CHEMICAL, PHYSICAL, TEXTURAL AND SENSORY EVALUATION ON RICE

Comparison between characterizations of Italian rice varieties

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Introduction

The characterization of rice has been carried out by chemical analysis which require the use of more or less sophisticated equipment and trained technicians to the application of analytical methods.
The descriptive analysis is a new experience in the evaluation of Italian rice that allows to describe and quantify the sensory properties of the different varieties. As with the traditional analysis is fundamental the instrument calibration and the choice of the adequate analytical method as well as the equipment for the sensory analysis is the basic choice of assessors who will be part of the panel and their training.

Goals

Ten heterogeneous varieties of Italian rice were characterized both from a traditional point of view, namely, chemical, physical and textural (length and width, gel-time, resistance to extrusion, stickiness, amylose content), that sensory, involving a panel of tasters selected, chosen and trained.
The analytical data will then be compared in order to bring out similarities and differences.

Materials and Methods

The ten rice varieties selected for the purpose are: Aiace, Arborio, Baldo, Carnaroli, Loto (*long A*); Gange, S. Andrea, Thaibonnet (*long B*); Selenio (*round*); Vialone Nano (*medium*). The classification in: long A and B, round and medium is according to the European legislation (Reg. CE 1234, 2007).
In the LCM were carried out the following analytical determinations: length and width (UNI EN ISO 11746:2012) with an image analyzer WinSEEDLE; determination of texture, that is the resistance to extrusion, in the next called for semplicity hardness (UNI EN ISO 11747:2012) and stickiness (MP14 rev.09) with a texture analyzer TA.XTplus (SMS); gel-time with the manual *Ranghino* method (UNI ISO 14864:2004) which is correlated to cooking time of varieties (Simonelli *et al*, 2013) and the amylose content (UNI ISO 6647-1:2008) with a UV-VIS spectrophotometer (Perkin Elmer).
The sensory evaluation were made in the ERSAF laboratory (constituted according to the ISO 8589:2007); was carried out the sensory profile (ISO 13299:2003) of each variety prior identification of perceived sensory characteristics (descriptors) that are measured quantitatively to define the perceived differences between different varieties of the same product.

