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Title: **Archaeozoological research on animal remains from excavations in Dongola (Sudan) in 2010**

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Keywords: Dongola, Makuria, palace, archaeozoology, animal economy, animal breeding, cattle, pig, goat/sheep, camel, crocodile

SUDAN

ARCHAEOZOOLOGICAL RESEARCH ON ANIMAL REMAINS FROM EXCAVATIONS IN DONGOLA (SUDAN) IN 2010

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Abstract: The faunal assemblage from the citadel in Dongola was analyzed with full application of the archaeozoological method thanks to the excellent preservation of the material (92.28% of 4070 bones identified from four chronological horizons). An analysis of the material from 6th and 7th century contexts (early Makurian kingdom) gave similar results: predominance of goat and sheep, followed by cattle and pig. Other species included Dorkas gazelle, antelope, big birds and small fish. The 13th–14th century assemblage (late Makuria) demonstrated a continued domination of goat and sheep, rising share of cattle and presence of camel and pig, as well as donkey, dog, Dorkas gazelle, crocodile, domestic hen, catfish and tilapia. In post-Makurian times (16th–17th centuries) sheep and goat remains predominated, cattle coming as a close second. Also present were camel, pig, donkey, Dorkas gazelle, domestic hen, mussels and catfish. A reconstruction of the animal breeding model demonstrated the growing importance of cattle. The drop in pig breeding could reflect socio-religious or political changes in Makuria. New elements in the economy of late Makuria included the appearance of camel and domestic hen, and greater interest in Nile fish consumption.

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Archaeozoological research on the animal remains from excavations carried out in Dongola, Southern Dongola Reach, Sudan, by a PCMA team headed by Włodzimierz Godlewski, were resumed in 2010 after several years' break, following a first season conducted in 2003. The assemblage from fieldwork in 2004–2009 counted altogether 4070 animal bones, bone fragments, teeth and other organic remains. The finds came from the palatial residence of Makurite kings (B.I), the citadel area in general (SWN) and the post-Makurite dwellings superimposed on the palace ruins (H). In chronological terms, the animal remains could be divided on stratigraphic archaeological and pottery-dating grounds into four assemblages: 1) end of 6th century, 2) 7th century, 3) 13th–14th century, and

4) 16th–17th century. For the purposes of the present discussion and based on data from the excavator, the first two phases were classed together as early Makurian, the third was considered as late Makurian and the fourth as post-Makurian.

ASSEMBLAGE

The examined bone material was in excellent state of preservation, the depositional conditions combined with environmental factors ensuring perfect preservation of the bones, as well as hides, horn sheaths and hair. Bone fragmentation and presence of non-osteological animal remains depended on topographic and stratigraphic units. The oldest assemblages from the 6th and 7th centuries were made up mainly of rather heavily fragmented bones. In taphonomic terms, they were dismembered at the first biostratinomic stage. Shortly after the meat had been consumed, the bones were discarded on a dedicated dump, minimizing thus the impact of different factors at the second and third diagenetic stage. High temperatures and a highly alkaline environment had an influence on the condition of the bones. Osteological remains in late Makurite assemblages (13th and 14th centuries) were preserved in much larger pieces and more bones were intact. Both whole and fragmentary horn sheaths were recorded. Finally, the post-Makurite animal remains were made up of large quantities of intact bones, either whole skulls or large fragments thereof, cornual process with horn sheaths, fragmentary animal hides, as well as large parts of skeletons with dried cartilage still joining the bones together.

Moreover, the high percentage of faunal remains identified to species and parts of the anatomy (92.28%) also attests to the excellent state of preservation of the bones. This definitely raised the analytical value of the faunal assemblages recovered from the excavations in the citadel of Dongola.

RESEARCH METHODS

In the early stages of archeozoological analysis class and species were determined, the latter as near as possible; only with regard to ovicaprids, remains without distinctive features were classed jointly as "goat/sheep". Remains were sorted also by the proportion of identified bones and by the percentage of systematic groups identified in the successive chronological assemblages. Five different topographic and stratigraphic units were distinguished. The remains were divided by class into mollusks (*Mollusca*), fish (*Pisces*), reptiles (*Reptilia*), birds (*Aves*) and mammals (*Mammalia*), calculating percentages from the general number of identified remains. Frequencies and percentage shares of the chief domestic species in successive chronological phases were tabulated [***Tables 1–2***], 100% being taken as the total number of remains of cattle, goat/sheep, pig and camel in each given assemblage.

