

# BaSeFood

(G.A. n° 227118)

Sustainable exploitation of bioactive components  
from the Black Sea Area traditional foods



## D 2.4 – Final report on the evaluated dataset of the BSAC traditional foods investigated

**Helena S. Costa, Tânia G. Albuquerque, Ana Sanches-Silva (INSA)  
Paul Finglas (IFR)**

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## **Contributors to the analyses**

Helena S. Costa, Ana Sanches-Silva, Tânia G. Albuquerque, Ana Valente, Tânia Fontes, Carla Mota, Cristina Flores, Mariana Santos, Susana Santiago, Ana Cláudia Nascimento (INSA)

Paul Finglas, Mark Roe (IFR)

## **Contributors of food samples**

Iordanka Alexieva (UFT)

Carmen Costea, Alexandru Stroia (ASE)

Dmitry V. Karpenko, Elena Beteva (MSUFP)

Mariam Jorjadze, Elene Shatberashvili, Zaza Kilasonia, Ia Ebralidze, Irma Davadze (ELKANA)

Nadiya Boyko, Mariia Mudryk, Larysa Buhyna, Viktor Petrov, Andriy Pauk, Nelya Koval (UZHNU)

Osman Hayran, Bike Koçaoglu (YEDITEPE)

Sergey Fedosov, Leonid Kaprelyants, Katerina Fedosova (ONAFIT)

Francesca Danesi and L. Filippo D'Antuono (UNIBO)



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## Summary

Traditional foods are key elements that differentiate the dietary patterns of each country. In most countries, there is limited information on the nutritional composition of such foods, therefore, there is a need to investigate, register and promote traditional foods. These foods are also a valuable contribution to the development and economic sustainability of rural areas and preservation of biodiversity. One of the aims within BaSeFood project is to provide new data on the nutritional composition of traditional foods of plant origin from six Black Sea area countries (Bulgaria, Georgia, Romania, Russian Federation, Turkey and Ukraine). Thirty-three traditional foods were selected in WP1 according to specific criteria: documentation of traditional character; availability and quality of existing compositional data; frequency of consumption; beneficial versus detrimental health implications and marketing potential. Chemical analyses to determine the nutritional composition of the selected traditional foods were performed and the data were fully documented and evaluated according to EuroFIR guidelines and standardised procedures. To assure the quality of analytical results accredited laboratories or laboratories with successful participation in proficiency testing schemes were chosen. The use of a common methodology for the study of traditional foods will enable countries to further investigate their traditional foods and to continue to update their national food composition databases.

The present deliverable provides information on the work developed in Task 2.2 “*Establishment of common methodology, sampling strategy and delivery of samples*” and Task 2.3 “*Chemical determination of bioactive compounds and nutritional composition in BSAC traditional food samples*”. The evaluated analytical results of nutrients and bioactive compounds were compared per country and per component, in order to assess the variability among the selected BSAC traditional foods in the frame of BaSeFood.



## **Traditional foods**

Traditional foods constitute an important part of the culture, history, identity, heritage, local economy of a region or country and are key elements for the dietary patterns of each country. These foods are commonly perceived as foods that have been consumed locally or regionally for a long time and the methods of preparation of such foods have been passed from generation to generation (Trichopoulou *et al.*, 2007; Costa *et al.*, 2010).

Specific eating habits and foods play an important role in traditional habits of many cultures (Weichselbaum *et al.*, 2009). Lifestyle changes are affecting eating habits across Europe and some traditional foods are at risk of disappearing. In most countries, there is limited information on the nutritional composition of such foods, and consequently there is a need to investigate, register and promote traditional foods. These foods are also a valuable contribution to the development and economic sustainability of rural areas and preservation of biodiversity.

Nutritional composition data of traditional foods is also necessary to elucidate their role in the traditional dietary pattern of a population. Some traditional foods and patterns may have potential health properties which have been tested over time (Trichopoulou *et al.*, 2006, 2007) and in the last years, consumers have shown an increased interest and demand for traditional foods which are often perceived as having specific sensory characteristics and higher quality (Cayot, 2007; Chambers *et al.*, 2007; Guerrero *et al.*, 2009; Pieniak *et al.*, 2009).

Therefore, one of the aims of WP2 is to provide new data on the nutritional composition and bioactive compounds content of traditional foods of plant origin from six Black Sea Area countries (Bulgaria, Georgia, Romania, Russian Federation, Turkey and Ukraine) to promote their sustainable development and exploitation.

Bioactive compounds are defined as “inherent non-nutrient constituents of food plants with anticipated health promoting/beneficial and/or toxic effects when ingested” (Gry *et al.*, 2007). Identifying bioactive compounds is of major importance in understanding the underlying mechanisms of action and interactions of natural products in the human body. Although some foods have already been and continue to be studied for their nutritional and health-promoting value, traditional foods from BSAC remain an expansive and potentially novel source of bioactive compounds. The need of accurate data on bioactive compounds is increasing due to the influence they may have in nutritional and clinical studies (Granado *et al.*, 2001).

## **Value documentation of traditional foods data for inclusion in Food Composition Databases**

Food composition tables existed only in printed form, with the oldest tables dating back to the early 1800s. Nowadays, a trend towards electronically available Food Composition Databases (FCDB) can be observed. They can hold large amounts of data and allow easy access to and manipulation of data. More recently, many European FCDB have become available online on the Internet, a move influenced by EuroFIR ([www.eurofir.org](http://www.eurofir.org)) within Europe.



FCDB usually contain information on a wide range of components, including: Energy; macronutrients (e.g. protein, carbohydrate, fat) and their components (e.g. sugars, starch, fatty acids); minerals (e.g. calcium, iron, sodium) and vitamins.

In addition, some FCDB have values for individual amino acids and/or vitamin fractions (e.g. individual carotenoids, such as lycopene and lutein). Some specialised databases are also available; for example, bioactive compounds are included in the EuroFIR eBASIS database (<http://ebasis.eurofir.org/>).

FCDB that provide detailed and reliable information on the nutritional composition of foods are essential in a range of applications including public health nutrition, clinical practice, research, food industry, food consumption surveys, sports nutrition, nutritional education, as well as being used for the development and implementation of nutritional policies at national and European levels (Harrison, 2004; Williamson, 2006; Egan *et al.*, 2007; Church, 2009). Nutritional composition data are an essential resource for health researchers and epidemiologists who investigate the relationship between food and disease in populations and require accurate estimation of nutritional intake, the basis also for dietary recommendations (Ireland *et al.*, 2002; Egan *et al.*, 2007).

In order to include traditional foods data in FCDB, it is essential to guarantee data quality which is strictly dependent on the documentation of each sample.

Fig.1 summarizes the most important categories that should be taken into account to assure the full value documentation, which includes: Information on food description, sampling plan, sample handling, component identification, method specification, value and quality assessment. This information was collected for each of the traditional foods for inclusion in the available national food composition tables/databases.

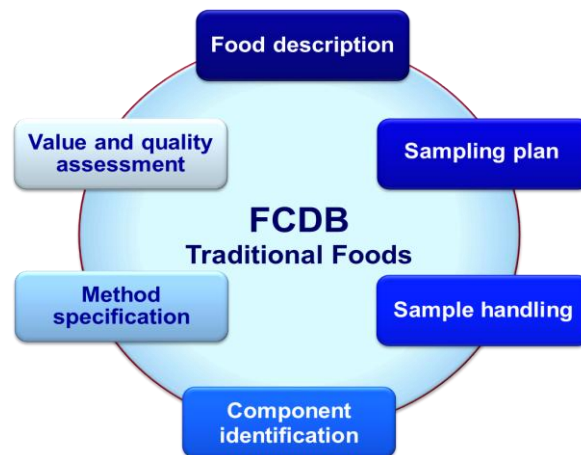








Fig.1. Categories included in full value documentation.

### Prioritisation of traditional foods and components








A total of 33 traditional foods from Black Sea Area countries (Bulgaria, Georgia, Romania, Russian Federation, Turkey and Ukraine) were selected and prioritised in WP1 by Prof. Antonia Trichopoulou and her team from Hellenic Health Foundation, Greece. Food description using LanguaL was also performed in WP1.



**Table 1.** Selected traditional foods from Black Sea Area countries







Food group	Country	Traditional food (English name)	Traditional food (National language)	Brief food description	Traditional food photo
Cereals and cereal based foods	Bulgaria	Baked layers of pastry stuffed with pumpkin	<i>Tikvenik</i>	A dessert made of layers of pastry with pumpkin, sugar, cinnamon, walnuts	
	Georgia	Tsiteli Doli Bread	<i>Makhobeli</i> <i>dolis puri</i>	A light blue tinged bread of oblong or oval shape, containing a small amount of floured makhobeli	
	Romania	Cornmeal mush	<i>Mămăligă</i>	Mămăliga is prepared from corn flour boiled in salted water	
	Russian Federation	Buckwheat porridge crumby	<i>Каша гречневая рассыпчатая</i>	A mass of non-agglomerated tenderized cereal grain prepared from fried buckwheat	
	Turkey	Bulgur pilaf	<i>Bulgur pilavi</i>	A type of pilaf made from bulgur and served hot	
	Ukraine	Sour rye bread	<i>Хліб житній</i>	Rye bread is a type of bread made with various percentages of flour from rye grain	

**Table 1.** Selected traditional foods from Black Sea Area countries (cont.)





Food group	Country	Traditional food (English name)	Traditional food (National language)	Brief food description	Traditional food photo
Vegetables and vegetables based foods	Bulgaria	Rodopian dried beans	<i>Rodopski fasul</i>	A bean soup with a characteristic taste	
	Georgia	Nettles with walnut sauce*	<i>Chinchris mkhali nigvzit</i>	A meal of boiled stinging nettle seasoned with walnut	
	Romania	Nettle sour soup	<i>Ciorbă de urzici</i>	A liquid dish consisting of a sour soup made from fermented wheat bran, vegetables and green nettle leaves harvested from young plants	
	Russian Federation	Vegetable okroshka	<i>Овощная окрошка</i>	A cold soup with shredded vegetables and bread kvass. A light-brown liquid, served at a temperature not exceeding 14 °C	
	Turkey	Kale soup	<i>kara lahana corbasi</i>	Vegetable soup	
	Ukraine	Transcarpathian green borsch	<i>Zelenyj borshch Zakarpats'kyj</i>	Thick vegetable soup with sorrel, served with smoked meat	
	Ukraine	Ukrainian borsch	<i>Борщ український пісний</i>	A mildly tart vegetable soup in which beets predominate	








**Table 1.** Selected traditional foods from Black Sea Area countries (cont.)

Food group	Country	Traditional food (English name)	Traditional food (National language)	Brief food description	Traditional food photo
Fruit or fruit based foods	Bulgaria	Rose jam	<i>Dko ot rozi</i>	Sweet thick syrup with rose petals ( <i>Rosa damascena</i> Mill.)	
	Georgia	Churchkhela	<i>Churchkhela</i>	Traditional dish made of walnuts sewn onto a string, dipped in thickened grape juice and dried in the shape of a sausage	
	Romania	Plums jam	<i>Magiun de prune</i>	A traditional plum paste, obtained by boiling the plums without sugar.	
	Russian Federation	Watermelon juice	<i>Арбузный сок</i>	Watermelon juice with pulp	
	Turkey	Fruit of the evergreen cherry laurel	Karayemiş	<i>Prunus laurocerasus</i> L. Cherry laurel belongs to the rose family	
	Ukraine	Uzvar	<i>Узвар</i>	Boiled desiccated fruits in large quantities of water	






**Table 1.** Selected traditional foods from Black Sea Area countries (cont.)

Food group	Country	Traditional food (English name)	Traditional food (National language)	Brief food description	Traditional food photo
Oilseeds or oilseed products	Bulgaria	Halva	<i>Tahan Halva</i>	A dessert prepared with sugar or sugar syrup and sunflower seed and sesame seed tahini	
	Georgia	Flax oil	<i>Selis zeti</i>	Flaxseed oil ( <i>Linum usitatissimum</i> L.)	
	Russian Federation	Mustard oil	<i>Горчичное масло</i>	A yellow oil with a spicy taste derived from mustard seeds	
	Ukraine	Roasted sunflower seeds	<i>Smazhene nasinnya</i>	Roasted sunflower seeds ( <i>Helianthus annuus</i> L.)	

**Table 1.** Selected traditional foods from Black Sea Area countries (cont.)

Food group	Country	Traditional food (English name)	Traditional food (National language)	Brief food description	Traditional food photo
Herbs, spices and aromatic plants	Bulgaria	Mursal tea	<i>Mursalski chai</i>	An infusion of <i>Sideritis scardica</i> Gri	
	Georgia	Wild plum sauce	<i>Tkhemlis satsebeli</i>	A well seasoned wild plum sauce	
	Romania	Herbal dish	<i>Mâncărică de verdeață</i>	The herbal dish is served cold during fasting periods. It is cooked with sauce	
	Turkey	Black tea	<i>Çay</i>	Medium sized black tea particles	
	Ukraine	Cottage cheese with dill and garlic	<i>Pomazanka</i>	Cottage cheese spread with dill and garlic nationally called Pomazanka	

**Table 1.** Selected traditional foods from Black Sea Area countries (cont.)

Food group	Country	Traditional food (English name)	Traditional food (National language)	Brief food description	Traditional food photo
Low or non-alcoholic fermented foods and beverages of plant origin	Bulgaria	Millet ale	<i>Boza</i>	A thick, fermented cereal based beverage with a sourish or sweetish taste	
	Romania	Elderberry soft drink	<i>Socata</i>	Natural home-made soft drink, without preservatives or artificial colorants made from elder flowers ( <i>Sambucus nigra</i> L.)	
	Russian Federation	Kvass southern	<i>Квас южный</i>	A fermented beverage made from rye bread and juniper berries ( <i>Juniperus communis</i> L.)	
	Turkey	Sautéed pickled green beans	<i>Fasulye turşusu kavurması</i>	A vegetable dish	
	Ukraine	Sauerkraut	<i>Капуста білокачанна квашена</i>	Prepared from white cabbage	

The list of components for the nutritional composition of each traditional food were prioritised on the basis of (1) Inclusion of relevant data in national food composition databases; (2) the most relevant components to be analysed for each food and (3) their importance in relation to the increased risk of diet-related chronic diseases. The prioritised list of components was: water, ash, total protein [NCF], total fat, individual fatty acids, cholesterol, total starch, total sugars, total dietary fibre, minerals and trace elements (sodium, iron, zinc, selenium), and vitamins A, E, C, B<sub>2</sub> and total folate. Besides the prioritised components in the DoW, INSA also performed analyses for the following minerals: potassium, calcium, magnesium, phosphorus, copper, manganese and bioactive compounds ( $\alpha$ -carotene,  $\beta$ -carotene and lycopene).



## **Sample collection and preparation**

Sampling of traditional foods in each country was carried out using harmonised approaches (Trichopoulou *et al.*, 2007; Costa *et al.*, 2010). INSA and IFR have developed guidelines for the sampling and sample handling of primary and composite Traditional Foods of BSAC in order to establish a common approach for all countries and to ensure that representative food samples are analyzed and that they produce reliable and high quality data to include in FCDB. A form was prepared to harmonise the information collected by the partners in different countries and instructions to help fill out the form were also prepared.

This document (M2.1) contains information regarding Food description (including name in English and in the original language and the scientific name in the case of primary foods); Sampling plan (including date and time of collection, sampling point, process and preservation method and description of the ingredients) and Sample handling (including mixing/homogenization method, storage/container; information about pool preparation, storage and transport to the laboratory).

