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ORIGINAL ARTICLE

# Changing foodways: watermelon (*Citrullus lanatus*) consumption in Roman and Islamic Quseir al-Qadim, Egypt

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**Abstract** The identification of size differences in watermelon seeds recovered at Roman and Islamic period Quseir al-Qadim, Egypt, initiated research into the signature of seed eating. Distinct breakage patterns were found on the testa of watermelon seeds eaten by seven volunteers. Comparison of these patterns with those of the archaeological material established that some of the watermelon seeds at Quseir al-Qadim were eaten during the Islamic, but not the Roman, period. This, plus a size difference in the seeds (larger in the Islamic period), has raised questions about which subspecies of *Citrullus lanatus* was/were present at this site, and exactly when human consumption of the sweet fruit flesh and the seeds was first established in Egypt. Ancient DNA research may be needed to resolve these questions.

**Keywords** Watermelon · *Citrullus lanatus* · Foodways · Seed eating · Quseir al-Qadim

## Introduction

Archaeobotany is concerned with the identification and analysis of plant species found in archaeological contexts. These botanical remains are used to reconstruct past human/plant relationships such as agricultural systems, including strategies for feeding animals, exploitation of wild resources, dietary breadth, and social differentiation in access to food. The accuracy of these reconstructions is highly dependent on our ability to correctly identify plant remains, and identification is thus an important focus of our work. However, as Sherratt (1991) has pointed out, people do not eat species, they eat food. So how do we move from our list of identified species to a reconstruction of food consumption? Here we aim to address this issue by looking at one particular food—watermelon, *Citrullus lanatus* (Thunb.) Matsum. et Nakai—and attempt to reconstruct the way in which this particular food was eaten. The term foodways used in the title is here used to refer to the complex, culturally specific practices relating to food, i.e. what is eaten, how it is eaten, acquired, prepared and who participates in the meal.

The case study is Quseir al-Qadim, a Roman and Islamic port located on the Red Sea coast of Egypt and used in the trade of foodstuffs (especially spices) from India and further afield (Van der Veen 2003; Van der Veen et al. in press). The rich assemblages of desiccated plant remains from this site are currently being studied at the University of Leicester, to reconstruct aspects of the Roman and Islamic spice trade, the diet and foodways of the people living and working in the port, and the fodder supplied to the working animals used in the transport of the foods to the Nile valley. The Roman deposits at this site date to the 1st–3rd centuries A.D., the Islamic deposits to the 11th–15th centuries A.D. The watermelon seeds were recovered from a series of large midden (refuse) deposits.

Today the seeds of watermelon and other genera of the Cucurbitaceae are eaten as a snack food (Fig. 1); they are a rich source of fat and protein. This practice is common in many regions, including Egypt and the other North African countries, as well as the eastern Mediterranean. This raises the question of whether the watermelon seeds from Quseir represent the consumption of the fruit flesh, the seeds or both.

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**Fig. 1** Consumption of watermelon seeds. **a** Splitting the seed coat in order to consume the cotyledons; **b** and **c** seed consumption in modern day Cairo (photos by Dr. Ahmed Fahmy)

## Materials and methods

### Watermelon seeds from Quseir: seed size

During sorting of the samples it became clear that there were substantial variations in the size of the *Citrullus* seeds. While some seeds belong to *Citrullus colocynthis* (L.) Schrad., a wild species with small seeds, the majority belong to the cultivated watermelon, *Citrullus lanatus*, and a size difference was noted within the latter group (Fig.2). However, the number of measurable seeds of Roman date was small (many seeds were damaged and could not be measured), so to increase the Roman dataset we also measured the watermelon seeds from two further Roman sites. These were Mons Claudianus and Mons Porphyrites, both quarry settlements located nearby in the Eastern Desert and of similar date (Van der Veen 2001; Van der Veen and Tabinor 2007).

### Ethnographic analysis: seed eating

To determine whether the eating of the seed results in a distinct signature in the remains of the testa, two workmen at Quseir were asked to eat a few handfuls of seeds and the leftovers were identified in terms of the breakage pattern. When it was clear that significant similarities existed between the two samples, a further five samples were obtained with the help of A. Fahmy, Helwan University, Cairo. All seven modern samples were analysed using a classification that described the breakage patterns visible in the remains of the testa.

### Breakage patterns in the archaeological watermelon seeds

In order to determine whether or not the archaeological seed remains were the result of seed eating, they were analysed using the same breakage categories.

