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HEAVY METAL CONTAMINATION IN LEGUMES: FOOD SAFETY EVALUATION OF LENTILS, CHICKPEAS, AND BEANS

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Abstract

The aim of the study was to evaluate the level of heavy metals in lentils, chickpeas, and common beans using X-ray fluorescence (XRF) in order to quantify metal concentrations and ensure the compliance with Codex Alimentarius and EU standards.

Keywords: Food safety, XRF analysis, Contamination assessment, Risk evaluation

Introduction

Lentils (*Lens culinaris*), chickpeas (*Cicer arietinum*), and common beans (*Phaseolus vulgaris*) represent three of the most important grain legumes, providing essential plant-based proteins, carbohydrates, fibers, and minerals that support global nutrition and food security. They can accumulate heavy metals from soil, irrigation water, fertilizers, or atmospheric deposition, posing potential food safety concerns. Metals such as cadmium (Cd), lead (Pb), and mercury (Hg) are toxic even at low concentrations, while essential elements like iron (Fe), zinc (Zn), and copper (Cu) are beneficial only within safe limits. Therefore, assessing their concentrations relative to international standards (FAO/WHO) is critical to ensure both nutritional value and consumer safety.

Material and method

Nine samples of lentils, chickpeas, and beans were collected from Romanian market and were analyzed using XRF spectrometry.

Results and discussions

The elemental analysis revealed distinct accumulation patterns among the studied legumes. Lentils showed the highest levels of Fe (ranging from 250–320 mg/kg) and Zn (40–60 mg/kg), confirming their nutritional importance. Chickpeas exhibited moderate concentrations of Cu (15–20 mg/kg) and Mn (25–35 mg/kg), while beans had comparatively lower micronutrient levels but occasionally higher Cd traces (up to 0.25 mg/kg). Pb and Hg were either not detected or remained below permissible limits (0.1 mg/kg and 0.03 mg/kg, respectively), suggesting minimal contamination.

Conclusions

The regular analysis of vegetables is crucial to protect consumers and sustain their nutritional and environmental value.

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