

Isotopic ratio as a confirmation of the geographical origin of autochthonous cheese produced in Croatia

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Cheese has been widely consumed by people all over the world, not only for its nutritional value (bioactive compounds with antioxidant, antimicrobial, anti-inflammatory, immunomodulatory and analgesic activity) but also the gourmet experience. As the global health awareness is on the rise, consumption of cheese increased with regional variation all over the world, lowest being in Africa and highest in Central and Eastern Europe and USA. Cheese serving per week are higher in more educated versus low educated adults, urban versus rural areas and adults versus children in general. Following the increase in world population and market demand, cheese production faces quantitative and qualitative challenges for meeting these requirements. Within the project Center for Food Safety and Quality at the Andrija Štampar Teaching Institute of Public Health, the isotopic composition of characteristic elements in indigenous agricultural food products is being determined. Croatia has a long-standing tradition of producing high-quality indigenous cheeses. This study presents the results of carbon and nitrogen stable isotope ratios that can be linked to the geographical origin of the cheese.

80 Cheese samples were collected all over the Republic of Croatia from domestic manufacturer. The samples were tested for the basic quality parameters of fat, protein, dry matter, salt and pH. Their DELTA C ($\delta^{13}\text{C}$) and DELTA N ($\delta^{15}\text{N}$) values were determined, and their mutual ratio was used to determine the geographical origin of the cheeses. Different types of cow's, sheep's, goat's cheese and their mixtures were tested over three years. After lyophilization, the cheese samples were analysed using EA IRMS technique and the total ratios of carbon $\delta^{13}\text{C}/^{12}\text{C}$ and nitrogen $\delta^{15}\text{N}/^{14}\text{N}$ isotopes were determined. IRMS measurements were performed by IRMS Delta V Plus (Thermo Fischer Scientific, Bremen, Germany) coupled to Elemental Analyzer FlashEA. Instruments were controlled by the Isodat 3.0. software (Thermo Fischer Scientific, Bremen, Germany). Solid specimens were introduced into the EA system contained in tin capsules. The isotopic ratios were expressed in part per thousand (‰). The samples were measured against the certified reference material Protein (Casein) Standard OAS (IVA Analysentechnik GmbH & Co. KG, Meerbusch). The analysis was performed using combustion reactor filled with copper (II) oxide, silver cobaltous/cobaltic oxide, and chrome (III) oxide (Thermo Fischer Scientific, Bremen, Germany). The reactor is followed by a water-separator and packed GC column for separation of the evolved gases (N_2 and CO_2).

Out of 80 analysed cheese samples collected from the entire territory of the Republic of Croatia only cheese samples from Krk and Cres could be geographically determined using just their DELTA C ($\delta^{13}\text{C}$) and DELTA N ($\delta^{15}\text{N}$) values and their mutual ratio. Mean values were calculated from triplicate analyses.

Keywords: isotope ratio, geographical origin, cheese

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Acknowledgment

This project is funded by European Regional Development Fund under "Food Safety and Quality Center" (KK.01.1.1.02.0004) project

References

- [1] Katerinopoulou K, Kontogeorgos A, Salmas A.E, Patakas A, Ladavos A (2020): Geographical Origin Authentication of Agri-Food Products: A Review. *Foods*, 9(4), 489; doi: <https://doi.org/10.3390/foods9040489>
- [2] Kelly S, Brodie C, Hilkert A (2018): Isotopic-Spectroscopic Technique: Stable Isotope-Ratio Mass Spectrometry (IRMS). In: Da-Wen Sun (ed): *Modern Techniques for Food Authentication* 2nd Ed, Academic Press, 349-413,