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# Preliminary study of food residues and cooking practices in the Medieval Hospital of *Santa Maria della* Scala in Siena (Central Italy)

## Residuos de alimentos y prácticas culinarias en el Hospital Medieval del *Santa Maria della Scala* en Siena (Italia Central). Resultados preliminares

**PALABRAS CLAVES:** Medioevo, hospital, uso de la cerámica, residuos orgánicos, alimentación, Siena-Italy.
**GAKO-HITZAK:** Erdi Aroa, ospitalea, zeramikaren erabilera, hondakin organikoak, elikadura, Siena-Italy.
**KEY WORDS:** Middle Ages, hospital, ceramic use, organic residues, food practices, Siena-Italy.

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**RESUMEN**

El artículo trata sobre el estudio del uso de algunas cerámicas medievales y de los alimentos preparados y consumidos en el Hospital medieval del Santa Maria della Scala en Siena (Italia Central).

Esta investigación muestra la integración entre los datos obtenidos con el análisis arqueológico y arqueométrico (utilizando el análisis de residuos orgánicos) de las cerámicas y la investigación sobre los documentos históricos encontrados en el mismo contexto, el hospital medieval del Santa Maria della Scala en Siena.

Después del estudio arqueológico-formal, algunas cerámicas han sido seleccionadas para el análisis con cromatografía de gases acoplada a espectrometría de masas con el fin de identificar los residuos orgánicos preservados y conocer su contenido original. Los datos obtenidos han sido integrados con la información proporcionada por los documentos escritos encontrados durante el estudio del Hospital acerca de las compras y de la vida cotidiana en su interior.

**LABURPENA**

Erdi Aroko zeramika batzuen eta Sienako (Italia erdialdea) Santa Maria della Scala Erdi Aroko Ospitalean kontsumitutako eta prestatutako elikagaien azterketari buruzkoa da artikulua.

Zeramiken azterketa arkeologikoarekin eta arkeometrikoarekin lortutako datuen eta testuinguru berean, Sienako Santa Maria della Scala Erdi Aroko ospitalean, topatutako dokumentu historikoei buruzko azterketaren arteko integrazioa erakusten du ikerketa honek.

Azterketa arkeologiko-formalaren ondoren, zeramika batzuk hautatu dira masen espektrometriari lotutako gasen kromatografiarekin aztertzeko, hala, gordetako hondakin organikoak identifikatzeko eta haien jatorrizko edukia ezagutzeko. Lortutako datuak Ospitala aztertzean topatutako dokumentu idatziek emandako informazioarekin integratu dira. Dokumentuak ospitaleko eguneroko bizitzaren eta erosketen inguruko informazioa dute.

**ABSTRACT**

This paper shows the application of an integrated approach to the study of the use of ceramic wares and of the food prepared and consumed in the Medieval Hospital of *Santa Maria della Scala* in Siena (Central Italy). This approach takes into account data obtained by the archaeological and archaeometrical study of ceramic vessels and the investigation of historical documents recovered at the Hospital.

A selection of ceramic vessels was analysed to identify the organic residues preserved in them and therefore their original content. The analyses were carried out performing different extractions and the samples were analysed with gas chromatography-mass spectrometry. The data obtained were integrated with the information provided in the written documents found during the study of the Hospital, regarding purchases and daily life at the Hospital.

## 1.- INTRODUCTION

The study of food practices during the Middle Ages has been traditionally carried out thank to the possibility of studying historical sources (i.e. Montanari for Italy, Flandrin for France). However, during the last decades, data emerging from the study of archaeological materials have been acquiring importance. Information on dietary practices and land management have been gathered from the study of animal and plant remains recovered in both urban and rural contexts (among others,