Remains were identified by anatomical parts and the anatomical distribution tabulated for the bones of cattle, goat/sheep, pig, antelope and gazelle for the early

Makurian period (6th and 7th century), goat/sheep, cattle, pig, camel, horse/donkey, dog, gazelle and crocodile for the late Makurian phase (13th/14th century) and goat/sheep, cattle, pig, camel, equid and gazelle for the post-Makurian (16th/17th century). Subsequently, the skeletal remains of the main consumption species that were sufficiently numerous were divided into seven groups: *head* (H), bones of cranium, cornual processes, maxilla, teeth and mandible; *body* (B), vertebrae, sacrum, sternum and ribs; *proximal part of the anterior limb* (PPAL), scapula, humerus, radius, ulna; *distal part of the anterior limb* (DPAL), carpal bones, metacarpals I–V; *proximal part of the pelvic limb* (PPPL), pelvis, femur, patella, tibia, fibula; *distal part of the pelvic limb* (DPPL), calcaneus, talus, metatarsi; *phalanges* (Ph) I, II, III.

This division served to calculate the percentage shares of specific parts of the carcass for the given species. The presence of phalanges and a balance between anterior and pelvic limbs were considered when searching for indications of meat distribution. Imbalance was found when the difference between the remains of the two limbs equaled or exceeded 10%. In analyzing anatomical distribution, the concepts of attractive and non-attractive parts of the carcass were applied. The criterion was the "meatiness" of a given part and its caloric content. The body and proximal parts of limbs were classed as attractive, whereas the head, distal parts of limbs and phalanges were considered as not attractive from a consumers' point of view.

Age at death was determined wherever possible, based on an evaluation of ontogenetic development of teeth and bones. The degree of fusion of the long bones with the epiphysis was assessed (Kolda 1936; Chaplin 1971). Percentage shares of remains of morphologically immature animals were calculated on the grounds of tooth development in domestic animals (Lutnicki 1972; Müller 1973), 100% being taken as the total sum of remains of a given species. Animal husbandry objectives were thus studied. Considerable numbers of young animals among the remains attested to meat being the prime supply objective, whereas a prevalence of bones from adult animals indicated purposes other than meat consumption. There could have been extended utility of live animals.

The share of male and female animals in particular species and stratigraphic units was also assessed. Depending on the species, sex was established based on sexual dimorphism traits revealed by the skeleton. For pigs it was the shape of the transverse section of the tusks and alveoluses. For cattle, the diagnostic feature was the shape of the horn cores and the morphological ratio of metatarsi to metacarpi (Całkin 1960), modified by the author to suit African finds. Research on the Makurian cattle morphological type indicated that it was a humped longhorn version of *sanga*, hence the author deemed it wise to adopt new sex determination criteria based on her field observations. Long massive horn cores and horns of both crescent and lyre shape, were recorded in the material. The former type of horn is characteristic of males of *sanga*-type cattle, while females have the lyre-shaped horns (Epstein 1971). Height at the withers was calculated using coefficients by necessity developed for European animals, but the results should be treated as nothing but estimates in view of the observed traits of

longleggedness and humpedness (Chaix, Grant 1992). The shape of the horn core and the presence of a forehead suber in goats were taken into account for the small ruminants. Data on the sex of animals representing a given species helped to assess domestic breeding strategies and the regular everyday utilization of domestic animals.

Morpohological studies of animal remains provided extensive information. Bones were measured for the purpose and the results were unified according to a system for all domestic creatures established by von den Driesch (1976). Height at the withers was measured using appropriate coefficients (Teichert 1975; Fock, Schramm, cited after Lasota-Moskalewska 2008).

Bone remains were also analyzed in terms of form and bone splinters, as well as preservation. Note was taken of tool traces and damages caused by successive stages of carcass processing and dismemberment, filleting and preparation of meat for consumption.

Note was taken of possible pathological changes observed on the bones.

RESULTS OF FAUNAL ANALYSES

The animal bone assemblage was analyzed in terms of species, anatomy, age and sex. Carcass dismemberment procedures were looked at and meat consumption models were reconstructed as far as possible for the different phases.

SPECIES

The animal bone assemblage from the end of the 6th century counted 1621 bone fragments; of these 127 fragments could not be identified (7.83%). Most of the bones represented mammals (*Mammalia*). Remains of seven species were identified [***Table 1***]. There were also a few bird and fish bones (7 and 191 fragments respectively). The most numerous group consisted of the remains of small domestic ruminants (44.29%). Half as many sheep *Ovis oriental* f. *domestica* (2.0%) as goat *Capra aegagrus* f. *domestica* (1.2%) were identified specifically. Second in number in this context were cattle *Bos primigenius* f. *domestica* (28.98%). Pig remains *Sus scrofa* f. *domestica* were the least numerous group among domestic species (12.38%). Two wild species were observed, but the bones of Dorcas gazelle *Gazella dorkas* were much more frequent (0.93%). The other species represented by corneal processes was the Addax antelope *Addax nasomaculatus* (0.13%). The bird species were not identified, but they were big wild birds living in a water environment (0.46%). All of the fish remains came from very small species, most likely marine forms (12.78%).

In terms of species distribution, the assemblage of faunal remains from the first half of the 7th century AD appeared to be very similar to that from the end of the 6th century AD. Remains of ovicaprids were the most numerous group (45.95%) again with specifically sheep remains dominating over identified goat remains [see ***Table 1***]. Cattle bones were noted to be second in number (32.61%), followed by pig (13.16%). Wild game was represented by the Dorcas gazelle (0.88%). Remains of large water birds and very small fish were also present in this context.

