Terracotta and Wine

Experiences on amphora wine-making

Impruneta

Antica fornace Agresti

19-20 november 2016

The Convention:

“Terracotta and Wine”

New discoveries and ancient traditions. A dialogue between Oenological Science and Archaeology.

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“Terracotta and Wine”

New discoveries and ancient traditions. A dialogue between Oenological Science and Archaeology.

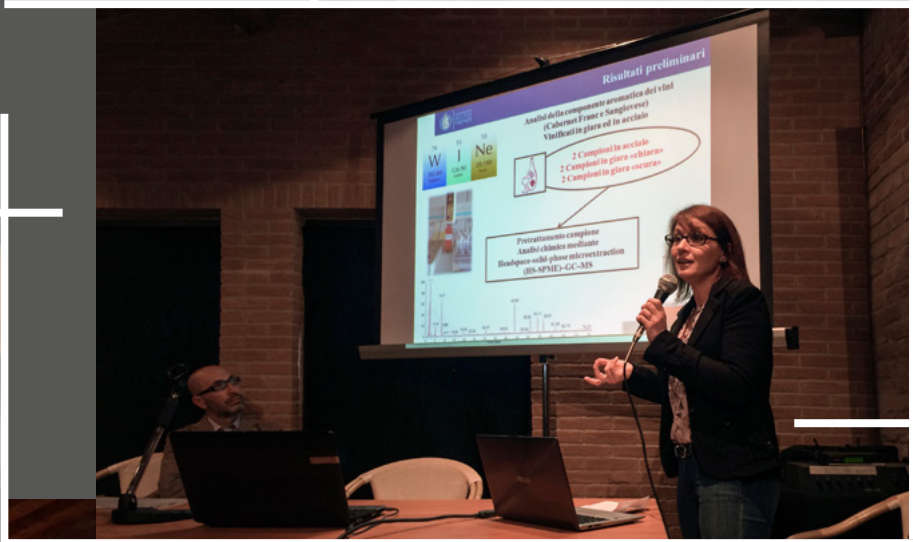
Relators:

Francesco Bartoletti and Adriano Zago, Oenologists:
“Metals and wine in amphorae, analytical surveys and state of the art”

Luciano Lepri, Tania Martellini and Alessandra Cincinelli, Università of Florence
“The influence of fermentation and refinement in terracotta jars based on the characteristics of wine “

Dr Paul J. White, Oxford University
“Burn your Barrels, Clay is here to Stay!” the newest trend in winemaking inspired by the ancient winemaking techniques of Georgia and Portugal.

Ilaria Alfani and Marzio Cresci, Archaeological Museum of Montelupo
The Amphora of Empoli and the creation of a network of museums about “terracotta and wine”.



Metals & Wine in Amphora

Analytical surveys and state of the art

Edited by
Adriano Zago and Francesco Bartoletti

Impruneta 19/10/2016 The Conference of Terracotta and Wine 2016

Materials and Methods

⋆Method of laboratory analysis OIV-MA-AS322-13 R2013

ICP-AES (inductively coupled plasma/atomic emission spectrometry)

⋆Analysis of must before going into the Terracotta jar

⋆Analysis of the wine at the end of its alcoholic fermentation

⋆Amphora with and without beeswax coating inside

⋆Amphorae from Impruneta, Georgia, Spain

⋆Cement vessel

Metals analyzed

* Silver
* Aluminium
* Arsenic
* Boron
* Barium
* Beryllium
* Calcium
* Cadmium
* Cobalt
* Chrome
* Copper
* Iron
* Germanium
* Potassium
* Lithium
* Magnesium
* Manganese
* Sodium
* Lead
* Rubidium
* Silicon
* Strontium
* Titanium
* Vanadium
* Zinc

Metals with consented legal limits in Wine

- Silver 100 µg/l
- Lead 200 µg/l
- Zinc 5mg/l
- Copper 1mg/l
- Arsenic 200 µg/l
- Boron 80 µg/l
- Cadmium 10 µg/l
- Sodium 80 mg/l

In Italy the limits are for Copper and Zinc DM 29/12/1986

For Lead - Reg.CE 1881/2006

In Code OIV of Oenological Practices there are limits for As,Cd and Ag

In China also for Fe and Mn

Aluminium OMS 0,2mg/l in water (200µg/l)

First investigation phase
year 2010

* Nerello Mascalese in Terracotta from Impruneta
* Chromium < 0,005 µg/l
* Mercury < 0,005 µg/l
* Iron 2,49 mg/l
* Lead 4 µg/l
* Zinc 1,15 mg/l

* Nerello Mascalese in French oak Barriques
* Chromium < 0,005 µg/l
* Mercury < 0,005 µg/l
* Iron 0,9 mg/l
* Lead 3 µg/l
* Zinc 0,20 mg/l

Comparisons

Red Wine 2013 Vintage

Artenova Terracotta jar - no beeswax	Terracotta with beeswax	French Oak Barrels .
Aluminium 2,48	0,18	0,18 µg/l
Calcium 15	20	13 mg/l
Iron 3,29	3,10	2,47 mg/l
Lead 0,07	0,06	0,05 µg/l
Copper 0,11	0,27	0,21 µg/l
Zinc 1,85	1,53	1,68 mg/l

2015 Vintage
Trebbiano Toscano

*	White Must			*	Used Jar with beeswax
*	Silver	1,4	µg/l	*	N.d
*	Aluminium	82	µg/l	*	162
*	Calcium	100	mg/l	*	74,6
*	Copper	4,58	mg/l	*	0,06
*	Iron	0,07	mg/l	*	0,19
*	Lead	10	µg/l	*	32

2015 Vintage
Cannonau Sardinia

	Must	Artenova jar	Georgian jar
Silver	1,5	0,9	1,1 µg/l
Aluminium	211	144	168 µg/l
Calcium	74,2	74,8	75,5 mg/l
Copper	0,4	0,08	0,05 mg/l
Iron	0,21	0,85	1,12 mg/l
Sodium	15	16	17 mg/l
Lead	38	21	26 µg/l

2015 Vintage
Barbera Emila Romagna

*	Must		*	4378 µg/l
*	Silver	6,4	*	1 µg/l
*	Aluminium	n.d	*	122 mg/l
*	Calcium	109	*	0,18 mg/l
*	Copper	2,21	*	2,7 mg/l
*	Iron	0,24	*	10 mg/l
*	Sodium	3	*	27 µg/l
*	Lead	27	*	885 µg/l
*	Strontium	236		

* Artenova jar

2015 Vintage
Teroldego Trentino

*	Must		*	Nd	*	2210	µg/l
*	Silver	1,4	*	661	*	51,5	mg/l
*	Aluminium	99	*	30,1	*	0,04	mg/l
*	Calcium	58,8	*	0,05	*	2,23	mg/l
*	Copper	0,39	*	1,2	*	4	mg/l
*	Iron	0,14	*	4	*	33	µg/l
*	Sodium	6	*	30			
*	Lead	27					
			*	Spanish jar			
*	Artenova jar		*	Nd µg/l			

2015 Vintage
Nosiola Trentino

White Must	Spanish Amphora
Silver N.d	N.d µg/l
Aluminium 105	599 µg/l
Calcium 60,8	54,3 mg/l
Copper 2,88	0,06 mg/l
Iron 0,13	1,05 mg/l
Sodium 6	6 mg/l
Lead 13	30 µg/l

2015 Vintage
Cabernet Toscana

*	Must	*	Nd	*	2210 µg/l
*	Silver 1,4	*	661	*	51,5 mg/l
*	Aluminium 99	*	30,1	*	0,04 mg/l
*	Calcium 58,8	*	0,05	*	2,23 mg/l
*	Copper 0,39	*	1,2	*	4 mg/l
*	Iron 0,14	*	4	*	33 µg/l
*	Sodium 6	*	30		
*	Lead 27				
		*	Spanish Amphora		
*	Artenova Amphora	*	Nd µg/l		

2015 Vintage
Piedirosso Campania

Wine in Cement vessel		Wine in Artenova Amphora	
Silver	1,8	1,2	µg/l
Aluminium	553	917	µg/l
Calcium	72,6	59	mg/l
Copper	0,08	0,05	mg/l
Iron	2,01	1,83	mg/l
Sodium	12	7	mg/l
Lead	32	31	µg/l

2015 Vintage
Teroldego Trentino

Must	Wine in CLC Cement vessel
Silver N.d	N.d µg/l
Aluminium 82	97 µg/l
Calcium 69,9	60,1 mg/l
Copper 0,48	0,14 mg/l
Iron 0,16	0,95 mg/l
Sodium 7	4 mg/l
Lead 45	31 µg/l

2015 Vintage
Cabernet Toscana

* Must		* New Artenova jar	* Used Spanish jar
* Silver	1,4	* 1,5	* Nd µg/l
* Aluminium	311	* 248	* 375 µg/l
* Calcium	67,2	* 66	* 54 mg/l
* Copper	0,24	* 0,32	* 0,05 mg/l
* Iron	0,92	* 1,05	* 2,42 mg/l
* Sodium	7	* 8	* 9 mg/l
* Lead	21	* 30	* 40 µg/l

Analysis of musts

2015 Vintage
Cabernet Toscana

Must	N.d µg/l
Silver 2,1	478 µg/l
Aluminium 539	60 mg/l
Calcium 114	0,09 mg/l
Copper 2,55	2,55 mg/l
Iron 2,9	13 mg/l
Sodium 11	14 µg/l
Lead 21	

* Artenova amphora

Artenova jars -Impruneta

Artenova and Georgian jars

Georgian Qvevri

Spanish Tinajas

Spanish Tinajas

Artenova jars -Impruneta

Project realized with contribution from:

* Olianas-Tenute Casadei
* Tenuta Belvedere
* Foradori
* Ampeleia
* Al di là del Fiume
* I Cacciagalli

