Analysis of the Paleobotanical Collection from Khirbat al-Jariya, an Early Copper Production Site in the Faynan, Jordan

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Introduction

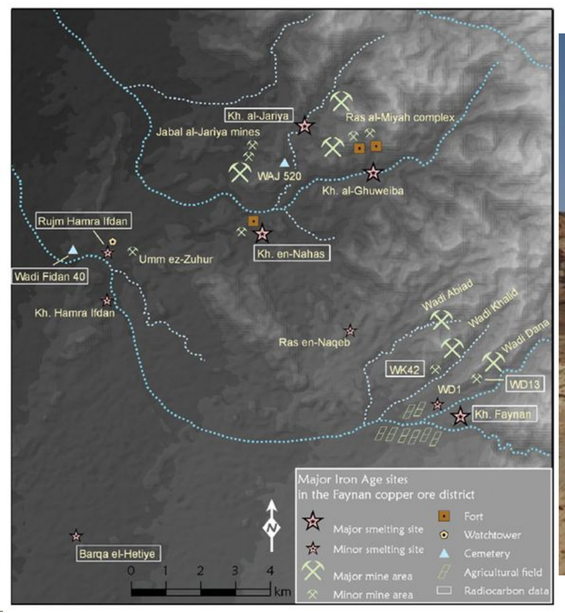

Figure 1. Major Iron Age sites within the Faynan copper ore district. From Ben-Yosef et al. 2010:Figure 1.

Figure 2. Khirbat al-Jariya.

How did the Iron Age metalworkers of Khirbat al-Jariya feed themselves? Were they able to produce their own food or were the workers provisioned from elsewhere?

We analyzed macrobotanical samples from Khirbat al-Jariya (Faynan, Jordan; KAJ), an Early Iron Age (ca. 11th to 10th centuries BCE) copper smelting site (Figures 1 and 2).

Our analysis revealed an overall dominance of fruit taxa that could be sourced locally, within the Faynan region, at the expense of non-local taxa or foods that required extensive preparation (Table 1).

This supports prior interpretations that KAJ was occupied by itinerant worker communities, likely supported by a regional exchange network centered around the nearby smelting center, Khirbat en-Nahas.

The excavated contexts are Area B and Area C, the largest structure at the site and a copper slag mound, respectively.

Table 1. Ubiquity by percentage of samples in which a given taxa was present.

Source	Grains	Pulses	Fruits	Weeds	N
Area B	10.64%	12.77%	25.53%	4.26%	47
Area C	55.56%	55.56%	66.67%	33.33%	9
Stratum IID	44.44%	44.44%	55.56%	22.22%	9
Stratum IIC	100%	100%	100%	100%	1
Stratum IIB	25.00%	50.00%	62.50%	12.50%	8
Startum IIA/B	0.00%	0.00%	11.11%	0.00%	9
Stratum IIA	25.00%	12.50%	25.00%	0.00%	8
Stratum IC	5.56%	5.56%	22.22%	5.56%	15
Stratum IB	0.00%	0.00%	0.00%	0.00%	3
Overall Site	17.86%	19.64%	32.14%	8.93%	56

Methods

We analyzed the light fraction of 56 soil samples taken from throughout the site. The samples were filtered through geological sieves (2 mm, 1 mm, 0.5 mm, and 0.25 mm fraction), and two of these samples (23 and 15) were filtered through a 4 mm fraction. We pulled wood charcoal and identifiable seeds from the 1 mm fraction and above but only recovered identifiable specimens from the 0.5 and 0.25 mm fractions. All archaeological macrobotanical material was counted and weighed.

Figure 3. a) *Phoenix dactylifera* recovered from Khirbat al Jariya; b) *Phoenix dactylifera* with fruit preserved. Figure by Arianna Garvin.

Identifications were based on comparative collections from the Guedes lab and reference books, including *Digital Atlas of Economic Plants in Archaeology* (Neef et al. 2012) and *Identification of Cereal Remains from Archaeological Sites* (Jacomet 2006).

Spot density choropleth maps and principal component analyses revealed no meaningful pattern of spatial distribution by area or stratum (Table 2).

Table 2. Loadings from PCA showing dominance of scatterplots by few, dense, variables. Only loadings with coefficient of variation greater than 0 are included in the table.