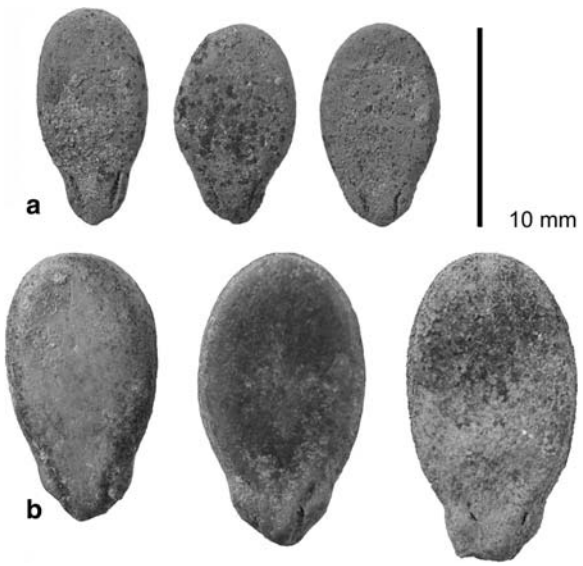


**Fig. 2** Size differences in the seeds of watermelon from Quseir al-Qadim. **a** Seeds of Roman date; **b** seeds of Islamic date

## Results

Measurements of seed length and width showed that the size difference was directly correlated to the two separate periods of occupation at Quseir al-Qadim (Fig. 3), with the Roman seeds measuring ca. 9.5–11.5 mm long by 5.5–7 mm wide and the Islamic ones ca. 12–16 mm long by 7–9 mm wide. This is confirmed by the measurements from the two further Roman sites Mons Claudianus and Mons Porphyrites (Fig. 4). Watermelon seeds from all three Roman sites are significantly smaller than those from the Islamic layers at Quseir, suggesting that a change in variety or subspecies had occurred between the Roman and Islamic periods.

The data from the seed eating experiments are remarkably similar (Fig. 5). Virtually all the seeds were broken open in order to remove the cotyledons, in line with the fact that the volunteers were asked to eat the seeds. The percentage of "entire" (that is uneaten) seeds lies between 0 and 7%. Furthermore, ca. 50% of the testa halves displayed some form of damage, the remaining testa being undamaged. The damage fell into a series of reasonably well-defined categories (Table 1; Fig. 6). The most characteristic form of damage was a v-shaped or l-shaped notch broken off the tip (Fig. 7b) or top of the seed coat (Fig. 7d). Other characteristic damage patterns were cracks in the tip (Fig. 7a) or top of the seed coat, cracks in one or both sides (Fig. 7e) and, in extreme cases, the complete vertical (Fig. 7c) or horizontal (Fig. 7f) splitting of the testa. The category "other" in Table 1 refers to the damage to more than one part of the seed thus making classification impossible. The results were consistent over the seven samples, suggesting that this type of damage can be used as a signature of watermelon seed eating.

In contrast to the modern samples, more than 80% of Roman and ca. 50% of Islamic "seeds" were left entire, i.e.

