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Unravelling the art of feints recycling for whisky: a production survey

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Abstract

Why the work was done: Batch distillation is used globally to produce a number of different categories of spirit using a variety of methodologies. This work aims to gain a better understanding of the current institutional knowledge on batch distillation techniques for the various categories of whisky, including the recycling and processing of 'final runnings' or the 'tails' fraction.

How the work was done: A survey was designed to gain insight into current distilling knowledge and practice. Sixty distillers from eight countries respnded to the survey and reported their distillation practices with particular emphasis on how decisions are made regarding where the individual liquid fractions begin and end during distillation and how the feints ('heads' + tails') are subsequently handled.

What are the main findings: Of the 60 distillers surveyed, 59 responded that they recycled feints in some way and 93.2% of those respondents noted that the feints did appear to stabilise after a few distillation cycles. The majority (75%) noted that there is a cost benefit to recycling feints and 61.7% also felt that feints recycling improved the character of the overall spirit.

Why is the work important: Despite the prevalence of recycling feints, little is understood about how this process affects spirit character or why the phenomenon of stabilisation occurs. This and further research, will provide distillers with better insight into their practices and offer tools for continued improvement in spirit quality.

Keywords

whisky; feints; tails; heads; hearts; batch distillation; pot still; distillation technique; survey

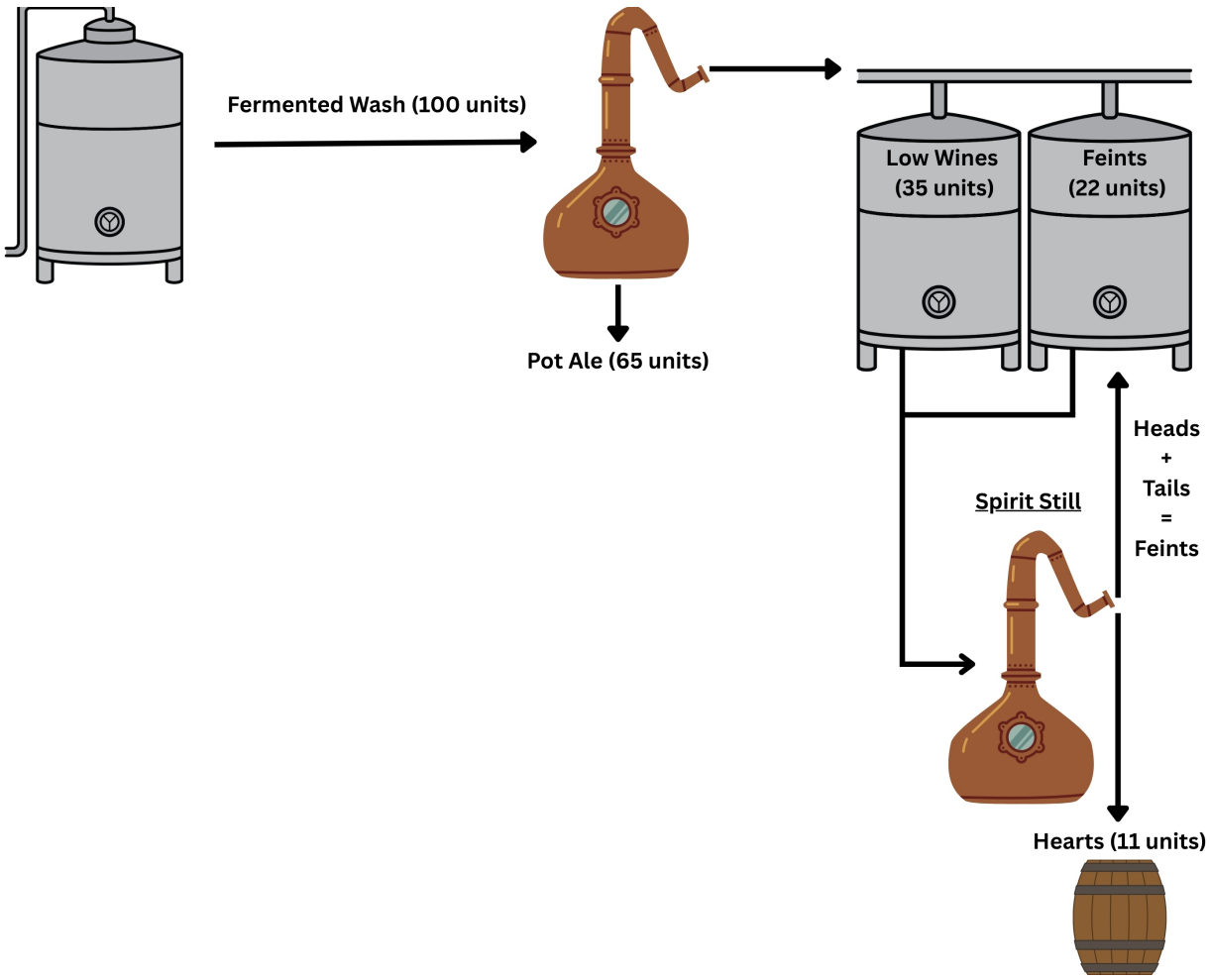
Introduction

Whisky, as defined by the European Union, is a distilled spirit produced from the distillation of fermented cereal grains, distilled to less than 94.8% alcohol by volume (ABV) and matured for at least three years in wooden casks of a volume not exceeding 700 litres (*https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32019R0787*). In bottle, whisky has minimum alcoholic strength of 40% ABV. Other countries may impose slightly different definitions, but all modern forms of commercial whisky are spirits distilled from grain in such a manner to retain some character of the original substrate (*https://www.ttb.gov/system/files/images/pdfs/beer-bam/chapter4.pdf2007*).