PCA with All Variables				
Loadings	Component 1	Component 2	Component 3	Component 4
Wood	1			
Lens sp.			0.159	
Pisum sativum				
Cicer sp.				0.953
Vitis sp.			0.159	0.203
Phoenix dactylifera		-0.994		
Starch			0.958	
Carbon				0.168
Proportion of Variance	0.9993379	0.000635018	1.89E-05	8.06E-06
Cumulative Proportion	0.9993379	0.999972918	0.999991815	0.999999879
PCA with no Wood				
Loadings	**Component 1**	**Component 2**	**Component 3**	**Component 4**
Hordeum vulgare				-0.438
Lens sp.		0.157		-0.2
Pisum sativum				0.44
Cicer sp.			0.955	
Fabaceae				
Lentil/Pea				0.118
Vitis sp.		0.155	0.198	-0.337
Phoenix dactylifera	0.995			
Ficus sp.				0.101
Vicia sp.				0.147
Shiny starch				0.616
Starch		0.962		0.126
Carbon			0.168	
Proportion of Variance	0.971224	0.01998873	0.008412046	2.73E-04
Cumulative Proportion	0.971224	0.99121273	0.999624776	0.999897823
PCA with no wood, Lens sp., Vitis sp., Phoenix sp., or starch				
Loadings	**Component 1**	**Component 2**	**Component 3**	**Component 4**
Cerealia		0.133	-0.293	0.22
Linus usitatissimum			-0.176	0.133
Pisum sativum		0.511	0.206	
Cicer sp.	0.979			
Fabaceae		0.104	-0.199	0.152
Lentil/Pea		0.326	-0.376	0.346
Ficus sp.		0.333	-0.32	-0.304
Shiny starch		0.598	0.568	
Proportion of Variance	0.89296448	0.065242475	0.0318332	9.72E-03

Results

The statistical analysis revealed no meaningful clustering by area or stratum. Each sample was consistently dominated by a single variable with a coefficient of variation approaching 1.

We only recovered a small number of crop processing remains, such as rachis bases or spikelet forks, primarily in Area C during strata associated with potential domestic occupation and refuse (Figure 4).

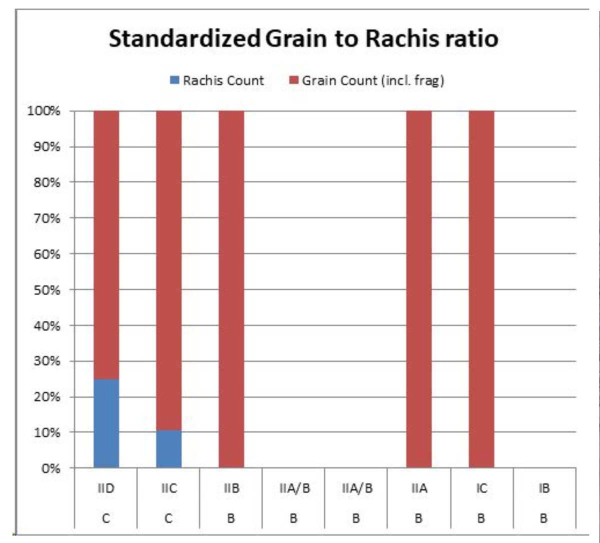

Figure 4. Ratio of grains to rachises by stratum and area. Figure by Fabian Toro-Uribe.

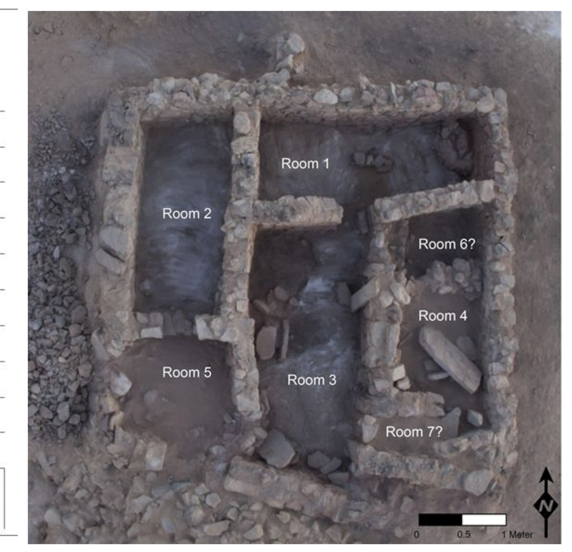

Figure 5. Area B of Khirbat al-Jariya. Figure by Matt Howland.

