

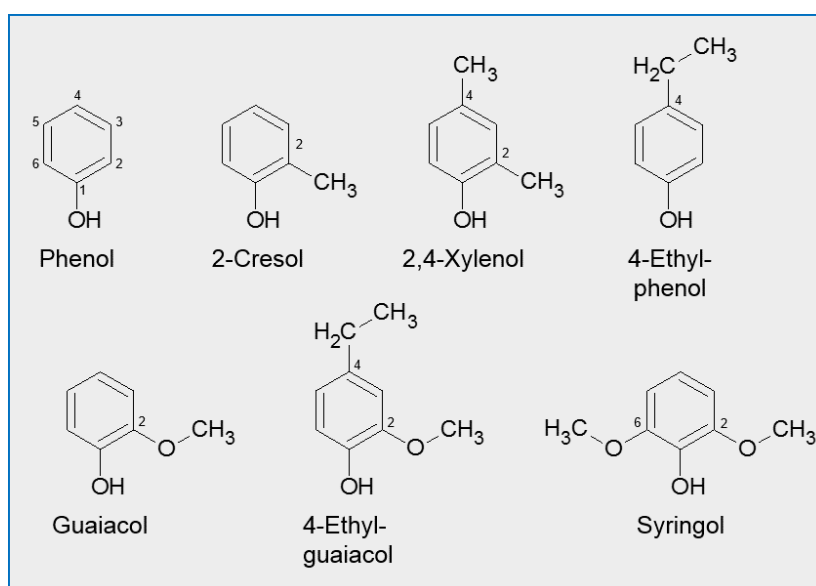
# PHENOLS, PEAT AND SMOKE

Our [Fellow](#), Dr. Heinz Weinberger, from Germany, is a scientist and a passionate whisky lover. He writes his own blog – [Whisky-Connaisseur.de](#) – but he also guest blogs for us, and this one delves into the chemical secrets of phenols, peat and smoke...



We as Whisky drinkers have all heard of them: the phenols. They belong to a substance class of aromatic alcohols in which one or more hydroxy (OH)-groups are attached to a benzene ring (ring of six carbon atoms). The base form with only one OH-group at the unsubstituted benzene ring is phenol itself. Depending on the type of additional organic groups – so-called substituents – at the benzene ring, various derivatives of phenol are obtained which have different properties. The smokiness and peatiness of a whisky is linked to the amount of these chemicals. The combustion of peat produces a wide range of chemical products, starting from simple hydrocarbons to complex, saturated, aromatic, and nitrogenous compounds – and phenols. Phenol, as well as its derivatives, are distinguished by their flavouring effects and contribute significantly to the typical smell and taste of the new make spirit, and later, the matured Whisky. Besides phenol, the most important representatives of these aromatic compounds include cresols (phenol with an additional methyl group), xlenols

(phenol with two additional methyl groups), ethylphenols (phenol with an additional ethyl group), guaiacol (phenol with an additional methoxy group in the 2-position) and 4-ethylguaiacol (guaiacol with an additional ethyl group in 4-position). Depending on the position and/or number of attached groups at the phenolic ring, different compounds with different



properties are obtained. While phenol, cresols and 4-ethylphenol are described as *medicinal*, guaiacol is considered *smoky* and *tarry*, and 4-ethylguaiacol as *sweet* and *spicy*.

