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MINERAL COMPOSITION OF CHICKEN EGGSHELLS SOLD ON THE LOCAL MARCHET AND THEIR VALORIZATION

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Abstract: *The purpose of this paper was to characterize the mineral profile of chicken eggshells from products sold on the local market, as well as to investigate the possibility of utilizing them as an alternative source of minerals in various applications, including in the food fortification process. Elemental analysis was performed by flame atomic absorption spectrometry, quantifying eight mineral elements: sodium (Na), potassium (K), calcium (Ca), magnesium (Mg), iron (Fe), manganese (Mn), zinc (Zn), and copper (Cu). The determinations were performed on eggshell powders collected from three distinct commercial sources, and the resulting values were reported in milligrams per 100 g of dry matter (mg/100 g DM). The obtained data indicated differences between samples regarding the concentrations of all the investigated elements, suggesting variations in mineral composition depending on the source of origin. Analysis of the results revealed the predominance of calcium in the mineral composition of eggshells, with concentrations ranging from 34.472 to 38.531 mg/100 g DM, with an average of 36.763 ± 1.698 mg/100 g DM. Regarding the other elements determined, the recorded values ranged from 36.3 to 48.7 mg/100 g DM for sodium, 117 to 175 mg/100 g DM for potassium, and 359 to 474 mg/100 g DM for magnesium, respectively. For the elements present in lower concentrations, values of 2.86–4.32 mg/100 g DM were obtained for iron, 0.22–0.51 mg/100 g DM for manganese, 0.72–1.28 mg/100 g DM for zinc, and 0.382–0.831 mg/100 g DM for copper. The abundance of calcium supports the interest in exploiting eggshells as a mineral resource to obtain ingredients with potential use in the food industry, including for the nutritional enrichment of certain products.*

• Introduction

Despite their high mineral content, chicken eggshells are generated in significant quantities as a byproduct of egg production and processing, in many situations, being disposed of as waste. In recent years, their utilization has attracted increasing scientific interest, especially due to the fact that they represent a natural and abundant source of calcium, which can be recovered and used in food, nutritional, agricultural, pharmaceutical applications, but also in other fields.The obtained eggshell powder has potential as a natural source of calcium, being utilized as an ingredient in the formulation of food products with improved mineral content.

Scientific literature highlights the fact that the high level of calcium makes eggshells a raw material of interest for obtaining calcium-enriched products and ingredients intended for food fortification.The interest in the valorization of eggshells is closely related to their chemical and mineral composition (ADITYA et al., 2021; LIU et al., 2021; ALI and BADAWI, 2017).

• Material and method

In the experimental part, chicken eggshells were collected from eggs purchased from three local retail outlets. After removal of the egg contents, the eggshells were initially washed under running tap water. The inner membrane was subsequently removed, and the eggshells were rinsed with distilled water and boiled in water for 5 min. After cooling and removal of excess water, the eggshells were dried in a laboratory drying oven at 80 °C.

The dried eggshells were subsequently ground using a kitchen grinder to obtain a fine powder. Based on their origin, the samples were divided into three experimental groups, coded ES1 (eggshell 1), ES2 (eggshell 2), and ES3 (eggshell 3). Until analysis, the prepared samples were stored under refrigerated conditions in amber glass containers. The concentrations of essential and potentially toxic mineral elements (Na, K, Ca, Mg, Fe, Mn, Zn, and Cu) in the eggshell samples were determined by flame atomic absorption spectrometry (FAAS) using an air–acetylene flame.

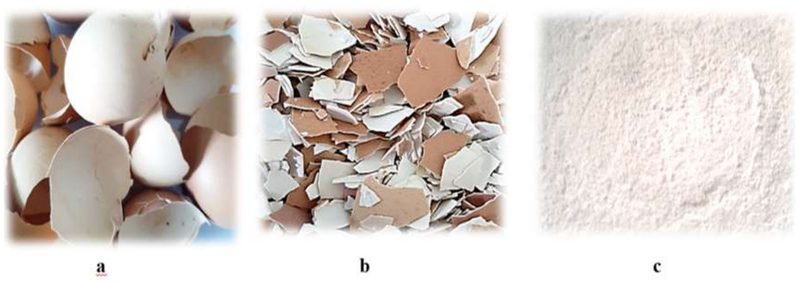


Figure 1. Appearance of chicken eggshell at different processing stages: raw eggshell (a), cleaned eggshell (b), and eggshell powder (c).

• Results and discussions

• The concentrations of mineral elements determined in the chicken eggshell samples are presented in Table 1.

Table 1

Mineral composition of eggshell powder from eggs sold on the local market

Sample	Na	K	Ca	Mg	Fe	Mn	Zn	Cu
ES1	36,3	175	34.472	359	2,86	0,22	0,72	0,382
ES2	43,6	117	38.531	474	4,32	0,51	1,28	0,831
ES3	48,7	151	37.287	435	4,11	0,48	0,81	0,745
Mean ± SD	42,87 ± 5,09	147,67 ± 23,80	36.763 ± 1.698	423 ± 47,45	3,76 ± 0,64	0,40 ± 0,13	0,94 ± 0,25	0,65 ± 0,19

- **For** all the elements analyzed, differences were observed differences between samples from different commercial sources. The amplitude of the variations differed depending on the element analyzed, with the most obvious differences being observed in the case of potassium, calcium, magnesium and zinc.
- **Calcium** was the predominant element in the mineral composition of the analyzed shells, with individual concentrations ranging from 34.472 to 38.531 mg/100 g DM and a mean value of 36.763 ± 1.698 mg/100 g DM.
- For **potassium,** concentrations ranged from 117 to 175 mg/100 g DM, with a mean value of 147.67 ± 23.80 mg/100 g DM.
- **Sodium** showed lower values, ranging from 36.3 to 48.7 mg/100 g DM, with a mean of 42.87 ± 5.09 mg/100 g DM.
- **Manganese** was determined within the range of 0.22–0.51 mg/100 g DM, with a mean value of 0.40 ± 0.13 mg/100 g DM.

For **zinc**, concentrations of 0.72–1.28 mg/100 g DM were recorded, with a mean of 0.94 ± 0.25 mg/100 g DM, while **copper** ranged from 0.382 to 0.831 mg/100 g DM, with a mean value of 0.65 ± 0.19 mg/100 g DM.

Overall, the results indicate that the eggshell samples analyzed constitute a mineral matrix characterized primarily by a very high calcium content, associated with the presence of smaller amounts of magnesium, potassium, sodium, iron, manganese, zinc, and copper. The comparative analysis of the results obtained in the present study with data available in the specialized literature reveals, overall, an agreement with the values reported for the majority of the mineral elements investigated.

• Conclusions

The analyzed eggshells showed a high mineral content, with calcium being the predominant element, with an average concentration of 36,763 ± 1,698 mg/100 g dry matter. This result confirms the importance of calcium in the mineral structure of the eggshell and highlights its potential as a calcium-rich raw material.

In addition to calcium, measurable amounts of Mg, K, Na, Fe, Mn, Zn and Cu were identified, demonstrating that eggshell powder represents a complex mineral matrix, and not just a source of calcium. Differences were observed among the samples from the three commercial sources analyzed, with the most evident variations recorded for K, Ca, Mg, and Zn.

These differences may be associated with the origin of the raw material and with biological, nutritional and technological factors, but attributing the variations to a single cause cannot be achieved based on the limited number of samples investigated.