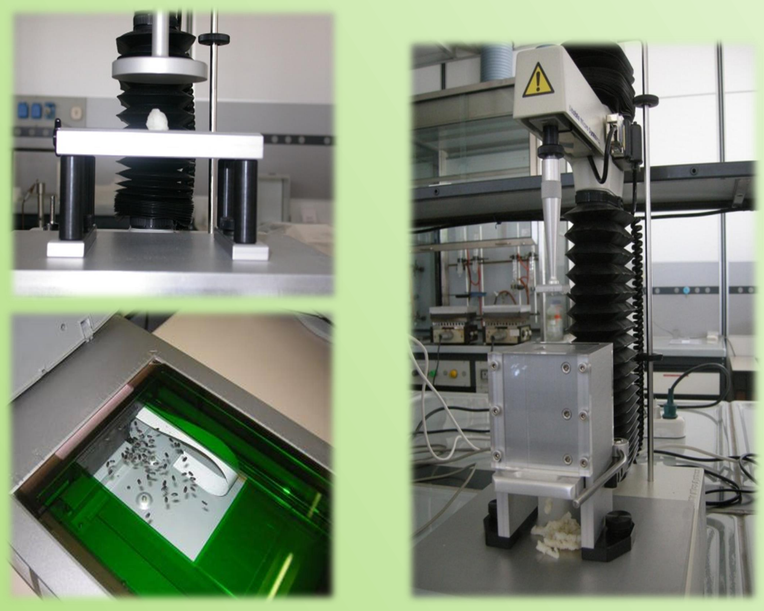


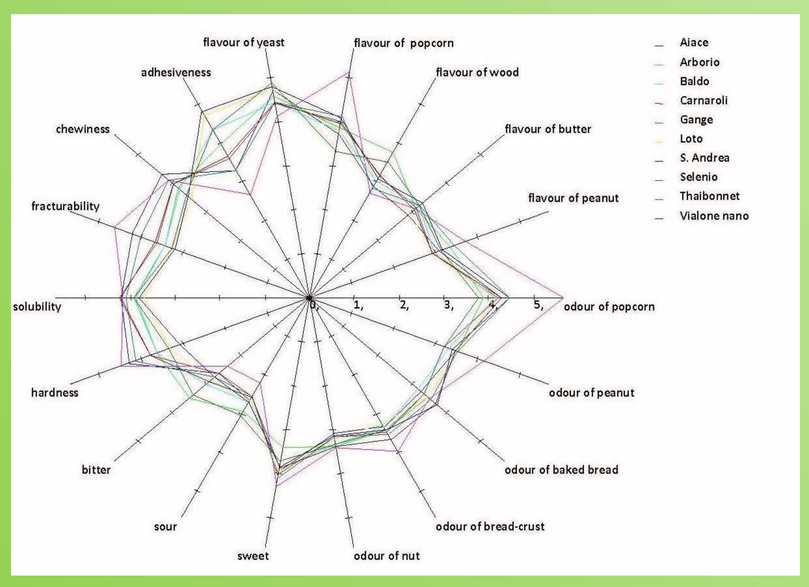
Figure 1 – in clockwise: texture analyzer TA.XT plus details on the determination of stickiness; detail on the determination of hardness, image analyzer WinSEEDLE detail on the determination of length and width (at LCM – ENR): the testing booths *(ERSAF).*

Results and Discussion

SENSORY EVALUATION

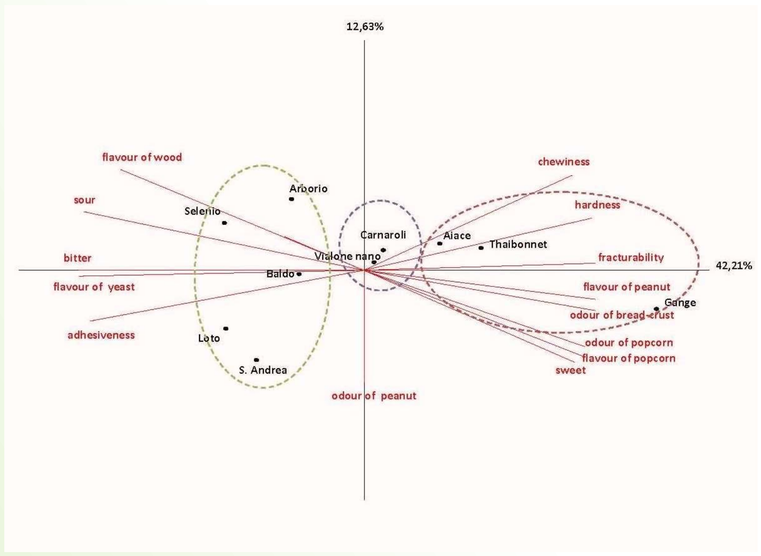
The sensory profile is the complete description of the sensory properties of a product (rice), obtained by listing the sensory attributes and assigning an intensity value to each attribute. It is obtained by treating statistically the data originated by 11 judges (Fig. 2).

Figure 2 – Spiderplot showing sensory profile of 10 Italian rice varieties



The elaboration was carried out through the Procustes Generalized Analysis (GPA) that is able to assess the existence of particular features that differentiate the samples and the presence with the level of agreement of the judges in identifying and measuring the characteristics (Fig. 3).

Figure 3 – Graphical visualization of GPA for 10 Italian rice varieties



Evaluating the results show clearly that the Gange is a very peculiar variety than all the others, for the following characteristics: odour of pop-corn, peanuts and crust of bread odours, sweet, hardness, friability, pop-corn and peanuts flavour. The Selenio variety differed in sourness, the Aiace one in chewiness and the Arborio one in bitterness and wood flavour.

CHEMICAL, PHYSICAL AND TEXTURE PROPERTIES

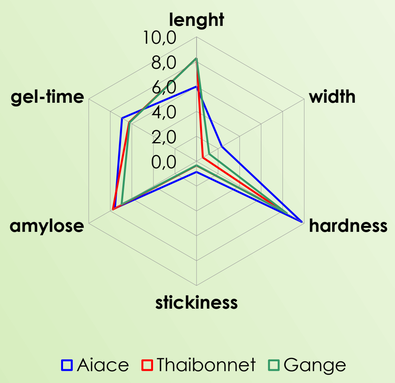
The selected varieties were characterized in the LCM obtaining the results reported in Table 1

