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Praca kazuistyczna
Case reports

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Development of a procedure involving artifact examination to determine the species affiliation of its biological material, as illustrated by an attempt to demystify an alleged Nazi lampshade made from human skin

Procedura badania artefaktu w celu określenia przynależności gatunkowej materiału biologicznego – weryfikacja autentyczności rzekomego nazistowskiego abażuru z ludzkiej skóry

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Abstract

Objectives: The main purpose of the study was to identify the species origin of the material from which the incriminating lampshade bought at a flea market had been made.

Methods: The histological and molecular biology methods commonly used in forensic genetics were selected to achieve this goal. The DNA for the research was isolated using a QIAamp DNA Mini Kit (Qiagen) according to the manufacturer's protocol for tissues. The quantitative and qualitative evaluation of genetic material was carried out by the real-time PCR method with a Quantifiler Duo DNA Quantification Kit (Applied Biosystems). Specific genetic markers of mtDNA of cattle, equines, deer, wild boar, and sheep were selected to identify species.

Results: Histological tests showed that the lampshade had been made from intestinal flaps. The DNA from sample tested positive for cattle. The test results dispelled the suspicion that the researched lampshade had been made from human skin.

Conclusions: The proposed testing method can be used to verify the origin of the artifacts misleadingly described as made from human skin. To our knowledge, such artifacts can be found in museums and private collections. Further-

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more, it has been widely believed until now that human-skin products, mainly lampshades, were mass-produced in Nazi concentration camps, mainly in Buchenwald

Key words: lampshade, forensic genetics, molecular biology, histology, human skin

Streszczenie

Cel pracy: Określenie pochodzenia gatunkowego materiału, z którego wykonano inkryminowany abażur zakupiony na pchlim targu.

Metody: Do osiągnięcia tego celu wybrano metody histologiczne oraz biologii molekularnej powszechnie stosowane w genetyce sądowej. DNA do badań wyizolowano przy użyciu zestawu QIAamp DNA Mini Kit (Qiagen) zgodnie z protokołem producenta przeznaczonym dla tkanek. Ocenę ilościową i jakościową materiału genetycznego przeprowadzono metodą real-time PCR z użyciem zestawu Quantifiler Duo DNA Quantification Kit (Applied Biosystems). W celu identyfikacji gatunków wybrano specyficzne markery genetyczne mtDNA bydła, koniowatych, jeleni, dzików i owiec.

Wyniki: Badania histologiczne wykazały, że abażur wykonano z płatów jelitowych. DNA uzyskany z próbki dał pozytywny wynik testu dla bydła. Wyniki badań wykluczyły przypuszczenie, że badany abażur został wykonany z ludzkiej skóry.

Wnioski: Zaproponowaną metodę badawczą można wykorzystać do weryfikacji pochodzenia artefaktów błędnie określanych jako wykonane z ludzkiej skóry. Według naszej wiedzy takie artefakty można znaleźć w muzeach i kolekcjach prywatnych. Co więcej, do tej pory powszechnie uważano, że wyroby z ludzkiej skóry, głównie abażury, były produkowane masowo w nazistowskich obozach koncentracyjnych, głównie w Buchenwaldzie

Słowa kluczowe: abażur, genetyka sądowa, biologia molekularna, histologia, skóra ludzka

1. Introduction

Knowledge of artifacts made from, among others, human skin in the German Nazi concentration camp in Buchenwald is well documented [1,2]. This activity was inspired by the wife of the commandant of this camp, Ilse Koch [3]. According to the witnesses (former camp prisoners), Koch used to pick specific prisoners who were killed, and their flayed skin was used to make specific luxury goods, such as handbags, gloves, and wallets. Among items found and documented in the camp by American Army in 1945, there was a lampshade made from human skin (Fig. 1). This cruelty is in line with many other barbaric acts perpetrated on concentration camp prisoners by the Nazis. Medical tests and experiments on prisoners supposedly had some "scientific" justification. However, making everyday objects from human skin is nowadays considered the expression of eccentric, purely criminal cruelty that cannot be rationally explained. Nonetheless, considerations of forensic esthetics can be found in literature, including the beauty of crime [4].

