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Historical and Archeametric Evaluation of a Group of Copper Coins Belong to Artuqids Period Available in the Batman Museum

Batman Müzesinde Bulunan Artuklu Dönemine Ait bir Grup Bakır Sikkenin Tarihsel ve Arkeometrik Olarak Değerlendirilmesi

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Abstract: Analysis of a group of coins belonging to the Artuqid period, which came to the Batman Museum by purchasing, was analyzed with the Energy-Dispersive Portable X-Ray Fluorescence Spectrometer (P-EDXRF). With on-site analysis and P-EDXRF technique, which has a non-destructive method characteristic, the element percentages in the composition of the coins were identified. According to the results of the P-EDXRF analysis, it was identified that it contains avarage %97.24 copper as a main element, trace amount of lead % 0.926, % 0.462 iron, %0.347 siliciumn and %0.210 phosphorus.

According to the P-EDXRF analysis results, it was confirmed that the coins were not imitations. Because of their location Artuqids influenced by many cultures, and this condition also influenced their economic life. It has been observed that this interaction is also reflected in the coins.

Keywords: Archaeometry, P-EDXRF, Artuqid, Coin.

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Öz: Batman Müzesi'ne satın alma yoluyla gelen ve Artuklular dönemine ait olan bir grup sikkenin Enerji Dağılımlı Taşınabilir X-Işını Floresans Spektrometresi (P-EDXRF) ile analizi gerçekleştirilmiştir. Yerinde analiz ve tahribatsız bir yöntem özelliğinde olan P-EDXRF tekniği ile sikkelerin bileşimlerinde olan element oranları tespit edilmiştir. P-EDXRF analiz sonucuna göre ana element olarak ortalama % 97.24 oranında bakır, eser düzeyde %0.926 kurşun, %0.462 demir, % 0.347 silisyum ve % 0.210 fosfor içerdiği tespit edilmiştir.

P-EDXRF analiz sonuçlarına göre sikkelerin sahte olmadıkları tespit edilmiştir. Artuklular, sahip oldukları konumdan dolayı birçok kültürden etkilenmiş, bu durum ekonomik hayatlarına da yansımıştır. Bu etkileşimin sikkelere de yansıdığı görülmüştür.

Anahtar Kelimeler: Arkeometri, P-EDXRF, Artuklu, Sikke.

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1.Introduction

Before the Neolithic age, for the continuation of life, people tried to make a living by hunting and gathering. With the property consciousness that developed in the Neolithic Age, people settled down (Altan, 1993). People living in this period used the technique called barter in trade to improve their living standards (Tekin, 1992). In this barter technique, it became hard to understand the real value of the goods, and as a result of this money was needed to determine the value of the goods. In the early days of trade, instead of money people used implements such as grain products, animals, tools and metal rods. They had difficulty

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in storing, transporting and sharing these goods. In time, as it is easy to use, precious metals were used for barter. These mines came to the prominence firstly as gold and then silver because of their scarcity, easy preservation and lack of depletion (Tekin, 1992). These metals' value was determined by specifying only the size and weight at first, later these metals were stamped as a sign and this stamp showed the value of the metal. Various forms of these metal coins were used in Egypt, the Mediterranean, Anatolia and Mesopotamia in the end of 4th millennium BC until the invention of the coin. By the second half of the 7th century BC, with the ever- increasing trade; It is thought that the coin, which is defined as "a small piece of round metal, weight adjusted, bearing the official coat of arms or sign of the authorized administration or the state that minted it and put into circulation and guarantee to take it back when requested, was invented (Tekin, 1992).

It is estimated that the coins minted from a mixture of gold, silver and metal were first invented in the west of Anatolia, Lydia. Coins were generally minted by using electrum, gold and silver. After the second half of the 4th century, bronze coins also began to be minted (Tekin, 1988).