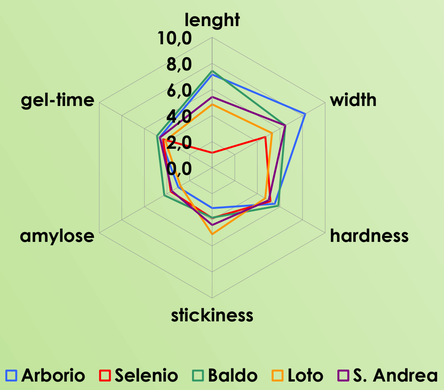
Table1 – chemical, physical and textural characterization of Italian rice varieties

varietà	length	width	hardness	stickiness	amylose	gel-time
	mm	mm	kg/cm²	g.cm	g/100g	minutes
Aiace	6,4	2,4	1,37	0,92	24,9	22,55
Arborio	6,8	3,4	0,82	3,14	15,3	19,53
Baldo	6,9	3,1	0,86	3,87	17,9	19,85
Carnaroli	6,6	3,1	1,11	0,93	20,6	19,72
Gange	7,2	2,2	1,19	0,39	23,6	21,62
Loto	6,0	2,9	0,71	5,13	14,9	18,87
S. Andrea	6,2	3,1	0,75	4,43	16,5	19,50
Selenio	4,7	2,8	0,77	3,90	16,7	19,13
Thaibonnet	7,2	2,1	1,13	0,41	25,3	21,67
Vialone Nano	5,6	3,3	1,10	0,91	22,4	15,95

As a result of sensory characterization carried out in ERSAF laboratory, is possible group the different varieties of rice according to group shown in Figure 3 and indicate in Table 1 with different chromaticity.
It is possible to make an assessment of the individual characterization of each variety and represent it using radar charts. They are overlapped and reported for group membership (as reported in Table 1).

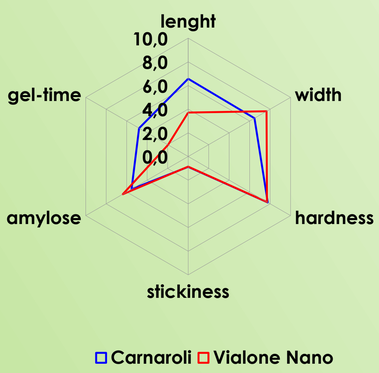
The data reported in Table 1 arise similarities between the varieties Aiace, Thaibonnet and Gange (similar biometric characters, gel-time, high amylose, high hardness and low stickiness).
There is confirmation of their similarity even after the sensory characterization (Fig. 2), which shows further peculiarity of the Ganges, as the sole aromatic rice.





The second group (taken from Figure 2) consists of dissimilar varieties: Arborio, Selenio, Baldo, Loto and Sant'Andrea. However all are comparable for amylose content and consequent hardness and stickiness; also the gel-times are similar. Biometrics characteristics are significantly different (the varieties have in fact different classification)

The third group emerged from Figure 2 belong to the Carnaroli and Vialone Nano, different in dimensionality (respectively a long A and long B), but comparable for amylose content and consequent hardness and stickiness; they are heterogeneous for the parameter: gel-time.

