blend, malt, new make spirit, nosing, temperature.

INTRODUCTION

Sensory evaluation is an important tool for both quality control and research in the Scotch Whisky industry, providing data of direct relevance to consumer perceptions. In recent years there has been increased focus on exploration of sensory and analytical correlations, with the aim of providing analytical measures that can be used to predict and control flavour character[4]. Since sensory evaluation plays a key role in whisky production, it is vital that the quality of the data produced is high. A number of factors can influence sensory data quality; experimental design, selection and training of panellists, and sensory room design. There are standard procedures in place for carrying out sensory evaluation[1]. All of the parameters mentioned previously are covered by these standards, and if they are adhered to they will go some way to ensuring quality data. However, there are also issues of sample handling and preparation that are not addressed by sensory standards, as they are specific to the appraisal of whisky. In this paper the factors that could potentially affect sample condition have been identified, and research carried out to evaluate their impact. Results of this study have allowed guidelines to be drawn up, specific to the preparation and handling of Scotch Whisky samples for sensory evaluation. Following these guidelines should aid in the optimisation of sensory data quality.

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IDENTIFICATION OF FACTORS THAT COULD POTENTIALLY AFFECT SAMPLE CONDITION

Sensory evaluation in the Scotch Whisky industry differs from sensory evaluation in most other food industry applications as assessments are traditionally based on aroma only (referred to as nosing) and samples are not ingested. Why nosing became the routine means of flavour assessment is not well documented. However, the traditional blender (a single sensory expert) would assess numerous samples on a daily basis. The detrimental effects of consuming large amounts of high strength spirit on both health and judgement are obvious. Nosing allows full assessment of the aroma characteristics of a whisky, which are the key attributes in terms of product quality.

The routine procedure for the assessment of Scotch Whiskies is to dilute the samples to 20% alcohol by volume (abv) prior to nosing. Such dilution decreases the perceived pungency (alcohol burn), which results from the presence of ethanol and makes high strength samples uncomfortable to nose. Since the samples are not ingested, the same sample can be shared among a number of panellists.

If sensory assessments are carried out using the standard procedure outlined above, there are three factors that could potentially affect sample condition;

- General sampling and preparation issues
- Effects of sample sharing
- Effects of temperature

Each of these areas is dealt with separately in the following sections.

METHODOLOGY

Throughout this research the sensory tests were performed in accordance with British Standards for Sensory Evaluation (BS5929)[1].

Aliquots (30 mL) of whisky (diluted with water to 20% abv) were presented in 130 mL volume clear nosing glasses, covered with watch glasses. Assessments were carried out by the Institute's internal sensory panel. This panel was comprised of 20 highly trained members of staff who had undergone extensive sensory training and had substantial experience in the assessment of whiskies. The majority of the panel also had additional scientific expertise in whisky. A minimum of 10 panellists participated in each test. Assessments were carried out in individual booths, under red light, to overcome any bias resulting from sample colour. Data were collected using sensory software (Compusense 5 V3.8, Compusense Inc., Guelph, Canada).

In the Scotch Whisky industry there are 4 types of samples that commonly undergo sensory assessment;

- Malt whisky: The mature (3 years$^+$) product of an individual malt distillery
- Grain whisky: The mature (3 years$^+$) product of an individual grain distillery
- New make spirit: Unmatured spirit from either a malt or grain distillery
- Blended whisky: A blend of mature malt and grain whiskies from a number of distilleries.

In this research the effects of sample preparation and handling were examined for the full range of sample types.

GENERAL SAMPLING AND PREPARATION ISSUES

General sampling and preparation should be carried out in accordance with standard procedures for sensory evaluation[2]. It is important to ensure that the sample taken is representative of the product being tested. Samples should also be coded in a manner that makes them not readily identifiable, e.g. using three-figure random codes.

There are no standard procedures specific to the preparation of whisky samples for nosing. However, through interpretation of the general sensory procedures[1] and experience of running sensory tests for the evaluation of whiskies, the following recommendations have been formulated.