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ALBARELLA 1999; BANDINI MAZZANTI *et al*. 2009: BUONINCONTRI *et al*. 2007; CORBINO and MAZZA 2013; GRAU-SOLOGESTOA *et al*. 2016; VAN DER VEEN *et al*. 2013; VIGIL-ESCALERA GUIRADO *et al*. 2013; WOOLGAR *et al*. 2006). Furthermore, investigation of anthropological remains from cemetery communities, along with isotopic analyses of bones have provided important data on paleodemography, paleopathology and, more rarely, paleonutrition (HAKENBECK *et al*. 2010; HERRSCHER *et al*. 2001; FORNACIARI, 1984; FORNACIARI *et al*. 1984; FULLER *et al* 2010; JOHANSEN *et al*. 1986; KOSIBA *et al*. 2007; MALLEGNI 1987; MALLEGNI, FORNACIARI 1985; MAYS 1997; MULDNER, RICHARDS 2007; MULDNER G.H. 2009; MUNDEE 2009; POLET and KATZENBERG 2003; RETISEMA *et al*. 2010; YODER 2010). Some of these studies have explored the basis of nutrition in the Middle Ages and other complex topics, including food and social issues, such as gender, identity and cultural changes. An important role in the understanding of food production and preparation is played by the study of ceramic vessels (among others, BIDON 2005; CANTINI 2005, CANTINI *et al*. 2015; DE GASPERI *et al*. 2006; DE FERRARI 1996; DE VINGO 2011; GABRIELI 2015; GRASSI 2010; GELICHI and BALDASSARRI 2010; GIOVANNINI 2001; MELLOR 1994; MOLINARI 2003), which can be integrated by residue analysis of ceramics, allowing to obtain information on the food prepared and consumed in the different vessels (i.e. CHARTERS *et al*. 1993, 1995; COTTICA and NOTASTEFANO 2006; GIORGI *et al*., 2010; KIMPE *et al*. 2004; INSERRA *et al*. 2015; MOTTRAM *et al*. 1999; PECCI 2009; PECCI and CAU 2014; PECCI *et al*., 2016; ROMANUS *et al*. 2008; SALVINI *et al*. 2008). An interesting approach to ceramic study is the highlighting of differences in dietary habits, which could be related to social status (BECK BOSSARD 1981; POLET, KATZENBERG, 2003; DEGASPERI, PRUNO, CORBINO, 2006). For what concerns Italy, various historical syntheses on food habits during the Middle Ages have been produced since the Seventies using mainly written sources (FLANDRIN, MONTANARI 1996; LARIOUX 1996; MONTANARI 1979, 1988, 1997, 2012, 2015; REDON 1994). An important moment for the study of food habits in the Italian Middle Ages was the publication of the 1981 issue of the journal "Archeologia Medievale", where the study of medieval diet was discussed integrating the contributions of various historians and archaeologists. This was a first attempt to investigate the relationship between man and his natural environment, as well as between production and consumption of food. As for medieval Tuscany, the contribution of Ginatempo, who used archaeological data for historical interpretation of food practices, was crucial, as she firstly highlighted the potential of combining different sources, involving data obtained from the study of faunal and human remains (GINATEMPO, 1984, 1988). Following this line of research, the study of ceramic vessels recovered in Tuscany and the analysis of organic residues preserved in them have improved our knowledge of ceramic use and food practices during the Middle Ages. The results have been particularly fruitful especially when integrated with botanical and faunal studies (BUONINCONTRI *et al*. 2007, in press; CANTINI *et al*. 2015; GIORGI *et al*., 2010; GOBBATO, GRASSI, 2000; GRASSI, 2004, 2007, 2010; PECCI, 2004, 2005, 2009, 2015; SALVINI *et al*. 2008).

Although the application of residues analyses on archaeological materials began in the 1970s (CONDAMIN *et al*., 1976; CONDAMIN, FORMENTI, 1978), and since then this kind of study has greatly improved (COLOMBINI, MODUGNO, 2009; BARNARD, EERKENS, 2007; EVERSHED, 1993, 2008; GARNIER, 2007; GUASH JANE *et al*. 2004; KIMPE *et al*., 2004; PECCI, 2009; NIGRA *et al*. 2014; REGERT 2011; ROMANUS *et al*., 2009; SALVINI *et al*., 2008), to date few investigations of residues in vessels related to health care exist. In this line of research, the majority of vessels analyzed are mostly related to the preparation of medicines (for instance PÉREZ-ARANTEGUI *et al*. 2011; FRASER *et al*. 2011). Despite the understated investigation of food residues in ceramic vessels from hospitals, food had a crucial role in the care of the body and the soul during the Middle Ages (HAGEN 2006; MONTANARI 2012; MURRAY JONES 1997; WALLIS 2010). Food restrictions related to religious events (involving mainly the abstention from meat and consumption of other animal products) as well as food consumption recommendations related to specific body characteristics, as suggested i.e. in the famous *Tacuina Sanitatis*, were, in fact, important elements of medieval daily life.

In this contribution, we present an integrated approach to the study of the use of different Medieval ceramic vessels, along with information on the food prepared and consumed at the Hospital *Santa Maria della Scala* in Siena (Central Italy) (Fig. 1). A selection of ceramic vessels previously studied archaeologically were analysed to identify the organic residues preserved in them. A crucial aspect of the research is that it was possible to relate the data obtained from the residue analyses with those recovered from the written documents found at the Hospital. In fact, during the investigations of the Hospital, Beatrice Sordini (SORDINI 2004 and 2010)


**Fig. 1.** Location of Siena (Italy) / Localización de Siena (Italy).

studied a rich collection of documents belonging to the Medieval Inventory of the facility. These documents consisted of expense records (*Registro di spesa*), which included information related to the life of the Hospital. In particular, they enlighten us on the purchase of food, clothing, animals and other necessities of those who lived and worked at the hospital, as well as of its guests. Additional records include information about the objects and furniture present inside the Hospital.

This integrated approach, despite its great potential of comparing data coming from different sources, can be applied only rarely due to the difficulties of having available at the same time archaeological and archaeometric data (in this case from organic residue analysis), along with information preserved in historical documents recovered from the same context.

