

Identification procedure of mealy apples by instrumental means. Extraction of storage features

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Barreiro P.¹⁾; Ruiz-Altisent M.¹⁾; Ortiz C.¹⁾; Recasens I.²⁾ Asensio M.A.²⁾
1) Rural Engineering Dept. ETSIA-UPM. Email : labpropfis@iru.etsia.upm.es
2) Postharvest Dept. CeRTA. Centro Udl.-IRTA. Lerida, Spain

INTRODUCTION

Mealiness is a negative attribute of sensory texture that combines the sensation of a dis-aggregated tissue with the sensation of lack of juiciness. Since January 1996, a wide EC Project entitled : "Mealiness in fruits. Consumers perception and means for detection" is being carried out. Within it, three sensory panels have been trained at : the Institute of Food Research (IFR, United Kingdom), the Instituto de Agroquímica y Tecnología de los Alimentos (IATA, Spain) and the Institut voor Agrotechnologisch Onderzoek (ATO-DLO, Netherlands) to assess mealiness in apples. In all three cases, mealiness has been described as a multidimensional sensory descriptor capable of gathering the loss of consistency (of crispness and of hardness) and of juiciness. Also within the EC Project several instrumental procedures have been tested for mealiness assessment. In this sense the Physical Properties Laboratory (ETSIA-UPM) has focused its aims in a first stage on performing instrumental tests for assessing some textural descriptors as crispiness, hardness and juiciness. The results obtained within these tests have shown to correlate well with the sensory measurements (Barreiro et Ruiz-Altisent, 1997) in apples, but also have succeed when trying to generate several texture degradation levels on peaches from which mealiness appears to be the last stage (Ortiz et al. 1997).

OBJECTIVES

- To test the feasibility of the identification procedure of mealy apples (Top-Red & Golden Delicious), previously tested with high success on peaches

MATERIAL AND METHODS

Apples were grown in Lérida, the main area of pome fruit production in Spain, by Udl.-IRTA, a subcontractor of UPM according to the experimental design. The apples were sent along the 96/97 season during the harvesting period (September 96) and after 3 and 6 months of storage (December 96/ January 97 and April 97 respectively). Apples were stored in commercial chambers. A factorial design was followed covering four experimental factors : *variety*, *harvesting date*, *size of the fruit*, *storage temperature*, and *storage period*. The total amount of fruits that have been tested per variety has been **420 apples per variety**. The tests carried out on these samples can be summarised as follows:

- Optical tests (visible spectrum and colour assessment ; NIR spectrum in the range 900-1600 nm),
- Mechanical tests, that have been performed for: *the whole fruit*: Magness-Taylor penetration test have been performed for a 8mm diameter rod, *fruit probes*: in this case confined compression as well as compression and shear rupture tests have been performed (Barreiro et Ruiz-Altisent, 1997). The textural descriptors assessed through this tests are indicated in Table 1.

	Crispness	Hardness	Elasticity	Juiciness
Confined compression	X	XX	XX	XX
Compression rupture test	XX	X	-	-
Shear rupture test	XX	X	-	-

Table 1. Texture descriptors assessed through the mechanical tests on fruit probes

- Chemical tests, divided into: *solid soluble content*, measured refractometry, and *titratable or total acidity* using NaOH 0.1 N and phenolphthalein indicator

RESULTS AND DISCUSSION

At a first stage an Analysis of Variance has been carried out to detect the effect of the experimental factors on the texture descriptors assessed by instrumental means with the following results :

- **Golden apples** : Not always Crispness(C) & Hardness(H) evolve in the same way. Date of harvest affects more to C ($F=81$) than to H (ns). Juiciness is not affected by the date of harvest or the size of the fruit, it is affected by the interaction date of harvest/storage time ($F=9.7$). Storage temperature affects C ($F=5.5$) and H ($F=5.3$), unlike Magness-Taylor Firmness (ns)
- **Top-Red apples** (main differences from Golden apples) : Juiciness is not affected by the storage temperature (-0.5°C , $+0.5^{\circ}\text{C}$ & $+2^{\circ}\text{C}$), but the same interaction as for Golden is found for date of harvest/time of storage ($F=11.4$). Storage temperature affects Elasticity ($F=18.7$) and Hardness ($F=17.6$), more than to Magness-Taylor Firmness ($F=12.2$)

The identification procedure of mealy fruits is based on the definition given by the human experts (sensory panels), that is, lack of crispness, of hardness and of juiciness. Instrumental shear crispness (SF) and juiciness are categorised using non supervised clustering procedures. The clustering procedure enables to generate several degradation stages of texture from which mealiness appears to be the last stage (non crispy + non juicy, see Figure 1). The loss of crispness appears as a quicker/sharper transition for Golden than for Top-Red apples. For both apple varieties the juiciness evolution is gradual in spite of the crispness behaviour. The use of the categorisation procedure will enable to extract features from the experimental factors in the sense of the conditions that lead to higher percentages of mealy fruits.

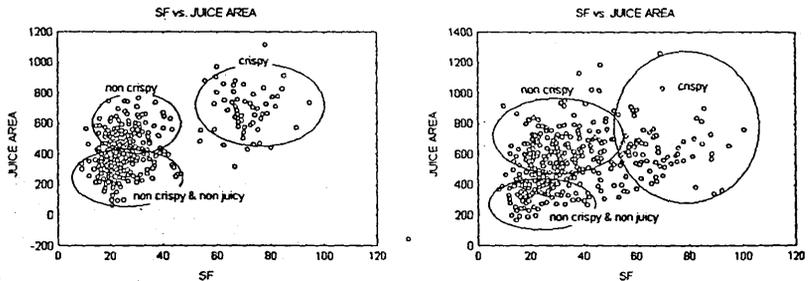


Figure 1. Bi-dimensional data gathering procedure used to identify mealy fruits (non crispy + non juicy).

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