It is important that appropriate nosing glasses are used (standard tulip-shaped glasses). All glasses in a test should be of the same specification. The glassware must be clean, and should not impart a taint to the product. Washing in detergent should be avoided. The amount of sample in each glass should allow for sufficient headspace above the product (around 20–25% full), and all glasses in a test should contain the same amount of sample. The glasses should be covered with watch glasses immediately, to trap the volatiles in the headspace above the sample. These watch glasses should be kept in place between assessments.

EFFECTS OF SAMPLE SHARING ON SAMPLE CONDITION

Sensory tests in the Scotch Whisky industry generally involve the advanced preparation of sets of samples, which are then nosed by a number of panellists. The sharing of samples provides a number of advantages. Sample costs are minimised, which is particularly important as whisky is a high value product. Tests can be carried out even if there is a limited amount of sample available, and the time involved in sample preparation is lower than it would be if fresh samples had to be prepared for each panellist. Although the benefits are apparent, such sample sharing could have a number of potential effects on sample condition. These have not previously been investigated.

The aspects of sample sharing that could potentially impact on sample condition are as follows;

a) Effects of advanced preparation on sample condition. Samples are prepared in advance of assessment, as all panellists cannot nose the same samples at the same time. This advanced preparation time can extend to long periods, depending on the availability of the panellists. It is possible that changes in the aroma (intensity or character) of the sample could occur over time.

b) Effects of repeated nosing on sample condition. Repeated nosing of a sample could lead to significant decreases in the level of flavour active volatiles.

c) Time interval required for headspace regeneration. Nosing may deplete the headspace of aroma volatiles above the sample, and it may take time to regenerate. If this did occur then a panellist nosing a sample immediately after another panellist would not be evaluating the sample in the same condition as the first panellist.

a) Effects of advanced preparation on sample condition

Tests were carried out to determine whether or not whisky samples change in the glass if prepared in advance of assessment. Triangle Tests[3] were used to compare freshly poured samples with ones that had been prepared eight hours earlier (but left covered and untouched). This time interval was selected to replicate the maximum period of time (1 working day) that samples might realistically be prepared in advance of assessment.

These tests were carried out for a range of Scotch Whisky samples; three blends, three malts and a single grain whisky. The effects of advanced preparation on three new make spirits were also studied. However, a problem was encountered in these tests. When new make spirit is diluted, heat is generated due to its high initial alcoholic strength. This meant that panellists could readily pick the difference between the freshly poured and the previously prepared samples based on temperature. Therefore for new make spirit, nine-hour-old samples were compared with 1-hour-old samples. Again this replicated the 8-hour advanced preparation time, but overcame the problems of temperature generation. The results are summarised in Table I.

Significant sensory differences were observed for the malts, grain and new make spirits, but not for the blends. Where differences did occur, the advanced preparation time was reduced to 6 hours and the tests repeated. Results of these tests revealed no differences between the fresh samples and ones prepared 6 hours earlier.

In summary the blended Scotch Whiskies were more stable over time than single whiskies (malts or grains) or new make spirit, and could be prepared 8 hours in advance of assessment with no detrimental effect on sensory

character. The single whiskies and new make spirits did change over an 8-hour period. However, no detectable changes were observed when the advance preparation time was reduced to 6 hours. It should be emphasised that although changes were identified they were extremely subtle, being difficult to pick out even on direct comparison of the samples. The product-to-product variation indicates that effects probably depended on the initial characteristics of the sample. Blended Scotch Whiskies are created so that they have a rounded character, with fewer distinctive sensory peaks than unblended whiskies. Therefore it is not wholly unexpected that sensory changes were less readily identified in blends. Single malt and grain whiskies and new make spirit have more complex flavour profiles, each with their own distinctive aroma notes. Changes in sample character over time were more apparent in these types of products.