## **Selection of laboratories and quality assessment**

A list of proposed laboratories to perform the chemical analysis of the selected bioactive compounds and for the nutritional composition of the selected BSAC traditional foods, according to quality requirements (technical competence and methodology to analyze each component) has been provided at the 2<sup>nd</sup> Consortium meeting and in M2.2. Selected laboratories (IFR, UNIBO and INSA) have been allocated for bioactive compounds analyses.

For laboratories to provide consistently reliable and accurate results in food analysis, a program of quality assurance must be in place that includes the following elements: validation of the analytical method; the use of certified reference materials, where available; and the use of routine internal quality control. According to laboratory accreditation standards ISO/IEC (International Organization for Standardisation/International Electrotechnical Commission) 17025, food analysis laboratories are required to ensure the quality of their results by participating in interlaboratory comparison or in proficiency testing (PT) schemes, when these are available.

INSA was the laboratory selected to perform the nutritional composition of the 33 selected traditional foods, and IFR was responsible for total folate content determination. UNIBO evaluated the total polyphenol content of each traditional food (M2.2). INSA also determined bioactive compounds in the selected traditional foods.

A template “Laboratory analyses results form” was developed within the EuroFIR Network of Excellence and adapted for the BaSeFood project. This excel file was prepared to collect and document information on the methods that were used to determine the nutritional composition of the selected traditional foods and also to report the analytical results. The results form was further developed based on FAPAS “Appendix II: Analytical Methods Used by Participants”. The template includes the following information: (1) Laboratory and Sample Identification; (2) Individual spreadsheets with the method description used for each component and (3) results form to complete with the analytical results.



INSA received the thirty-three selected traditional food samples from BSAC between May 2010 and July 2011. The samples were identified with the sample codes given previously in the guidelines (M2.1), homogenized, stabilized if necessary, divided in appropriate quantities and frozen or kept refrigerated until analysis (M2.3 and M2.4). INSA sent twenty-one traditional food samples on February 2011 and nine samples on June 2011 to IFR for total folate determination. Freeze dried samples were sent by BSAC partners to UNIBO, homogenized, packed in air-tight plastic bags and stored at -20 °C until analyses.

### **Method specification**

The list of analytical methods used for the nutritional composition of traditional foods from BSAC is shown in Table 2 and the list of limits of detection and quantification is shown in Table 3.



**Table 2.** List of analytical methods used for the nutritional composition and bioactive compounds of traditional foods from BSAC

Component	Method	Reference	Accredited (Yes/No) or PT schemes
<b>Water</b>	Gravimetric method	NP 475; NP 1088; NP 1614; NP EN 12145	Yes
<b>Ash</b>	Charred on sand bath and Bunsen burner before ashing	AOAC Official method, 945.46 - Gravimetric method; NF V04-208, October 1989	Yes
<b>Total N - protein</b>	Kjeldhal	Based on: AOAC Official method, 991.20, 2000	PT Schemes
<b>Total fat</b>	Acid hydrolysis with extraction	NP 876; NP 1613; NP 1974	Yes
<b>Individual fatty acids</b>	GC-FID	Based on: AOAC Official method, 996.01, 2000	PT Schemes
<b>Starch</b>	Enzymatic	Boehringer Mannheim	PT Schemes
<b>Total dietary fibre</b>	Enzymatic-gravimetric	AOAC Official method, 985.29	Yes
<b>Total sugars</b>	Munson-Walker	Based on: AOAC Official method, 950.50; AOAC Official method, 906.03; AOAC Official method, 945.2	PT Schemes
<b>Cholesterol</b>	GC-FID	Based on: AOAC official method 994.10, 2000	PT Schemes
<b>Vitamin B<sub>2</sub>, riboflavin</b>	HPLC	EN 14152:2003	Yes
<b>Vitamin C, L-ascorbic acid</b>	HPLC	In-house full validated method	PT Schemes
<b>Vitamin A</b>	HPLC	In-house validated method	PT Schemes
<b>Vitamin E, α-tocopherol</b>	HPLC	In-house validated method	PT Schemes
<b>Total folate</b>	Microbiological assay	EN14131:2003	Yes
<b>α-carotene</b>	UHPLC	In-house validated method	No
<b>β-carotene</b>	UHPLC	In-house validated method	No
<b>Lycopene</b>	UHPLC	In-house validated method	No
<b>Sodium, Na</b>	ICP-OES	Based on: AOAC Official method 984.27	PT Schemes
<b>Potassium, K</b>	ICP-OES	Based on: AOAC Official method 984.27	PT Schemes
<b>Calcium, Ca</b>	ICP-OES	Based on: AOAC Official method 984.27	PT Schemes
<b>Magnesium, Mg</b>	ICP-OES	Based on: AOAC Official method 984.27	PT Schemes
<b>Phosphorus, P</b>	ICP-OES	Based on: AOAC Official method 984.27	PT Schemes
<b>Iron, Fe</b>	ICP-OES	Based on: AOAC Official method 984.27	PT Schemes
<b>Copper, Cu</b>	ICP-OES	Based on: AOAC Official method 984.27	PT Schemes
<b>Zinc, Zn</b>	ICP-OES	Based on: AOAC Official method 984.27	PT Schemes
<b>Manganese, Mn</b>	ICP-OES	Based on: AOAC Official method 984.27	PT Schemes
<b>Selenium, Se</b>	AAS	Based on: AOAC Official method 986.15	Yes



**Table 3.** Limit of detection (LOD) and limit of quantification (LOQ) for the prioritised components

Component	LOD		LOQ	
<b>Water</b>	0.03	g/100 g	0.1	g/100 g
<b>Ash</b>	0.03	g/100 g	0.1	g/100 g
<b>Total N - protein</b>	0.03	g/100 g	0.1	g/100 g
<b>Total fat</b>	0.03	g/100 g	0.1	g/100 g
<b>Starch</b>	0.01	g/100 g	0.3	g/100 g
<b>Total sugars</b>	0.03	g/100 g	0.1	g/100 g
<b>Total dietary fibre</b>	0.1	g/100 g	0.4	g/100 g
<b>Minerals and trace elements</b>				
<b>Sodium, Na</b>	7.0	mg/100 g	20	mg/100 g
<b>Potassium, K</b>	8.0	mg/100 g	25	mg/100 g
<b>Calcium, Ca</b>	7.0	mg/100 g	20	mg/100 g
<b>Magnesium, Mg</b>	3.0	mg/100 g	10	mg/100 g
<b>Phosphorus, P</b>	7.0	mg/100 g	20	mg/100 g
<b>Iron, Fe</b>	0.2	mg/100 g	0.5	mg/100 g
<b>Copper, Cu</b>	0.06	mg/100 g	0.2	mg/100 g
<b>Zinc, Zn</b>	0.2	mg/100 g	0.5	mg/100 g
<b>Manganese, Mg</b>	0.06	mg/100 g	0.2	mg/100 g
<b>Selenium, Se</b>	5.0	µg/100 g	16	µg/100 g
<b>Vitamins and carotenoids</b>				
<b>Vitamin B<sub>2</sub> (Riboflavin)</b>	0.007	mg/100 g	0.02	mg/100 g
<b>Vitamin C (L-ascorbic acid)</b>	0.044	mg/100 g	0.115	mg/100 g
<b>Vitamin A (Retinol)</b>	2.0	µg/100 g	6.0	µg/100 g
<b>Vitamin E (α-tocopherol)</b>	0.03	mg/100 g	0.12	mg/100 g
<b>Total folate</b>	---		5	µg/100 g
<b>α-carotene</b>	2.8	µg/100 g	9.0	µg/100 g
<b>β-carotene</b>	2.0	µg/100 g	6.0	µg/100 g
<b>Lycopene</b>	2.2	µg/100 g	8.0	µg/100 g

The document D2.3 provided information on sample collection, sample handling and presented the analytical results on the nutritional composition of the selected traditional foods per country. The results for total polyphenols content were also shown.

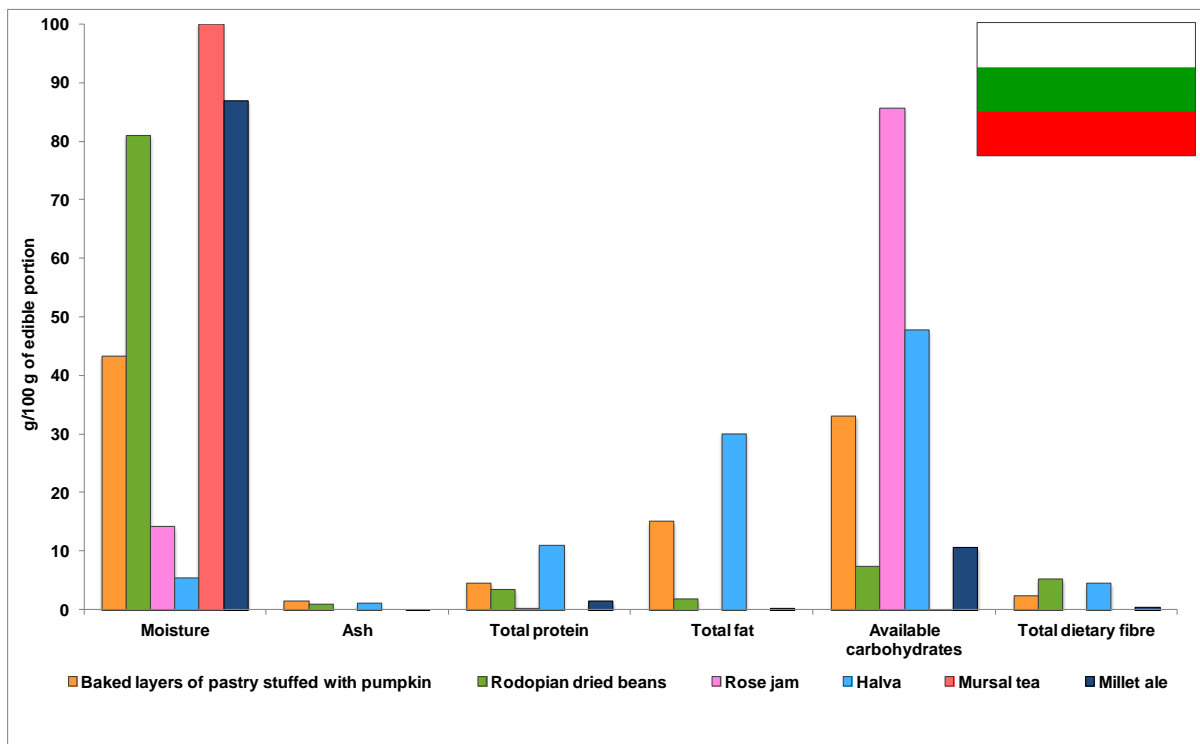
This final report D2.4 compares the nutritional composition and bioactive compounds content per country and per nutrient.

## Comparison of analytical results

### Individual countries

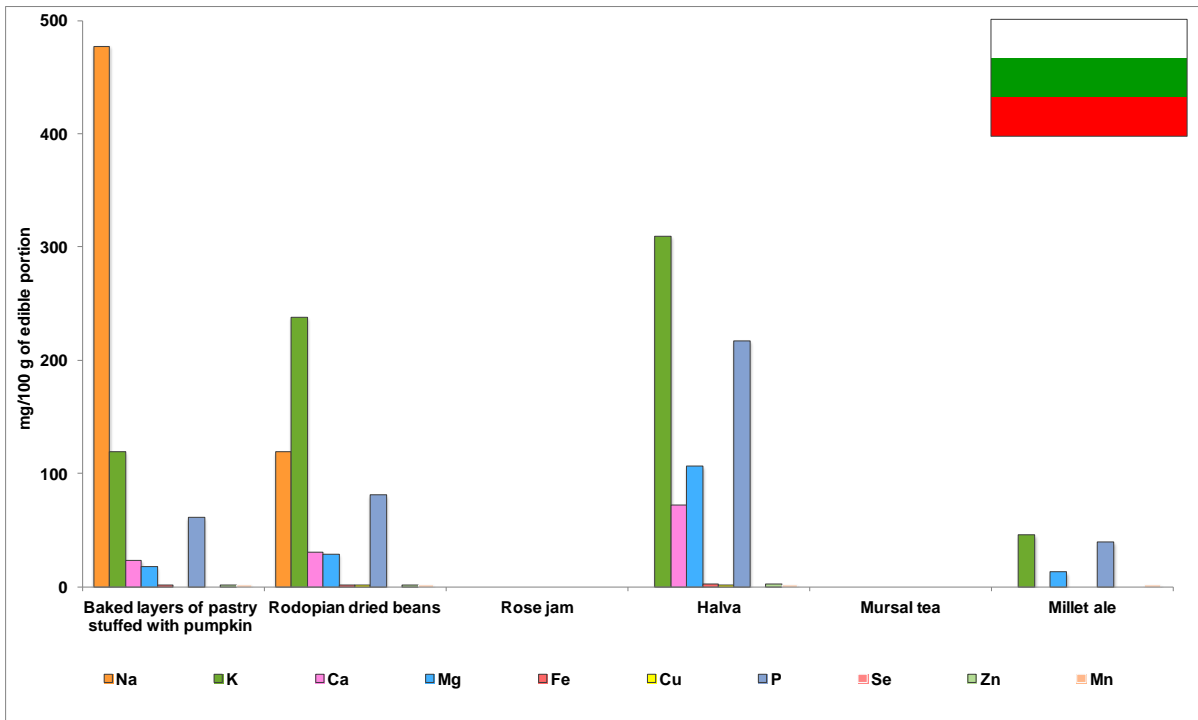
#### **Bulgaria**

From the six selected traditional foods for Bulgaria (Fig. 2), two were mainly constituted by carbohydrates (rose jam and halva) and the others mainly by water. Besides having a high content on carbohydrates, halva has also a high fat content and a considerable protein content, since it is prepared with sunflower and sesame seeds. Baked layers of pastry stuffed with pumpkin have also a higher content of carbohydrates and fat and a considerable amount of protein, since it is prepared with pumpkin, sugar and walnuts.



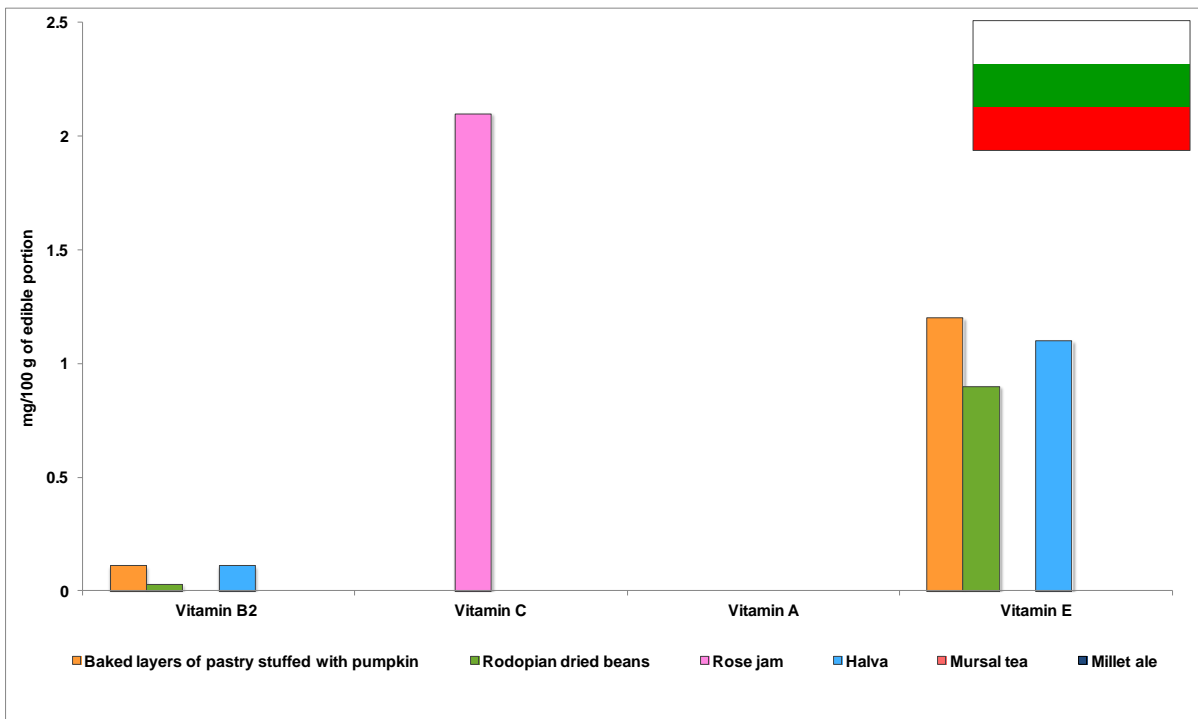
**Fig. 2.** Macronutrients content of the analysed Bulgarian traditional foods.

