Milling wheat and barley with rotary querns: the *Ouarten* women (Dahmani, Kef, Tunisia)

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Women of the *Ouarten* Berber tribe (Kef, western Tunisia) still manually perform many of the domestic tasks related to the preparation of cereals for consumption: cleaning, roasting and milling with rotary querns. These tasks have been studied from an ethnoarchaeological perspective within the framework of the research project “*Ouarten*: ethnoarchéologie d’une tribe berbère en Tunisie (Kef)”. The manual cleaning and grinding of bread and durum wheat, the cleaning, roasting and milling of hulled barley, as well as the cooking of the different cereals, have been recorded. This study presents the different steps of each process, the present-day tools and technical skills, as well as the different products, by-products and residues resulting from each stage of the operation.

He goes away from here and posts himself
Besides his quern, ’and on a little shelf
Which fixed to it for other uses did
The wall support, he puts his faithful light.
Then from his garment both his arms he frees;
Begirt was he with skin of hairy goat
And with the tail thereof he thoroughly
Doth brush the stones and hopper of the mill.
His hands he then doth summon to the work
And shares it out to each, to serving was
The left directed and the right to th’ toil.
This turns about in tireless circles and
The surface round in rapid motion puts,
And from the rapid thrusting of the stones
The pounded grain is running down.
The left relieves its wearied fellow hand,
And interchanges with it turn about.
Thereafter country ditties doth he sing
Introduction: the Ouarten project

In this poem, attributed to Virgil, there is a description, among other culinary items, of the different steps of processing of wheat from grinding to cooking. Reading the ancient text, it is hard not to recall the actions, techniques and chants of the Ouarten woman while grinding and preparing, for example, mlawi (although it not is baked under a tile). Actually, the analysis of present-day traditional technology could help us to study ancient techniques (even from Prehistoric and Protohistoric times) because the tools could be the same or similar, and so would be the gestures and products, which are not easily documented by Archaeology.

The Ouarten project is based on an ethnoarchaeological survey of the traditional technology of members of the Ouarten Tribe in the Upper Tell region in northwestern Tunisia (Fig. 1). The study area is located in the Governorate of Kef, 215 km southwest of the capital city of Tunis, and less than 50 km from the Algerian border. The hamlets are under the administration of the town of Dahmani about 10 km away. The Upper Tell region, with an average altitude of 700 m.a.s.l., is characterised by a succession of mountain ranges, plateaux, alluvial plains and valleys. Cereal crops are predominant, although small permanent rivers in the valleys also allow cultivation of rich horticultural crops and shrubs.

Today the landscape is open due to deforestation, although here and there remain small groves of pine trees. The Ouarten people live either isolated or in hamlets, such as El Souidat, El Baten, and Gouasdya. Their homes comprise several rooms and pens that open to a central courtyard (Fig. 2). They do not benefit from running water and electricity was introduced only a few years ago.

The objective of the Ouarten project in general is to observe and analyse various technological processes that generate material remains that can be compared with those unearthed at archaeological sites. The main lines of research are the following: agricultural processes and the transformation of agricultural products, the use of wild plants, livestock and their uses, and the production of pottery.

The milling of cereals, the main focus of this article, is one of the aspects that we have centred on in order to grasp the transformation process that takes place between the moment cereals are stored until their preparation for consumption. It is possible that this traditional activity that has survived intact for centuries will soon disappear. The process we observed is comparable to that reported in publications by French authors of the early 20th century such as A. Bernard (1933) and E.-G. Gobert (2003 [1940]).

The main purpose of this study is to understand the traditional techniques of milling with rotary querns, specifically the different steps and their resulting products and by-products. In addition, we consider

1 Inde abit adsistitque molae; parvâque tabella,/Quam fixam paries illos servabat in usus, /Lumina fida locat; geminos tum veste lacertos /Liberat, et cinctus villosae tegmine capræ,/Praeverrit cauda silices gemiumque molarem./Advocat inde manus operi, partitus utrimque:/Laeva ministerio, dextra est intenta labori./Haec rotat assiduis gyris et concitat orbem./Tunsa Ceres rapido silicum decurrit ab ictu./Iuterdum fessae succedit laeva sorori,/Alternatque vices. Modo rustica carmina cantat,/And solaces his toil with rustic speech,
As soon as toil of turning has fulfilled
Its normal end, he with his hand transfers
The copious meal from there into a sieve,
And shakes it. On the grid the refuse stays,
The real corn refined doth sink and by
The holes is filtered. Then immediately
He piles it on a board that’s smooth, and pours
Upon it tepid water, now he brought
Together flour and fluid intermixed,
With hardened hand he turns it o’er and o’er
And having worked the liquid in, the heap
He in the meantime strews with salt, and now
His kneaded work he lifts, and flattens it
With palms of hand to rounded cake, and it
With squares at equal distance pressed doth mark.
From there he takes it to the hearth
....
And covers it with tiles and heaps the fire.