As a word, coin means "discurrent". However, this term is a word that was borrowed from Arabic as the equivalent of money in ancient and medieval times. The Greek equivalent of the coin is Nomos, which means "law", and Nomisma, which is derived from this term, and its meaning in Latin language is "Nummus". The science of coins is called Numismatic, and people studying on this science are called as Numismatists (Okçu, 2005).

The reason why the first coins in history were minted in Anatolia is related to reality that Anatolia is the place where civilizations developed. Anatolia continued this superiority and the world's first big royal mint was founded in Istanbul, Simkeşhane (Artuk, 1982).

The minting process of coins; This is accomplished by placing a blank coin stamp between two dies and then hitting the upper die with a hammer. As a result of the hammer strike, the depiction and writing on the molds is transferred on coin stamp. One of the dies, and usually the face of the coin, could be engraved on the anvil or also could be placed in a drilled slot on the anvil. Until the 17th century the minting of coins was made by hammer strike and after 17th century the minting machine started to be used. However, with the transition to mechanization in the 17th century, the coin stamps became smoother and the currency in circulation increased a lot compared to the previous rates (Tekin, 2009).

Coins are the minor coins which include the symbols and inscriptions of the rulers or the state. The coin is an Arabic origin word and it means "mold that prepared for printing stamps or decoration" (Tekin, 2009). Coins reflect numerous historical events in terms of the rulers of states, polity and reign period, economy, politics and religion. At the same time, the depictions, writings and decorations on the coins have a scientific document value in revealing many historical events that have been lost on paper and these coins show the religious belief, language, cultural and artistic aspects, artistic interaction and geographical location of the society (Parlar, 2015).

In the Islamic world, as from Umayyads, coins had been accepted as the symbol of official authority and sovereignty. Hence, minting coin and giving sermon in his own name as a sign have become a tradition for the ruler who ascend the throne. Although pictures were not used on Islamic coins, tradition of not using pictures was not followed by the Seljuks, Artuqids and other Muslim states. Especially the Artuqids are among the principalities that use pictures and descriptions the most in coin minting. On the coins there are verses from the Qur'an, religious terms like kalime-i tevhid and informations about the ruler (Tekin, 2009). It can also be said that the Artuqids were influenced by many cultures. For example, human figure is not appearing in Islamic coins but can be found in Artuqid coins (Table 1 and figure 1). In addition, the presence of figures of many rulers on the coins indicates that the ruler followed a peaceful policy with other states. The minting of coins also gives information about the strength and weakness of the state (Çayırdağ, 1988). The coins recovered during the archaeological excavations not only help to find out which period or king the coin belongs to, but also enable us to date the layer that the coins found (Altan, 1976).

Protecting the materials that giving information about the past and maintaining our cultural heritage is extremely important. It is seen that for this purpose researchers make use of Archaeometry (Aydın, 2017, Aydın, 2020; Işık, 2019, Öztoprak, 2019). Archaeometry can be defined as the application and use of mathematical measurement and analysis methods of science and natural sciences in archeology. Archaeometric studies contribute to the understanding and interpretation of life in the past.

Academic studies on these materials facilitate the understanding of religious, political, social and cultural values of mentioned period. When we consider these features of coins, it is extremely important to analyze their physical and chemical components.

This study was designed on a group of coins belonging to the Artukid period available in the Batman Archeology Museum. The analysis of these coins was carried out with the P-EDXRF device, which is used in non-destructive studies, provides fast results and is easy to use. The most important feature of this device is that the analyses were carried out non-destructively and directly without taking any pieces from the artifact. Another important feature is that as it is a portable device it offers on-site analysis without damaging the artifacts. Scientists have enabled the examination of many work of art by using these advantageous features of P-EDXRF (Aydin, 2017). In addition, this device can complete the analysis of 32 elements at the same time and in a short time and give the results in the form of ppm and percentage (Aydın, 2013). The most important aim of this study is by making archaeometric analyzes of the coins belonging to the Artuqid period in the Batman Archeology Museum to understand the composition of the artifact, to determine the alloy ratios, to detect the change of metal ratios over time, and to determine the corrosion they suffered. As a result of the studies, it is aimed to have important information about the chemical structure of the coins and to contribute to the scientific world with the information obtained about the political, economic, commercial and social structure of the period.