Regarding minerals (Fig. 3), baked layers of pastry stuffed with pumpkin have a high Na content (477 mg/100 g edible portion) and rodopian dried beans and halva have a high K level (238 and 309 mg/100 g edible portion, respectively). Halva also presented a high P content (217 mg/100 g edible portion).



**Fig. 3.** Minerals content of the analysed Bulgarian traditional foods.

In what concerns to vitamins (Fig. 4), vitamin C was only found in rose jam (2.1 mg/100 g edible portion) while vitamins B<sub>2</sub> and E were found in three Bulgarian traditional foods (baked layers of pastry stuffed with pumpkin, rodopian dried beans and halva).

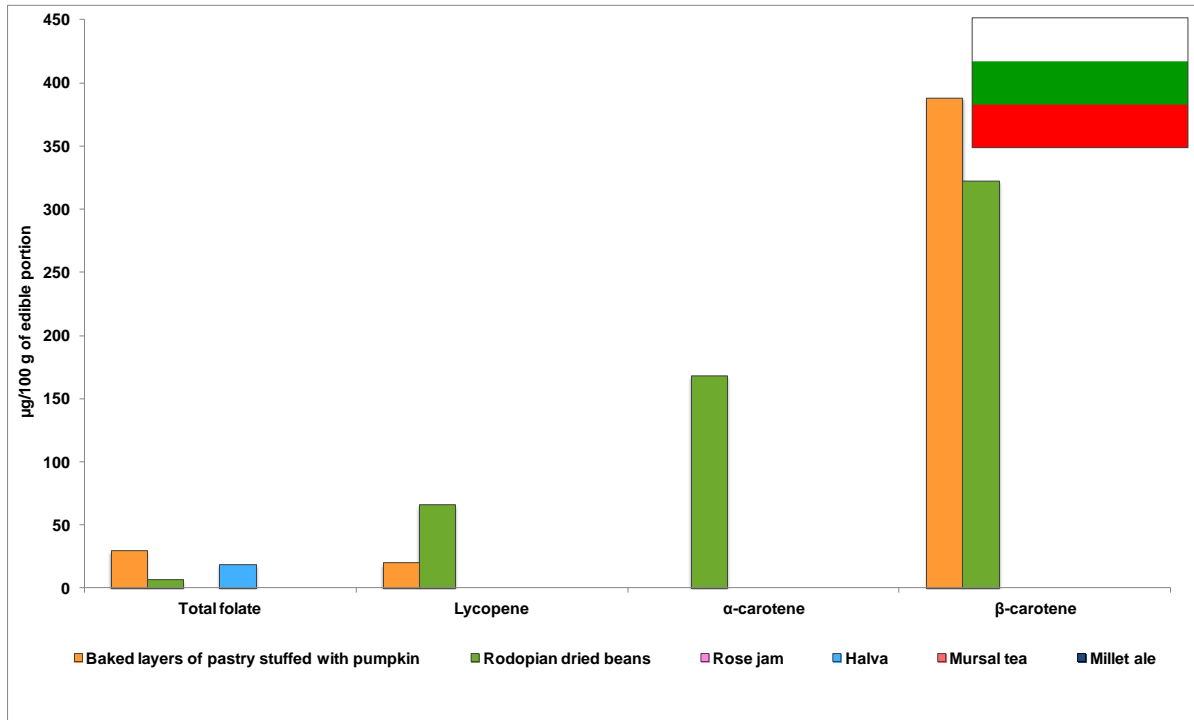


**Fig. 4.** Vitamins content of the analysed Bulgarian traditional foods.



Mursal tea was only analysed for vitamin C and Vitamin B<sub>2</sub> (Fig. 4).

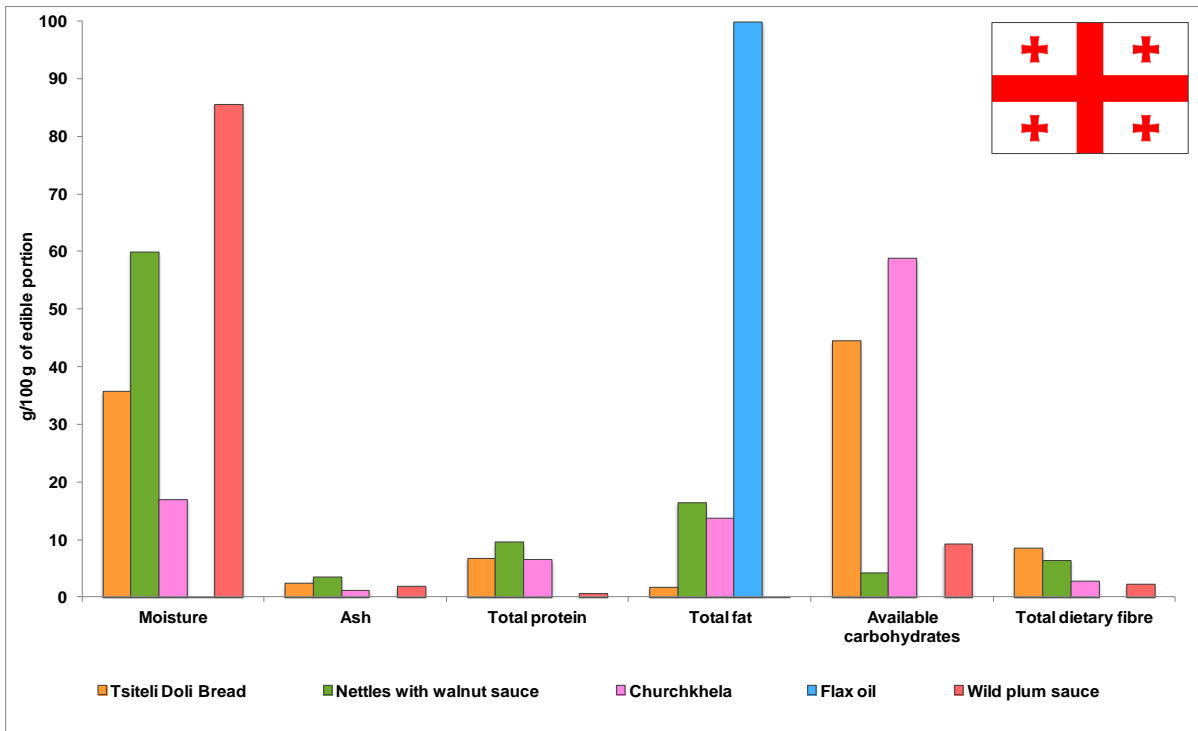
Total folate was also found in these three foods (Fig. 5). Baked layers of pastry stuffed with pumpkin presented lycopene and  $\beta$ -carotene while rodopian dried beans presented  $\alpha$ -carotene besides these two carotenoids (Fig. 5).



**Fig. 5.** Total folate, lycopene,  $\alpha$ - and  $\beta$ -carotenes content of the analysed Bulgarian traditional foods.

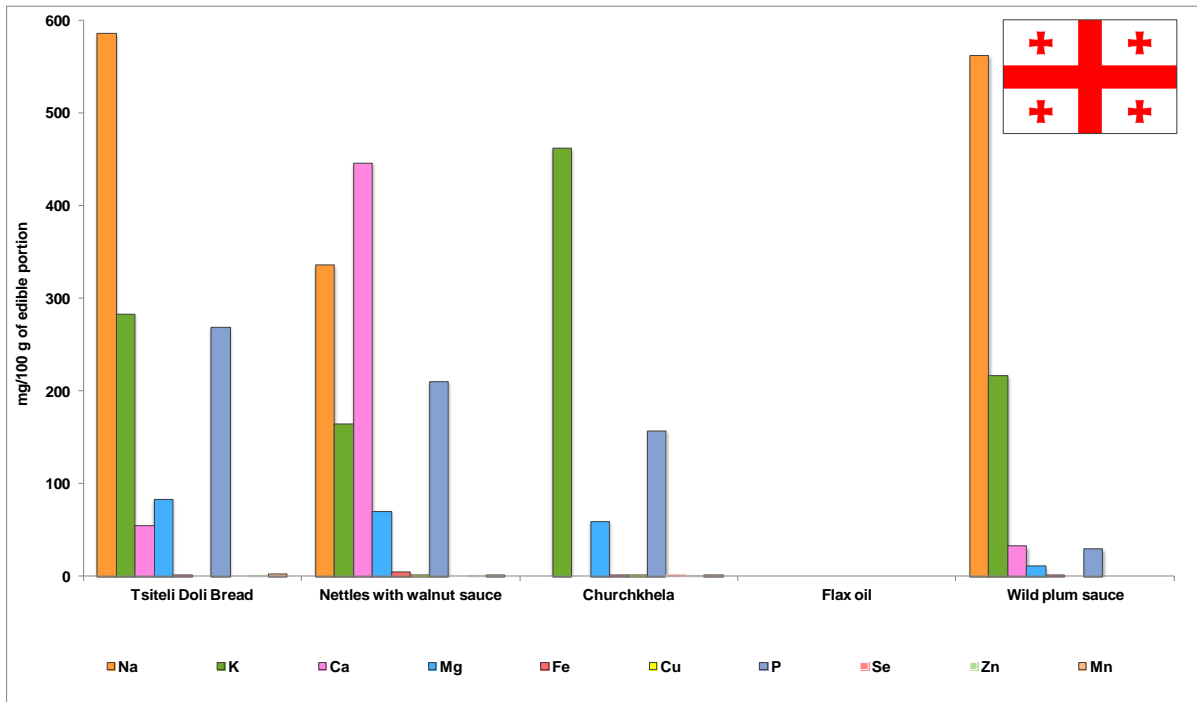
## Georgia

For Georgia, five traditional foods were selected to be analysed. From these, two were mainly constituted by carbohydrates, two by water and one was only constituted by fat, because it is oil (Fig. 6). Besides its high carbohydrate content, tsitelli doli bread and churchkhela have also high water content, although churchkhela has about 8 times more fat than the bread because it is made with walnuts.



**Fig. 6.** Macronutrients content of the analysed Georgian traditional foods.

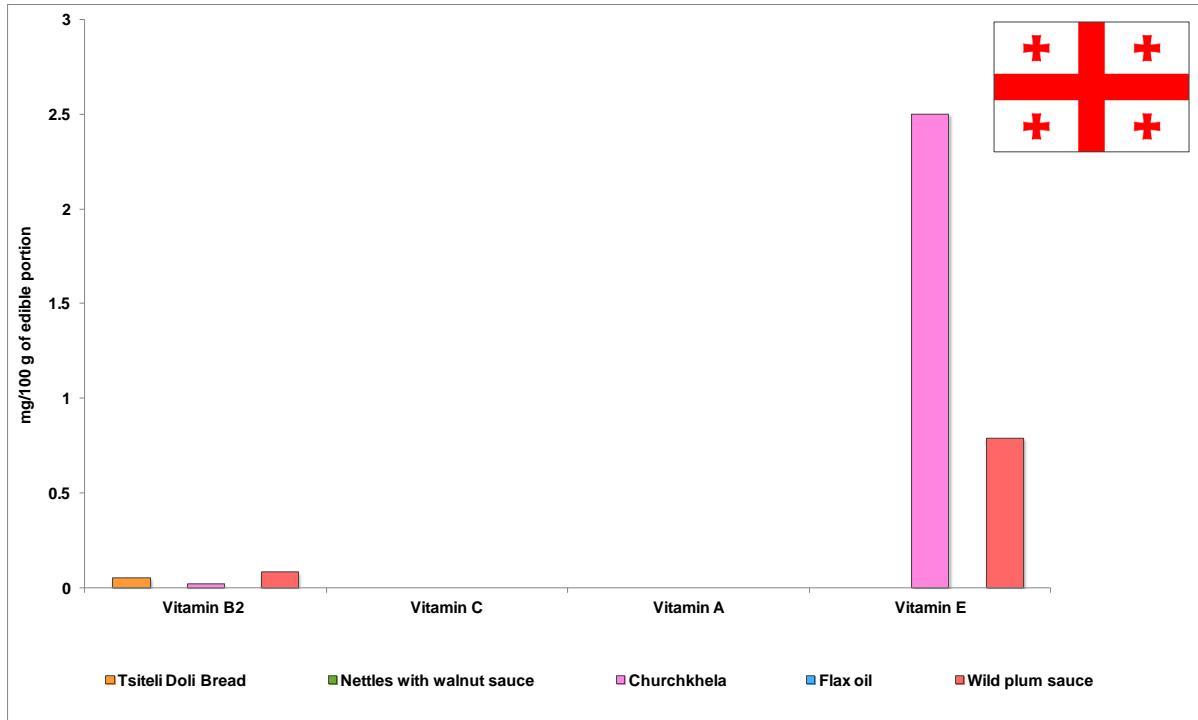
Na, K, Ca and P were the major minerals found in the traditional foods from Georgia, although none of the analysed minerals were found in flax oil (Fig. 7). Nettles with walnut sauce were particularly rich in minerals, with a very high content of Ca (446 mg /100 g edible portion).



**Fig. 7.** Minerals content of the analysed Georgian traditional foods.

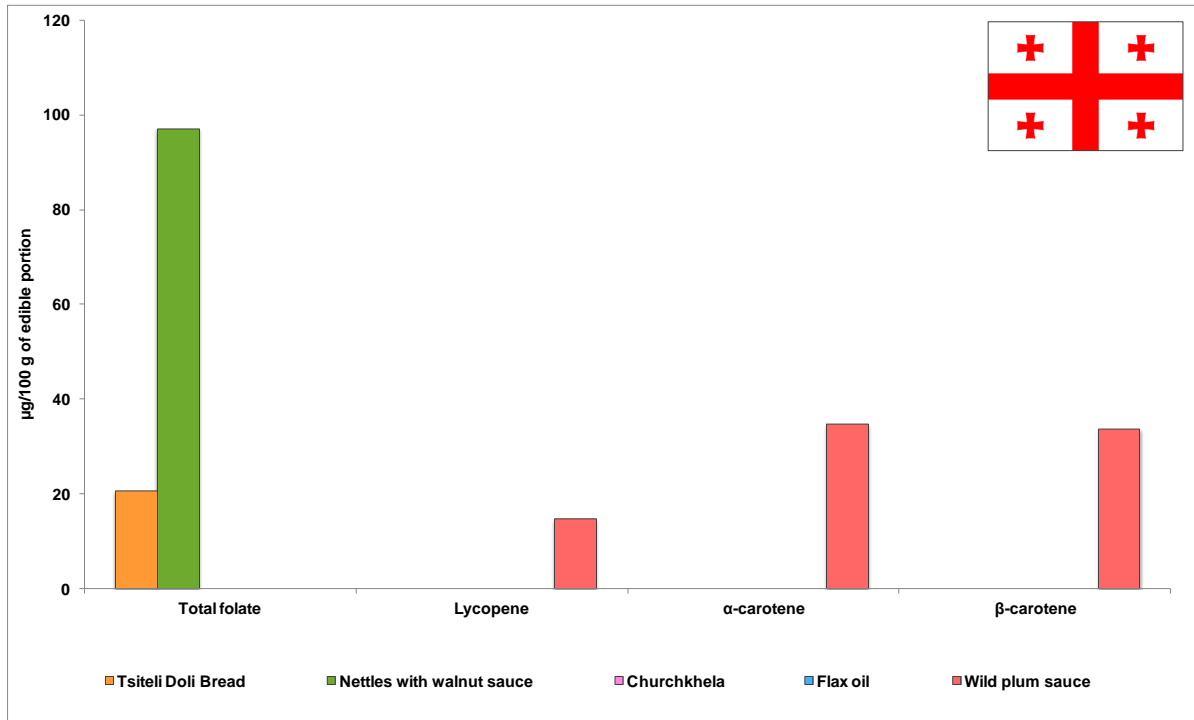


Regarding vitamins (Fig. 8), vitamins B<sub>2</sub> and E were found in churchkhela and wild plum sauce. Tsiteli doli bread also presented vitamin B<sub>2</sub> (0.05 mg/100 g edible portion).



