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A limited protein high-fat diet may explain the low δ^{66}Zn conundrum in the Neandertal from Gabasa

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Jaouen et al. (1) measured zinc isotopes in the Neandertal tooth enamel from the Cueva de los Moros 1 in Gabasa, Spain, to elucidate its owner's trophic level. They found that the Neandertal's diet is best characterized as carnivorous, which is in line with the nitrogen isotope analysis of other Neandertals (e.g., ref. 2). However, they were puzzled by the extremely low level of δ^{66}Zn compared with other carnivores from the site and spent most of the discussion section reviewing possible explanations. We find their results of utmost importance in reconstructing the Neandertal diet and lifeways; however, we feel that they have altogether disregarded a very important piece in the puzzle: fat. It seems to us that animal fat is the missing component in their equation, able to provide the perfect explanation for the low zinc levels identified.

One explanation presented in the paper was that Neandertals may have consumed body parts and animals that were relatively poor in zinc, like the liver or deer.

We want to suggest a high animal fat consumption with zero zinc content (3) (https://fdc.nal.usda.gov/fdc-app.html) as a probable explanation for the extremely low δ^{66}Zn in the Gabasa Neandertal. The potential for high-fat consumption in Neandertals and other *Homo* species was described by us and others before (e.g., refs. 4 to 9). We argued that a carnivorous *Homo*, including the Neanderthal, is bound to consume a high–fat content diet because of the limited ability of humans to consume protein compared with other carnivores (9). The limit, which may amount to 35 to 40% of the caloric value of the diet (4, 9), dictates an obligatory consumption of 60 to 65% of the diet from carbohydrates and/or fat. We have listed evidence for the significant investment of Neanderthals and other *Homo* species in obtaining large and prime adult fatty animals and fatty parts of animals and exploiting the fat from animals in the form of marrow and bone grease.

To conclude, the protein constraint causes the carnivorous Neanderthal to consume less δ^{66}Zn-rich protein than other carnivores in Gabasa, which could digest more than double the amount of protein. The relatively moderate protein consumption was then completed with the zero δ^{66}Zn-laden fat rather than the relatively δ^{66}Zn-rich plants.

Jaouen et al.'s (1) contribution to the arsenal of diet reconstruction tools is most welcome, especially as it seems that zinc isotope studies can also elucidate cases where fat formed a high portion of the diet.

We wish to take advantage of this opportunity to propose that fat not be ignored in the analysis of nitrogen isotopes and other studies of ancient human nutrition. The authors who find a carnivorous-level consumption of protein based on nitrogen isotopes tend to make a point to emphasize that plants could form a substantial part of the diet and still not contribute a strong signal to the nitrogen isotope analysis because of their low protein content. While the consumption of plants is a probable explanation, they ignore fat as an alternative energy source to plants that contribute zero protein signal.

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The authors declare no competing interest.

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