

Alcalde-Eon, Cristina^{1,*}, Martín-Baz, Alberto^{1,2}, Ferreras-Charro, Rebeca¹, Barajas-Tola, Enrique², Escribano-Bailón, María-Teresa¹, García-Estévez, Ignacio¹

¹ Grupo de Investigación en Polifenoles. Facultad de Farmacia. Campus Miguel de Unamuno. Universidad de Salamanca. 37007 Salamanca (España). *presenting author: crisalcaldeon@usal.es

² Instituto Tecnológico Agrario de Castilla y León (ITACyL). Ctra. Burgos-Portugal, km. 119 (Finca Zamadueñas). 47071 Valladolid (España).

One of the possible alternatives that are currently being explored to reduce the negative impact of global climate change in traditional wine-producing areas involves the recovery of minority grape varieties, usually better adapted to the conditions of the growing area (1). In the Spanish "Castilla y León" region, an important number of *Vitis vinifera* L. minority varieties have been identified and conserved in a germplasm bank (2). This recovery must be supported by a deep knowledge of their composition and, specifically, of those compounds critical for the quality of the wine and for its capacity for aging, as is the case of phenolic compounds. Preliminary studies have revealed differences in the technological features (3) and in the phenolic composition (4) of some of these minority varieties. These results offers oenologists the possibility to use these minority varieties to make monovarietal wines with typicity or to use them in combination with other varieties to supply certain phenolic compounds. These promising results have been obtained in grapes grown in their native locations. However, in the present scenario of global climate change, it is of interest to study if their differential features are maintained if they are grown in other viticultural regions.

OBJECTIVE

To determine if the varietal phenolic potential (anthocyanin and flavanol compositions) of seven *Vitis vinifera* L. minority grape varieties coming from Castilla y León region (Spain) is maintained when they are grown in viticultural areas different from where they are native