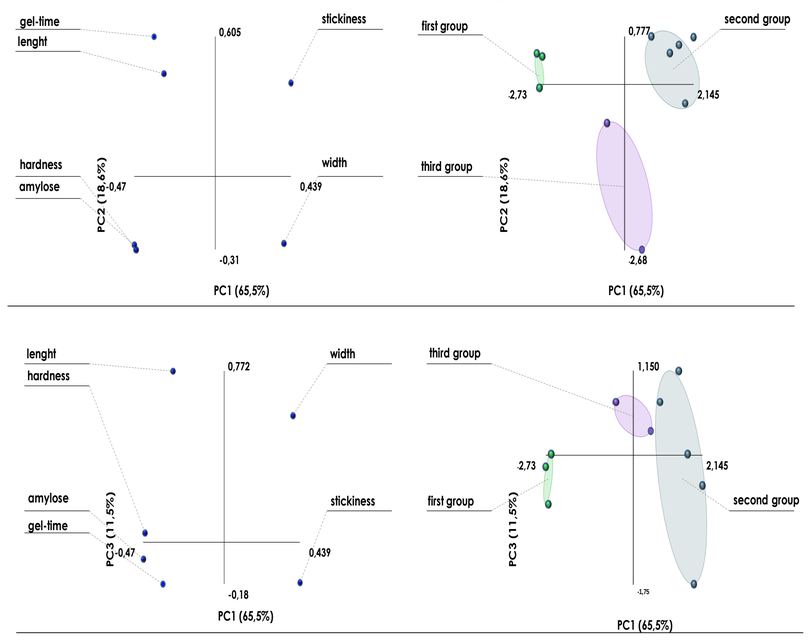


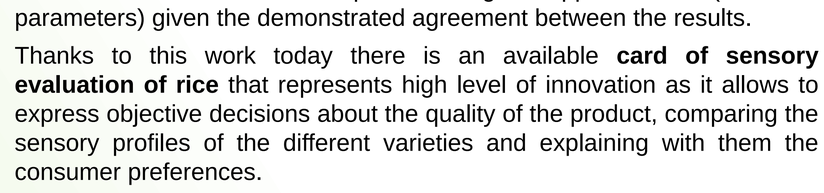
Comparing the chemical-physical and textural determinations with sensory emerged a close analogy between the sensory character chewiness and hardness, as well as between adhesiveness and stickiness. This is particularly evident for the variety Aiace which presents the highest hardness and the highest score for the character chewiness. The varieties Loto and S. Andrea are the ones with more marked character adhesiveness and which have the highest value of stickiness. The score of the character chewiness for both, is the lowest among the varieties and similarly their hardness are the lowest recorded.

PCA ON CHEMICAL, PHYSICAL AND TEXTURE PROPERTIES

After the data normalization of the results in Table 1, is possible to make the Principal Component Analysis (PCA). Two sets of scatter plots are considered: [PC1 and PC2]; [PC1 and PC3].

Figure 4 – PCA on Table 1 data. Left: variables (loadings); right: samples (score)





[PC1 and PC2]: confirmed the analogy of the first group for gel-time and length; in the second group the stickiness is similar.
[PC1 and PC3]: note the heterogeneity of the second group

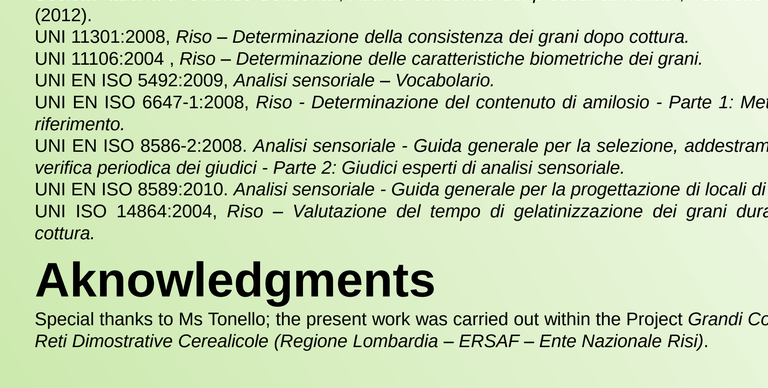
Conclusions

From this work it appears that there is agreement between sensory analysis and chemical physical and textural characterization of milled rice. In fact there is an analogy between the texture analysis (hardness and stickiness) and some sensory characters (respectively, chewiness and adhesiveness). Noteworthy is the fact that this correspondence is marked even if the experimental data are obtained with different analytical techniques (instrumental and sensory analysis) and the methods of preparing the samples are different. From the practical point of view, the tests carried out with the equipment, in particular the above-mentioned analysis of texture (hardness and stickiness) are faster for execution and usability of the results than sensory analysis. On the other hand we must not forget that rice is a **staple food**, so it is important the sensory characterization by a panel of tasters, representing consumers who use the food rice. The sensory characterization undoubtedly provides a more complete and accurate information than the current instrumental characterization that however provides a good approximation (on some parameters) given the demonstrated agreement between the results.

Thanks to this work today there is an available **card of sensory evaluation of rice** that represents high level of innovation as it allows to express objective decisions about the quality of the product, comparing the sensory profiles of the different varieties and explaining with them the consumer preferences.

The future perspective of this work is to use the card for sensory evaluation of rice in combination with the product analysis to bring out the peculiarities linked to the territory. Will be taken into consideration some varieties of Italian rice (Baldo and Carnaroli) grown in different areal (Lombardy, Piedmont and Emilia-Romagna), but in the same year (2013). The preliminary work conducted in 2012 (Fig. 5) revealed significant differences linked to the territory, thanks to the combined assessment of soil maps. Link the growing area with its characterization will allow to derive important information about the typicity of origin of the product.

Figure 5 – Spiderplot showing sensory profile of some varieties of rice grown in different locations (2012)



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Aknowledgments

Special thanks to Ms Tonello; the present work was carried out within the Project *Grandi Colture e Reti Dimostrative Cerealicole (Regione Lombardia – ERSAF – Ente Nazionale Risi)*.