The osteological material from late Makurite assemblages (13th–14th century) was richer in different species [see ***Table 1***].

Eleven species and classes were identified among the 507 bone remains making up this set, and the number of unidentified (by species and by anatomy) remains was significantly lower. Small ruminants were the most numerous (42.44%). The number of specifically identified remains indicated a balance between sheep and goat. Cattle was only a slightly smaller group (40.64%). A major difference was the occurrence of considerable numbers of camel remains *Camelus dromedarius*

Table 1. Animal species distribution in successive stratigraphic units from Palace B.I

	End of 6th century AD		7th century		13th–14th centuries		16th–17th centuries	
SPECIES	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Sheep/ goat	614		438		183		308	
Sheep *Ovis orientalis* f. *domestica*	30	40.83	23	39.59	15	41.61	38	47.56
Goat *Capra aegagrus* f. *domestica*	18		7		13		6	
Cattle *Bos primigenius* f. *domestica*	433	26.71	332	28.08	202	39.84	309	41.75
Pig *Sus scrofa* f. *domestica*	185	11.41	134	11.33	14	2.76	6	0.81
Camel *Camelus dromedarius* f. *domestica*	–	–	–	–	56	11.04	40	5.40
Addax *Addax nasomaculatus*	2	0.12	–	–	–	–	–	–
Horse/donkey *Equidae*	–	–	–	–	5	0.98	2	0.27
Dog *Canis lupus* f. *domestica*	–	–	–	–	1	0.19	–	–
Dorcas gazelle *Gazella dorcas*	14	0.86	9	0.76	1	0.19	1	0.13
Bird *Aves* sp.	7	0.43	3	0.25	4	0.78	9	1.21
Mollusc *Etheria nilotica*	–	–	–	–	–	–	2	0.27
Nile crocodile *Crocodylus niloticus*	–	–	–	–	2	0.39	–	–
Fish *Pisces* sp.	191	11.78	72	6.09	1	0.19	6	0.81
Unidentified	127	7.83	164	13.87	10	1.97	13	1.75
N (total)	**1621**	**100**	**1182**	**100**	**507**	**100**	**740**	**100**

f. domestica (11.26%). There was significantly less pig remains compared to the previously analyzed phases (2.81%). The other domestic species, that is, horse/donkey and dog, were noted in lesser numbers. Wild species were represented by Dorcas gazelle (0.20%) and crocodile (0.40%). The bird remains could very well have been the domestic hen *Gallus gallus* f. *domestica*), but because only vertebrae and ribs were preserved, the identification could not be certain. The fish were represented by different species than before as well. For the most part these were tilapia and Nile catfish.

Osteological material from the time of the decline and fall of the kingdom of Makuria (16th–17th century) counted 740 remains. Only 1.7% could not be identified, attesting to a very good state of preservation of the bones. Sheep and goat again were the most numerous group (48.4%) and specific identification indicated the superiority of sheep among the remains. Cattle bones constituted a percentage only slightly smaller than that of goat/sheep remains (42.5%). Camel was the next most numerous species in the assemblage, although it was distinctly less frequent than sheep/goats and cattle (5.50%). The other species were recorded in minimal numbers: pig (0.82%), equids (0.27%), Dorkas gazelle (0.13%), domestic hen (1.23%). Two fragments of mollusk shells were also recorded, as well as a few bones of Nile catfish [see ***Table 1***].

A comparison of percentage shares of the main domestic species from successive stratigraphic units demonstrated certain trends [***Table 2***]. Small ruminants, mainly sheep, were the most important group for consumption from the 6th through the 16th century, but the percentage share of these species demonstrated a distinctly dropping tendency over the ages. It was only after the fall of the Makurite kingdom that mutton and goat meat recovered some of their significance in the indigenous diet. Beef showed a continuously growing popularity in the diet, starting from early Makurian times and continuing even after the fall of the kingdom. Pork played a relatively important role early one, only to become marginalized by the 16th and 17th century. On the other hand, the introduction of camel meat in the diet is marked in the archaeozoological record. Both current and earlier research (Osypińska 2004) have shown that camel was not consumed in the palace during the early and classical phases of the Makurian kingdom. It made an appearance in the late period and seems to have been quite popular at this time. By the 16th and 17th century it had lost some of this popularity.