**Fig. 8.** Vitamins content of the analysed Georgian traditional foods.

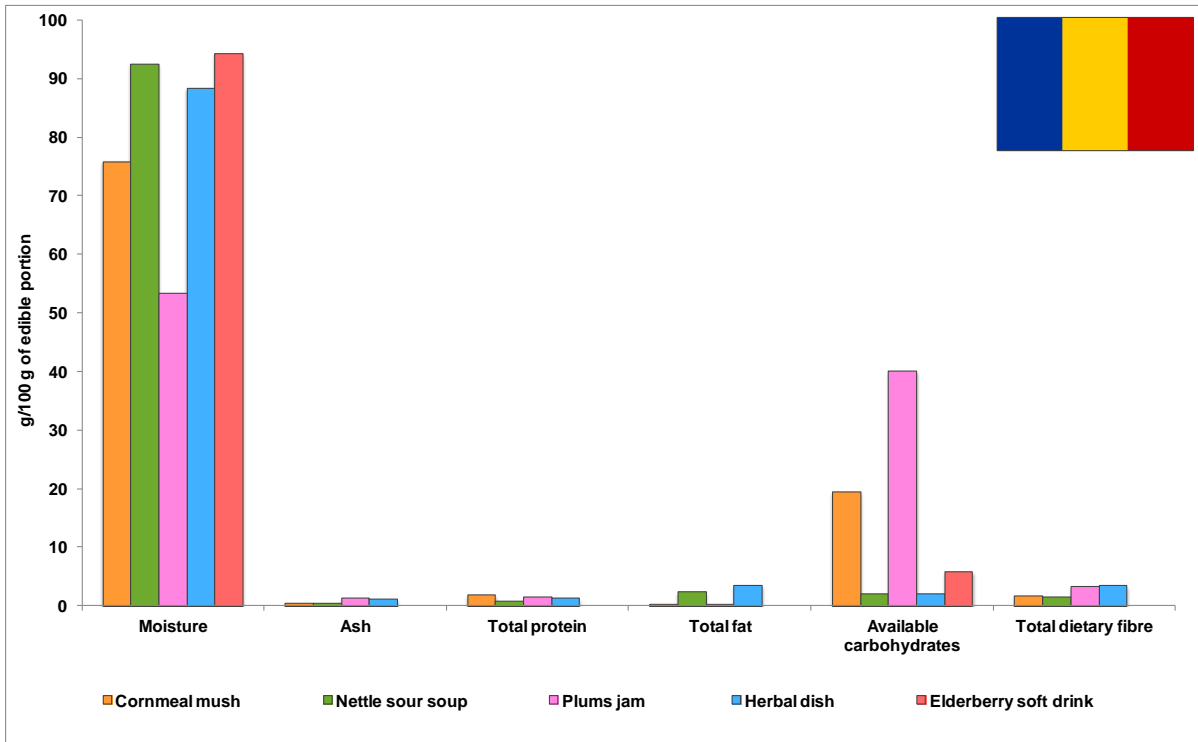
Wild plum sauce revealed to have lycopene,  $\alpha$ - and  $\beta$ -carotenes while nettles with walnut sauce presented a considerable amount of total folate (97.2  $\mu\text{g}/100\text{ g}$  of edible portion) (Fig. 9). Tsiteli doli bread also presented total folate but only 20.5  $\mu\text{g}/100\text{ g}$  of edible portion.



**Fig. 9.** Total folate, lycopene,  $\alpha$ - and  $\beta$ -carotenes content of the analysed Georgian traditional foods.

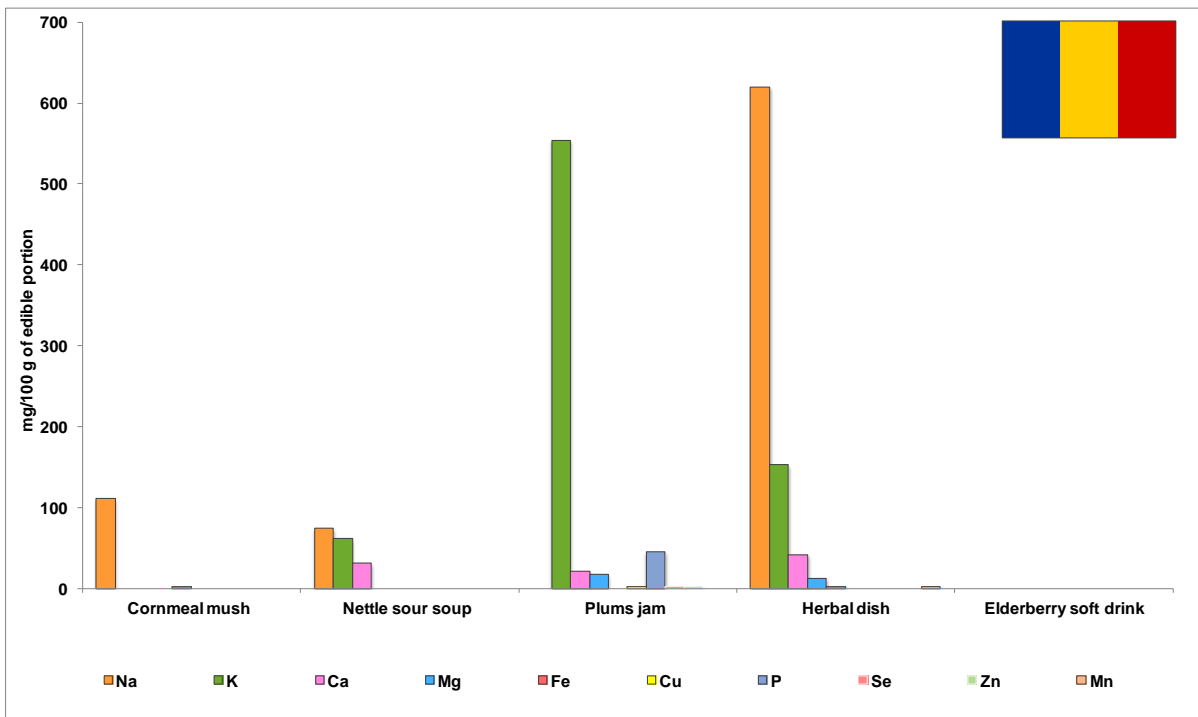
### **Romania**

All the selected traditional foods for Romania are mainly composed of water, although two have significant carbohydrates content (cornmeal mush and plums jam) (Fig. 10). In what concerns to minerals, none of the analysed minerals was found in elderberry soft drink (Fig. 11).



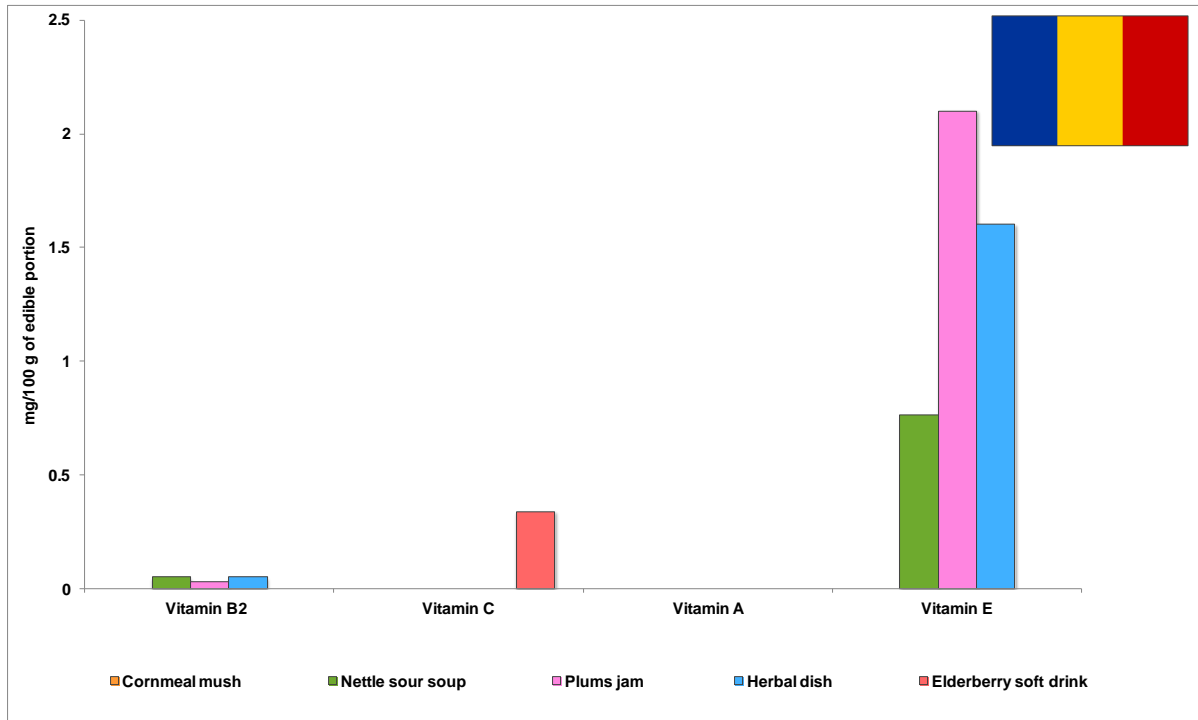
**Fig. 10.** Macronutrients content of the analysed Romanian traditional foods.

Plums jam has a high K content (553 mg/100 g edible portion) and herbal dish a high Na content (619 mg/100 g edible portion).



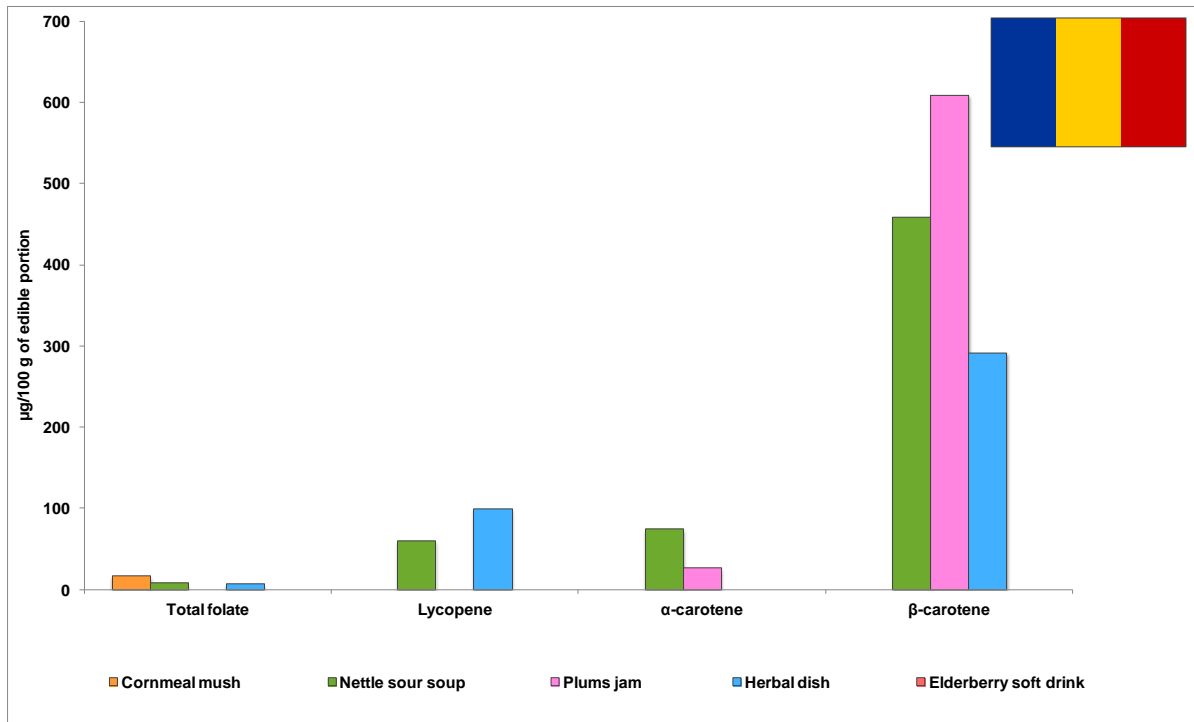
**Fig. 11.** Minerals content of the analysed Romanian traditional foods.

Three of the five analysed Romanian traditional foods presented vitamins B<sub>2</sub> and E (nettle sour soup, plums jam and herbal dish) but only elderberry soft drink presented vitamin C (0.34 mg/100 g edible portion) (Fig. 12).



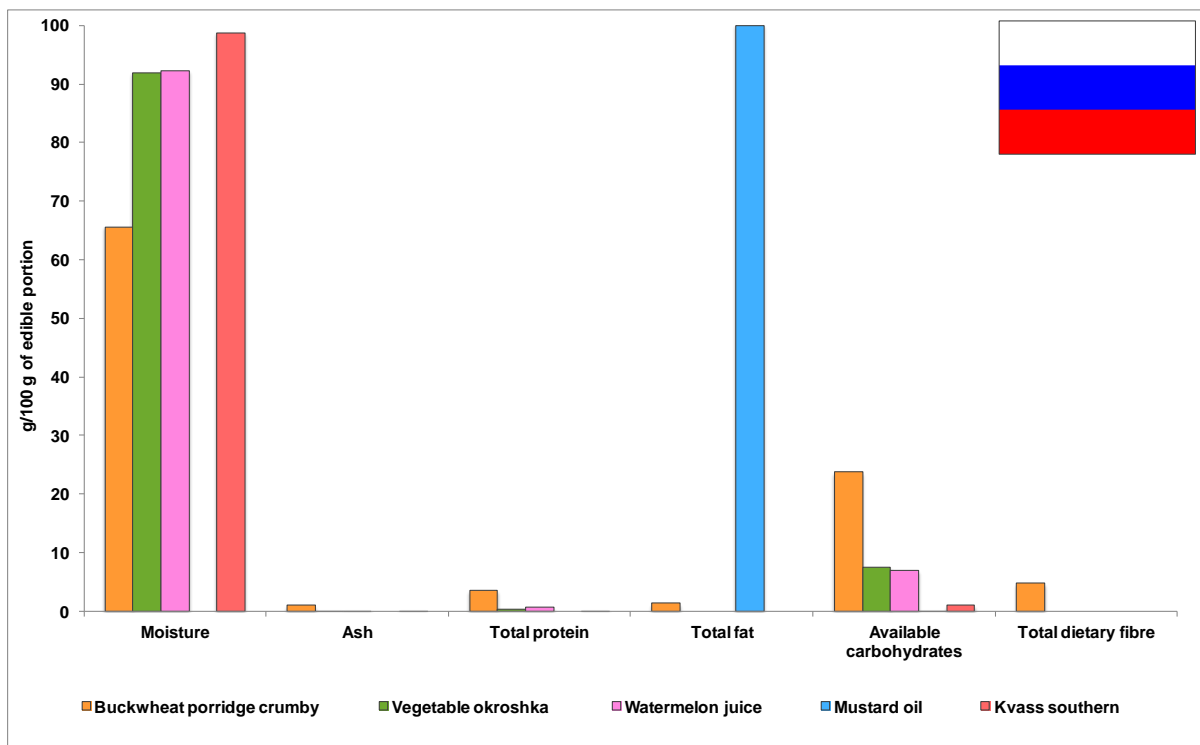
**Fig. 12.** Vitamins content of the analysed Romanian traditional foods.