Results of this research indicate that, wherever possible, the length of time between preparation and assessment should be minimised. In tests where samples are being directly compared (e.g. Difference Tests) care should be taken to ensure that the time between preparation and assessment is the same for all samples. For example, if one of the samples is spilled during the course of a sensory session, then all of the samples in the set should be replaced. If this is not carried out, differences between the fresh sample and the remaining samples could be identifiable, and could skew the results of the test.

b) Effects of repeated nosing on sample condition

Sharing means that samples are repeatedly nosed over the course of a sensory session. Tests were carried out to examine whether or not repeated nosing has an effect on sensory character. A range of sample types were examined; three blends, three malts, one grain and three new make spirits. Two sets of sample were prepared for each product. The first set was prepared and left covered and untouched. The second set of samples was prepared in an identical manner, but was nosed 10 times over the course of the day. Triangle Tests[3] were then used to compare these two sets of samples. In this test the samples had to be prepared in advance of assessment, as the repeated nosing had to take place over a period of time. The advanced preparation time was the same for both the untouched and the "nosed" samples, being set at eight hours for the blended whiskies and six hours for the single whiskies and new make spirits. The results are summarised in Table II.

Again blends appeared to be most stable, with no differences observed. The stability of the single whiskies (malts and grains) and new make spirits varied. Repeated nosing altered the sensory characteristics of some of these products, while no significant effects were observed for other products. Again these effects probably depend on the initial sensory characteristics of the samples. It is important to note that even where differences were observed they were extremely subtle, being difficult to pick out even on direct comparison of the samples.

Results of this research indicate that, wherever possible, the number of panellists assessing the same set of samples should be minimised. In tests where samples are being directly compared (e.g. Difference Tests), care should be taken to ensure that the number of times each of the samples in the set has been nosed is the same. For example, if one of the samples is spilled during the course of the sensory session, then all of the samples in the set should be replaced. If this is not carried out, differences between the fresh sample and the remaining samples could be identifiable, and could skew the results of the test.

c) Time interval required for headspace regeneration

Volatile, aroma active compounds gather in the headspace of the glass above the liquid phase, and are trapped by the watch glass cover. It is these aroma volatiles that are assessed during nosing. Tests were carried out to determine whether or not nosing would significantly deplete the levels of volatiles in the headspace. In other words, would a panellist nosing a sample immediately after another panellist get the full impact of aroma volatiles, or is a time interval between assessments required to allow the headspace to regenerate.

Three Scotch Whisky samples were tested: one blend, one malt and one new make spirit. Each product was tested individually, using the same methodology. The first step was to prepare three identical samples for each panellist. One of these samples was presented to the panellist, who was asked to nose it and carry out a descriptive appraisal. This sample was returned to the experimenter, re-coded and presented back to the panellist alongside the other two untouched samples. A Triangle Test[3] was immediately car-

TABLE I. Results of Triangle Tests comparing fresh samples with ones prepared 8 hours in advance of assessment.

Sample	Results of Triangle Test (no. correct/ total no.)	Level of significance (ns = no significant difference)
Blend A	5/11	ns
Blend B	3/13	ns
Blend C	5/14	ns
Malt A	9/13	Significant difference ($p = 0.009$)
Malt B	9/14	Significant difference ($p = 0.017$)
Malt C	9/14	Significant difference ($p = 0.017$)
Grain A	8/13	Significant difference ($p = 0.035$)
New Make A	12/16	Significant difference ($p = 0.038$)
New Make B	12/16	Significant difference ($p = 0.038$)
New Make C	11/14	Significant difference ($p = 0.029$)

TABLE II. Results of Triangle Tests comparing untouched samples with ones that had been nosed 10 times.

