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Reports

Studies

Obituaries

Biographies

Miscellanies

Front cover. General view of Site WNP-J-22\1, Al-Jabalain, White Nile State. Photo by Hamad Mohammed Hamdeen.

Newly identified macrobotanical remains from Old Dongola (14th-18th centuries AD), Northern Sudan: a breakthrough in archaeobotanical research

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Introduction

The archaeological site of Old Dongola (Old Nubian *Tungul*, Arabic *Dunqula* - دنقلا) is located in Sudan's Northern State province (N 18.1323°, E 30.4438°) (Figure 1). It is situated on the east riverbank at the southern outskirts of the Letti Basin, formed by a Nile paleochannel, offering vast agricultural potential. The location of Old Dongola at the end of the Wadi Hawar, an important Sub-Saharan communication route, facilitated its growth (Obłuski *et al.* 2022). According to Godlewski (2013), the city was founded in the 5th to early 6th centuries AD by one of the first kings of Makuria.

Old Dongola became the capital of Makuria (AD 500-1300). As the city developed, it reached approximately 200 ha in its heyday between the 10th and 12th centuries (Obłuski *et al.* 2022, 260). At the end of the 13th century, the regional political situation deteriorated after the Mamluk takeover of Egypt (Obłuski *et al.* 2022). After the Mamluk invasion in 1276, Makuria was subdued by Egypt and became a vassal state. The Makurian kings relinquished parts of the territory to the sultan, paid an annual tribute, and later imposed a *jizya* tax on Christians (Obłuski forthcoming). Historical sources refer to the Kings of Makuria as governors; while the name Makuria disappears from Arabic sources, and the Kingdom of Dongola is used instead. The Makurian elite tried to fight off Mamluk control for almost the entire next century (Obłuski forthcoming). Mamluk interest in Makuria gradually declined, and around the mid-14th century, the situation became more complex with the migration of various tribes into the Middle Nile Valley (Obłuski forthcoming). During the Funj Period (AD 1504-1821), the kingdom of Dongola was an essential part of the Funj Sultanate, often involved in power struggles. The kingdom's end is linked to the Shaiqiya invasions in the 18th century, and during the 1780s, the last king of Dongola moved out of the city and ceased to use the royal title (Obłuski forthcoming).

The archaeological work at Old Dongola began in 1964 by the Polish Centre of Mediterranean Archaeology of the University of Warsaw (Godlewski, 2013). In 2018, a new phase of archaeological investigations began, headed by Artur Obłuski and funded by the European Research Council, abbreviated as the ERC-UMMA Starting Grant project. UMMA is an abbreviation for the project *Urban Metamorphosis of the Community of a Medieval African Capital City*, funded by the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation programme (grant agreement no. 759926). One of the main objectives of the ERC-UMMA Starting Grant project is to investigate the impact of migration on the social structure of the inhabitants after the collapse of the Makurian kingdom (see Obłuski *et al.* 2022; Obłuski and Dzierzbicka 2021; 2022).

Background to archaeobotanical studies in Nubia

Historically, archaeological work in Sudanese Nubia focused on cemeteries and monumental buildings, such as temples, pyramids, and palaces, with a notable lack of systematic excavations of settlements and residential sites across the country. Thus, systematic investigations of ancient subsistence strategies are very rare, and patchy evidence is only available from a few key sites across Nubia, e.g., Qasr Ibrim (Clapham and Rowley-Conwy 2007; 2009; Rowley-Conwy 1989), Sai Island (Heinrich and Hansen 2020; Hildebrand 2007; Hildebrand and Schilling 2016; Out *et al.* 2016), Amara West (Ryan 2018; Ryan *et al.* 2012; Spencer *et al.* 2014), Kawa (Cartwright 2001; Fuller 2004; Welsby 2014), Kerma (Bonnet 1992; Honegger

Figure 1. Location of Old Dongola and the medieval Nubian Kingdoms, including major

2003), Nauri (Fuller and Edwards 2001), and Dangeil (Anderson and Ahmed 2006; Logan *et al.* 2007). In the past ten years, interest in this field has grown. Several archaeobotanical studies have emerged from different archaeological sites in Sudan, focusing on issues of plant subsistence and the agricultural economy (Clapham 2019; Fuller and Lucas 2020; Nasreldein *et al.* 2024). It is also worth mentioning that some of the new archaeobotanical investigations at Sudanese sites are still awaiting final publication, such as the work at Jebel Barkal, Old Dongola, Hamadab, Shaqadud, Jebel Moya, and probably other sites.