Virgil Moretum 19–30 and 39–511


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the application of the results to archaeobotanical studies. It is not our purpose to present here an extensive ethnographical description of all the aspects concerning society, women and female work. In fact, a part of the traditional context in Ouarten villages is lost already because of diverse causes, such as the mechanical milling of bread wheat flour in the town of Dahmani, children attending school or the emigration of young people to the cities.

We will first present the agricultural operations related to cereals that are fundamental to the economy of these families. We will then analyse the domestic processing techniques, as well as the tools and milling instruments used for each type of cereal. We discuss the resulting products, some of the techniques of preparation for their consumption, and their connection with former products known through both recent and ancient written sources. To conclude, we will compare the ethnoarchaeological results with those from archaeology and archaeobotany.

Cereals: farming practices and domestic processing

The diet of the Ouarten is based chiefly on cereals prepared in a variety of ways and accompanied most often by vegetables and legumes; meat and eggs are sometimes also added. Although there are contrasts
between families depending on their economic means, an average family owns several head of sheep and goats, poultry, rabbits and sometimes a cow. Donkeys are indispensable for transport and traction.

Their main activity is farming and raising livestock. Although the Ouarten are basically self-sufficient, a part of the younger generation now studies or works either in the nearby town of Dahmani or beyond. The principal cereals consumed are common or bread wheat [farîne / امرك], durum wheat [karîm / ميرك] and six-row hulled barley [rihâni / يناحير]. Most families till their land with a swing plough drawn by a donkey (Fig. 3a). Their fields are sown manually and harvested by sickle by both men and women (Fig. 3b). Although the harvesting work is mostly manual, combine harvester machines are at times rented.

When the harvest is completed, the sheaves are left to dry in the field before being loaded onto donkeys and taken to the threshing floors near the houses (Fig. 3c). The threshing process begins by treading the sheaves with donkeys until the grain is almost completely free of the stalks, chaff, and weeds (Fig. 3d–e). Today, the grain is collected in synthetic sacks (sacks were formerly made from dyed wool woven by the women) and stacked on benches inside the houses (Fig. 3f). Traditionally, however, until the country’s independence from France in the late 1950s, grain was stored in underground silos near the houses (Fig. 3f). Today, these silos are either unused or, in the case of those closest to the houses, filled with refuse. A few silos, abandoned about 30 years ago, were excavated for this research project and their remains recovered for analysis.

The by-products of the harvest, whether that be straw or the more minute remains of chaff and other parts of the spike resulting from winnowing, are collected in stacks around the threshing floors (Fig. 3h). The cereals used by these people are of the free-threshing type; that is, the grains separate easily from the spikelet. This is the case whether it be naked cereals (bread wheat, *Triticum aestivum*, and durum wheat, *Triticum durum*) or hulled grains that retain

![Fig. 3. Photographs of the agricultural process: a) ploughing, b) harvesting with sickle, c) carrying the sheaves, d) threshing by animal trampling, e) winnowing, f) silo, g) grain storage in a sack, h) straw and by-products stored in a stack.]
the bracts (palea and lemma), as in the case of hulled barley (Hordeum vulgare) (Fig. 4a). This factor sets these cereals apart from those with glumes (such as emmer), which are tougher to thresh and are stored in the spikelet. Domestic processing, including grinding, varies depending on the type of cereal (see, for example, Hillman 1981).

In this regard, it is necessary to define the boundary between agricultural and domestic processing. We adhere to the position that the concept of domestic work covers activities related to maintenance that is performed on a daily basis to ensure the physical and social reproduction of people (González Marcén et al. 2005:1–2).

For example, in the case of cereals, if the culinary preparation of these foodstuffs is deemed as housework, the agricultural tasks closest to it are those of processing and storage. Processing comprises several operations that can be undertaken on a “large scale” in a short period of time – in what may be considered the agricultural system – or on a “small scale”, on a daily basis – in what can be considered a domestic operation.

As we have noted, this difference in the scale and timing of the processing operations is directly related to a fundamental variable that depends on whether the cereal is hulled or naked (that is, whether the glumes are retained or not after threshing).

In the case of naked grains, such as bread wheat or durum wheat, these operations are intended to thresh the seed from the glumes, awns and other chaff, as well as weeds. This is chiefly performed after the harvest, until the grain is virtually clean and can be stored. These operations are for the most part threshing, winnowing and coarse sieving, and are considered to be part of the agricultural tasks. For consumption, they only require a fine sieving and a manual culling of any remaining weeds, a culinary process that falls completely within the domestic sphere.

In the case of hulled cereals such as emmer, einkorn or hulled barley (among others), the grain, although threshed, must be stored hulled (i.e. each grain still attached to the glumes such as emmer and einkorn, or to the bracts, as with hulled barley). This is due to the fact that these grains, without their hulls, are not as resistant as naked cereals, which have a multi-layered epidermis (Küster 1985:60, Jones et al. 1986:100, Meurers-Balke & Lüning 1992:346). This leads to greater cleaning operations after storage, and therefore a more complex domestic processing system comprising roasting, dehusking and multiple sieving.