MATERIAL AND METHODS

7 *Vitis vinifera* L. minority varieties

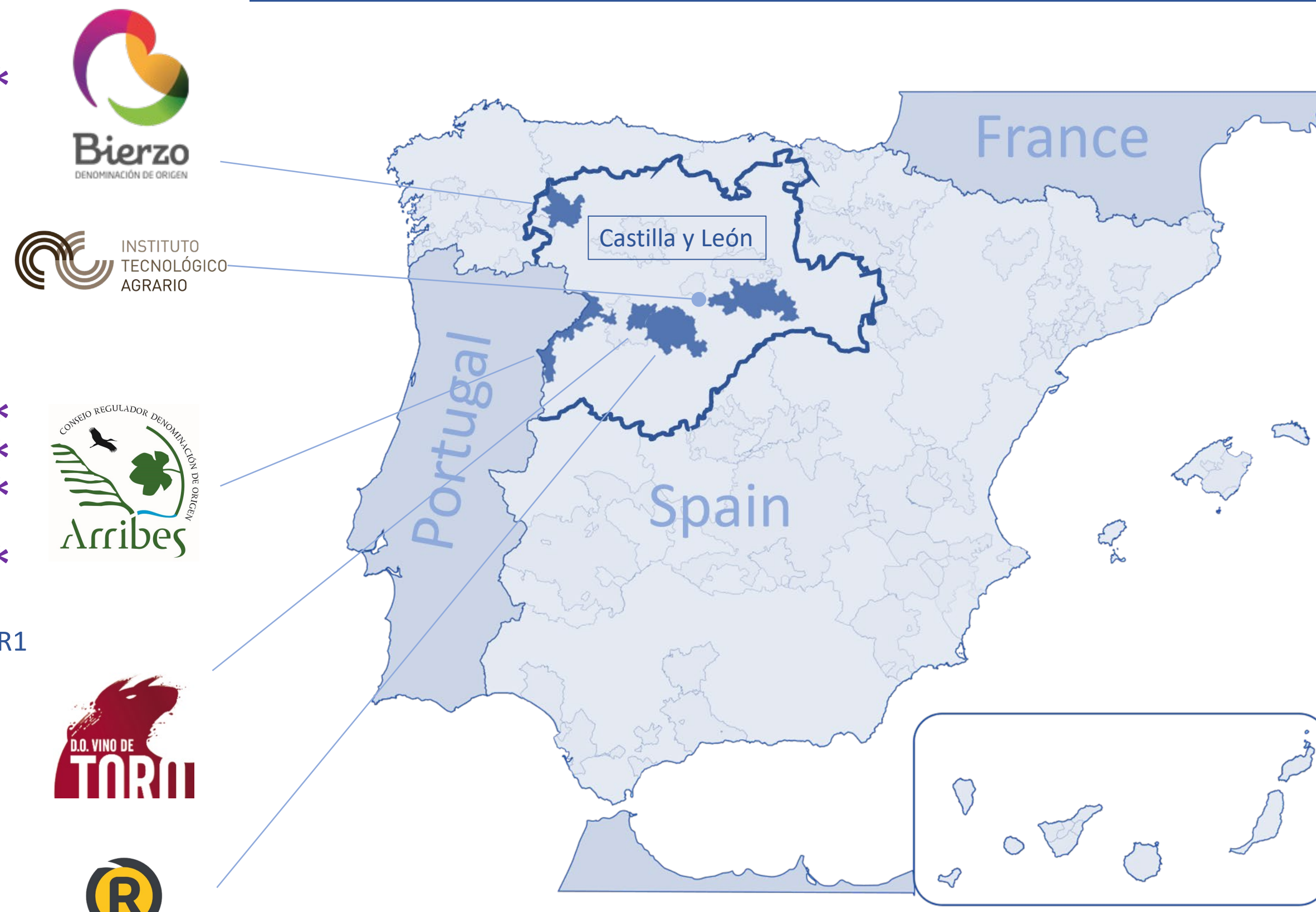
Grown in five different locations

Sample codification * native location

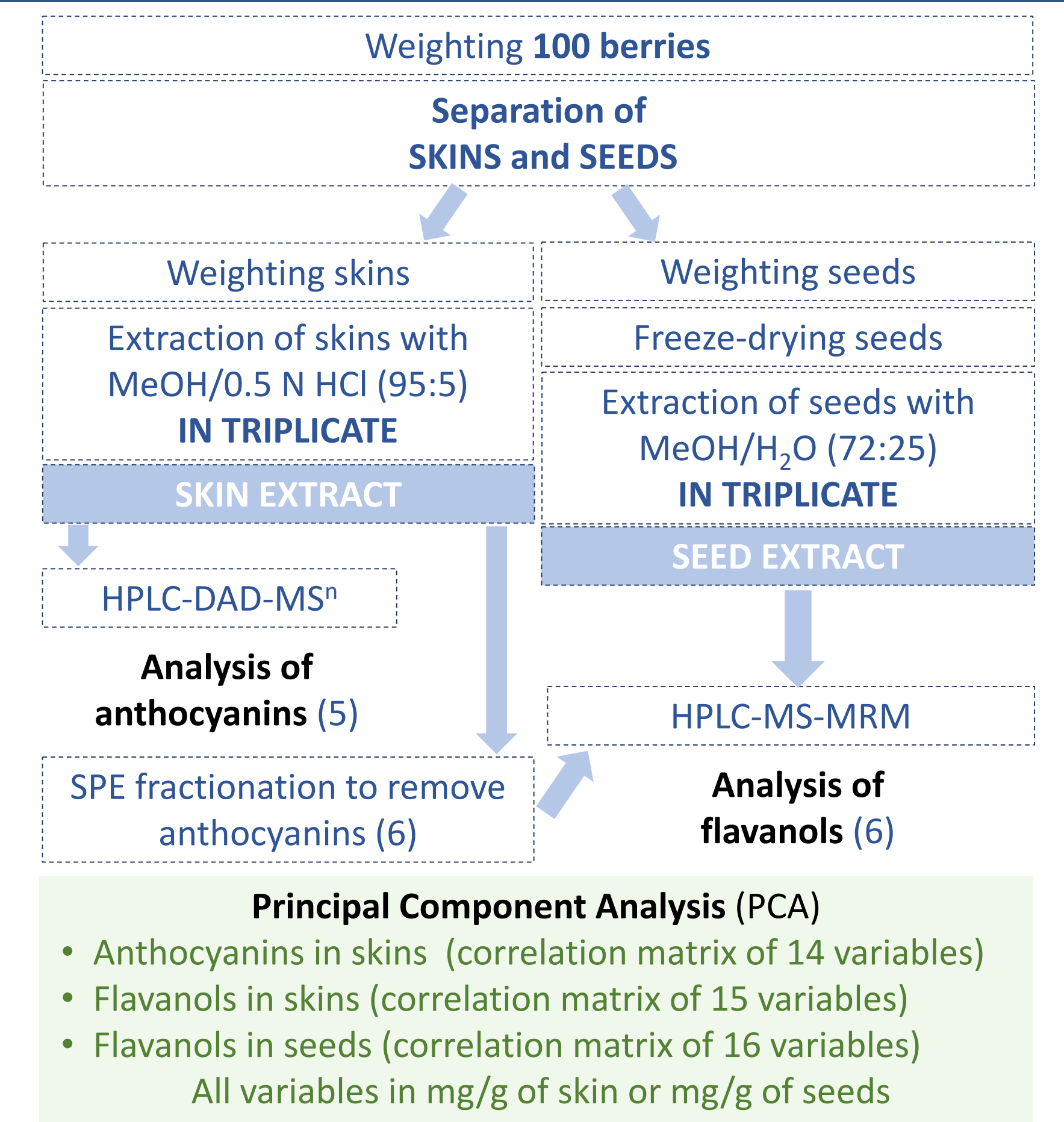


- Merenzao: MER_LEO *
- Bruñal: BRU_ZAM
- Cenicienta: CEN_ZAM
- Estaladiña: EST_ZAM
- Mandón: MAN_ZAM
- Merenzao: MER_ZAM
- Tinto Jeromo: TIN_ZAM
- Bruñal: BRU_ARR *
- Gajo Arroba: GAJ_ARR *
- Mandón: MAN_ARR *
- Merenzao: MER_ARR *
- Tinto Jeromo: TIN_ARR *
- Bruñal old vines: BRU_TOR1
- Bruñal: BRU_TOR2
- Cenicienta: CEN_TOR
- Estaladiña: EST_TOR
- Gajo Arroba: GAJ_TOR
- Mandón: MAN_TOR
- Merenzao: MER_TOR
- Cenicienta: CEN_RUE *