In light of previous research, it appears clear that Nubia's geographical location served as a 'corridor to Africa' (Adams 1977, 20) by connecting African content with the rest of the world, as well as controlling the trans-Saharan caravan trade routes. According to Fuller and Lucas (2020), Nubia has played a major role in the spread of agricultural technologies and winter crops of Middle Eastern origin to the southern parts of Africa, and vice versa by transferring African summer crops to Egypt, Asia, and Europe. To some extent, this hypothesis was recently supported by recent archaeobotanical investigations at Nubian sites (e.g., Clapham 2019; Clapham and Rowley-Conwy 2007; Fuller and Lucas 2020; Heinrich *et al.* 2024; Heinrich and Hansen 2020; Ryan *et al.* 2022).

Regarding Old Dongola, although archaeological research has been ongoing at the site since 1964, a complete understanding of the cultural aspects of subsistence practices and cash crop cultivation has yet to be achieved. To bridge this gap, we carried out extensive, large-scale archaeobotanical sampling at Old Dongola, to shed light on the complex agricultural systems and crop production in the area. This paper aims to highlight the importance of archaeobotanical research in revealing more life aspects of ancient societies, as well as to shed light on the recent macrobotanical discoveries from Old Dongola. On the one hand, some of the plants discussed in this paper are identified for the first time in Sudan, which highlights their history of utilising and probably their first introduction into the region. On the other hand, other plants discussed in this paper were only reported from one or two sites in Sudan. Making comparisons of this sort of data is important, and highlights the history of utilising these plants across Nubian sites in different historical periods.

Material and methods

Excavations were carried out from 2018 to 2023 at the citadel of Old Dongola. Sediment samples ranging between 1 and 20 litres were collected systematically from every excavated context for archaeobotanical analyses (Dzierzbicka 2018; Obłuski and Dzierzbicka 2022, 8), to ensure the representativeness of the seed assemblages for the different settlement periods.

During the winter of the 2022-2023 excavation season, sediment samples were floated using the bucket flotation method (Champion and Fuller 2018; Pearsall 2015). The buoyant material was poured off and collected in a metal mesh sieve (2mm, 1mm, 0.5mm, and 0.2mm mesh size). The procedure was repeated by adding more water and stirring three to four times for each sample to ensure that all plant remains were floated. Then, a mesh of 1mm size was used for the heavy fractions remaining in the bucket's bottom. All fractions were labeled and packed in fine nets (0.5mm), hung to dry, and then packed for transport.

In total, 134 samples (consisting of *c.*1434.8 litres of sediment) were processed by water flotation and dry sieving methods in the 2022-2023 field seasons. During the fourth season (winter 2022), 73 samples of different volumes of litres of sediment comprising *c.*508.8 litres of soil, were processed by water flotation. Furthermore, during the fifth season (winter 2023), 61 samples were processed by water flotation, comprising 886 litres of sediment. The majority of the samples were selected based on the priority list provided by the excavators focusing mainly on samples from the older layers of the 14th century.

Samples were processed at the archaeobotany laboratory of the Institute of Archaeological Sciences, University of Tübingen, Germany. Then, samples of volume between 1-3 litres were sorted fully, and 3-10