”The Influence of fermentation and refinement in terracotta jars on the characteristics of wine"

T. Martellini, A. Cincinelli, C. Marinelli, R. Giorgi, S. Pucci, L. Tenori,
C. Luchinat, P. Baglioni, L. Lepri

Dept. Chemistry «Ugo Schiff» – University of Florence
Laboratory of Microanalysis - DISPAA- University of Florence
Interuniversity Consortium for Developmental Studies of Large Interfase Systems (CSGI) - Florence
Florence Research Centre of Magnetic Resonance (CERM) - Florence
Analytical FOOD - Florence

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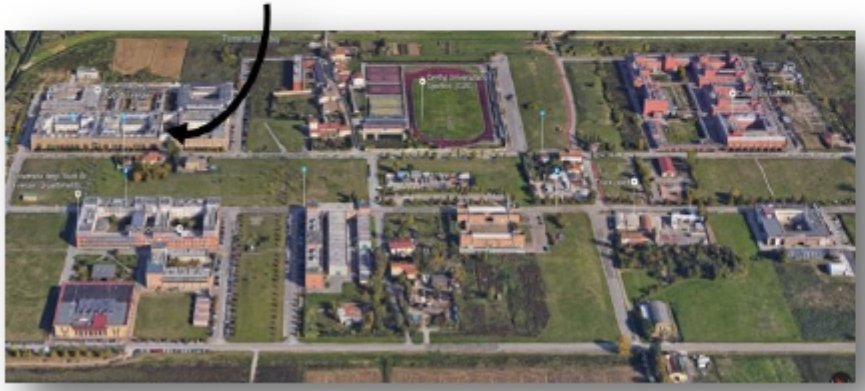
The Scientific and Academic Centre of Sesto Fiorentino



The Department of Chemistry «Ugo Schiff»

The Department of Agriculture (DISPA)

CERM

CSGI

In collaboration with:

ARTENOVA
TERRECOTTE ARTISTICHE di Leonardo Parisi

LA TERRA COTTA E IL VINO ARTENOVA

CASTELLO DEL TREBBIO

Multidisciplinary research centre for the study,

Development, creation of model prototypes

Using advanced methods of synthesis

And advanced techniques for the characterization

Of environmental matrices and materials

Outline of the Project

Impruneta clay

Influence of composition and firing

Terms of firing
“Dark” jar
T= 1050°C ; t= 70h

Terms of firing
“Light” jar
T= 900°C ; t= 78h

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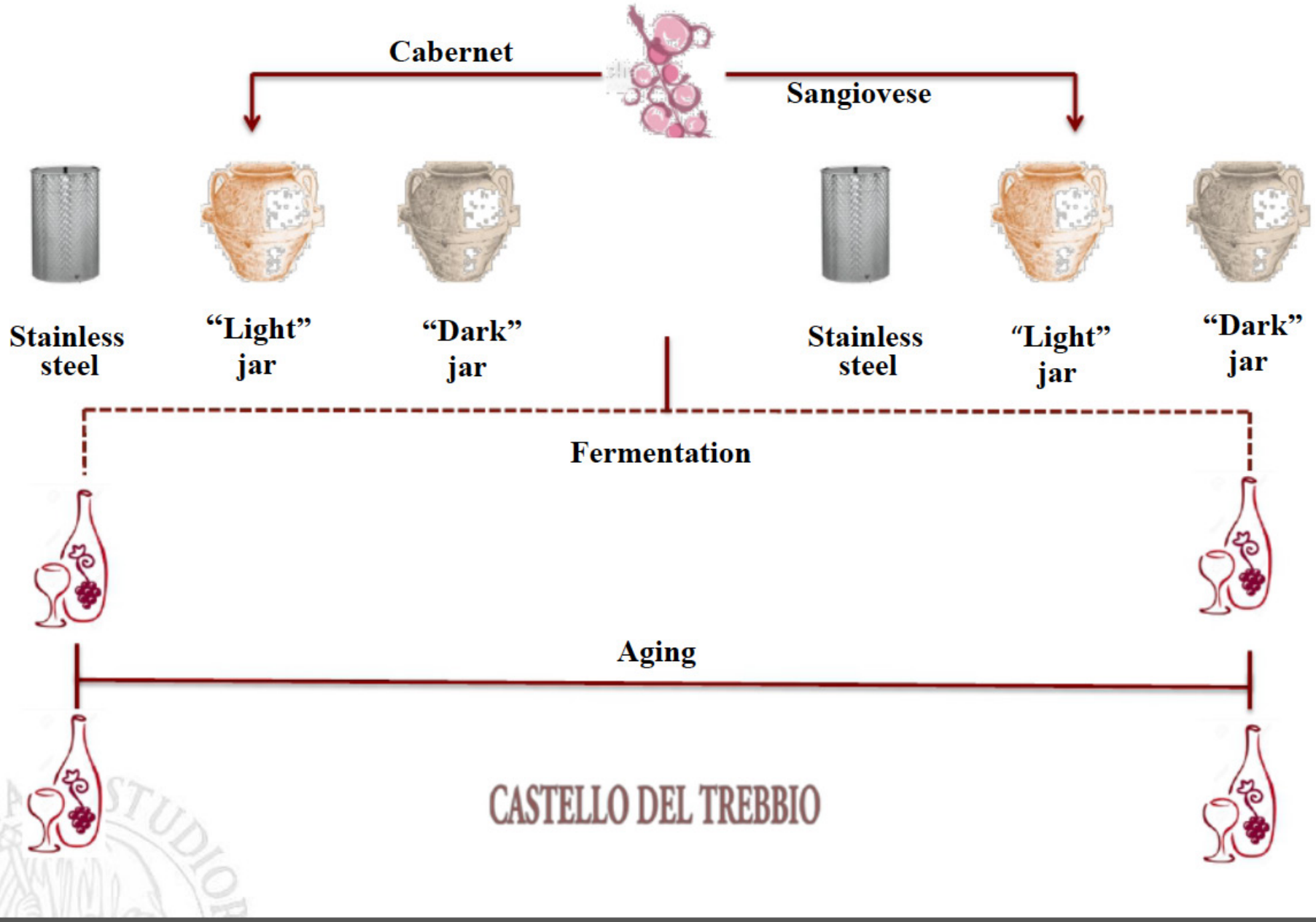
Outline of the Project



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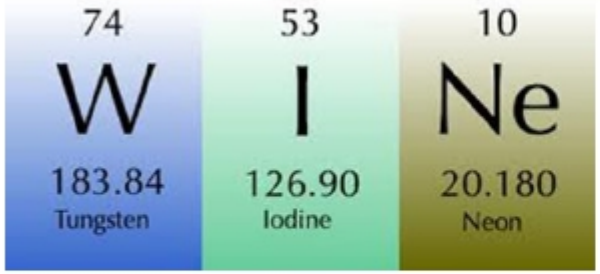
Outline of the Project



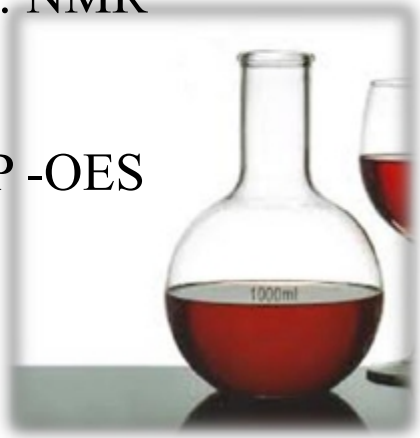
Analysis of the mineral composition of the clay: ICP-MS / ICP-OES

Analisys of the porosity of the jars: Capillary ascent, Absorption, Drying kinetics, Permeability, Gas -porosimetry

Analysis of the aromatic components of the wine: Head Space- SPME –GC-MS

Analysis of the composition of organic compounds of the wine: NMR

Analysis of the mineral composition of the wine: ICP-MS / ICP -OES



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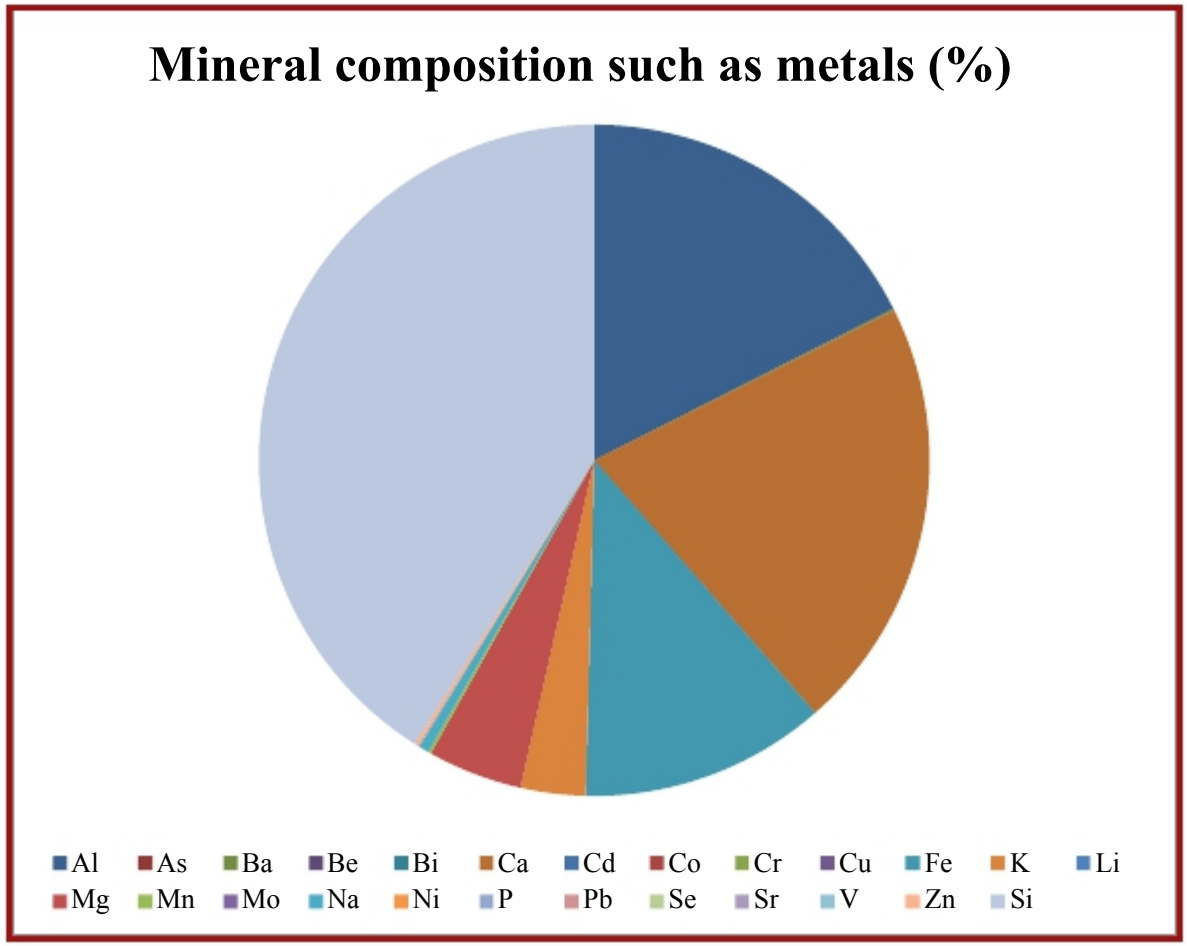
Preliminary results

