ZOOARCHAEOLOGY by MASS SPECTROMETRY (ZooMS)

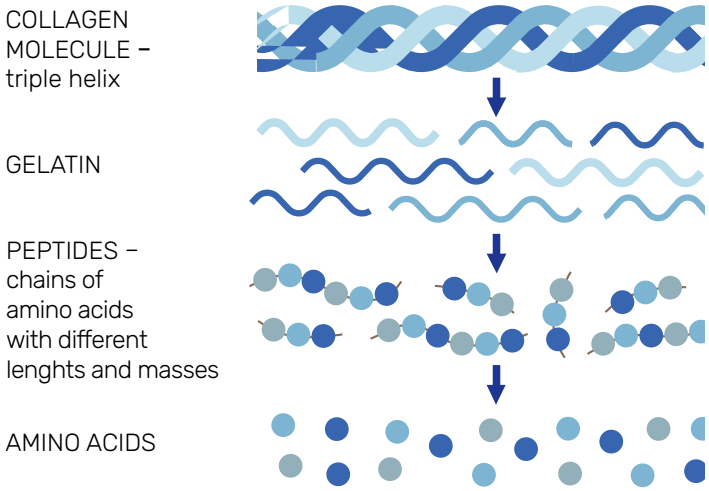
ZooMS is an abbreviation for 'Zooarchaeology by Mass Spectrometry'. It is a collagen-based analysis used to determine the taxon (species or animal group) of a bone find.

Zooarchaeological material is often quite fragmented, making identification almost impossible on the basis of external bone features. Additionally, some animal species (e.g. sheep and goats) are so similar that it is difficult to distinguish between them on the basis of individual finds. In such cases, the species or animal group can be identified bimolecularly using the ZooMS method.

Method Principle

Collagen is extracted from the bone, and peptides are then isolated from the collagen. The mass of the peptides is measured using mass spectrometry. The resulting spectrum is compared with a reference database to determine the animal species or group.

ZooMS has become a widely used tool because it is relatively inexpensive, requires a very small sample size, and has a low risk of sample contamination.



Collagen is a protein molecule made of amino acids.

Material

ZooMS can be used to identify mammals, birds, fish, and reptiles. Most commonly, animal bones and bone artifacts are analysed, but there are more possibilities.

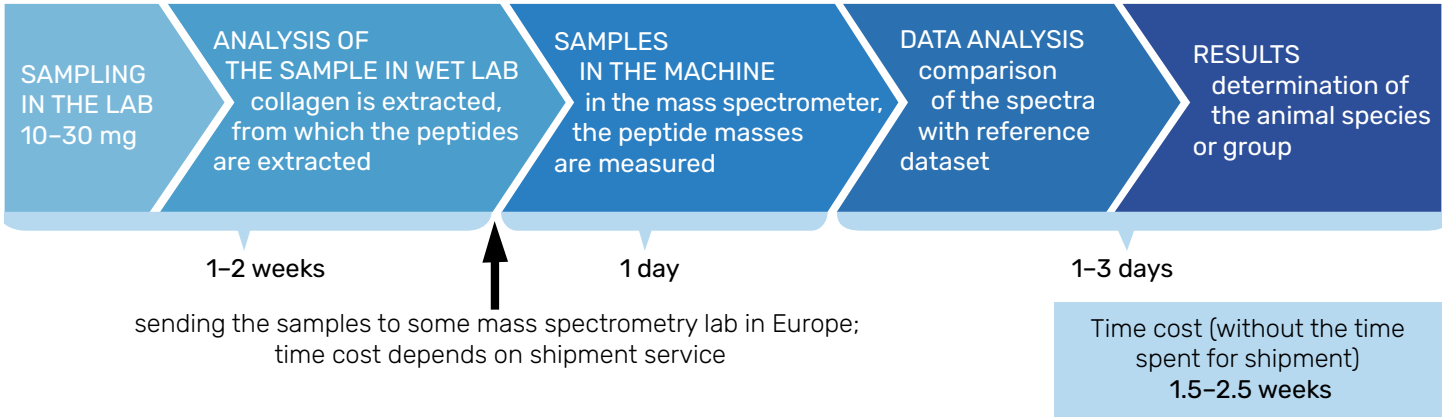
In archaeological contexts, various artifacts and ecofacts are found, for which it is important to know which animal species they belong to.

