

This article was written by Ian Palmer of the InchDairnie Distillery and Jennifer Riffkin of Tatlock and Thomson.

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Ex bourbon barrels are one of the most common cask types used for the maturation of Scotch whisky. This is a barrel that has been charred as part of the coopering process and then used for the maturation of bourbon. When we started the process of developing our RyeLaw whisky we studied the process used in Canada and America and, in particular, looked at the definition of Rye whisky in America. The definition calls for the use of 'new charred oak' casks. The definition of Scotch Whisky on the other hand asks simply for oak casks no greater than 700 ltrs capacity.

As part of the development process, we discussed the type of casks to be used with Speyside Cooperage and their view was that char number three was the most used type of cask. So, our first distillation went into new oak casks char number three. But what did that mean and why use the same specification as that used in America when so much of the distillate and maturation conditions were so different? Our new oak cask supplier Speyside Bourbon Cooperage Inc, part of the same group as Speyside Cooperage produces barrels to five different char specifications.



Speyside Cooperage, Scotland Char #3

First what do we mean by char and char number three? In Europe casks are toasted to different levels and not charred. The European cooperages toast the casks by using the heat from a wood fired brazier or similar, the wood being the waste wood from the coopering process. The different levels of toast are achieved by measuring the temperature of the inside of the cask with an infrared temperature gauge and measuring the time the inside of the casks was at the specified temperature. Generally speaking, the inside of the cask will not completely ignite if it does it will be for a short period only.

In America the casks are charred using a natural gas flame. The gas flame is burnt at a high rate for a short period to ignite the inside of the cask and then the gas is turned down to a low burn in order to

maintain the combustion of the wood. The different chars are achieved by changing the length of time the second low level burn lasts. Char number one is the shortest burn time while five is the longest burn time.



Speyside Bourbon Cooperage. Jackson, Ohio

In addition to toast versus char, European cooperages use European oak while the American cooperage use American oak. They are two quite different oaks, which simply widens the difference between casks from European and American cooperages.

Our RyeLaw distillate is produced using malted rye and malted barley, the wort is filtered before adding the special yeast to allow the fermentation to take place. The fermented wash is distilled, first, in a wash pot still and the low wines is then distilled in a Lomond Hill still. So, in general, the raw materials are different, and the batch distillation is different to that employed in most American rye whiskies. The RyeLaw will be matured for 5 years in a Scottish maturation warehouse. The warehouse temperature is lower than that experienced in America. In the winter the InchDairnie warehouses are around 5°C while in the summer they are around 15°C. In America they will range from 34°C on the top of the warehouse in the summer to 8°C on the floor in winter.



InchDairnie uses palletised warehouses while a lot of the American warehouses are racked.

With so many differences why use the same casks?

We asked Speyside to send us casks charred to the full range, from char number one to char number five. In addition, we asked our cooperage in Spain to send us American oak casks, but this time toasted the European way to the three different toast levels. These casks were all filled in 2018 and all from the same batch of RyeLaw and located in the same area of the same warehouse.

After only one year of maturation samples were drawn from each of the casks and organoleptically assessed. This analysis indicated significant differences across the range with the toast casks and the charred casks in two quite distinct groups, while significant differences were noted across the range of the charred casks.

This early assessment also showed there was a distinct difference between the heavily toasted casks and char number one and char number five was distinctly different from char number one, almost aggressive with strong burnt wood flavour. Char number one was quite the opposite with very light flavours.

Samples were again drawn from these casks in early 2022, just over three years of maturation. The samples were sent to Tatlock and Thomson here in Fife for detailed analysis and independent organoleptic assessment. At Tatlock and Thomson, independent triplicate samples were analysed for a number of maturation congeners using High Performance Liquid Chromatography (HPLC) with Ultra-Violet (UV) and fluorescence detection and Gas Chromatography Mass Spectrometry (GCMS) with large volume injection.

In addition, samples were organoleptically assessed by the Tatlock and Thomson sensory panel. The results from both the toasted and charred casks have been combined and are shown in Figure v-ix. Results were analysed using IBM SPSS 16 statistical software using ANOVA (Analysis of Variance) with Tukey post-hoc testing. Generally, there does not appear to be a significant difference between the different char levels, but the varying toasting levels do appear to affect the congener concentrations and the greatest difference is seen when heat intensity is increased from toasting to charring.