Table 2. Percentage shares of the remains of the chief consumption animal species in successive occupational phases of the citadel in Dongola

Chronology	Sheep / goat	Cattle	Pig	Camel
6th century	51.71%	33.82%	14.45%	–
7th century	50.10%	35.54%	14.34%	–
13th–14th century	43.68%	41.82%	2.89%	11.59%
16th–17th century	49.78%	43.70%	0.84%	5.65%

ANATOMY

Skeletons of cattle and small ruminants had the fullest representation in early Makurian material, although pig skeletons were also quite complete. The absence of corneal processes belonging to ruminants, except for one fragment, are noteworthy, as is the small number of phalanges, especially of the small ruminants and pig. Fragments of ribs and vertebrae clearly dominated the oldest assemblages. The anatomical distribution of Dorkas gazelle remains was relatively rich and varied, but antelope was represented only by two fragments of horn sheaths and corneal processes. The anatomical distribution of sheep/goat remains in the early Makurian assemblages (6th and 7th centuries AD) indicated a clear predominance of the best cuts of meat [***Table 3***] and a poor representation of bones from the least meaty parts of a carcass compared to the model skeleton. The anatomical distribution for small ruminants also demonstrated an imbalance between the proximal parts of limbs with a clearly higher percentage, exceeding 10%, of the remains of anterior limbs [see ***Table 3***].

The anatomical distribution of cattle carcasses also indicated a considerable modification of proportions owing to consumption processing [see ***Table 3***]. More than half the remains consisted of fragmented ribs and vertebrae. The rest represented the distal limbs, which are the meatiest parts. There were less bones from the less attractive parts of the carcass than in the model skeleton. Distal and pelvic limb remains were balanced. Pig remains demonstrated a very similar anatomical distribution of the bones. Ribs and vertebrae predominated in this group, constituting almost 50% of the assemblage of pig bones [see ***Table 3***]. The percentage of distal limbs was also significant, unlike the unattractive parts of the carcass, which were represented in significantly less numbers than in the model. These consumption preferences are shown clearly in graphic form [***Fig. 1***]. The trunk and shoulder of the small ruminants were preferred, and so were the heads. With regard to cattle carcasses, the body was preferred; brawn was practically not consumed. As for the pig carcasses, the body and ham were the preferred parts.

In late Makurian material the cattle skeleton was the most fully represented with practically all the bones present. In the group of sheep/goat remains, phalanges were missing. The camel skeleton was also relatively well represented, but not the pig skeleton, which was represented mainly by remains of the proximal part of the anterior limb. A study of the sheep/goat anatomical distribution divided into parts of the carcass has shown that compared to the model skeleton the proximal parts of the anterior and pelvic limbs underwent the most extensive processing and a similar regularity can be observed in the case of cattle remains [see ***Table 3***]. The remaining species were not analyzed in terms of carcass dismemberment, there being too little bones representing different parts of the skeleton.

In the post-Makurite assemblage only the domestic ruminants were represented anatomically by all bones of the skeletons. The third phalanges and the minor metatarsal and talus bones were missing, a fact which could be due to particularly burdensome conditions of exploration. The anatomical distribution of camel remains was also quite differentiated. As for the other species, there were only singular

bones and thus only remains of cattle and small ruminants were studied in terms of carcass division. The percentage share of bones from specific parts of the sheep/goat carcass demonstrated that, similarly as in the early Makurite period, the proximal parts of the limbs were divided with great precision. Anterior limbs were more prevalent than pelvic ones. As for the other parts of the carcass, the remains were not that distant from the model skeleton [see *Table 3*]. The cattle carcass division was slightly different, with the numbers of skull and teeth approaching those given for the model skeleton [see *Table 3*]. There were much less body remains. Consumers appear to have preferred the proximal parts of limbs, the pelvic ones in particular.

Table 3. Anatomical distribution of sheep/goat, cattle and pig carcasses compared to the model skeleton in different phases

Phases	6th–7th century		13th–14th century		16th–17th century		Model skeleton
Body part	n	%	n	%	n	%	%
SHEEP/GOAT							
H	186	**16.34**	21	**22.58**	96	**24.30**	20
B	397	**34.88**	30	**32.25**	132	**33.41**	43
PPAL	317	**27.85**	19	**20.43**	87	**22.02**	5
DPAL	22	**1.93**	2	**2.15**	9	**2.27**	8
PPPL	183	**16.08**	15	**16.12**	60	**15.18**	3
DPPL	32	**2.81**	6	**6.45**	9	**2.27**	7
Ph	1	**0.08**	0	–	2	**0.50**	14
CATTLE							
H	41	**5.35**	31	**16.66**	69	**20.47**	20
B	451	**58.87**	73	**39.24**	72	**21.36**	43
PPAL	125	**16.31**	22	**11.82**	53	**15.72**	5
DPAL	5	**0.65**	10	**5.37**	14	**4.15**	8
PPPL	115	**15.01**	34	**18.27**	84	**24.92**	3
DPPL	15	**1.95**	7	**3.76**	33	**9.79**	7
Ph	14	**1.82**	9	**4.83**	12	**3.56**	14
PIG							
H	22	**6.37**	20				
B	156	**45.21**	34				
PPAL	73	**21.15**	4				
DPAL	2	**0.57**	10				
PPPL	85	**24.63**	3				
DPPL	6	**1.73**	9				
Ph	1	**0.28**	20				