Sample Collection

- ZooMS requires a small sample, usually 10–30 mg, which is only a few millimetres in size.
- The sample can be taken by scraping with a scalpel or carefully breaking off a suitable piece with tweezers. Ideally, the sample should be taken from an already broken edge of the specimen or from a piece that has already broken off.
- Bone powder obtained with an electric drill (left over from another sampling) can also be used for ZooMS. When choosing between bone fragments and bone powder, ZooMS specialist usually prefers bone fragments, as their demineralization (dissolution of minerals) is easier to monitor.
- For finds that cannot be broken, a sample can be taken using an eraser. The surface of the find is rubbed with a clean eraser, and collagen is extracted from the eraser debris. Note: Document this process to ensure future researchers do not interpret the eraser marks as usage traces.
- In extreme cases, collagen can be extracted from an empty ziplock bag that previously contained the specimen. It is crucial to ensure that the bag has contained only the specific find for which the result is expected. Generally, the success rate of such a sample is low.

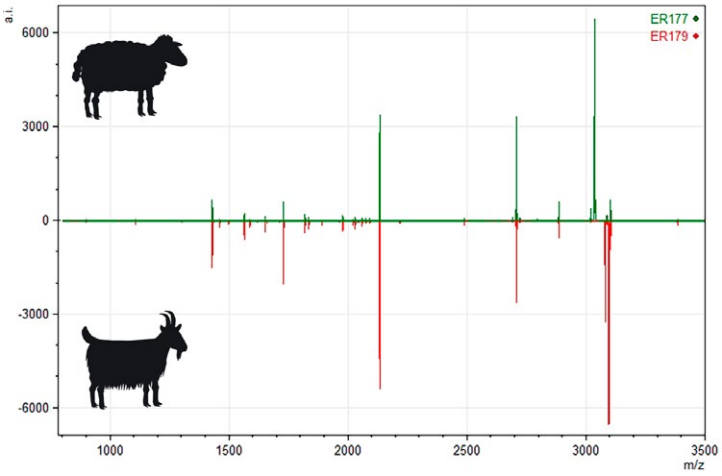
Note: If you send an animal bone for dating and it cannot be identified on the basis of external features (e.g. it can only be identified as a 'large mammal' or 'herbivore') and the entire bone will be destroyed during dating, leave enough of the bone find so that a ZooMS analysis can be performed later. **It is important to know which animal species has been dated!** To do this, place 10–30 mg of bone fragments in a plastic microtube (or a small clean ziplock bag), write the sample weight on the tube, and store the sample with other animal remains in the collections.

Lab work



Interpreting Results

The results are presented as text files, which can be read as mass spectra using the mMass software. Different animal species/groups have peptides with different masses.



The mass spectrometer result obtained from ZooMS analysis, which distinguishes between goat and sheep, species that are often difficult to differentiate in osteological material.

Using ZooMS, the taxon for the specimen can be determined on the species level. However, in the current reference database, there are several animal groups that are identified by the same peptide masses, meaning the sample cannot be determined on the species level. The find context of the specimen can help clarify this. For example, both roe deer and white-tailed deer have the same markers. Since white-tailed deer have never been present in Estonian fauna, this sample (most likely) can only be from a roe deer.

ZooMS enables us to identify, for example, the sheep, goat, horse, and human. It is impossible to distinguish domestic cattle from the aurochs or domestic pig from the wild boar.

See more: www.archemy.ee

This leaflet has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No. 101079396, and from UK Research and Innovation (UKRI) under the UK government's Horizon Europe funding guarantee (grant agreement No. 10063975).
Text Eve Rannamäe, English language editing Enn Veldi, design Jaana Ratas.