Globally, there are multiple modes of whisky distillation, though most are either continuous or batch distillation. Continuous distillation is when the fermented substrate is continuously pumped into a distillation column heated by steam, and a continuous stream of product distillate is collected (Buglass et al. 2011). Batch distillation (Figure 1) is practiced with a variety of spirit categories including whisky, rum, gin, brandy, and vodka. Compared to continuous distillation, the concept and general practice of batch distillation is older and relatively inefficient. However, many distillers practice batch distillation due to regulations guiding the production of specific spirit categories, a preference for the mode of production or the character of the spirit it produces. For instance, in Scotland, single malt whisky is legally required to be distilled using a batch process *(https://www.legislation.gov.uk/uksi/2009/2890/contents)*.

The process of batch distillation is relatively simple. A discrete volume of fermented liquid is transferred into a distillation vessel which has a direct or indirect heat source. The liquid

Figure 1. Typical two stage distillation process for the production of whisky



is heated to its boiling point, driving alcohols, aroma compounds (congeners), and water into a vapour state. The vapours are directed towards a condenser where they are cooled back to a liquid and collected into appropriate receiving vessels. The resulting distillate - referred to as 'low wines' - is typically redistilled (Allen 1897). Upon redistillation, care is taken to fraction or 'cut' the distillate at different points, redirecting the flow of liquid to different receiving vessels depending on flavour of the emerging distillate. The first flow of liquid that comes off the still is referred to as the 'heads', 'foreshots' or 'fores' and is composed of congeners responsible for solvent or orchard-like aromas which are generally deemed undesirable in the final commercial product. As these aromas fade, the distiller will direct the flow of distillate to the 'hearts' or 'spirit' receiver. This is the fraction of the distillate containing the most ethanol and sensorially the most desirable (Wolstenholme 2023). With further distillation, the spirit takes on negative sensory characters and is redirected to the 'tails' receiver. The tails contain esters and acids of increasing chain length (ethyl lactate and caprylic, capric, and lauric acids), but also contain a significant amount of ethanol (Esteban-Decloux et al. 2023; Douady et al. 2019; Monica Lee et al. 2001). Once the distillation ends, the heads and tails fractions (feints) are either disposed of or recycled into a subsequent distillation to recover the ethanol and congeners (*https://assets.publishing.service.gov.uk/media/5fd36667e90e07662ed92c85/Scotch_Whisky_Technical_File_-_June_2019.pdf*).

