

Evaluation of Old Italian Apple Cultivars by Means of Sensory Analysis

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Abstract

Sensory analysis has been applied to characterize and to evaluate old/local germplasm with the aim to obtain information on fruit quality and to explore the cultivar acceptability. In 1999, thirty-six old Italian cultivars were analysed for their sensory profile and qualitative characteristics in comparison with four cultivars presently widely grown in Italy. The fruits were tasted by 15-17 partially trained panelists, and the following descriptors were assessed by means of a non-structured scale: sweetness, acidity, flavour, astringency, crispness, firmness, mealiness, juiciness; a global preference was also expressed. Soluble solid content, titratable acidity, pH and penetrometric index were measured. The coefficients of multiple regression among global preference and sensory attributes show that sweetness and crispness were the most important determinants, sweet, crispy and aromatic apples being the most appreciated by the panelists. Positive relationship, with flavour and juiciness, and negative with astringency and mealiness were observed. Some local cultivars (Zuccherina, Iaccia) were appreciated at the same level of the old and always highly estimated Annurca and more than Golden Delicious, Red Delicious and Ozark Gold.

INTRODUCTION

In the last twenty years attention has been devoted in Italy to the collection, conservation and evaluation of fruit tree diversity, with two main purposes: to guarantee the availability of a wide genetic variability for breeding programs and to extend the possibility of diversification of fruit offer.

The potential of exploitation of old varieties is dependent on the interest of consumers for a wider range of fruit traits and for intrinsic quality and to the tendency to the application of organic or integrated fruit growing processes.

The old apple cultivars are generally characterized by quite unusual pomological traits and have sometimes a lower external appeal with respect to the standard apples. As a consequence, the success of their introduction into commercial production for niche markets is highly dependent on the intrinsic quality of the fruits and on the capacity of the consumer to distinguish the peculiar characteristics in comparison with the conventional cultivars. The hypothesis of a re-proposal of old local cultivars for fruit growing may be then supported by the evaluation of the level of acceptability and of the capacity of the consumer to perceive peculiar qualitative traits.

Sensory analysis has been applied in the last years to the classification of fruit cultivars and to the evaluation of the effect of provenance, harvesting time and storage conditions on sensory profile (Durner et al., 1992; Daillant-Spinnler et al., 1996; Bernalte et al., 1999; Eccher Zerbini et al., 1999; Stainer et al., 2000).

The results of a panel test could help to the exploitation of old local germplasm, integrating the characterization and evaluation work and giving supplementary information on fruit quality. In that way, the hypothesis of introduction of old varieties may be better supported by the evaluation of the level of acceptance and of the perception capacity of the distinctive traits of the fruit by the consumer.

The aim of this work was to evaluate old apple cultivars individuated in central Italy and collected at the experimental farm of Tuscia University on the basis of their acceptability, qualitative traits and sensory profile, in comparison with well known and

commercially diffused apple cultivars.

The final goal of the trial was the definition of the potential of the old genetic resources for unconventional systems of fruit growing and for niche markets and the understanding of the level of preference by potential consumers.

MATERIALS AND METHODS

The list of apple cultivars and the area where they were individuated are reported in table 1. Thirty-six old autumn and winter ripening apple cultivars, collected at the experimental farm of Tuscia University - Viterbo, central Italy, were compared with three cultivars presently widely grown in Italy (Golden Delicious, Red Delicious and Annurca). The summer cultivar Ozark Gold and a commercial sample of Golden B bought on the market were also considered. Four plants per cultivar, 8-11 year old, grafted on M 26 rootstock and trained to free palmette at a distance of 4 m x 2 m apart were considered.

At the beginning of November 1999, samples of fruits stored in a cold room at 4°C and 80 % RH for 1-2 months, depending on the date of harvest, were submitted to a panel test and some qualitative traits were analysed.

Qualitative Analysis

One slice of each of the five fruits used for sensory analysis was frozen at -20°C for the determination of soluble solid content (R.S.R., °Brix), by means of a digital refractometer Atago PR-101, pH and titratable acidity, titrating the juice with NaOH 0.1 N to pH 8.2.

The flesh firmness was measured by means of a hand penetrometer (11 mm probe) on one side of each fruit, after removing the skin, immediately before preparing the slices for the tasting session.

