

## Apples: An important source of essential microelements

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### Abstract

The paper presents data on the concentration of some mineral bio elements in native apple varieties: Champagne, Double red, Florina, Jonathan, Rennet and Wagener. The aim of this research was at estimating the mineral supply in daily diet and the possibility of using them as a supplementary source of essential microelements. The total amount of bio metals: iron, manganese, zinc and copper, were determined by flame atomic absorption spectrometry after samples calcination and ash extraction with HNO<sub>3</sub>. The experimental results reveal important contents in essential micronutrients, their distribution in analysed fruits present the following trends: Fe (III) > Mn(II) > Zn(II) > Cu(II). The results made us consider that these traditional fruits can be used as additional source of mineralizing bio elements in daily diet.

**Keywords:** apples, mineral microelements, FAS, mineral intake

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### 1. Introduction

Known ever since Ancient times, apples are the most eaten of all fruits. These fruits with pleasant taste and appealing flavour have numerous healthy nutrients that are rarely found in other foods.

Apples are an extremely important source of bioactive compounds: they are rich particularly in vitamins and minerals. Red or yellow, apples are an important share of human diet because they are a good source of fibers including soluble pectin, vitamin A, vitamin C, minerals and poly-phenols [2,10,12,15]. Due to their high content in water (75-95%), apples contribute to the necessary body water supply.

The complexity of bioactive compounds, the low content of calories and the numerous fibers they contain make apples a true source of health and vitality [13]. Practically, the chemical composition of apples can be considered a good indicator of beneficial effects on humans' health state.

Nutritive and therapeutical features of apples are determined by the bioactive principles they contain, among which several essential minerals [2,3,4,6,12].

Minerals – under the form of macro- or micro-elements – are responsible for the good functioning of the body because they are involved in a series of functions that are extremely important: maintaining osmotic pressure and electrolytic balance in the muscular tissue and in the blood; buffering the

muscular tissue; contracting the muscles as activators and inhibitors of enzymes involved in the metabolism of carbo-hydrates, lipids and proteins; making up lipids, vitamins and enzymes where they structure tissues etc. [2,16].

As an important share of daily diet, apples are also a considerable source of minerals. As such, these fruits could be a supplementary, alternative source of such bio elements.

The goal of this study was to determine the content of microelements of different apple cultivars to estimate the nutritive supply in humans' daily diet.

We determined, with flame atomic absorption spectrometry, the total content of Fe (III), Mn(II), Zn(II) and Cu(II) in six native apple varieties – *Champagne*, *Dublu rosu*, *Florina*, *Jonathan*, *Rennet* and *Wagner* – harvested in a hill area from Banat, Romania, known as a anthropic or geogenous pollution free area.

The results made us consider that these traditional fruits can be used as additional sources of mineralizing bio elements in daily diet.

## 2. Material and Methods

To carry out the experiment, we used six native apple varieties – *Champagne*, *Dublu rosu*, *Florina*, *Jonathan*, *Rennet* and *Wagner* – harvested in a hill area from Caras-Severin County, Romania, known as an anthropic or geogenous pollution free area.

Total concentration of Fe, Mn, Zn and Cu of the apple samples we studied was determined with flame atomic absorption spectrometry after sample calcination at 550°C and ash extraction with a solution of HNO<sub>3</sub> with 0.5 N [1,6,7].

To measure absorbance, we used an atomic absorption spectrometer of the Varian dip AA 240 FS type.

## 3. Results and Discussion

Experimental results after analysis in Fe, Mn, Zn and Cu in the studied apples varieties are shown in Table 1 and Figure 1.

Data shown in Table 1 point out that the share of analysed bio elements is about the same in all analysed assortments.

Comparing the concentration values of Fe, Mn, Zn and Cu determined in the studied apple varieties with similar data from other researchers [3,4,8,9,12], we could see there are no important differences particularly if we take into account the fact that the share of minerals in fruits depends on a series of anthropic and geogenous (soil and climate conditions) nature [2,8,11].