Plums jam was the Romanian traditional food with the highest  $\beta$ -carotene content (608  $\mu\text{g}/100\text{ g}$  edible portion), followed by nettle sour soup and herbal dish (458 and 291  $\mu\text{g}/100\text{ g}$  edible portion) (Fig. 13). Nettle sour soup also contained lycopene and  $\alpha$ -carotene. Small amounts of total folate were found in cornmeal mush, nettle sour soup and herbal dish (between 7-16  $\mu\text{g}/100\text{ g}$  of edible portion).



**Fig. 13.** Total folate, lycopene, α- and β-carotenes content of the analysed Romanian traditional foods.

### **Russian Federation**

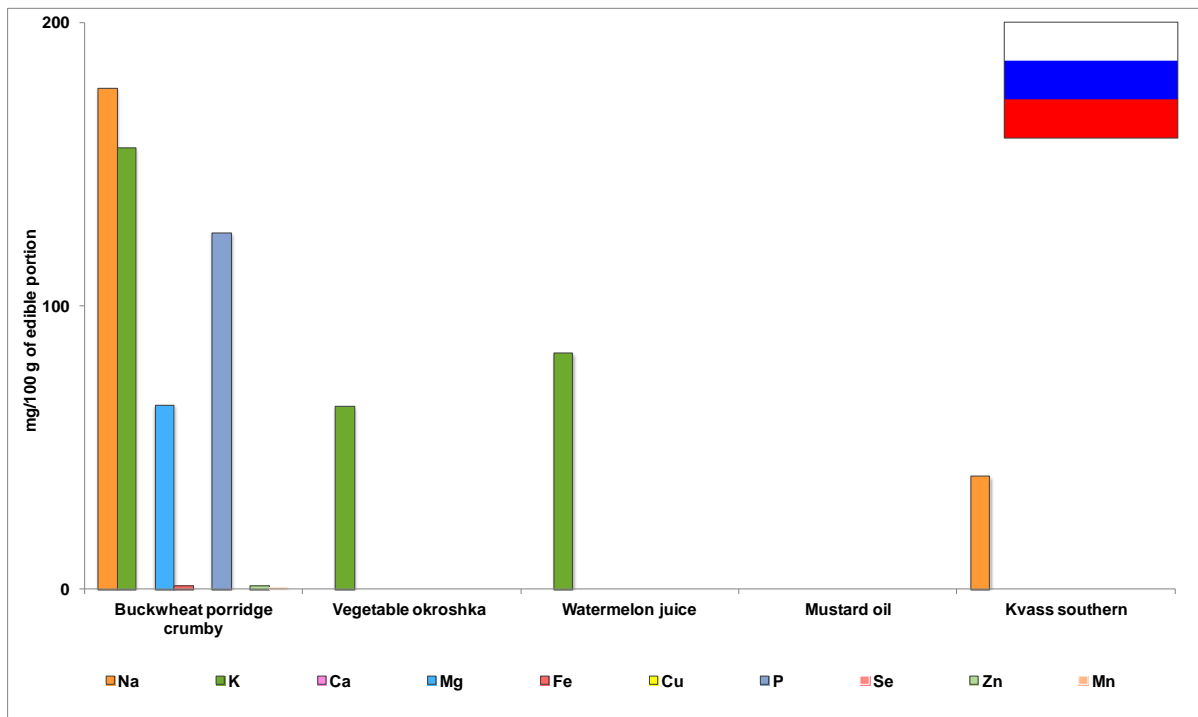


**Fig. 14.** Macronutrients content of the analysed Russian Federation traditional foods.



From the five analysed foods for Russian Federation, 4 are mainly constituted by water and one is only constituted by fat since it is oil (Fig. 14). The buckwheat porridge crumby has also a significant amount of carbohydrates and about 5% of total dietary fibre because it is prepared from buckwheat.

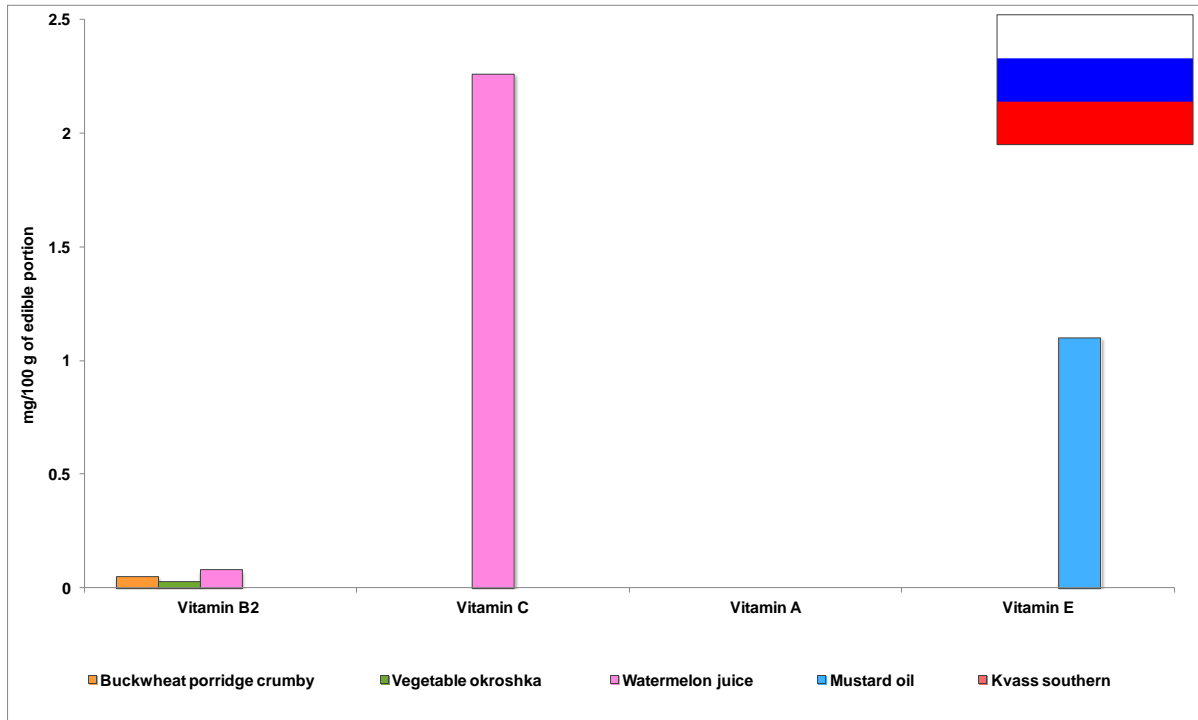
Regarding minerals (Fig. 15), buckwheat porridge crumby was the food with the highest mineral content from the analysed foods for Russian Federation. K was also found in vegetable okroshka and watermelon juice. The only mineral quantified in kvass southern was Na and none of the analysed minerals were found in mustard oil.



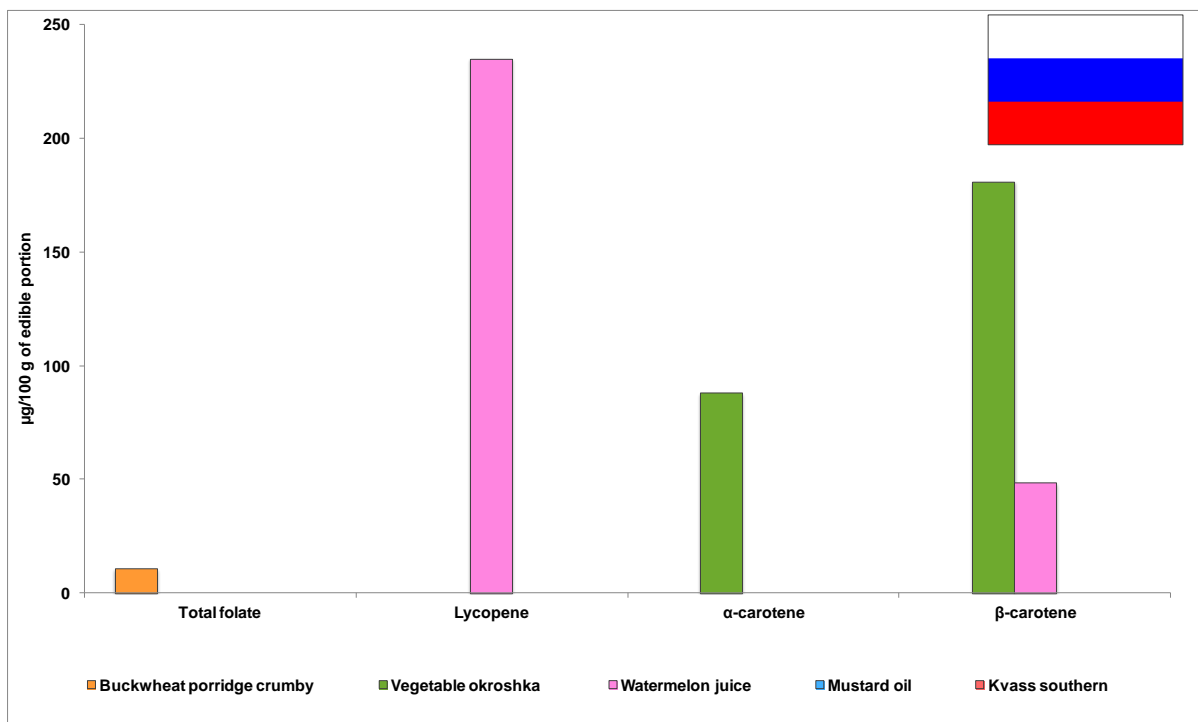
**Fig. 15.** Minerals content of the analysed Russian Federation traditional foods.

From the traditional foods selected for Russian Federation, mustard oil was the only one with vitamin E (1.1 mg/100 g of edible portion) and watermelon juice with vitamin C (2.26 mg/100 g of edible portion). (Fig. 16)

Vitamin B<sub>2</sub> was found in small amounts in three Russian Federation foods (buckwheat porridge crumby, vegetable okroshka and watermelon juice) ranging from 0.03 - 0.08 mg/100 g of edible portion.



**Fig. 16.** Vitamins content of the analysed Russian Federation traditional foods.



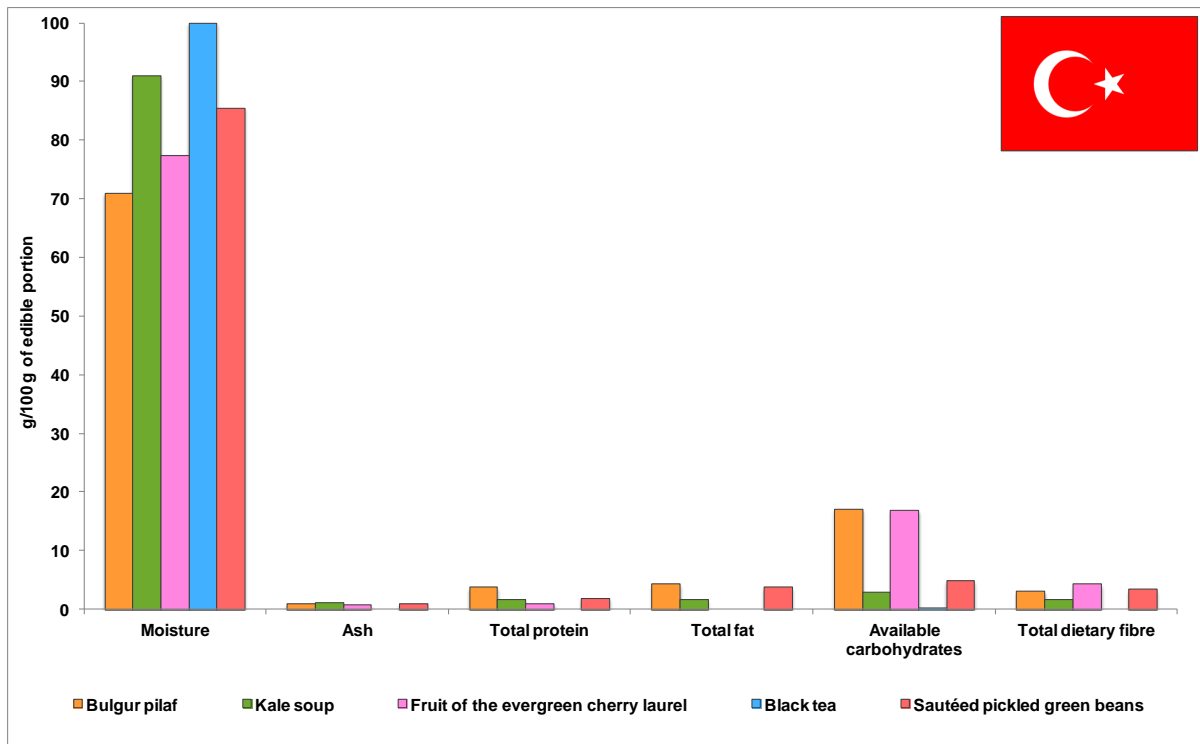
**Fig. 17.** Total folate, lycopene, α- and β-carotenes content of the analysed Russian Federation traditional foods.



Regarding Russian Federation traditional foods, total folate was only found in buckwheat porridge crumby, lycopene in watermelon juice and  $\alpha$ -carotene in vegetable okroshka (Fig. 17). However,  $\beta$ -carotene was found in vegetable okroshka (181  $\mu\text{g}/100\text{ g}$  edible portion) and watermelon juice (48.7  $\mu\text{g}/100\text{ g}$  edible portion).

