VITICULTURAL CLIMATE AND CLIMATIC GROUPS IN IBERO-AMERICAN WINE PRODUCER REGIONS*

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RESUMO

Clima Vitícola e Grupos Climáticos nas Regiões Produtoras de Vinhos Ibero-Americanas

A produção de vinhos constitui-se numa importante atividade sócio-econômica em diversos países Ibero-Americanos. As regiões vitivinícolas nestes países localizam-se em diversos tipos de clima. No âmbito de um projeto de zoneamento vitivinícola do CYTED (Programa Ibero-Americano de Ciência e Tecnologia para o Desenvolvimento), foi realizada uma caracterização climática na macrorregião Ibero-Americana. O projeto constituiu uma base de dados climáticos que caracteriza as regiões vitivinícolas, incluindo variáveis climáticas relevantes para a viticultura: temperatura do ar (média, máxima e mínima), precipitação pluviométrica e evapotranspiração, dentre outras. Através do uso dos índices climáticos do Sistema CCM Geovitícola (IH, IF e IS), mais de 90 mesoclimas de regiões vitícolas de diferentes países (Argentina, Bolívia, Brasil, Chile, Cuba, Espanha, México, Peru, Portugal e Uruguai) foram caracterizadas pelo seu respectivo clima vitícola. Os resultados, que integram a base de dados do Sistema CCM (www.cnpuv.embrapa.br/tecnologias/ccm), mostraram que a viticultura Ibero-Americana está localizada numa grande quantidade de grupos climáticos em relação ao conjunto de grupos climáticos da viticultura mundial. O trabalho apresenta os grupos climáticos encontrados na viticultura Ibero-Americana, identificando também novos grupos climáticos ainda não caracterizados em outras regiões vitivinícolas do mundo. Também são identificados alguns grupos climáticos não encontrados na vitivinicultura Ibero-Americana. A pesquisa destaca regiões caracterizadas pela existência de "clima vitícola com variabilidade intra-anual", com potencial para produzir mais de um ciclo vegetativo da videira por ano. Os resultados permitem constatar que a grande

variabilidade e diversidade climática presente na vitivinicultura Ibero-Americana constitui-se num dos motivos que explicam a grande diversidade existente em termos de tipos de vinhos produzidos, características sensoriais e tipicidade dos vinhos, bem como da originalidade da produção vitivinícola desta macrorregião.

1. INTRODUCTION

The wine production is an important activity in many Ibero-American countries. The wine producer regions of these countries configure a large use of different climate types and viticultural climates. In a vitivinicultural zoning project of CYTED (Ibero-American Program for Science, Technology and Development), a viticultural climatic characterization was done in this macro viticultural region (Cyted, 2003; Sotés & Tonietto, 2004; Catania et al., 2007).

The goal of this study was to characterize the viticultural climate and the climatic groups found in the wine producing regions in Ibero-American countries (a large grape-growing region) and also to compare these groups with the variability found in the viticulture worldwide.

2. MATERIAL AND METHODS

The Geoviticulture MCC System (Tonietto, 1999; Tonietto & Carbonneau, 2004) was used as the methodology to characterize the viticultural climate and the climatic groups of more than 90 mesoclimates in viticultural regions in 10 Ibero-American countries: Argentina, Bolivia, Brazil, Chile, Cuba, Spain, Mexico, Peru, Portugal and Uruguay (Table 1).

The CYTED project has assembled a climatic database to characterize the viticultural regions (database presented in the different Chapters - Part II of this book), including relevant variables for viticulture. The database established regarding grape-growing regions correspond to the inter-annual monthly means of climatic variables, as much as possible the normal climatic of the 1961–1990 series (minimum, maximum and mean air temperature; precipitation; and Penman's potential evapotranspiration, among others) from standardized meteorological stations representing the climate of the grape-growing regions. For each region the three indices of the MCC System were calculated: Heliothermal index (HI), Cool night index (CI) and Dryness index (DI).