Legend:
H – head
B – body
PPAL – proximal part of anterior limb
DPAL – distal part of anterior limb
PPPL – proximal part of pelvic limb
DPPL – distal part of pelvic limb
Ph – phalanges

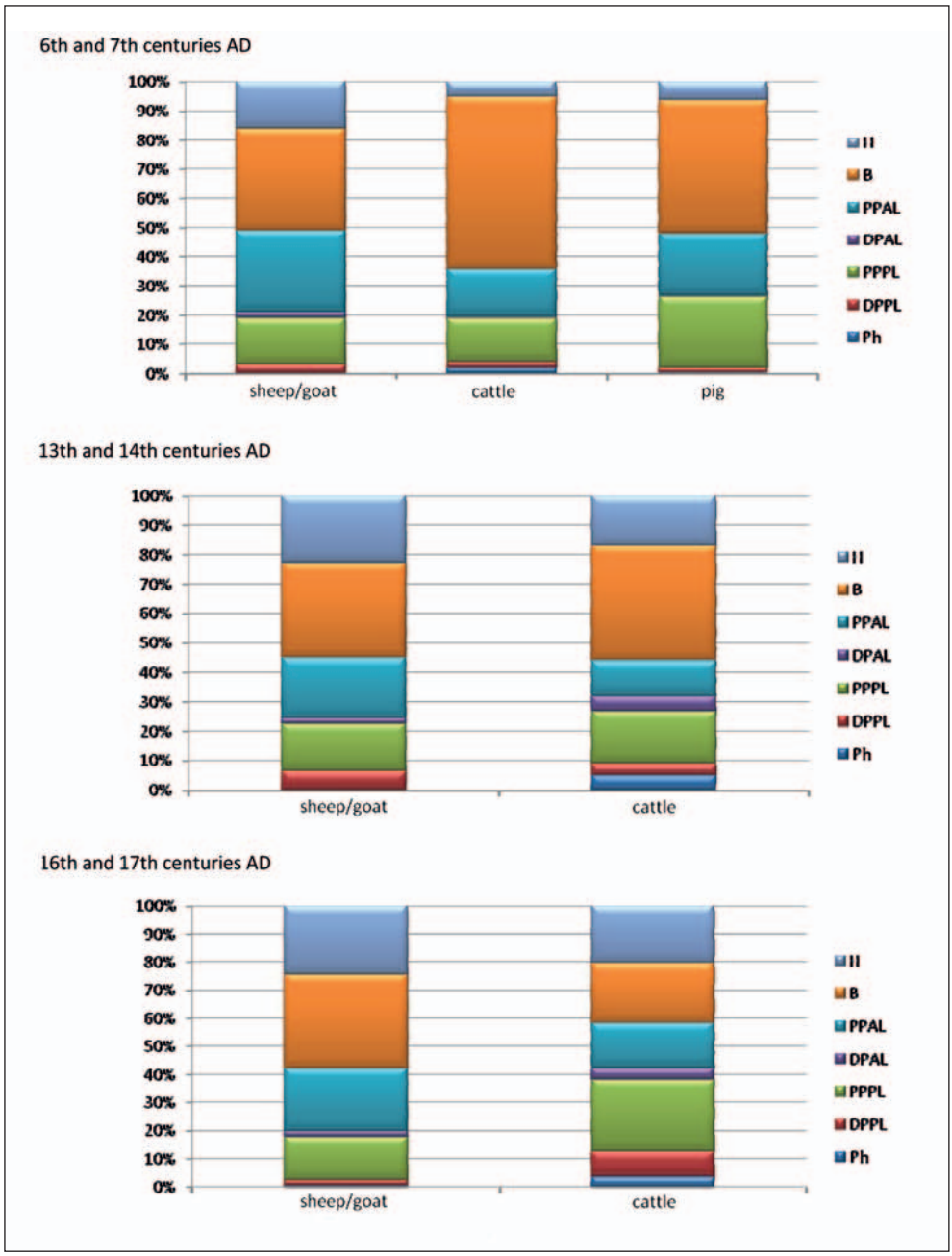

Fig. 1. Anatomical distribution of faunal remains taking into account parts of the carcass of the chief consumption species in successive stratigraphic units (for the legend see Table 3)

ANIMAL AGE

Early Makurians consumed meat of young sheep and goats episodically. The percentage of bones of animals slaughtered before reaching morphological maturity reached 4.5%. Meat of the youngest lambs and kids (slaughtered before completing five months of age) was seldom eaten, whereas grown animals, under three years of age, predominated. The percentage of morphologically immature animals in the late Makurite phase was closely similar (4.4%), but there were no very young animals present in the assemblage. In post-Makurian times the percentage of remains of animals slaughtered before maturing morphologically grew insignificantly to 5.1%. Even then, however, meat of very young animals was not consumed and mainly grown individuals were slaughtered.

