

Chemical Characterization of « Terroir » Effect in Garlic Productions



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Introduction

Garlic, *Allium sativum* is cultivated and appreciated for its particular taste. Six varietal groups were defined according to morpho-physiological differences and this variability was also explored using isozymes as biochemical tracers. Groups I and III are present in Mediterranean countries and the Chinese cultivars are characteristic of groups IV. Chinese garlic is less expensive than garlic produced in Europe and we can see falsification about the origin on our local market. Three cultivars are present in the South-West of France: “Rose de Lautrec”, from group I with a garlic label PGI since 1996, “Violet de Cadours” and “ail blanc de Lomagne” both from group III.

We were requested to help the producers of “Ail blanc de Lomagne” to prove the originality of their production to obtain a PGI and to help them against falsification from the origin of garlic cultivated in Spain. The four key compounds in the biosynthetic pathways of the garlic flavor, two alkenylcysteine sulfoxides (RCSO) and two related dipeptides (γ -glutamyl-alk(en)yl-cysteines) considered as storage compounds were quantified by HPLC-UV. Garlic lots are differentiated by principal component analysis (PCA) with the proportions of these compounds.

Materials and methods

Plant material

8-10 bulbs of each lot of garlic (7) were analyzed (table 1).

Lot	Varietal group	Cultivar	Site of production
1	III	« Thermidrome »	Drôme
2	III	« Jolimont »	Lomagne
3	III	« Messidrome »	Drôme
4	III	« Messidrome »	Lomagne
5	North China	No	Andalousia
6	III	« Morado »	Castilla
7	North China	No	China

Table 1. Characteristic of garlic lot analyzed.

HPLC Analysis

The methodology consisted of a HPLC-UV analysis of RCSO (alliin, isoalliin) and γ -glutamyl-alk(en)yl-cysteines (GLUALCSO and GLUPeCS) (fig.1) followed by a principal component analysis (PCA) of their relative proportions. Garlic cloves were extracted in using 10 ml methanol/water (80/20) v/v + 0.05 % formic acid (pH < 3). The samples were analysed with a ion pairing HPLC method according to Arnault et al. *

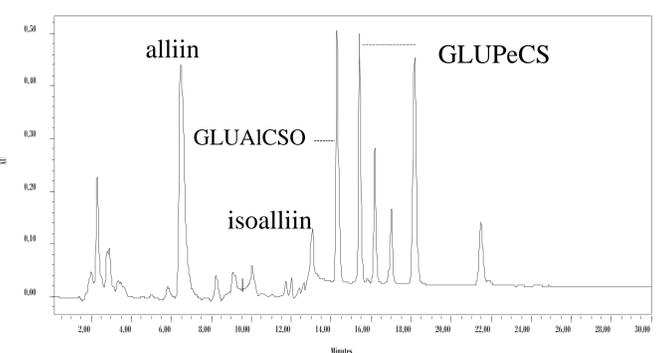


Figure 1. Chromatographic profile of garlic Messidrome from Drome (lot 3).

Results and discussion

“Terroir” effect

Standard lot 1 and 2 (fig. 2) are clearly separated but each one corresponding to different cultivars and localization :

➔ impossibility to conclude on the origin of the differentiation: “terroir” or “cultivar”?

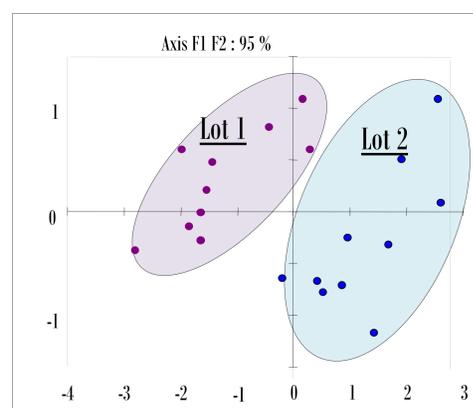


Figure 2. PCA of garlic S-compounds proportions in lots 1 and 2.

