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What do Egyptian mummies smell like?

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Abstract

There are lots of things to see in museums. Some museums even have things you can touch or hear. But not many museums have things you can smell. Smells from museum artifacts can provide a lot of information. They can tell us what artifacts are made of, how they are preserved, and what condition they are in. We wanted to know what ancient Egyptian mummified bodies smelled like. We analyzed air samples from nine ancient Egyptian mummified bodies. We used trained volunteers and chemical analyses to identify smells. We found that mummified bodies smell "woody", "spicy", and "sweet". Smells were more intense for mummified bodies in display cases. We also saw similarities between mummified bodies from the Late Period (664–332 BCE). We can use this technique to help us conserve and preserve museum artifacts in the future.

Introduction

Have you ever been to a museum and seen a **sarcophagus**? Sometimes they have mummified bodies inside! Mummified bodies from ancient Egypt are fascinating. They can show us what ancient civilizations were like. They can tell us things about people's health and their religious practices.

"Mummified bodies" are also known as "mummies". We used this term in our title! However, researchers prefer to use the term 'mummified bodies'. This is to show that a mummy was a person and helps us remember to treat them with respect.

The transition into the **afterlife** was very important in ancient Egypt. This required preservation of the person's body. This process is called **mummification**. The process uses a lot of natural materials. For example, they used **resin** and oils from pine, cedar, and juniper trees. They also used **bitumen**, spices, herbs, and waxes. These materials can have strong smells. And it was important to smell good for the afterlife!

Unfortunately, studying mummified bodies is hard. They are old and many are in bad condition. Scientists also need to be aware of ethical and cultural concerns for dead bodies. Ideally, we should study mummified bodies **non-invasively**, without even touching the body. One way to do this is by exploring what mummified bodies smell like.

Smells can give us lots of information about museum **artifacts**. They can help identify what artifacts are made from. They can help track how materials break down over time. They can even help discover what was done to conserve and restore artifacts.

We had several questions. What do ancient Egyptian mummified bodies smell like? Can we tell what materials were used in the mummification process? How much have the bodies broken down? How were they preserved? So, we explored the smells of mummified bodies from Egyptian museum collections.

Methods

We examined nine mummified bodies from the Egyptian Museum in Cairo. Four were in display cases and five were in storage. They were from different time periods. They were also made of different materials. And they had different preservation histories.

We did two analyses:

1. Smell analysis – We created a set of 13 descriptions of smells. These were things like "woody", "sweet", and "floral". Then we trained five volunteers and, along with three trained panelists, we assessed these smells and their intensity. They also rated if the smell was pleasant or not. We collected air from around the mummified bodies or from their display sarcophagi (Fig. 1a). Then we had the volunteers sniff the air and identify what they smelled.

2. **Compound** analysis – We used **gas chromatography-olfactometry-mass spectrometry** instruments (Fig. 1b) to help us. First, gas chromatography separates an air sample into individual compounds. Air that contains each compound is then split into two streams. One stream goes to the mass spectrometer. This helps identify the compounds. At the same time, the other stream goes to a trained human "sniffer". They describe the smell, intensity, and pleasantness of each compound. We can then match the compound with what it smells like! We used this process for air collected from all nine of our mummified bodies.

a)

b)

Figure 1: (a) Sampling air from around a mummified body. (b) Instruments used for gas chromatography-olfactometry-mass spectrometry compound analysis. The instruments separate the compounds at the same time a trained human "sniffer" smells them through the nose cone. **Photo credit:** (a) Cecilia Bembibre (b) Andrej Križ

Results

We found that mummified bodies mostly smelled pleasant. The most common smells volunteers identified were "woody" (78%), "spicy" (67%), and "sweet" (56%). They also sensed big differences in smell intensity (see Figure 2 on p.3).

We found that the overall smell of the mummified bodies wasn't always the same as the individual compounds. Using our instruments we found that smells were more intense from mummified bodies in display cases. We also saw that mummified bodies from the Late Period (664-332 BCE) had similar smells.

We found that smells came from four different things:

- materials used during mummification and when bodies broke down,
- microbes,
- oils to prevent pests, and
- **synthetic** pesticides.

Which smells were most intense for this group of mummified bodies? Which smell was the most common?