Samples and sampling points

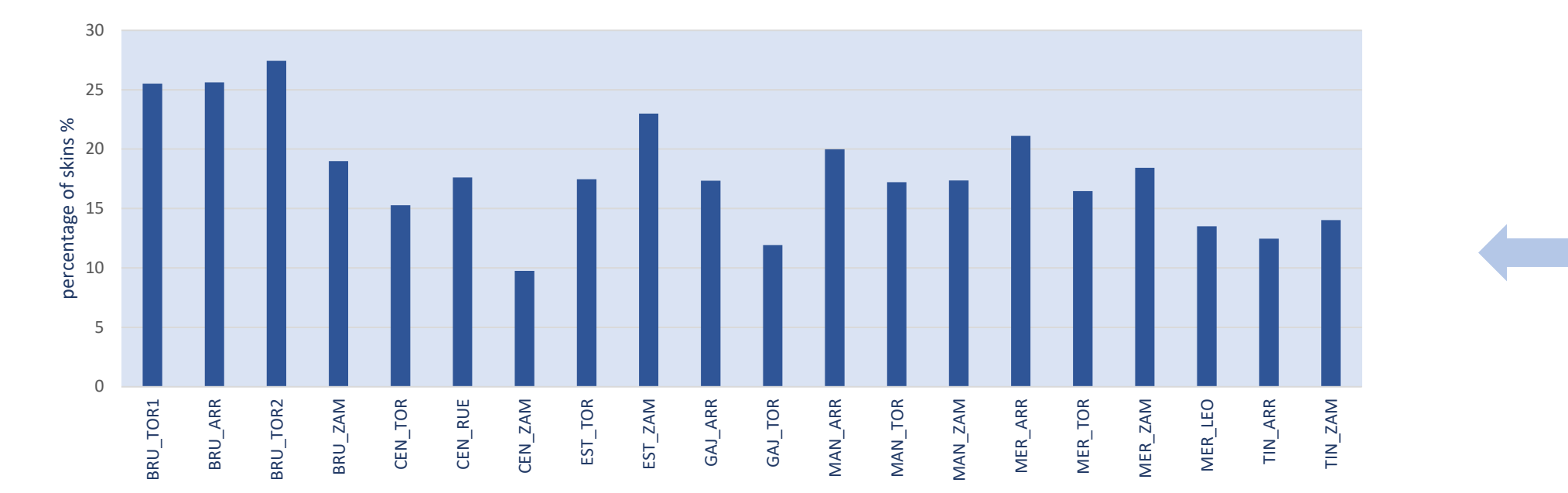


Study of the phenolic potential



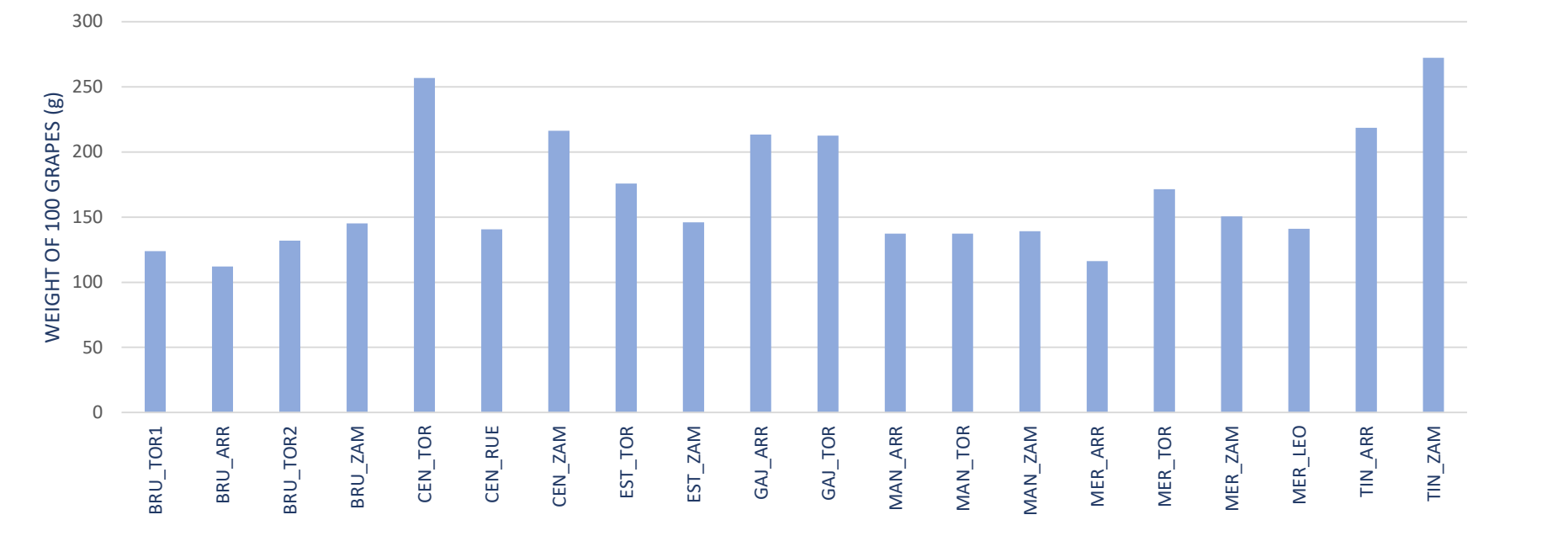
RESULTS AND DISCUSSION

Percentage of SKINS in the grapes (%)



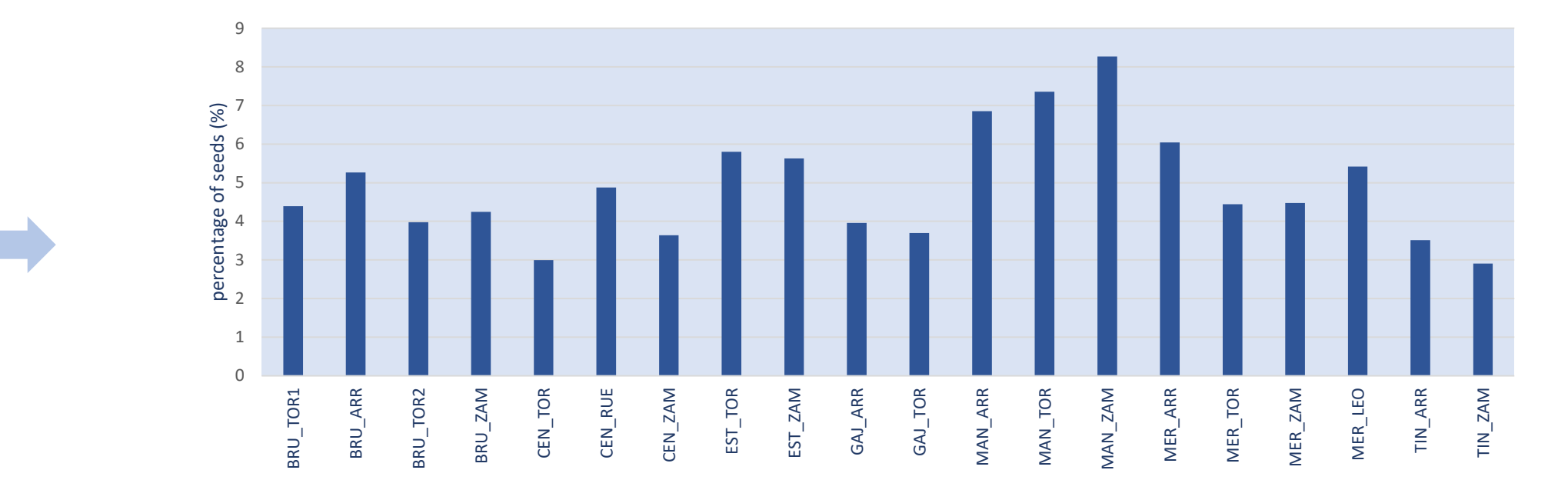
- ✓ Bruñal grapes showed in most locations the greatest percentages of skins (next to 25% of the berry weight), whereas Tinto Jeromo showed the lowest (next to 15%)
- ✓ For a given variety, the percentage of skins was more affected by location than the berry weight. However, the changes due to the growing area were not the same for all the varieties and no clear relationships between a given location and greater/lower percentage of skins could be found