2. Materials and Method

2.1. Material

In this study, 28 copper alloy coins belonging to the Artuqid Period were analyzed and those coins came to the Batman Museum by purchasing.

As it is known, the measurements carried out with the help of P-EDXRF device are made from the surface of the materials. Therefore, it is predicted that the contamination and corrosion that will occur on the surface of the material may affect the measurement result. Primarily their inventory data entered, mechanical cleaning and documentation done by experts in the course of purchasing process and after that the 28 coins analyzed during the study. Against the possibility of formation of a corrosion layer on the surface of the 28 coins studied, measurements were done on both surfaces of some coins to make the analysis results more accurate and reliable.

Inventory numbers, typological and characteristic features, analysis numbers and photographs of 28 coins used in the study are given in Table 1 and Figure 1.

Table 1. Characteristic of the coins in the Batman Museum Catalog

Inventory Number	**Front surface**	**Back surfaface**
2017-67	Human depiction on an animal	It has Arabic script. Faded, broken, missing and corroded
2017-68	Depiction of a monarch riding a lion	There are four lines of Arabic writing, it is faded and corroded.

2017-69	Depiction of a monarch riding a lion	There are four lines of Arabic writing, it is faded and corroded.
2017-70	Depiction of a monarch riding a lion	There are four lines of Arabic writing, it is faded and corroded.
2017-71	There are four human figures, three standing and one sitting.	There is faint Arabic writing. Corrosive
2017-72	Depiction of monarch facing right from profile	There are five lines of Arabic writing, it is faded and corroded.
2017-73	There is a depiction of the ruler looking to the right from the profile. It is broken	There are four lines of Arabic writing, it is faded and corroded
2017-74	There is a depiction of the ruler looking to the right from the profile. It is broken	There are four lines of Arabic writing, it is faded and corroded.
2017-75	Depiction of the ruler from the front	It has four lines of Arabic writing and is corroded.
2017-76	Depiction of the ruler from the front	It has four lines of Arabic writing and is corroded.
2017-77	Depiction of the ruler from the front	It has four lines of Arabic writing and is corroded.
2017-78	Depiction of the ruler from the front	It has four lines of Arabic writing and is corroded.
2017-79	Depiction of the ruler from the front	It has four lines of Arabic writing and is corroded.
2017-80	Depiction of the ruler from the front	There is faint Arabic writing inside the six-pointed star. Corroded, broken and missing
2017-81	Depiction of the ruler from the front	There is faint Arabic writing inside the six-pointed star. Corroded, broken and missing
2017-82	Frontal depiction of the ruler sitting cross-legged	Faint Arabic writing is present and corroded.
2017-83	Frontal depiction of the ruler sitting cross-legged	Faint Arabic writing is present and corroded.
2017-84	Depiction of a seated monarch from the front	Faded, corroded, broken and missing
2017-85	Front view of two people	There is a depiction of the ruler and Arabic writing on the front. The lettering is broken, missing and corroded.
2017-86	There are four lines of faint Arabic writing and it is corroded.	There are three lines of faint Arabic writing, it is broken, missing and corroded.
2017-232	Depiction of monarch facing right from profile and is corroded.	There are four rows of Arabic writing. Corroded and faded.
2017-233	Depiction of monarch facing right from profile and is corroded.	There are four rows of Arabic writing. Corroded and faded.
2017-234	Depiction of monarch facing right in profile. Corrosive and indistinct	There are four rows of Arabic writing. Corroded and faded.

