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Temperature effects on ash physical and chemical properties. A laboratory study.

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Fire temperatures have different impacts on ash physical and chemical properties that depend mainly of the specie affected and time of exposition. In a real prescribed or wildland fire, the temperatures produce ash with different characteristics. Know the impacts of a specific temperature or a gradient on a certain element and specie is very difficult in real fires, especially in wildland fires, where temperatures achieve higher values and the burning conditions are not controlled. Hence, laboratory studies revealed to be an excellent methodology to understand the effects of fire temperatures in ash physical and chemical. The aim of this study is study the effects of a temperature gradient (150, 200, 250, 300, 350, 400, 450, 500 and 550ºC) on ash physical and chemical properties. For this study we collected litter of Quercus suber, Pinus pinea and Pinus pinaster in a plot located in Portugal. The selected species are the most common in the ecosystem. We submitted samples to the mentioned temperatures throughout a time of two hours and we analysed several parameters, namely, Loss on Ignition (LOI%), ash colour – through the Croma Value (CV) observed in Munsell color chart – CaCO3, Total Nitrogen (TN), Total Carbon (TC), C/N ratio, ash pH, Electrical Conductivity (EC), extractable Calcium (Ca2+), Magnesium (Mg2+), Sodium (Na+), Potassium (K+), Aluminium (Al3+), Manganese (Mn2+), Iron (Fe2+), Zinc (Zn2+), Total Phosphorous (TP), Sulphur (S) and Silica (SiO2). Since we considered many elements, in order to obtain a better explanation of all dataset, we applied a Factorial Analysis (FA), based on the correlation matrix and the Factors were extracted according to the Principle Components method. To obtain a better relation between the variables with a specific Factor we rotated the matrix according to the VARIMAX NORMALIZED method. FA identified 5 Factors that explained a total of 95% of the variance. We retained in each Factor the variables that presented an eigenvalue >0.7. Factor 1 explained the majority of the variance (60.05%). LOI(%), CV, CaCO3, pH, Na+, K+, S (these last tree elements only in both Pinus) and SiO2, showed positive loadings. Inversely, TC, C/N ratio, Al3+, Fe2+ (these last tree elements for Quercus suber and Pinus pinaster ash) and Mn2+ (In the case of Quercus suber) presented negative loadings. Factor 2 explained 19.89% of the variance and showed higher loadings in TN, Ca2+ and Mg2+ (in the case of the ions only in both Pinus). Factor 3 explains only 6.69% of the variance and we identified higher loadings in Mg2+, Na+ and K+ of Quercus suber. Factor 4 explains less then the last Factor, only 4.60% of the variance and presented negative loadings above -0.7 in TP of Quercus suber and Pinus pinea. Factor 5 explained 3.93% of the variance, less than all other Factors and showed in Al3+, Mn2+ and Zn2+ of Pinus pinea and in the case of the last element, also in Pinus pinaster. The observation of the scores matrix allowed us to understand the major concentration of these elements according the temperature of exposition. Hence, the elements that showed higher positive loadings in Factor 1, have a major concentration at 450, 500 and 550ºC, and the ones with higher negative loadings presented higher concentration at 200 and 250ºC. The nutrients that presented higher positive loadings in Factor 2 have higher concentrations at 400ºC. The elements with higher positive loadings in Factor 3 have bigger amounts in the ash slurries produced at 350ºC and the ones with higher negative loadings in the Factor 4 showed greater concentrations in the ash produced at 300ºC. The elements with higher negative loadings in the Factor 5 showed higher amounts in the ash created at 150ºC of exposition. The results obtained showed that nutrients concentration is a function of the burned specie and temperature reached in the considered exposure time. Micronutrients and TC and C/N showed higher values at lower temperatures, TN, Ca2+, Mg2+ and TP at temperatures between 300-400ºC. The other variables in study have major concentrations at temperatures higher than 450ºC. Some differences between species can be identified and this is a result of the different litter vulnerabilities to the same temperature, producing diverse fire severities. This and other reasons for this behaviour will be

discussed in the communication.