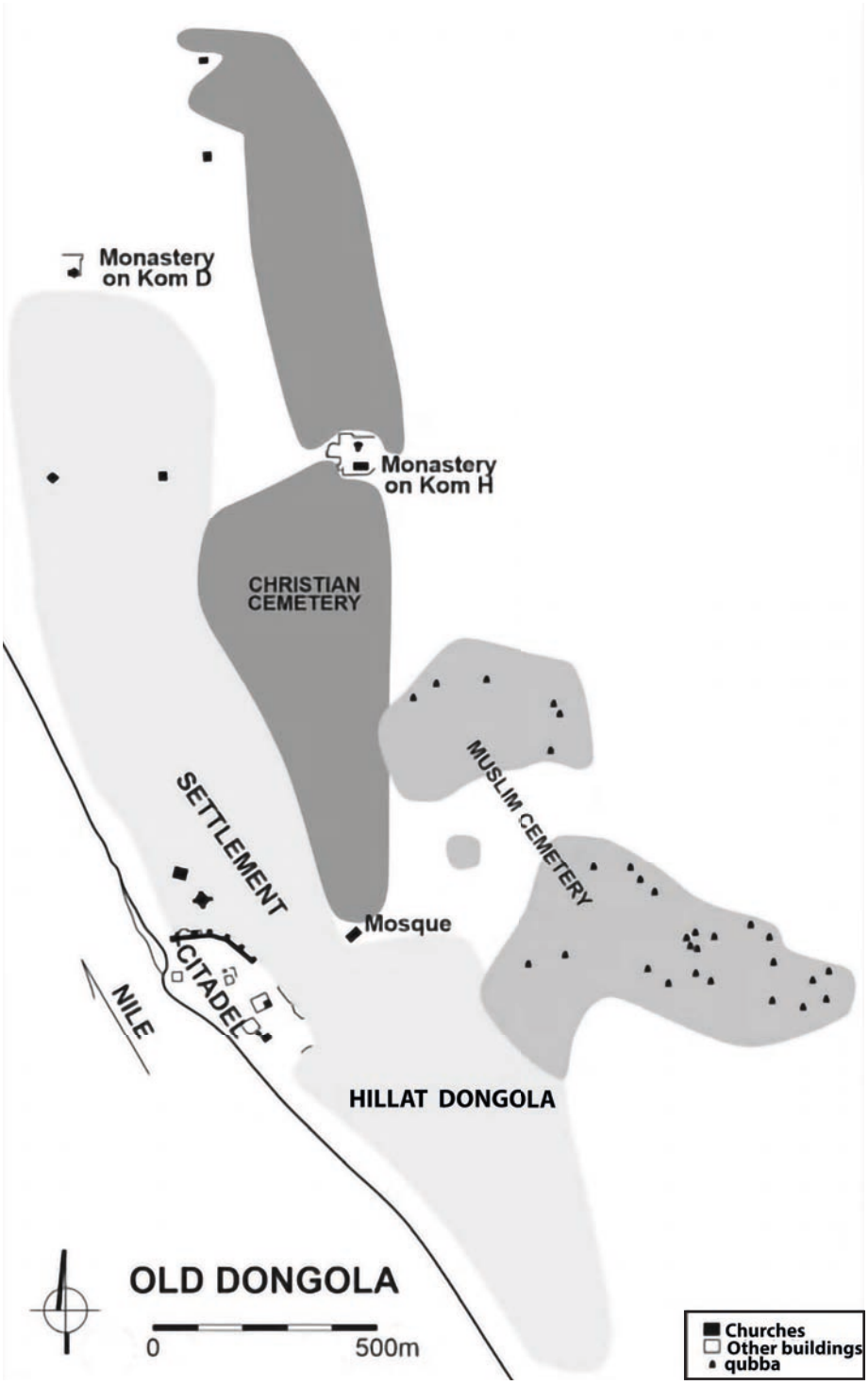

Figure 2. Archaeological map of Old Dongola (drawn by Agata Deptuła).

litres half of each was sorted, while for samples above 10 litres, only a quarter of each was sorted. The rest was subsampled using the rifle-type sample splitter. Before sorting, each sample was sieved through four nested geological screens with (2mm, 1mm, 0.5mm, and 0.2mm mesh sizes), and then each fraction was sorted separately.