74	53	10
W	I	Ne
183.84	126.90	20.180
Tungsten	Iodine	Neon

Main components: Si, Ca,Al, Fe, Mg, K

Trace components (<0.2%): Ba, Co, Cr, Cu, Mn, Ni, P, Zn



UNIVERSITÀ DEGLI STUDI FIRENZE

Preliminary results

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W	I	Ne
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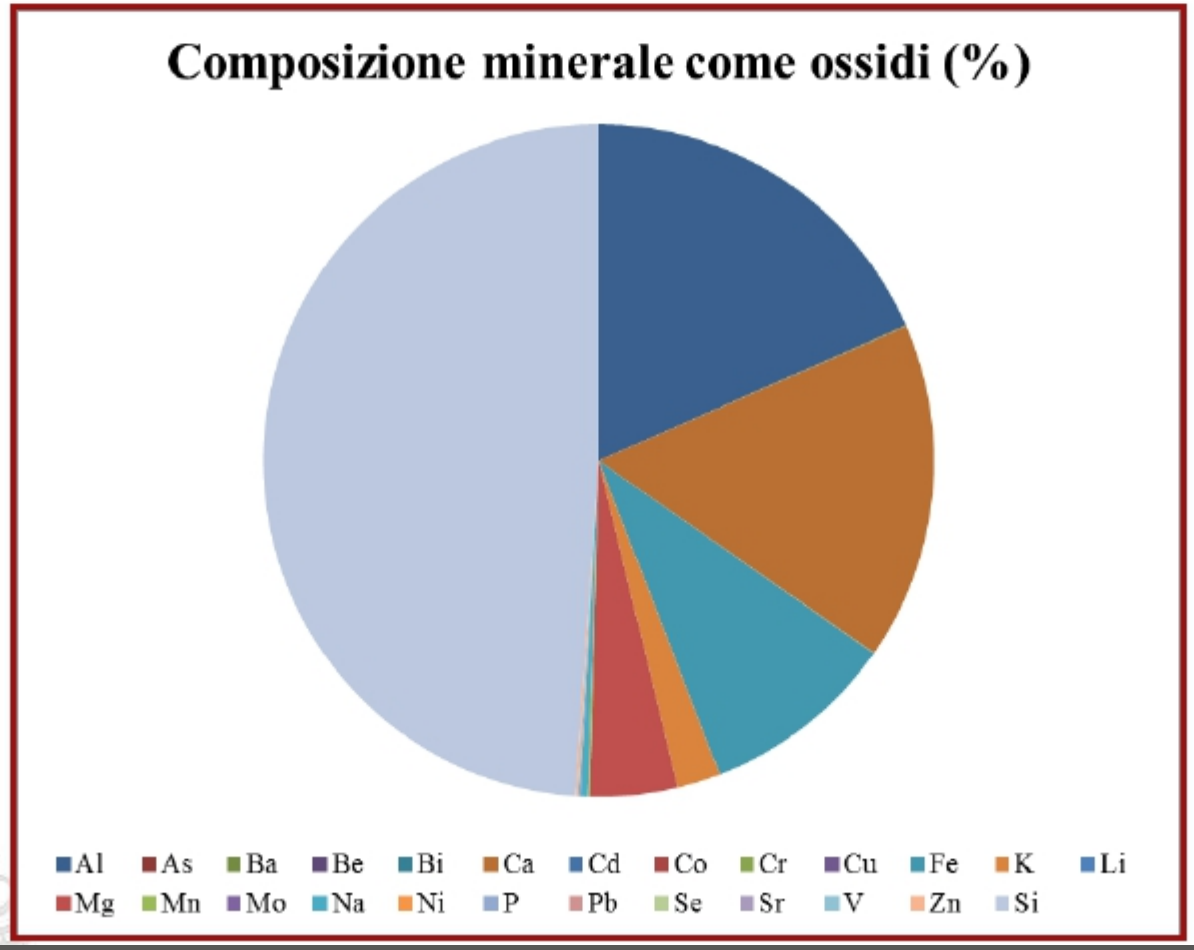
Tungsten	Iodine	Neon

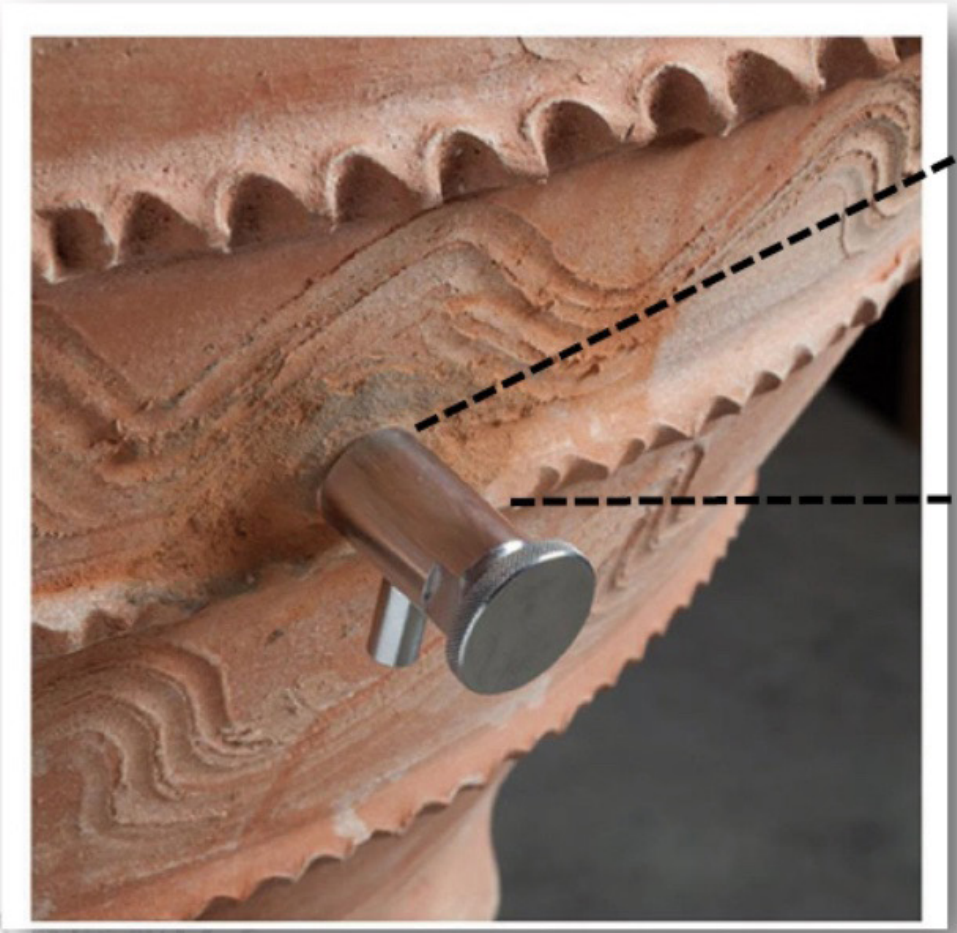
Main components: SiO_2, CaO,Al_2O_3, Fe_2O_3, MgO, K_2O

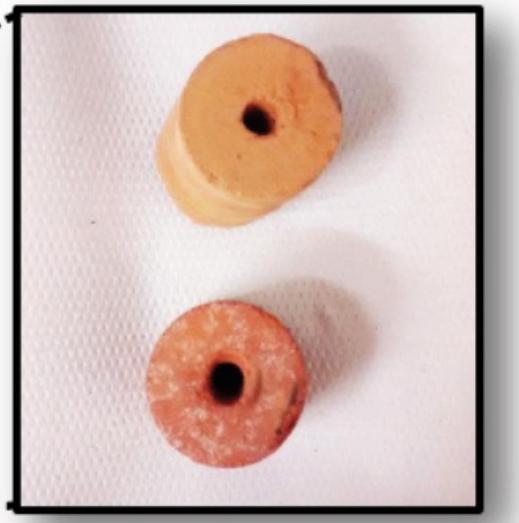
Trace components : BaO, CoO, Cr_2O_3, CuO, MnO, NiO, P_2O_5, ZnO