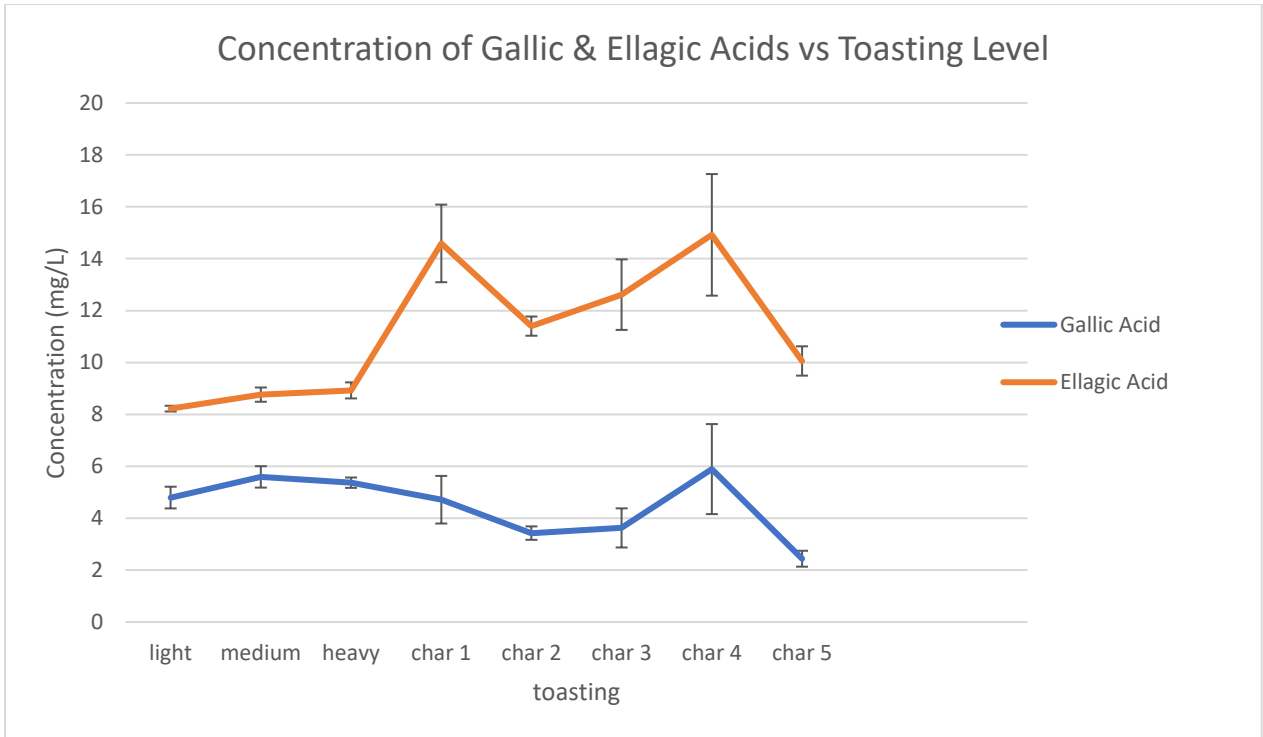


Figure i: Gallic and ellagic acid concentrations (mean \pm standard error of independent triplicates) of spirits matured in casks of varying heat treatment intensities

Ellagic and gallic acid, which are breakdown compounds of the more bitter and astringent oak tannin compounds, were not greatly affected by the toasting/charring process however there was statistically higher levels of ellagic acid in the spirit in the char one and four compared to that of the spirit from the toasted casks.