Seed identification is based on an anatomical and morphological comparison of modern, fresh seeds from the reference collection specimens in the archaeobotany laboratory at the Institute of Archaeological Sciences, University of Tübingen, Germany. In collaboration with the employees of the Botanical Garden at the University of Tübingen, collections from their herbarium were accessed to aid identification of

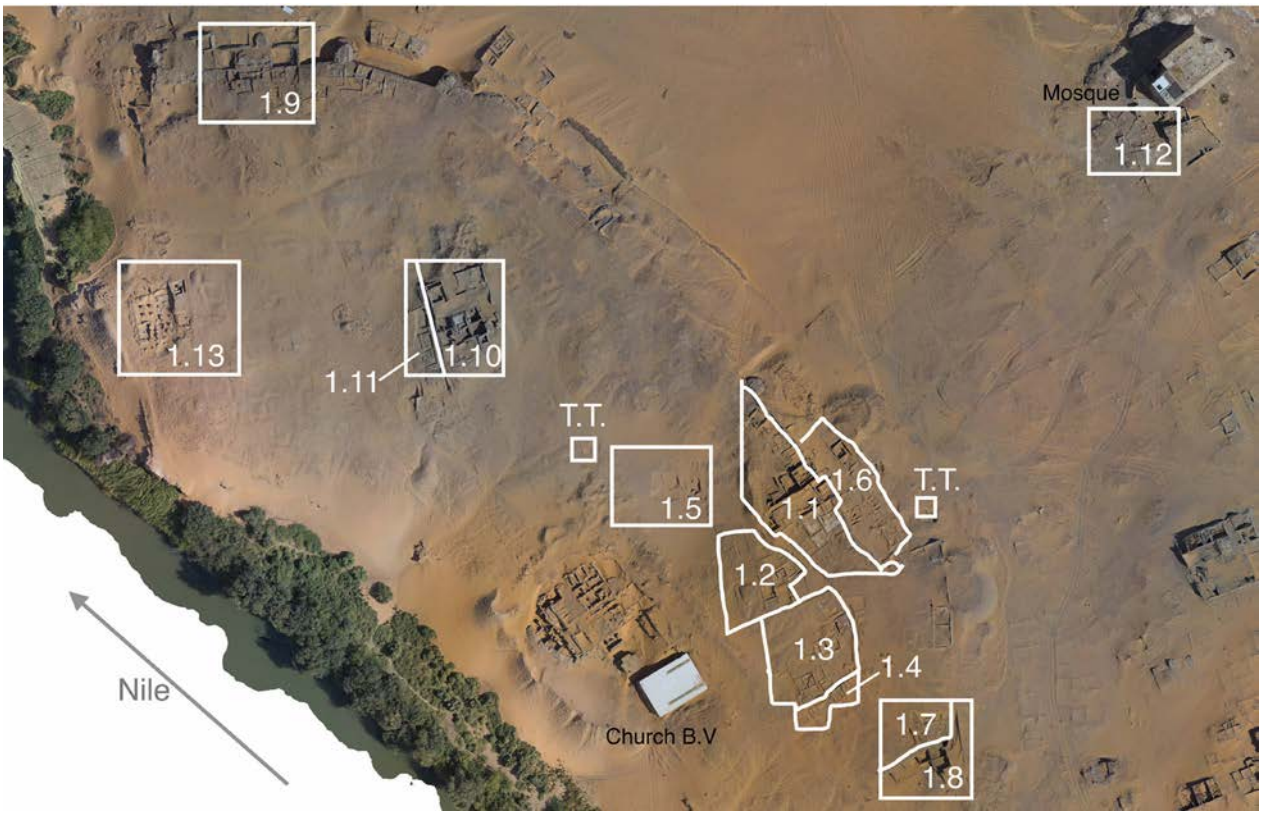

Figure 3. An orthophoto map of the citadel of Old Dongola, showing the excavated zones of the ERC-UMMA project (photo by Adrian Chlebowski).

botanical remains. These collections provided valuable reference materials for taxonomic comparison and facilitated the accurate identification of plant species recovered from archaeological samples. Seed identification was conducted using established atlases of seed identification (Bebawi and Neugebohrn 1991; Braun *et al.* 1991; Cappers *et al.* 2009; 2012; Neef *et al.* 2012). These atlases served as comprehensive references for taxonomic comparison, enabling the accurate identification of seeds recovered from archaeological contexts.

In addition to the atlases of seed identification, the African Plant Database (https://africanplantdatabase.ch/) was used to further refine the taxonomic identification of botanical remains from Old Dongola. This online database provided accessible and up-to-date information on African plant species, and aided the narrowing down of possible taxa during the identification process.