The recycling of feints ('heads' + 'tails') into subsequent distillations is important to many distillers as it enables the recovery of ethanol and increases the intensity of the spirit character (Kelly et al. 2023). It has also been noted, that after several distillations the feints stabilise in volume, alcohol content, and organoleptic character (Schidrowitz and Kaye 1906). However, the recycling of feints within the distillation process and the subsequent impact on the quality of new make spirit has not been extensively explored within the literature.

The aim of this study was to establish an understanding of current 'institutional knowledge' within the whisky industry around current practices and motivation for feints recycling. The purpose was to insight into current methodologies and the underlying reasoning of the batch distillation of whisky and other distilled spirits.

Methods and materials

A combination approach was undertaken to reach and engage with as many distillers as possible in this research study.

The approach was based on an initial survey, which could then be followed up by an optional online interview. The research had ethical approval from the School of Engineering and Physical Sciences Ethics Committee at Heriot-Watt University, Scotland (Project #9693).

Survey execution

Internal discussions determined the purpose of the project and rationale behind the survey, allowing a set of questions to be devised (Table 1).

Participants were recruited through sharing a brief, outlining of the basic premise of the survey and requesting participants. This was posted to various distilling industry forums, including LinkedIn, The American Distilling Institute, and Heriot-Watt's International Centre for Brewing and Distilling alumni network. The text was periodically reposted every few weeks to garner more potential respondents.

Interested participants were asked to connect to the research team via email. Once connected, participants were encouraged to ask questions surrounding their participation in the survey. On reaching agreement, participants were sent the questionnaire (Table 1) in the body of an email and were asked to complete the survey in a timely manner, responding either in a separate document or in the body of the email itself.

All responses were treated confidentially so as to ensure that no responses or subsequent analysis would compromise the intellectual property or proprietary production methodologies of an individual or company. Respondents were given the option to answer all or only some of the questions.

Responses were collected and aggregated using Microsoft Word and Excel. Data responses were organised by question. To simplify data analysis, responses were formatted into ranges and categories wherever appropriate.

Table 1. Survey and rationale behind the questions.

Question	**Rationale**
How do you define the following terms: heads/foreshots, hearts/spirit, tails, feints?	To establish if there is a shared lexicon among the respondents. It was also intended to clarify any potential confusion when comparing answers from one distiller to another.
How do you decide and at which point(s) do you 'cut' your spirit fractions (heads/foreshots, hearts/spirit, tails/feints)?	This question was to gain a better understanding of the decision matrix that distillers use to decide where one liquid distillate fraction ends and another begins. For example, when to stop collecting heads and switch to collecting hearts or product spirit.
Do you recycle the non-heart/spirit fractions? If so, how?	This question aimed to understand how the non-product fractions ('heads', 'tails' and/or 'feints') are further processed (if at all) by respondents.
How many cycles do you recycle the foreshots and feints? If at some point you do reach a maximum number of cycles and stop recycling, what do you do with the feints?	This question sought to gain further understanding of how the non-product fractions are handled and processed in the distillery.
Do you find that the volume (liquid and total alcohol basis) stabilises after a number of cycles? If so, how many cycles does it take to reach that point? If not, what does your distillery do to manage the liquid streams?	This question sought to gain insight into the curious phenomenon of feints reportedly stabilising in both volume and organoleptic character after several distillation cycles.
On a unit of alcohol basis what is the percentage of feints charged into the still compared to amount of low wines?	This question was intended to make the comparisons between distillers and their techniques easier to quantify numerically.
In what way do you feel the recycling of foreshots and feints contributes to the final hearts distillate (either positively or negatively)?	This question was to gain insight into why a distillery may or may not recycle the non-product fractions in their production methodology.