It is difficult to estimate the scale of producing items from human skin. Were they made at the camps, or were they also commissioned to be made by local craftsmen? It is rather unlikely to involve mass-scale production. However, various secured items and witness testimonies suggest this practice was not incidental. Because of the above doubts and the fact that the described items were mostly gifted to German soldiers, including the concentration camp staff, it is impossible to track the movement of those items, tracing the story of every single one. Antique shops now and then offer items suspected to originate from the Buchenwald concentration camp. The authors of this paper have been confronted with this situation.

The interest in items connected with the Holocaust also applies to the antique black market, which offers the personal belongings of concentration camp prisoners or even fragments of camp infrastructure. Camp clothing, empty Zyclon B cans, and small objects hand-made by prisoners are on offer, among others. It is worth noting that such items are also forged and offered for sale as genuine [5].

It is worth mentioning that objects made from human skin or bones were documented in the foren-

Figure 1. The two typical examples of Internet queries are "human skin lampshades" [Source: A: https://www.natgeotv.com/ca/human-lampshade-a-holocaust-mystery, B: https://marcuse.faculty.history.ucsb.edu/classes/33d/projects/naziwomen/ilse.htm]

Figure 2. Human-skin items made by Karl Denke, secured by the police [Source: *Archiv für Kriminologie, Bd. 95]*

sic literature. The authors may recall the practice of a notorious serial killer Karl Denke (1860-1924) from Ziębice, who made belts and suspenders from the skin of his victims (Fig. 2) [6,7]. His activity was commercial because Denke sold human flesh as veal along with small "leather" objects made of human skin, as it turned out later.

Fascination with death, including admiring or needing to collect items made from human body parts, has broader cultural substantiation. Various societies used such items for rituals, e.g., ritual Tibetan goblets made from human skulls or ornamental belts made from decorated human bones [8]. In addition, history is abundant with examples of using the bodies of convicts as talismans, as they

were believed to have supernatural, sometimes even healing properties. Hence people collected dried palms, hair, or skin pieces of dead convicts [8]. For example, objects, such as an ashtray from a skull fragment, a doctor's bag, or a pair of shoes from the skin of a convict, were noted as late as the 19th century [8].

Returning to the subject of items whose origin is traced to KL Buchenwald, it must be stressed that it is hard to establish the exact number of objects that might have been made there. However, photographic documentation may be helpful. It is worth mentioning that such items still appear on the antique market, and the best evidence is a photo album with covers made from human skin. This artifact was donated to the Auschwitz-Birkenau Museum in 2020 [9]. The museum confirmed its authenticity, and its origin is traced to Buchenwald. In this context, the object described in this paper fits well in the history of searching and researching unique and controversial items. The story of studying a similar lampshade found in the US was described by M. Jacobson in his book [10]. Undoubtedly, such artifacts will be offered on the antique market, and their authenticity will have to be verified in interdisciplinary studies.

Internet queries show many examples of alleged items of this type. For example, the most popular artifacts can be viewed after typing in the search engine: "human skin lampshade/photos." To illustrate, Figure 1 shows examples of such queries.

Looking for the roots of the belief that the lampshades of the first type might have been made from human skin, the authors found an interesting archival photo online in Der SPIEGEL magazine, issue of February 23, 2018. It is presented in Figure 3.

Figure 3. The photo shows evidence of Nazi crimes, presented after liberating KL Buchenwald. It shows museum preparation for the study of anatomy, treated skin flaps with tattoos, shrunken human heads, and on the right, a lampshade believed to be made from human skin [Source: https://aventurasnahistoria.uol.com.br/noticias/reportagem/ilse-koch-a-bruxa-de-buchenwald-que-torturava-de-forma-sadica-as-vitimas-do-nazismo.phtml]

The authors believe that this small but suggestive exhibition presented in Figure 3 led to the creation of an enduring conceptual relationship: "Nazi-era lampshades = human-skin lampshades."

It needs to be clarified whether, as commonly believed, human-skin lampshades were actually commercially produced in the Buchenwald concentration camp.

2. Objectives

The main purpose of the study was to identify the species origin of the material from which the incriminating lampshade bought at a flea market had been made.

3. Materials and methods

3.1 Material. In 2019 an anonymous donor, Ms. Urszula S., donated a lampshade bought at a flea market in Poland. The lampshade had been made from material that looked like delicate leather. The seller said he had bought the lamp at a flea market in Germany. After the buyer came back home, she searched the Internet. She started to suspect that the object might have been made from human skin, so she donated the lampshade to the museum of the authors. The artifact is shown in Figure 4. On the right are visible thin lines, which resemble scarred stretch marks on the abdominal skin of a pregnant woman.