Results

The sediment samples analysed in this study were collected from a variety of archaeological deposits, each offering unique insights into past human activities. These deposits included animal dung accumulations, hearths (indicative of food preparation areas), middens (rubbish/dump deposits), and sandy soils mixed with organic matter, probably representing activity areas. The majority of samples analysed were collected from hearths and middens. Additionally, some samples were preferentially chosen from other contexts related to domestic activities, such as living areas.

The botanical remains consisted of a mixture of desiccated and charred plant remains. The majority of samples were preserved by desiccation, and only a few contexts were fully charred. In a few cases, some samples contained a mixture of charred and desiccated remains - these were collected from dumps (middens). The mixture of desiccated and charred remains in one context could be the result of various activities, such as crop processing, food preparation, and fuel use.

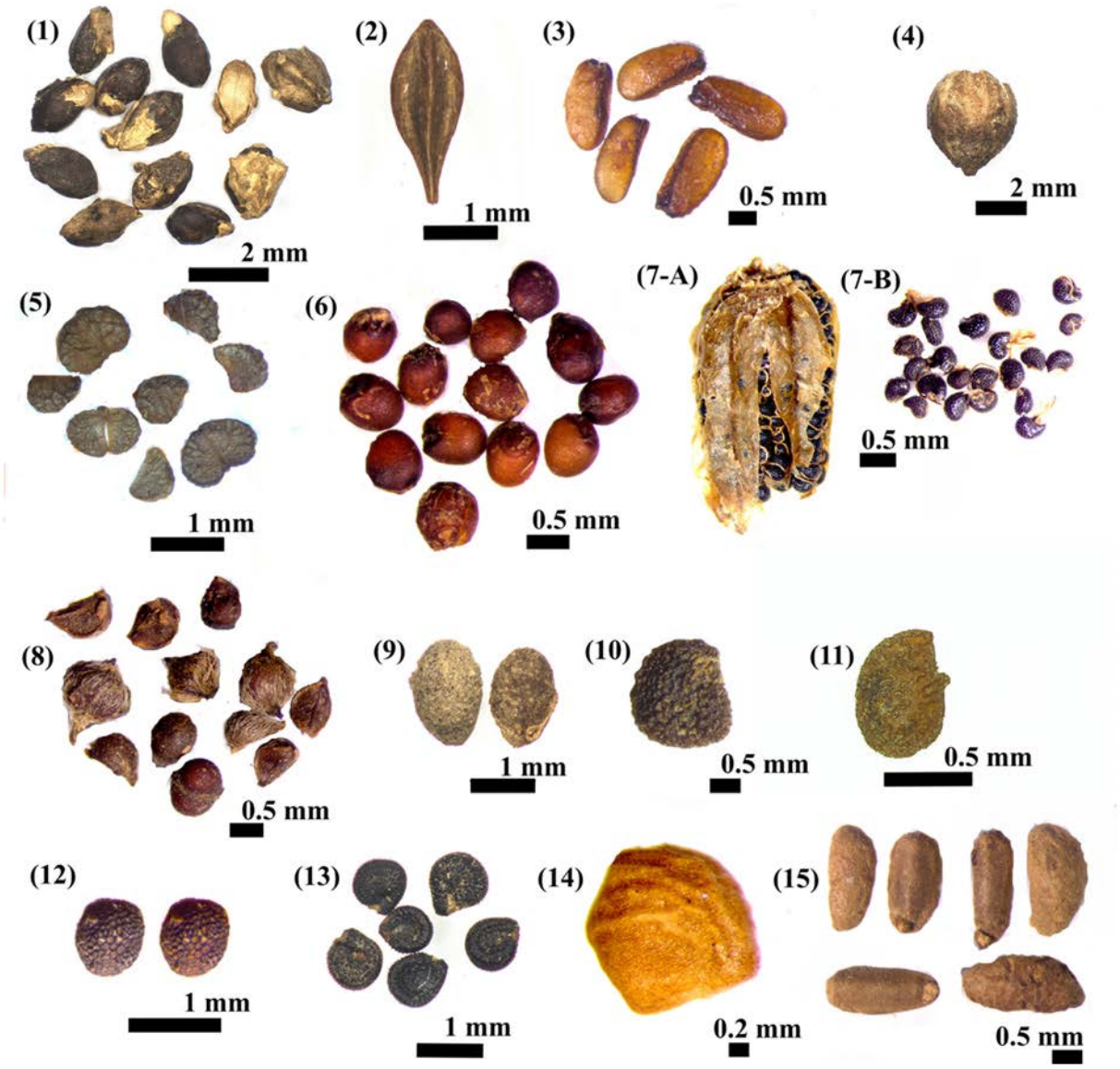

Figure 4. A selection of the newly identified plants from Old Dongola. (1) *Ambrosia* sp., (2) *Boerhavia* sp., (3) *Crypsis schoenoides* (L.) Lam., (4) *Coriandrum sativum* L., (5) *Coronopus niloticus* (Delile) Spreng., (6) *Eragrostis* sp., (7-A) *Glinus lotoides* L., (seeds capsule) (7-B) *Glinus lotoides* L. (seeds), (8) *Heliotropium ovalifolium* Forssk., (9) *Heliotropium ovalifolium* Forssk., (10) *Hyoscyamus muticus* L., (11) *Nicotiana tabacum* L., (12) *Nauclea latifolia* Sm. (13) *Portulaca oleracea* L., (14) *Potentilla supina* L., (15) *Verbena supina.*

No.	Taxon	Common name	Classification	Possible use	Date range (centuries)	Ubiquity
1	*Ambrosia sp.*	Ragweed	Wild plant	Medicinal plant/Folk. uses	14^{th}-18^{th}	30%
2	*Brachiaria sp.*	Brachiaria	Wild/weedy plant	Weedy plant/Fodder	14^{th} and 17^{th}	4%
3	*Boerhavia sp.*	Tar Vine	Wild/weedy plant	Undetermined	14^{th}-15^{th}	9%