Results

The questionnaire was sent to 101 people who expressed interest in participating in the study. From this initial campaign, 75 people responded with answers to the interview questions (a response rate of 74.3%). The respondents represented distilleries or industry agencies (such as consultancies) from 12 countries. Many respondents gave answers and data for multiple spirit categories. For instance, where a distiller produced both whisky and brandy, they may have responded to questions for both spirits. The total number of responses when including all spirit categories was 89. Of these responses, 60 (representing eight countries (Table 2)) considered some type of batch distilled whisky production (such as single malt or bourbon).

Sixty responses were recorded for how decisions are made regarding the cut point from heads to hearts during distillation. With few exceptions, the head to heart cut point was based on one or a or a combination of six decision factors: time, alcohol concentration (ABV), volume, vapour temperature, sensory assessment and a demisting test (where distillate is mixed with filtered water and assessed for visual cloudiness – when the spirit is clear, the cut can be made) (Nicol 2022).

Of the responses, 32 reported that they relied on one of the above methods to base their cut from heads to hearts. The most heavily weighted decision factor was sensory analysis with 43.8% citing it as the method for determining the head to heart cut point. Volume and alcohol concentration (ABV) were reported by 18.8% of respondents as the sole decision factor for cut from head to hearts. Time was used by 12.5% of respondents with temperature and the demisting test reported by 3.1% of respondents. Of the remaining respondents, a combination of decision factors was used. Twelve respondents used two decision factors, 12 used three decision factors, and four used four decision factors (Figure 2).

Interviewees were asked about the decision factors they use to determine the cut point from hearts to tails in the later stage of the whisky distillation. Five decision factors were identified: time, alcohol concentration (ABV), volume, temperature, and sensory analysis. Of the 58 respondents, the majority (70.7%) used just one decision factor for the cut point from hearts to feints/tails with 51.2% using alcohol concentration and 43.9% using sensory analysis (Figure 3).

Of the 60 responses, only one did not recycle the non-heart fractions (feints). There were 59 responses to whether feints stabilise over time, with 93.2% reporting that (given enough recycles) the feints volume and character stabilise. Of these, 23 respondees did not indicate how many recycles were needed for the feints volume to stabilise. Of the remaining respondents, 18 said that feints would stabilise within one to three distillation cycles with 17 reporting that stabilisation occurred between four and 15 cycles. The remaining respondee did not report the number of cycles but noted that stabilisation occurred within two to three weeks. When asked how many distillations feints could be recycled, 47 (79.7%) of respondents stated that feints could be

Country	Number of respondents	% of total respondents
Argentina	1	1.7
Australia	4	6.7
Austria	1	1.7
Canada	2	3.3
Ireland	5	8.3
Sweden	1	1.7
United Kingdom	21	35.0
United States of America	25	41.7