The lampshade (Fig. 4) has the following dimensions: height 30 cm, top diameter 25 cm, bottom diameter 35 cm, and is made of 8 flaps (with dimensions 9–13 cm × 30 cm) of parchment-like material stretched on the metal frame. The top and the bottom of the lampshade are trimmed with a decorative braid. The flaps are sewn together with a few millimeters overlap, which let us take samples for the research without visible damage to the artifact.

3.2 Methods. The DNA for examination was isolated from three pieces of about 0.5 cm^2 cut from three different panels using the QIAamp DNA Mini Kit (Qiagen) according to the manufacturer's protocol for tissues. Before extraction of genetic material, the lampshade sections were rinsed twice in 1 ml of molecular biology water and dried for 10 minutes under UV light. The quantitative and qualitative

Figure 4. The lampshade examined in this paper

evaluation of genetic material was carried out by the real-time PCR method with the Quantifiler Duo DNA Quantification Kit (Applied Biosystems). An attempt was made to designate a human profile using an NGM SElect genetic identification kit (Applied Biosystems). All tests were repeated three times, with samples from various lampshade parts. Specific genetic markers of mtDNA of cattle, equines, deer, wild boar, and sheep were selected to identify species.

The genetic material samples extracted from the lampshade were checked with a multiplex test by the authors (modification of the method proposed by Jinchun L et al. l [11]). The mtDNA genes whose fragments were amplified for a given species and the sequences of the primers used are included in Table I.

Multiplex amplification of specific fragments of genetic material was performed with the PCR method using the QIAGEN Multiplex PCR Kit (Qiagen) according to the producer's instruction.

The reaction was carried out in a total volume of 10 µl. The reaction mixture was made up of 1 µl of

Table I. Set of primers used in the multiplex reaction for species identification

Name of primers	Species	Name of mtDNA gene	Sequence of primers	Length of amplicon (bp)	Dye label
CMRC- Cattle	*Bos taurus*	CO I	5′-GTTCTTCACGACACATACTACGTT -3′ 5′- GCAAATACAGCTCCTATTGATAAA 3′	68	JOE
CMRC- Horse	*Equus caballus*	16S rRNA	5′ CAACCCAAACTAACTCCT 3′ 5′ ATAGATGCATGCCTGTGTT 3′	207	6-FAM
CMRC- Deer	*Cerwus nippon hortulorum*	12S rRNA	5′ GCTCACGACACCTTGCACAG 3′ 5′ GCTTTAACACACTTTACGCCGTATG 3′	175	JOE
CMRC- Pig	*Sus strofa domesticus*	CO I	5`- TACTTCTACTATCCCTGCCAGTTC-3` 5`- TGATAAAGGATAGGGTCTCCACCA-3`	115	6-FAM
CMRC- Ovis	*Ovis aries*	12S rRNA	5`- AAAATAAATGACGAAAGTAACCCTAC-3` 5`- GCCAAGTCCTTTGAGTTTCGG-3`	164	6-FAM

primer mix (1.6 μM each), 5 μl of QIAGEN Multiplex PCR Master Mix, and 4 μl of template DNA (1 ng/**μ**l). PCR was performed in a GeneAmp PCR System 9700 thermocycler (Applied Biosystems) according to the following thermal profile: initial denaturation 15 min at 95°C, 32 cycles of 30 s denaturation at 94°C, 90 s primer annealing at 58°C, 60 s primer extension at 72°C, and 10 min final extension at 72°C. A negative control was included in each PCR series to exclude possible contamination and the formation of non-specific amplification products. In addition, specificity control was also performed using human genetic material.

The amplification products were separated with the capillary electrophoresis method using an ABI Prism 3130 Genetic Analyzer (Applied Biosystems) and an internal size standard GeneScan 400HD ROX (Applied Biosystems).