## 2.- THE SANTA MARIA DELLA SCALA HOSPITAL AND THE RECOVERY CONTEXT

The *Santa Maria della Scala* Hospital was an important institution for care and hospitality during the Middle Age. It was located at the heart of the town of Siena, in front of the cathedral. Many pilgrims spent time there, and many people with illnesses were cared for. Several of those who stopped or died there left their goods as a donation to the hospital, and with time the assets of the institution grew considerably and extended far beyond the town's walls (PICCINNI, TRAVAINI, 2003).

The archaeological excavations carried out in and around the hospital complex, in the framework of the restoration works aimed at creating a site Museum revealed a long occupation of the area, which began during the Etruscan period (7$^{th}$ c. BC) and continued through the centuries until the Middle Ages. Many Medieval phases were identified, mainly associated with the function of hostel and hospital (BOLDRINI, PARENTI, 1991; CANTINI, 2005).

The abundant ceramic vessels found during the excavations have provided information on the broad spectrum of ceramic assemblages used during the 14$^{th}$ century in the kitchen, on the table and for storage (GRASSI, 2001 and 2004). The vessels studied were recovered during the 1998-2000 excavations conducted by the University of Siena, in the framework of the project for the restoration and conservation of the *Santa Maria della Scala* Hospital complex (GALLAVOTTI *et al.*, 1987; PICCINNI, 1995). The samples analysed date to the second half of the 14$^{th}$ century AD. They come from Area 18000 of the *Santa Maria della Scala* Hospital, an outdoor space located close to the city walls. The area was used over the centuries as a place to discard waste from the hospital. Such excavation allowed the understanding of the various occupation phases of the area, providing a chronological sequence for the accumulation of the waste. It also clarified that the area was characterized by the alternation of periods in which retaining walls and sewage systems were built and periods of waste disposal (RADICCHI 2007).

The trash pit where the studied vessels come from was filled in during the 14$^{th}$ century and was located just outside the Hospital. The accumulated materials included building materials, ceramic vessels, glass and animal bones discarded from the Hospital.

A selection of these ceramic vessels was analysed with gas chromatography-mass spectrometry to recover information on the residues preserved in them.

During the 14$^{th}$ century, the hospital had at least two kitchens addressing the separate needs of at least two groups of people: the "sick" and the "healthy" (members of the clergy and secular workers). Different diets were provided to the sick ones depending on their illness (PICCINNI, 1995: 11-23). Moreover, written documents from the Hospital inform that even among the "healthy" population there were differences in the food prepared, i.e. for women, for the Rector of the Hospital, and for the friars (SORDINI, 2004: 39). We are not able, however, to determine whether the vessels investigated came from the waste of the kitchen dedicated to the sick or from the one for the so-called "healthy" people.

## 3.- MATERIALS AND METHODS

The residue analysis study focused on nine samples taken from coarse ware cooking vessels found in the waste pit (Table I) (Radicchi 2007). The analyzed vessels are two pot-colanders (SMS1, SMS4), two pan/colanders (SMS2 and SMS3), two pans (SMS 9 and SMS10) and three testi (coarse ware plates used for cooking) (SMS5, SMS6 and SMS7)(Table I, Figure 2). All the vessels show soot marks attributed to their use over flame.

All the samples were mechanically cleaned with a scalpel to avoid post-depositional contamination and then ground to obtain a fine powder.

Different extraction were carried out on the samples:

a. The total lipid extract and its hydrolysis was obtained following MOTTRAM, *et al.* (1999). 10 µl of a standard solution of octacosane (1 mg/mL) were added to the powder before extraction.

| Sample | SU | Project n. | Form | Number in Fig.1 | Part sampled |
|---|---|---|---|---|---|
| SMS1 | 18407 | 2 | Pot-Colander | 1, 2 | Bottom |
| SMS2 | 18047 | 6 | Pan-colander | 3 | Bottom |
| SMS3 | 18047 | 8 | Pan-colander | 3 | Bottom |
| SMS4 | 18306 | 1320 | Pot-Colander | 1,2 | Bottom |
| SMS5 | 18306 | 1321 | *Testo* | 4 | Bottom |
| SMS6 | 18407 | 16 | *Testo* | 4 | Bottom |
| SMS7 | 18407 | 19 | *Testo* | 4 | Bottom |
| SMS9 | 18407 | 4 | Pan | 5 | Bottom |
| SMS10 | 18306 | 1322 | Pan | 5 | Bottom |

