A study of the sensory and nutritional quality of virgin olive oil in relation to variety, ripeness and extraction technology. Overview of the three year study and conclusion

By **Mario Bertuccioli***
Dipartimento di Biologia, Sez. Tecnologie Alimentari
Università della Basilicata, Via N. Sauro 85, 85100 Potenza, Italy

SUMMARY

A study of the sensory and nutritional quality of virgin olive oil in relation to variety, ripeness and extraction technology. Overview of the three year study and conclusion

This lecture provides an outline of the main goals achieved during three years of research activity. The results show how to ensure the maximum chance of success by matching consumer's needs and preferences. Information about consumer is obtained through preference tests and may be used in a company to formulate the right product. The key by which the consumer information reach the producers is the sensory profile of the product. A olive oil sensory wheel has been proposed to clarify and improve the list of standardized olive oil flavour descriptors. The order of terms has been organized to facilitate its use. This proposed system represents a powerful tool to facilitate communication among producers and consumers of the international market.

Sensory preference, flavour profile testing, and complex statistical procedures for relating olive oil attributes to the preferences represent important improvement in traditional approaches for defining and identifying desirable product attributes.

A secondary Flair goal has been to develop a strategy to predict a specific property (i.e. oxidation stability) of olive oil.

KEY-WORD: Preference - Sensory profile - Sensory wheel - Stability prediction - Virgin olive oil.

INTRODUCTION

The goals of the three years research have regarded different aspects that are summarised in Table I. The aim of this paper is to present a strategy to ensure the maximum chance of commercial success of virgin olive oil, according to the results obtained in the Flair project.

The starting point is the necessity to match the product to the consumer's needs and preferences. Consumer information is obtained through the preference test and is used in the company laboratory to formulate the right product. The pathway by which this information can be utilized by the producing company is quite complex and can involve several steps (Moskowitz, 1991)

Olive oil producers need to know what makes a product acceptable, what motivates the consumers. The consumer's attitude towards olive oil is mainly related to sensory factors: appearance, odour, taste, mouthfeel, and each of these factors interacts differently with the consumer according to the situation. The consumer is also influenced by non-sensory factors, including those related to physiology, health, culture, geography and climate, as well as other variables such as availability and convenience.

Table I
Overview of research activity (summary)

The fundamental goal of the FLAIR research program was to develop , through sensory and nutritional studies, a methodology to define the virgin olive oil quality.

A) SENSORY QUALITY
- Set-up of a standard terminology describing the sensory profile of virgin olive oil;
- Standardization of sensory analysis of olive oil (tasting procedure, statistical approaches);
- Sensory profile of virgin olive oil differing in origin, technology and shelf-life;

B) CONSUMER PREFERENCE
- Identification of critical sensory parameter for consumer preference (traditional and potential consumers);

C) NUTRITIONAL QUALITY
- Experimental evidence and quantitative evaluation of in vivo antioxidant activity of virgin olive oil; set-up of a routine analytical index related to quality.

Virgin olive oil preference

Approach

In order to identify the most important sensory profile descriptors in terms of consumer preference, two different tests were conducted to provide data from potential English consumers and from traditional Italian consumers .

Preference British test: objective and results (Watson and MacEwan, 1993).

Olive oil products are relatively new to the British market and a preference test was carried out, first of all, to provide an initial insight into reaction to this emerging market. It highlights a variety of influences on the decision to incorporate olive oil into the British cuisine and looks at the way in which olive oil is currently being used. It goes on to

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highlight consumer reactions to the products and looks specifically at consumer reactions to taste, colour, packaging, branding, country of origin, purchasing pattern and storage. The findings show that the British are responding positively to this product but remain somewhat confused as to what to look for in deciding to select an olive oil.

Some of the attitudes of British consumers are:

- Main influences on the decision to use olive oil arise from health benefits associated with consuming olive oil, holiday and eating out experiences along with exposure to the product through cookery books and television programmes.
- Olive oil has traditionally been used for medicinal purposes.
- There is confusion over various product descriptors, notably the terms 'extra virgin', virgin', 'hot pressed' and 'cold pressed'.
- Darker oils are considered to be stronger, better quality, thicker, heavier, 'over-ripe' and more bitter.
- Lighter coloured oils are associated with cooking oils.
- Glass packaging is preferred over plastic or tin in half or one litre containers.
- The containers need to be strong, robust, not too heavy, easy to open, pour, reseal, and not messy to handle.
- The packaging which includes the label, brand name, country of origin and details on the contents are all surrogate indicators of quality.
- Given the lack of information on what constitutes a good quality olive oil, high reliance is placed on price and a positive price/quality relationship.
- Many individuals believe there is a difference in quality between olive oils but are unclear about how to distinguish between different brands.