4. Results

At the time of receiving the troublesome gift, the museum of forensics, taking into account the donor's suggestions and the well-known fact that the Nazis manufactured human-skin products (including lampshades), mainly in KL Buchenwald, the authors had to consider the fact that they may be dealing with such a unique artifact. These products have never been inventoried. In any case, there is no reliable documentation indicating the number and diversity of such products. It needs to be kept in mind that even during the operation of KL Buchenwald, these products were gifted to German soldiers. Reconstructing their circulation, also on the black market, seems to be impossible today. The main purpose of the study was to identify the species origin of the material from which the incriminating lampshade had been made. Considering that one of the patches had fibrosis resembling gestational pregnancy stretch marks, the first stage of the research was a three-time attempt to isolate the genetic material with an assessment of its quantity and quality. The results from three repetitions indicated a DNA level below the detection threshold for the Quantifiler Duo assay. Despite this, genotyping attempts were made, resulting in only one PCR product for the sex marker, namely amelogenin. The resulting amplification reaction product of 98.91 bp indicated material of human female origin. The positive result drew the attention of the authors. The next planned step was histological tests to verify whether the material was leather, followed by radiocarbon dating. When the authors were looking for a cooperating subject to perform the test, they obtained the results of histology tests. To their surprise, it turned out, without a shadow of a doubt, that the lampshade had been sewn from intestinal flaps and not skin (Fig.5). Due to the fact that the lampshade had not been made from leather but intestine, the object was not radiocarbon dated. However, a test for species identification from the intestinal lobes was performed.

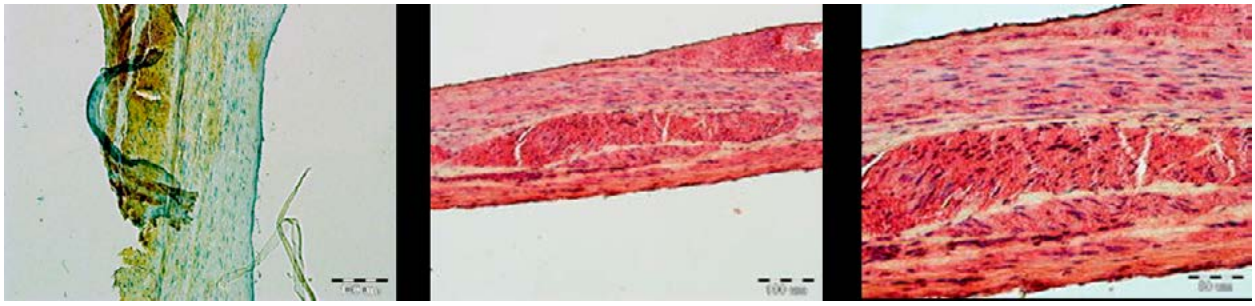
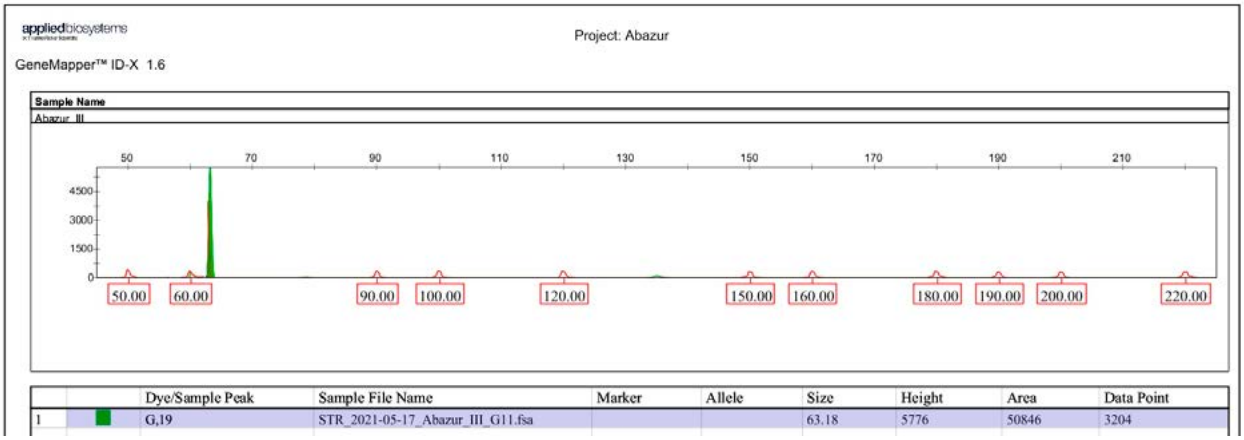


Figure 5. Histological examination of lampshade fragments. The resulting histological image is characteristic for the intestine and not mammalian skin. Photo on the left: unstained tissue specimen; middle photo and photo on the right: two tissue sections from different parts of the lampshade, classical HE (hematoxylin-eosin) staining.