Remains of morphologically immature cattle constituted a high percentage in the osteological material from the early Makurite period, exceeding the typical percentage shares for this species (9%) (Lasota-Moskalewska 2008). Young cattle remains represented grown, although morphologically immature individuals. Cattle for slaughter were aged two to four years. Much less remains of young cattle were found in osteological assemblages from later periods. Also in this phase the very young animals were not slaughtered.

The meat of young pigs was eaten only in the early Makurian period (7.13%). Animals were slaughtered at the age of 3.5 years. But data from the state of the dentition, which is slightly more precise than an evaluation of skeleton development, suggest that animals for slaughter were not even two years of age.

ANIMAL SEX

Sex identification was among the most difficult tasks, especially with regard to the early Makurian phase which was represented by bones without the traits that would permit such identification of the slaughtered animals. Only one metacarpal cattle bone, measured using appropriate indicators, could be said to come from a female. The late Makurian material contained two corneal processes of goats and three of male cattle. The largest number of remains with distinctive traits used in determining sex were found in the 16th–17th century assemblage. These included corneal processes of a she-goat and a he-goat, three of male sheep and four of female cattle. In the early Makurian assemblage there was one fragment of the skeleton of a male pig and three of female pigs. Only one pig bone from the 13th–14th century set could be attributed to the skeleton of a male pig.

MORPHOLOGICAL TYPE

Despite the size of the bone assemblages from the citadel in Dongola, few skeletal remains were sufficiently well preserved to permit osteometric measurements [*Tables 4, 5*]. The early Makurian material was especially poor in data of this kind owing to the degree of fragmentation and anatomical distribution (mostly ribs and vertebrae). Despite this it was possible to reconstruct some of the morphological types of domestic animals bred in Dongola over ten centuries of occupation.

The morphological type of small ruminants is perhaps the least known despite the economic importance of these animals. The osteometric measurements of modern varieties of sheep and goats

Table 4. Osteometric measurements for sheep remains from successive stratigraphic units

	6th–7th centuries AD	13th–14th centuries AD	16th–17th centuries AD
Scapula (mm)			
SLC	19, 16, 19, 13, 19, 21	16, 20, 19, 18, 18, 19	14, 14, 17, 20, 17, 18, 16, 20
GLP	31, 31, 33, 24, 31, 35	28, 31, 34, 31, 31.2, 31 159	28, 27, 29, 34, 31, 31, 31, 32, 34
HS			135
Humerus (mm)			
Bd	25, 25, 27, 27, 27, 27, 27, 27, 27, 28, 28, 28, 29, 29, 29, 30, 30, 30, 30, 30, 30, 30, 30, 30, 30, 31, 32, 32, 33, 34	29, 29, 31, 31, 34, 37	27, 27, 28, 28, 28, 28, 28, 29, 29, 30, 32, 32, 34
Radius (mm)			
Bp	25, 28, 28, 33, 34, 37	29, 32	25, 27, 27, 28, 30, 32
Bd	–	29	–
Os metacarpi III+IV (mm)			
Bp	22, 24	–	24, 23, 24
SD	–	–	14, 13, 13
Bd	–	–	25, 25
GL	–	–	137.6, 137
WH (cm)	–	–	67.3, 67
Femur (mm)			
Bd	31	–	37
Tibia (mm)			
Bd	–	–	25, 25
Calcaneus (mm)			
GL	54, 73, 84	60	–
Os metatarsi III+IV (mm)			
Bp	–	–	20
SD	–	–	11
Bd	–	–	23, 24
GL	–	–	148
Talus (mm)			
GLI	29, 28	24	–
GLm	27, 27	24	–
Bd	17	15	–
Phalanx proximalis (mm)			
Bp	19	12	–
SD	7	7	–
Bd	18	13	–
GL	–	42	–

Table 5. Osteometric measurements for cattle remains from successive stratigraphic units

	6th–7th centuries AD	13th–14th centuries AD	16th–17th centuries AD
Processus cornuales (mm)			
Basal arc.	–	180, 200, 200	150, 210, 200
Lenght		270	200, 480
*Scapula (*mm*)*			
SLC	41, 48, 40, 43, 28, 36, 43, 43	48	47
GLP	59, 68, 63, 63, 62, 55, 67, 64, 64	58	59
HS	360, 360, 268.7	–	–
Ld	143	–	–
Humerus (mm)			
Bd	–	51, 70.8	65.8, 67, 70
GL	–	222	–
Radius (mm)			
Bp	66	74	71, 66, 73, 68
Bd	66	–	–
GL	–	–	290
Os metacarpi III+IV (mm)			
Bp	47	53	52.8, 54.6, 59, 60, 59
SD	25.5	–	27.7
Bd	–	–	53, 62, 65.2
GL	194.8	–	207
WH (cm)	116	–	–
Femur (mm)			
Bd	–	–	84.5
Tibia (mm)			
Bp	–	94.6, 79	52, 53, 56, 57.5, 58,60,
SD	–	–	71.8
Bd	–	57	–
GL	–	–	–
Calcaneus (mm)			
GL	109.14	128.26	–
Os metatarsi III+IV (mm)			
Bp		–	–
SD		–	–
Bd	57	–	48, 59
GL		–	–
Talus (mm)			
GLI		63.3, 70, 67	64, 65, 68, 70, 65, 51, 71.2, 66.4, 67.5, 66
GLm	–	57.8, 64, 41	58, 60, 63, 53, 62, 64.8
Bd	–	67, 62, 39	40, 40, 42, 43