Weight of 100 grapes



- ✓ For a given location, Cenicienta, Gajo Arroba and Tinto Jeromo varieties showed the heaviest grapes
- ✓ For a given variety, the berry weight was quite maintained in the different locations
- ✓ Cenicienta was the variety whose berry weight changed the most, whereas Mandón was the most stable

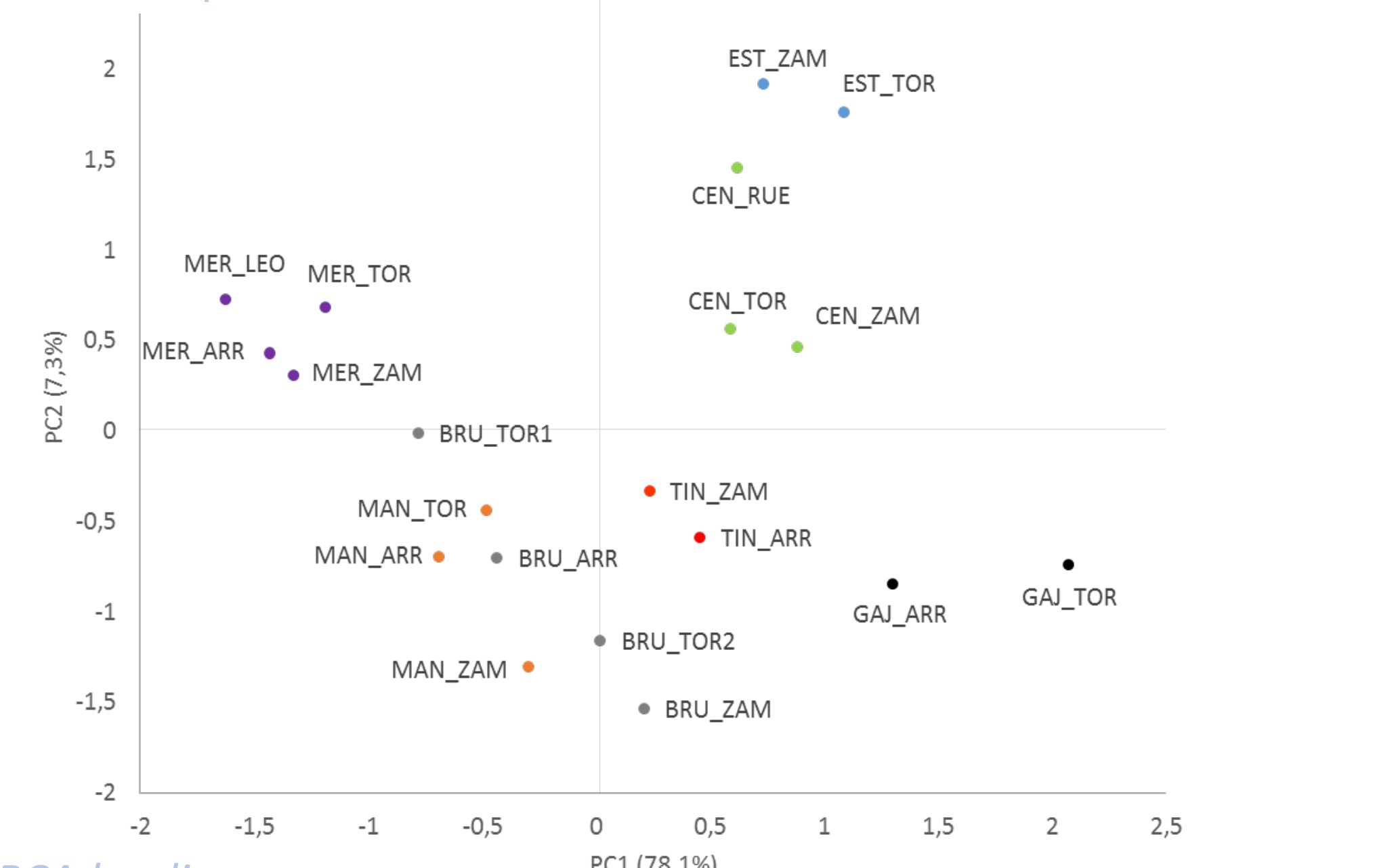
Percentage of SEEDS in the grapes (%)



- ✓ For a given location, Mandón variety showed the greatest percentages of seeds (7-8%), whereas Tinto Jeromo showed the lowest
- ✓ Cenicienta variety was the variety most affected by the location of the vineyard. In the native location (Rueda), it showed the smallest grapes, but with the greatest percentages of skins and seeds, whereas in the other two, the grapes were heaviest, but with lower percentages of skins and seeds