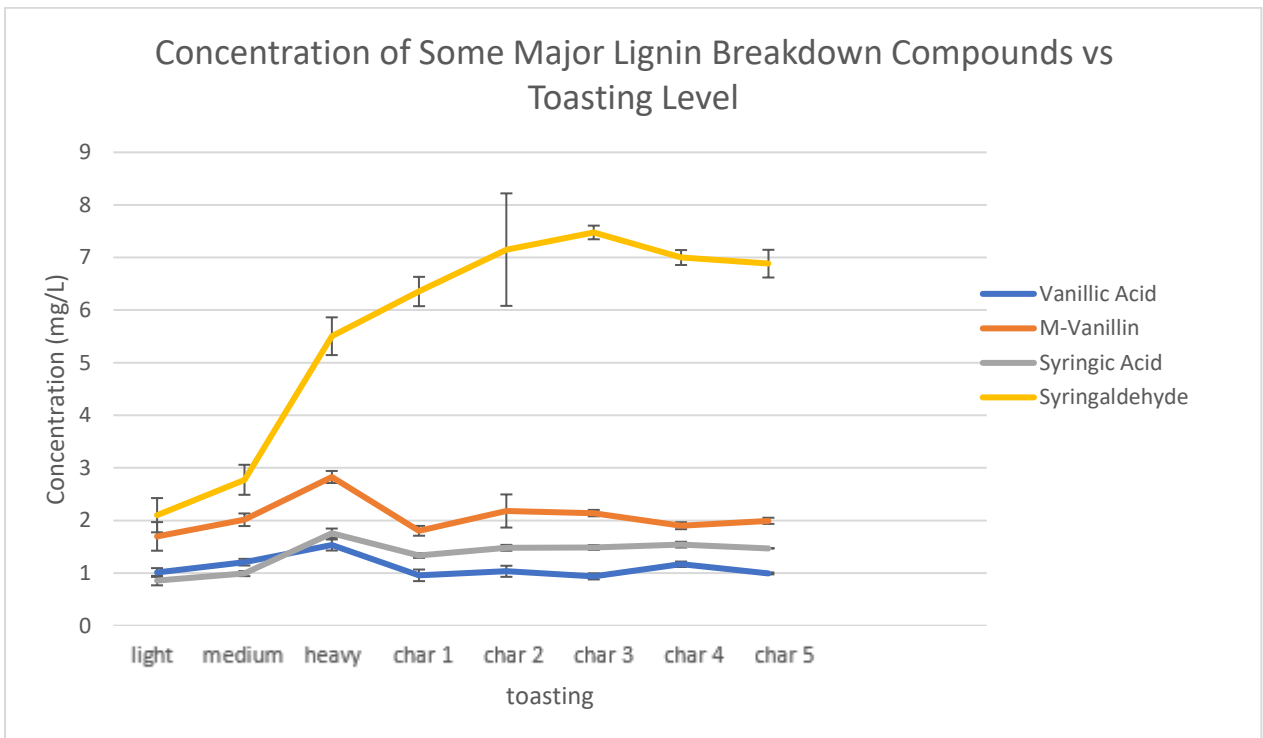


Figure ii: Lignin breakdown compound concentrations (mean \pm standard error of independent triplicates) of spirits matured in casks of varying heat treatment intensities

Some of the most important lignin breakdown compounds are shown in figure vi. These congeners impart sweet, vanilla like compounds to the spirit and are an important marker of maturation. It is clear from the graph that the levels of syringaldehyde greatly increase with high toasting levels, and although a slight increase was seen with charring, these levels are not significantly higher when the wood is charred. Vanillin, perhaps the most important of the lignin breakdown compounds due to its low aroma threshold, appears to peak when the wood is highly toasted. A similar pattern is seen for the two acids shown in figure vi. Coniferaldehyde and sinapaldehyde, two of the other major lignin breakdown compounds are shown in Figure vii.