Table 5 (continued)

	6th–7th centuries AD	13th–14th centuries AD	16th–17th centuries AD
Phalanx proximalis (mm)			
Bp	31, 29, 28, 25, 26, 31, 25	33, 27	27.7, 27, 26, 30, 28
SD	27, 24, 21, 22, 28, 21	27	23, 25, 24, 24
Bd	29, 27, 25, 23, 24, 29, 24	30	24, 27, 25, 27, 28
G	70, 67, 67, 60, 62, 64, 57	63	54.5, 62, 56, 61, 59, 73.4
Phalanx media (mm)			
Bp	30, 31, 28	25, 26, 28, 31, 30	25, 25
SD	26, 26, 24	23, 24	22, 22
Bd	28, 27, 25	22, 23, 24, 19, 26	24, 21
GL	40, 46, 45	38, 43, 40, 36, 43	41, 38, 35.1, 41.1
Phalanx distalis (mm)			
DLS	58, 67, 61	–	–
Ld	46, 50, 51	–	–

(Osypińska, own research) from northern Sudan leave no doubt that similar varieties were bred in Makuria. The sole observed difference are horns, which Makurian goats and sheep had, whereas modern varieties are hornless. Goats had horns both under the kingdom and after its fall, the males twisted around the horn axis, the females much smaller and twisted only a little, curving back and flaring to the sides. Today horned goats of this kind can be seen near Khartum and Shendi. Also Makurian and post-Makurian sheep were horned, the males having massive examples that were twisted back. The height of sheep at the withers in post-Makurian times was about 67 cm.

Much more can be said about the morphological type of cattle at Dongola and the changes of the breeding and consumption models in force at the palace. Despite the impossibility of calculating height at the withers, especially for cattle from the oldest phases, conversion of metric data to points proved instructive (Lasota-Moskalewska 2008). Charted on a scale, the points formed two clusters, demonstrating that the meat consumed in the palace in the 6th and 7th centuries represented two different cattle populations. The first was a small and middle-sized brachycerious, short-horned variety. There is a tradition of breeding this particular variety in northern Sudan since at least the Kushite period (Chaix 2007). It was also the variety occurring outside the citadel, in Banganarti and in the monastery on Kom H in Dongola. The other cattle population, which was more common in the early Makurian material, is primigenious, large and longhorned. Bone assemblages from this period produced thoracic vertebrae belonging to humped cattle. In the late Makurian period the situation changed and the cattle population became homogeneous, mainly middle-sized and large, although there was also a group of small cattle and very high cattle. The corneal processes and horn sheaths from this period are characteristic of African *sanga* cattle believed to be indigenous to eastern Africa. One of

the traits of this variety is clear sexual dimorphism manifested by the shape of the horns [*Fig. 2*]. Males have horns that are massive at the base and turned up in a crescent, whereas females have somewhat more slender horns that are lyre-shaped. Both forms are present in the assemblages from the palace at Dongola. Studies of south-Saharan rock art (Osypińska 2012) and archaeozoological research (Chaix 2010) has shown that cattle of this kind was traditionally bred in the region from the late Neolithic and Kerma periods.

The cattle population in post-Makurite times appears to have differed little from that observed for the late Makurian assemblages. There is an innumerous but distinct small cattle population, but the main herd consisted of middle-sized and large animals. In the 16th and 17th century the animals were somewhat larger than in the 13th and 14th century and the herd was overall less differentiated. Horns typical of sanga cattle were found also in these contexts.

Pigs in Dongola were not large; their height at the withers is estimated to have been 60–70 cm. The animals featured long snouts and a long lacrimal bone. The bones were long and slender, without massive muscle attachments. In all the calculated cases, the index of the shoulder was large, pointing to local pig breeding in Dongola, either at home or on a farm.

The absence of distinctive features made it impossible to determine the morphotype of other domestic breeds, the remains of which were recorded in the palace

Fig. 2. African sanga cattle horns showing clear sexual dimorphism in the shape (All photos by the author)

assemblages. All that can be said is that these species included donkeys and horses, dogs, as well as camels and domestic hen, which made their way into the Makurian diet in the late period.

As regards non-domestic species, the Dorcas gazelle was hunted at all times. Large Nilotic birds were also hunted from the beginning of the kingdom of Makuria. The presence of corneal processes and horn sheath of the Addax antelope is difficult to evaluate. As no bones were discovered, it is possible that the animal was not hunted anywhere near Dongola, but that the horn was brought as an item of exchange from the south. It also seems that the Nile started to be used as a food resource, but it was not until the late period and post-Makurite times that tilapia and Nile catfish, still popular today, began to be consumed. The remains of a small crocodile were also noted in the younger assemblage.