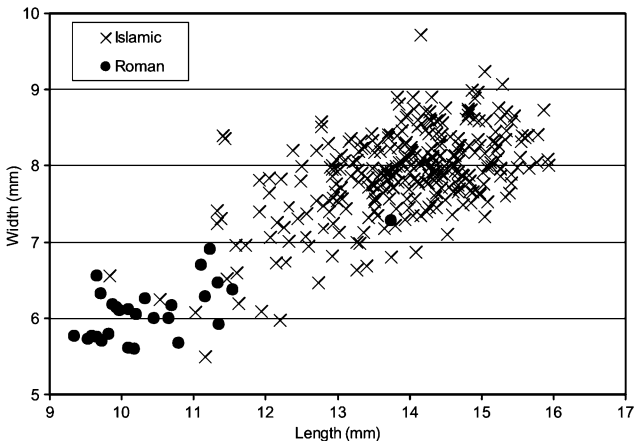


**Fig. 3** Measurements of Roman and Islamic period watermelon seeds from Quseir al-Qadim

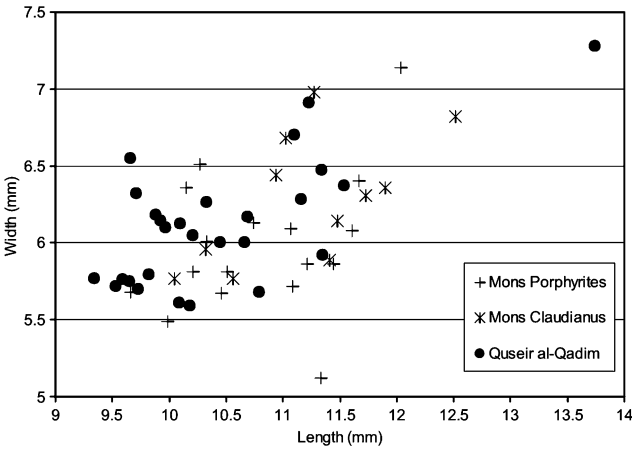


**Fig. 4** Measurements of the Roman period watermelon seeds from Quseir al-Qadim, Mons Claudianus and Mons Porphyrites

the cotyledons were not removed and thus not eaten (Fig. 8). In the case of the Roman samples the pattern is the same for Quseir al-Qadim, Mons Claudianus and Mons Porphyrites. Additionally, in the Islamic material the percentage of damaged seed coats is high—the majority of the split testa were damaged compared to only 50% in the modern samples. Moreover, some of the archaeological seeds show evidence of animal damage, rather than of breakage patterns related to seed eating. Animal damage took two broad forms: damage by rodents and insects (gnawing marks, small holes, etc.; Fig. 9a), and damage possibly caused by passage through an animal's digestive tract (Fig. 9b). The latter seeds are often thinner and more fragile in appearance than the others, with part of the seed missing but not showing actual breaks. In the case of the Roman samples the majority of the seeds show signs of animal damage, rather than the breakage patterns associated with human consumption of seeds. In contrast, animal

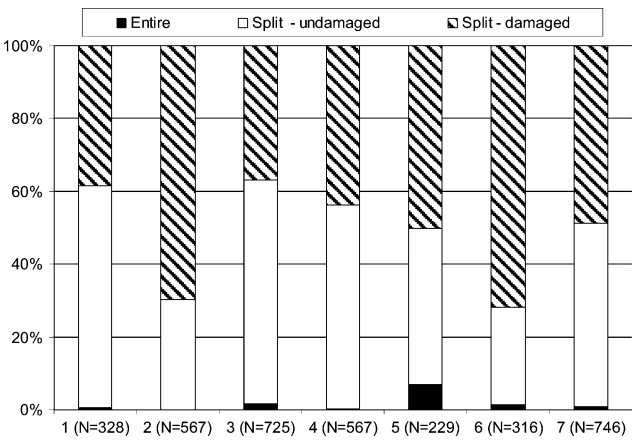


**Fig. 5** Relative proportions of entire, split/undamaged and split/damaged seeds in the modern samples of watermelon after consumption of the seeds

**Table 1** Breakage patterns in the testa of modern watermelon seeds that have been consumed (Quseir 2003 and Cairo 2006, see also Fig. 7)

| Sample number | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| Sample origin | Quseir | Quseir | Cairo | Cairo | Cairo | Cairo | Cairo |
| Age volunteer | ca. 35 | ca. 45 | 43 | 35 | 44 | 52 | Mix of 3 indiv. |
| Sex volunteer | Male | Male | Female | Male | Male | Male | Mix of 3 indiv. |
| Entire halves | | | | | | | |
| Halves—entire + fused | 4 | 0 | 24 | 2 | 32 | 8 | 10 |
| Halves—entire + split | 399 | 344 | 890 | 636 | 196 | 170 | 754 |
| Damage to tip | | | | | | | |
| Halves—tip damaged | 52 | 58 | 61 | 104 | 30 | 13 | 93 |
| Halves—tip cracked | 52 | 110 | 60 | 73 | 59 | 24 | 126 |
| Damage to top | | | | | | | |
| Halves—top damaged | 17 | 50 | 67 | 27 | 24 | 17 | 32 |
| Halves—top cracked | 65 | 269 | 191 | 236 | 30 | 306 | 360 |
| Damage to sides | | | | | | | |
| Halves—sides damaged | 17 | 20 | 12 | 5 | 28 | 14 | 21 |
| Halves—sides cracked | 27 | 135 | 95 | 25 | 45 | 60 | 58 |
| Halves—horizontally split | 9 | 19 | 17 | 11 | 7 | 8 | 13 |
| Damage to tip and top | | | | | | | |
| Halves—crack in tip and top | 10 | 78 | 0 | 9 | 0 | 3 | 11 |
| Halves—vertically split | 4 | 32 | 11 | 2 | 7 | 8 | 5 |
| Other | 0 | 19 | 21 | 4 | 0 | 0 | 8 |
| Total (halves) | 656 | 1,134 | 1,449 | 1,134 | 458 | 631 | 1,491 |
| Total (complete seeds) | 328 | 567 | 725 | 567 | 229 | 316 | 746 |