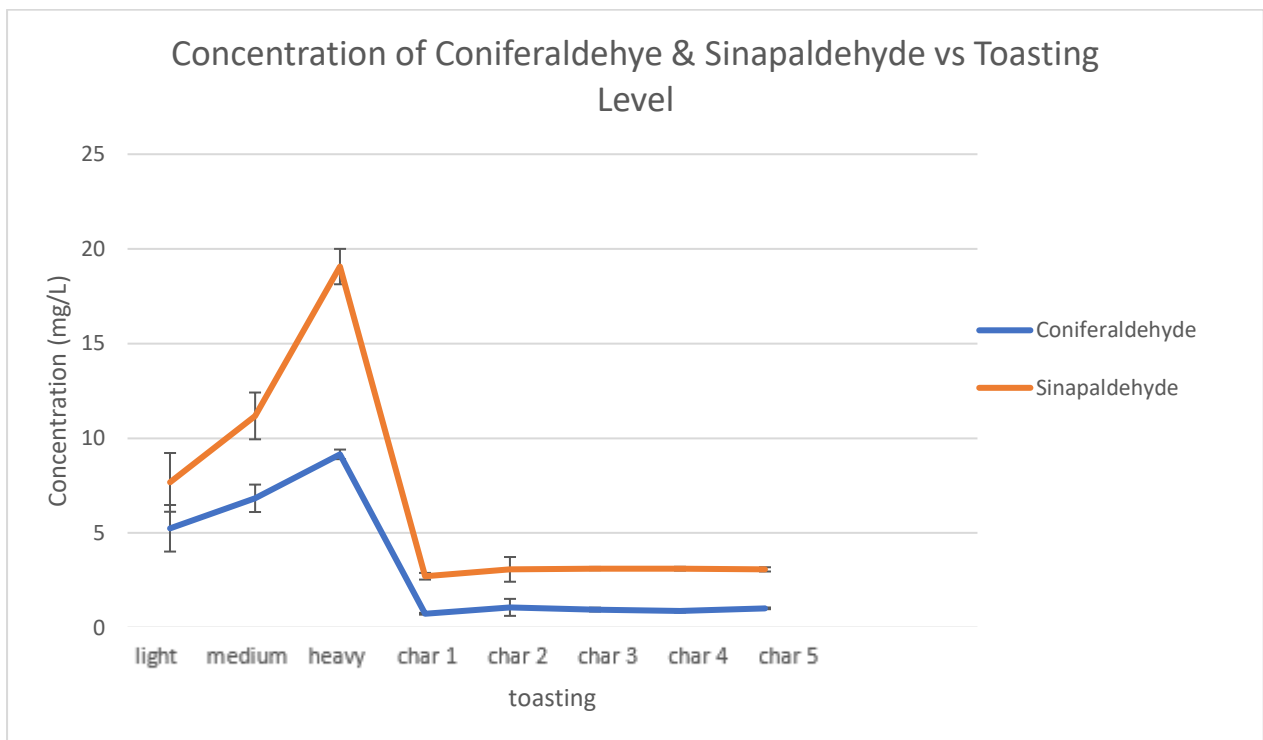


Figure iii: Lignin breakdown compound concentrations (mean \pm standard error of independent triplicates) of spirits matured in casks of varying heat treatment intensities

Similarly, to the other lignin compounds, coniferaldehyde and sinapaldehyde peaked in the casks which were heavily toasted whilst statistically lower levels were found in the light and medium casks and the lowest in the charred casks. Figure viii shows extractives found in oak matured spirit which are not generally associated with the degradation of the oak structure during cask production (i.e. like the hemicellulose and breakdown compounds). However, they do impart key aroma and flavour attributes to the spirit. The lactones impart coconut, woody aromas whilst the eugenol compounds impart a spicy, clove aroma.