2017-235	A depiction of a monarch on a horse. Corrosive and indistinct	There are three lines of Arabic writing, it is faded and corroded.
2017-236	Depiction of a monarch riding a lion	Silik Arapça yazı mevcut ve korozyonludur
2017-237	Two human depictions, one from the front and the other from the profile. It is faint and corroded	It has four lines of Arabic writing and corrosion.
2017-238	Two human depictions from the front, faded and corroded.	Depiction of a monarch through a dotted border. Faded, broken, missing and corroded
2017-39	Seated human figure on the ground with three people standing	It has faint Arabic writing and corrosion.

Figure 1. Photos of Coins

2.2. Method

The study was carried out with the P-EDXRF (Olympus, Delta Premium) spectrometer, which lets us to do *in situ* (on site) and non-destructive analysis to determine the chemical components of 28 coins that belongs to the Artuqid period. These 28 coins were brought in to the Batman Museum in 2014 by purchasing.

Figure 2. P-EDXRF Spectrometer

The following process steps were performed in the analysis of coins with P-EDXRF:

- Before starting the analysis, it was checked whether the coins were clean or not
- Coins having dust on their surfaces were dusted off with a soft-tipped brush.
- Considering the possibility of an unremovable clean area, by performing filtered analysis surface pollution effect is minimized.
- After suitable time duration and the mode (Alloy Plus) suitable for the analysis of metal alloys had been set, the analysis was completed by placing the P-EDXRF device on the sample or placing the sample on device (Figure 2).
- to keeping the device stable on the sample or keeping the sample stable on the device is extremely important to obtain recurring and accurate results in each analysis.
- When the device is kept steady for 2-3 minutes during the analysis, the relevant results of analysis are automatically recorded as % and ppm on the screen.
- Recorded results were transferred from device to the computer.

3. Discussion and Conclusion

The P-EDXRF analysis results of 28 coins are summarized in Figure (1 and 2). Some coins' both reverse and obverse were analyzed. When Figure 1-2 is examined in detail, it is seen that the highest element ratio in all coins is Cu with an average of 97.24%. Briefly, Si, P, Fe, Ni, As, Sn, Sb and Pb elements were detected at trace levels. In addition, two sides of the coins that have the inventory numbers 2017-75 and 2017-76 were analyzed and Sb element was detected on only one side of each coin. Sb element's ratio was detected as 0.5% on the written side of the coin with inventory number 2017-75 and Sb element's ratio was detected as 0.554% on the figured side of the coin numbered 2017-76. However, among all the analyzed coins, Sn element was detected only in the coin with inventory number 2017-86 and its' ratio was 0.309%.

Bronze is one of the leading metal troves found during the excavations. Artifacts made of bronze tend to deteriorate more quickly and easily. Bronze reacts more easily with the atmosphere and deteriorates more quickly. Bronze made up of a mixture of many elements. It consists of alloys such as copper-tin, copper-antimony, copper-arsenic, copper-lead (Basaran, 1980). The term "bronze" is generally used for an alloy containing copper and tin (Moorey, 1994). To define the alloy as bronze, it is considered sufficient if the ratio of tin is 6-10%, and bronze alloys with 10% tin are described as "quality bronze"(Esin, 1985). In the

inventory information of the Batman Museum 28 coins were identified and recorded as bronze. When the values in Figure considered, the Cu ratio was found more than 97%. According to the literature, to call the coins as Bronze coin, a certain alloy ratio and the Sn element must be included in this alloy. According to the analysis results of P-EDXRF technique, the Sn element was detected only in the coin with inventory number 2017-86 (0.309%). To call it as a bronze coin, the Sn ratio must be at least 6% (Esin 1969). Again in the same coin, the Cu ratio was found 97%. Consequently, it can be said that not allcoins have Bronze features. In the composition of all coins' elements like Cu, Fe, As, Pb, Si and Ni have the highest level and their rates of distribution is given in Figure 2.