Anthocyanins

PCA score plot



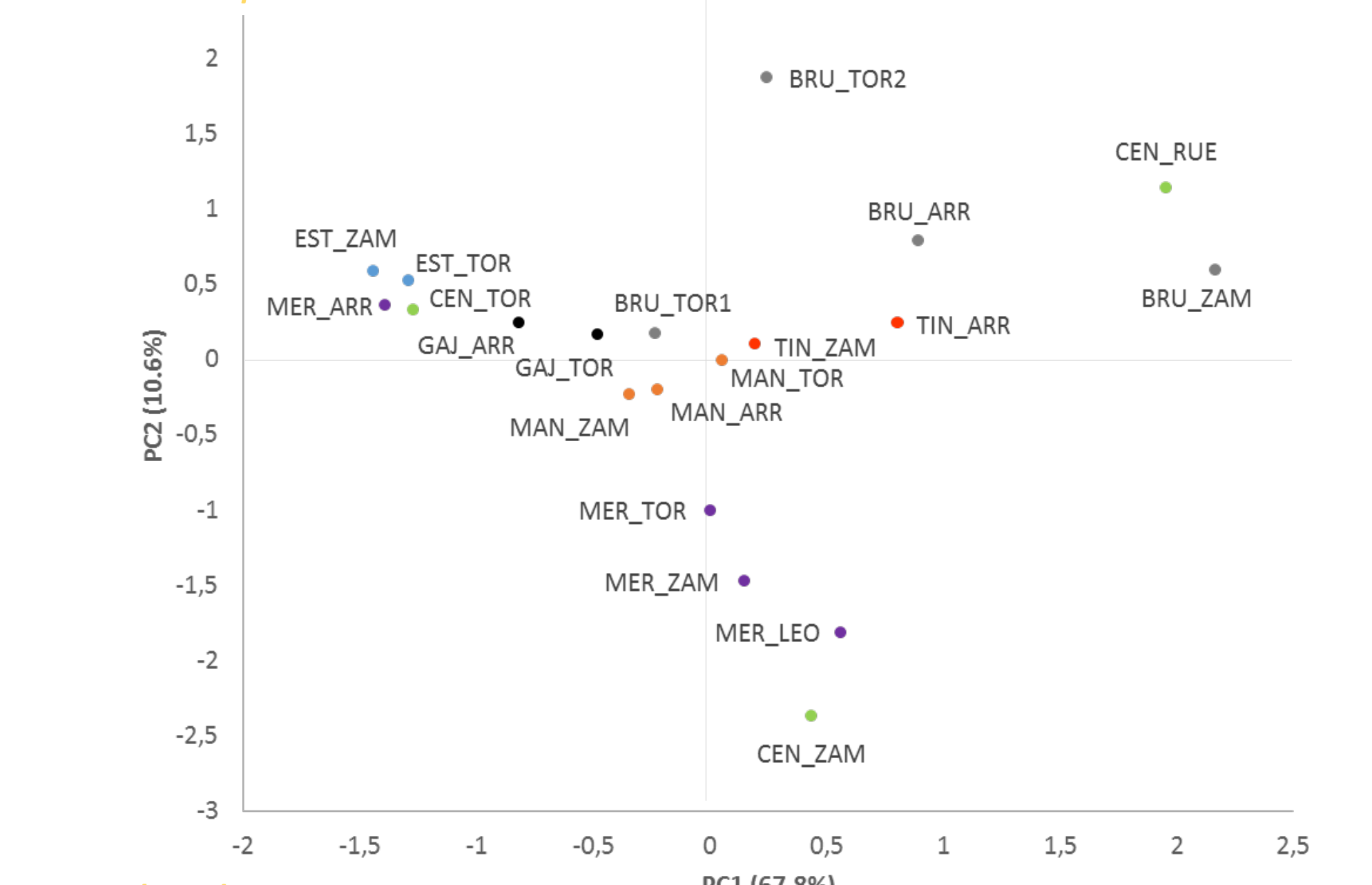
PCA loadings

VARIABLES	PC1	PC2
TOTAL CONTENT (mg/g skin)	0.982	-0.168
Difficult resolution pigments	0.765	-0.206
Monoglucosides	0.982	-0.155
Acetyl derivatives	0.830	0.305
Coumaroyl derivatives	0.876	-0.396
Caffeoyl derivatives	0.863	-0.096
Flavanol anthocyanin direct condensation products	0.942	0.131
Flavanol anthocyanin acetaldehyde-mediated products	0.805	0.223
Prodelphinidin dimers	0.874	0.368
Cyanidin derivatives	0.804	0.523
Petunidin derivatives	0.929	0.251
Pelargonidin derivatives	0.870	-0.071
Peonidin derivatives	0.816	-0.042
Malvidin derivatives	0.898	-0.416