Fruits dominate the sample, in particular the date palm (*Phoenix dactylifera)*. Although figs (*Ficus* sp.) dominate the standardized count by density, when the counts are standardized by the average number of seeds per fruit (Figure 6), dates become the most abundant fruit.

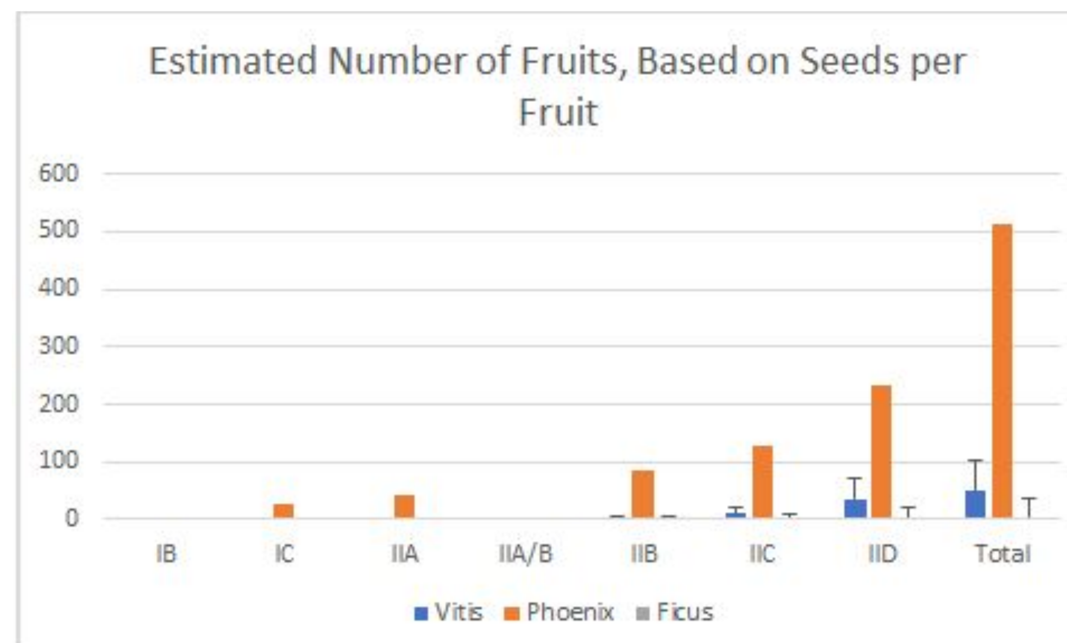

Figure 6. Estimated number of fruits corresponding to low and high estimates based on the total number of recovered seeds. Error bars indicate the low number of seed estimates per fruit. Low estimates per fruit are 2 seeds per *Vitis* sp., 30 seeds per *Ficus* sp., and 1 seed per *Phoenix dactylifera*. High estimates per fruit are 4 seeds per *Vitis* sp., 1600 seeds per *Ficus* sp., and 1 seed per *Phoenix dactylifera*. Figure by Bridget Lawrence.

The sample appears to mostly consist of easily obtainable, local fruit taxa that require little preparation (Figure 7). These taxa are particularly abundant in the structure (Area B; Figure 5). There did not appear to be any meaningful pattern of distribution of the fruits as aggregate, but Room 4 exhibited the largest concentration of date palm pits.

Figure 7. Ratio of grains to pulses to weeds to particular fruits, by stratum and area, standardized by counts per volume and weights per volume, including both whole and fragmented specimens. Figure by Luke Stroth.

Conclusion

The presence of glume bases, rachises, and culms, which are removed in the early stages of cereal processing, has been attributed to "producer" sites that process the grain, whereas higher ratios of seeds to chaff may represent "consumer" sites (Jones 1985; Stevens 2003). This model has been criticized as oversimplifying the complex dynamics of supplying sites across a landscape but provides a useful starting point for interpreting archaeobotanical assemblages. In this case, we have neither an abundance of chaff nor seeds. The results of our analysis of the macrobotanical remains suggest that the inhabitants of KAJ were favoring locally available, easily preparable foods.

There is no evidence of the full spectrum of food harvesting and preparation, from cutting to threshing, sieving, and grinding. If food made from cereal was consumed, it was introduced to the site in a form that is not represented by the paleobotanical assemblage, such as pre-processed flour. The primary source of food appears to have been convenient "snack foods."

It is likely that KAJ was provisioned by a regional network, perhaps centered at KEN, and that KAJ was inhabited by an itinerant population that took advantage of resources local to the Faynan region but did not undertake intensive agriculture.

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