The results of this preference test conducted in England are of greate interest to the producers. They show that the English consumer is suspended somewhere between a relatively positive expectation and an uncertainty about what should be considered a *good* or a *bad* olive oil. Under these conditions it would be completely wrong to introduce olive oils with very different and varying qualities. It is illogical to think that the new consumer will be able to distinguish between the types and qualities, variety of cultivar or technology used.

The test conducted in England gives very simple and clear suggestions: the need to emphasize the nutritional and convenience aspects and to standardize the sensory quality. At this stage, a simple, clear and informative label would be the most valuable promotional tool.

Preference Italian test: objective and results (Pagliarini et al, 1993)

Whereas British consumers may have difficulty in evaluating olive oil, Italian consumers have no difficulty in saying which of a series of products they prefer, providing, furthermore, information on the relative appeal of the products.

To investigate consumer preferences in Italy, two separate groups of people were involved in the test:

a) People who buy olive oil directly from the producer (families Southern Italy)
b) People who buy olive oil from the shops and supermarkets (Individuals of Northern Italy).

Various regression models can be used to link profile information to consumer preference data, enabling vectors or surfaces to be placed in a product space or map (PREFMAP plot, MacFie and Thomson,1988) showing how the samples relate to one another from the point of view of preference.

The results referred to as PREFMAP models (a combination of conventional panel data and consumer preference data, Figure 1) present two fundamental ideas that should be considered.

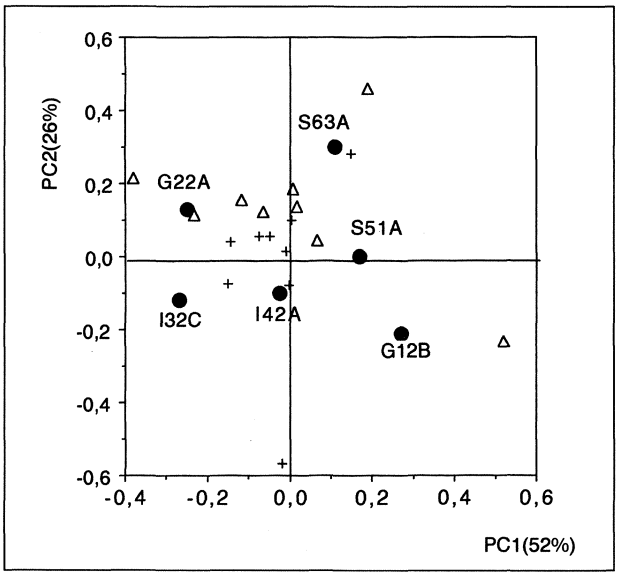

Fig. 1
Preference mapping model (phase 3, Schiffman et al, 1981) for 16 consumers. • Extra virgin olive oils ; + positive ideal points; Δ negative ideal points.

The first in that whoever sells extra virgin olive oil should be able to standardize the sensory profile because without this, one would run the risk of disappointing the consumer who has rather specific preferences and aversions. No client remains faithful to a product if it is satisfactory one time and not the next. This consideration is even more important for the emerging consumer (English) who are not accustomed to using olive oil. They must acquire a knowledge of the new product and then form a judgement about it. This is only possible if the product has definite, recognizable, consistent characteristics.

The second point is that standardization should not be understood as a homogenization of tastes, since different consumers have different preferences. The standardizations should be based on a constancy of sensory profiles that characterize the various types of oils according to the preferences of the various consumer groups.

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The conclusion is that the sensory profile cannot be used as a measure of the level of quality. No oil exists or will ever exist that is preferred by all. As can be seen from the PREFMAP plot, the same point in the sensory space may represent preferences (positive ideal point) and aversions (negative ideal point) for others. This is proof that the COI test, including some sensory attributes in the context of oil quality evaluation, has assumed an inappropriate importance.

The olive oil sensory profile: the Sensory Wheel. (Mojet et al., 1993)

One of the aims of the project was to prepare a common vocabulary of attributes, together with appropriate standards and definitions for each attribute. As a first step towards this end , sample and attribute structures were compared for the British, Dutch, Italian and Spanish (COI) profiles. The Standardized System of Olive Oil Terminology as a Sensory Wheel (Figure 2), has been prepared to clarify and improve the list of attributes important in describing the olive oil profile. The order of terms has been organized to facilitate its use.

This system represents a tool to facilitate communication among producers and consumers in the international market.

By means of this standardized system it is possible to prepare a specific scorecard to evaluate the influence of raw material or technological variables on the olive oil sensory profile. Figure 3 is an example of scoresheet for descriptive test.