**Table 1:** Samples analysed / Muestras analizadas.

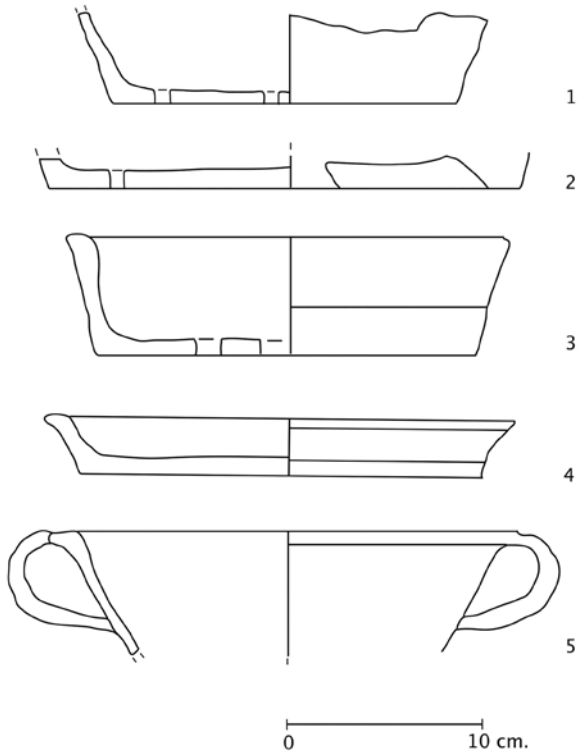


**Fig. 2.** Ceramics analysed. Holes can be seen in the bottom of vessels 1,2 and 3. 1 and 2: pot colanders; 3: pan colander; 4 testo; 5 pan colander (modified after Radicchi 2007). / Cerámicas analizadas. Los agujeros pueden verse en la parte baja de las vasijas 1, 2 y 3. 1 y 2: escurridores; 3: colador; 4 tiesto; 5: colador (modificado despues Radicchi 2007).

b. After the total lipid extract a hydrolysis with KOH in water (1 M, 3 mL) was carried out on the solid fraction (GIORGI, *et al*. 2010).
c. The extraction aimed at identifying wine residues was carried out on 1 gram of powder following PECCI *et al*. (2013).

All the extracts were derivatised by adding 25 µL of N,O-bis (trimethylsilyl) trifluoroacetamide (BSTFA, Sigma-Aldrich) and heating at 70 °C for 1 h.

The samples were analysed by GC-MS using a gas chromatograph CP3800 (Varian, Walnut Creek, CA, USA) equipped with a DB5 30 m, 0.25 mm (i.d.) - 0.25 µm film thickness fused silica capillary column, and a mass spectrometer Saturn 2000 (Varian, Walnut Creek, CA, USA) operated in the electron ionization mode (70 eV). The mass range was scanned in the range of m/z 40-650. The GC oven temperature was held at 50°C for 1 min, then it was raised at 5°C/min up to 300°C and held isothermally for 10 min.

## 4.- RESULTS OF THE ANALYSES

### 4.1. The Pans

The presence of cholesterol, which is accompanied by high stearic acid, and monostearin in both pan samples (SMS 9 and SMS 10) indicates the cooking of abundant animal products in the pans (Figure 3). In both samples there are also odd number fatty acids ($C_{15}$ and $C_{17}$) in branched forms. Although no isotopic analyses were carried out, their presence suggests that at least part of the animal products cooked came from ruminants (MOTTRAM *et al*. 1999; EVERSHED, 2008; REGERT, 2011).

Both pans show evidence of vegetal products: ß-sitosterol is present and the $C_9$ acid is the highest among the short chain fatty acids. Azelaic acid is the highest amongst the dicarboxilic acids in the chromatogram of extraction (c) of sample SMS 10, being typical distributions resulting from the cooking of oil. (PECCI, 2005; PECCI *et al*. 2015).

Dehydroabietic acid is present in both samples. This acid is a marker of *Pinaceae* products that could be related to an organic coating of the vessels or a content. In fact, *Pinaceae* products are common in Tuscan unglazed Medieval vessels and their identification has led to the suggestion of regular use of this organic material as a coating of ceramic vessels (PECCI, 2006; PECCI, 2009). However, *Pinaceae* products were also used for medical purposes. Mattioli, a 16$^{th}$ c. doctor and writer from Siena, taking inspiration from Dioscorides, says they had different medical uses, through ingestion and as ointment (MATTIOLI 1549). Moreover, Sordini has identified products used in the Hospital of Santa Maria della Scala that could be related to resins and pitch (SORDINI, 2004: 36, see paragraph 6). Therefore, these products could also be related to the content of the vessels.

### 4.2. The *testi*

*Testi* are cooking plates typical of Medieval Italy (PRUNO 2003, VANNINI, PRUNO 2015). Samples SMS5, SMS6, and SMS7 belong to this vessel type. They all show internal and external soot marks.

In sample SMS7, the residues are scarce and there is much contamination from plastic (phthalic acids). However, amongst the residues identified, cholesterol (marker of animal products), is abundant, and $C_{15}$ and $C_{17}$ in branched forms, markers of ruminants products, are also present. Moreover, the traces of ß-sitosterol, $C_{18:1}$ acid more abundant than $C_{18:0}$ and acid $C_9$ being the highest acid in the chromatogram, suggest that both animal and vegetable origin lipids are present in the sample. In SMS 6 too, residues are scarce. However, there is cholesterol, $C_{15}$ and $C_{17}$ in branched forms both in the total lipid extract and in the hydrolysis, suggesting the cooking of animal products (Figure 4). In the sample, vegetable products are indicated by the