**Table 1.** Share of Fe, Mn, Zn and Cu in different Romanian apple varieties

Apple varieties	Bio element content (mg/kg fresh matter)			
	Fe	Mn	Zn	Cu
Champagne	5.24	0.31	0.22	0.15
Dublu rosu	4.35	0.22	0.31	0.23
Florina	6.02	0.28	0.25	0.21
Jonathan	5.97	0.43	0.32	0.28
Rennet	3.86	0.32	0.30	0.20
Wagener	4.12	0.28	0.38	0.26

The best represented in all analysed fruits is Fe with values ranging between 3.84-6.02 mg/kg. The other bio elements, Mn, Zn and Cu, were identified in lower, relatively close concentrations ranging between 0.15 mg/kg of Cu (*Champagne*) and 0.38 mg/kg of Mn (*Wagner*).

The considerable concentrations of bio elements (Table 1) point out the fact that the studied apple varieties could be used as supplementary sources of bio elements in the recommended daily diet.

Mean concentrations of Fe, Mn, Zn and Cu in the studied apple varieties as well as the recommendations of the Food and Nutrition Board, Institute of Medicine, National Academies [14] (Table 2) allowed an estimation of the mineral supply in the recommended daily diet.

**Table 2.** Values of recommended daily diet in males and females aged 19-50

Element	Recommended daily intake, mg/day	
	Males	Females
Fe	8	18
Mn	2,3	1,8
Zn	11	11
Cu	0,9	0,9

In estimating the mineral supply, we took into account the fact that the share of Fe, Mn, Zn and Cu in all apple assortments is about the same: we used mean values of the concentrations corresponding to 500 g of fresh apples. In these conditions, the mean values of the mineral supply or the degree of coverage of the recommended daily intake (%) for 500 g of fruit (a medium-size apple at each main meal) in people aged 19-50 are shown in Table 3.

**Table 3.** Mean values of the concentrations of Fe, Mn, Zn and Cu and the mineral supply of 500 g of apples

Element	mg/500g fresh fruit	Mineral supply, % of the daily recommended intake	
		Males	Females
Fe	2,46	0,79	13,69
Mn	0,15	6,67	8,52
Zn	0,15	1,35	1,85
Cu	0,11	12,31	12,31

These values point out the fact that mineral supply from apples, i.e. the share of Fe, Mn, Zn and Cu, in experimental conditions show different values.

The best represented of the studied minerals is Fe (with values ranging between 13.69% in females and 30.79% in males), followed by Cu (12.31%), Mn (with values ranging between 6.67% in females and 8.52% in males) and Zn, with an almost insignificant supply in the daily diet (1.35% in males and 1.65 in females).

All this confirm that the studied apple assortments could be used as supplementary sources of minerals such as Fe, Cu and Mn.

However, we need to mention that, in the conditions of our experiment, the concentrations of bio elements in the 500 g of fruit cover only part of the necessary daily intake. The increase of the mineral supply in the daily diet, the degree of coverage of minerals necessary daily could be improved through increased consumption of dried fruit [5]. We need to take into account that improper consumption (excessive consumption) could load the body with minerals or nutrients with side effects. This is why we need to control the supply of such minerals to avoid excess or cumulated effects of other constituents.

#### 4. Conclusions

Experimental results of the analysis of Fe, Mn, Zn and Cu content in the six native apple varieties – Champagne, Dublu rosu, Florina, Jonathan, Renet and Wagner – harvested from the hill area of the Caras-Severin County, Romania, point out considerable concentrations of such bio elements.

The best-represented mineral in apple is Fe, with values ranging between 3.84-6.02 mg/kg. Mn, Zn and Cu were identified in lower, relatively close concentrations ranging between 0.15 mg/kg of Cu (Champagne) and 0.38 mg/kg of Mn (Wagner).

Data after assessing mineral supply of apples in daily diet point out the fact that the degree of coverage of the recommended daily intake of Fe, Mn, Zn and Cu – in experimental conditions – shows different values.

The best represented of the studied minerals is Fe (with values ranging between 13.69% in females and 30.79% in males), followed by Cu (12.31%), Mn (with values ranging between 6.67% in females and 8.52% in males) and Zn, with an almost insignificant supply in the daily diet (1.35% in males and 1.65 in females).

The conclusion is that apples, our traditional fruit, can be used as a supplementary source of Fe, Cu, Mn and less of Zn.

**Compliance with Ethics Requirements.** Authors declare that they respect the journal's ethics requirements. Authors declare that they have no conflict of interest and all procedures involving human / or animal subjects (if exist) respect the specific regulation and standards.

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