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CHEMICAL EVIDENCE FOR A WINE RESIDUE FROM WARKA (URUK) INSIDE A LATE URUK PERIOD SPOUTED JAR[1]

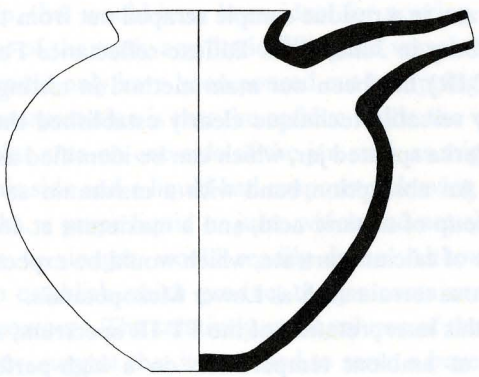

Fig. 1 W 19604. Height 14.3 cm. M. 1:3.

ABSTRACT

The chemical analysis of a residue inside a Late Uruk Period (c. 3500-3100 B.C.) spouted jar (Fig. 1) from Warka (ancient Uruk) produced positive evidence for the presence of tartaric acid. The shape and other features of this jar type, as well as the nature of the residue, indicate that it originally contained a liquid, and was probably a

[1] The jar, W 19604, is published by H. Lenzen in UVB 17, 1961, 27 Taf. 17 a.

serving vessel for a beverage. Tartaric acid occurs in large amounts in nature only in grapes. Under normal conditions and at room temperature, grape juice easily and quickly ferments to wine. This finding supports Algaze's recent suggestion[2] that the widespread occurrence of this jar type at Late Uruk Period sites, especially in upland regions, is related to a wine trade. The presence of a grape residue within the Warka jar suggests that the function of similar jars found elsewhere was also to serve wine, although any customs or circumstances surrounding this activity, whether local or southern Mesopotamian, is not known. Since grapevines are not native to the region around Warka and grow with difficulty in Lower Mesopotamia, it is likely the contents of this vessel were imported.

CHEMICAL IDENTIFICATION OF THE RESIDUE

Three physicochemical techniques were employed to identify tartaric acid and its salt, calcium tartrate, in a residue sample scraped out from the inside of the vessel by V.R.B. in Heidelberg in June, 1994. Diffuse-reflectance Fourier-transform infrared spectrometry (FT-IR) has been our main method in testing for tartaric acid and its salts[3]. This highly versatile technique clearly established the presence of an organic material in the Warka spouted jar, which can be identified as tartaric acid and its salt, calcium tartrate. An absorption band with a maximum at 1725 cm^{-1} is due to the carboxylic acid group of tartaric acid, and a maximum at 1612 cm^{-1} results from the carboxylate group of calcium tartrate, which would be expected to form from the acid in a basic, calcareous terrain such as Lower Mesopotamia.

In support of this interpretation of the FT-IR spectrum, a methanol extract of the residue was run at ambient temperature on a high-performance liquid chromatograph, using a 25 cm x 4.6 mm silica column, a flow rate of 2.0 ml/min, and an ultraviolet (UV) detector over the 200-400 nm range. Organic material came off the column at about 1.3 and 1.6 minutes. The UV spectra at these times are closely comparable with those of a large group of ancient and modern wine samples. There is strong evidence, as well, that the second peak correlates with the presence of a tree resin, perhaps used as a preservative or to enhance antibiotic properties.

[2] G. Algaze, Fourth Millennium B. C. Trade in Greater Mesopotamia: Did it Include Wine?, in P. E. McGovern, S. J. Fleming, and S. Katz (eds.), The Origins and Ancient History of Wine, in press.

[3] R. H. Michel, P. E. McGovern, and V. R. Badler, The First Wine and Beer: Chemical Detection of Ancient Fermented Beverages, Analytical Chemistry 65.8, 1993, 408 A-413 A; also see: P. E. McGovern and R. H. Michel, The Analytical and Archaeological Challenge of Detecting Ancient Wine, in McGovern, Fleming and Katz (eds.), op. cit.

Finally, a third analytical technique confirmed the presence of tartaric acid/tartrate, viz., a specific, wet-chemical Feigl test in which β,β′-dinaphthol and concentrated sulfuric acid are used to convert tartaric acid to a compound that exhibits green fluorescence under UV light. Once again, the Warka residue gave a positive result.

The results of the three independent chemical analyses together strongly support the presence of tartaric acid and its salt, calcium tartrate, in the Warka spouted jar (W 19604). Thus, the vessel must have once contained a grape product.

WINE AS THE PROBABLE CONTENTS

The vessel type is crucial in establishing what kind of grape product was present. Two features of the Warka jar point to its grape product having been originally a liquid, viz., a narrow mouth (7.4 cm in diameter) and a long spout (7 cm), narrowing to 1 cm diameter at its tip, that would have been ideal for pouring. With the end of the spout above the height of the neck, any liquid filling the vessel to this level would not have spilled out and could only have been poured out by tipping the jar. Another detail that supports this interpretation is that the residue inside the vessel was limited to an approximately circular area on one side of the jar, such as might be expected if the vessel had fallen on this side and a liquid had evaporated leaving a precipitant.

In the climate of Warka, a grape liquid or juice which had not already fermented to wine, or subsequently, to vinegar, would readily do so. Although the chemical evidence is insufficient to establish which product the jar contained, wine would be the most likely intended contents. The relatively small volume of the vessel (ca. 1.3 l) and its long spout, however, suggest that it was used to serve a beverage, rather than to transport, store, or process a grape product. If the beverage were imported into Warka, it would be preferable to use a larger pottery vessel, without a spout that might be easily broken off and would need to be stoppered to prevent spoilage or leakage of the liquid; or perhaps, a container made of a less fragile and lighter material such as animal skins or leather was used. Chemical and/or petrographic analysis of jar W 19604 might be able to establish whether it is a local product or an import.