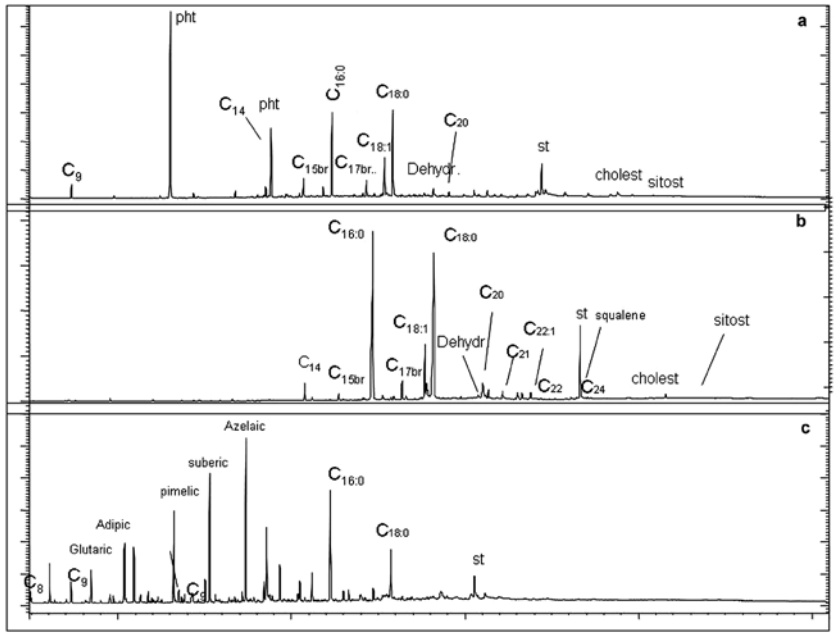


**Fig. 3.** Chromatograms obtained with the analysis of the total lipid extract (a) and the extract for the identification of wine markers (b) of sample 10 and the total lipid extract of sample 9 (c) / Cromatogramas obtenidos con el análisis del extracto lipídico total y el extracto para la identificación de marcadores de vino de la muestra 10 y del extracto total de lipido de la muestra 9.

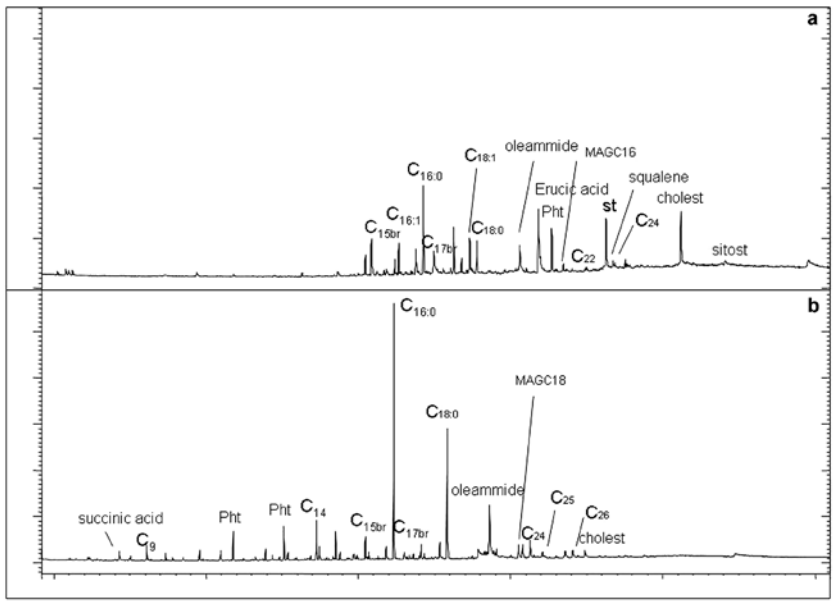


**Fig. 4.** Chromatograms obtained with the analysis of the total lipid extract (a) and its hydrolysis (b) of sample 6 / Cromatogramas obtenidos con el análisis del extracto lipídico total y su hidrólisis de la muestra 6.

traces of ß-sitosterol. Moreover, $C_{18:1}$ is similar to $C_{18:0}$ in the total lipid extract, while in the hydrolysis on the solid fraction there is abundant oleamide, which could derive from contamination or from a degradation of the $C_{18:1}$ (VACCARO *et al.,* 2013). In the hydrolysis of SMS 5 azelaic acid is the highest amongst dicarboxylic acids, suggesting (together with ß-sitosterol) the presence of a vegetable oil, possibly olive.

The dehydroabietic acid in the samples of the three *testi* indicates that *Pinaceae* products are present in all of them.

## 4.3. The colanders

SMS1 and SMS4 are pot-colanders, while SMS2 and SMS3 are pan-colanders. These forms are characterized by the presence of holes in the bottom, pot-colander being deep vessels, while pan-colanders shallow.

### 4.3.1. The pot – colanders

In colander SMS1 the residues are not very abundant. However, cholesterol and the high proportion of stearic acid suggest the presence of animal origin pro-

ducts (Figure 5). Furthermore, the ß-sitosterol indicates the contact with vegetal products. The presence of long chain alcohols ($C_{24}$-$C_{32}$), fatty acids (until $C_{30}$), and hydrocarbons may be related to the presence of waxes, which might derive from postdepositional contamination or from the leaves of vegetables that were filtered in the colander. (EVERSHED, 2008).