Therefore, we establish the boundary between what is agricultural work and what is domestic work at the stage of large-scale grain storage. It is at this step that the agricultural process ends. Once cereals are inside the domestic space and ready for consumption, they become a raw material that will undergo a series of manipulations for its preparation. The agricultural-domestic boundary varies depending on the type of crop, type of cereal and storage system, and milling that takes place in the domestic sphere. If the milling is undertaken elsewhere on a larger scale, then the boundary between agricultural and domestic work is once again altered. The economic value of these tasks, which are performed exclusively by women, is very high (Ferchiou 1985, Alonso in press).
The milling tools: rotary querns and sieves

The rotary querns [rahā / رَحِّ]² used by Ouarten women are small (Fig. 5), with a diameter between 31 and 38 cm and their total height does not exceed 15 cm. Their grinding surfaces are flat and the top of the upper stone, or runner, is flat to convex. The spindle of the lower, or bed, stone is of wood and lodged in a small hole that pierces the stone. The eye of the upper stone measures from 5 to 10 cm, depending on the state of wear, which in some cases can be very marked (Fig. 6c). In only one case did we observe rynd [gotba / مِبطق]³ cuttings (Fig. 5a), although the rynd itself was no longer used. In the absence of a rynd, a bone is occasionally wedged between the spindle and the

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² The Tunisian vocabulary presented here is based on both our research and that of E.-G. Gobert (2003 [1940]).

³ Rynd, wooden or iron piece that permits the interlock of the grindstones in a rotary quern.
quern to secure and stabilise the motion of the upper stone (Fig. 6a).

The upper stone has a lateral hole with an L-shaped section stretching from the top to the side (Fig. 5a). This hole, designed to take the handle, due to excessive wear of the stone, at times attains the lower grinding surface (Fig. 5c). A cord or piece of cloth [al-tarcha / مشرطة] is threaded through the hole and bound into a loop (Fig. 6a). A vertical handle [ez-zrar / رازر] is then secured in the loop with a twist (Fig. 6b) and sometimes adjusted with a bone [al-kâba / شكلان].

In general, these mills have been used extensively, as seen by the wear on the eye of the upper stone (Fig. 6c) and the concentric striations or grooves on the grinding surfaces (Fig. 6d). The active surfaces are not dressed. In fact, most of these hand mills are old, bequeathed from mother to daughter, and their origin almost forgotten.

The querns were not produced in the area. They were probably imported from the region of Gafsa in central Tunisia. For a long time, most rotary querns throughout the country were produced in Gafsa, in particular at the quarries of El Guettar, about 250 km from our study area (Gobert 2003:41 [1940]). The quarry, located at a periclinal Eocene outcrop in the western extremity of the Mountains of El-Aiacha (Burseaux 1910:365), exploited a hard, vesicular lumacaqua with excellent milling properties (as some of the Ouarten querns). However, by the early 20th century the sites were for the most part depleted.

Gobert (2003:54, note 2 [1940]) observes that the El Guettar quarry produced querns of different weights depending on whether they were to be driven by one, two, or three women. Upper stones for one woman weighed about 25 kg, for two women between 35 and 45 kg, and for three could exceed 50 kg. The rotary querns of the Ouarten women in our study are all of first type.

Today, domestic milling is limited for the most part to durum wheat and hulled barley, while bread wheat, instead of milling it themselves, is sold in the form of grain and then purchased as flour, as we have said before. In fact, milling is a task that is being lost and in few years will surely disappear like so many others traditional activities (i.e. hand-made pottery).

During grinding, the rotary quern is placed on a sheepskin [rogâ / رغزنا] with its fleece facing down
(Fig. 6e). According to Gobert (2003:42 [1940]), so as to the secure the mill on the skin, it was set in a shallow pit (see also the photograph by M. Gast in Amouretti 1986:145, Fig. 23). We did not directly witness this specific practice since the grinding we observed was performed inside on cement floors. The sheepskin serves as a “flour catcher” to collect the product. In some cases, during specific steps of the process, especially when sieving, a cloth or an open sack replaced the fleece.

Women operate the mill sitting with one leg bent and the other outstretched (Fig. 6b). They grip the vertical handle with one hand while collecting and feeding the grain into the eye of the upper stone with the other. To rest their arms, they switch hands – without halting the rotating motion. Once the work is finished, the quern stones are propped vertically against a wall or a sack in the cereal storage area (Fig. 5a and Fig. 13a left, respectively).

Rotary querns, however, are not the only tools used in the milling process. Sieves of different types are an equally important tool (Fig. 7). They are first used to sift the various cereal parts – as we saw in section 2, the cereals are only semi-clean – and secondly to separate the different products of grinding. They are also essential in the preparation of foodstuffs made up of granules, such as mhammssa [محمص] (a type of “noodle soup”) or couscous.