Sample	Results of Triangle Test (no. correct/ total no.)	Level of significance (ns = no significant difference)
Blend A	7/15	ns
Blend B	8/15	ns
Blend C	8/15	ns
Malt A	6/13	ns
Malt B	8/13	Significant difference ($p = 0.035$)
Malt C	9/15	Significant difference ($p = 0.031$)
Grain A	7/15	ns
New Make A	7/15	ns
New Make B	7/14	ns
New Make C	9/14	Significant difference ($p = 0.017$)

ried out to determine whether or not the panellist could pick out the sample that had just been nosed from the other two. These tests were performed on freshly poured samples. The tests were then repeated using samples that had been prepared six hours in advance of assessment. This was carried out in order to test the hypothesis that the headspace may take longer to regenerate in older samples.

No significant differences were observed in any of the tests, for all three product types, and for both freshly poured and older samples. These results indicate that the level of aroma volatiles in the headspace above a whisky sample is not significantly depleted on nosing. Therefore, a panellist can nose a set of samples immediately after another panellist, without the need for a time interval to be imposed between assessments.

EFFECTS OF TEMPERATURE

Although the temperature in a sensory room should be controlled, fluctuations can occur over the course of the day, particularly in rooms with windows. Such changes in temperature could potentially have an impact on sample condition. Research was carried out to explore the effects of temperature. This research was divided into two sections;

a) Effects of temperature fluctuations on sample condition. Rises or drops in room temperature could potentially affect the condition of a sensory sample, making it change more rapidly when prepared in advance, or vice versa.

b) Effects of nosing samples at different temperatures. Samples could potentially have different aroma characteristics depending on the temperature at which they are nosed.

a) Effects of temperature fluctuations on sample condition

Research outlined in the previous section demonstrated that samples can change if prepared in advance of assessment. It is possible that these changes are temperature dependant. It was hypothesised that an increase in temperature for a prolonged period might accelerate changes in aroma.

In order to examine the potential effects of a rise in room temperature, two identical sets of samples were prepared. Half of these samples (the test samples) were held at 30°C for 4 hours, then allowed 2 hours to come back to room temperature (21°C). The Control samples were held for the full 6 hours at room temperature. The two sets were compared using Triangle Tests[3]. This was carried out for three Scotch Whisky products; one blend, one malt and one new make spirit. Results revealed no sensory differences between the Test and Control samples, for all 3 product types. The temperature used (30°C) was more extreme than is ever likely to occur under normal test conditions. Results demonstrated that even an extreme rise in temperature, for a prolonged period of time, was unlikely to have a significant influence on sample condition – if the samples are not repeatedly opened and tested during this time.

Similar tests were carried out to look at the possible influence of a drop in room temperature. Again two identical sets of samples were prepared, with the Test samples being held at 5°C for 4 hours, then allowed 2 hours to come back to room temperature (21°C). Tests on the same three products again showed no effects on sensory character. Therefore, even an extreme drop in temperature, for a prolonged period of time, is unlikely to have an impact on sample condition.

In summary, fluctuations in temperature in the sensory room are unlikely to have a major impact on the condition of sensory samples, if the samples are allowed to equilibrate to room temperature before nosing. The potential effects of nosing samples at different temperatures are explored in the next section.

b) Effects of nosing samples at different temperatures

If the temperature in the sensory room does vary, the temperature of the samples will also vary. Research was carried out to determine whether or not the temperature at which a sample is nosed affects it flavour profile.

Quantitative Descriptive Analysis[5] was used to compare the flavour profiles of products at three different temperatures; 5°C, room temperature (21°C) and 30°C. Three products were examined; one blend, one malt and one new make spirit. The panel scored the samples for the following characteristics:

- Malt and blend – pungent, phenolic, feinty, cereal, aldehydic, estery, sweet, woody, oily, sour, soapy, sulphury and stale.
- New make spirit – pungent, phenolic, feinty, cereal, floral, aldehydic, estery, solventy, oily, sour, soapy, sulphury, meaty, stale and clean.