- ✓ The PCA performed with the variables related to anthocyanin composition (mg/g of skins) showed a grouping of the samples according to variety meaning that **varietal anthocyanin composition is quite maintained independently of the location of the vineyard**
- ✓ **Bruñal samples showed the greatest dispersion**
- ✓ **Along PC1**, samples were mainly separated according to the contents of the different groups of pigments, with those located at positive values (Estaladiña, Gajo Arroba, Cenicienta and Tinto Jeromo) showing greater contents than those located at negative values (Mandón and Merenzao)
- ✓ **The type of anthocyanidin** conditioned the separation of the samples **along PC2**: those located at **positive** values showed greater contents of **cyanidin derivatives**, whereas those located at **negative** values showed greater contents of **malvidin derivatives**

Flavanols in skins

PCA score plot



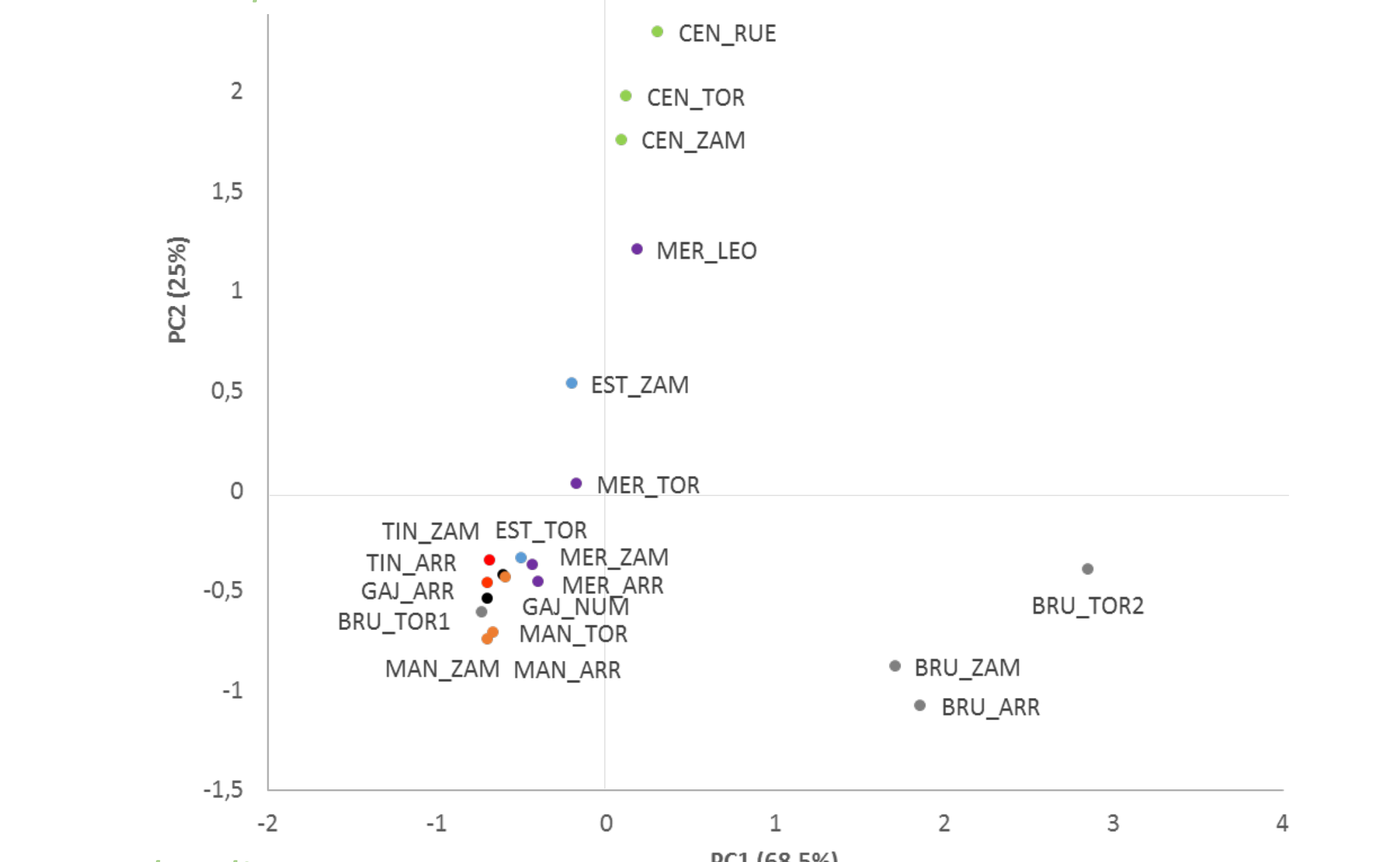
PCA loadings

VARIABLES	PC1	PC2
TOTAL CONTENT (mg/g skin)	0.951	0.128
Total prodelphinidin	0.921	-0.337
Total procyanidin	0.934	0.175
Total galloylated flavanols	0.731	0.501
Prodelphinidin monomers	0.818	-0.298
Prodelphinidin dimers	0.656	-0.692
Prodelphinidin mixed dimers	0.918	-0.324
Prodelphinidin mixed trimers (2 IE/GC units)	0.890	-0.056
Prodelphinidin mixed trimers (1 IE/GC unit)	0.856	-0.173
Epigallocatechin gallate (EGCG)	0.539	-0.166
Procyanidin monomers	0.849	0.169
Procyanidin dimers	0.862	0.140
Procyanidin trimers	0.905	0.209
Procyanidin tetramers	0.742	0.158
Epicatechin gallate (ECG)	0.651	0.570

- ✓ The PCA performed with the variables related to flavanol composition (mg/g of skins) showed for a given variety more dispersion of the samples than in the case of anthocyanin composition: **Flavanol composition in the skins is more affected by the location of the vineyard than anthocyanin composition.**
- ✓ **Bruñal and Cenicienta samples showed the greatest dispersion**
- ✓ **Estaladiña and Mandón seemed to be less affected by the location of the vineyard in what respects flavanol composition in the skins**
- ✓ **Along PC1**, the samples were mainly separated according to the contents of the different groups of flavanols, with those located at positive values (Bruñal) showing greater contents than those located at negative values (Estaladiña)
- ✓ **Along PC2**, the separation was mostly driven by the type of proanthocyanidin. Positive values were related to greater contents of procyanidins and galloylated proanthocyanidins, whereas negative values were related to greater contents of prodelphinidins

Flavanols in seeds

PCA score plot



PCA loadings

VARIABLES	PC1	PC2
TOTAL CONTENT (mg/g seed)	0.635	0.761
Procyanidin monomers	0.047	0.980
Procyanidin dimers	0.501	0.838
Procyanidin trimers	0.952	-0.291
Procyanidin tetramers	0.975	-0.180
Procyanidin pentamers	0.980	-0.079