SMS4 has thin walls and only four small holes on the bottom (approx. 2mm wide), which were made before the firing of the vessel (RADICCHI, 2007). The sample shows abundant animal products that are comparable to those of the pans and are indicated by the presence of cholesterol, abundant $C_{18:0}$ , (Figure 6). Traces of $C_{15}$ and $C_{17}$ in branched forms suggest that these products come, at least in part, from ruminants. The presence of short chain fatty acids (included $C_6$ and $C_8$) could be associated with dairy products, but to confirm it, isotopic analyses should be carried out. In the hydrolysis of sample SMS4, ß-sitosterol is present, suggesting that the vessel probably also came into contact with vegetal origin substances. $C_9$ is the highest amongst short chain fatty acids, and there is abundant oleammide.

Finally, in both SMS4 and SMS1 samples there are traces of dehydroabietic acid, marker of *Pinaceae* products.

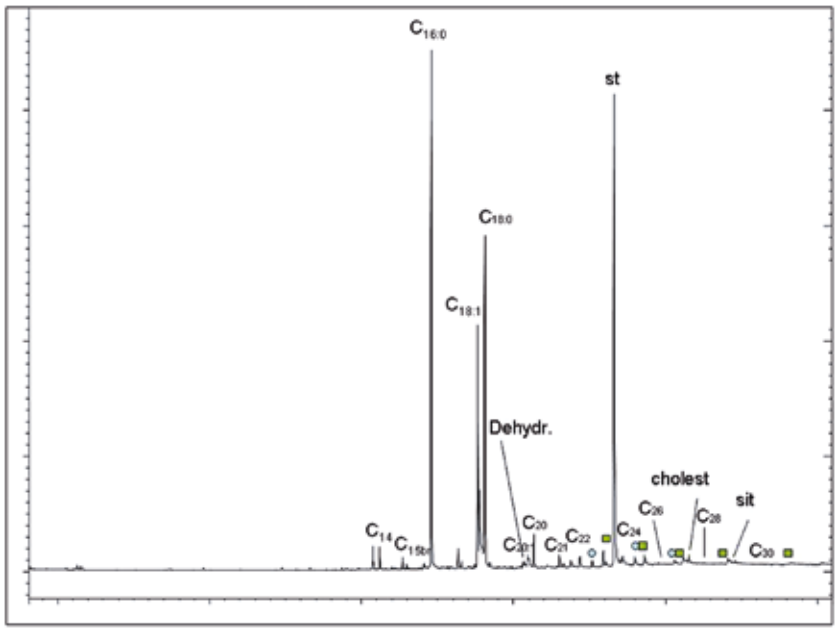


**Fig. 5.** Chromatogram obtained with the analysis of sample 1 / Cromatograma obtenido del análisis de la muestra 1.

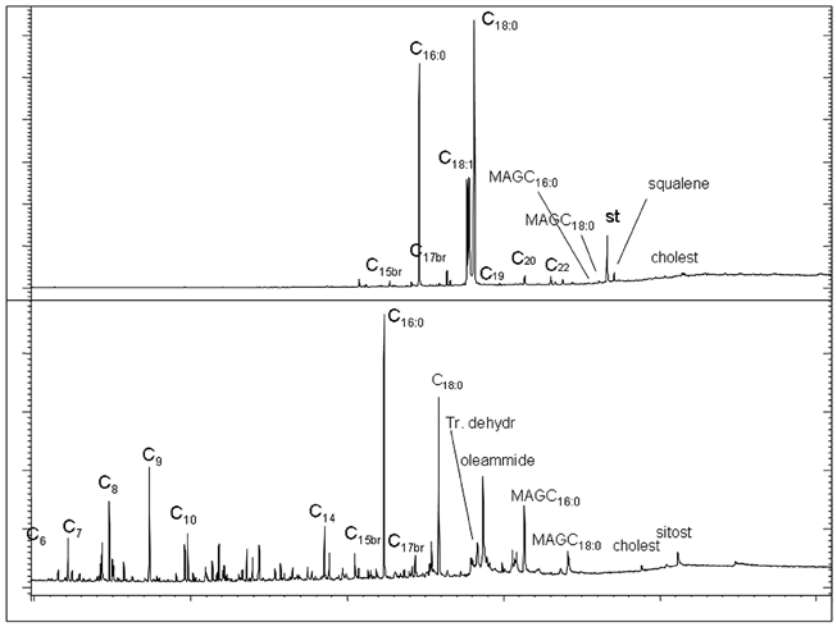


**Fig. 6.** Chromatograms obtained with the analysis of the total lipid extract (a) and its hydrolysis (b) of sample 4 / Cromatogramas obtenidos del analisis del extracto lipídico total y su hidrólisis de la muestra 4.

#### 4.3.2. The pan-colanders

SMS2 and SMS3 are pan-colanders, and are very similar to a pan-colander coming from the Carmine Convent in Siena that was previously analysed, mainly because of the dimension of the holes (GIORGI *et al.* 2008; PECCI *et al.,* 2006).

