



Comparative study on the use of three different near infrared spectroscopy recording methodologies for varietal discrimination of walnuts

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ABSTRACT

Walnut fruit (*Juglans regia* L.) is an internationally well-known product with an important tradition of consumption. Its health benefits and economic importance in the food industry make this nut an interesting research topic.

In this feasibility study, 200 walnut samples of 5 different varieties were collected and their near infrared (NIR) spectra were recorded with 3 different devices: a benchtop Fourier transform near infrared (FT-NIR) spectrograph, a dispersive hyperspectral imaging camera and a portable NIR dispersive spectrograph. Discriminant analyses were applied and different methods for the varietal discrimination of walnuts were obtained and compared.

Up to 96 and 84% of correct identification were respectively obtained in internal (training set) and external validations. Better results were obtained covering the entire shell surface than collecting a unique random spectrum per sample. Moreover, FT-NIR and hyperspectral tools produced classification models with a lower classification error in internal and external validations than the portable NIR one.

1. Introduction

The consumption of walnut fruit (*Juglans regia* L.) has a relevant importance in both health and economic fields. Health benefits of walnuts are due to their chemical composition. These nuts are rich in polyunsaturated fatty acids and tocopherols, being linoleic acid the most abundant fatty acid [1–3]. Moreover, bioactive compounds with potential health benefits, such as dietary fibre, folic acid, polyphenolic compounds and other antioxidants, are present in walnuts [4,5]. Therefore, it has been demonstrated that the regular consumption of walnuts is linked with a decrease of the risk of coronary heart disease, metabolic syndrome and other chronic diseases [4,6].

The demonstrated health benefits together with the wide tradition of this nut in the human diet (since the pre-agricultural times) and their tasty sensory attributes [7], have created and consolidated an important international walnut market. In 2017/2018, global walnut production was estimated at 870000 metric tons (kernel basis), consolidating the growing trend observed over the last 10 years [8]. This positive trend has also been observed in Portugal, where walnut production reached 4600 metric tons in 2017. It is in Alentejo, the south-

central region of Portugal, where is located the most important production area of walnuts in Portugal, yielding approximately 2000 metric tons. However, this production region is characterised by young orchards which did not reach yet the full production potential. According to the Instituto Nacional de Estatística (INE), in 2017, walnut production ranks fourth among other fruit nuts being an important agricultural commodity from Alentejo [9]. In this region, the commercial walnut production occupies an area of about 4000 acres and the trend is still upwards. Most orchards are family owned with an average dimension between 7.5 and 50 acres distributed over different soil types. This orchard fragmentation leads to a heterogeneous quality of fruit production.

Contrary to other regions in the world, where approximately two-thirds of walnut production is traded shelled, in Europe most of the walnuts production are traded in-shell and, particularly, Portuguese market for walnuts is half divided into walnuts with and without shell [9]. Europeans value in-shell walnuts for considering them more natural and less processed. Moreover, in-shell walnuts can be better preserved than walnut kernels.

Walnuts can also be destined to the production of other products

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