Preliminary results

Physical-chemical measurements to determine the porosity of the jars





Dark jar **Light jar**

V= 18.8 cm_3 ; A= 6.3 cm_2

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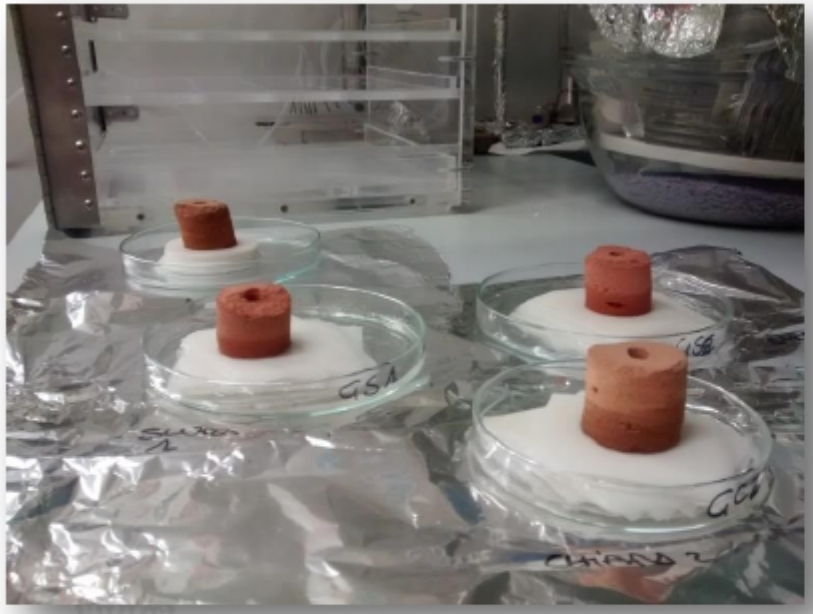

Physical-chemical measurements to determine the porosity of the jars

Physical characteristics of the jars

- **Drying kinetics**
- **Capillary ascent**
- **Absorption**
- **Gas-porosimetry**
- **Permeability**

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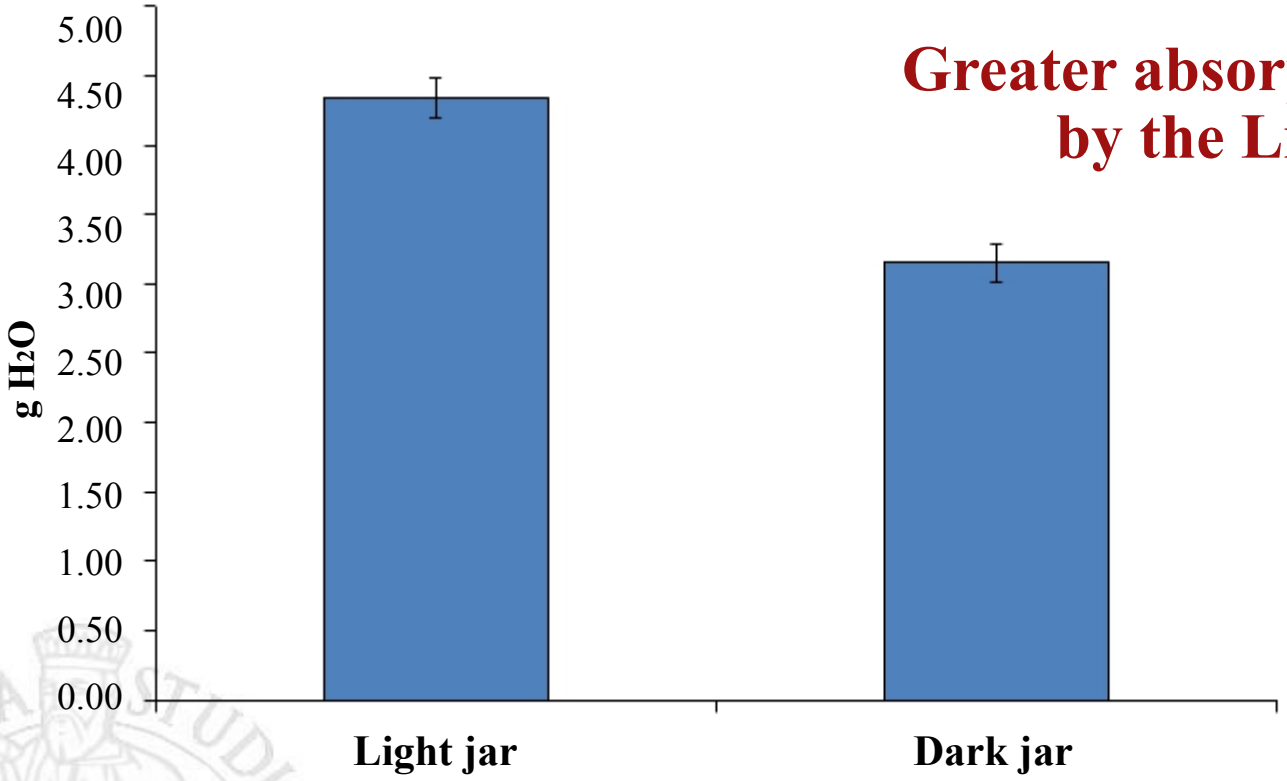

Greater absorption of H_2O by the Light jar

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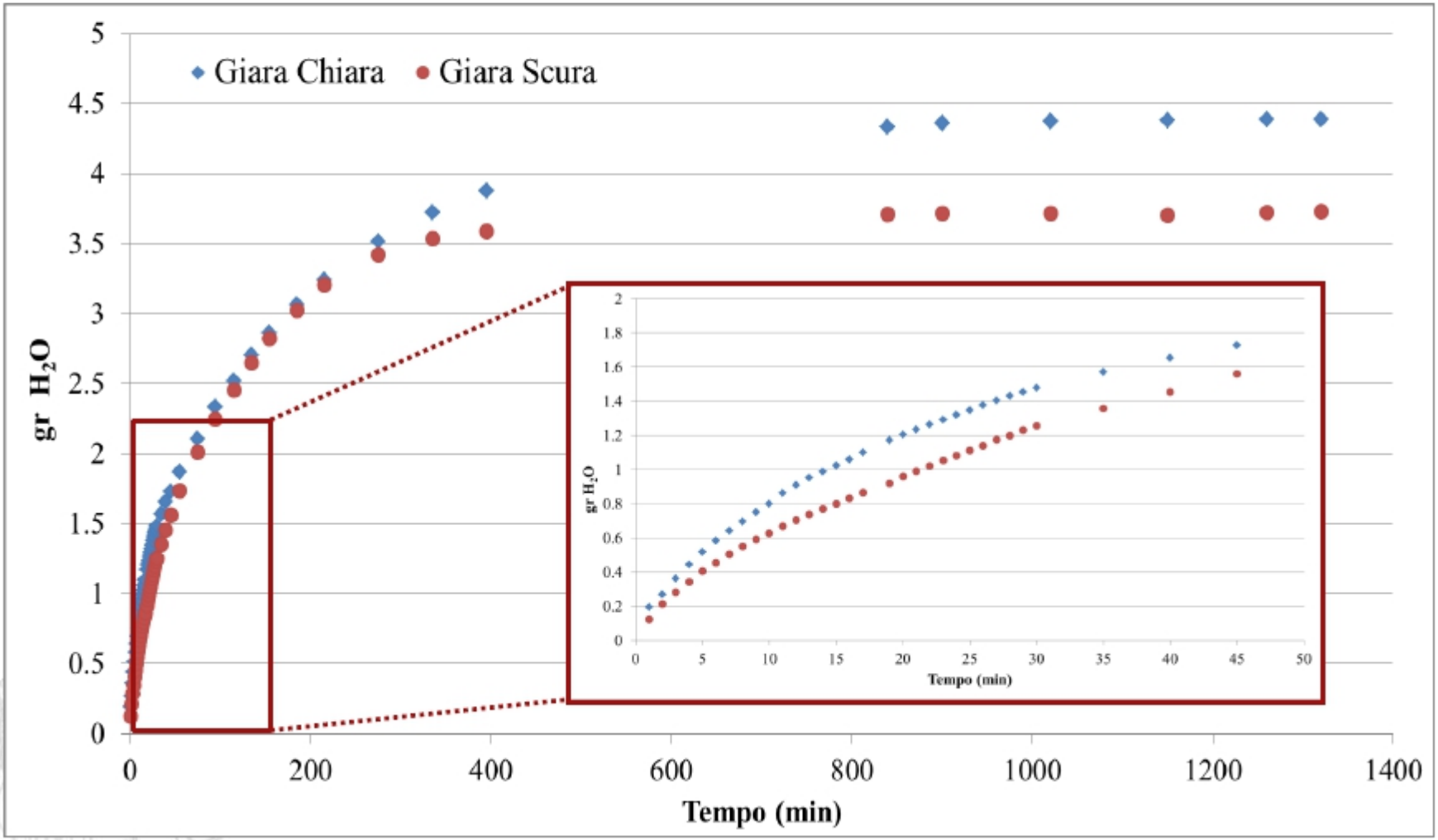
Preliminary results

