

Application of Stable Isotope Technique and Multi-element Analyses in Tracing the Origin of Gelatin Production

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Abstract:

Gelatin is a kind of important food and medical intermediate, which is mainly extracted from animal bones. With the frequent occurrence of animal epidemic and quality problem of raw materials in the world, it is of great significance to trace the geographical origin of bone raw materials to ensure gelatin safety, strengthen quality control and protect geographical indication products. However, the traceability system of bone raw material has not been well developed until now and the researches on its traceability methods are also scarce, which not only brings safety risks to gelatin products, but also greatly limits the import and export trade of bone raw materials.

Therefore, the potential of the stable isotope and multi-element analyses for distinguishing the geographical origin of bone samples from various provinces in China was investigated. The C, N and H isotopic compositions and the contents of 18 elements in bovine bone samples were studied by isotope ratio mass spectrometry (IRMS), inductively coupled plasma mass spectrometry (ICP-MS) and inductively coupled plasma optical emission spectrometer (ICP-OES), combined with one-way analysis of variance (ANOVA), principal component analysis (PCA) and linear discriminant analysis (LDA).

It was shown that the values of $\delta^{13}\text{C}$, $\delta^{15}\text{N}$ and $\delta^2\text{H}$ as well as the contents of 16 of the 18 elements were significantly different in bone samples among the regions. A total correct classification rate of 95.7% and 100% was obtained by the stable isotope traceability method and multi-element traceability method, while the cross-validation rate was 91.5% and 97.9%, respectively. It was concluded that both stable isotopes and mineral elements can be good indicators for tracing the geographical origin of bone raw materials. Due to the minor difference in the discrimination accuracy of these two methods, it is preferable to establish traceability models using stable isotope method in practical work considering economic feasibility and efficiency.

Key words: stable isotope, multi-element, bone raw materials, gelatin, traceability method