The results of Ibero-American regions were analyzed and characterized by Principal Component Analysis (PCA). Also, the climatic groups of the different viticultural regions of Ibero-American countries of this study were displayed with the international database of viticultural climate available in Tonietto (1999) and Tonietto & Carbonneau (2004) – Table 2, for 20 other countries in the world, in order to characterize the placement of the Ibero-America viticulture in the world context (Colombia: La Unión – COla; and, Guatemala: Estanzuela – GTes; database obtained in the same bibliography).

3. RESULTS AND DISCUSSION

The viticultural climates found in the Ibero-American región are presented in the

Table 1. Viticultural regions/mesoclimates of the climatic database in Ibero-American countries.

COUNTRY	VITICULTURAL REGION / MESOCLIMATE	ACRONYM
ARGENTINA	Valles de Famatina/Chilecito	ARri
	Valle del Tulum/San Juan (INTA)	ARsj
	Valle del Tulum/Albardón INTA	ARai
	Valle del Tulum/Sarmiento INTA	ARsi
	Valle del Tulum/San Martín INTA	ARmi
	Valle del Tulum/Las Casuarinas (25 de mayo)	ARlc
	Jáchal/Jáchal	ARja
	Zona Alta del Río Mendoza/Chacras de Coria	ARcc
	Norte de Mendoza/Mendoza Aero	ARme
	Este de Mendoza/San Martin	ARsm
	Este de Mendoza/INTA Junin	ARju
	Valle de Uco/El Peral (Mza)	ARpe
	Valle de Uco/San Carlos (Mza)	ARsc
	Valle de Uco/Vista Flores (Mza)	ARvf
	Sur de Mendoza/San Rafael Aero	ARra
	Sur de Mendoza/Malargue Aero	ARma
	Valles del Rio Negro/INTA Alto Vale	ARav
	Valles del Rio Negro/Neuquen Aero	ARna
	Catamarca/Tinogasta	ARca
	Córdoba/Córdoba	ARco
BOLIVIA	Valle Central de Tarija/Avilez/Juntas	BOav
	Valle Central de Tarija/Avilez/Cenavit	BOce
	Valle Central de Tarija/Cercado/El Tejar	BOte
	Valle Central de Tarija/Cercado/Yesera Norte	BOyn
	Valle Central de Tarija/Mendez/Sella Quebrada	BOme
BRAZIL	Campanha/Bagé	BRca
	Serra do Sudeste/Encruzilhada do Sul	BRss
	Campos de Cima da Serra/Vacaria	BRcc
	Serra Gaúcha/Bento Gonçalves	BRsg
	Planalto Catarinense/São Joaquim	BRsj
	Minas Gerais/João Pinheiro/Oct.-Mar. Period	BRj3
	Minas Gerais/João Pinheiro/Mar.-Aug. Period	BRj8
	Vale do Submédio São Francisco/Petrolina/Aug.-Jan. Period	BRs1
	Vale do Submédio São Francisco/Petrolina/Sep.-Feb. Period	BRs2
	Vale do Submédio São Francisco/Petrolina/Oct.-Mar. Period	BRs3
	Vale do Submédio São Francisco/Petrolina/Nov.-Apr. Period	BRs4
	Vale do Submédio São Francisco/Petrolina/Dec.-May. Period	BRs5
	Vale do Submédio São Francisco/Petrolina/Jan.-Jun. Period	BRs6
	Vale do Submédio São Francisco/Petrolina/Feb.-Jul. Period	BRs7
	Vale do Submédio São Francisco/Petrolina/Mar.-Aug. Period	BRs8
