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Intersection of Toxicology and Archaeology Sciences

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ABSTRACT

Toxicology is a science that dates to Ancient Egypt. Animal and herbal poisons were classified according to their source, and cases were categorized based on symptoms, with comments about prognosis, were included at texts were written Ancient Egypt period. In the texts written by the ancient writer Strabo, it is understood that communities with mastery on snakes lived in Anatolia. There is also information that plant-derived poisons were used in hunting and war tools in ancient time. It is seen that poisons were used quite widely in the Roman Period. There is also the extensive use of lead, especially in Roman plumbing, caused researchers to think about whether there was mass chronic poisoning.
The aim of this study is to determine the current situation in order to use the Toxicology discipline in the field of Archaeology and to shed light on the period by using animals that met needs such as food sources, mounts and protection in the ancient period as biomarkers.

INTRODUCTION

Toxicology, deals with the physicochemical properties of toxic substances, classification, effects on living organisms (human, animal, etc.), treatment and prevention procedures, analysis methods (qualitative and quantitative; chromatographic, molecular, in silico, new aprroches, in vivo, in vitro, experimental, screening, etc.) in different matrices for diagnosis/treatment and scientific researchs, as well as future predictions in order to take/develop measures, etc. (Langman and Kapur, 2006; Yipel and Altınok-Yipel, 2025). Toxicology, which is called the science of poisons and while dates back to Ancient Egypt, starts scientificaly with Paracelsus and Orfila.

Although there are many legends claiming that the entrance to Tust's Tomb, which is known to date back to 3000 BC, is indeed cursed as described in the hieroglyphs, an extraordinary article has suggested that there may be a scientific explanation for the tomb's curse. According to this article, the tomb's remains were found to contain much higher levels of radiation than would be expected from limestone, a common building material, suggesting an artificial source. In addition, Egyptologists working in the tomb reported unusual deaths that coincided with the symptoms of radiation sickness (Fellowes, 2024).

One of the oldest known texts on toxicology is the Ebers Papyri, dated to around 1550 BC. The Ebers Papyri are thought to be copies of texts by Imhotep, who lived in the early 3rd millennium BC. Discovered in 1872, the papyri contain more than 900 prescriptions. The text contains passages on opium, aconitine, arsenic trioxide, cyanogenic glycosides or physostigmine isolated from Calabar beans (Nepovimova and Kuca, 2019).

One of the oldest known written texts on toxicology is the Brooklyn Papyrus (600-525 BC), written in Ancient Egypt. In these texts, besides the description of venomous snakes; three prognoses defined as certain death, uncertain and survival were mentioned. In making these distinctions, not only the type of snake but also its adulthood was taken as a criterion; in addition, the prognosis was described according to the severity of the poisoning according to the symptoms (Wexler, 2014). This has great similarities with the methods used in modern toxicology to characterize the clinical picture. It shows a very similar understanding of the use of criteria such as factors related to the toxin and

its source, dose-related factors and patient-related factors. It is possible to see in the Ebers papyrus that they treat mental illnesses as they do in the modern world without separating them from physical illnesses.

The Berlin Medical Papyrus, written in approximately 1200 BC, contains treatments used for scorpion bites, while the Edwin Smith Papyrus describes tetanus, which is said to be caused by open wounds, and explains that treatment is not possible (Wexler, 2014).

In the West, probably the best known case of poisoning is that of Socrates, who ended his life by drinking hemlock (*Conium maculatum, Apiaceae*) poison. Hippocrates (460-377 BC) almost never mentioned poisons in his *Corpus hippocraticum*, one of the main sources of medicine. This was probably because he condemned the use of poisons in murder. However, he did mention the symptoms of poisoning (Nepovimova and Kuca, 2019).

In the section where the ancient writer Strabo mentions the ancient city of Parion, which is located in the Biga District of Çanakkale today, he mentions a community called Ophiogen, which he states that they belong to the Snake Tribe. Strabo attributed the Ophiogenes to the Psyls, the ancient Libyans, and stated that they had the same abilities (Strabon, 2000).

The ancient Libyan Ophiogenes were immune to snake venom, knew how to treat various poisonings, and the Romans held them in high esteem because of this (Jones-Lewis, 2016).

Nikandros of Colophon, who lived in the 2nd century BC, has two writings on poisons and antidotes, Alexipharmaca and Theriaca. It is known that Nikandros recommends flaxseed tea as an emetic as a general antidote and recommends the removal of the poison from the tissues in poisonous animal bites and stings by sucking the poison with the mouth (Nepovimova and Kuca, 2019).

The term mithridatism has its origins in a legend about the King of Pontus Mithridates VI (132-63 BC). The king's fear of dying by poisoning was so great that he spent his entire life trying to develop a single, marvelous antidote, which would be called “mithridaticum” by the Romans. According to legend, at the end of his life, the king wanted to end his life by poisoning himself, but he was unsuccessful in his suicide attempt because he had developed a tolerance to poisons by constantly poisoning himself in small doses. This is why the term 'mithridatism' is used today, meaning becoming resistant to poisons through exposure to small doses (Nepovimova and Kuca, 2019).