### Turkey

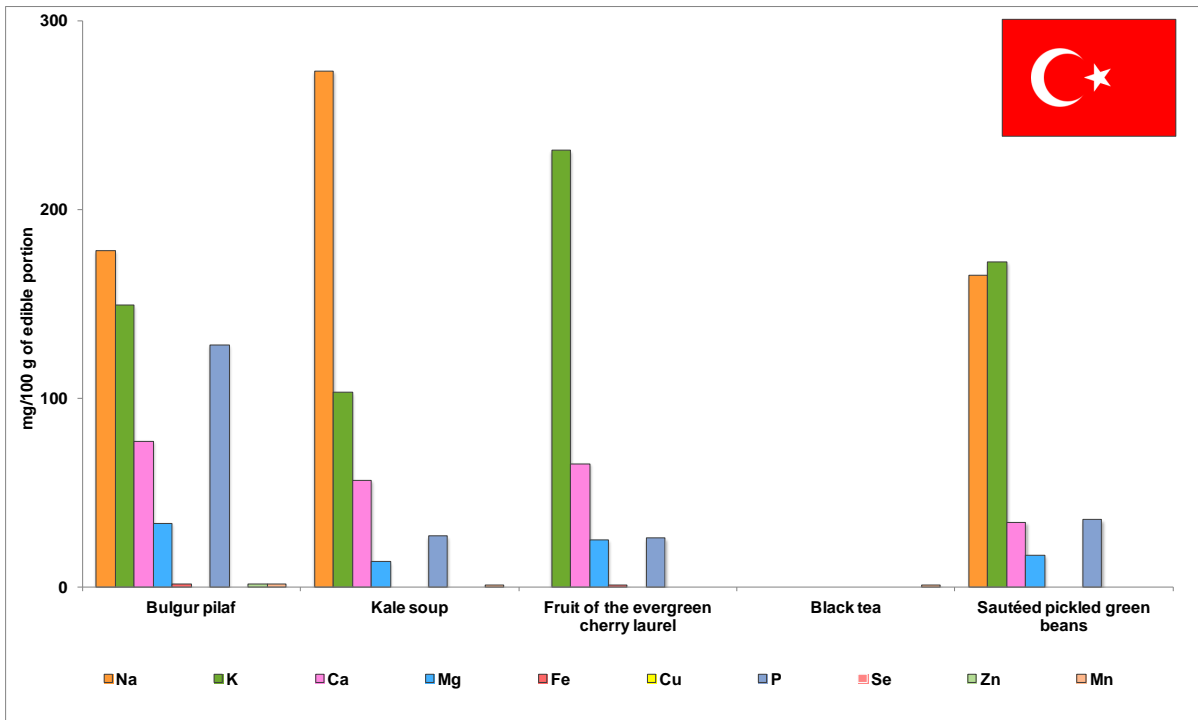
The five selected traditional foods from Turkey presented very high water contents (Fig. 18). However, bulgur pilaf and fruit of the evergreen cherry laurel also have considerable carbohydrates content (about 17 %).



**Fig. 18.** Macronutrients content of the analysed Turkish traditional foods.

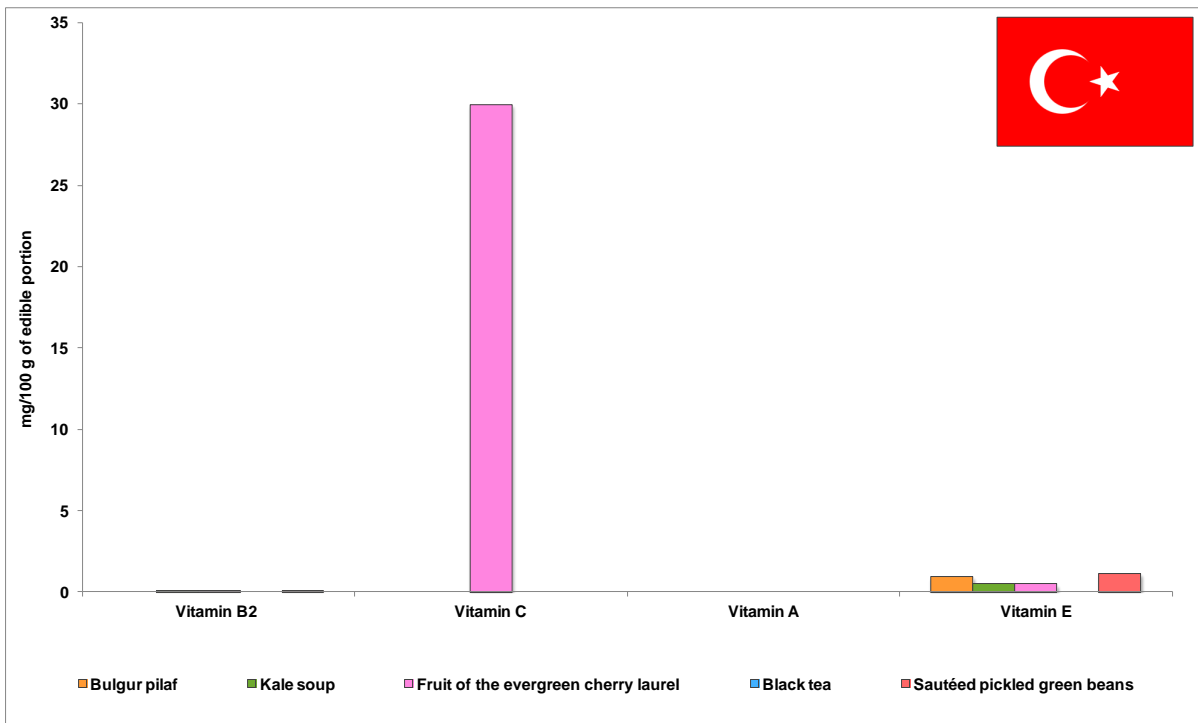
Several minerals were found in these foods, mainly Na, K, Ca, Mg and P, and black tea only had a small amount of Mn (Fig. 19).

Regarding the analysis of vitamins, folate and carotenoids, black tea was only analysed for vitamins B<sub>2</sub> and C. Four of the five Turkish foods presented vitamin E content ranging from 0.48 - 1.1 mg/100 g edible portion (Fig. 20).



**Fig. 19.** Minerals content of the analysed Turkish traditional foods.

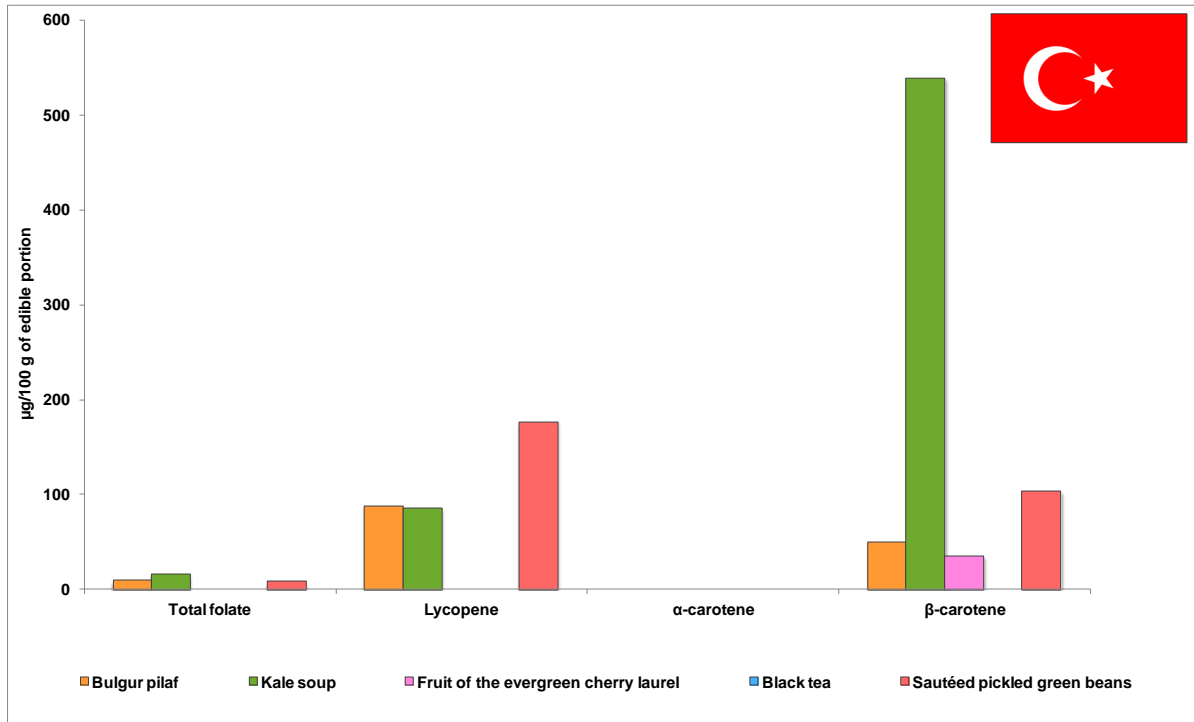
Fruit of the evergreen cherry laurel was the only Turkish traditional food with vitamin C content, although this was considerably high (29.9 mg/100 g of edible portion) (Fig. 20).



**Fig. 20.** Vitamins content of the analysed Turkish traditional foods.



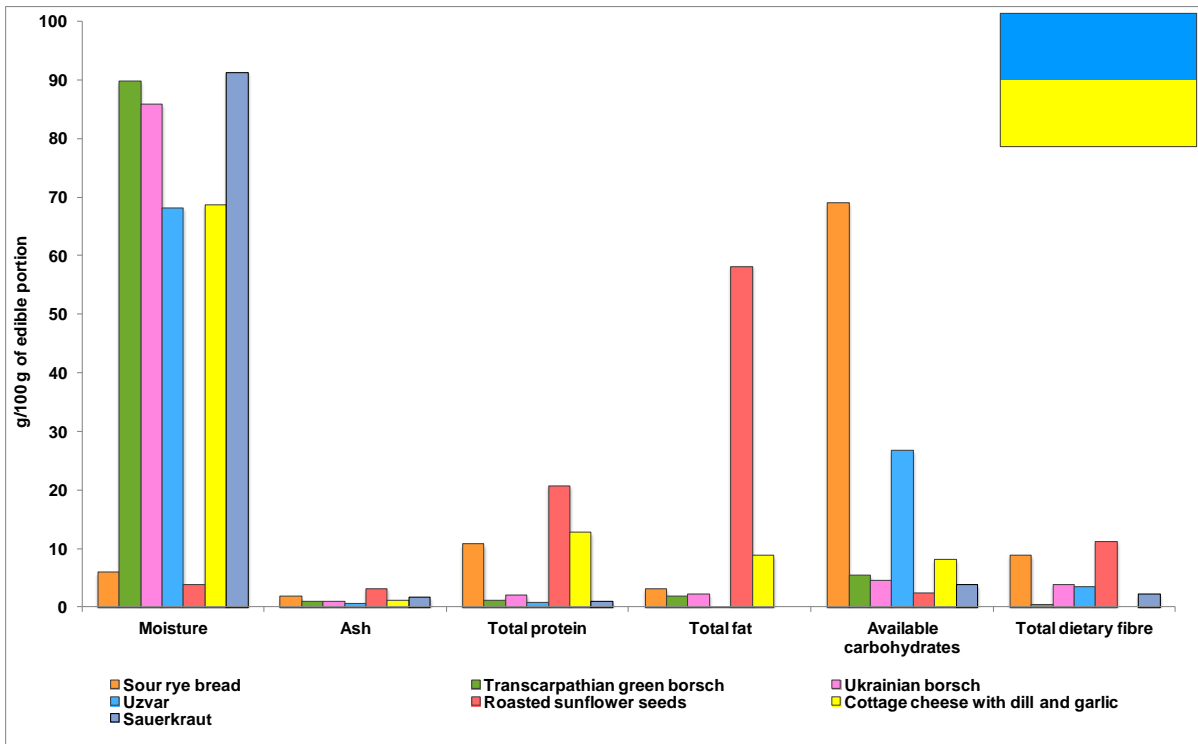
Bulgur pilaf, kale soup and sautéed pickled green beans presented total folate, lycopene and  $\beta$ -carotene (Fig. 21). Kale soup was the Turkish traditional food with the highest  $\beta$ -carotene content (538  $\mu\text{g}/100\text{ g}$  of edible portion) while sautéed pickled green beans (176  $\mu\text{g}/100\text{ g}$  of edible portion) presented the highest lycopene content.



**Fig. 21.** Total folate, lycopene,  $\alpha$ - and  $\beta$ -carotenes content of the analysed Turkish traditional foods.

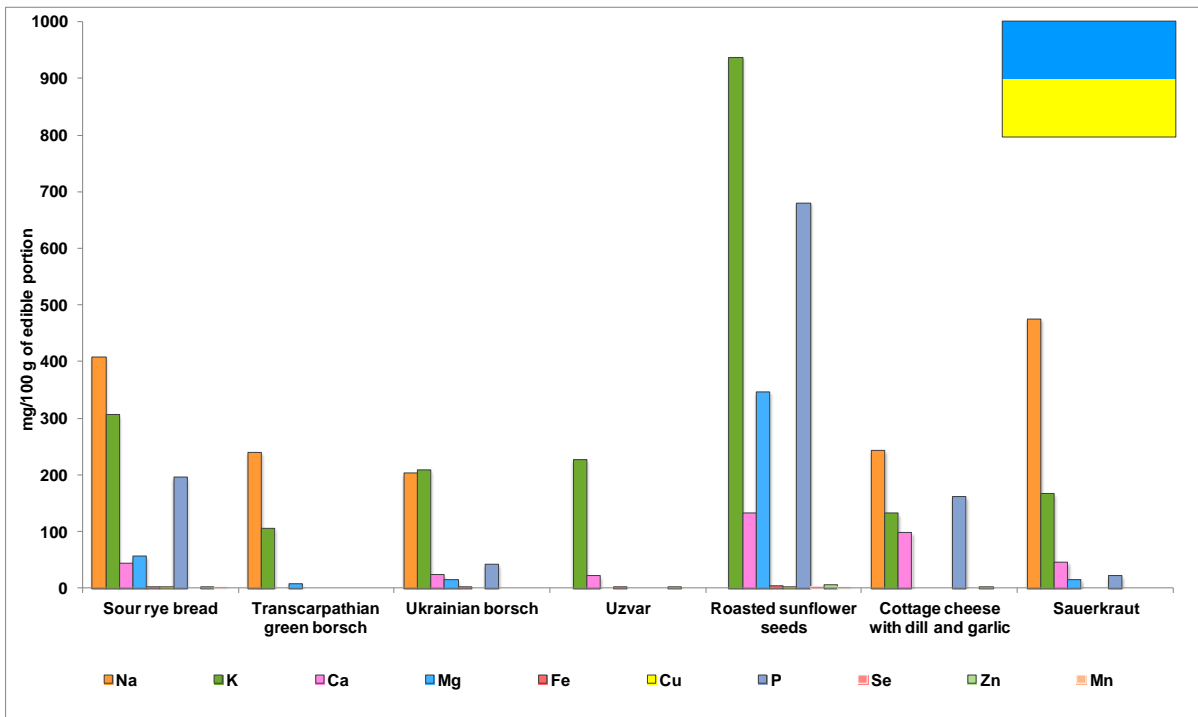
### **Ukraine**

From the seven foods selected for the two BaSeFood Ukrainian partners, one is mostly composed of fat, another is primarily composed of carbohydrates and the others are mostly composed of water (Fig. 22). Besides a great fat content, roasted sunflower seeds have also a high protein content (20%) and a considerable total dietary fibre content (about 11%). This total dietary fibre content was similar in sour rye bread (about 9%).