	Vale do Submédio São Francisco/Petrolina/Apr.-Sep. Period	BRs9
	Vale do Submédio São Francisco/Petrolina/May.-Oct. Period	BRs10
	Vale do Submédio São Francisco/Petrolina/Jun.-Nov. Period	BRs11
	Vale do Submédio São Francisco/Petrolina/Jul.-Dec. Period	BRs12
CHILE	Valle de Casablanca/Casablanca	CLcb
	Valle del Maipo/La Platina	CLlp
	Valle del Maipo/Pirque	CLpi
	Valle del Maipo/Talagante	CLta
	Valle del Maipo/Melipilla	CLme
	Valle de Cachapoal/Totihue	CLto
	Valle de Cachapoal/Graneros	CLgr
	Valle de Cachapoal/Quinta de Tilcoco	CLqt
	Valle de Colchagua/San Fernando	CLsf
	Valle de Colchagua/Colchagua	CLcl
CHILE	Valle de Curicó/Curicó	CLcr
	Valle de Curicó/Huaquen	CLhu
	Valle de Maule/Cauquenes	CLcq
	Valle de Maule/Linares	CLli
	Valle de Maule/Talca	CLtc
CUBA	Sur de la Habana/Batabanó	CUsh
	Banao/Sancti Spiritus	CUba
	Jagüey Grande/Provincia Matanzas	CUjg
MEXICO	Baja Califórnia/San Vicente/La Calentura	MXlc
	Baja Califórnia/Valle de Guadalupe/Olivares Mexicanos	MXgu
	Baja Califórnia/San Vicente/San Vicente	MXsv
	Baja Califórnia/Santo Tomás/Santo Tomás	MXst
	Baja Califórnia/Valle de Palmas/Valle de Palmas	MXvp
	Baja Califórnia/Ojos Negros/Valle de San Rafael	MXon
PERU	Valle de Cañete/Cañete	PEca
	Valle de Ica/Ica	PEic
PORTUGAL	Vinhos Verdes/Viana do Castelo/Meadela	PTvv
	Trás-os-Montes/Chaves	PTtm
	Trás-os-Montes/Miranda do Douro	PTmd
	Douro-Porto/Régua	PTdo
	Dão/Viseu	PTda
	Bairrada/Anadia	PTba
	Beira Interior/Figueira de Castelo Rodrigo	PTbi
	Beira Interior/Fundão	PTfa
	Lisboa-Torres Vedras/Dois Portos	PTes
	Ribatejo/Santarém	PTri
	Península de Setúbal/Setúbal	PTrs
	Alentejo/Évora	PTal
	Alentejo/Beja	PTbe
	Algarve-Tavira/Tavira	PTag
SPAIN	Extremadura/Ribera Guadiana-Tierra de Barros y Montánchez/Almendralejo	ESet
	Madrid/Madrid/Retiro	ESmd
	La Rioja/Rioja/Logroño	ESri
	Canaria/Tenerife y Lanzarote/Sta Cruz de Tenerife	ESte
	Castilla y León/Bierzo/Villafranca	ESbi
	Cataluña/Tarragona y Priorato/Reus	ESta
	Cataluña/Penedés/Vilafranca del Penedés	ESpe
	Castilla y León/Toro/Toro	ESto
	Castilla y León/Ribera del Duero/Aranda de Duero	ESrd
	Murcia/Jumilla/Jumilla	ESmu
	Navarra/Navarra/Olite	ESna
	Andalucia/Jerez/Jerez de la Frontera	ESje
	Andalucia/Málaga/Málaga	ESma
	Galicia/Ribeiro, Orense/Orense	ESor
	Galicia/Rias Baixas, Pontevedra/Pontevedra	ESpv
	Castilla y León/Rueda y Cigales/Valladolid	ESrc
	Aragón/Calatayud/Calatayud	ESca
	Aragón/Campo de Borja/Borja	EScb
	Aragón/Cariñena/Cariñena	ESñe
	Aragón/Somontano/Barbastro	ESso
	Comunidad Valenciana/Utiel-Requena/Requena	EScv
	Castilla-La Mancha/Castilla-La Mancha, Uclés/Alcazar de San Juan	ESuc
	Castilla-La Mancha/Valdepeñas/Valdepeñas	ESvl
URUGUAY	Canelones/Las Brujas	UYca

