Shedding light on metal extraction from chestnut wood fragments to wine spirit

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The mineral composition of wine spirit (WS) is of relevant interest due to its potential effect on physicochemical stability, sensory characteristics, safety, and legal limits.[1] In particular, iron (Fe) and copper (Cu) are of primary importance for WS quality, and seem to play an important catalytic role on oxidation reactions involving the phenolic compounds extracted from the wood and other substrates for oxidation in WS, e.g. ethanol. Fe content in WS is normally lower than 1 mg/L, while Cu concentrations often range between 1 and 3 mg/L in WS obtained from distillation systems made of copper.[1,2,3]

The ageing of wine spirits is traditionally performed in oak barrels. In spite of the high quality achieved by the WS, this is a time-consuming and costly ageing technology, requiring a high demand for wood, among other drawbacks. For these reasons, in recent years, special attention has been dedicated to alternative ageing technologies, e.g. by using wood fragments, to meet the sustainability criteria.[3]

Having in mind that wood ash contains Fe and Cu besides other elements, the release of these metals to the WS during ageing is expected. However, in spite of substantial understanding of the organic extractive compounds, little has been published on metal extraction from wood to WS and even to wine.[4,5] The main aim of this study was to uncover the effect of wood ageing by chestnut staves combined with micro-oxygenation (MOX) on WS Cu and Fe contents.

A wine distillate produced by Adega Cooperativa da Lourinhã (Lourinhã, Portugal), was aged with Portuguese chestnut wood (*Castanea sativa* Mill.) staves, in 50 L demijohns, comprising different MOX modalities (O15, O30 and O60) and one modality with nitrogen application (N; control), with two replicates, during 12 months.[3] The WSs were sampled at 0, 8, 21, 60, 180, 270 and 365 days of ageing and assessed in terms of their Cu and Fe contents by flame atomic absorption spectrometry methods.[6] A Perkin-Elmer Analyst 100, equipped with an air-acetylene burner and appropriate hollow cathode lamps, was used. One-way ANOVA was applied to assess wood ageing and time effect on both metals concentrations.

The concentrations of total Fe found in WS were quite low, varying between 0.086 and 0.28 mg/L. At each sampling time, the Fe content of the WS was not significantly affected by the ageing modality. Time had a significant effect on its concentration, with slight and progressive increases until 270 days of ageing, most probably explained by Fe release from the wood to the WS.

In respect to Cu, the concentration varied between 0.939 and 0.320 mg/L, with the highest values being observed in the WS obtained with higher supply of oxygen, likely due to the different oxidation-reduction potential of the medium, governing the balance between of Cu oxidation forms. The ageing time had a significant influence on Cu concentrations in WS but, unlike Fe, progressive decrease was observed until 180 days, probably assigned to the insolubilisation and precipitation of Cu. At last, the depletion of this metal is positive from the WS quality perspective, given its potential participation in physicochemical instability phenomena and risk to WS safety.

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