Innovation and optimization of the steam distillation process

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**Abstract.**

Steam distillation is a particular type of distillation. It is the traditional method used for the extraction of bioactive compounds from natural sources such as essential oil from plants. Currently, in the contest of scientific research, steam distillation is considered an ancient method to use and often, it is only used to compare with other emerging extraction. However, steam distillation presents some advantages it has over other technologies such as, for example, the simplicity of execution, the relatively low cost of installation, generates solvent-free products and by-products, no need for further separation of final products, extensive methodology know-how is available, and has a wide application on an industrial scale. On the other side, the main disadvantages are the long extraction times, the consumption of energy and sometimes of raw material. Therefore, in this research the steam distillation process was studied and deepened the overall aim to optimize and innovate the whole process. Two main themes were addressed. The first concerned the optimization of the process to minimize consumption and maximize the yield of the essential oil. Two studies were conducted focused on the investigation of the factors affecting the yield of essential oil and, on the development the application of a photoionization detector for monitoring and controlling of the different products in several phases of the distillation process. The second concerned the innovation the process, understood as the possibility of expanding its field of application as a sustainable method for the recovery of bioactive compounds with high added value from the waste of some agri-food industries. Thus, it was possible to establish the best operating conditions to extract the maximum yield of rosemary essential oil. That is, with the steam distillation method for an extraction duration of 120 min. Furthermore, it was possible to develop the application of a photoionization detector (PID) that was able to capture different signals from different varieties of rosemary plants, and a sort of 'fingerprint' for each varieties used was obtained. Thus, it was possible to distinguish different varieties of rosemary plants entering in the steam distillation process. At the end, steam distillation was applied as an alternative and sustainable method for the recovery of bioactive compounds with high added value from the waste of some agri-food industries. It was possible to obtained two fractions. One richer in volatile compounds and another richer in bioactive compounds such as phenolic compounds.