Sieves [ghorbel / لابرغ] serve different functions depending on the size of their mesh. The mesh size is thus the criteria for their classification. According to Gobert (2003:43–44 [1940]), mhammssa is prepared with ghorbâl saqqât [طاقس لابرغ] and ghorbâl gemah [حمق لابرغ], whereas ghorbâl al-kouskousi [نابرغ] and ghorbâl harâymi [يهمهارح لابرغ] are used for couscous. Ghorbâl bsissa (1.5 mm. mesh size) is used to sieve other coarse products while ghorbâl daqiq and taqîda are used for finer sieving (1 mm mesh size). Traditionally these sieves are assembled with a mesh of tendons or gut. Although the traditional type is still seen, most sieves today have metal wire mesh.

Milling: process and products

The milling process is aimed at obtaining results that can be adapted to both cooking and long-term preservation. It requires a series of steps that vary depending on the type of cereal, whether it is hulled or naked, how clean it is when stored, and the final desired product or products. Although some of these operations are common to all cereal species, other operations are related specifically to particular species. As we have indicated, the cereals in our study area are of the free-threshing type.

The milling process also depends on the skill of the woman who carries it out, as well as other factors, such as the quantity of cereal to be ground, the types of sieves or the amount of time available. For example, if grinding has to be done quickly, the amount of grain engaged will be higher. In this case, however, the yield will be coarser since the grains will be simply broken into small fragments but not properly ground. If fine flour is desired, grinding must be carried out at a slower pace, feeding in a small amount of grain at a time, so that the stones can produce a better bite. So there are two grades of grinding: a finer grind rahia sammâdi [يهدامص هوير] and a coarser grind rahia laouâhi [هويريلاوة] (Gobert 2003:262 [1940]).
In the following section, we describe the different operations performed by the Ouarten women for bread wheat, durum wheat and hulled barley. Each cereal type yields a product \([P]\) that will be further processed until the desired final product (or products) is attained \([P]\). This process, in turn, generates by-products \([bP]\) that have different uses, as well as various types of residue \([R]\). Diagrams and pictures of the processes are shown in Figures 8–11, and a description of the components of each product, by-product and residue per step can be found in Tables 1 and 2.

**Milling bread wheat**

Bread wheat is a tender cereal with a whitish and mealy interior, which easily yields a high quality white flour (in powder form). The naked grain comprises the endosperm, the germ and a series of external coats that make up the bran (Fig. 4b). The following operations for grinding this type of grain are illustrated diagrammatically in Fig. 8 and 9. As we have already stated, threshing does not leave the grains completely free of weeds, husks, awns and other parts of the stem. So one of the first steps is to remove these undesired particles \([1]\) (Fig. 8.1) in the sieve by sifting and centrifugation. This step, which takes place in the backyard or outside the house, will depend largely on the state of cleanliness of the grains.

A sieve with a 3 mm mesh is used in this operation, which combines both vertical and circular (rotation) movements. The rotation has a centrifugal effect that concentrates the lighter particles toward the centre of the sieve (Fig. 8.1). These elements are then removed with both hands (shaped into the form of a cup) and placed either in a sack or in another type of container \([1bP]\). The centrifugal movement also forces the smaller weed particles to exit the sieve and fall either onto the ground or into a sack \([1bP]\). These two by-products are then fed to the chickens. The bread wheat grains remain inside the sieve \([1P]\) and are regularly poured into a vessel.

The next step is washing the bread wheat grains with water and rubbing them with the hands in order to detach the bran \([2]\). This step, undertaken either at home or at a fountain, is followed by drying on a cloth or a tapestry in the sun \([3]\) (Fig. 8.2–8.3). These dried grains are the product that will subsequently be ground.

However, prior to grinding in a rotary quern, the cereal is sieved again with a 3 mm mesh using a slight motion \([4]\) (Fig. 8.4), so as to expel any remaining weed particles that will be swept away and discarded \([4R]\). The completely clean grain remains in the sieve \([4P]\). This step could be also be performed through hand cleaning.

The grinding process begins with the hand mill placed on a sheepskin. The upper stone is turned with one hand while the grain is fed in with the other. This operation continues until the desired amount of product is ground \([5P]\) (Fig. 8.5). Once completed, the mill is set upright and each quern stone is struck lightly to remove any remaining flour. Then the quern stones are rolled away to the side. The flour that has collected on the sheepskin is then gathered and put in a container.

This is followed by sifting with a 1 mm mesh \([ghorbâl dqîq / قهربال دقيق\) using the method of tapping and the centrifugal movement, as described above (Fig. 9, bread | Table 1. Bread and durum wheat: processes and products, by-products and residue components for each step (P: product, bP: by-product, P: final product, R: residue).
However, instead of a vertical movement raising the sieve, it undergoes a series of jolts and, after lifting it slightly, undergoes sharp drops combined with a rotating motion.

The lighter particles that remain in the centre of the sieve are parts of bran (wheat pericarp) [bread wheat 6P] [nokhala / نوكلله]. When this bran is gathered by hand, some granules of wheat are also collected. This by-product, mixed with barley (either whole or in the form of granules), is fed to cows and sheep, in particular to those that have just given birth.

Two final products are generated from bread wheat. The finer of these, a flour [dqîq / دقيق], is sifted through the mesh of the sieve [bread wheat 6P] and intended for sourdough bread. The remaining particles inside the sieve are a coarse semolina [bread wheat 6P] [dshîsh / شيش] used for making tender wheat couscous [kouskousî farîne / كوزكوسي فان].