4	*Crypsis schoenoides (L.) Lam.*	Swamp pricklegrass	Wild/weedy plant	Weedy plant	14^{th}-18^{th}	55%

Figure 5. The list of the newly identified plants at Old Dongola.

No.	Taxon	Common name	Classification	Possible use	Date range (centuries)	Ubiquity
5	*Coriandrum sativum L.*	Coriander	Economic crop	Condiment/herb/spices	14th-16th	4%
6	*Coronopus niloticus (Delile) Spreng.*	Swinecress	Wild/weedy plant	Weedy plant/Fodder	14th-17th	53%
7	*Corchorus olitorius L.*	Wild Jute	Economic crop	Edible leaves	14th	2%
8	*Dactyloctenium aegyptium Willd.*	Crowfoot grass	Wild/weedy plant	Fodder	15th-18th	21%
9	*Eclipta prostrata L.*	Eclipta	Economic crop	Medicinal plant/Folk. uses	14th-16th	23%
10	*Eragrostis sp.*	Lovegrass	Wild/weedy plant	Weedy plant	14th-18th	74%
11	*Glinus lotoides L.*	Rabaat el-Bahr	Wild/weedy plant	Animal fodder	14th-18th	60%
12	*Heliotropium ovalifolium Forssk.*	Common Heliotrope	Wild plant	Weedy plant/folk. uses	14th-17th	23%
13	*Heliotropium europaeum L.*	European heliotrope	Wild plant	Weedy plant/folk. uses	14th-16th	23%
14	*Hyoscyamus muticus L.*	Egyptian henbane	Wild plant	Medicinal plant/Folk. uses	16th-18th	19%
15	*Malva sp.*	Mallow	Economic crop	Economic crop	14th	2%
16	*Nicotiana tabacum L.*	Tobacco	Economic crop	Economic plant	16th-18th	13%
17	*Nauclea latifolia Sm.*	African peach	Economic crop	Wild fruit	16th-18th	13%
18	*Pimpinella anisum L.*	Anise	Economic crop	Condiment/herb/spices	14th	2%
19	*Portulaca oleracea L.*	Purslane	Economic crop	Edible leaves	14th-18th	91%
20	*Potentilla supina L.*	Cinquefoils	Wild/weedy plant	Undetermined	17th-18th	4%
21	*Rumex sp.*	Dock Sorrel	Wild plant	Undetermined	14th-17th	19%
22	*Senna sp.*	Senna	Economic crop	Herbal /Folkloric plant	16th	4%
23	*Solanum melongena L.*	Eggplant	Economic crop	Vegetable	16th and 18th	6%
24	*Trianthema sp.*	Black pigweed	Wild plant	Weedy plant	14th, 17th-18th	6%
25	*Verbena supina*	Trailing Verbena	Wild/weedy plant	Undetermined	14th-18th	43%

Figure 5 (cont.). The list of the newly identified plants at Old Dongola.