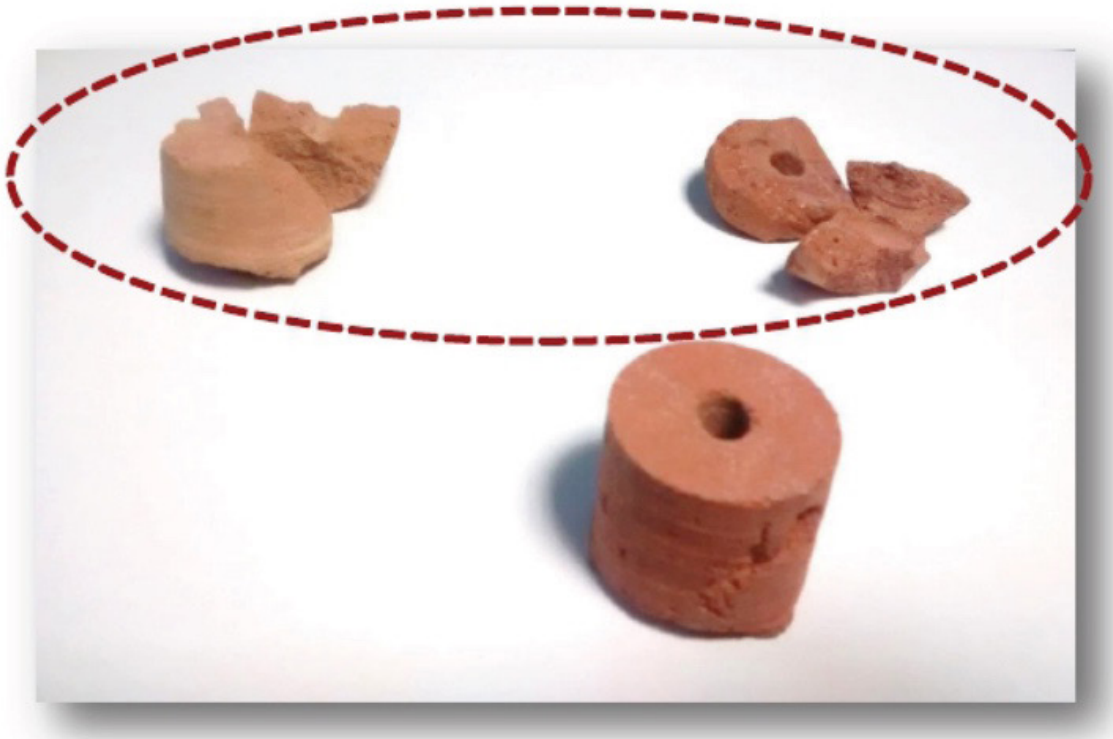
Physical-chemical measurements to determine the porosity of the jars: Capillary ascent

The light jar absorbs 17.7% more water



Preliminary results

Physical-chemical measures of the jar after fermentation



Breakage of two Cylinders during The coring procedure

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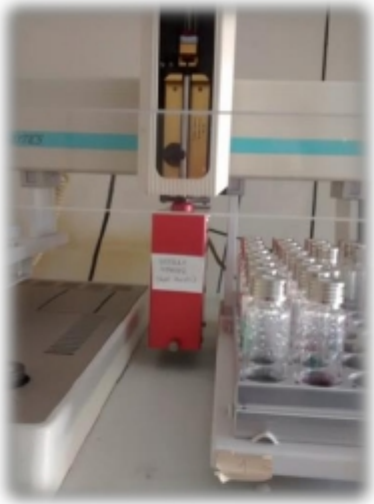
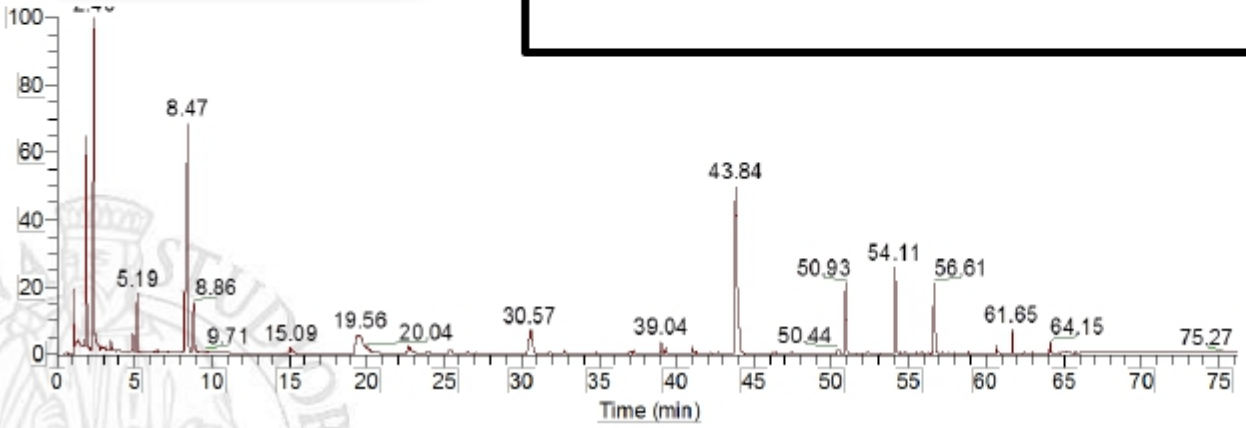
Analysis of the aromatic component of wines (Cabernet Franc and Sangiovese) made in Terracotta and Stainless steel

2 Samples in stainless steel
2 Samples in the "light" jar
2 Samples in the "dark" jar



Chemical analysis by sample pre-treatment Headspace-solid-phase micro-extraction (HS-SPME)–GC–MS



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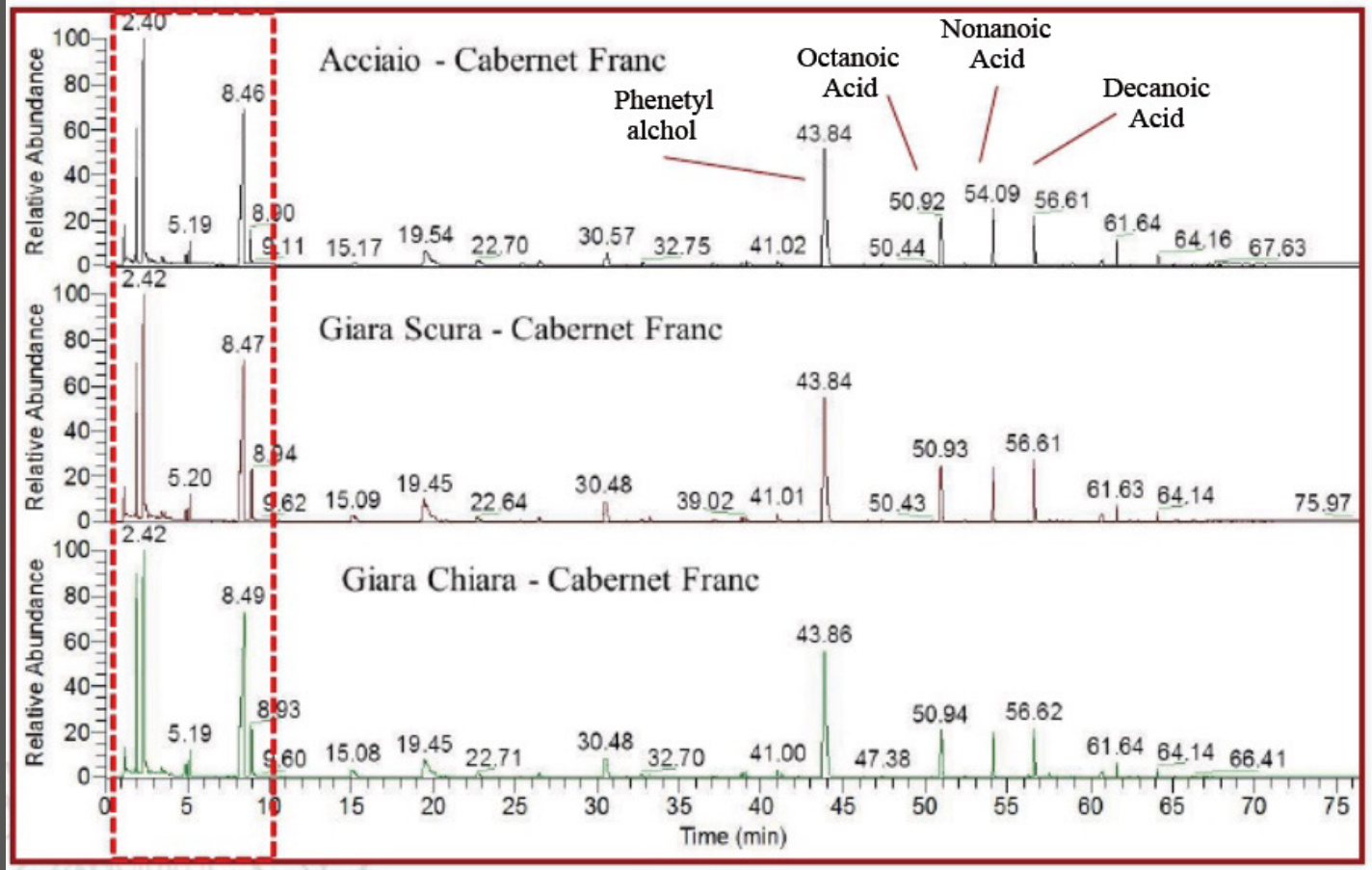

The same wine fermented in two different types of jar and steel do not show substantial differences

