

Effect of Diet on the Stable Isotopes of Carbon and Nitrogen in Cow-Sheep-Goat Milk - Abstract

Paraskevi Chantzi^{1,2}, Nives Ogrinc³, Doris Potočnik³, Stella Dokou¹, Ilias Giannenas¹, Michalis Vernikos² and Nektarios D. Giadinis⁴

¹ Laboratory of Nutrition, Faculty of Veterinary Medicine, Aristotle University of Thessaloniki, 54124 Thessaloniki, Greece

² Union of Agricultural Cooperatives of Naxos, 84300 Cyclades, Greece

³ Department of Environmental Sciences, Jožef Stefan Institute, Jamova 39, 1000 Ljubljana, Slovenia

⁴ Clinic of Farm Animals, School of Veterinary Medicine, Faculty of Health Sciences, Aristotle University of Thessaloniki, Thessaloniki, 54124, Greece

Summary

Twelve (12) bulk samples of Holstein cow's milk, fifteen (15) bulk samples of sheep and goat's milk, and forty-three (43) feed samples were collected in August 2020 from livestock farms in Naxos Island, South Aegean, Greece. Three milk samples were taken from milk coolers in 25ml falcon bottles from each station and subjected to isotopic analysis to determine their carbon ($^{13}\text{C}/^{12}\text{C}$) and nitrogen ($^{15}\text{N}/^{14}\text{N}$) isotopic ratios. The isotopic values of the feed ranged from -26.1 ‰ to -16.8 ‰ for $\delta^{13}\text{C}$ (mean value -21.4‰) and from 1.5‰ to 6.5‰ for $\delta^{15}\text{N}$ (mean value 3.9‰). When plotted against each other (fig. 1), the samples could be discriminated into three groups. The first group corresponded mainly to cow feed with lower $\delta^{15}\text{N}$ values (1.3‰ to 2.8‰), while the second group is represented by cow feed with higher $\delta^{15}\text{N}$ values (3.5‰ to 6.5‰ and lower $\delta^{13}\text{C}$ values (-26.1‰ to -23.9‰). The third group is made up predominantly of sheep/goat feed with higher $\delta^{15}\text{N}$ values (3.8‰ and 6.5‰) and $\delta^{13}\text{C}$ values (-21.7‰ to -16.8‰). From the carbon and nitrogen values of soya [$\delta^{13}\text{C}$: -26.6‰, $\delta^{15}\text{N}$: 0.7‰] and maize [$\delta^{13}\text{C}$: -11.8‰, $\delta^{15}\text{N}$: 4.3‰] used in the sampled feed, it can be concluded that both feed components determine the isotopic record of feed rations. Milk casein isotopic values ranged from -24.4‰ to -18.1‰ for $\delta^{13}\text{C}$ (mean value -20.7‰) and from 3.9‰ to 8.4‰ for $\delta^{15}\text{N}$ (mean value 5.7‰). The $\delta^{13}\text{C}_{\text{casein}}$ values in cow milk were also higher than in feed for -3.14‰ and 2.96‰ agreeing with the $\delta^{13}\text{C}_{\text{feed-casein}}$ values reported in the literature. In addition, a 1-4 ‰ increase in the $\delta^{13}\text{C}$ ‰ values are reported during the metabolism of feed into milk protein, while feeding maize results in a -4‰ reduction. The data from this study shows that animal proteins were naturally ^{15}N -enriched relative to their diet ($\delta^{15}\text{N}_{\text{feed-milk}} = -4.3$ to -1.1 ‰), a trophic shift consistent with reported values for dairy cows (2.4‰ and 3.2‰) and in growing cattle (3.6‰ and 3.8‰). The $\delta^{13}\text{C}_{\text{feed-casein}}$ (-5.5‰ to 4.4‰) and $\delta^{15}\text{N}_{\text{feed-milk}}$ (-4.1‰ to 0.6‰) for sheep/goat samples were higher, reflecting a semi-extensive type of farming and those environmental parameters that affect the isotopic record.

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EMAIL: pchantzi@geo.auth.gr (A. 1); nives.ogrcinc@ijs.si (A. 2); doris.potocnik@ijs.si (A. 3); dgstylian@gmail.com (A. 4);

igiannenas@vet.auth.gr (A. 5); m.vernikos@easnaxos.com (A. 6); ngiadini@vet.auth.gr (A. 7)

ORCID: 0000-0001-5444-4887 (A. 1); 0000-0002-5709-1594 (A. 2); 0000-0002-4636-5916 (A. 3); 0000-0002-0181-8416 (A. 4); 0000-0003-3145-3734 (A. 5); 0000-0001-5646-3627 (A. 7)



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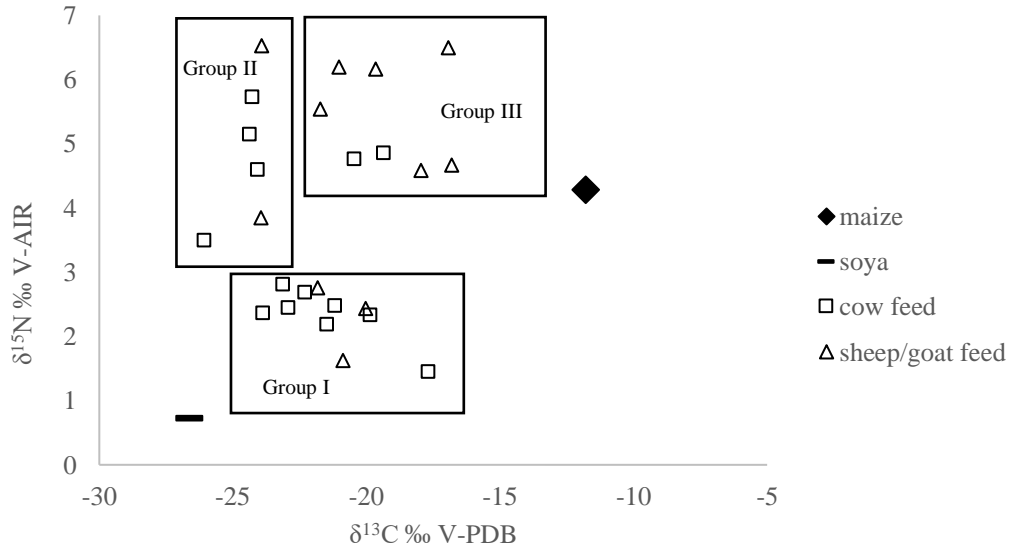


Figure 1: Carbon and nitrogen isotope values for feed samples from livestock farms in Naxos Island, South Aegean, Greece

Keywords

Isotopes, carbon, nitrogen, milk, feed, traceability, authenticity

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