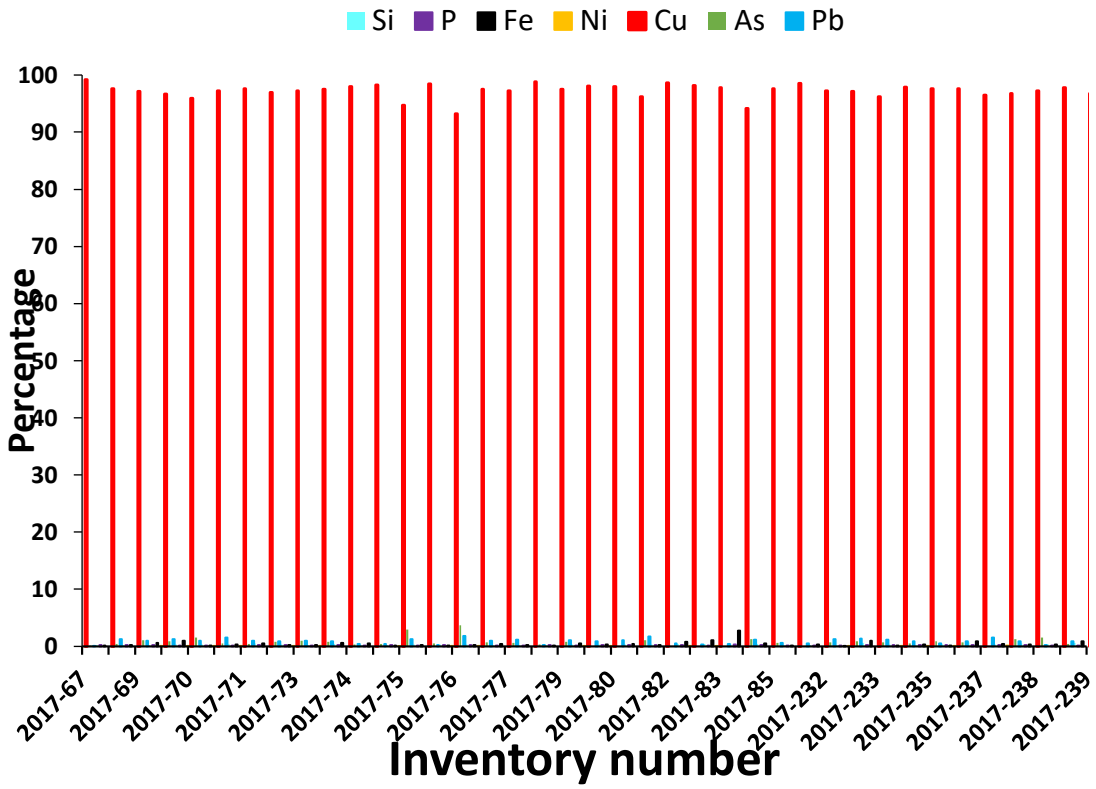

Figure 2. Distribution of P-EDXRF Analysis Results of Cu, Fe, As, Pb, Si, P and Ni Elements in Coins

As it can be seen from the P-EDXRF results given in Figure 2, as the coins have the highest number of Cu element, the primary material of these coins is Cu. The highest value of Cu in coins 99.18%, minimum value 93.19% and average; 97.24% (fig. 2). According to these results, such a high rate of Cu also means that these coins are not imitations.

The second element identified in the analysis made via P-EDXRF is Pb. When take the Pb rates into the account, the highest value in these coins is 1.82%, minimum value 0.080% and average is 0.926%. The distribution of the Pb element in 28 coins is clearly seen in Figure 1-3. According to the literature, it is stated that adding lead to copper reduces the heat needed for operating on metal alloys (Smythe, 1936)). In the production of objects that are technically mixed, it is stated that in order to reduce the viscosity of the molten metal and increase the strength of the metal against deterioration lead is added to the form (Smythe, 1936). Such a low rate of Pb in the coins make us think that the technological refining level was good, well separation and Pb alloy was not added deliberately it come from ore Besides, the separation of precious metals from Pb element is an ancient purification technique and it is also known as a purification technique (Yıldız, 2019). When this information is considered, it can be said that the purification technology of that period was at a high level.