damage was minimal in the Islamic samples (Fig 10). As a result, it was not possible to obtain breakage details from the Roman samples, the seeds being either entire or damaged by animals; only the Islamic data could be classified in the same way as the modern data (Table 2). It became obvious very quickly that the characteristic v- and l-shaped notches were present in the Islamic material (Fig. 11a and c), as were the splits in the tips (Fig. 11b) and tops of the seeds, the vertical (Fig. 11b) and horizontal splits (Fig. 11e), and the cracks in the sides (Fig. 11d). A comparison of the Islamic and modern data (Fig. 12) shows that there are significant similarities in the breakage patterns, though there is proportionally more damage to the sides in the archaeological material and more damage to the top in the modern data.

Thus, the analyses have provided a clear pattern, summarised in Table 3. The Roman seeds are smaller than the Islamic ones, are mostly entire (i.e. seed coat not split in two and cotyledon thus not eaten) and ca. 80% show some evidence of animal damage. We can thus safely conclude that there is no evidence that the human occupants of Roman Quseir al-Qadim, Mons Claudianus or Mons Porphyrites ate the seeds of watermelon. In contrast, the seeds from Islamic Quseir are larger and only half of them are still entire. Of the other half, less than 10% show evidence of animal damage. The breakage pattern on the remaining seeds is very similar to that identified from the modern

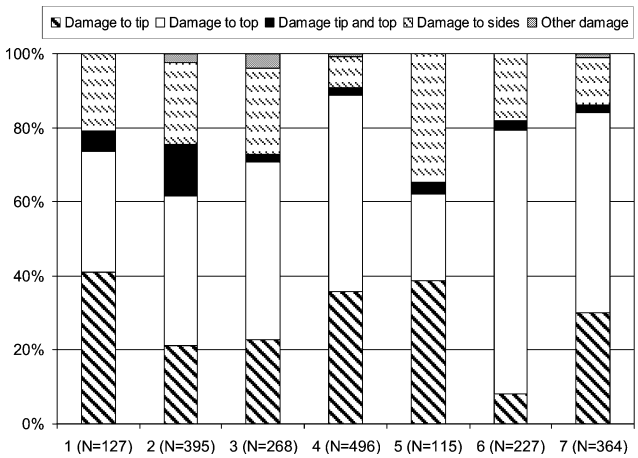


**Fig. 6** Relative proportions of the breakage patterns of the testa of watermelon seeds in the modern samples after consumption of the seeds

samples, though with proportionally more damage to the sides. The larger proportion of entire seeds can be explained by the fact that the archaeological (Islamic) remains originate from a range of different deposition events in midden areas, whereas the modern samples originate from one specific and isolated consumption event. The different breakage patterns may also be explained by the origin of the samples; the archaeological material will