Table 2. Respondents by Country

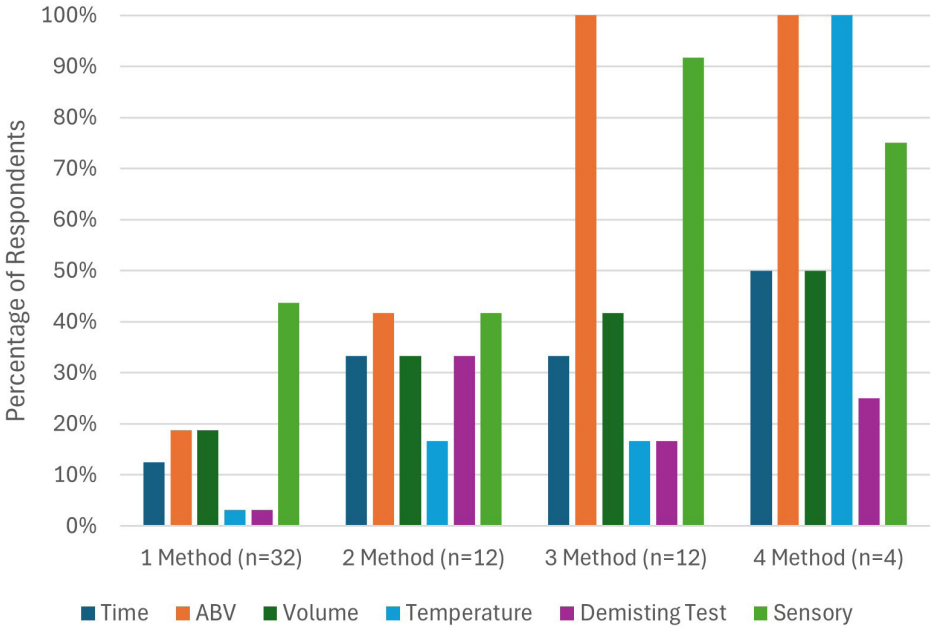
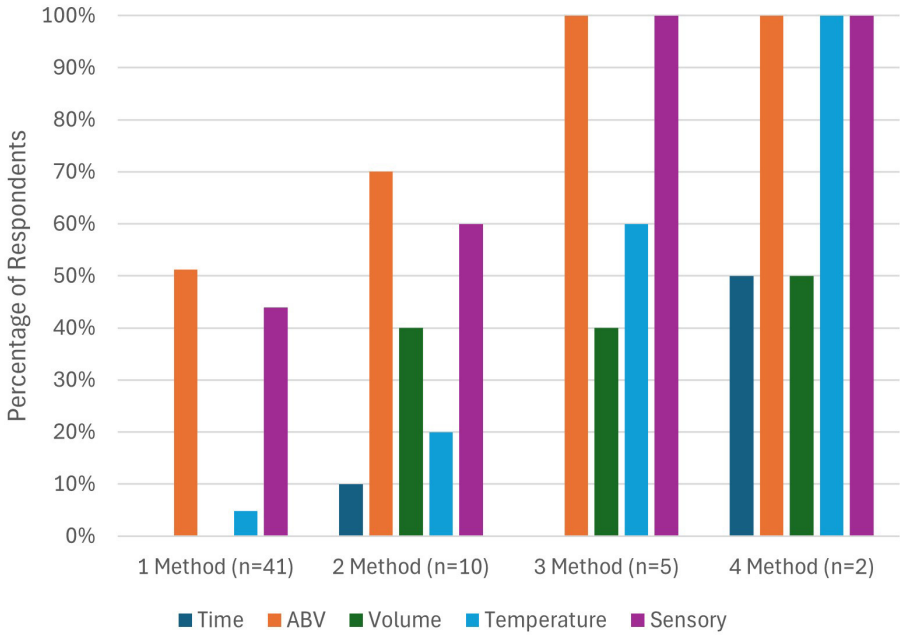


Figure 2: Decision factors used by respondents (%) to determine the head to heart cut point. Illustrating where one method, or a combination of methods are used from time, % alcohol by volume (ABV), temperature, demisting and sensory checks.

Figure 3: Decision factors used by whisky distiller respondents (%) to determine the hearts to tails cut point. Illustrating where one method or a combination of methods are used from time, % alcohol by volume (ABV), volume collected, temperature and sensory checks.



