



## Statistical Approach to Archaeobotanical Data

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### Abstract

The excavation of Arslantepe in the Upper Euphrates valley is an important archaeological enterprise in which archaeologists paid particular care in recovering plant remains. Charred wood and carpological remains (tens of kilos), found in several archaeological fire strata of Late Chalcolithic and Bronze Age, constitutes an *unicum* from a botanical point of view. The big quantity of caryopses and legumes found in the level belonging to Early Bronze age I (3000-2750 B.C.) makes necessary the establishing of valid subsampling and data management criteria.

### Introduction

Arslantepe (Malatya, Turkey), with its millennia of buried history (from Late Chalcolithic to Neo-Hittite age) is an anthropogenic hill in which *Missione Archeologica Italiana in Anatolia Orientale (Turchia)* of Sapienza University (<http://w3.uniroma1.it/arslantepe/>) is excavating since the sixties. An international team is working on the several anthropological aspects of the site and single efforts are joined in a multidisciplinary research. The seeds and fruits measurements and their statistical elaboration will constitute the basis for the comparison with macroremains from the other poorest sites of the Near East and a consistent help to the whole scientific community.

During the Early Bronze Age the dwelling structure was a village [1] with small houses completely burnt when the inhabitants had just stored edible cereals and legumes. Tens of thousands of charred seeds and fruits have so far been studied, but the excavation is still in progress and new archaeobotanical material became available every year. In this work we take into consideration the big amount of charred macroremains (several kg) from a small house in order to establish a possible criterion of subsampling and to perform multivariate analyses.

### Materials & Methods

The house A170 was destroyed with its entire village during a violent fire. The archaeobotanical study is problematic for the huge quantity of the remains as the recovery is total; tens of kilos of soil full of charred plant remains have been sampled and dry sieved on site. The archaeological evidence indicates that the crops were stored both inside the rooms and on the roofs. Due to the richness in plant macroremains, the complete analysis is quite impossible. A criterion aimed to obtain a homogeneous subsampling, which is at the basis of statistical processing, was searched. During the trial, the procedure based on the study of subsamples with known weights, was followed. Two soil samples from the same area ( $\alpha$ ), but from different archaeological substrata, were chosen; one of them ( $\alpha R3^*$ ) was gathered from the pavement, the other ( $1c\alpha$ ) from an above substratum. The samples differ both for weight and on-site sampling pre-processing.  $\alpha R3^*$  was dry sieved on-site getting free of part of the sediment, while  $1c\alpha$  was delivered to the Rome lab with all its soil. In Rome a different subsampling procedure was undertaken.  $1c\alpha$  (about 740 g) was divided in five subsamples, of similar weight;  $\alpha R3^*$  was divided in three subsamples of different weight (50 g from top and 50 g from bottom of the containing plastic bag, 550 g constituting the remaining part). The separated cereal grains were then analysed, sorting them according to their taxonomic features. 50 well preserved caryopses

for each abundant taxon in each subsample was then measured along their three standard dimensions.

Tab. 1: Arslantepe, Early Bronze age period, house A170 (sample  $\alpha R3^*$ ). Number of caryopses and related percentages for each taxon

A170 – $\alpha R3^*$	Caryopses number					
	TOP		BOTTOM		TOTAL	
Subsample	n	%	n	%	N	%
<i>Triticum dicoccum</i>	457	64	389	70	5424	62
<i>T. monococcum</i>	250	35	160	29	3229	37
<i>T. aestivum/durum</i>	6	1	3	1	74	1
<i>Hordeum vulgare</i>	6	1	4	1	58	1

suggesting crop processing of the stored grains.

The percentage values for both most abundant taxa of the TOP subsample (A170  $\alpha R3^*$ , tab. 1) can be considered representative of the entire sample as they wander only 2% from the TOTAL one. *T. aestivum/durum* and *Hordeum vulgare* values of the subsamples, even if low, are representative.

Tab. 2: Arslantepe, Early Bronze age period, house A170 (sample 1 $\alpha$ ). Number of caryopses and related percentages for each taxon.

A170 - 1 $\alpha$	Caryopses number											
	1		2		3		4		5		TOTAL	
Subsample	n	%	n	%	n	%	n	%	n	%	N	%
<i>Triticum dicoccum</i>	408	80	373	79	362	70	509	67	224	62	1876	72
<i>T. monococcum</i>	79	15	78	17	137	26	220	29	126	35	640	24
<i>T. aestivum/durum</i>	14	3	12	2	8	2	13	2	7	2	54	2
<i>Hordeum vulgare</i>	10	2	9	2	10	2	13	2	2	1	44	2

The macroremains distribution of 1 $\alpha$  (tab. 2) should better represent the *in situ* situation because the only manipulation consisted in pouring the soil into the plastic bag. This fact very likely resulted in an overturning of the sample, being subsample 1 coming from the lowermost level and 5 from the uppermost one. In this sample the best representing subsample is 3. The variation in taxa distribution could be explained in several ways, *e.g.* with a difference in crop storing, as the result of a mixing during the conflagration or with a cereals sorting according to their morphobiometric features. To better evaluate the last possibility, a K-means Cluster Analysis with centroids randomly selected, with three variables (length, width, thickness) measured on 50 grains of *T. dicoccum* and 50 of *T. monococcum* for each subsample was carried out.

## Conclusions

This study indicates that only two study cases are not enough to provide nor a univocal subsampling general criterion, neither to allow estimating correction factors for single subsampling. It is clear that the best way to subsample starts on site during the sampling. The sampling protocol should therefore be adapted in the case of big charred macroremains finds. The grid mesh (1 m<sup>2</sup>) has to be reduced, and the sampling should be carried out from single squares of 20 cm side (25 squares/1 m<sup>2</sup>). This protocol will hopefully be applied during the next excavation seasons and will constitute the right start of a new subsampling procedure.

## References

- 1) M. Frangipane, The late Chalcolithic/EB I sequence at Arslantepe. Chronological and cultural remarks from a frontier site, in *Chronologies des pays du Caucase et de l'Euphrate aux IVe et IIIe millénaires*, C. Marro, H. Hauptmann Eds., Proc. Varia Anatolica XI Istanbul dec/98, Paris (2000) 439-471