Sensory Evaluation

15-17 partially trained panelists tasted the fruits after 2 days of shelf life. The panel included members of the Department staff and students; they had previously received some training on sensory evaluation of apple for the understanding of the meaning of the attributes and for the assessment of sweet and sour taste and aroma intensity, according to Eccher Zerbini et al. (1999). At each sensory test 8 varieties were evaluated. The evaluation was conducted in a room equipped with individual sites and with white incandescent light. Two slices of anonymous samples were submitted to the panelists. They were invited to drink a sip of water and eat some saltless crackers between samples, in order to avoid tiring effects. The most important descriptors of apple taste and quality were assessed: sweetness, acidity, flavour, astringency, crispness, firmness, mealiness, juiciness; a global appreciation was also expressed. A sensory score sheet with a 11 cm unstructured line scale, each with anchored terms at both ends was used for descriptive terms. The judges were requested to indicate the intensity of each attribute by placing a vertical line on the unstructured scale line. Sensory data were then quantified as the distance from the origin and the vertical line.

Statistical Analysis

Analysis of variance was performed on all the collected data, using the procedure SYSTAT MGLH (Wilkinson, 1998). The agreement among panelists was checked by ANOVA, considering cultivar, panelist and the interaction cultivar x panelist. Multiple regression analysis between global preference and the tested attributes was then applied. The coefficient of correlation among sensory variables was also calculated.

RESULTS

Qualitative Traits

The cultivars were characterized by a quite high soluble solid content and by a high variability of titratable acidity (Fig. 1). The level of soluble solids showed evident

differences among varieties, and ranged between extreme values of 11.9 for Agre and more than 18.5 for Rotella and Ruzza, with a mean refractometric index higher than the reference cultivars (12.7 for Golden Delicious and 11.7 for Ozark Gold).

The pH was generally low and with a high variability among cultivars, ranging from 3.2 and 4.7. The titratable acidity ranged from very low (0.12 % in the cultivars Iaccia, Zitella and Zuccherina) to very high values (1.29 % in the cultivar Agre), with a mean of 0.4-0.5 %.

As a mean, the flesh of the old cultivars showed a higher firmness than the reference cultivars Golden Delicious and Ozark Gold. For some varieties the measured values of penetrometric index were more than double than those of the reference cultivars: 9-11 kg (Rotella, Tosta, Mela Rosa) and 3.6 - 3.9 kg (Ozark Gold, Golden Delicious and Red Delicious).

Sensory Analysis

Analysis of variance indicated a good agreement among the panelists for nearly all the attributes.

In figure 1, the global appreciation expressed by the panelists is reported. Some of the local varieties (Zuccherina, Iaccia) were appreciated at the same level of the old and always highly estimated Annurca and more than Golden Delicious, Red Delicious, Ozark Gold and the commercial sample of Golden B (Fig. 2).

The coefficients of multiple regression among global preference and sensory attributes showed that sweetness, aroma and crispness were the most important determinants, sweet, crispy and aromatic apples being the most appreciated by the panelists (table 1). Juiciness was also positively related to the global preference, whereas preference ratings were significantly dependent on a negative relationship with mealiness and astringency.

Among the sensory attributes, a good perception of acidity is revealed by the significant linear relationship between analytical and sensory determinations (Fig. 3). The lowest scores of acidity were attributed by the panelists to Zuccherina, Iaccia and Zitella (Fig. 3), which revealed at the analysis very low values of titratable acidity (Fig. 1). Similarly, Agre, which is characterised by a very high acidity, obtained the highest scores by the panelists. The correct evaluation of sweetness seems more difficult (Fig. 3). The judgement on sweet taste was in fact probably strongly affected by acidity. The high level of sugars of Ruzza (19° Brix) was masked by the quite high acidity to the panelists and was then underestimated. The unbalance between high acidity (1.2 %) and the medium sugar content (13.3° Brix) of Agre also determined the underestimation of sweetness of this cultivar. Similarly, the low acidity of Iaccia and Zuccherina led to a strong perception of fruit sweetness, which showed values quite high (R.S.R. higher than 14° Brix).

Some sensory attributes were directly (crispness and firmness) related each other (table 2), demonstrating some redundancy of the sensory characteristics evaluate; other attributes were negatively related (firmness and mealiness).

CONCLUSIONS

A good variability of qualitative traits was observed in the apple germplasm collected, which offers good perspectives of exploitation for fruit use. The panelists, who gave their preference to sweet, aromatic and crisp apples, appreciated some cultivars. Mealiness and astringency were considered the most negative attributes for fruit acceptability.