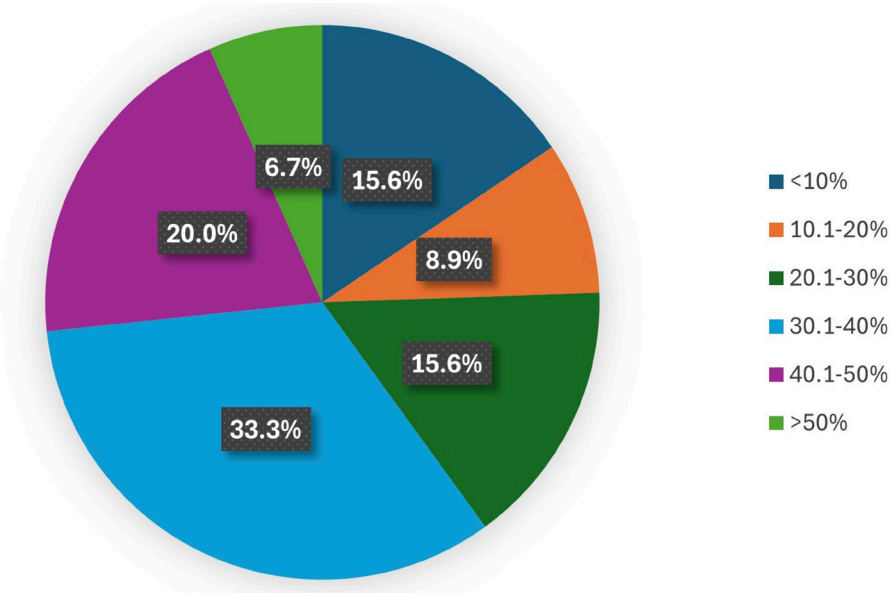


Figure 4: Range (%) of recycled feints volume in surveyed whisky charges.

recycled for an infinite number of cycles without any change in volume (total volume of collected feints and hearts fractions) or spirit character.

Fifty-one responses were given to what percentage of the distillation charge was composed of feints. Figure 4 shows that this ranged from < 10 to > 50%, with a third of respondees reporting that 30-40% of the distillation charge was from feints.

When asked about the pros and cons of feints recycling, most distillers reported net positive benefits to the practice. Of the 60 respondents, 75% noted a cost benefit to recycling feints with 61.7% indicating that feints improved the character of the spirit. Further, 21.7% of respondents indicated that recycling feints contributed to consistency between batches. A smaller percentage (11.7%) considered recycling of feints to have an adverse effect on spirit character. Of those seven respondents, five noted a positive benefit to the practice elsewhere implying a potential trade off.

It was important to understand how many distillation stages each distillery used to produce their whiskies. Most respondents noted whether they utilised a one, two, or three stage distillation process in their responses to other questions. Where answers were not clear, the respondents were contacted again. Within the group of 60 distillers, the majority (83.3%) used a traditional two-stage distillation process. A single stage distillation process was used by 10% with 6.7% using a three-stage process.

Discussion

For single method distillers, sensory analysis was used by 43.8% of respondents in determining the cut point between the heads and hearts fraction. However, as the number of methods for the cut point increased, sensory analysis became less important with increasing emphasis on alcohol concentration and still temperature. Depending on the scale of the operation, sensory analysis can add complexity with differences in taste and aroma perception between individuals (Strickland 2021). Therefore, in some distilleries with multiple distillers and shifts, sensory analysis may be deemed potentially too inconsistent. Further, as one respondent noted there may be compliance issues where they are not legally allowed to come into physical contact with the distillate. A multi-method decision process to determine cut points is often desirable. Unlike sensory assessment, measurement of temperature and ABV is not subjective. Temperature is measured by inline thermometers at strategic points in the vapour path inside the still. Alcohol is measured through densitometry via NIR-based electronic handheld devices, picnometry, or glass hydrometers (Santos 2021). It has previously been suggested (Thomas et al. 2023) that distillers use time as the primary decision factor for the cut point between heads and hearts, but this was not confirmed in this study.

Overall, sensory analysis was an important decision factor for all groups when determining the cut point from hearts to tails, however in the single methodology group, measurement of alcohol concentration was more widely used.

Of the distillers who participated in the survey, only one (of 60) did not recycle their feints in any way. Of the remaining respondents, 57 reported that they recycled the feints into subsequent spirit distillations, with no variation to the number of distillation cycles that were practiced. Interestingly, three respondents (all using 2-stage distillation) opted to distil their feints in separate distillations and then blend the hearts fraction back into the hearts from previous distillations.