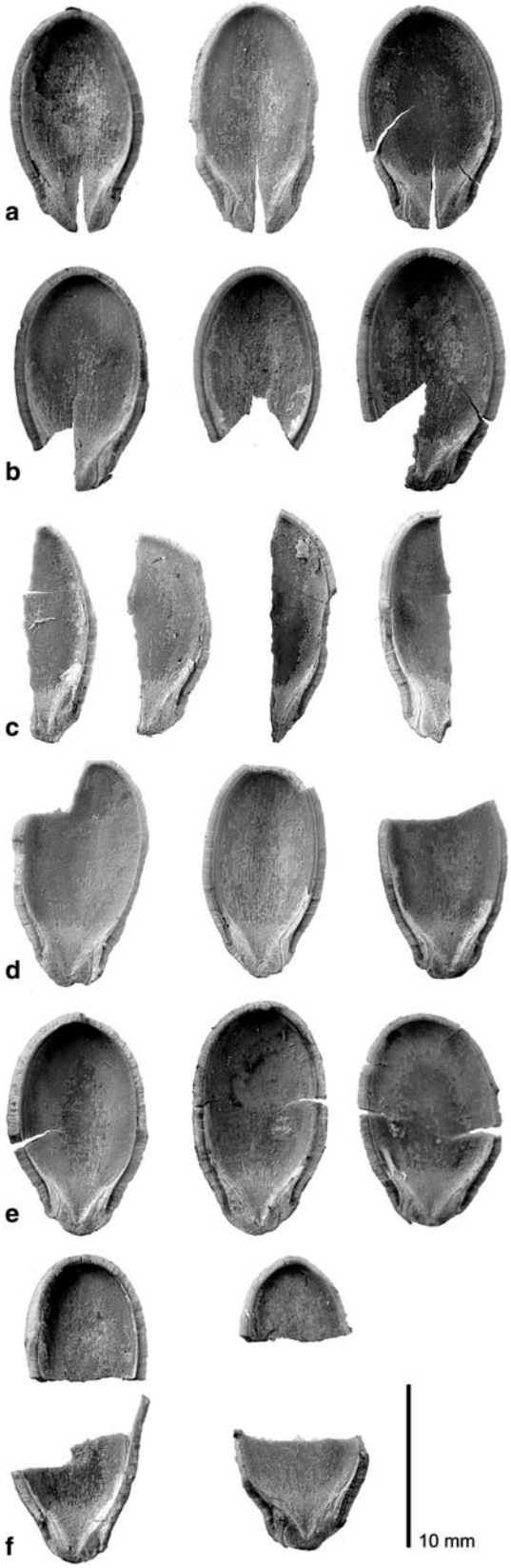


**Fig. 7** Testa of modern watermelon seeds after consumption of the seeds, showing characteristic breakage patterns: **a** damage to tip: tip cracked; **b** damage to tip: v- and l-shaped notches; **c** damage to tip and top: vertical split; **d** damage to top: fragment broken off and l-shaped notch; **e** damage to sides: sides cracked; **f** damage to sides: horizontal split

have been subject to trampling and redeposition, increasing the chances of breakage. The presence of small cracks will have made the testa more prone to breaking when subjected to mechanical pressure. Consequently, while there are differences in the breakage patterns between the archaeological (Islamic) and modern samples, the similarities are very strong and this suggests that at Islamic Quseir the seeds of watermelon were sometimes eaten.

What remains to be determined is whether the fruit flesh was eaten in either period. It is often assumed that the presence of the seeds in archaeological deposits signifies the consumption of the fruit (e.g. Van der Veen 2001; Van der Veen and Tabinor 2007), but these results from Quseir al-Qadim suggest that the situation may be more complex. Skin fragments of *Citrullus* cf. *lanatus* were recovered from the Islamic period deposits at Quseir, but were very rare in the Roman deposits and at the two other Roman sites. The presence of skin fragments indicates that entire fruits were brought to the site and thus suggests, although it does not prove, that the fruits as well as the seeds were eaten at Islamic Quseir. This raises the question of how watermelon was used at the three Roman sites. We have already established that the seeds were not eaten. The absence of skin fragments cannot, of course, be taken as evidence that only the seeds were brought to these sites. After all, animals wandering around the sites and feeding on domestic refuse may have consumed all the skin fragments. There is sufficient evidence of animal dung across these sites to suggest that animals (especially donkeys) had free range in some parts of the settlements. Two possible explanations of the pattern found at the Roman sites are apparent. Firstly, watermelon fruits were brought to the settlements, the occupants ate the fruit flesh and, subsequently, animals such as donkeys consumed the leftover skin fragments and some of the seeds. Secondly, the seeds (and possibly the entire fruits) were brought to the settlements specifically as fodder for the working animals. A detailed contextual analysis of all food and fodder remains is planned, in the hope that this may provide further insights.

## Discussion

The earliest reliable finds of watermelon seeds in Egypt and elsewhere come from the tomb of Tutankhamun (ca.

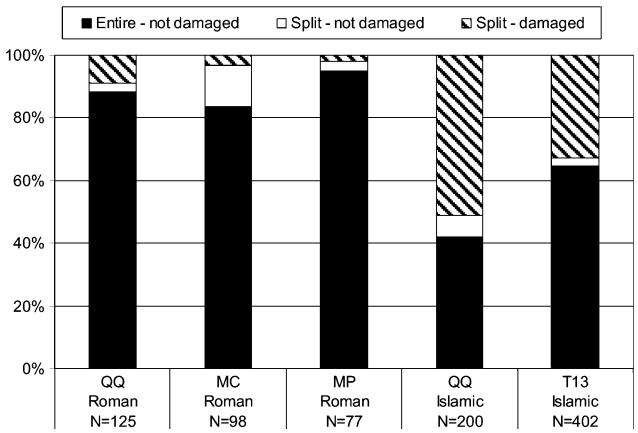


**Fig. 8** Relative proportions of entire, split/undamaged and split/damaged seeds of watermelon in the Roman and Islamic samples; *QQ* Quseir al-Qadim, *MC* Mons Claudianus, *MP* Mons Porphyrites. The Islamic samples from Quseir have been divided into two groups, those from trench 13 (very rich midden deposit) and those from the remaining trenches