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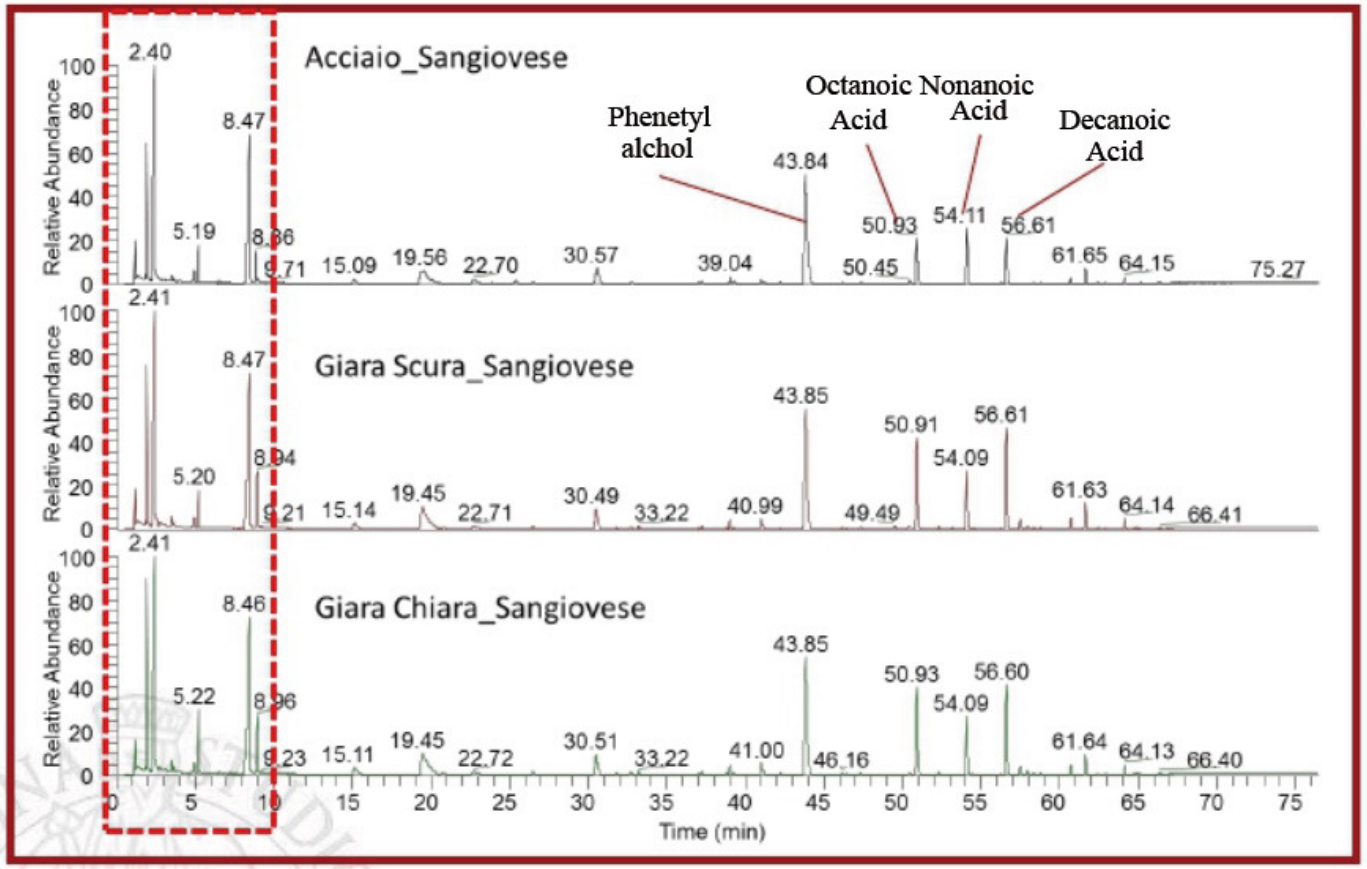

Some differences are noted between the fermentation in steel and in the 2 jars, mainly for the different relationship between the octanoic, nonanoic and decanoic acids

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2 Samples in stainless steel
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2 Samples in the "dark" jar

Sample digestion

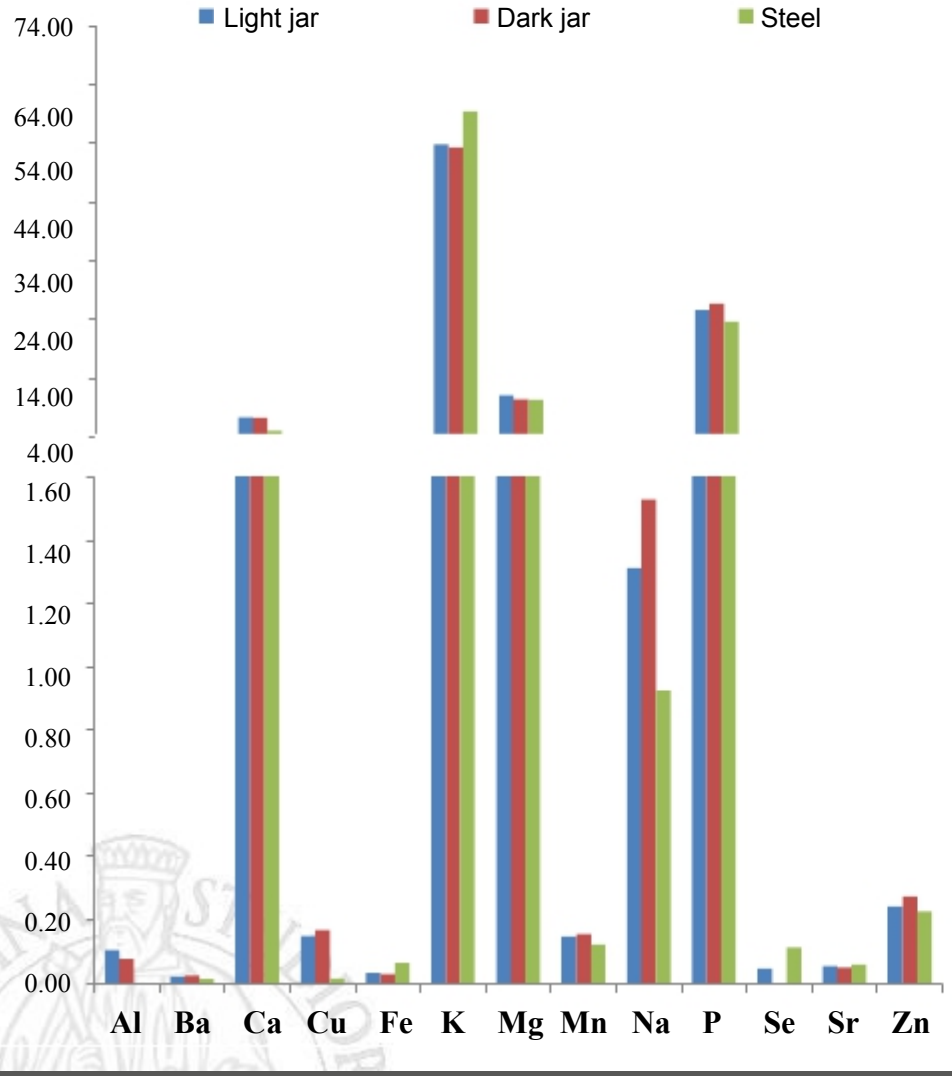
ICP-MS Analysis / ICP-OES

UNIVERSITÀ DEGLI STUDI FIRENZE

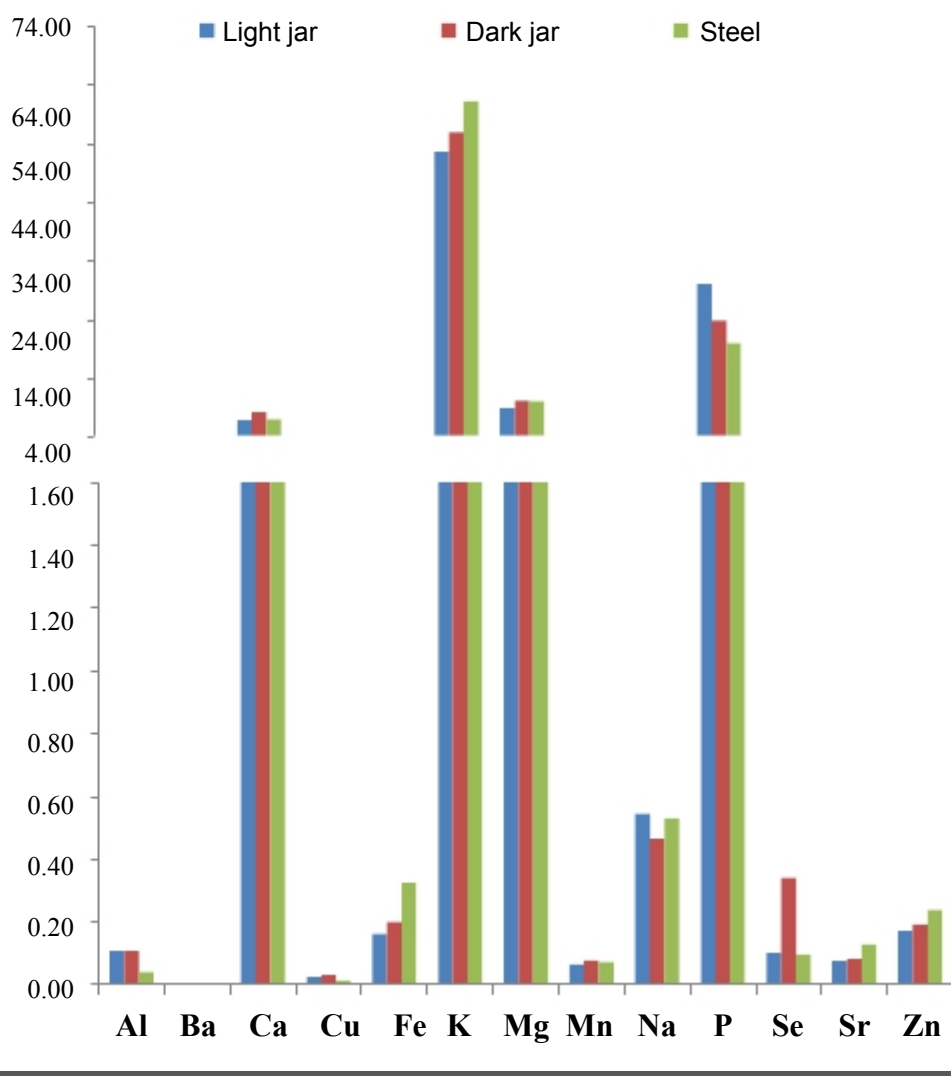
Preliminary results

Analysis of the mineral component of wines (Cabernet Franc and Sangiovese) made in Terracotta and Stainless steel

% Mineral composition of Cabernet Franc



% Mineral composition of Sangiovese



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Burn down the barrels

Clay… is here to stay

Early Music and ‘Original’ Instrument Performance.

a revolutionary movement within the classical music genre during 1970s and 1980s.

