Instrumental quality assessment of fresh peaches: Optical and mechanical parameters.

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Introduction

In developing instrumentation for the measurement of fruit quality, there is the need for fast and non-destructive devices, based on sensors, to be installed on-line. In the case of some fruits, like peaches, post-harvest ripeness, which is closely related to high quality for the consumer, is a priority. During ripening, external appearance (colour) and internal mechanical (firmness) and chemical (sugars and acids) quality are main features that evolve rapidly from and unripe to a ripe (high quality) stage.

When considering the evolution of fruit quality in this scheme, external colour and firmness are shown to evolve in a parallel pattern, if monitored from the time of harvest to full consumer ripeness (Rood, 1957; Crisosto et al, 1995; Kader, 1996). The visible (VIS) reflectance spectrum is a fast and easy reference that can be used to estimate quality of peaches, if we could show it to be reliably correlated with peach ripening rate during post-harvest (Génard et al. 1994; Moras, 1995; Delwiche and Baumgartner, 1983; Delwiche et al. 1987; Slaughter, 1995; Lleó et al., 1998). Taste, described as an expert acceptance score, improves with ripeness (firmness and colour evolution), when considering the fruits on the tree, and also post-harvest.

Objectives

In the scope of a large study of purchase and consumers' quality assessment of peaches carried out during a complete season in Murcia (production site) and Madrid (consumers market) representing the actual situation of peach quality (1997), the objectives are: to analyse and compare VIS characteristics with firmness, in the packinghouse and in the market; and to contribute to the studies of feasibility of using optical reflectance to estimate peach ripeness and consumers' acceptance.

Materials and Methods

Over a hundred of varietal samples of peaches were analysed: 95 (6-fruit)samples in the market in Madrid and 12 (25-fruit) samples at the packinghouses in Murcia. They were grouped into: yellow and red peaches and yellow- and white-flesh nectarines; a total number of 1146 fruits were analysed in the Laboratory for: firmness (impact response, microdeformation, Magness-Taylor penetration resistance); and for optical parameters (VIS spectra), sugar (°Brix) and acid content (titration) and acceptance score (evaluated by an expert).

Results

From a study of the spectra, it was identified that apart from the standard (CIE) L, a, b parameters the relative reflectance values at 450 and 680 nm (carotenoids' and Clorophyll a absorbing bands) were the most relevant and reliable variables when describing peach visible (colour) quality, which corresponds to literature. Their values on both sides of the fruits (ground colour and blush), were determined and analysed separately for: a) all peaches; b) selected groups (i.e. 'yellow peaches'), and c) two selected (on-site) varieties (Caterina and Sudanell). A study was carried out on the variation of quality variables, in relation to colour and reflectance, as well as non-destructive firmness along the season.

Using PCA analysis on the optical variables, it is shown that, when considering all measured fruits, and both blush and ground sides, L, a , b and R450 are closely correlated, but R680 varies as an independent factor and all these account for 88% of all the variability in the (colour) data. R680 maintains its independency from the other four colour variables throughout all the groups' analysis, and it is shown that, through the season, and for all groups, R680 maintains the same range of variability (correlated with post-harvest ripening stage) both on the ground and on the blush sides. On the other hand, the groups and single varieties allocate themselves according to R450 (plus L, a and b). It is shown that L, a and b give no different information from R450 for this purpose in peaches.

When combining mechanical and optical data in one of the variety groups (yellow peaches) it is shown that firmness is well correlated to R680 and R450, and that (Magness-Taylor) firmness can be predicted by impact response force plus R680 and R450 (multiple linear regression, $r^2 = 0{,}65$, st. error of the estimation = 7 N) using any of the sides of the fruit (blush / ground) , two measurements per fruit. Classification of fruits into three firmness classes (<20N, 20-40 N and >40 N) is modelled and validated, with an average of an 80% of correct classification. Therefore, a prediction of firmness would be feasible by these non-destructive measurements. When considering data of one single variety (Caterina, on production-site, 50 fruits) close correlation is shown for firmness with both R450 and R680, and in this case, sugar content shows some relationship with colour and firmness. When analysing the expert's score, the 'very good' peaches were well predicted (classified by a discriminant analysis) based on contact firmness and R680.

It is concluded that estimating peach quality on the basis of non-destructive optical and firmness measurements shows feasibility if calibrating the sensors for each variety and site would be made possible. R450 and R680 show good potential, as they can be easily implemented in image-based sensors.

References

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