The panelists showed a good capacity of a correct perception of the distinctive traits of many compared varieties, in particular for acidity and firmness.

The interest of some varieties for niche markets seems to be confirmed on the basis of their sensory profile.

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Tables

Table 1. Coefficients of multiple regression (\pm standard error) and correlation between scores of global preference and sensory attributes.

Attribute	Coefficient of multiple regression	Significance	Coefficient of correlation
Sweetness	0.365 \pm 0.038	**	0.48**
Acidity	0.055 \pm 0.037	n.s.	-0.01
Aroma	0.205 \pm 0.035	**	0.36**
Astringency	-0.184 \pm 0.044	**	-0.12
Crispness	0.260 \pm 0.047	**	0.41**
Firmness	0.014 \pm 0.052	n.s.	0.38**
Mealiness	-0.079 \pm 0.034	*	-0.09
Juiciness	0.156 \pm 0.041	**	0.33**

Table 2. Coefficients of correlation among sensory variables for the forty apple varieties.

Attribute	Sweet	Acidic	Aromatic	Astringent	Crispy	Firm	Mealy	Juicy
Sweet	1.00							
Acidic	-0.30**	1.00						
Aromatic	0.26**	0.07	1.00					
Astringent	-0.20*	0.47**	0.09	1.00				
Crispy	0.04	0.23**	0.18*	0.14	1.00			
Firm	0.09	0.17*	0.14	0.13	0.72**	1.00		
Mealy	0.21*	0.07	0.08	0.05	-0.31**	-0.33**	1.00	
Juicy	0.25**	0.23**	0.14	0.14	0.25**	0.31**	0.01	1.00

Figures

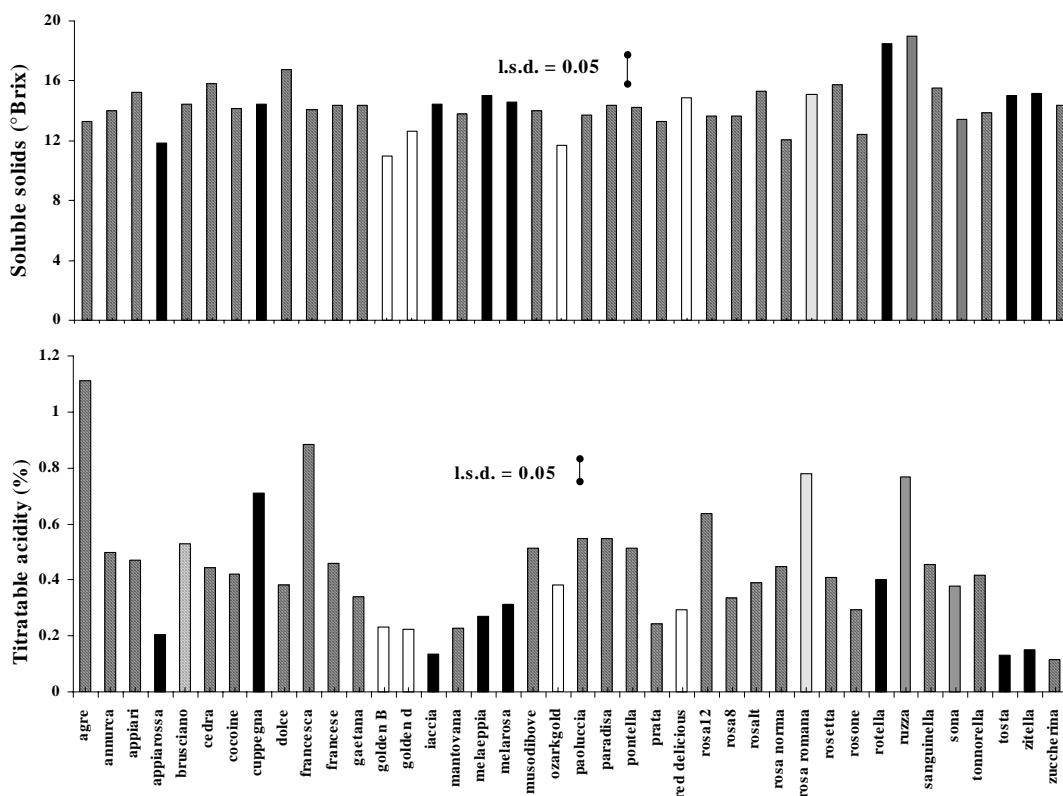


Fig. 1. Soluble solids and titratable acidity of the apples submitted to the panel test