Recreate a more accurate sounds, colors and rhythms similar what composers like Vivaldi, Bach, Mozart and Beethoven would have heard.

Restore the instruments from each composer historic era with a respect for national, regional and sub-period instrument styles.

Assumption was that old technology was not primitive or inferior, but instead was perfectly suited to the music of its time.

Classical Music’s answer to Natural Wine.

The discovery and definition of musical terroir

Historical Musical terroir evolutionary development of fagotto 1600-1960

Traditional, unique, handmade, individually crafted, each sounds and plays differently

Product of industrial revolution, machine made standardized, highly technological. Each is played and sounds exactly the same way.

Denner 1655

Heckel 1955

Forward through the past

Restoring ancient musical technology created the planet's newest musical sound

Terracotta parallels this movement

Barrique fermentation = becoming old fashion

Terra Cotta fermentation = our most modern technology

Adolf Hitler
=
New French Oak Barriques

A brief history of the modern use of barrels

1945-1955 Universities of Bordeaux and Burgundy discover barrel corruption (brettanomycis) is the major problem in industry.
All of French winemakers replace 'dirty' old barrels with New French Oak barriques.

1945-1955 Californian winemakers (former WWII 'GI' soldiers) return to France between 1945-1955 to understand why Californian 'Burgundy' and 'Bordeaux' styles do not taste like original French wines. Bring back New French barriques to the New World.

1970-1990 All US producers adopt French barrique for fermenting and maturing wine. Spanish, Italians, Portuguese, French, Chileans, Argentinean students at University of Davis return home to introduce Californian adoption of French barrels to their cultures.

THINK SUPER TUSCAN, THINK BARRIQUE AGED BAROLO…. NEBBIOLO TANNINS PLUS NEW OAK TANNINS!

1990-2000 Australia, New Zealand and South Africa adopt French barrique. Some US producers develop 200% French oak aging. Bordeaux styles imitate Napa Valley Cabernet.

By the 21st Century

French Barriques ruled the world of wine

Talha culture

Rediscovering the lost Roman tribe of *Talha*

Professor Arlindo Ruivo in his 17th century adega

Rediscovering the last Roman wine factory

Adega
Jose de Sousa

Saving the last Roman wine bars, restaurants and culture

Evolution of Terracotta over 4-6000 years

Qvevri = Ancient technology

Georgia retains the most ancient and original form of terra cotta winemaking technology 6-8000 years old.

Talha = modern Ancient technology

Portugal retains the final upgraded designs for this technology that evolved within the next 4-6000 years. Talha are 2000 year old designs.

Both are perfectly suited to non-refrigerated, low CO2, no chemical winemaking.

'one pot' does everything: Place grapes in, ferment, mature, then drain for drinking.

Differences between Qvevri and Talha

- Qvevri buried vs Talha free standing
- Qvevri temperature control via earth vs Talha cool via external water poured over walls
- Qvevri drained from above vs Talha drained below with natural, gravitational filtering
- Qvevri reinforced, less likely to explode vs Talha more fragile
- Qvevri stable and camouflaged vs Talha moveable and replaceable
- Qvevri difficult to clean vs Talha more easily cleaned
- Qvevri sealed by wet clay vs Talha sealed by oil film

Terracotta vs New Oak Barriques

Flavor of pure grapes vs flavor of barrel

Grape tannins vs barrel tannins

Late 20th Century technology

Inox/stainless steel tank production (anaerobic) = pure fruit, hard skin tannins

Inox/stainless steel tank production micro ox = pure fruit, oxygen softened skin tannins

New barrique fermentation = oak tannins and oak flavors dominate fruit and skin tannins, but oxygen softened skin tannins, integrated textures

Old barrique fermentation = less oak tannins and less obscured fruit and softened skin tannins and integrated textures

vs

Terracotta

just flavor of grapes and tannins of grapes

plus natural micro-ox (4 times rate of barrels), so tannins polymerized faster.

End result is advanced texture maturation with pure fruit expression and pure structure

OTR: Oxygen Transfer Rates

Terracotta = 20 grams oxygen per liter per month

Oak barriques = 5 grams oxygen per liter per month

Traditional Techniques for slowing or inhibiting rate

OTR can be adjusted and controlled for a desired wine style equating to the OTR of barrel fermentation or micro ox.

Qvevri has choice of pure ceramic porosity or an external concrete or lime wash or internal bees wax coating. Bees wax believed to have anti-septic qualities.

Talha have choice of pure ceramic porosity or ‘peshe’ a mixture of plant resin, oil and various herbs, many of which are anti-septic in nature.

Both external and internal coatings provide an anti-septic help in defeating bacteriological contamination.

Wary of inherent dangers of porous clay, winemakers are scrupulous about cleaning their pots before the next fermentation.

The ancient art of terracotta-fermented wines gets new life in Oregon

Ceramicist-turned-winemaker Andrew Beckham in his studio with some of his terracotta amphorae. *(Katherine Cole/Special to The Oregonian)*

New Zealand, South Africa, Chile…

Terracotta is beginning to conquer the world

IMPRUNETA 18/11/2016 - THE CONFERENCE

The Empoli Amphora and the creation of a network of museums to divulge the culture of "Terracotta and Wine."

INTRODUCTION

Good morning. My name is Ilaria Alfani I am vice president of GAM a consortium of cultural cooperatives that in 2015 took over the management of the Archaeological Museum of Montelupo Fiorentino.

To give a brief idea of its localization: the Museum is located in the town itself, in the park of the “Ambrogiana” close to the River Arno in a scenic and historical environment of considerable interest due to the presence of important monumental evidence, among which, in addition to the well known Villa Medici is the former seat of OPG, the same site as the Museum and the ancient church of Saints Quirico and Lucia dell’ Ambrogiana, the long history of which dates back to the Lombard period.

The consortium manages the museum in the form of a grant, a form definitely challenging, but also extremely interesting for its innovative character, to which GAM has responded with a complex three-year technical project, structured around integrated and inter-industrial activities, some of which are aimed precisely towards the development of relations between the Museum and various productive activities of the area.

REGARDING TERRACOTTA AND WINE - WHY THE EMPOLI AMPHORA?

In wanting to share with you the proposal of a project focused on this particular aspect and finalised in the creation of a network of museums and relationships between museums and companies centred around terracotta and wine, it seemed interesting to relate, as a premise, the history of an ancient Italic amphora used for transporting wine. “The Empoli Amphora ” has specific and functional characteristics, in our view that can give rise to foreseeing the potentialities between historical research and the current production activities of the relative territories.

In this sense, there are three main points of interest:

THE LOCATION OF PRODUCTION. As is evident from the name assigned to it by archaeologists, the Empoli Amphora makes explicit reference to one of the main production centres of terracotta so this vessel is characterized by strong territorial links. On the basis of current data the precise district of production relates to a fairly wide area of Northern Etruria between the Arno valley and the Tyrrhenian coast. To say that this jar is produced in this area of course means to say that these territories were also characterized by a significant wine production for the marketing of which the Empoli Amphora was specifically produced. So essentially it was a specific agricultural vocation that urged an equally specific manufacturing production.

- DATES OF PRODUCTION. The Empoli Amphora dates from the maximum production period between the fourth century AD and the beginning of the sixth century AD, an age that historians call late antiquity, the predecessor of the Middle Ages. In many territories this was a time of crisis and recession, but the Arno valley seems to have responded with a renewed economic development, and it is precisely the Empoli Amphora that attests to it. This brought back, if I may say so, a vocation that this territory had already manifested at least three centuries before. In fact, already around the end of the last century B.C and around the first century AD at the time of the foundation of the Roman colony of Florence and Pisa etc., the Arno Valley was well known for its wine production: the variety of its grapes, associated to specific cities. The Pariana grapes of Pisa, the Sopina of Florence etc. Ancient literary sources (Pliny, Martial, medical sources etc.), frequently mention the higher quality wines and also the lesser valuable (non-matured) wines from the area.

- THE MARKET. The wine contained in this amphora was intended not only for the domestic market of the main urban centres of the region i.e. Florence, Pisa, Empoli etc. but also and in a consistent manner to the extra-regional market and specifically to the market of Rome. It is no coincidence that this amphora was recognized for the first time as a new type of amphora in the excavations of Ostia. The extra-regional dimension which, as we shall shortly see included the export of this type of vessel to the Mediterranean coast, (although in quantities yet to be assessed) is for the historic period we are talking about, a very important fact as during these particular centuries, Italic productions both in food and in manufacturing were almost completely replaced by imported products. These came principally from the African provinces of the empire due to an Italic economic crisis that began in the second century AD and became chronic in the third century AD.

THE EMPOLI AMPHORA- WHICH MANUFACTURING TRADITION?

A quick reflection on the characteristics of this vessel that are also indications of the market environment in which it circulated.

A) A comparison with the “Dressel 2/4”

The Empoli Amphora is a vessel characterized by a mouth diameter of an average 10 cm, with a ring lip of triangular section or disc shaped; a cylindrical neck or slightly truncated cone with distinct signs of having been turned on a potters wheel inside; a moderately broad shoulder without signs of distinction from the neck; the handles, slightly flattened in section, almost always marked by deep longitudinal grooves, set just below the lip; a body with a spinning-top-shaped profile ending with a small tip. The walls are of reduced thickness (on average less than 1 cm). The raw material usually appears well worked and processed: the clay is purified with very small particle sizes.

To give you an idea of the peculiarities of this morphology I propose a comparison with the most well known of the Italic amphorae the so-called “Dressel 2/4”, which was produced between the middle of the first century BC and the end of the second century AD. This corresponds to the explosion of Italic wine production between the principality (Emperor Augustus) and the first imperial age, which had characterized the Arno valley as mentioned above.