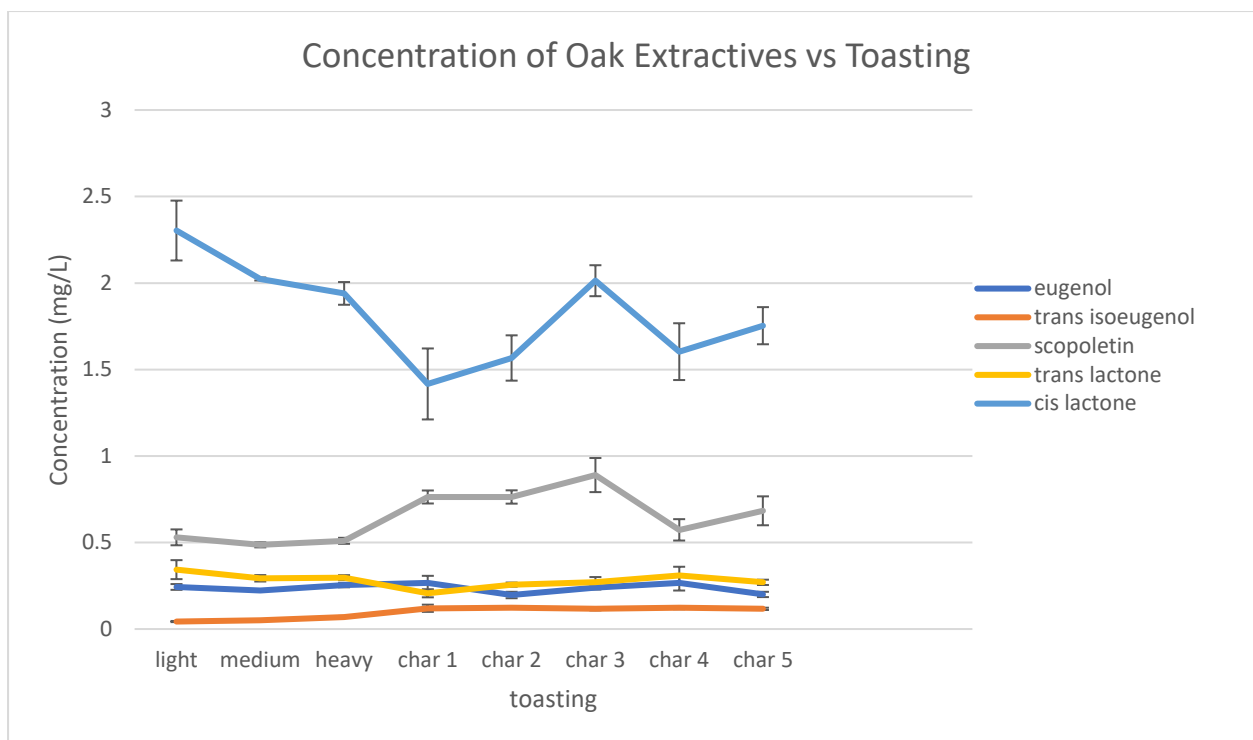


Figure iv: Lignin breakdown compound concentrations ((mean \pm standard error of independent triplicates) of spirits matured in casks of varying heat treatment intensities

Trans-isoeugenol was found to be statistically higher in the charred cask spirit compared to that of the toasted casks. Similarly, scopoletin, which is not generally associated with a particular aroma or flavour but may impart bitter and astringent notes, was found in increased levels in the charred casks. Whilst *trans*-lactone levels appeared relatively unaffected by heat treatment, the levels of *cis*-lactone, which is the more intense aroma of the two lactones, were elevated in the casks which had undergone light levels of toasting.

Figure ix shows three of the main oak hemicellulose breakdown compounds. These contribute toasty, woody notes to the spirit. Furfural is also associated with almond-like aromas. In addition, contrary to the other compounds described here, furfural is also found in significant levels in the non-matured spirit (New Make Spirit). The hemicellulose compounds were found to peak in the casks which were heavily toasted and were significantly higher than the casks which had undergone light and medium toasting and the spirit matured in the charred casks.