The histological consultation proved that the material used to make the lampshade was not skin but mammalian (non-human) intestine because human intestines are too small to fashion such large flaps. The material was subjected to a multiplex test for species identification. The multiplex test included primers of three big animals (cattle, equines, and deer) and two smaller ones (sheep and wild boar). The sample tested positive for cattle (Fig. 6).

Figure 6. Electropherogram of multiplex reaction of amplification. The visible green peak, confirming the presence of the PCR product, corresponds to the length of the specific amplicon for the *Bos taurus* species (cattle). No amplification product was found for the other species.



Conclusions from experiments allow the authors to propose an algorithm of procedure that can be applied not only to examine other objects suspected of Nazi origin but also to identify other biological artifacts. e.g., from protected species:

1. Preliminary, legal, literature, and online studies to determine what the object is, whether something similar has already been researched, and if so, by what methods and whether the object might have been made in violation of the law.
2. Comparative research (macroscopic and microscopic) to correctly determine its systematic affiliation.
3. Research by molecular biological methods for species determination.
4. If really important (examination of object authenticity or determination whether the statute of limitations applies to any crime involved), the age can be determined by consultation with the material expert, e.g., for analyzing the age of threads, wires, etc., or radiocarbon dating.

5. If there is reference material – genetic "geoancestry" and/or human identification.

5. Discussion

The main purpose of the study was to identify the species origin of the material from which the incriminating lampshade had been made. The histological and molecular biology methods commonly used in forensic genetics were employed to achieve this goal. However, why the samples tested positive for human female DNA is still unclear. The authors think it might have been due to multiple contaminations with the epidermis of the lampshade maker, users, or the last owner from Poland, who cleaned the item by hand. In the meantime, the authors found a film online concerning research on a lampshade similar to our artifact. The filmmaker had been initially sure that he had a genuine object from the Nazi era and conducted highly specialized genetic tests. To his astonishment, the tests showed that the lampshade had been made from cow tissue, not human. The story was also in print in 2010 [10].

The test results dispelled the suspicion that the researched lampshade had been made from human skin. The complex tests confirm that scientific moderation is needed to investigate highly controversial and sensitive cases. The authors are convinced that artifacts similar to the studied lampshade will appear on the antique market, including the illegal one. The research model proposed in this paper enables verifying the authenticity of artifacts such as lampshades.

Because the knowledge of the number of such items produced mainly (but not only) in KL Buchenwald is limited, it seems more than likely that they will be offered for sale to collectors, provoking strong emotions and media interest.

The proposed testing method can be used to verify the origin of the artifacts misleadingly described as made from human skin. To our knowledge, such artifacts can be found in museums and private collections. It has been widely believed until now that human-skin products, mainly lampshades, were mass-produced in Nazi concentration camps, mainly in Buchenwald. Examination of the sampled lampshade fragments showed that it had been made not from the skin but from intestines and that the intestine in question came from a cow, not a human.

After the research, the authors conducted an Internet query: they watched an online video about a similar lampshade tested in the US – with the same results. They also visited flea markets and talked to professional traders (who claimed that this type of product was cheap, common, often found in antique shops in Germany, and made from animal guts, and leather lampshades were a rare luxurious product and looked sturdier and more solid). The authors believe that historical truth is the most important, and real lampshades made from human skin do exist, but they are a rarity and not, as previously thought, the norm. In view of the case investigated by the authors, similar to the case presented in the above-mentioned video, one may have reasonable suspicions as to the number and authenticity of the objects made in the Nazi extermination camps. Placing items related to the Holocaust on the market (mainly the black market) may raise justified objections, primarily of an ethical nature. There have also been cases of forgeries of such objects being offered for sale (e.g., camp clothes, personal belongings of the victims, Zyklon B cans) [5]. It is not ruled out that objects made from human skin or considered as such will also appear on the collector's market.

The research methods presented in this article can effectively confirm or disprove their authenticity.

The authors plan to continue the research and will make efforts to obtain more such objects. They are now convinced that, contrary to popular belief, most period lampshades were not made from human skin.

Declarations of interest

none

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