This study provides preliminary results based on 53 fully processed samples from two seasons. These samples yielded a total of 30680 seed remains belonging to 66 specimens, of which 21310 (69%) are seed remains of wild plant species and 9370 (31%) are seed remains of cultivated plants. This paper focuses on 25 specimens, which represent rare discoveries from archaeological sites in Sudan; while some of these plants are unique, being the first identifications of their kind in Sudan.

Preliminary thoughts on the newly identified plants

The new findings from Old Dongola, mostly wild/weedy plants, are known to be of high economic value regarding their uses by contemporary societies. The list of these plants includes the first-ever plants discovered from a Sudanese archaeological site with high economic value, such as tobacco (*Nicotiana tabacum* L.), and other plants such as the African peach fruit (*Nauclea latifolia* L.), False daisy flower (*Eclipta prostrata* L.), Egyptian henbane (*Hyoscyamus muticus* L.), and the wild plant (*Coronopus niloticus*) which is known for its value as animal fodder.

As previously discussed by Nasreldein *et al.* (2024), the evidence of tobacco seeds from Old Dongola is the earliest archaeobotanical evidence for tobacco cultivation in Sudanese Nubia, dating to the 17th century AD. In addition, the evidence of False daisy flower (*Eclipta prostrata* L.) from 14th century contexts is a notable discovery and a good addition to the history of archaeobotanical research in Sudan. The False daisy flower has a long history of traditional uses in folkloric and traditional medicinal practices, particularly in the preparation of hair oils and hair dyes (e.g., Feng *et al.* 2019; Silalahi 2022; Timalsina and Devkota 2021; Yang *et al.* 2023).

The discovery of Egyptian henbane (*Hyoscyamus muticus* L.) provides important evidence for the usage of medicinal and psychoactive plants in Sudanese Nubia. The plant is widely known for its medicinal properties containing valuable tropane alkaloids, especially hyoscyamine and scopolamine, which are used in folkloric medicine for treating many ailments, such as backache, articular pain, ocular damage, muscle cramps, recent wounds, kidney diseases, anxiety, mycoses, and lice (Ahmadi *et al.* 2008; Ayari-Guentri *et al.* 2017; Elsharkawy *et al.* 2018). This indicates that the plant was probably brought to the site for medicinal practices.

This research revealed another important evidence of a wild fruit known as the African peach (*Nauclea latifolia* L.). This fruit is native to the tropical and savanna regions of Africa and Asia, it is rich in sugars, fibre, and proteins (Abdel-Rahman 2019; Odeniyi *et al*. 2020). The tree is commonly distributed across the Sudanic region, and the seeds have been discovered in several West African sites (Champion *et al.* 2023; Neumann *et al.* 2022). To date, the evidence of this fruit comes from Old Dongola, particularly from the house of the Mekk - 16th century AD - represents the only available evidence from the Nile Valley.

The list of newly identified plants also provides important botanical evidence for the existence of two edible crops at Old Dongola, represented by purslane (*Portulaca oleracea* L.) and eggplant (*Solanum melongena* L.). The macrobotanical evidence of purslane is of great interest regarding the importance of this leafy plant for Nubian diets. The evidence shows it represents the key vegetable in the archaeobotanical assemblage at Old Dongola, and it was discovered in almost every sample, representing 91% ubiquity. Therefore, it was probably an important factor in the dietary practices of the inhabitants of Old Dongola. Additionally, the evidence of eggplant (*Solanum melongena* L.) represents another key piece of evidence for the consumption of this vegetable in Nubia during the Funj period. It is not yet evident exactly when the consumption of eggplants began in Nubia, as it is unclear when the cultivation of this plant started. To date, the discovery of eggplant seeds at Old Dongola represents the first evidence in hand for the consumption of this vegetable during the period between the 16th to the 18th centuries AD.