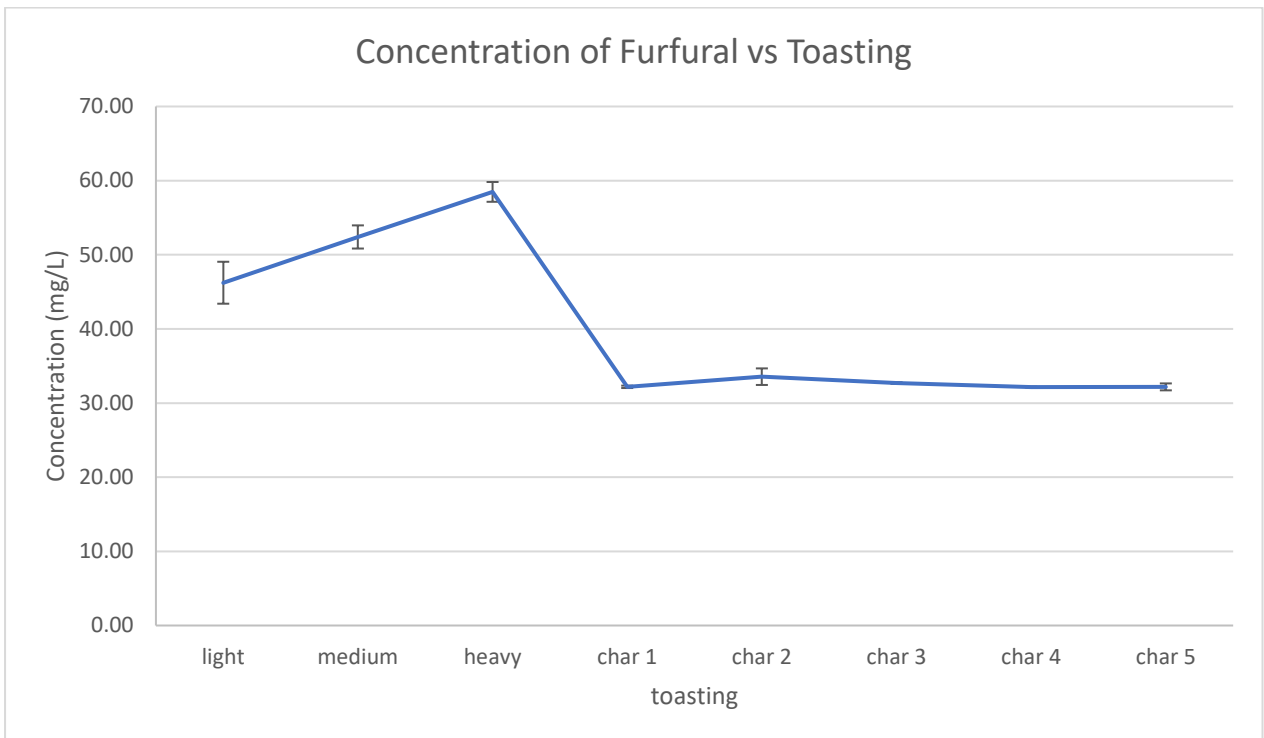
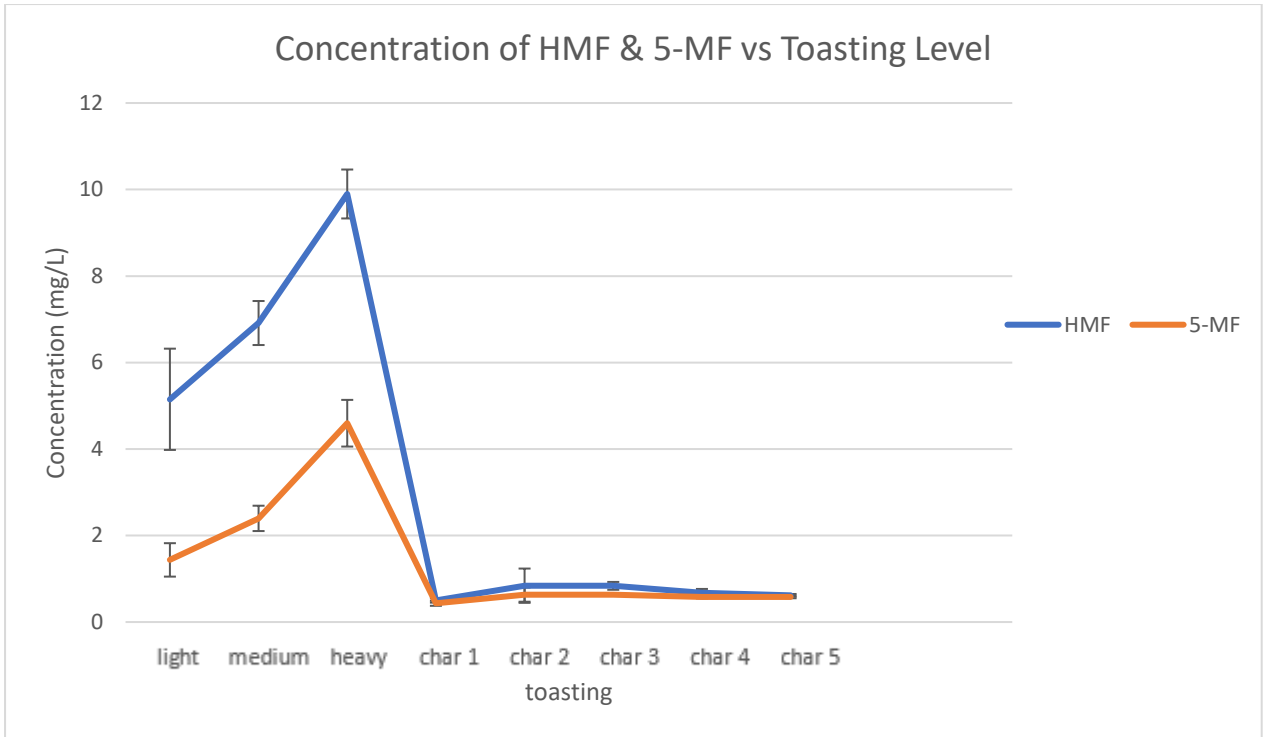


Figure v: Lignin breakdown compound concentrations of spirits matured in casks of varying heat treatment intensities

Whilst the analytical analysis offers vital insight into the chemical fingerprint of the spirit, it is not the defining parameter, and it is the organoleptic assessment that is the final judge. Set out in the graph below is our assessment of all the samples.