In order to except an element added to metal alloy deliberately it must be up to %2.

The third element identified in the analyzes made via P-EDXRF is Fe. In the analysis results of the coin, the highest value of Fe is 2.73%, minimum value is 0.079% and average value is 0.462%. 28 coins' Fe element ratios are shown in Figure 2-3. When we consider the Fe values, the possibility of the high Fe level resulting from surface corrosion is thinkable. At the same time, during the analysis process a corrosion layer was observed on the surface of the coins (Table 1). In addition, since P-EDXRF is designed as a surface measurement technique, the possibility of the coins' surfaces being affected by contamination and corrosion should be considered (Aydın and Devecioğlu, 2015). Therefore, it is possible that the corrosion process on the surface affected the Fe rate.

The fourth element identified in the analyzes made via P-EDXRF is Si. When we look at the analysis results in Figure 2-3; highest value is 0.740%, minimum value 0.2098% and average value is 0.347%. When the analysis results are evaluated, detection of Si in all coins suggests that the element Si was not deliberately added to the coins. In addition, as Tanrıkulu (2019) stated, it is thought that the element Si comes from the pollution that penetrates the surface and inner structure of the coin samples.

The fifth element identified in the P-EDXRF analysis of 28 coins is P. The highest value 0.309%, minimum value 0.157% and average value is 0.210%. The change in P rate is given in Figure 2-3. P was detected very low level, and it is thought that P did not consciously added in to the form, and the P ratio detected in the coin is originate from the ore or it come from human touching hand remains

When the P-EDXRF results in Figure 2-3 are examined in detail, we can see that the elements P, Fe, Ni, As (detected in 22 coins), Sn (detected in 1 coin) and Sb (detected in 2 coins) were not consciously added to these coins and it is thought that these elements originate from the ore.