CARCASS DISMEMBERMENT

The archeozoological analysis also demonstrated changes occurring in the way the carcass was dismembered and the meat prepared for consumption. It has already been pointed out repeatedly that animal bone remains from the earlier phase were largely fragmented, but it was possible on their grounds to reconstruct a carcass dismemberment model applied on a regular basis. Butchering precision suggests consistency, pointing in turn to professional butchers at work. An observable characteristic of the carcass, whether sheep, goat or pig, was the chopping of the shaft of the shoulder bone a few centimeters above the distal epiphysis [*Fig. 3*]. Chopped ribs were another characteristic element of the carcasses; the bones were cut into fragments from 9 to 15 cm long in the case of small ruminants and pigs, and most frequently from 11 to 18 cm in the case of cattle.

The particularly high share of chopped rib and vertebrae fragments of all the consumed species suggests that there was a preference in the palace in early Makurian times for eating small pieces of boned meat, possibly in thick gravy and soup. A considerable number of ribs and femur bones also bore traces of deboning. It appears to have been equally common to split the long bones lengthwise, chop of the heads and split jawbones, all of which indicates a liking for highly caloric and nutritious marrow. Mandibles were cut open usually at the point of the diastema.

To conclude, animal fat was a most welcome part of the meat diet and one of the most popular dishes were chopped ribs, back and bone heads with gristle, the latter used perhaps to enrich soup and gravy.

CONSUMPTION MODEL

The consumption model appears to have changed over time judging by the changes in carcass dismemberment methods. The different character of processing traces preserved on the bones from the late assemblage may have been due most probably to the different nature of late deposits. The early Makurian assemblage can be seen as kitchen waste and refuse from the table, but the set of remains from the post-Makurian period (16th and 17th centuries) looks more like butchering remains. The bones here were not chopped into small fragments and most were preserved in big pieces. Most of the ribs were broken and not chopped regardless of species. The sole traces preserved on the bones that could attest to carcass dismemberment practices was splitting of the long bones lengthwise and some

Fig. 3. Damage resulting from carcass division: ribs (top) and humerus of sheep, goat and pig

evidence of chopping off of the bone heads (also in one case of an equid humerus). In terms of meat preparation traces, the late and post-Makurite evidence was similar with the bones of cattle in particular being preserved whole or in big fragments and few traces of chopping at the heads, lengthwise splitting and breaking open of the jawbone, the latter only with regard to the small ruminants. For the first time there was some evidence of charred bones and gnawing by dogs. There does not seem to have been a single accepted way of dismembering the carcass either in late or in post-Makurite times. The observed evidence suggests chaotic and summary action [***Fig. 4***].

Some traces of trauma and pathological change were noted on the bones. Accreted broken ribs were found among the cattle and pig remains from the 6th and 7th centuries. The material from the 13th and 14th centuries produced evidence of changes at the distal head of the radial bone of cattle, indicating longlasting joint inflammation. Evidence of healed broken ribs in cattle were observed in the post-Makurite assemblages.

CONCLUSION

The faunal assemblage from the palace in Dongola constitutes an incomparable source for studies on the economic importance of animals in Makuria and, by extension, on the state economy as such. The archaeozoological data points to the exceptional importance of cattle. In the early period the palace in Dongola made use of small local cattle as well as the bigger longhorn species which was imported in

Fig. 4. Damage due to activities resulting from consumption patterns

all likelihood. The rising significance of beef in consumption patterns between the 6th and 17th centuries merits note. Morphological analyses have also demonstrated changes occurring in the morphology of local cattle, which was bred to be bigger. This attests indirectly to better fodder and breeding conditions. There can be no doubt on these grounds as to the growing importance of cattle in the animal economy of the kingdom, but it also demonstrates the extent of the political power wielded by Makurian kings and the central character of cattle breeding in the Makurian state. The state's control of cattle breeding and herd distribution is confirmed by the traditional Nubian economy model as well as by some, not very numerous written sources (Jakobielski 2001).

The presence of pig is also noteworthy. Pig was never as important for the meat consumption patterns of Nubian society as it was in the Makurian period. The dropping interest in pig rearing over time indicates that the animal was not accepted and included in the animal economy model. Pigs may have been brought to the Dongola Reach from Egypt and their presence could have been part of a "fashion" for things from the north, which also encompassed products like wine and fish sauce etc. Its disappearance in turn could have reflected political changes taking place, that is, the Arab invasion of the Dongola Reach. In this context, the Arab influence could be considered as responsible for the introduction and spread of camel breeding, as well as for the appearance of domestic hen in the region under discussion.

Detailed examination of the remains will help to interpret meat consumption patterns and to differentiate them over time as well as in a socio-topographic view. The results show processes and changes occurring in husbandry and hunting patterns. They will likely have bearing on the investigation of the economic and political power of Makurite kings and on understanding the pillars of Makurian economy.

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