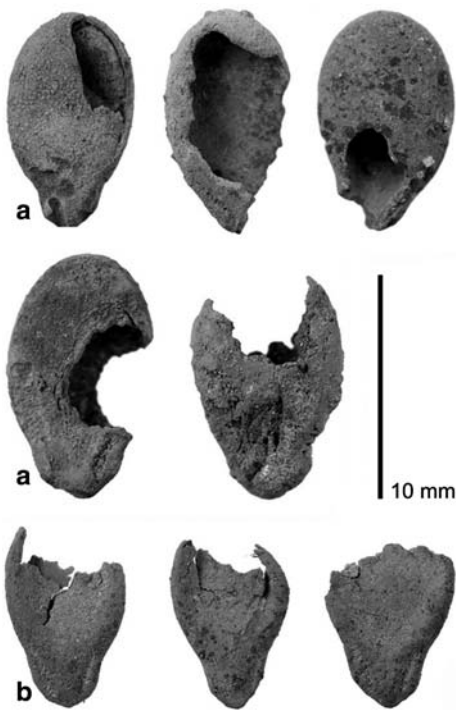


**Fig. 9** Archaeological seeds of watermelon showing damage by **a** insects or rodents and **b** passage through digestive tract

1330 B.C., Hepper 1990) and a temple in Sudan (ca. 1500 B.C., Van Zeist 1983), suggesting that watermelon was available in Egypt and northern Sudan from the mid-second millennium B.C. It then spread into other parts of North Africa and the Mediterranean, although finds are still few. The classical authors rarely mention the fruit and it appears to have been relatively uncommon in Italy; for example, only one mention of the fruit occurs in the recipes of Apicius (Andrews 1956). The seeds are commonly found at Roman period sites in Egypt (Murray 2000; Van der Veen 2001; Cappers 2006; Van der Veen and Tabinor 2007) and Libya (Van der Veen et al. 1996). Several authors have suggested that in ancient Egypt watermelon was grown primarily for its seeds (e.g. Murray 2000, referring to Täckholm 1961 and Germer 1985), although no explanation or evidence is provided. Watson (1983) claims, wrongly, that no seeds of watermelon have been found in Egypt pre-dating the Islamic period, and that wall-paintings in tombs depicting *Citrullus* probably represent the wild species, *Citrullus colocynthis*. He also suggests that an improved variety of watermelon, larger and with sweet flesh, was developed in India and brought back to North Africa sometime during the late first millennium A.D., by a mechanism not known. The fruit is commonly mentioned in the Islamic literature only from the 12th or 13th century onwards, although it was already discussed in some detail in 11th and 12th century Hispano-Arabic farming manuals (Watson 1983, pp. 58–61). Bates and Robinson (1995) mention that in European texts historical accounts of the fruit prior to the 16th century are sparse.

There has been much debate about which species of *Citrullus* forms the ancestor of the modern cultivar, with Zohary (1983) favouring *C. colocynthis*, a wild species found across North Africa, while Zeven and Zhukovsky (1975) and Jeffrey (2001) favour *C. lanatus* ssp. *lanatus*, a species today only found in the Kalahari desert. The find of 5,000-year-old *C. lanatus* seeds in Libya, far from the current distribution of the wild *C. lanatus* has raised the possibility that the wild distribution was much more extensive in the past and that its domestication could have occurred somewhere in northern Africa. This would tie in with the earliest evidence for agriculture in Africa and with the early records of watermelon in Egypt (Wasylikowa and Van der Veen 2004). More recently, however, DNA research has identified *C. ecirrhosus* Cogn., endemic to the desert regions of Namibia, as the probable progenitor of the cultivated watermelon (Dane and Liu 2007).

Today, three varieties of *C. lanatus* are distinguished:

*C. lanatus* ssp. *vulgaris* (Schrad. ex Eckl. et Zeyh.) Fursa; the common cultivated fruit we know today, whose sweet flesh and seeds are consumed. The fruits are also sometimes used as fodder.