Table 2. Regions representing viticultural mesoclimates in 20 wine producer countries (Source: Tonietto, 1999; Tonietto & Carbonneau, 2004).

COUNTRY	VITICULTURAL REGION / MESOCLIMATE	ACRONYM
AUSTRALIA	Mildura	AUmi
	Mount Gambier	AUmo
	Nuriootpa	AUnu
CANADA	Québec	CAqu
	Summerland	CAsu
	Vancouver	CAva
CHINA	Bei Jing	CNbe
	Tong Chuan	CNto
	Urumqi	CNur
	Yi Couniy	CNyc
	Yi Li	CNyl
ENGLAND	Maidstone	GBma
FRANCE	Agen	FRag
	Ajaccio	FRaj
	Angers	FRan
	Bastia	FRba
	Besançon	FRbe
	Bordeaux	FRbo
	Carcassonne	FRca
	Cognac	FRcg
	Colmar	FRcl
	Macon	FRma
	Montélimar	FRmm
	Montpellier	FRmp
	Nantes	FRna
	Pau	FRpa
	Perpignan	FRpe
	Reims	FRre
	Toulouse	FRte
	Toulon	FRtn
	Tours	FRtr
GERMANY	Freiburg	DEfr
	Geiseinheim	DEge
	Neustadt	DEne
	Stuttgart	DEst
GERMANY	Trier	DEtr
	Würzburg	DEwü
INDIA	Ludhiana	INlu
	Pune	INpu
ISRAEL	Haifa	ILha
ITALY	Lecce	ITle
	Modena	ITmo
	Perugia	ITpe
	Ravenna	ITra
	Trapani	ITta
	Treviso	ITte
JAPAN	Kofu	JPko
NEW ZEALAND	Napier	NZna
REP. OF KOREA	P'ohang	KRpo
	Suwon	KRsu
SLOVAKIA	Bratislava	SKbr
SLOVENIA	Beli Kriz	SIbe
	Bizeljsko	SIbi
	Murska Sobota	SImu
	Novo Mesto	SInm
SOUTH AFRIQUE	Cape Town	ZAca
SWITZERLAND	Geneva	CHge
THAILAND	Bangkok	THba
	Chiangmai	THch
TUNISIA	Bizerta	TNbi
	Nabeul	TNna
	Tunis-Cartagena	TNtu
TURKEY	Izmir	TRiz
	Tekirdag	TRte
USA	Cleveland	UScl
	Fresno	USfr
	Medford	USme
	Portland	USpo
	Rochester	USrc
	Sacramento	USsc

PCA of the Figure 1 for 9 producer countries. These results show the high variability in terms of viticultural climate existing in Ibero-America.

Considering the total variability in climate of worldwide viticultural regions described in previous works (Tonietto & Carbonneau, 2004), the viticultural regions of each Ibero-American country have viticultural climates that cover complementary spaces, making possible a whole climate conditions for wine production (Figure 1).

The results also shows viticultural regions characterized by tropical climates with intra-annual climatic variability: Vale do Submédio São Francisco region (BRs1 to BRs12) and João Pinheiro region (BRj3 and BRj8) (Figure 1), with the possibility to have more than one growing cycle per year. Cuba (CUsh, CUba, CUjg regions) also has climates in evaluation for viticulture with intra-annual variability classified in the climatic groups IH+3 IF-2 IS-2