Mean scores were calculated across the panel, and the results displayed in the form of spider diagrams (Figs. 1, 2 & 3). Nosing temperature was found to have a significant impact on perceived aroma. The observed effects were

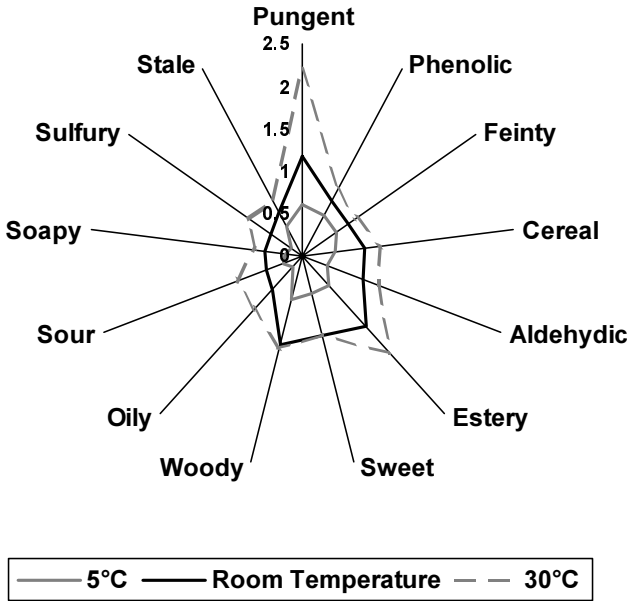

Fig. 1. Flavour profiles of a blended Scotch Whisky at three different temperatures.

similar for all three products. At low temperature pungency and overall intensity of aroma were lower than at room temperature. At high temperature the opposite effect was observed, with much higher pungency and higher scores for other flavour characteristics.

Although 5°C and 30°C were more extreme than would generally be encountered in the sensory room, this research highlights the potential effects of nosing samples at different temperatures. As the temperature is raised, it can be assumed that a greater amount of flavour volatiles enter the headspace, as the intensity of all of the sensory attributes increase. There is, however, a simultaneous increase in pungency, which makes nosing uncomfortable. It is important to note that even although aroma intensity is altered at different temperatures, the overall flavour profile of the samples remains the same. Standard room temperature (in Scotland around 21°C), as well as being most convenient, is probably best suited for nosing whiskies and new make spirits, as at this temperature there is a balance been aroma intensity and pungency.

In summary, the temperature at which a sample is nosed has a major impact on sensory character. This is likely to be of greater importance than the effects that result from sample sharing. When running sensory tests a comfortable room temperature should be maintained (~21°C). Under no circumstances should samples at different temperatures be directly compared, and all samples should be allowed to equilibrate to room temperature before nosing. The nosing of cold samples should be avoided, as at lower temperatures flavour characteristics are suppressed.

DEVELOPMENT OF GUIDELINES

The findings of this research have allowed guidelines for the preparation and handling of sensory samples in the Scotch Whisky industry to be drawn up. These guidelines follow.

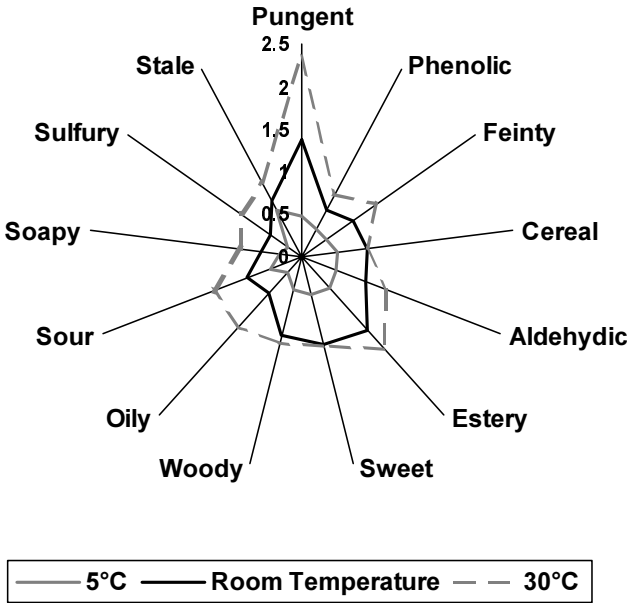

Fig. 2. Flavour profiles of a malt Scotch Whisky at three different temperatures.