It is known that poisons were widely used in Ancient Rome. Although the Romans had knowledge of poisons of plant, animal and mineral origin, it is reported that they generally used plant-based poisons. Especially during the reigns of Julius Caesar and Cladius, the use of poisons became very widespread and many specific and general antidotes were widely used (Cilliers and Retief, 2000; Nepovimova and Kuca, 2019).

It is said that the Romans threw angry bees at the enemy with slingshots, and that Mithridates, while fighting the Romans, drilled holes in the tunnels dug by the Romans and sent wasps into the tunnels. Other ancient sources mention the existence of winged scorpions in Ancient Egypt and India. Scorpion venom was said to be more effective than snake venom. For a long time in both Egypt and Rome, scorpions were associated with cursed or evil spirits that were feared, but later they became the symbol of Rome's elite military units and even became the name of a kind of instrument used in sieges because of its power (Arıkan and Akcicek, 2022).

However, the use of lead metals was extremely widespread in Ancient Rome. Lead oxide was used in construction, lead carbonate in medicine, and lead acetate in wine and food flavorings and condoms. Lead and tin alloys were frequently used to coat containers for storing food and drink. In ancient Rome, lead was used so extensively in the transportation and storage of drinking and potable water that the word 'plumbing' was derived from the Latin word 'plumbum' meaning lead. For these reasons, there are opinions that lead exposure indirectly accelerated the decline of the Roman Empire by causing a decrease in the aristocratic population due to its effect on fertility. However, the amount of lead found in the analysis of bones from the Roman period is reported to be less than half of that of today's European populations (Cilliers and Retief, 2019).

Analytical Studies Conducted on The Topic

A study was conducted to identify herbal poisons that may have been used in arrows and similar hunting weapons used on game animals, and then to compare their standards with archaeological samples. Then, in order not to damage the precious artifacts, samples were prepared by rubbing the surfaces of the artifacts with pure water and cotton and sent to the laboratory. In the laboratory, the samples were first enriched by removing solvents with nitrogen and then derivatized. Then they were analyzed by LC-Q Orbitrap and GC- MS. The analysis confirmed the presence of aconite in the Chinese ceramic vessel containing aconite. An iron arrow, a wooden dart and a bone spearhead were found to contain compounds that can be considered as evidence for the presence of Antiaris toxicara, and an iron arrow and a spatula were found to contain compounds that can be considered as evidence for the presence of *Strychnos* species plants. It was also mentioned that the artifacts from which the samples for these analyzes were obtained were found in European museums after being obtained from the Asian and African continents and that the sampling was done from the museum inventory (Borgia et al., 2017).

In this study, the fact that the finds were sampled perhaps years after they were unearthed, the lack of enlightening records about their fate during this period, and the difficulty of obtaining standards are important handicaps. However, the use of a double quadropole device for more precise determination of the compounds sought would have provided more satisfactory results, at least on the gas chromatography side.

In another study, LC-MS/MS was used in skull bone tissues obtained from burial chambers containing the remains of people who were treated and died during the 17th century in Milan, and active components of Erythroxylum spp. including cocaine were found. Exposure was thought to be due to the therapeutic use of cocaine at the time (Giordano et al., 2024).

In another study, human bones obtained from excavations in a necropolis in the Lombardy region of Italy and dated from the Neolithic to the Bronze Age (9000-1000 BC) were sampled and trace elements were determined using ICP-MS. Lead isotopes were used to detect post-mortem contamination. The study provided insight into the diet of the period, and the low Cu and Zn values led to the conclusion that they were fed a low-protein diet. Furthermore, no significant differences were observed between different bone tissues of the same

individuals and between genders. In addition, the importance of a multidisciplinary approach with chemical, statistical and archaeological perspectives is emphasized. Analysis of trace elements in bone tissue has been shown to provide a well-preserved archive of nutrition and therefore lifestyle (Corti et al., 2013).

Trace elements are elements that can be both essential and toxic depending on their concentration, presence and some other factors, and have an impact on environmental problems, human, plant and animal health (Swaine, 2000).

In another study conducted in Cartagena, Spain, 30 bones and 8 recent bone tissues covering a period from the Neolithic Period to the Byzantine Period were studied. As a result of the study, an increase in trace element levels was detected starting from the Neolithic period and it was noted that different trace element levels increased in different periods (Martínez-García, et al., 2005).

A comparison of pre-Hispanic and modern bones from El Hierro Island revealed that Pb and Cd levels were lower in pre-Hispanic remains and that Pb and Cd levels in El Hierro Island were lower than in the other Canary Islands. Considering the presence of volcanic activities on El Hierro Island, it should be considered that the distribution of heavy metal residues from ancient periods may be significantly different due to non-anthropogenic factors (González-Reimers, et al., 2005).

Although archaeology and toxicology seem to be two unrelated disciplines, the relatively recent introduction of instruments such as LC-MS/MS, LA ICP-MS, LC-Q Orbitrap HRMS may have made this field difficult to recognize. Although the number of studies on the presence of trace elements is higher than others, it is far from being a routine to investigate the presence of trace elements in valuable bone remains from archaeological excavations. On the other hand, the study to detect the presence of herbal poisons on archaeological hunting tools is one of the very rare examples in this field (Borgia et al., 2017).