A clear majority of respondents (93.2%) reported that feints could be recycled indefinitely and that the volume and characteristics of the resulting distillates stabilise. The phenomenon of feints stabilisation has been noted fleetingly before (Schidrowitz and Kaye 1906; Hastie 1925; Muller 1992; Esteban-Decloux et al. 2023). To the best of our knowledge, there is no publicly available explanation of this phenomenon. Indeed, it may be argued that unwanted compounds in the feints fractions would continue to compound as the number of distillation cycles increases. This does not seem to be the case for the vast majority of respondents.

The volume of feints folded back into subsequent distillations was varied. While 60% of the respondents utilised 30-50% or more of feints in their still charges, 40% of the distillers utilised much less. The quantity of feints recycled is affected by distillation technique, equipment, and choices on

.the part of the distiller. For instance, one distiller commented that they recycled the heads fraction into the next spirit distillation, while the tails fraction was recycled with the next wash distillation, keeping the feints split into their constituent parts. Here, they reported two figures, 23.1% heads into the spirit distillation and 25% tails into the wash distillation (as total alcohol).

Respondents were asked to report on the amount of feints recycled in terms of absolute alcohol (litres of pure alcohol or proof gallons). Many were unable to offer more than approximations. Often feints were automatically mixed in with the low wines in predetermined tanks without prior measurement. For instance, one respondent reported that they added 26.5 litres of heads back into 800 litres of fermented wash. Which, by volume equates to the heads contributing 3.2% of the charge. However, since the heads contain a higher concentration of alcohol per unit volume than the fermented wash, it is assumed that the contribution of the heads (as pure alcohol) is higher.

When asked about the benefits and/or disadvantages of recycling feints, 75% of respondents noted that there is a significant economic advantage as the heads and tails contain significant levels of alcohol. On an absolute alcohol basis, 60% of respondents reported that the feints composed 30.1% to over 50% of the still charge. Were the distiller to dispose of the feints instead of recycling them, this would be a large cost to the distillery and increase the cost of goods sold. Indeed, the economic benefits were sufficiently important that 8.3% of respondents reported that although they felt the recycling of feints to be detrimental to spirit character, the practice was worthwhile over the financial implications of disposal.

However, 61.7% of respondents felt that recycling feints added positive character to the final spirit. One respondent noted that the practice increased ‘spirit texture’, another noted the ‘tails add complexity’ and another reported an increase in ‘flavour intensity’. In other spirits (Da Porto et al. 2010), the recycling of feints increases congeners (esters, aldehydes, and higher alcohols) in the hearts which may contribute an increased flavour perception.

Conclusions

This study has shown a wide array of distillation techniques and spirit management methodologies. The use of a two-stage distillation is common in whisky and many of the techniques reported by respondents are similar to those discussed elsewhere (Strickland 2021; Nicol 2022). However, it was noted that there was a wide array of approaches to fraction management and decision factors on display.

It was noted that most distillers recycle the spirit/heart fractions in some manner. While there may be differences in how distillers recycle these fractions, there is strong belief that after a series of distillation cycles, the amount and character of these fractions achieve a stabilised equilibrium that persists indefinitely. Several respondents noted the importance of these practices, and that the stabilisation phenomenon confers consistency between distillation batches. However, there is currently no publicly available explanation that addresses this. Future work will explore the phenomenon of feints stabilisation in a commercial distillery so as to ascertain the 'why' and the 'how' feints chemically and volumetrically stabilise over time. This work will offer distillers insight on how to best manage and inform their liquid management practices.

CRediT author contributions

Matt Strickland: conceptualisation, methodology, investigation, writing (original draft).
Dawn Maskell: conceptualisation, writing (review and editing), supervision.

Conflict of interest

The authors declare there are no conflicts of interest.

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