Milling durum wheat
Durum wheat products, because of their properties, differ from those of tender wheat. As the name
suggests, it is a hard grain that is less floury. In fact, when ground, for the most part, it is sheared into yellow granules.

The operations performed for grinding durum wheat are the same as for bread wheat (Fig. 8). However, there are more siftings at the final stage (Fig. 9, durum wheat 6 and 7). The first [durum wheat 6] generates two final products, fine semolina [smid / دیمس] that filters through the mesh and falls on the sheepskin [durum wheat 6P2] and coarse semolina [zdir or gloub smid / دیمر / روپک / رزز] that remains in the sieve [durum wheat 6P1], and a product, lighter elements that remain concentrated in the centre of the sieve [durum wheat 6P3].

These last particles are removed with both hands, in the same manner that we have noted before, and sifted again in a different sieve of 1.5 mm mesh [ghoral dchîch / شيشد لابرغ] using the prior movements [durum wheat 7]. This sieving yields two final products, the particles that pass through the mesh [dshisha / دیشیش / durum wheat 7P1], the larger elements that remain in the sieve [karfaa / كفرک] [durum wheat 7P2].
and, finally, the lighter bran [durum wheat 7 bP] that is fed to animals.

Most of these durum wheat products, as we will see below, are used for pastas (like couscous) and unleavened bread.

**Milling hulled barley**

Hulled barley, with its bracts still attached to the grain, is a more complex cereal to process (Fig. 10–11 and Table 2). In fact, the bracts at times constitute 10–14 % of the weight of the grain. After washing [1] and drying [2], a new procedure, roasting [3], is necessary to eliminate the remaining awns so as to facilitate the process of removing the hulls (Fig. 10.1–10.3). Roasting, which sterilises the grains and is thus beneficial to the preservation process, takes place after harvesting and especially during Ramadan. Since the bracts of this grain are difficult to remove, it is first roasted, then ground and the bract fragments subsequently removed.

Roasting is carried out in a domestic cylindrical-shaped oven [tabouna / تبون] made of clay, straw and dung, and which is fuelled exclusively by dung (Fig. 10.3). At this phase, some of the grain is burned or charred (Fig. 13b), an event that is favourable for subsequent archaeobotanical analysis (to be discussed in the last section).

The elimination of the charred grains is necessary before the barley is ground in the mill [4] (Fig. 10.4). These grains are culled by hand, one at a time, and thrown to the ground from a tray or sieve [4R]. In the case of the use of a sieve, culling takes place at the same time as the smaller fragments of awns or charred awns are sieved [4R]. This operation can be performed in the patio of the house (Fig. 13c), or in a room where the floor is swept and the debris can be thrown away so that the barley grain remains pure [4P].

G. Hillman (1981:136, Fig. 7) notes a special step for dehusking hulled barley by pounding in large wooden or stone mortars or with a loosely-set rotary quern or other types of querns. S. Ferchiou (1979:194) explains that, in the south of Tunisia, after roasting the grain, the women pounded it in a mortar to remove the bracts before sieving. F. Aubaile-Sallenave (2010:348) also describes a barley dehusking by roasting and rubbing. These techniques, however, have not been observed in our study area.

At this stage, the hulled barley is ready for milling [5] (Fig. 10.5). The product of milling (grain fragments and bract fragments) [5P] is sifted with a 3 mm sieve [6], applying both tapping and rotation movements, in the same manner as in the operations described above for bread wheat (Fig. 10.6). Two products [6P] result from this process, in addition to the by-product of large bract fragments that is scooped up with cupped hands [6bP]. With this step, a first dehusking is carried out. This by-product is then placed in a container and the two other products are combined.

The products resulting from the previous step [6P + 6bP] are milled together (Fig. 11.7), generating a new product [7P] that is again sieved [8], using the same motions, with a 1.5 mm mesh (Fig. 11.8). This sifting yields a finer