*C. lanatus*, ssp. *mucosospermus* Fursa, found primarily in West Africa with wild and cultivated forms; the seeds are used as a source of edible oil.

*C. lanatus* ssp. *lanatus*, with two varieties:

– var. *caffer* (Schrad.) Mansf. ex Fursa, regarded the ancestor of the modern cultivar by Zeven and Zhukovsky (1975), and Jeffrey (2001).

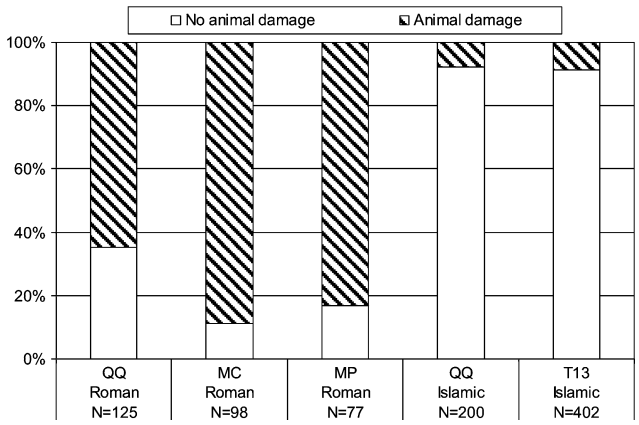


**Fig. 10** Degree of animal damage of archaeological seeds of watermelon; *QQ* Quseir al-Qadim, *MC* Mons Claudianus, *MP* Mons Porphyrites. The Islamic samples from Quseir have been divided into two groups, those from trench 13 (very rich midden deposit) and those from the remaining trenches

– var. *citroides* (Bailey) Mansf. ex Greb., the variety today used both as a preserving melon and as a fodder melon (Laghetti and Hammer 2007).

Today people in Egypt eat both watermelon flesh and seeds, but two varieties of the fruit are utilised. Complete fruits are sold in markets and shops, and the flesh of these fruits is consumed. In many households the seeds (mostly black and shiny) of these fruits are removed from the fruit flesh and these are then dried and roasted with some salt, before being consumed. Additionally, watermelon seeds ("libb") are sold in markets and special shops (roasters), but these seeds come from a variety of watermelon rich in seeds rather than fruit flesh (A. Fahmy, personal communication). These seeds tend to be brown or dark orange in colour and the flesh of these fruits is not consumed. This crop is grown in Upper Egypt, but today is mostly imported from Sudan. It is sometimes referred to as C. *lanatus* var. *colocynthoides* Schweinfurth (Hassib 1938: A. Fahmy, personal communication). How this variety relates to the those mentioned above is not known, though it is assumed to belong to *C. lanatus* ssp. *vulgaris*. The archaeological seeds—both the Roman and Islamic ones—were brown or dark orange in colour; no black shiny seeds were present.

Three key questions arise. First, are seed characteristics (size, colour and texture) specific to different subspecies and/or varieties? Second, do the watermelon seeds from Roman and Islamic Quseir belong to separate subspecies and, if so, which ones? And third, when did the modern cultivar, *C. lanatus* ssp. *vulgaris*, first become cultivated and consumed in Egypt; that is, can any credence be placed in Watson's (1983) suggestion that the modern fruit is a mediaeval improvement? Suffice it to say that researching these three questions falls outside the scope of this paper,

**Table 2** Breakage patterns in the testa of archaeological watermelon seeds (see also Fig. 11)

| Sample origin<br>Phase | QQ<br>Roman | MC<br>Roman | MP<br>Roman | QQ<br>Islamic | QQ T13<br>Islamic |
|---|---|---|---|---|---|
| Entire halves | | | | | |
| Halves—entire + fused | 66 | 16 | 22 | 152 | 458 |
| Halves—entire + split | 0 | 0 | 1 | 12 | 12 |
| Damage to tip | | | | | |
| Halves—tip damaged | 6 | 1 | 0 | 27 | 25 |
| Halves—tip cracked | 1 | 0 | 0 | 25 | 35 |
| Damage to top | | | | | |
| Halves—top damaged | 0 | 0 | 0 | 17 | 13 |
| Halves—top cracked | 0 | 0 | 0 | 5 | 6 |
| Damage to sides | | | | | |
| Halves—sides damaged | 3 | 1 | 0 | 8 | 15 |
| Halves—sides cracked | 6 | 0 | 0 | 38 | 38 |
| Halves—horizontally split | 2 | 1 | 0 | 41 | 46 |
| Damage to tip and top | | | | | |
| Halves—crack in tip and top | 0 | 0 | 0 | 6 | 4 |
| Halves—vertically split | 3 | 0 | 1 | 14 | 35 |
| Other | 1 | 3 | 2 | 23 | 48 |
| Animal damage | | | | | |
| Halves—intact + fused with animal damage | 154 | 148 | 124 | 16 | 62 |
| Halves—entire + split with animal damage | 7 | 26 | 4 | 15 | 7 |
| Total (halves) | 249 | 196 | 154 | 399 | 804 |
| Total (complete seeds) | 125 | 98 | 77 | 200 | 402 |