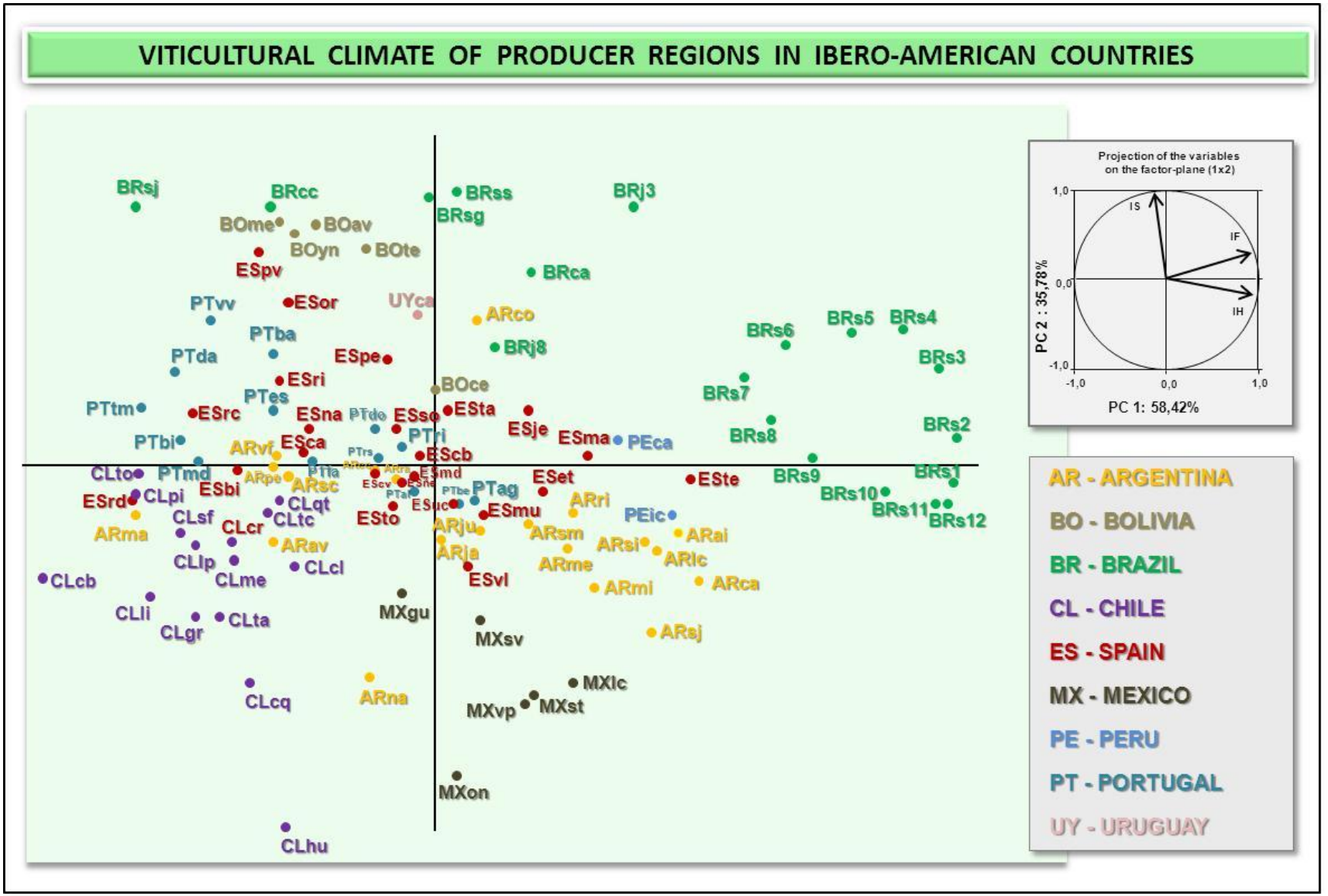


Figure 1. PCA showing the variability of the viticultural climate (HI, CI and DI indices of the MCC System) of the regions (Table 1) in 9 Ibero-American countries.

