KININVIE®

KININVIE WORKS WHITEPAPER 001

OBJECTIVE:

To investigate the influence continuously rousing spirit has on the organoleptic and analytical characteristics of new make whisky spirit.

SUBJECT:

The Influence of the Continuous Rousing of Spirit on the Characteristics of New Make Whisky Spirit.

BACKGROUND:

Aeration of wine, or knowing when to let a wine 'breathe' is customary with wine connoisseurs – most Sommeliers learn to perfect the art over their many years of training. There are many theories as to why this is done, with many claiming it increases the oxygen content of the spirit, which then in turn oxidises some of the 'harsher' compounds such as the tannins (known for their astringency – mouth feel/drying effect), into more palatable and vibrant flavours.[1,2,4]

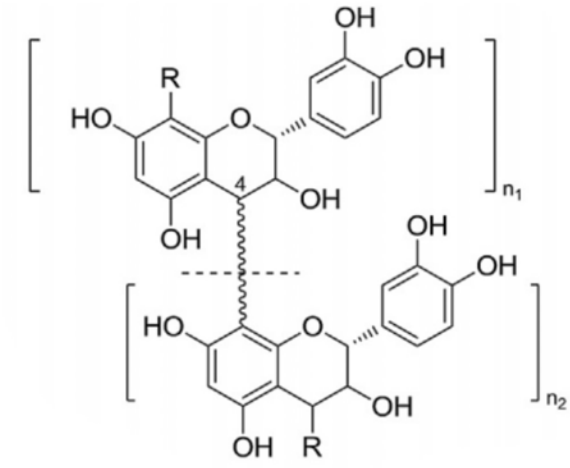

Image 1: Generalised tannin structure[3]

Others believe it simply rouses the different compounds, and forces them to interact with one another due to the movement of the liquid in the glass. Despite it being common practice with wine drinkers, the exact science behind the apparent flavour change remains unknown.

While traditionally wines were simply opened and left to breathe, many found it could take hours to achieve the desired profile. Therefore, in recent years, a significant area of focus amongst the wine community has been developing a method to accelerate the process without having any detrimental effect on the wine itself.[5]

Initial ideas were as simple as decanting the spirit back and forth between two vessels, in the hope that the movement and force exerted by the liquid would cause air to interact with it, enhancing the flavours. However, most wine enthusiasts reported that after a while, the vibrant flavours dull, and the wine regresses back to its original state quite quickly.[5]

Several advancements have been made since then – resulting in the development of more sophisticated devices, which aerate the spirit during the physical pouring motion of the bottle – most of which are based on utilising a phenomenon known as Bernoulli's Principle.

SCIENTIFIC BASIS:

Bernoulli's Principle is a branch of fluid dynamics, which relates several aspects of a liquid (or gas) including pressure, velocity and fluid density.[6,7]

$$P_1 + \frac{1}{2}\rho V_1^2 + \rho g h_1 = P_2 + \frac{1}{2}\rho V_2^2 + \rho g h_2$$

Where;
- P is the pressure
- ρ is the density
- V is the velocity
- h is the elevation
- g is the gravitational acceleration

Equation 1: Bernoulli's Equation relating pressue and velocity[6,7]

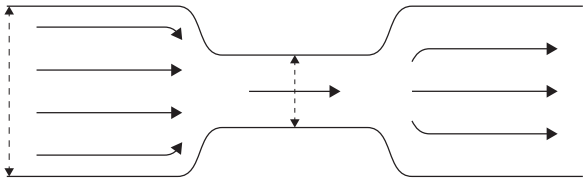

Image 2: Diagram depicting Bernoulli's Principle

Interestingly, the reasoning behind Bernoulli's theorem is the reason that aeroplanes are able to take flight. As the aeroplane moves forward, its precisely designed wing means that the air flowing over the top of the wing is displaced further, resulting in it having a greater velocity and thus has a lower pressure than the air underneath – causing lift.

Overall, it is claimed these specialist devices exploit this phenomenon, and during the pouring process, the wine's velocity is increased (decreasing its pressure), causing air to be drawn in and mixed with the liquid.

APPLICATION TO SCOTCH:

Whilst recently the idea of aerating, and letting whisky breathe has been adopted by Scotch drinkers, the focus (for both Scotch and wine) has been on the mature spirit, at the stage immediately before drinking.

As complex structures such as tannins (derived from wood), which are traditionally thought to be influenced by rousing, end up in the final spirit due to the maturation process, it would be interesting to see if by applying the principles of Bernoulli's theorem to the new make spirit, it is possible to alter the spirit profile in a different way.

THEORY:

After distillation in a typical distillery, the new make spirit from each set of stills is combined in a spirit receiver and transferred to a vat to be filled to cask. At this point, the new make spirit is roused slightly to ensure consistent spirit is filled across the casks.