**Fig. 22.** Macronutrients content of the analysed Ukrainian traditional foods.

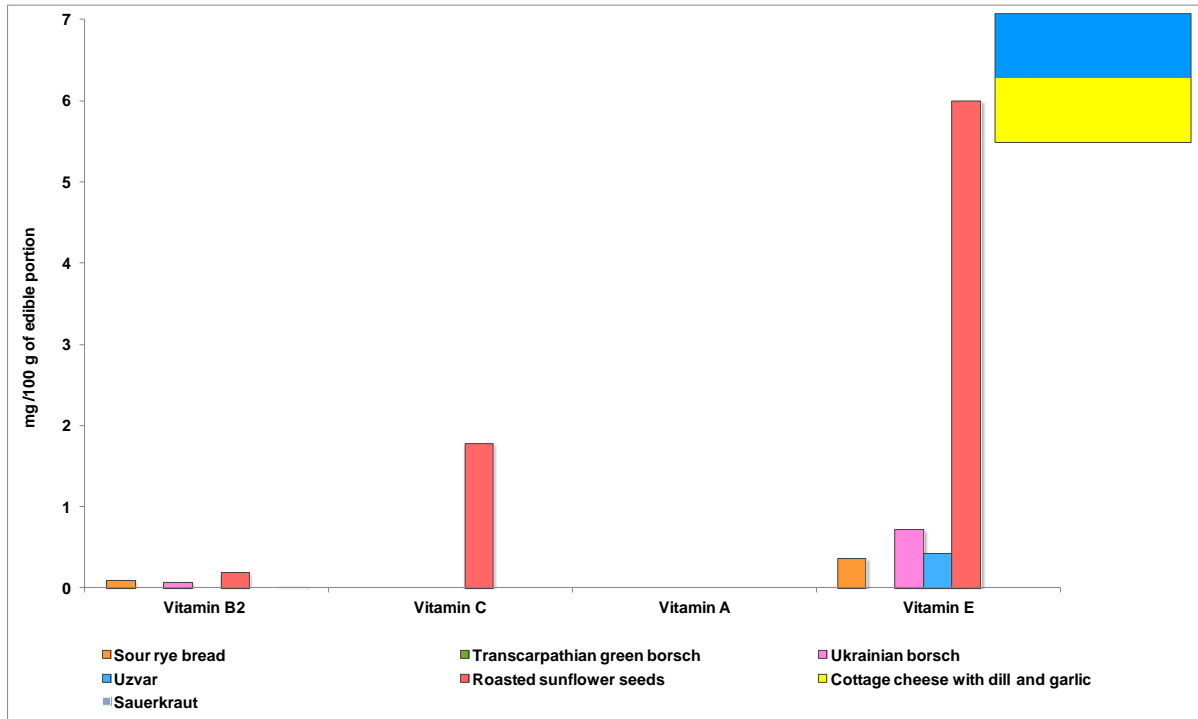
Regarding minerals (Fig. 23), the selected foods for Ukraine were the ones that presented the highest mineral content. The major minerals found in these traditional foods were Na, K, Ca, Mg and P. Roasted sunflower seeds showed a higher value for K, Ca, Mg and P.



**Fig. 23.** Minerals content of the analysed Ukrainian traditional foods.

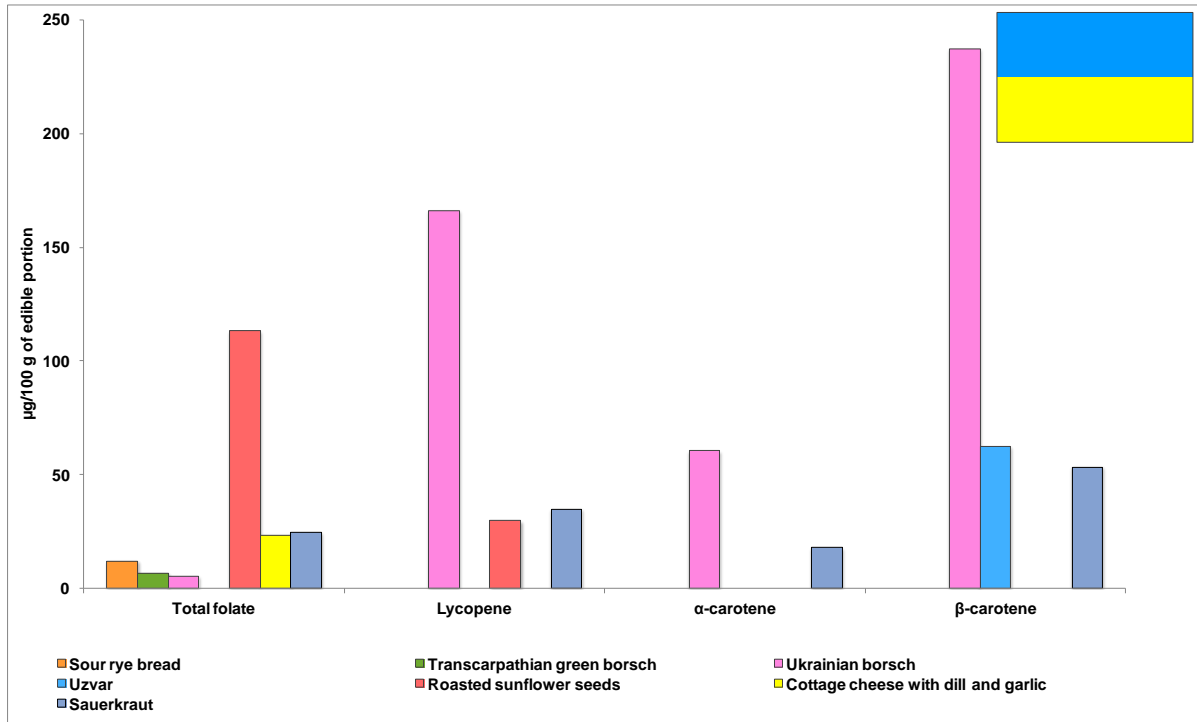


In what concerns to vitamins and carotenoids, Transcarpathian green borsch and cottage cheese with dill and garlic were not analysed since they were lyophilized. From the other four analysed Ukrainian foods, all presented vitamin E and vitamin C was only found in roasted sunflower seeds (1.78 mg/100 g of edible portion) (Fig. 24). The highest vitamin E value was found for this food (6 mg/100 g of edible portion)



**Fig. 24.** Vitamins content of the analysed Ukrainian traditional foods.

Uzvar was the only Ukrainian food without total folate (Fig. 25). On the other hand, in this group, roasted sunflower seeds had the highest total folate content (113  $\mu\text{g}/100\text{ g}$  of edible portion). Ukrainian borsch and sauerkraut presented lycopene,  $\alpha$ -carotene and  $\beta$ -carotene, although Ukrainian borsch had much higher levels of these carotenoids (Fig. 25). Roasted sunflower seeds presented only lycopene (29.6  $\mu\text{g}/100\text{ g}$  of edible portion) and uzvar only  $\beta$ -carotene (62  $\mu\text{g}/100\text{ g}$  of edible portion).



**Fig. 25.** Total folate, lycopene,  $\alpha$ - and  $\beta$ -carotenes content of the analysed Ukrainian traditional foods.



## Food components

In this section the traditional foods, categorized in six groups (cereals and cereal based foods; vegetables and vegetables based foods; fruit or fruit based foods; oilseeds or oilseed products; herbs, spices and aromatic plants and low or non-alcoholic fermented foods and beverages of plant origin) were compared regarding a specific component.

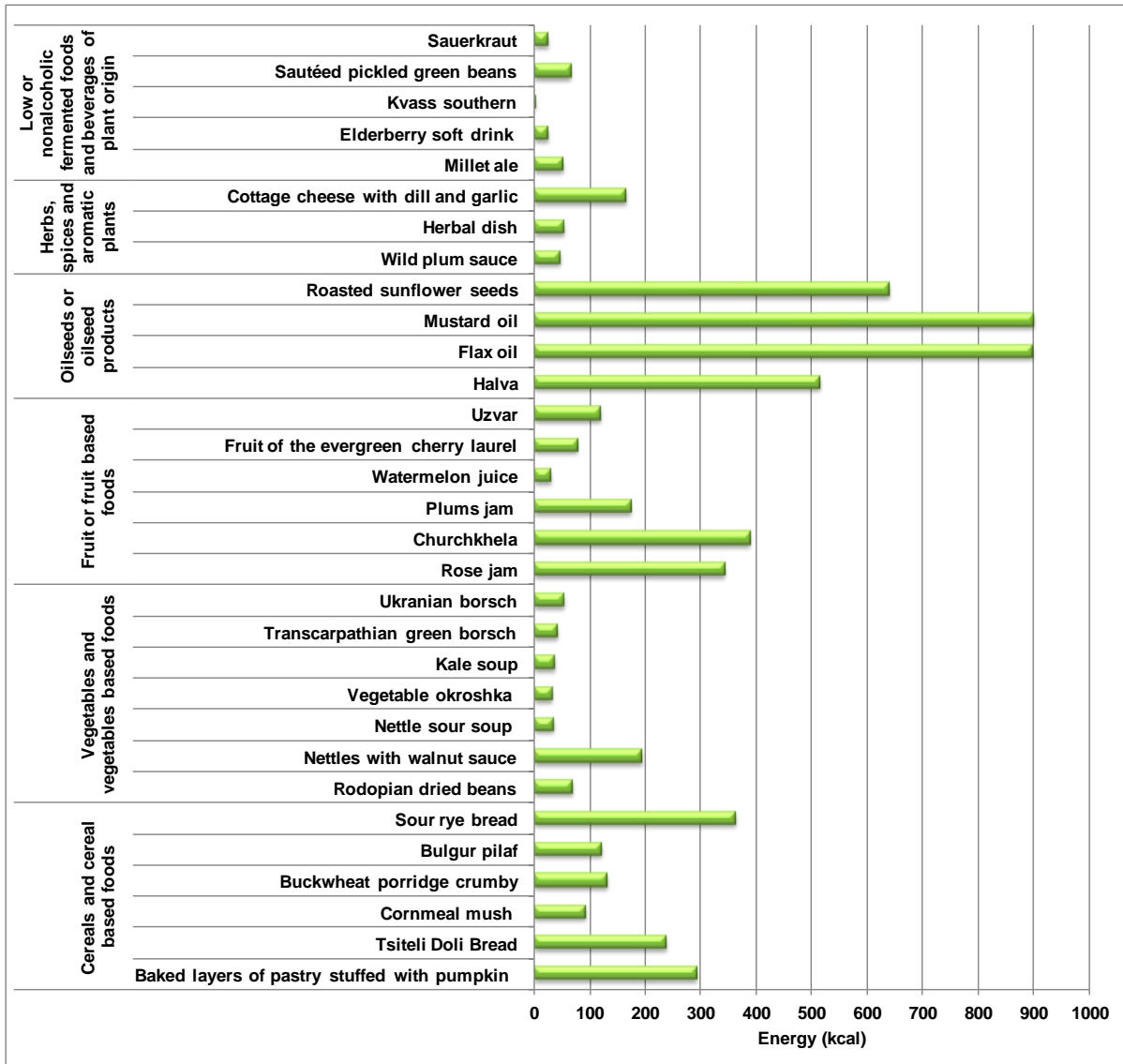
Moreover, Dietary Reference Intake (DRI) was used to calculate the contribution that traditional foods can give for DRI. This comparison was used for the foods with highest content of each component. DRIs were established by the Food and Nutrition Board of the Institute of Medicine, National Academy of Sciences (2002). A list of the DRI is presented in Table 4. Values are given for healthy adult males and adult females.

**Table 4.** Dietary Reference Intakes (DRIs). (Values represent Recommended Dietary Allowances or Adequate Intake for some nutrients).

Nutrients	DRIs	
	Males	Females
Total protein (g/d)	56	46
PUFA (linoleic acid)	17 <sup>a*</sup>	12 <sup>b*</sup>
PUFA (α-linolenic acid)	1.6 <sup>*</sup>	1.1 <sup>*</sup>
Total Fibre (g/d)	38 <sup>c*</sup>	25 <sup>d*</sup>
Carbohydrate-total digestible (g/d)	130 <sup>**</sup>	130 <sup>**</sup>
Vitamin A (µg/d)	900 <sup>**</sup>	700 <sup>**</sup>
Vitamin B <sub>2</sub> (mg/d)	1.3 <sup>**</sup>	1.1 <sup>**</sup>
Vitamin C (mg/d)	90 <sup>**</sup>	75 <sup>**</sup>
Vitamin E (mg/d)	15 <sup>**</sup>	15 <sup>**</sup>
Folate (µg/d)	400 <sup>**</sup>	400 <sup>**</sup>
Calcium (mg/d)	1000 <sup>e**</sup>	1000 <sup>f**</sup>
Cooper (µg/d)	900 <sup>**</sup>	900 <sup>**</sup>
Iron (mg/d)	8 <sup>**</sup>	18 <sup>g**</sup>
Magnesium (mg/d)	420 <sup>h**</sup>	320 <sup>i**</sup>
Manganese (mg/d)	2.3 <sup>*</sup>	1.8 <sup>*</sup>
Phosphorus (mg/d)	700 <sup>**</sup>	700 <sup>**</sup>
Selenium (µg/d)	55 <sup>**</sup>	55 <sup>**</sup>
Zinc (mg/d)	11 <sup>**</sup>	8 <sup>**</sup>
Potassium (g/d)	4.7 <sup>*</sup>	4.7 <sup>*</sup>
Sodium (g/d)	1.5 <sup>j*</sup>	1.5 <sup>j*</sup>

<sup>a</sup> For >50 years old is 14 g/d; <sup>b</sup> For >31 years old is 11 g/d; <sup>c</sup> For >50 years old is 30 g/d; <sup>d</sup> For >50 years old is 21 mg/d; <sup>e</sup> For >70 years old is 1200 mg/d; <sup>f</sup> For >51 years old is 1200 mg/d <sup>g</sup> For >51 years old is 8 mg/d; <sup>h</sup> Between 19-30 is 400 mg/d; <sup>i</sup> Between 19-30 years old is 310 mg/d; <sup>j</sup> Between 51-70 years old is 1.3 and >70 years old is 1.2 g/d; \*Adequate Intake (AI); \*\*Recommend Dietary Allowances (RDA).

## Energy



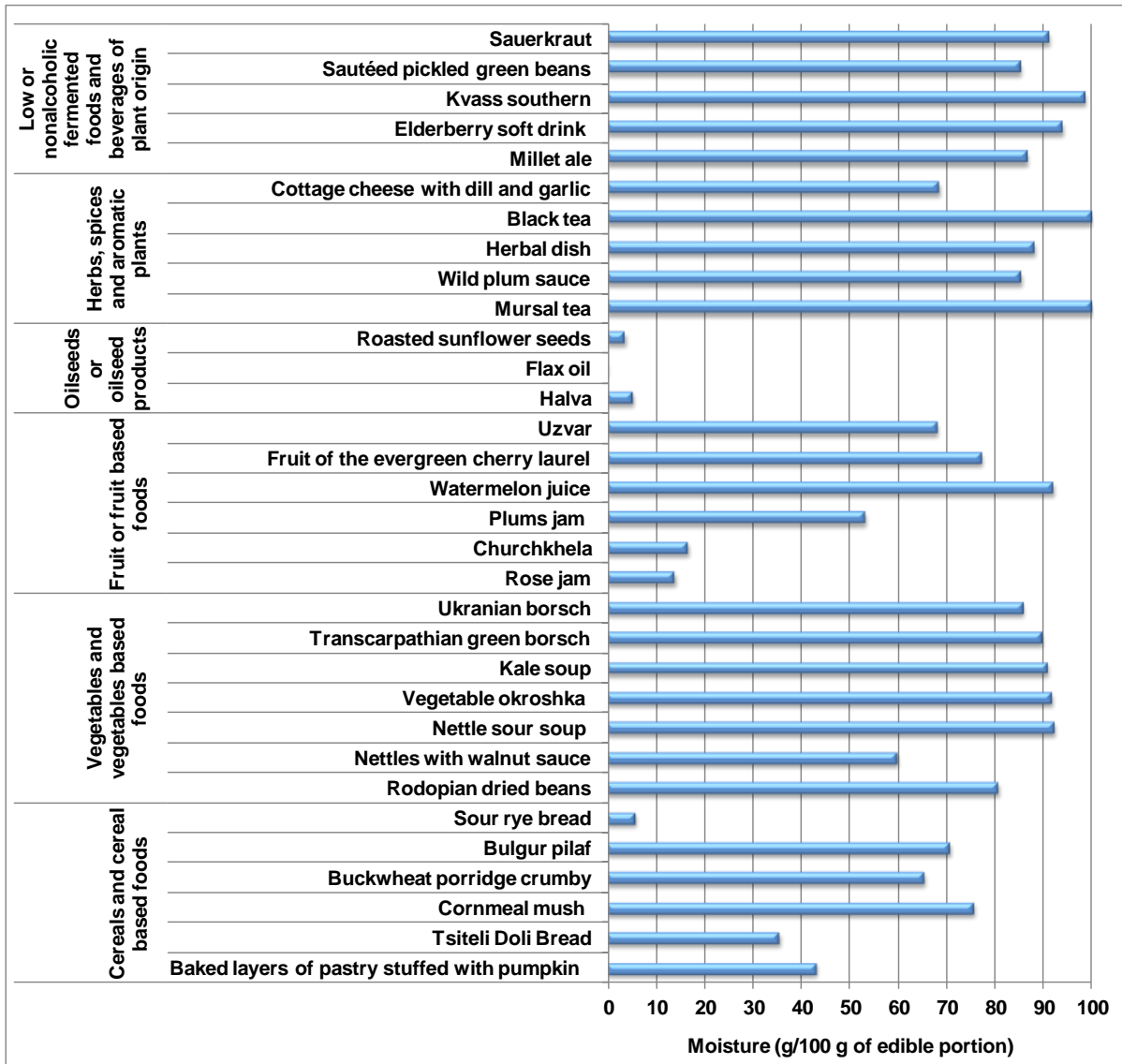
**Fig. 26.** Energy content (kcal) of the analysed traditional foods.