CONCLUSION

Information on toxicology (toxic substances, individual and social cases, effects of toxicology on political and cultural history, etc.) before Paracelus (1493-1541) and especially before ancient Egypt is very limited. The historical implications of potential toxicological events have become more important, especially since toxic substances have caused deaths and illnesses since antiquity, have been used in political and other crimes, and toxicological methods have played an important role in wars in the past century. On the other hand, with the discoveries and developments in the fields of forensic toxicology, archaeology and anthropology etc. with chromatographic analysis methods (mass spectroscopy etc.) and forensic toxicology, working hypotheses involving the analysis of archaeological findings with modern toxicological methods have become popular research topics.

As mentioned by the researchers, the fact that the hunting implements were sampled from the inventories of museums in other countries long after they were obtained from archaeological excavations, and that no records of the treatments applied to the hunting implements and the conditions in which they were found were not kept during this time, although these were major disadvantages for the study, promising results for the future could be obtained.

In the future, with the advancement of technology in the field of analytical chemistry, the presence of toxicologists in the scientific committees of archaeological excavations, and the protection of data on the remains, just as the protection of ancient artifacts, may enable the disciplines of archaeology and toxicology (both medicine, veterinary, and environmental sciences fields) to obtain important outputs regarding the past and the future.

Conflict of Interest

The authors declare that they have no competing interests.

Authorship contributions

Concept: D.C.N., M.Y., Design: D.C.N., M.Y., Data Collection or Processing: D.C.N., M.Y., Literature Search: D.C.N., M.Y., Writing: D.C.N., M.Y.

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REFERENCES

Borgia, V., Carlin, M. G., and Crezzini, J. 2017. Poison, plants and Palaeolithic hunters. An analytical method to investigate the presence of plant poison on archaeological artefacts. Quaternary International, 427: 94-103.

Cilliers, L., and Retief, F. 2019. Lead poisoning and the downfall of Rome: Reality or myth?. In Toxicology in Antiquity, Academic Press, 221-229.

Cilliers, L., and Retief, F. P. 2000. Poisons, poisoning and the drug trade in ancient Rome. Akroterion, 45(1): 88-100.

Corti, C., Rampazzi, L., Ravedoni, C., and Giussani, B. 2013. On the use of trace elements in ancient necropolis studies: Overview and ICP-MS application to the case study of Valdaro site, Italy. Microchemical Journal, 110: 614-623.

Fellowes, R. 2024. The Pharaoh's Curse: New Evidence of Unusual Deaths Associated With Ancient Egyptian Tombs. Journal of Scientific Exploration, 38(1): 41-60.

Giordano, G., Mattia, M., Biehler-Gomez, L., Boracchi, M., Porro, A., Sardanelli, F., ... and Cattaneo, C. 2024. Forensic toxicology backdates the use of coca plant (Erythroxylum spp.) in Europe to the early 1600s. Journal of Archaeological Science, 170: 106040.

González-Reimers, E., Arnay-De-La-Rosa, M., Velasco-Vázquez, J., Galindo-Martín, L., and Santolaria-Fernández, F. 2005. Bone cadmium and lead in the ancient population from El Hierro, Canary Islands. Biological Trace Element Research, 105: 37-51.

Arıkan and Akçiçek, Scorpious “Living Fossils” Ege Üniversitesi Yayınları, 2022.

Jones-Lewis, M. 2016. The case of the Psylloi. The Routledge Handbook of Identity and the Environment in the Classical and Medieval Worlds, 192.

Langman, L. J., and Kapur, B. M. 2006. Toxicology: then and now. Clinical Biochemistry, 39(5): 498-510.

Martínez-García, M. J., Moreno, J. M., Moreno-Clavel, J., Vergara, N., García-Sánchez, A., Guillamón, A., ... and Moreno-Grau, S. 2005. Heavy metals in human bones in different historical epochs. Science of the Total Environment, 348(1-3): 51-72.

Nepovimova, E., and Kuca, K. 2019. *The history of poisoning: from ancient times until modern ERA*. Archives of Toxicology, 93(1). 11-24.

Strabon, G. A. A. C. K. 2000. XII-XIII-XIV, Adnan Pekman (Eds.), Arkeoloji ve Sanat Yayınları, 4th ed., İstanbul, 96.

Swaine, D. J. 2000. Why trace elements are important. Fuel Processing Technology, 65: 21-33.

Gonzalo M. sanchez and W. Benson Harer 2014. Toxicology in Ancient Egypt, in Philip Wexler (Eds.) History of Toxicology and Environmental Healt Toxicology in Antiquity, Volume :1 Academic Press is an imprint of Elsevier 225 Wyman Street, Waltham, MA 02451, USA, 1-8.

Yipel ve Altınok-Yipel. 2025. Aquatic Animals in Experimental Studies. In Laboratory Animal Medicine, Güneştıp Kitapevi.