While the pan-colander from the Carmine Convent had no residues, SMS2 shows animal origin products, with cholesterol, $C_{15}$ and $C_{17}$ in branched forms and short chain fatty acids, (including $C_5$ and $C_6$), which suggest the possibility of contact with ruminant fats and dairy products although isotopic analyses should be performed to verify it. The traces of β-sitosterol, together with traces of $C_{18:2}$ (linoleic acid), and the fact that $C_9$ is the highest peak amongst the short chain fatty acids suggest the presence of a plant oil, which - due to the linoleic acid- could be different from olive oil. In SMS 2, dehydroabietic acid, marker of *Pinaceae* products, is more abundant than in SMS1 and 4.

In sample SMS3 dehydroabietic acid is especially abundant. This could indicate that the colander was heavily coated with *Pinaceae* products or that it was used to filter these products. Moreover, β-sitosterol and long chain hydrocarbons, possibly related with some vegetable waxes, have been identified.

## 5.- DISCUSSION OF THE RESULTS

The results of the analyses suggest that most of the ceramic vessels were in contact with animal and vegetal products.

In the pans, the animal products identified are probably related both to the cooking of meat and to the use of animal fat and lard as a condiment (MONTANARI 2012). As for the intake of meat, the written documents found at the *Santa Maria della Scala* state that both the sick and the healthy consumed some meat. Usually the sick ate “white meat”, chicken, young goat, and veal, which can be better digested, while the healthy ate mostly lamb, ox, goat, and pig (SORDINI, 2004). The presence of odd numbers fatty acids in branched forms confirms the consumption of ruminant animals, although isotopic analyses should be performed to verify it.

Written documents from the hospital do not speak about cooking practices. However, in the Middle Ages pots were commonly used to boil food, while pans were used for roasting, stewing, and frying (GRASSI, 2010: 16). Sometimes meat that was previously boiled in pots could be later roasted or fried in pans (DE VINGO, 2011: 82-83; GIOVANNINI, 1994; GRASSI, 2004: 74-76). In fact, during the Middle Ages meat was often very hard, since the animals were often old, therefore long and/or multiple cooking processes were very common (GIOVANNINI, 1994; MONTANARI, 1988). The analyzed pans might then have been used to roast, stew, or fry meat. Because those objects bear soot marks on the bottom, we suppose that pans where used for cooking by direct contact with fire.

As for the condiments employed at the hospital, the documents state that the sick used only oil and vinegar, which are lighter, while the healthy could also eat food garnished with animal fats such as lard (SORDINI, 2004: 29). No traces of vinegar (whose markers are the same of wine with exctraction c, PECCI *et al.* 2013), were identified in the analyzed vessels. On the contrary, abundant traces of possible vegetable oils are present in the pans and in the *testi* SMS5 and SMS7. In fact, the distribution pattern of the chemical compounds identified suggests the presence of cooked oils. The traces identified in the pans could therefore be caused by the use of plant oils in the roasting or frying process, in order to prevent the food from sticking, or as a condiments.

Vegetables were also very common in the diet of the sick and the healthy at the hospital. The purchase record shows that during the summer pumpkins, cabbage, and salad were consumed in large quantities. Instead, in spring and in September cabbage, *minute* (mixed herbs intended for boiling and to be chopped), salad, and leafy greens were bought. In winter, large amounts of turnips, cabbage, leeks, and carrots entered the hospital. In addition, garlic, onion, and parsley were regularly consumed and used for their therapeutic qualities. Many of the vegetables consumed came from the hospital’s own garden, which was dedicated to growing vegetables for the domestic needs of the structure. For instance, the registers mention that onions, garlic bulbs and cabbage were bought to be planted in the garden (SORDINI, 2004: 17-19). Many of them could have been consumed both as food and as medicines (WILLIS 2010).

Traces of vegetal waxes were identified in colanders SMS1, SMS2, SMS3. Although their origin should be better investigated, and they could also derive from contamination, it is possible that these waxes are a by-product of the filtering of vegetables leaves previously boiled in pots, such as the leafy vegetables mentioned above, which were consumed throughout the year (SORDINI, 2004). For the moment we can say that no markers of *Brassicaceae nor allium porrum* are present in the studied vessls. Leafy vegetable were an important ingredient of the Tuscan diet during the Middle Ages and chemical traces of *Brassicaceae* have been identified in pots recovered at other archaeological sites in Tuscany. (BUONINCONTRI *et al.*, 2007, in press; GIORGI *et al.*, 2010; MAZZI, 1981; SALVINI *et al.*, 2008; PECCI, SALVINI, 2007).