Each product is scored based on the characteristics present in that particular product by using some form of scaling procedure. In this way the sensory characteristics of each product is presented in term of words and numbers. The above information is useful in itself if one is trying to understand why a particular product is performing in a particular way in the market place. When handling large numbers of product however, the production of perceptual maps provides a deeper insight into how products relate to one another. By representing each of the attributes being scored in a profile in a multidimensional space, each of the products can be given a unique position in that space depending on how it has scored with respect to the attribute. When all the samples are placed in such a space the positions of the samples reflect their similarity and differences. Samples which are close together are similar in character and those which are far apart are different. By exploring the position of the axes relative to the samples, it is also possible to determine why such samples are similar or different.

An example of such a map based on the assessment of thirty two oils of different origin, using the terminology extracted from the sensory wheel, is presented in Figure 4 (Biplot).

Prediction of olive oil characteristis: the case of oxidation stability

One of the aims of the project was also to explore the possibility of predicting some olive oil characteristics, important for the quality (nutritional value, stability), by means of chemical variables. It is well known that phenolic compounds have a fundamental importance in the nutritiónal, stability and sensory characteristics of virgin olive oils (Cortesi and Fedeli, 1983; Montedoro et al., 1992, Perrin, 1992). For example the stability of oil is linked to its phenolic content. Some tests of stability (i.e. Rancimat test), based on the measurement of products formed during the oil oxidation are quite time consuming so an alternative method of predicting the stability could be useful.

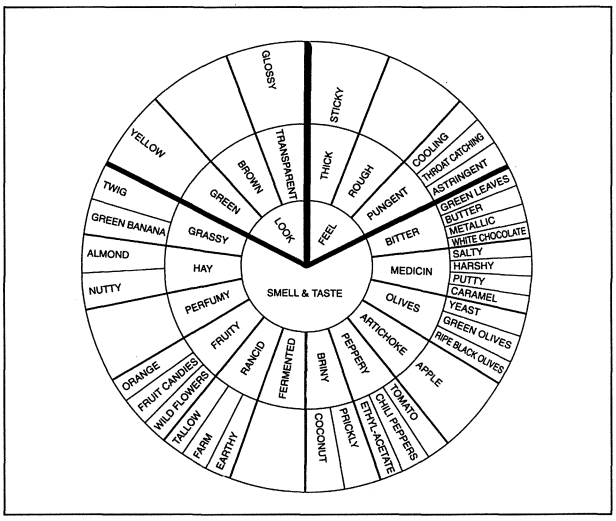

Fig. 2
The Sensory Wheel (Mojet et al, 1993)

S A M P L E C O D E

....

INTENSITY SCORE
(1=low intensity 9=high intensity)

COLOUR
1.- yellow ....
2.- green ....

AROMA
3.- tomato ....
4.- green olive ....
5.- ripe black olive ....
6.- cutty grassy ....
7.- artichoke ....
8.- apple ....
9.- yeast ....

TASTE
10.- bitter ....

MOUTHFEEL
11.- pungent ....
12.- astringent ....

FLAVOUR BY MOUTH
13.- tomato ....
14.- green olive ....
15.- ripe black olive ....
16.- cutty grassy ....
17.- artichoke ....
18.- apple ....

Fig. 3
Descriptive sensory scoresheet.

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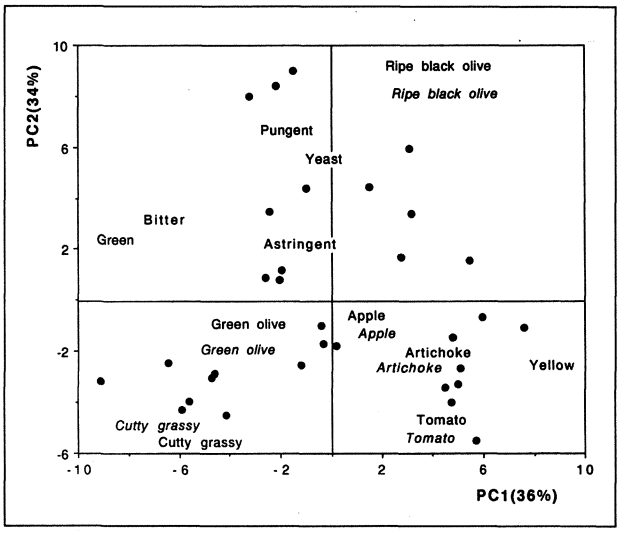