The Islamic samples from Quseir have been divided into two groups, those from trench 13 (very rich midden deposit) and those from the remaining trenches

*QQ* Quseir al-Qadim, *MC* Mons Claudianus, *MP* Mons Porphyrites


**Fig. 11** Testa of archaeological specimens of watermelon seeds showing breakage patterns characteristic of seed consumption: **a** damage to tip: l- or v-shaped notches in tip of seeds; **b** damage to tip: cracks in tip of seeds; and damage to tip and top: vertical split; **c** damage to top: fragment broken off and v-shaped notch; **d** damage to sides; **e** damage to sides: horizontal split

but that future DNA analyses, possibly including ancient DNA, may help resolve the complex cultivation history of this food plant.

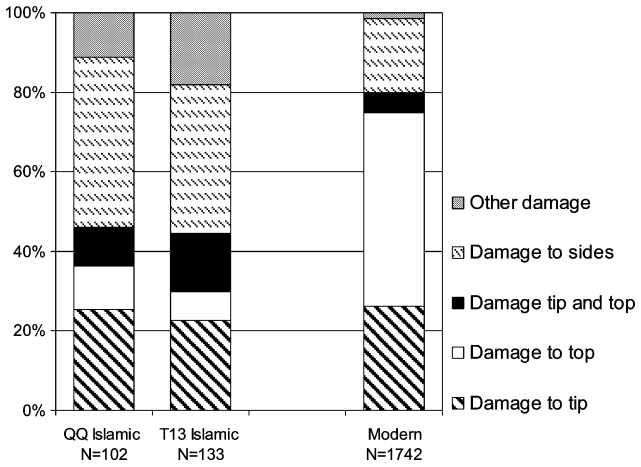


**Fig. 12** Relative proportions of each breakage patterns in the Islamic period seeds from Quseir (trench 13 and remaining trenches displayed separately) and the average of the seven modern samples of watermelon

**Table 3** Summary results

| | Roman period 1st–3rd cent. A.D. | Islamic period 11th–15th cent. A.D. |
|---|---|---|
| Seeds | Small | Large |
| | Mostly entire | Ca. 50% are split |
| Animal damage | Very many | Few |
| Seed consumption | No evidence | Yes (ca. 50%) |

## Conclusions

Detailed observation of the breakage patterns of the testa (seed coat) of *Citrullus lanatus* seeds from Roman and Islamic Quseir allows us to suggest that there is currently no evidence that seeds of this food plant were eaten at this site in Roman times, but that they were eaten at the site during the Islamic period. The metric data raise the possibility that the archaeological remains originate from different varieties or subspecies. The eating of the seeds of the Cucurbitaceae and other species is very much a cultural trait and is today commonly found in North African and eastern Mediterranean countries, including many Islamic countries, but is rare in North-West Europe. Exactly when the consumption of these seeds started in Egypt is yet to be determined, but the next step in our research will be the analysis of the watermelon seeds from Late Antique Berenike, Egypt (by kind permission of R. Cappers, Groningen University, The Netherlands). Whether the entire, uneaten, watermelon seeds found in Roman and Islamic layers signify the consumption of the fruit flesh or the use of the fruits as animal fodder requires further contextual research. While we hope to have demonstrated that archaeobotanical analyses can be used to study

changes in foodways, it is clear that our research has raised many additional questions. Future DNA analysis may help resolve some of these and thus help illuminate cultural and agronomic transformations in the use of watermelon.

**Acknowledgments** We are very grateful to Ahmed Fahmy for his help in collecting and supplying the five samples from Cairo, the photographs of volunteers eating the seeds and for information regarding current practice. We would also like to thank the volunteers for facilitating this research, and Jacob Morales for taking the seed photographs. The research on the archaeobotanical remains from Quseir is funded by a grant from the Natural Environment Research Council (NER/A/S/2003/00336) to the second author.

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