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<td><strong>Hulled barley</strong></td>
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<tr>
<td>1. Washing</td>
<td>1P</td>
<td>wet hulled grain</td>
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<tr>
<td>2. Drying</td>
<td>2P</td>
<td>dry hulled grain</td>
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<tr>
<td>3. Roasting</td>
<td>3P</td>
<td>roasted hulled grain + some charred grain + awns</td>
</tr>
<tr>
<td>4. Manual sort of burnt grain</td>
<td>4P</td>
<td>hulled grain</td>
</tr>
<tr>
<td></td>
<td>4R1</td>
<td>charred grains</td>
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<tr>
<td></td>
<td>4R2</td>
<td>awns and charred awns</td>
</tr>
<tr>
<td>5. Grinding</td>
<td>5P</td>
<td>naked and hulled grain fragments + bract fragments</td>
</tr>
<tr>
<td>6. Sieving/centrifuged (3 mm)</td>
<td>6P1</td>
<td>whole grains + heavy broken fragments (hulled or not)</td>
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<tr>
<td></td>
<td>6P2</td>
<td>small bract fragments + small grain fragments</td>
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<td></td>
<td>6bP*</td>
<td>large bract fragments</td>
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<tr>
<td>7. Grinding</td>
<td>7P</td>
<td>small grain fragments + bract fragments</td>
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<tr>
<td>8. Sieving/centrifuged (1.5 mm)</td>
<td>8P1</td>
<td>fine grain fragments + some small bract fragments</td>
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<td></td>
<td>8P2</td>
<td>coarse grain fragments (with some bract fragments)</td>
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<td></td>
<td>8bP*</td>
<td>medium bract fragments</td>
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<td>9. Adding salt</td>
<td>9P</td>
<td>fine grain fragments + some small bract fragments</td>
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<tr>
<td>10. Sieving/centrifuged (1 mm)</td>
<td>10P1</td>
<td>fine grain fragments</td>
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<td></td>
<td>10P2</td>
<td>flour</td>
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<td></td>
<td>10bP*</td>
<td>fine bract fragments</td>
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</tbody>
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*these by-products are mixed at the end
product \[8P_1\] and inside the sieve remains the heavier fragmented particles of barley, a final product \[8P_2\] [melthouth / الثومخل], and a by-product that is a fraction lighter \[8bP\] and is mixed with the by-product 6bP.

Salt is then added to \(8P_1\) for preservation, [9] and, once again, the product is sifted by tapping and rotating the sieve with the finest mesh (1 mm) (Fig. 11.9–11.10). This yields two products. The first are fine grain fragments \[10P_1\] [dshisha / دشيشة] used in soups, couscous barley or barley for leavened bread. The second is a fine barley flour \[10P_2\] [dgîg / دحيق] that is consumed either fresh or boiled, for example with oil and sugar, or that can be fed to animals. The light by-product \[10bP\] is mixed with the first two by-products \[6bP+8bP+10bP\] [nokhala / نكالخ], and, after adding water, is fed to rabbits and dogs (Fig. 13d).

All these final products of milling have their use in different food preparations cooked and consumed by Ouarten people. Although our main objective in this paper is the description of the steps of the milling process continue with step 7 in the next figure.
process, we will present some of the cereal products known in Tunisia below.

The final products of milling and some traditional and ancient forms of cereal consumption

There are numerous foods made with cereals by Ouarten women: khobs, mlawi, braish, kouskousi, bsissa and rfiassa (Fig. 12). Ferchiou (1979) notes that in Tunisia there are 35 varieties of dishes based on wheat and 12 based on barley, 15 types of couscous, more than 20 types of stews, and more than 15 varieties of breads and flat cakes (unleavened breads). Nowadays, most of these traditional cereal products are still also consumed in big cities, where it is usual to find them in small or big stores, packaged or cooked. Nevertheless, in the cities, unlike in rural areas, the knowledge of the ways in which these products are prepared is lost, mainly how to mill the grain.

It is not our purpose to provide an exhaustive list of food products made in Tunisian cuisine. Nevertheless, we consider it interesting to mention a few of them, as well as, in some cases, to highlight their similarity with the dishes described by ancient sources. Ancient texts are potentially very informative, but they can present problems related to the translation of certain words or the attribution of certain food products to modern equivalents (Valamoti 2011:31). There is much literature on this subject and it should be a matter for another paper on this topic (see for
As we have seen, the types of milling products and resulting processes differ depending on the type of cereal. Next, we will recall the final products described above and some of the meals made with them according to the ethnographic records.

Bread wheat yields the finer, gluten-rich, flour. It is easier to grind than durum wheat, but contains more bran. The adjustment of the space (called the “light”) between the upper and lower quern stones and the regularity of the grinding surfaces are essential to obtain a good result. This process yields two milling products: *dqîq* [bread wheat final product 6P]. It is used for bread *khobs* / زبخ also called *kisra*, in Tunisia. It is made of leavened dough and baked in a *tabouna* oven (Gobert 2003:144–145 [1940]) (Fig. 12a). In ancient Greece, leavened bread seems to have been in the minority. For example, in the teachings about bread by Hippocrates and other authors, there are lists of bread recipes (Amouretti 1986:127), such as bread made with non-sifted flour (whole wheat bread); bread made with sifted flour; bread made with yeast; bread made with liquid yeast; unleavened bread; bread baked in an oven; bread stuck on the wall of a vessel or an oven (in Latin: *panis clibanicius*); bread cooked under ashes; bread made with semolina; bread made with groats; bread made from wheat fermented for three months; and finally bread made with watered bran.
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*Fig. 13. a) rotary querns not in use: left, stored propped vertically against a sack in a storage area; right, lower stone reused in a patio for closing a rabbit den, b) roasting barley in a tabouna oven and detail of charred residues in the oven during a later use, c) hand cleaning of barley in a courtyard before milling and detail of a carbonised caryopsis of barley on the floor, d) nohhala for animals.*

dshîsh / شيشد are coarse grain fragments [bread wheat final product 6P2]. It can be kneaded and eaten fresh with oil or with a sauce, and is also used for making tender wheat couscous [kouskousî farîne / هنيرف يسكسك].