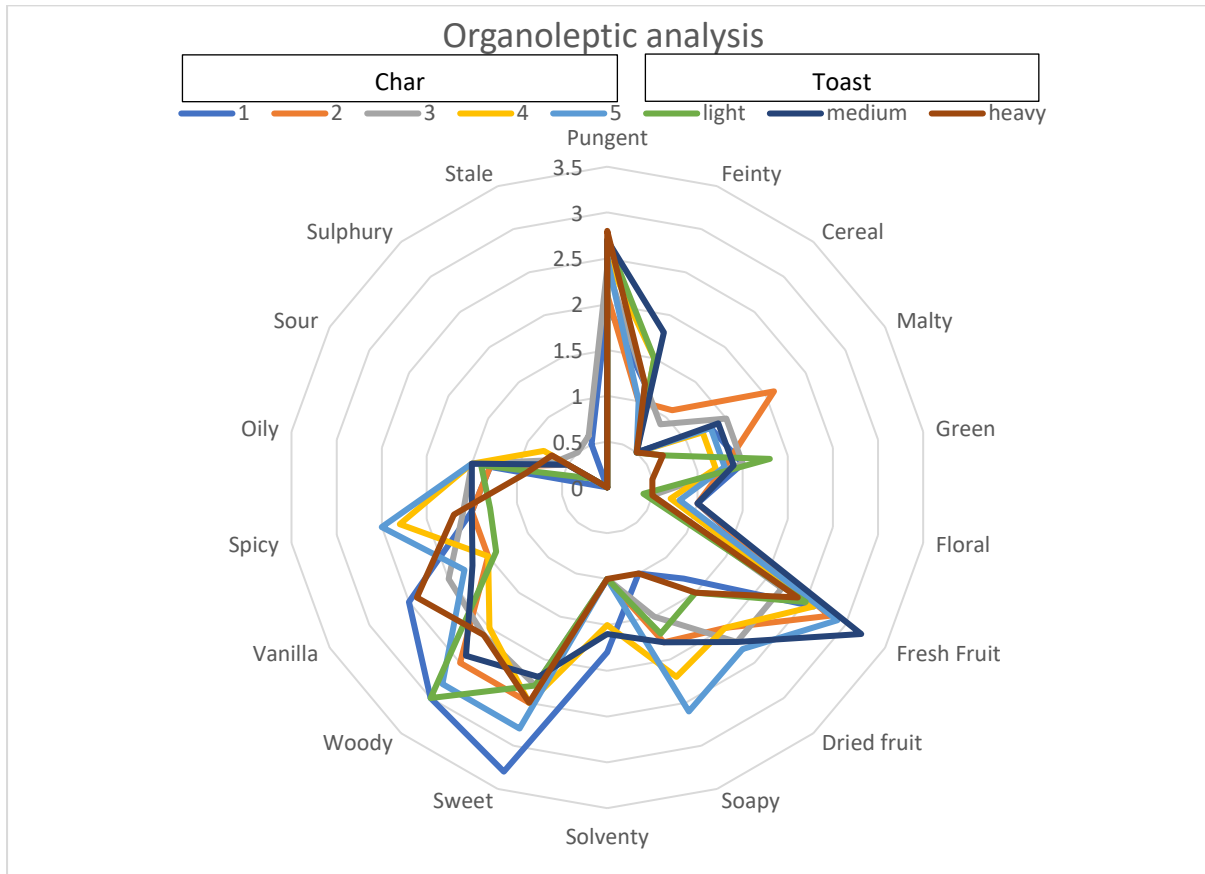


Figure vi: organoleptic assessment.

So, what is our conclusion? The casks have another year to go before completing their maturation but from these samples it looks like char 3 gives a more rounded and complex flavour profile thus avoiding a more one-dimensional flavour profile which may overpower all the others, as well as the all-important spirit flavour of our RyeLaw whisky. Char 3 is the normal char used in America. Here at InchDairnie we do things differently but not just for the sake of it, we do it because it makes a difference to the flavour. Never different for difference's sake.