Procyanidin monomers galloylated	0.003	0.825
Procyanidin dimers galloylated	0.945	0.049
Procyanidin trimers galloylated	0.970	-0.156
Procyanidin tetramers galloylated	0.961	-0.248
Procyanidin pentamers galloylated	0.934	-0.097
Procyanidin monomers digalloylated	0.948	-0.006
Procyanidin dimers digalloylated	0.921	-0.306
Procyanidin tetramers digalloylated	0.942	-0.318
Procyanidin pentamers digalloylated	0.567	0.808
Total of non-galloylated	0.947	0.149
Total of galloylated	0.947	0.149

- ✓ In the PCA performed with the variables related to flavanol composition of seeds (mg/g of seeds) **Bruñal and Cenicienta were clearly separated from the rest of the samples independently of the location of the vineyard**
- ✓ **Bruñal was separated mainly along PC1**, pointing to greater contents of **total flavanols and of oligomeric and galloylated procyanidins** in this variety than in the rest of the varieties
- ✓ **Cenicienta was separated mainly along PC2**, pointing to a **greater total content of flavanols in seeds** and a **greater content of monomeric procyanidins** in this variety than in the rest
- ✓ According to the dispersion observed, **the flavanol composition of seeds from Bruñal, Cenicienta, Merenzao and Estaladiña seemed to be affected by location of the vineyard.** In spite of this, in the case of Bruñal and Cenicienta, the typicity in relation to flavanol composition of seeds is retained
- ✓ The rest of samples were all located in the same quarter, with low dispersion between locations and between varieties

CONCLUSIONS

- ✓ Varietal features concerning berry weight and percentages of skins and seeds were quite maintained in the different locations for a given variety, although not all the varieties behaved similarly. In this sense, Cenicienta was the variety most affected by the change in the growing region.
- ✓ The different varieties in their native locations showed different anthocyanin and flavanol compositions, pointing to their potential to be used to make quality wines with a certain phenolic typicity.
- ✓ The different varieties were differently affected by the changes in the growing region. Furthermore, location affected differently the different phenolic compounds, with anthocyanins (related to the potential colouring matter of the future wines) being more stable towards changes in the growing region than flavanols (related to the astringency and bitterness of the future wines).
- ✓ Bruñal and Cenicienta showed the greatest dispersion between samples in the PCA's built from flavanol compositions, showing that they are the most sensitive varieties towards changes in the growing region. Despite of this, their varietal typicity regarding flavanols in the seeds are not completely lost. Mandón, Tinto Jeromo and Gajo Arroba were, in general, the varieties less affected by these changes.

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