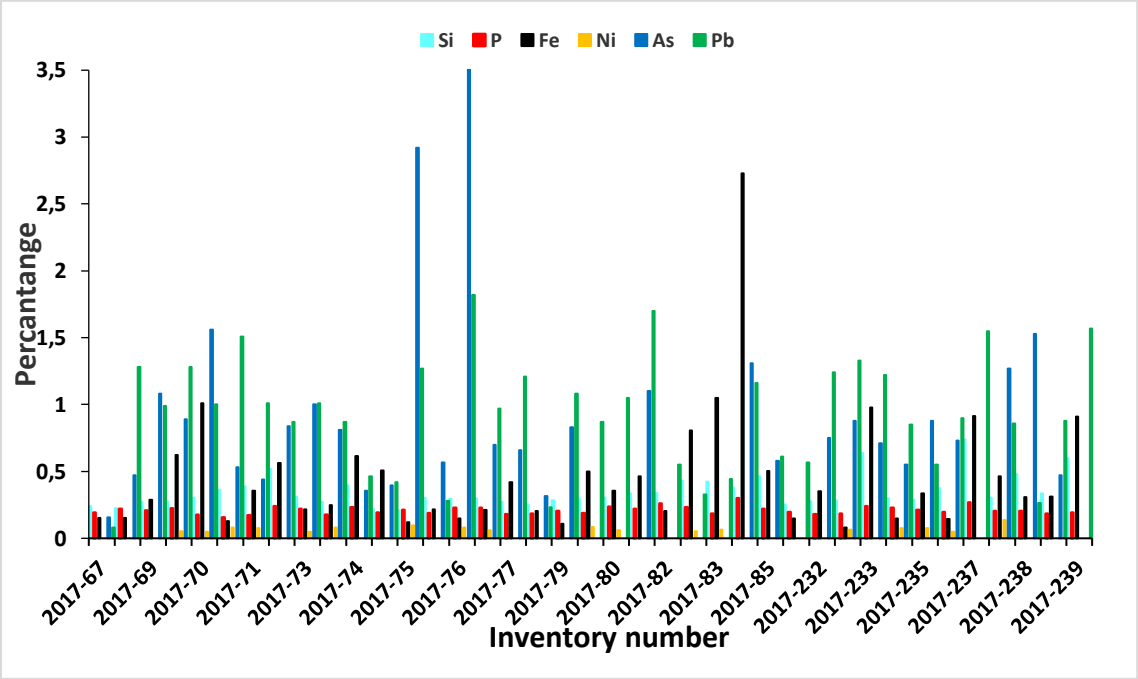

Figure 3. Distribution of P-EDXRF Analysis Results of Fe, As, Pb, Si, P and Ni Elements in Coins.

4. Conclusion and Recommendations

In this study, 28 coins belonging to the Artuqid period, which were bought by Batman Museum, were analyzed. In the evaluation of the analysis results obtained, it is identified that there was contamination and corrosion on the surfaces of the coins until the time they were found and brought to the museum. The

chemical compositions of the coins were detected and the change in the element ratios in the chemical structure was determined in the form of percentage (%) and given in Figure 2-3.

In the result of the analysis the copper rate of the coins was found very high and it was understood that the main element was Cu. Not adding different cheaper elements to the Cu at a high rate shows that the economy of the Artuqids was good and also their technology was good compared to that period. Detection of P in such a low amount gives the evidence of the well-developed purification technology.

A corrosion layer was observed on the surface of the coins. Although corrosion affects the Fe ratio, the fact that the Fe ratio is so low indicates that the purification technology was at a high level.

The Si ratio in the samples is low and it is thought that this amount derives from the contamination on the surface. Only in one coin (inventory number 2017-86) Sn element was identified. Sb was detected on only one side of the coin with inventory number 2017-76. Ni and As were also detected on some coins.

As a result, it was determined that the coins were highly produced from Cu, Pb element was added consciously, and other elements were not deliberately added and they were trace elements from the ore.

Although the arrival dates of 28 bronze coins brought to the Batman Museum through purchase are different, according to the P-EDXRF analysis results it is understood that they were homogeneous.

When we evaluate the P-EDXRF analysis results acquired in this study, it was determined that the compositions of these coins in the Batman Museum were made of copper, not bronze, as in the inventory definitions made by looking with the naked eye.

While the alloys that compose Bronze should contain a certain level of elements, main element of the 28 coins is Cu and other elements are observed at very low levels and it can be understood by looking at Figure 2-3.

In this study it is propound that, as a result of archaeometric scientific research and evaluation the chemical structures of the coins, which are defined as gold, silver, copper, bronze, *etc.* with visual examination, are revealed. And this revealing is both important and necessary for eliminating the identification errors.

It is aimed to contribute to the science world by understanding the artificiality and authenticity of the artifacts brought to the museum via purchases or excavations by analyzing the artifacts archeometrical point, so that we also have knowledge about the content of the artifacts.

As museums in Turkey have been exposed to counterfeit artifacts in many national and international studies, The Ministry of Culture and Tourism, General Directorate of Cultural Heritage and Museums is of a great importance in terms of the preservation and display of cultural assets, proving the originality of the artifacts in museums in by using nondestructive archaeometric methods. We can define our museums, which constitute the most important part of tourism, as the inexhaustible energy of our country. When these museums are filled with fake artifacts, the money paid for their purchase is wasted, fake artifacts with low artistic characteristics exhibited in the museums causes a decrease in artistic quality and this come up with a decline in the number of museum visitors, and our country loses its reputation and finances.

Ethics Statement

No human studies are presented in this manuscript.

Author Contributions

The author confirms being the sole contributor of this work and has approved it for publication.

Conflict of Interest

The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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