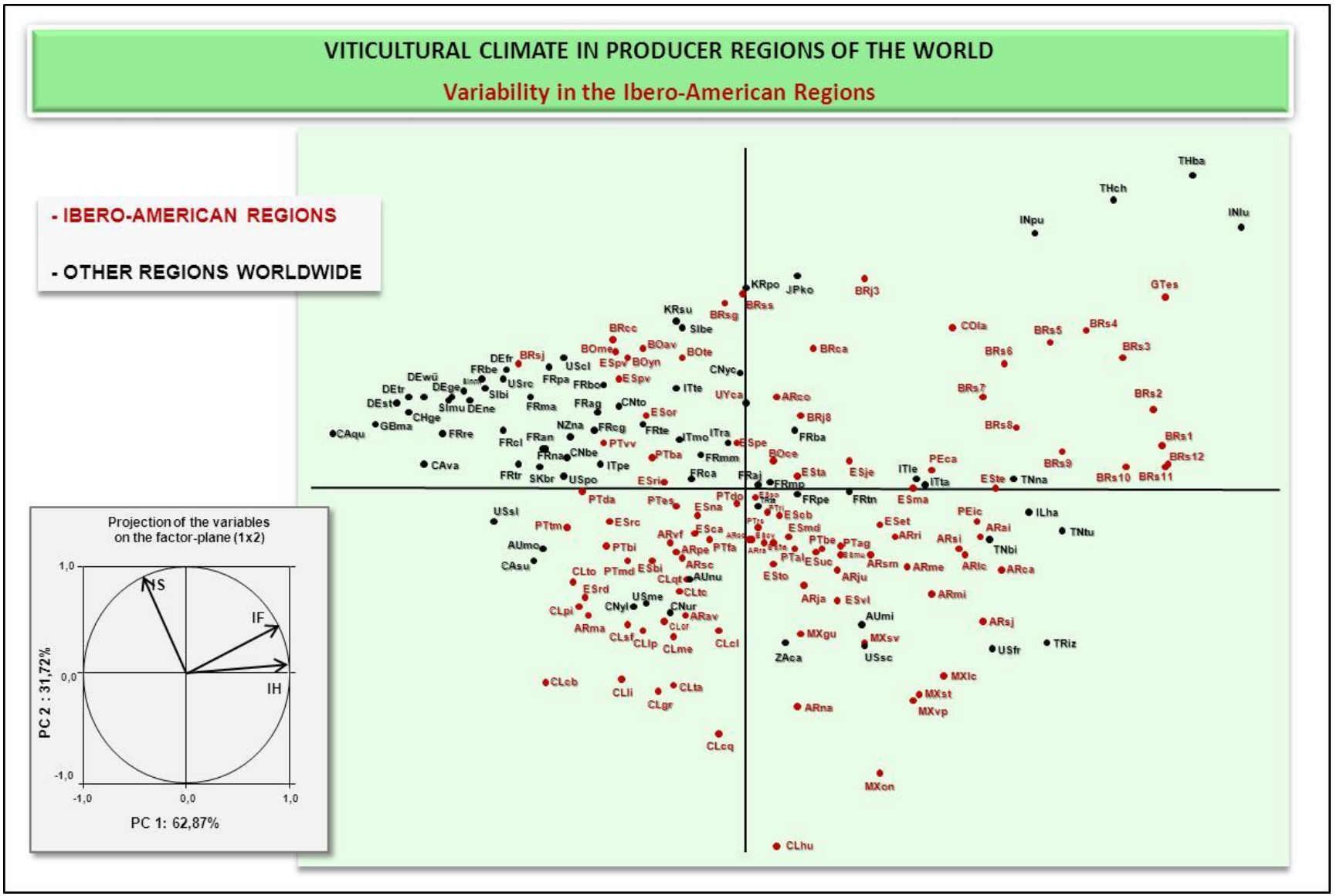
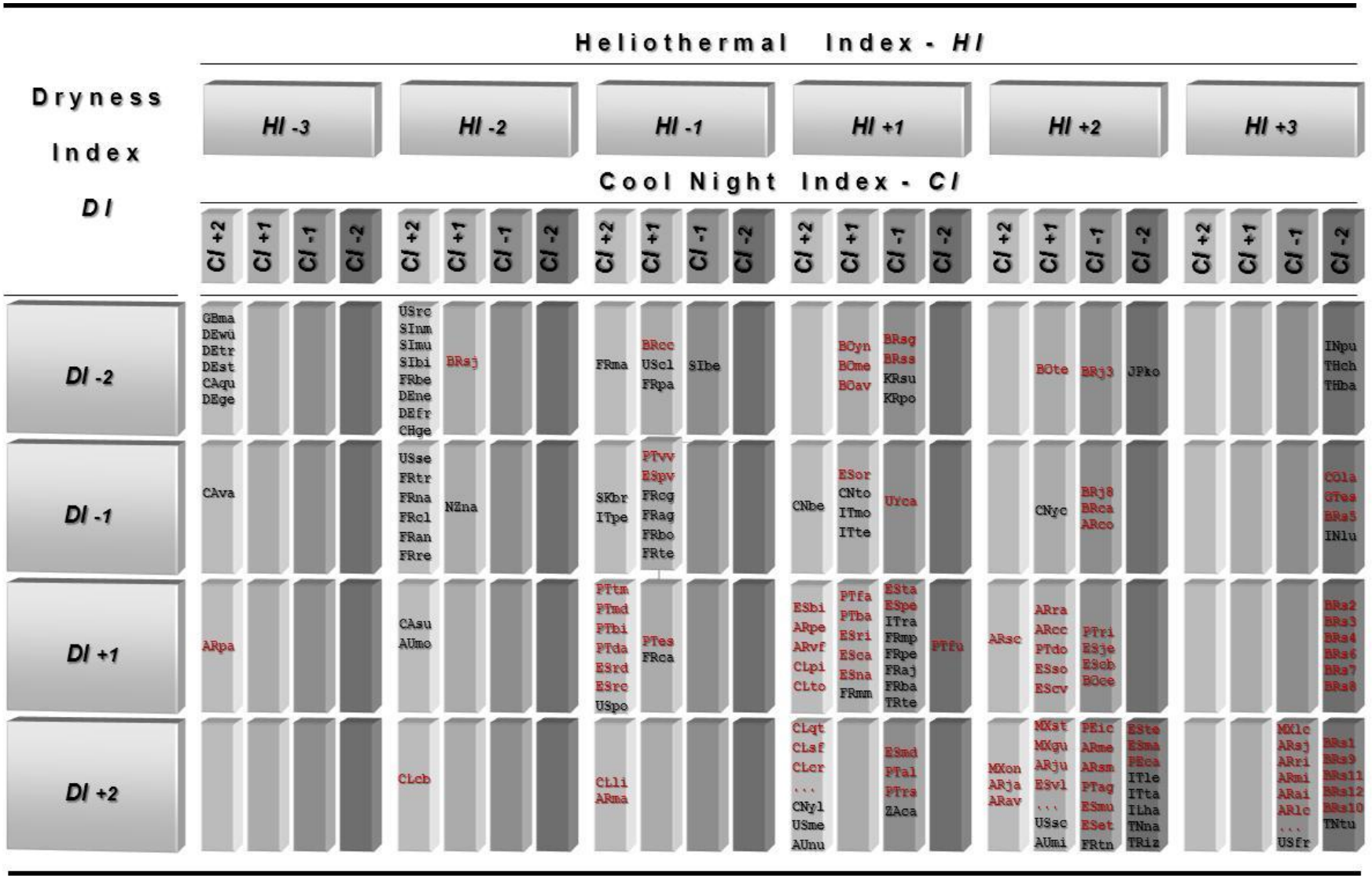