Furthermore, the plant assemblage from Old Dongola revealed other wild plants with potential use

as animal fodder. This group of wild/weedy plants, which includes two types of the so-called lovegrass plants (*Eragrostis* sp.), appears to have been identified for the first time in Sudan. The most common plant of *Eragrostis* sp. is Teff (*Eragrostis tef*), which is the most important cereal grain in Ethiopia and Eritrea (Beldados *et al.* 2015; Fornaciari *et al.* 2018; Lancelotti *et al.* 2019). However, the Eragrostis seeds remains from Old Dongola are certainly not Teff, but another wild species that possibly could be used as fodder and potentially as human food as well. Further research is required to identify these remains at the species level, which might reveal more information about their possible uses for the inhabitants of Old Dongola. This category also includes a newly identified plant known as the swamp pricklegrass (*Crypsis schoenoides* (L.) Lam.), which is a wild grass that is known for its potential use as animal fodder.

The last group of the newly identified plants at Old Dongola is represented by some wild plants that are known for their potential uses in folkloric medicine among contemporary societies in the region. These plants are represented by Senna (*Senna* sp.), common heliotrope (*Heliotropium ovalifolium* Forssk.), European heliotrope (*Heliotropium europaeum* L.), tar vine (*Boerhavia* sp.), and trailing verbena (*Verbena supina*). Therefore, this group provides unique findings that were not previously reported in Nubia, indicating the importance of systematic sampling in urban sites across Sudanese Nubia to better understand the subsistence of the ancient Nubians.

This research also revealed an important aspect regarding garden crops. In Sudan, it is very rare to find garden crops that are directly linked to the subsistence and daily use of plants. This lack of evidence could be due to a lack of systematic archaeobotanical investigations in Nubia, or a matter of preservation. However, for the archaeobotanical investigations in the Nile valley, the best example of garden crops comes from the workmen's village at Amarna in Egypt (Stevens and Clapham 2014), and Qasr Ibrim (Clapham and Rowley-Conwy 2007; Rowley-Conwy 1989). Thus, the investigations at Old Dongola revealed some of the rare findings represented by the presence of some condiments and herbs, such as coriander (*Coriandrum sativum* L.), cress (*Lepidium sativum* L.), anise (*Pimpinella anisum* L.), and black mustard (*Brassica nigra* L.).

In addition, the plant assemblage also revealed other plants that fit the category of rare findings in Sudan, due to their existence in smaller quantities and only in one or two sites across the entire region. Plants in this classification were represented by Ragweed (*Ambrosia* sp.), Crowfoot grass (*Dactyloctenium aegyptium* Willd.), Wild Jute (*Corchorus olitorius* L.), Rabaat el-Bahr (*Glinus lotoides* L.), Brachiaria (*Brachiaria* sp.), and the Two-Flowered Grass (*Fimbristylis bisumbellata*). These plants are widely used as animal fodder and have potential use in folkloric medicines as shown by some contemporary communities along the Sudanese Nile Valley (e.g., Bebawi and Neugebohrn 1991; Braun *et al.* 1991; Darbyshire *et al.* 2015; El Ghazali *et al.* 2022; Harrison and Jackson 1961). Wild Jute (*Corchorus olitorius* L.), is known in the Arabic language as *Malukhia*. This plant has edible leaves and is used widely in Sudan to prepare meat stews.

Conclusion

The archaeobotanical assemblage from Old Dongola revealed wide varieties of plant remains, including large quantities of economically important plants, as well as large numbers of wild plants with potential use in folkloric medicine and as fodder. Considering the archaeological contexts and deposits where the samples were originally collected, it appears that these plants were part of the life activities and dietary habits of the inhabitants and their associates. The assemblage provided a wide range of well-preserved plant remains, mostly desiccated seeds, most of which retain their original bright colours and texture. This is a unique case for archaeobotanical materials from Northern Sudan, not only to attest to the subsistence and agricultural practices; but also, to provide reference materials for future investigations in the region.

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