However, if the process were to be adapted, and the vat were to be continuously roused for an extended period, a hypothesis is that it may be possible to have an influence on the composition, and therefore the characteristics of the spirit.

The principle behind distilling is separating congeners with differing volatilities, removing unwanted compounds to achieve our desired spirit profile. This means that even within the new make spirit we have numerous compounds all of which have different relative volatilities. Typically, some of these compounds with lower volatilities are able to transfer from the liquid into the gas phase and are said to 'flash' off. Which, if the spirit were in an enclosed vat, would result in the compounded residing in the headspace of the vat.

Compound	Boiling Point (°C)
Acetaldehyde	20
Ethyl Acetate	77
Acetate	103
n-Propanol	97
n-Butanol	117
iso-Butanol	108

Table 1: Boiling points of several volatile compounds[9]

By rousing the enclosed spirit vat, it may be possible to create a liquid of dynamic pressure, which in accordance with Bernoulli's Principle, would allow air (or in this case the volatile rich headspace) to be drawn back into the body of the spirit, aerating it in a vigorous motion.

This mechanical forcing of the different compounds to interact and mix may lead to additional molecule to molecule interactions which wouldn't occur in a static solution. It may be possible for some of these volatile compounds to form intermolecular interactions such as weak hydrogen bonds, or dipole interactions with molecules in the bulk spirit. This could hold the structures in the bulk liquid, stopping them from contributing to the initial organoleptic profile of the spirit, altering its properties.

qualities from standard Kininvie, and if further trialling is required.

A rate of rousing would need to be determined that, depending on the trial volume, could be scaled up and replicated on a plant scale.

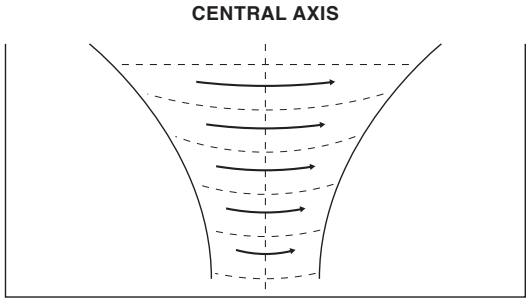

Image 3: Sketch depicting vortex within spirit being continuously stirred

EXPERIMENTAL:

To assess the validity of this theory, initial trials would need to be carried out in a laboratory-sized scale to answer several key questions;

1. Is the energy exerted by the rousing and mixing process enough to overcome any potential energy barrier of the constituent compounds to go from the liquid to gas phase?
2. Is the influence, if any, long lasting, or does the new make spirit simply regress back to its typical characteristics after a certain period of time?
3. Would results from a lab-sized trial be comparable to that of a plant-sized trial?

For simplicity, the basic principle could be trialled in a laboratory setting, using a sealed vessel filled with fresh Kininvie new make spirit placed upon a magnetic stirring plate left to stir rapidly for a set period of time. Very quickly, a whirlpool like vortex would be established which would exhibit the differential pressures in discussed above.

Setting the trial up in this manner would allow a quick conclusion to be drawn over whether the resulting spirit has differing organoleptic

ANALYSIS:

As with all samples, resulting from distilling, organoleptic analysis is crucial in noting any differences between sample sets. It is likely a difference to control test would be carried out immediately after completion of the trial to determine if there is a difference from standard Kininvie new make spirit.

Further samples would be nosed after set time intervals to determine if there is a definitive long-lasting difference between the spirits, or if the roused spirit regresses back to 'normal' as is typically observed when aerating wine.

In addition, a triangle test (three 'blind' glasses are compared, two of which contain one sample, and one of the other sample type) may also be set up to ensure reliable, unbiased results.

Additional analysis could also be carried out at independent facilities looking at specialist techniques such as 1H NMR, comparing the spectra of 'typical' Kininvie new make spirit, with that of 'roused' spirit. This may allow conclusions to be drawn as to whether any additional intermolecular interactions were occurring, shielding or de-shielding the nuclei, causing it peak to shift on the spectra.

For the trial to be a success, differences in analysis between trial spirit, and standard Kininvie new make would need to be observed. However, differences at this point does not necessarily mean that distinct differences would be observed when the spirit matures and becomes of age. It is quite possible that even slight nuances in the new make spirit at this point could fade throughout the course of maturation.

FUTURE WORK:

Assuming positive results, potential subsequent trials could involve accelerated maturation trials using small casks to give an indicative idea of the profile of the mature spirit. Different cask types, including 1st fill bourbons and refill casks, could then be trialled to determine the influence the cask quality has on the spirit, if any, and how differing cask types.

Different casks types including 1st fill bourbons and refill casks could then be trialled to determine the influence the cask quality has on the spirit, if any, and how differing cask types can result in distinctly different mature spirits.

Additionally, from a processing point of view, successful initial trials may lead to more trials varying the cut points of the spirit in a bid to increase the volume of favourable compounds in the heart of the spirit.

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