Cheese is often mentioned in the hospital purchase records, suggesting a wide consumption of this product. Together with eggs, cheese was eaten on the days in which the religious calendar called upon the faithful not to eat meat (The *vigilie*), and it is possible that also the inhabitants and workers of the hospital adhered to these indications (SORDINI 2004: 27). Although isotopic analy-

ses should be performed to verify it (EVERSHED 2008; REGERT 2011; STYRING *et al.* 2015), the residues identified in colander SMS4, are related to animal products and could be associated with dairy products. These data seem consistent with the hypothesis that colanders were used to drain cheese, as suggested in many Medieval recipes (DE FERRARI, 1996: 113-115; REDON, 1994). Animal products were also found in the SMS2 sample. However, the holes of this vessel are wider and would not be appropriate for the production of cheese.

It is more difficult to understand the origin of the vegetal fats identified in this colander (SMS4), but it is possible that colanders had multiple uses and that the by-products of these uses accumulated over time producing the different residues identified (DE FERRARI, 1996).

The high amount of *Pinaceae* products in SMS3 could be related to a thick coating, or, more likely, could suggest its use for filtering resin or pitch. The written documents of the hospital speak about the use of substances such as *"ragia di pino"* (pine resin) and *"pece nera"* (black pitch) (SORDINI, 2004: 36) used as ingredients for the therapies of the wealthier, and these probably come from *Pinaceae* products. Among the medicines bought by the hospital, there was also *"ragievo"* or *"ragiea"* probably a kind of resin (SORDINI 2004: 37). As stated above, pitch had long been used as a medicine, since Dioscorides to Mattioli (MATTIOLI 1549). Therefore, there could be a relationship amongst the residues identified and the use of these substances.

Finally, as for the *testi*, they have been traditionally interpreted as plates for the cooking of bread or *focacce* (GRASSI, 2011; PRUNO, 2003; QUIROS CASTILLO, 1998; VANNINI, PRUNO, 2015). The internal and external soot marks are consistent with this use. Here there are fewer residues than in the pans. These residues could indicate that at least some fat could have been used to prevent the contents from sticking to the ceramic, and to give flavor to the bread. Oil, lard or milk might have been added in these cases. In this regard, it is very interesting to note a document that records the purchase of eight trays to make *"migliacci"*, traditional Tuscan thin *focacce*, a sort of thin bread prepared with fat and pig blood. Unfortunately, no analyses aimed at identifying starch residues in the ceramics have been carried out. However, it is possible that the *testi* found in the hospital (with a rim diameter of about 30 cm) might have been suitable for preparing this traditional food (GRASSI 2004: 79).

## 6. CONCLUSION

This study provides a new insight onto the daily life at the Medieval hospital, combining different of sources: written records, archaeological and archaeometrical data.

Although future research should broaden the spectra of the techniques applied, we provided the first pilot study of a Medieval Hospital kitchen complex.

In the future, it will be interesting to complement this investigation, carrying out isotopic analysis of the residues preserved in the vessels. This will provide a deeper understanding of the species of the animal products identified, and confirm whether dairy products and cheese are present in the analysed vessels (EVERSHED 2008; REGERT 2011; STYRING *et al.* 2015). Furthermore, starch analyses could help in the identification of the traces of legumes and cereals, which cannot be identified by the residue analysis. In order to obtain a deeper insight on the products at disposal and on food habits, the data obtained from the residue analysis of ceramic vessels should also be integrated with those coming from archaeobotanical and archaeozoological studies, as well as paleonutritional studies of the human bodies recovered in the same archaeological context.

The research presented here allowed to make a step forward toward the understanding of the use of pottery and the type of food prepared at the hospital. The residue analysis performed has confirmed the use of pans to cook (roast, stew, or fry) meat and/or other animal products, using for this purpose not only animal origin condiments but also plant oils, possibly deriving from olive tree and other plants. It has also confirmed the introduction of animal and vegetal products in the *testi*, probably aimed at preventing the bread to stick to the surface. Moreover, it is only through the residue analysis that we know that, at least for the vessels analysed, neither wine nor vinegar were used in the cooking. This confirms what emerged from the analysis of vessels coming from other medieval Tuscan contexts, where wine or its derivatives was identified in pots and jugs, but never in pans, colanders or *testi* (PECCI 2009, 2015). On the contrary, one medieval pan from Cyprus shows residues of wine or its derivatives possibly related with a sauce or a condiment (PECCI *et al*. 2016).

It is worth noting that residue analysis highlights the sum of the residues absorbed by the vessels and cannot make a "stratigraphy" of the absorption. This is probably why we observe multiple residues in the colanders that could be related to a multiple use, such as draining cheese, possibly filtering leafy vegetables and preparing *Pinaceae* products that could be used in the hospital. These last products are common in medieval vessels and could also have been used to coat the vessels (PECCI, 2006).

The exceptional find of written documents at the hospital has given the opportunity of relating the residues identified in the ceramic vessels to the foodstuff described in the Hospital written records. This allowed for specific knowledge of some of the food that the archaeometric analysis identified in a more general way (i.e. the animal products). Moreover, these written sources have contributed with integrating data about most of the vegetal products consumed at the hospital that residue analysis could not provide by itself. This research, in conclusion, yielded a broader idea of the diet of the different people living within and around the Medieval

hospital and, in general, it should be considered a pilot project for similar studies in contexts in which we can compare multiple sources.

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