Fig. 4
Olive oil sensory characterization.:PCA -Bi-Plot

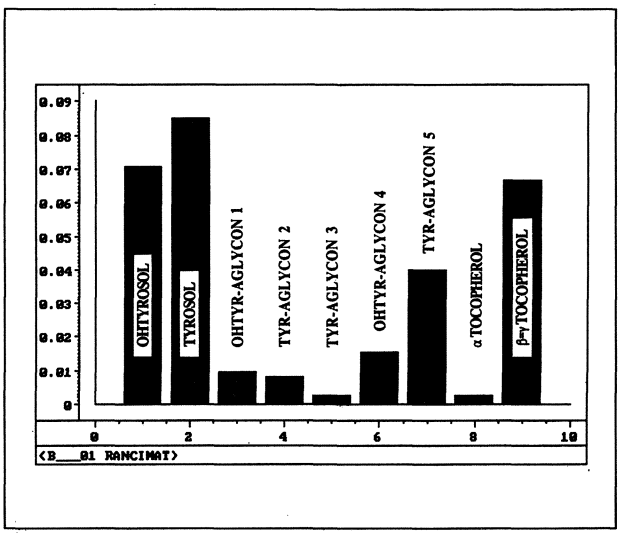

Fig 5
Estimated regression coefficients of calibration model

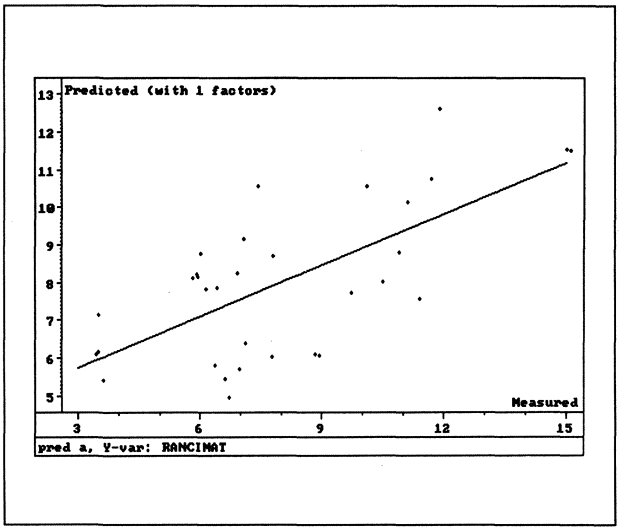

Fig. 6
Predicted *vs* measured Rancimat values of trained sample set

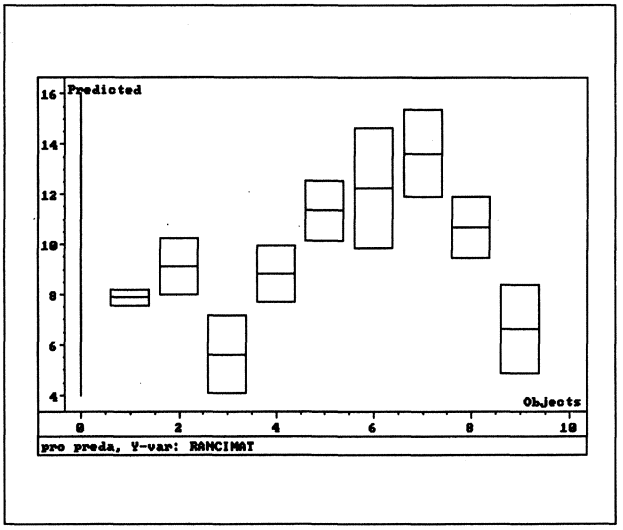

Fig 7
Predicted Rancimat values of unknown oil samples

A model based on multivariate calibration was built to predict the oil oxidation from a measure of phenolic compound content. The calibration model is based on the relationship between phenolic compound content and Rancimat values.

The procedure was as follows:

First, a model was established based on a reference group of oils (training set) with known Rancimat values and phenolic contents .In this experiment 32 olive oil samples were analyzed. Figure 5 shows the estimated regression coefficient of the calculated model. The estimated coefficients tell us the cumulative importance of each of the phenolic compounds with respect to the oxidation stability (Rancimat values). Tyrosol, hydroxityrosol-aglicon-1 b and g tocopherol are important for oxidation stability and their amount is positively correlated to the Rancimat values.

The second step was the validation of the model. To do this, predicted Rancimat values of the oil training set were compared with the experimental values. The graph of Figure 6 shows the results of this validation. Not all olive oil Rancimat values are correctly predicted. This is probably so because the basis for modelling -the training set- is still too small for this problem and some olive oil samples can be considered outliers.

The third step was the prediction of oxidation stability on new oil samples. In the Figure 7, the stability of nine virgin olive oils is predicted. The predicted values are given with uncertainty limits which tell how much one can trust the corresponding prediction. The prediction ability of the model is not very good, but it can be improved with further experiment and refinemen.

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CONCLUSION

We have attempted to illustrate some of the Flair project achievements. Some aspects have been given greater emphasis:

- the importance of consumer preference studies in determining success in marketing olive oil;
- the role of sensory profile analysis in product optimization.

The integration of these aspects can provide a strategy and guide for olive oil production and marketing.

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