Durum wheat is excellent for groats and semolina. Four final products of milling have been observed:

smîd / ديمس is fine semolina [durum wheat final product 6P1]. It is used for the preparation of unleavened breads and fritters (Fig. 12b, c or e), it represents a staple food in the country (Aubaile-Sallenave 2010:350).

zdîr / ردز or gloub smîd / دييمس سيولق is coarse semolina [durum wheat final product 6P2]. After wetting the flour meal, it is covered with fine flour, steamed and it is used for couscous [kouskousî] (Fig. 12f) (Bernard 1933:118, Ferchiou 1979:193, Gobert 2003 [1940]). Semolina borghól / لغرب is also made with this product (although we have not been able to document this process directly). That is, ripe grains, which are boiled, spread out to dry and salted. After one week, they are pounded in a wooden mortar to separate the bran and then sifted and dried to use them in porridge and stews (Ferchiou 1979:193, Amouretti 1986:120). It is the equivalent of the Turkish or Greek bulgur (Hillman 1985:13, Rivera & Obón 1989:249, Valamoti 2011:26). Originally, it was made with emmer wheat, but it can now be made with any type of cereal, even barley (Köksel et al. 1999).
is fine grain fragments [durum wheat final product 7]. Groats used primarily for soups.

karfaa / كرفا is coarse grain fragments [durum wheat final product 7], which are sometimes mixed with flour and used for heavier bread (Amouretti 1986:120).

These four products could correspond with those described by F. Ertug-Yaras (1997:423) obtained with a rotary quern in central Anatolia. Also from fine to coarse: flour; bulgur, suitable for cooking like rice; dügücük, finely ground wheat for soups and meta-balls; and aslik, coarser-grained.

Concerning barley, a cereal with numerous nutritional advantages, it is nowadays very marginal in the modern European diet, but it is important in Maghreb and also in Greece, both in ancient and in recent times (Ferchiou 1979, Amouretti 1986:135, Hallstead-Jones 1989, Aubaile-Sallenave 2010, Valamoti 2011:23–24). We have described three final products:

mélthouth / مثولث is coarse grain fragments [barley final product 8]. It is used for soups or it is steamed and served with meat or fish. It is common in Maghreb (Aubaile-Sallenave 2010:348). Ferchiou (1979:194) noted that it could also be pounded in a mortar.

dshisha / دشيشة is fine grain fragments [barley final product 10]. It is used in soups and stews, similar to durum wheat, and also for couscous barley or for leavened bread.

bsîssa / برسيس is flour [barley final product 10]. It can be consumed as a paste with oil (Gobert 2003:123 [1940]) or used to make bread, biscuits and, especially, porridge. In summer, délayée is eaten in water with sugar (Fig. 12d) or consumed as an aromatised drink (Aubaile-Sallenave 2010:351). Maça, the real food of the Hellenes, according to M.-Cl. Amouretti (1986:135), was prepared with αλφιτα, which in classical times meant “barley flour”, as opposed to “wheat flour”.

Large number of other cereal products are consumed in Tunisia but they are beyond the scope of this paper because they do not have a direct relation to our final products of milling: e.g. unripe grains, roasted grains, frik, a variety of refreshing drinks, etc. (Ferchiou 1979, Amouretti 1986, Gobert 2003 [1940], Aubaile-Sallenave 2010).

As we have seen, some of the foods made from the milled products are actually preserved goods that account for part of the family food provisions. Among the foodstuff reserves comes the creation, diffusion and adoption of mhammes (a type of pasta) and couscous, a plate that has become the “national” dish of the Maghreb and the staple diet of many North African families. According to Gobert (2003:206–207 [1940]), these products where probably not known in Antiquity.

Flour and semolinas are usually stored in large jars, with a capacity of 100 to 200 litres, which were aligned next to each other against the wall in the domestic barns (Ferchiou 1979:192). Unlike the process involving storing grains in silos, women assume the leading role in preserving the products.

Archaeological and archaeobotanical implications

In the poem attributed to Virgil at the beginning of this paper, we read a description of the different steps in the processing of wheat from grinding to cooking, which is very similar to that which we have described above based on a present-day ethnographical example. The observation of these traditional techniques conserved in modern rural communities around the Mediterranean, mainly in the South and the East, can show us, keeping in mind the essential aspects, the “archaeological materials” in motion, by depicting the gestures and skills of the people who operated them and the products obtained.

Regarding the milling tools, the use of rotary querns for milling cereals is well known in the Western Mediterranean since at least 5th century BC (Alonso 2002, Alonso et al. in press). In the Iron Age and Antiquity, these querns could have been used in the same way as we have just described above, but could also have been placed on a support and operated by one or two people pushing a lever and walking around the quern (for details Alonso et al. in press). According to our ethnographical observations, the querns found in situ in an archaeological site could be e.g. in the place where they were used (mainly the big ones), in a storage place or where they were reused as material for building (Fig. 13a).