The flavour-active phenols are generated in the kilning step during Malt production when peat is being burned, usually in a temperature range between 200°C and 850°C. During kilning, smoke absorption is maximal at 15% to 30% moisture in malting barley. Which phenols are formed and to what extent can be controlled by the combustion temperature of peat. For example, if the temperature of the peat fire is increased from 400°C to 750°C during the kilning process, the peat smoke contains far more phenol and cresols, while the content of guaiacol is significantly reduced. This results in more *phenolic* or *medicinal* flavours in Malted barley at higher combustion temperatures and more *smoke* and *spice* at lower temperatures, respectively. However, peat can vary greatly. Its chemical composition is influenced by the geographical location, as well as the type and degree of decomposition (age) of the plant substances. For example, it has been scientifically shown that the combustion of peat from four different Scottish regions (Isle of Islay, St. Fergus in Aberdeenshire, Tomintoul in the Speyside, Orkney Islands) results in different combustion products, such as phenolic compounds, carbohydrates (sugar derivatives), aromatic and nitrogenous compounds, in different concentrations, generating a characteristic flavour profile of the Malt and final spirit. Thus, the smoke of Islay and St. Fergus peat is richer in phenols, guaiacol and the spicy-sweet phenol derivative syringol (guaiacol with an additional methoxy group in 6-position), while peat from the Tomintoul region and the Orkney Islands releases a relatively high proportion of carbohydrate derivatives during combustion. The depth of peat cutting also affects the aroma in the peat smoke. As the top layers of the cut peat are richer and more rooty, they generate more smoke and flavour-active phenols. In contrast, the lower part of cut peat produces more heat and less smoke – thus less Malt-flavouring compounds.



If you want to taste the typical Islay peat flavour try Douglas Laing's [Big Peat](#). A small batch bottling blended Malt only containing Single Malt Whiskies from the southern-most island of the Inner Hebrides – often referred to as *Queen of the Hebrides* – including Ardbeg, Caol Ila, Bowmore and closed distillery, Port Ellen, to name but a few. Big Peat is a feisty Islay character with a sweet side. Very well balanced with a medicinal curtain that unveils delicate sweet, Malty and lingering fruity flavours though. A great Whisky, providing rapid pleasant warmth, not only in the cold part of the year.

Phenols are resistant molecules. They adhere to the Malted barley during kilning, dissolve in hot water during the mashing process, can survive several days of fermentation and the high temperature of the distillation process, and then, after 10 years, 20 years or longer in a wooden cask, they are still noticeably present. However, a considerable amount of phenols are lost during the Whisky production process. Starting from Malted barley, the intensity of the phenolic taste does not remain stable. The new make spirit has only about 30% to 70% of the total amount of phenols in Malted barley and it further declines during maturation. For

verification, you can do an experiment by yourself. Take, for example, Laphroaig 10 Years Old distillery bottling and compare it to Douglas Laing's most recent Xtra Old Particular (XOP) release, Laphroaig 30 Years Old (1987-2017). While the first one is a medicinal and iodine rich single Malt with big, smoky, muscular peat notes, the elder XOP expression represents a pleasantly harmonious dram containing all the elements of a typical Laphroaig, but without its pungent edges. Over the three decades of maturation, the intensity of smoke, peat and medicinal notes has been softened and diminished with the creamy, Maltly sweetness and lingering fruitiness coming to the fore.



The amount of phenols is determined by means of a high-resolution analytical separation technique, the so-called high-performance liquid chromatography (HPLC). This versatile analytical method for the determination of soluble solid and liquid substances in chemistry separates complex sample mixtures into their individual components, identifies and quantifies them. The content of all phenols determined is expressed in parts per million (ppm). This is equivalent to the concentration of 1 molecule of phenol diluted in a mixture of 1 million other molecules. Unless otherwise stated, the ppm-values always refer to the malted barley. These, however, are only absolute numbers and their direct comparison says nothing about the smokiness and peatiness of a matured Whisky. Although Bruichladdich's Octomore 6.3 is heavily peated with 258 ppm (in the Malt), it doesn't smell and taste 5 times smokier and more peaty than Ardbeg TEN with a peat level of "only" about 50 ppm in the Malt. As already mentioned, every single phenol derivative tastes and smells different and its content decreases individually during the production and maturation process of Whisky. In the end, the sensory perception of each human being is unique. While for some its only ash, fireplace and hospital smell in a glass, for others sipping a peated dram is the highest enjoyment of fine smoke and delicate spicy peat-derived flavour.