On observing the two amphorae in comparison it is easy to see that the shape of the two vessels is completely different: first of all we see the diversity of the dimensions (the Empoli Amphora is smaller, its capacity was calculated to be about 2/3 that of the Dressel 2/4 (capacity 28 / 30l) with a variable capacity between 16 and 10 litres (36 to 19 “sestarie”); but also the diversity of form, that of Dressel 2/4 being strictly functional for stacking (a typical amphora intended for long sea transport) and that of the Empoli Amphora destined instead for another type of use.

B) The tradition of the Galoise 4 and the flat-bottomed Italic amphorae of the second century AD.

The shape of this vessel communicates yet another manufacturing tradition, which began in Gaul, as early as the first century AD, with the flat-bottomed amphora type “Galoise 4 /Pelichet 47” It was also developed in Italy between the end the 1st century AD and then extensively during the course of the 2nd century AD with a series of flat-bottomed vessels for which, as in the case of the Gallic amphora, it is assumed the presence of a straw cladding to protect the ceramic body. These amphorae were designed primarily for river transport but also for sea transport on small light boats intended for coastal navigation.

The Empoli amphora recalls these vessels in overall morphology where the difference linked to the presence of the tip, which has different features from that of the amphorae of the early imperial age, including precisely the Dressel 2/4, that can possibly be linked to a more significant spread of this vessel also by sea, as demonstrated by its presence in different places in the Mediterranean along the French and Spanish coasts and Corsica.

THE EMPOLI AMPHORA - ITS SPREAD AND TRANSPORTATION VIA RIVER AND COASTAL NAVIGATION

To understand the circulation of this amphora we must imagine a completely different landscape from the current one, featuring a fully navigable river system, not only with respect to the course of the Arno but also to its tributaries including for example the river Pesa, linked specifically to the area of Montelupo Fiorentino. A “photograph” of that period comes to us from the Tabula Peuntingeriana, a map reproduced in medieval times, but deriving from a Roman original probably of III / IV century AD.

The Tabula shows clearly the Empoli area, from whence the wine transported in the Empoli amphora reached Florence and, via the Arno/Clanis*/Tiber fluvial system, directly to Rome.

The Tabula also reproduces the area near Portus Pisanus which, according to the Maritimum Itinerary (dated sixth century) was located 9 “milia” from the mouth of the Arno (in an area today occupied by the northern outskirts of Livorno) and Vada Volaterrana (located according to the Itinerary Maritimum, 18 milia from Portus Pisanus in an area stretching beneath much of modern Vada, Rosignano M.mo - Livorno and beyond the northern outskirts of the present town). Portus Pisanus and Vada Volaterrana - the two seaports from which the amphorae set off for the Mediterranean, destination the French coast, Spain and Corsica.

The transport by river had a major role and included, it is also important to say, the use of other types of containers such as wooden barrels as attested by visual and literary sources, an important thing to remember because the consistency of the circulation of this wine was probably even greater than evidenced by the Empoli amphora on its own. Shipping lines reached Capraia e Limite (a municipality adjacent to that of Montelupo), similarly to fairly recent times.

* The Clanis was a river in southern Etruria, whose source was in the hills around Arezzo, and, after passing through the Val di Chiana along a route of about 70 km towards the south, merged into the Paglia, a tributary of the Tiber, at Orvieto in Umbria. The Clanis had sufficient water flow to make it navigable, as reported by Pliny the Elder in his Naturalis historia (III.53). As narrated by Tacitus, the river at one point, due to its extraordinary water capacity, was considered the main cause of the overflowing of the Tiber, which subsequently flooded Rome. For this reason the course of the Clanis was barred by the Romans causing the stagnation of its waters. These at first broke their banks, then poured into the Val di Chiana, transforming it into a swamp. The Clanis then disappeared altogether.

THE EMPOLI AMPHORA AND “VINUM TUSCUM” - THE PRODUCERS

From a passage by the orator Quintus Aurelius Symmacus (Symm. Ep.I, 51) who of V.P. Praetextatus asked 'vos Etruria quousque retinebit?' (For how long do you keep your Tuscan)?

Archaeological investigations from the territory of Capraia e Limite along with others in progress in the territory of Pisa and in the urban centre of Florence are providing us with many answers about the economic mechanisms in which to place the production of Empoli amphorae. The phrase quoted is contained in the letter that a famous orator of the era Quintus Aurelius Symmacus wrote to an illustrious politician Vettius Agorius Protestato who, according to recent data, is precisely the owner of the villa now under excavation at Capraia e Limite, under the scientific direction of Professor Cantini of the University of Pisa. The villa is a luxurious residence linked to the management of the territories in which this specific wine was produced along with others.

Vettius Agorius Protestato was a holder of several important political roles: “Corrector Tusciae ed Umbriae” before 362 AD and “Praefectus Urbi” in 384 AD.

These roles speak of a reorganization of Northern Etruria that promoted the economic development of the IV/ V centuries of which our amphora is an important testimony.

The ancient Regio VII, Tuscia, in the early fourth century, probably under the Emperor Diocletian became “Tuscia Annonaria”, a region that was included in the organization created by the government for the food supply, free of charge or at reduced prices, for the plebeians of large urban centres and in particular from the capital Rome*. During these years, documentation from different sources, attests to the close relations between “Tuscia” and the “Arca-Vinaria” - the cache of wine supplies for the populace of Rome, and not surprisingly, the “Vinum Tuscum” in the fourth century AD was among 4 Italic productions recorded in the “Expositio Totius Mundi” – a text dating from the late fourth century AD according to which: "Invenies enim ipsa Italia vinorum multa genera: Picenum, Sabinum, Tiburtinum, Tuscum” (There, in Italy you will find many different kinds of wines : the districts Picene, Sabine, Tiburtinan, and Tuscan)

This massive operation involved the senatorial aristocracy and the local elites** including those of Tuscia, where urban prefects, well documented via the sources, possessed vast territories: if the “Praefecti urbi” (urban prefects) of Protadio and Cecina Albino are mentioned by Rutilio Namanziano as owners of villas situated respectively at Portus Pisanus and Vada Volterrana (Rut.Nam. The 527/530, 465/468 I) More information comes from vast possessions in Tuscia belonging to other urban prefects such as Vettius Agorius Praetextatus, Aviano Symmachus (father of the orator Quintus Aurelius Symmachus) and Orfito father in law of the latter. All were heavily involved in the management of the “Arca Vinaria” - the cache of wine supplies for the populace of Rome (Orfito remained among other things involved in an accusation of embezzlement reported in the histories of Ammianus Marcellinus****).

During the fifth century, this export activity while suffering a decline (as attested by archaeological finds), also fell under the dominion of the Goths at the instigation of the emperor Theodoric who supported the export of Tuscia products particularly towards Provence, an area he had conquered in 508 and which remained under the Goths till 536 (Cassiodorus cites in his “Naviculariі Tusciae” that they controlled the exports in Gaul). The system came to a total crisis with new upheavals linked to the Greek Gothic War at the very beginning of the sixth century AD, the dating of which is today associated with the end of the production of the Empoli amphorae.

Future archaeological data will still have to allow for the verification of suggestions that could instead link this vessel to later times: At Vada we have the discovery of a specimen with a graffito cross which seems to suggest a later production phase during the late sixth century, linked to church hierarchy and the economy of the Church of Rome (cf.. Bernal Casasola in Santarosa).

So, to sum up, the Empoli Amphora is a testimony of a wine growing area that managed to revive its economy in a time of crisis, with a dimension linked to export and not only to domestic consumption which promoted the investment on the part of rich entrepreneurs who took advantage of a specific framework of land-reorganisation promoted, we might say, by the state.

A line of research that of course will have major future developments comes from the same Villa “Dell’Oratorio”, which every year provides new interesting elements. This gives us a functional framework for the proposal by Marzio Cresci (Director of the Museum) regarding the possible relationship between local production companies and a network of museums.

Thank you

**. This operation is part of a bigger picture involving other territories (in addition to Tuscia, Sicily, Sardinia, Apulia and Lucania) and many other food products (in particular grain), in order to respond to the increased demand of the market of Rome and other Italic centres, for which the imports from the African provinces were insufficient. Despite the fact that imports remained unchanged the province was already quite oppressed during the reigns of Commodus and Septimius Severus, and it is unlikely that there was an increase of the production surplus because at the time there was an imbalance between population growth and available cultivatable rural areas. This was from the fourth century onwards.

*** Continuing the comparison with the oldest productions of amphorae, the Empoli Amphora was for a long time considered, unlike those productions, a container not characterized by epigraphic accompaniment.

We know that the inscriptions found on jars used for transport, provided excellent clues for the understanding of the marketing and production of amphorae from the Republican and Imperial ages: the stamps, which were imprinted on the vessel before firing, have been interpreted, thanks to the support of written sources, as a sort of mark of origin and indication of the quality of the goods (remnants from the system of the slave trade); while the graffiti made after firing were more in connection with the time of sale, the order of storage, references to the destination of the goods etc. This epigraphic accompaniment became increasingly rare in the Late Antique period, and had already begun to disappear during the course of the second century AD.

The significance of three particular stamps, shown on three fragments of Empoli amphorae, are currently being investigated. They seem indeed to refer to names of persons of high rank:

The SULPICIUS stamp - on a fragment found at excavations in Fiesole.

The VINCENTIUS stamp - on a fragment found at excavations in Genoa (a known name from the fourth and sixth centuries, but not specific to TUSCIA, mentioned only on a funerary inscription at Chiusi dedicated to a young man named Sulpicius Vincentius)

****The SUL stamp (partially preserved) - on a fragment found at excavations in Florence (in Via dei Castellani).

With eventual reference to the practice of “Adaeratio”, for which the owners of the cellars could pay in cash the wine taxes to which they were obliged.