According to Lenzen[4], jar W 19604 was found in square Na XVI 2, approximately 70 cm below the bricks of a so-called offering/sacrifice place (Opferstätte)[5]. Three other spouted vessels - W 19600 (Taf. 17e), W 19605 (Taf. 16 i), and W 19606 (Taf.

[4] Lenzen, op. cit., 27.

[5] The field notebook, Uruk-Warka, Kamp. XII-XVIII, lists W 19604 as having been found approximately 80 cm below the bricks of the Opferstätte.

17c)[6] - are listed as coming from the same findspot. This context was assigned to levels V-VI, the Late Uruk Period. The three other spouted jars were not analyzed. It should be emphasized that the same type of vessel could have been used to hold different kinds of liquids, and the analysis of vessel W 19604 only indicates that at least one of these vessels held a chemically identifiable grape liquid, most likely wine.

IMPLICATIONS FOR THE INTERPRETATION OF ARCHAIC SUMERIAN WRITING

The finding of a chemically attested grape liquid, most probably wine, dating to the Late Uruk Period supports Green's interpretation[7] of the sign *tin* as being the earliest cuneiform ideogram for wine. Geštin, which is translated as wine in later periods, does not occur before the later Jemdet Naṣr Period (c. 3100-2900 B.C.), and appears on plant and fruit lists, not in contexts that can definitely be translated as a grape liquid, wine or vinegar[8].

IMPLICATIONS FOR LATE URUK PERIOD TRADE

Since the hot, dry climate of the Warka region of southern Iraq would preclude the large-scale growing of grapevines, it is most likely that the contents of vessel W 19604 were imported from a region where the climate is more conducive to the growing of wild and domesticated grapes[9]. Spouted jars similar to the Warka example have a wide geographical distribution during the Late Uruk Period, and are found at sites in southeastern Turkey, Syria, northern Iraq, and southern Iran, many of which are within the wild grape-growing regions. Grape seeds dating to the Late

6 Lenzen, op. cit.

7 M. W. Green, Early Cuneiform, in W. M. Senner (ed.), The Origins of Writing, 1989, 44.

8 M. W. Green and H. J. Nissen, Zeichenliste der archaischen Texte aus Uruk, 1987.

9 For the modern geographical range of the wild grapevine, see: D. Zohary and P. Spiegel-Roy, The Beginning of Fruit Growing in the Old World, Science 187, 1975, 319-327, fig. 3; J. M. Renfrew, Palaeoethnobotany, 1973, figs. 77, 78; see also D. Zohary and M. Hopf, Domestication of Plants in the Old World: The Origin and Spread of Cultivated Plants in West Asia, Europe, and the Nile Valley, 1988, and D. Zohary, The Domestication of the Grape Vine Vitis Vinifera in the Near East, in McGovern, Fleming and Katz (eds.), op. cit.

Uruk Period have been found at several of these sites[10], and at Godin Tepe in north central Iran there is slightly later evidence (ca. 3100-2900 B.C.) for winemaking[11].

It seems apparent that wine should be added to the list of Late Uruk Period trade goods. This new finding also answers two of the questions that had previously been asked[12]: viticulture was apparently far enough advanced in regions where the vine grows readily to produce surplus wine for long-distance export, and there was a foreign demand for wine in Mesopotamia at this very early date. The analysis of many more vessels is needed, however, to further ascertain the importance of the wine trade at this time, and the role of this alcoholic beverage in the formation of the large trading network which characterizes the Late Uruk Period.

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10 R. L. Zeitler and N. S. Miller, Searching for Wine in the Archaeological Record of Ancient Mesopotamia of the Third and Second Millennia B.C., in McGovern, Fleming and Katz (eds.), op. cit.; N.F. Miller, Appendix 1, Some Archaeobotanical Remains from the 1992 Excavation Season at Hacinebi Tepe, Anatolica 20, 1994, 168-172; H.J. Gregor, Paläobotanische Untersuchungen zur antiken Pflanzenwelt des Hassek Höyük im Tal des oberen Euphrat und ein Versuch zur Rekonstruktion des dortigen Ökosystems für den Übergang von der späten Urukzeit zur frühen Bronzezeit, in M.R. Behm-Blancke, ed., Hassek Höyük, Naturwissenschaftliche Untersuchungen und lithische Industrie, Istanbuler Forschungen 38, 1992, 34-57; N.F. Miller, The Near East, in W. van Zeist, K. Wasylikowa, and K.-E. Behre, eds., Progress in Old World Paleoethnobotany, 1991, 133-160.

11 V. R. Badler, P. E. McGovern, and R. H. Michel, Drink and be Merry!: Infrared Spectroscopy and Ancient Near Eastern Wine, in W. R. Biers and P. E. McGovern (eds.), Organic Contents of Ancient Vessels: Materials Analysis and Archaeological Investigation, Museum Applied Science Center for Archaeology Research Papers in Science and Archaeology 7, 1990, 25-36; and V. R. Badler, The Archaeological Evidence for Winemaking, Distribution, and Consumption at Proto-Historic Godin Tepe, Iran, in McGovern, Fleming and Katz (eds.), op. cit.

12 Badler, McGovern, and Michel, op. cit., 34.