Figure 2. PCA showing the distribution of the viticultural climate (HI, CI and DI indices of the MCC System) of producer regions (Table 1) belonging to Ibero-American countries in relation to the context of other worldwide producer regions (Table 2).

Table 3. Climatic groups (MCC System) of the Ibero-American regions (Table 1) (in red) integrated on the worldwide database regions (Table 2) (in black) of the MCC System (Tonietto & Carbonneau, 2004).



and IH+2 IF-1 IS-1 (detailed description on the Chapter of Cuba – Part II of this book).

The high diversity of the viticultural climate of the producers regions in Ibero-American countries is demonstrated in the PCA of Figure 2, which make possible to compare with representative part of the worldwide climatic variability. We can observe that only climate class of IH Very cold (ARpa) and Cold (CLcb, BRsj) in Ibero-American countries have little presence (Table 3).

In terms of climatic groups the results showed that the Ibero-American viticulture is placed in a wide range of variability when compared to other wine producing regions variability around the world. Compared to the world database of the article Tonietto & Carbonneau (2004), the Ibero-America viticulture is present in 32 of the 45 climatic groups identified in the world viticulture, many of them characterized, for instance, only in Ibero-America (Table 3).

The climatic variability found in the Ibero-America viticulture certainly is responsible for the numerous types and different qualities and originalities of wines produced in Ibero-America, as demonstrated for different countries in the Chapters of this book (Part II).

The Ibero-American climatic database will be integrated to the MCC database in the international website (www.cnpuv.embrapa.br/tecnologias/ccm/ccm.en.html).

4. CONCLUSIONS

The Ibero-American viticulture for wine production is representative of the most part of the macro climatic variability found in the world. The results allow to conclude that the wide variability and climatic diversity present in Ibero-America may be one of the reasons to explain the diversity in terms of wine types, sensorial characteristics, typicity and uniqueness of wines produced on this macro-region.

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