In any case, the different types of products do not depend only on the number of grinding actions but mainly on the types of sieves used. We do not have archaeological data about sieves. Nevertheless, they sometimes appear in texts and iconography alongside millstones and mortars. In texts their form, materials and cost vary according to their use (Moritz 1958:159–163, André 1961:61). For example, in Diocletian’s Edict, sieves are priced according to their size and whether they are made of leather, skin or textile. In the Greek
world there are, in particular, specific terms to designate sieves made of textile fabrics (Amouretti 1986:147–148).

Diocletian’s Edict also designated several categories of sieving. A first sieving, *cribium pollinarium*, yields *flos*, the finest quality of common wheat and, respectively, *pollen* for durum wheat (this term is also generally applied to all cereals). A second sieving yields a medium-fine flour called *siligo* for common wheat, and *similago* for durum wheat. A third sieving, that separates the bran and the coarse meal, with large fragments, is called *cribarium secundarium* (André 1961:61–62).

Some aspects we observed during our fieldwork, aside from the questions about querns and their typology, are also of great interest from archaeological and archaeobotanical standpoints. For instance: how can archaeobotany identify the products, by-products and residues described above? Cereal remains are one of the most frequently encountered archaeobotanical finds. They are recovered, primarily, in a charred state and their state of preservation can be very diverse, according to several variables, such as the degree and intensity of the heating treatment, the type of sediment in which they were located or the postdepositional processes that they suffered. Both the caryopses (grains) and the chaff fragments (that is to say, other parts of the ear, e.g. rachis fragments, rachis nodes and internodes, spikelet forks, glume bases, etc.) can be recovered.

Grains can be found complete or fragmented. The reasons for their fragmentation can have originated after charring, due to post-depositional processes (trampling, sedimentary pressure, soil acidity, etc., or the process of excavation and recovery of the remains) or prior charring (threshing and dehusking processes, Alonso et al. 2013a, but also milling as we have seen in this paper). The identification criteria for distinguishing both types of fragments have already been established by other authors (see, for instance, Valamoti 2002, Antolin & Buxó 2011), based on which it is possible to carry out an archaeobotanical evaluation of the fragmentation of the grain produced prior to charring. Therefore, it is possible that some small fragments of charred cereal grains that are very common in archaeobotanical samples correspond to crushed grains, groats or thick semolina. This is a very stimulating subject of future experimental research with the goal of furthering our knowledge of the process of ancient milling.

Likewise, of particular interest is the determination of the processes in the domestic sphere based on several types of evidence. For example, roasting barley is one of the actions most likely to generate charred grains, a residue that persists over time and that can be recovered during archaeological excavations. These blackened grains appear both in and around ovens (Fig. 13b) and are clear evidence of the widespread use of the roasting technique. Concentrations of charred grains, near the ovens, suggest that roasting was not performed on a daily basis, but maybe concentrated over short periods of time. In contrast, other procedures, such as the total or partial hand-cleaning of charred barley grains (Fig. 10.4 R) after roasting, which end up dispersed in small numbers on the floor of a patio or in a room, also generate future archaeological evidence (Fig. 13c). This cleaning is a daily chore and does not generate large amounts of waste. The discarded charred grains are sometimes accompanied by parts of seeds, weeds and chaff (e.g. 4R in Fig. 8.4 or 4R in Fig. 10.4). Among the by-products resulting from this operation, products reserved for animal fodder are sometimes detected (Fig. 13d), which in some cases are stored and eventually retrieved among the archaeobotanical samples. Since they are very flammable, they are sometimes used to light fires.

Some interesting research has also been undertaken to identify the space reserved for milling based on microscopic rock debris left in archaeological layers (cf. Saffioti 1999).

**Conclusion**

The traditional ways of preparing cereals in Tunisia are perfectly consistent with those around the southern and eastern Mediterranean, and capitalise on the available cereal resources and generate a wide variety of products. Milling is the principal operation that generates different types of groats, semolinas and flours that go into the preparation of these products, either for direct consumption or for long-term preservation.

The survey of the work of women of the Ouarten Berber tribe has allowed us to analyse the grinding process of the principal cereals grown and consumed in this area of Tunisia. Various steps, products, by-products and residues have been analysed in detail. Concerning bread wheat, six steps are documented for cleaning, washing, drying, grinding and sieving the fragmented grains, giving two final products (flour and coarse grain fragments) and one by-product. The process for durum wheat involves two more sieving/centrifuged steps, and four different final products are produced (fine and coarse semolina, and fine and...
coarse grain fragments) as well as one by-product. Finally, the technique used for milling barley takes a longer time and ten steps are needed for producing three final products (flour and fine and coarse grain fragments) and three by-products mixed at the end of the process. We have also reviewed some of the food products cooked with the final products of milling analysed.

We consider this work as a prelude to a future approach to research on milling in Protohistory and Antiquity. This research is based not exclusively on archaeological mills, but on other evidence, such as archaeobotanical data recovered at archaeological sites.

In fact, this ethnoarchaeological project aims to understand the whole process of milling, not only from the perspective of the rotary quern, but also from the archaeological remnants of fragmented cereal before carbonisation, weeds and microwear analysis.

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