GUIDELINES FOR THE PREPARATION AND HANDLING OF SENSORY SAMPLES IN THE SCOTCH WHISKY INDUSTRY

General preparation and presentation

- Ensure that the sample taken is representative of the product being tested.
- Samples should be coded in a manner that makes them not readily identifiable, e.g. using three-figure random codes.
- Appropriate nosing glasses should be used. These must be of the same specification for each of the samples being presented.
- Ensure that all glassware is clean and will not impart a taint to the product. Detergent should not be used for washing sensory glassware.
- Standard tulip shaped nosing glasses should be used.
- Samples should all be nosed at the same strength. Generally dilution to 20% abv is recommended. The water used for dilution should be free from taints.
- The amount of sample in each glass should allow for sufficient headspace above the product (around 20–25% full). All glasses in a test should contain the same amount of sample.
- Nosing glasses should be covered with a watch glass to trap the volatiles in the headspace above the sample. These watch glasses should be kept in place between assessments.

Sample sharing

- The length of time between sample preparation and assessment should be minimised (particularly when assessing single whiskies and new make spirits).
- The number of panellists assessing the same set of sam-

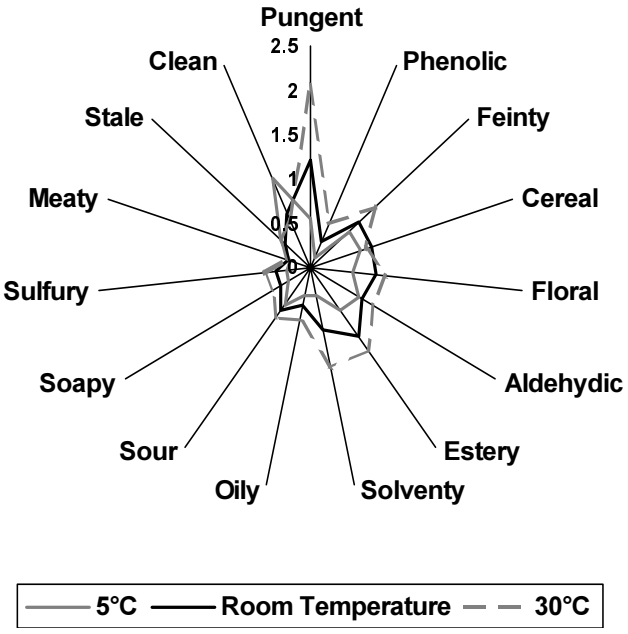

Fig. 3. Flavour profiles of a new make malt spirit at three different temperatures.

ples should be minimised, within the practical constraints of sample volumes and available preparation time (particularly when assessing single whiskies and new make spirits).
- In tests where samples are being compared, if one of the samples is spilled then all of the samples should be replaced. If not, differences might be detected between the freshly poured sample and the remaining sample/ samples causing erroneous results.
- There is no need to enforce a time interval between panellists assessing the same set of samples.

Control of temperature

- The sensory room should be held at a comfortable working temperature and fluctuations in temperature should be avoided.
- Samples should be allowed to equilibrate to room temperature before assessment.
- When samples are being directly compared it is important to ensure that they are at the same temperature.
- Nosing of cold samples is not desirable as the overall aroma character is suppressed at lower temperatures.
- Nosing of warm samples (above standard room temperature) is also undesirable, due to increased pungency and irritation which can lead to more rapid fatigue of assessors.

CONCLUSIONS

Adherence to these guidelines will ensure that sensory samples are presented to the panellists in optimum condition. This will help to achieve the goal of high quality sensory data. However, issues of experimental design, and panellist training and monitoring should not be overlooked and must also be carefully controlled.

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