Comparating lot 3 and 4 (fig. 3), we observe as well the separation of the same cultivar cultivated at two different places :

➔ real “terroir” effect.

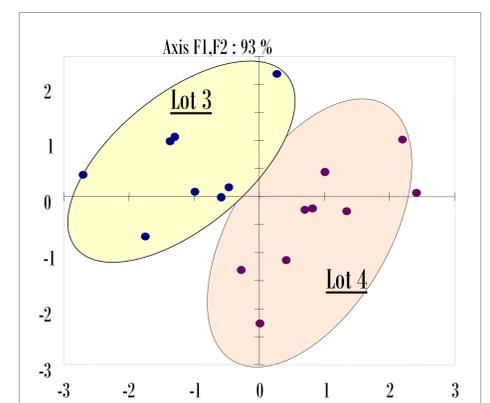


Figure 3. PCA of garlic S-compounds proportions in lots 3 and 4.

Falsification

The method can also bring to light the frauds. The same variety of garlic produced in Andalousia (lot 7) is clearly differentiated from the same garlic produced in China (lot 5) and by another local variety from Castilla (lot 6) (fig. 4).

➔ Garlic claimed to be cultivated in Spain is in reality chinese garlic cultivated in China, having only passed in transit by Spain

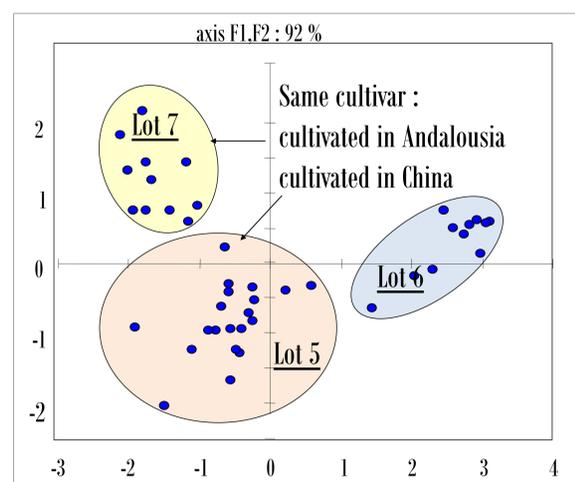


Figure 4. PCA of garlic S-compounds proportions in lots 5 and 6.

Conclusion

Significant variation in RCSO and related dipeptides was found within garlic collections and between plants grown under differing environmental conditions (Kamenetsky et al., 2005**). Huchette et al. (2007)*** showed the influence of combined nitrogen (N) and sulphur (S) fertility on the organosulphur compound content of garlic bulbs, especially alliin, as a specific flavour quality trait related to the health-value of garlic. These regular differentiation between garlic cultivar and « terroir » allowed to studied several concrete cases:

-The “terroir” and variety effect on the aromatic compounds in the garlic allows bringing a quality control on the business of the garlic. Indeed, we were able to show with chemical signatures that lots of garlic were not cultivated in the claimed country and also to determine their true origin.

-The aromatic particularity of a “terroir” for the “Ail blanc de Lomagne” allowed it to obtain a PGI.



*L. Arnault, J.P. Christides, N. Mandou, R. Kahane, T. Haffner, J. Auger, 2003. *Journal of Chromatography A*, 991, 69-75.

**Kamenetsky R., I. London Shafir, F. Khassanov, C. Kik, A.W. Van Heusden, M. Vrieland-Van Ginkel, K. Burger-Meijer, J. Auger, I. Arnault et H.D. Babionitch, 2005. *Biodiversity and Conservation*, 14, 281-295.

***Huchette O., Auger J., Arnault I., Bellamy C., Trueman L., Thomas R., Kahane R., 2007. *Journal of Horticultural Science and Biotechnology*, 82(1), 79-88.