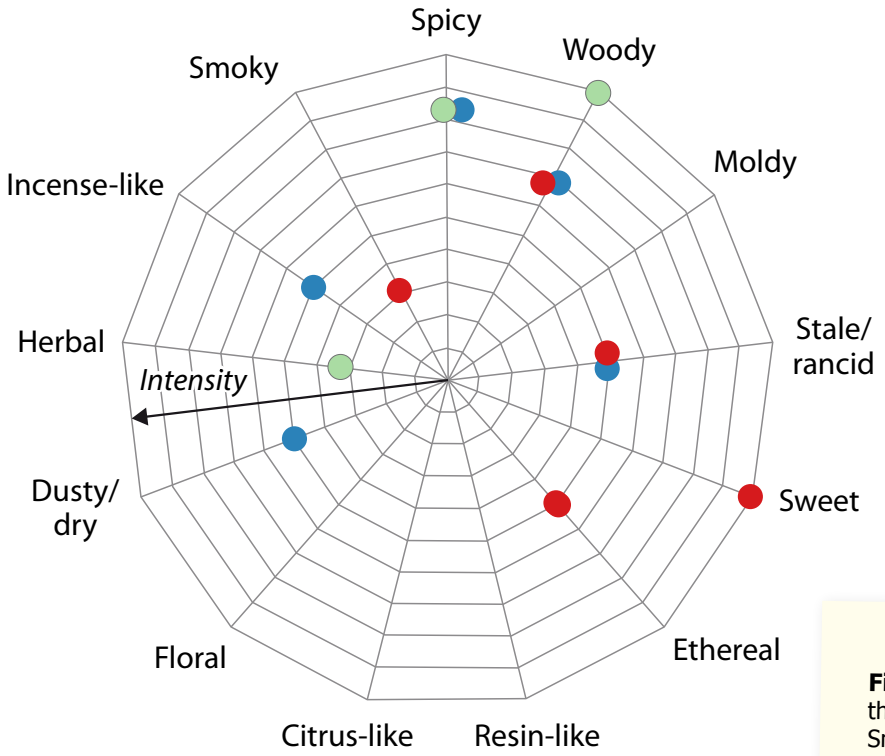

Figure 2: Smell profiles for three of the mummified bodies. Smells further from the center are more intense.

Discussion

We can learn a lot by smelling mummified bodies! Our compound analysis gave us extra insights. For example, we found a lot of **terpenoid** compounds. These come from plants used during mummification. Mummified bodies from the same time period also have similar smells. More samples might let us use smells to figure out how old mummified bodies are. We were surprised to find synthetic pesticides. Their use wasn't recorded in any conservation reports!

Examining the smells of museum artifacts is not very common. But it can help us be safe when we work with artifacts. Smells caused by fats breaking down or by microbes can tell us when mummified bodies decompose. This could help scientists better store and wrap mummified bodies. We can also protect museum workers by identifying pesticides or other toxic compounds. And our methods ensure that we can do this non-invasively!

Smell is an important part of human **sensory perception**. Smelling something can make interactions with ancient artifacts more significant. This can make museums more interesting and informative. In the future, we would like to make smells closely resembling those of ancient Egyptian mummified bodies. Future museum-goers will be able to experience the smells of mummification!

Conclusion

Do you have a favorite smell? For humans, we use sight and touch more than smell. But smell is an important part of our sensory perception. It can tell us that dinner is ready or if there is a fire. The next time you go somewhere new, try to use your sense of smell. What do you smell? Are there strong smells? How do the smells make you feel? You might be surprised at what you notice!

Glossary of Key Terms

Afterlife - the place where ancient Egyptians believed people continued to exist after they died.

Artifact - something, or a piece of something, made by humans. Artifacts are usually important historically or contain valuable information. Artifacts are commonly preserved in museums. Mummified bodies should not be dehumanized and treated as artifacts, but rather as human beings who once lived. Some examples of artifacts are tools, clothes, art, and pottery.

Bitumen - a black or brown material that can be sticky or solid. It is a type of petroleum and is waterproof.

Compound - a chemical made up of more than one element. For example, water is a compound. It is made up of oxygen and hydrogen. The oxygen we breathe (O_2) is not a compound because it only contains oxygen.

Gas chromatography-olfactometry-mass spectrometry - a collection of instruments used to identify compounds and what they smell like. This analysis is common in the development of foods, perfumes, and materials that could impact indoor air quality.

Mummification - the process of preserving a body through embalming. Embalming is when a body is treated with chemicals to prevent decomposition. During Egyptian mummification the bodies' organs were removed and the body was dried. The body was then treated with chemicals and wrapped in bandages. Each stage of the process had a ritual significance.

Non-invasive - describes a process that avoids putting anything into or damaging the artifact.

Resin - compounds produced by plants. In mummification it is used to protect bodies from moisture and decomposition. Amber is an example of a fossil resin from trees.

Sarcophagus - a coffin that was usually made of stone. It was used to protect the body. Many ancient Egyptian sarcophagi were decorated with the likeness of the person inside.

Sensory perception - the ability to detect, understand, and interact with the environment using your senses. Humans have five main senses: sight, hearing, touch, smell, and taste.

Synthetic - made by humans.

Terpenoid - compounds found in plants. They help protect plants from disease and herbivores. They also help attract pollinators.

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Check your understanding

1. Why is it important to be able to study museum artifacts non-invasively?

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2. Mummification was an important process in ancient Egyptian civilization. Why is examining the smells of mummified bodies a good method of collecting important information? What types of information can the smells give us?

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3. In the compound analysis, we used a collection of instruments to analyze smells from mummified bodies. What advantage is there to using several instruments instead of just one?

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4. Researchers developed a collection of 13 smell descriptors. You can find these in Figure 2. Pick any two familiar things and try to describe their smell using these descriptors. What other descriptors could you use to describe the smell of your objects?

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5. Scientists can describe and catalog the smells of museum artifacts to enhance their collections. This is called preserving their olfactory heritage. Go to the Smell Explorer website and pick one of their "fragrant spaces" (https://explorer.odeuropa.eu/fragrant-spaces). What do you imagine that space smells like? Does it match with the excerpts that are provided? The excerpts are from specific years (and you can see a summary of these years on the page for your space). Why might smells for your space be recorded in these specific years?

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