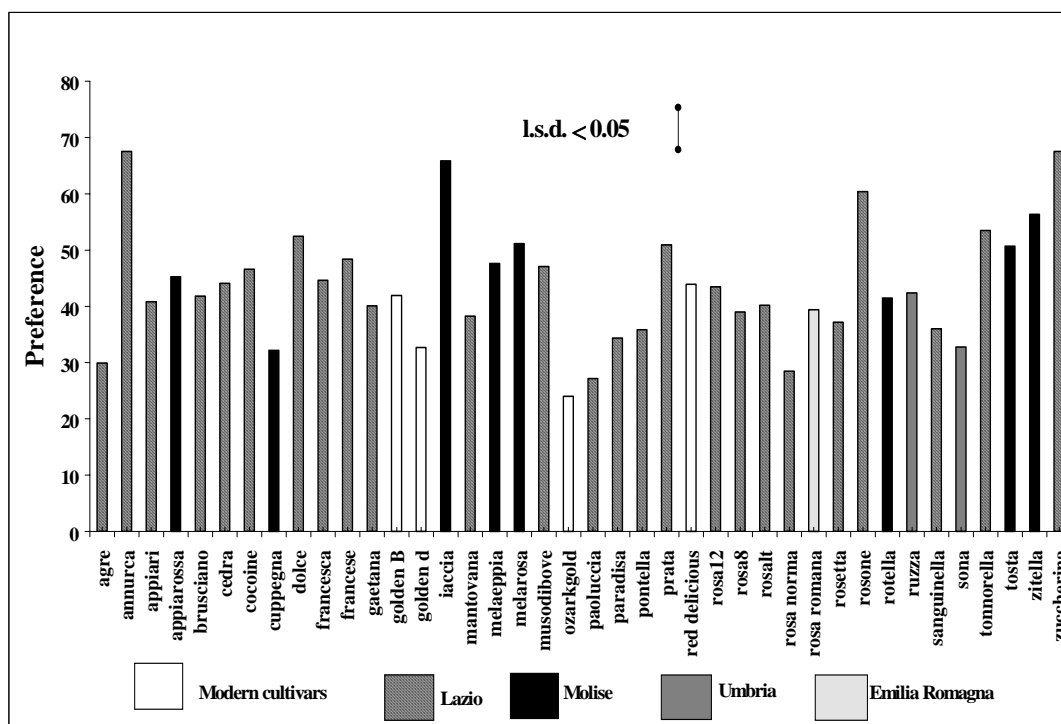


Fig. 2. Global preference expressed by the panelists for the tested cultivars.

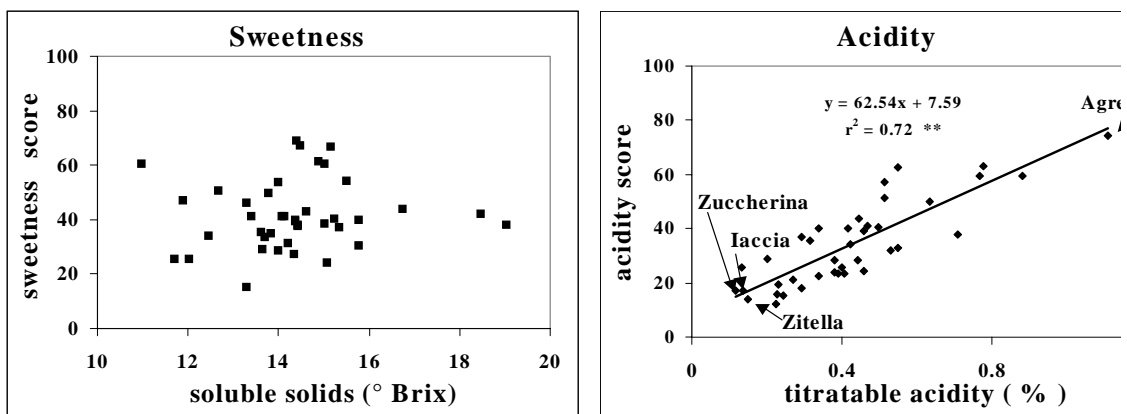


Fig. 3. Relationship between measured values and mean scores attributed to sweetness and acidity.