From the 6 groups of the analysed BSAC traditional foods, the group of oilseeds or oilseed products includes the highest energy values, ranging from 500 kcal to 900 kcal per 100 g of edible portion (Fig. 26).

On the other hand, the group of low or non-alcoholic fermented foods and beverages of plant origin, the group of herbs, spices and aromatic plants and the group of vegetables and vegetable based foods are composed of low energy foods with values lower than 100 kcal with exception of cottage cheese with dill and garlic and nettles with walnut sauce.



**Water**



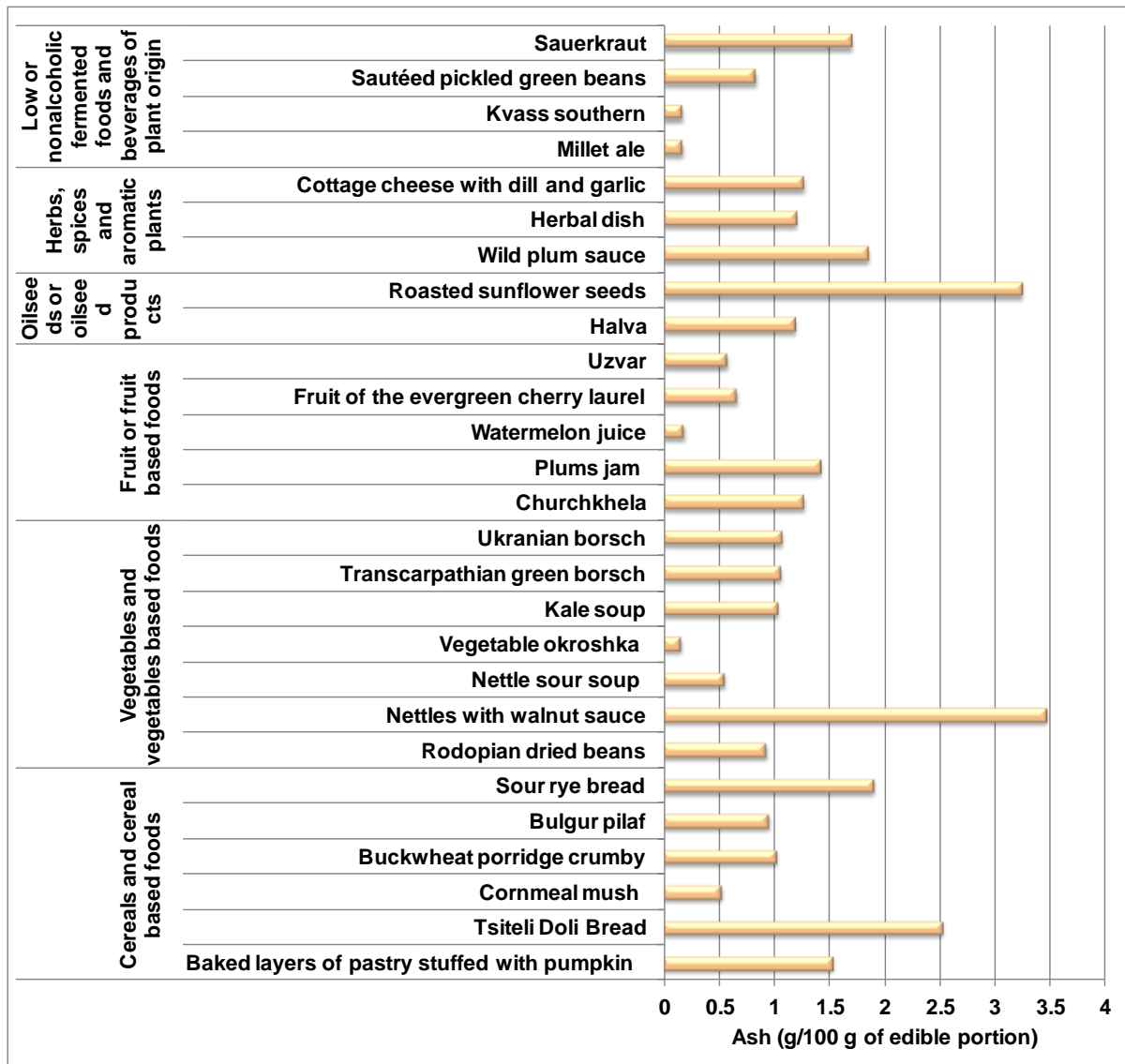
**Fig. 27.** Water content (g/100 g of edible portion) of the analysed traditional foods.

Water is essential to maintain homeostasis in the body and allows nutrients transport to cells, as well as it removes waste products of metabolism (Food and Nutrition Board of the Institute of Medicine, National Academy of Sciences, 2002).

In general, all the selected foods have high water content (Fig. 27). The foods with less water content are flax oil and mustard oil, followed by roasted sunflower seeds, halva, sour rye bread, rose jam and churchkhela.



### Ash

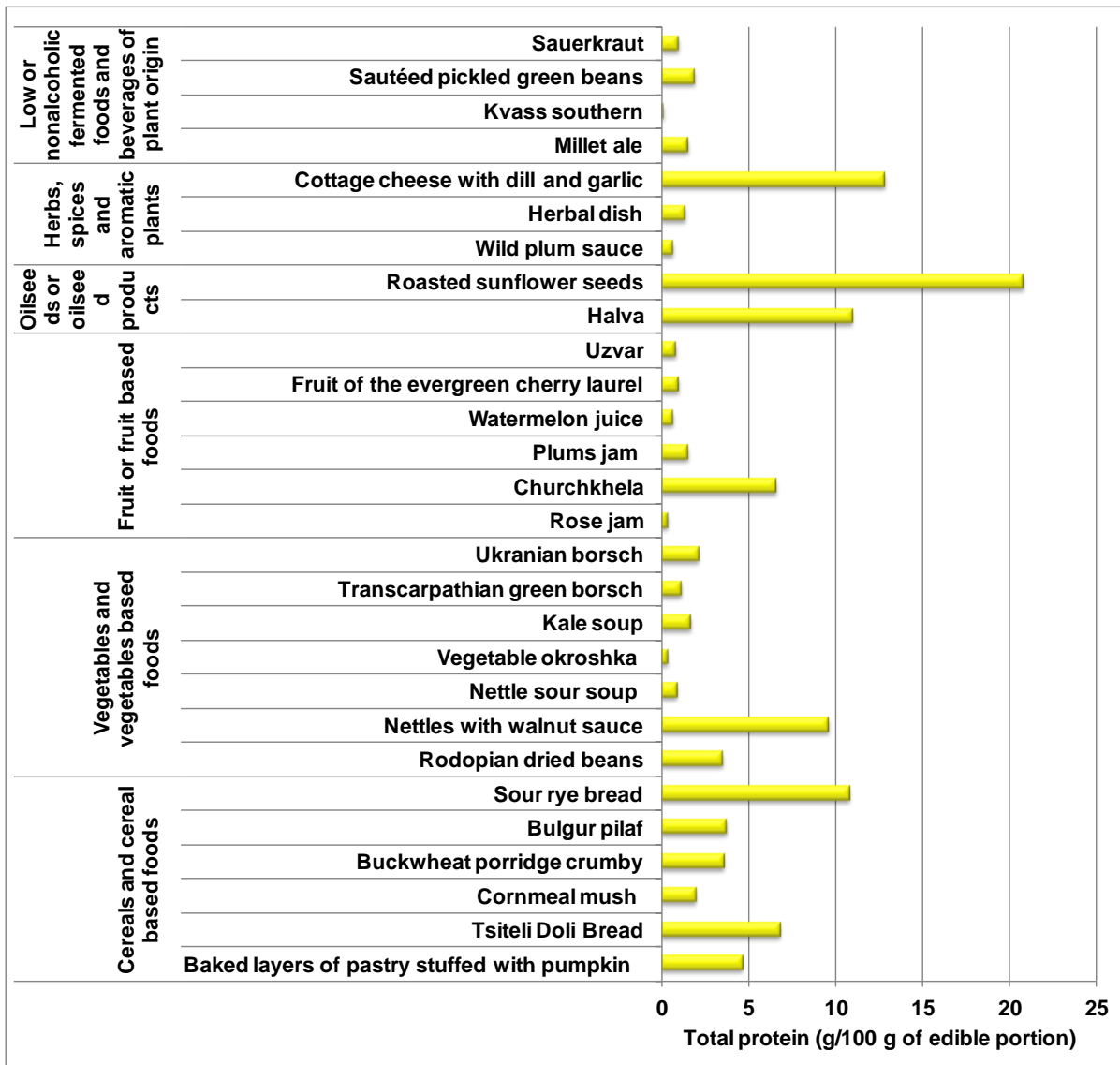


**Fig. 28.** Ash content (g/100 g of edible portion) of the analysed traditional foods.

The BSAC traditional foods with highest ash content (>2.5 g/100 g of edible portion) are nettles with walnut sauce, roasted sunflower seeds and tsiteli doli bread (Fig. 28). Six of the analysed foods (rose jam, flax oil, mustard oil, mursal tea, black tea and elderberry soft drink) had ash contents below the limit of quantification. Kvass southern, millet ale, watermelon juice and vegetable okroshka have ash contents between 0.15 - 0.2 g/100 g of edible portion.



**Protein**



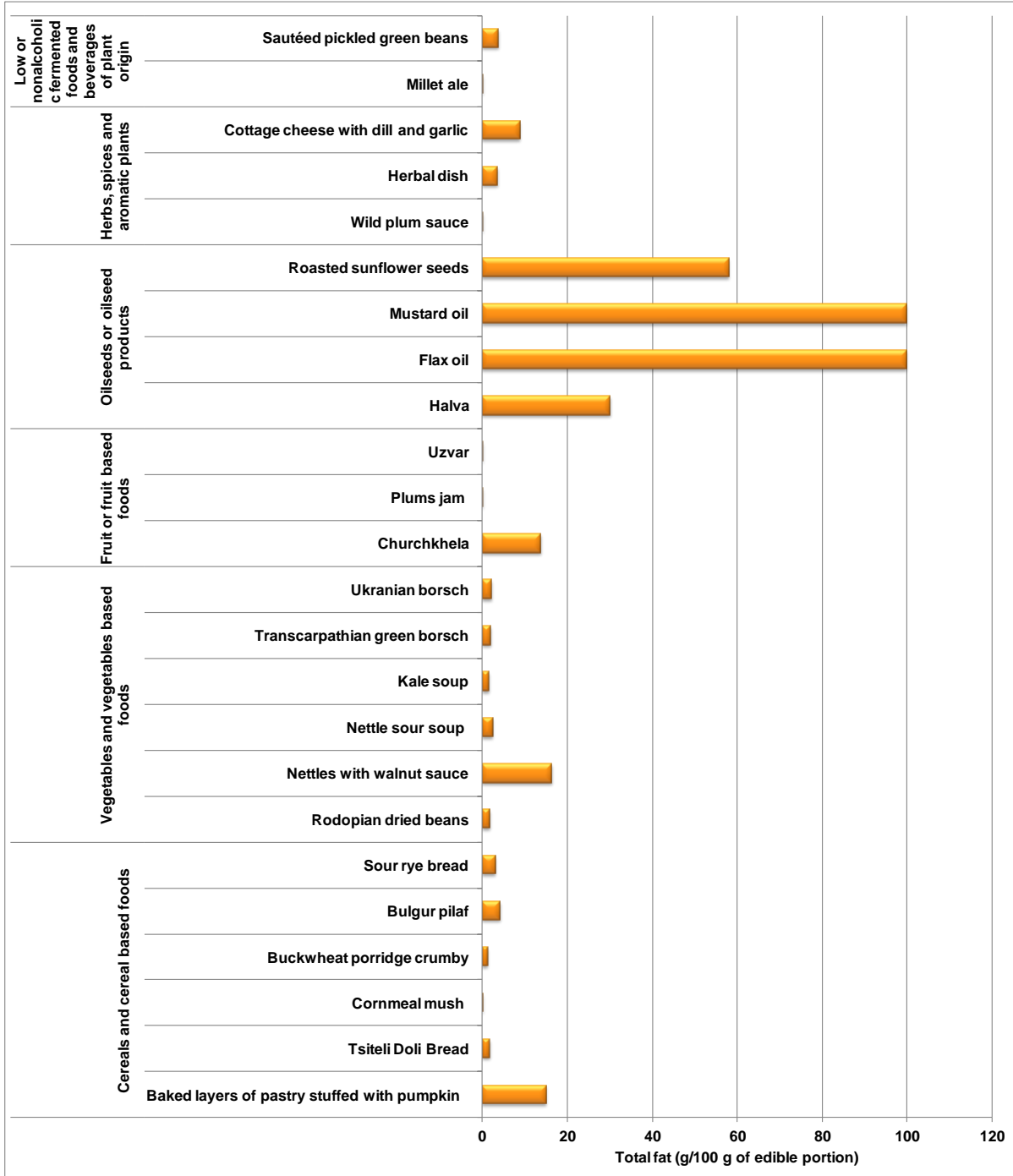
**Fig. 29.** Total protein content (g/100 g of edible portion) of the analysed traditional foods.

Protein is the structural component of all cells in the body. They also may function as enzymes, as transport carriers and as some hormones (Food and Nutrition Board of the Institute of Medicine, National Academy of Sciences, 2002). Roasted sunflower seeds was the traditional food with highest protein content (20.8 g/100 g of edible portion), followed by cottage cheese with dill and garlic (12.8 g/100 g of edible portion), halva (11 g/100 g of edible portion) and sour rye bread (10.8 g/100 g of edible portion) (Fig. 29). Considering a consumption of 100 g of these foods in one day, roasted sunflower seeds may contribute with 37% of the daily protein requirements, cottage cheese with dill and garlic with 23%, halva with 20% and sour rye bread with 19%, in the case of adult males (Table 4). In the case of adult females, roasted sunflower seeds can contribute with 45% of the daily protein requirements, cottage cheese with dill and garlic with 28%, halva with 24% and sour rye bread with 23%.



The protein content for the two oils (mustard and flax oils), the two teas (black and mursal tea), elderberry soft drink and kvass southern was below the limit of quantification.

**Fat**



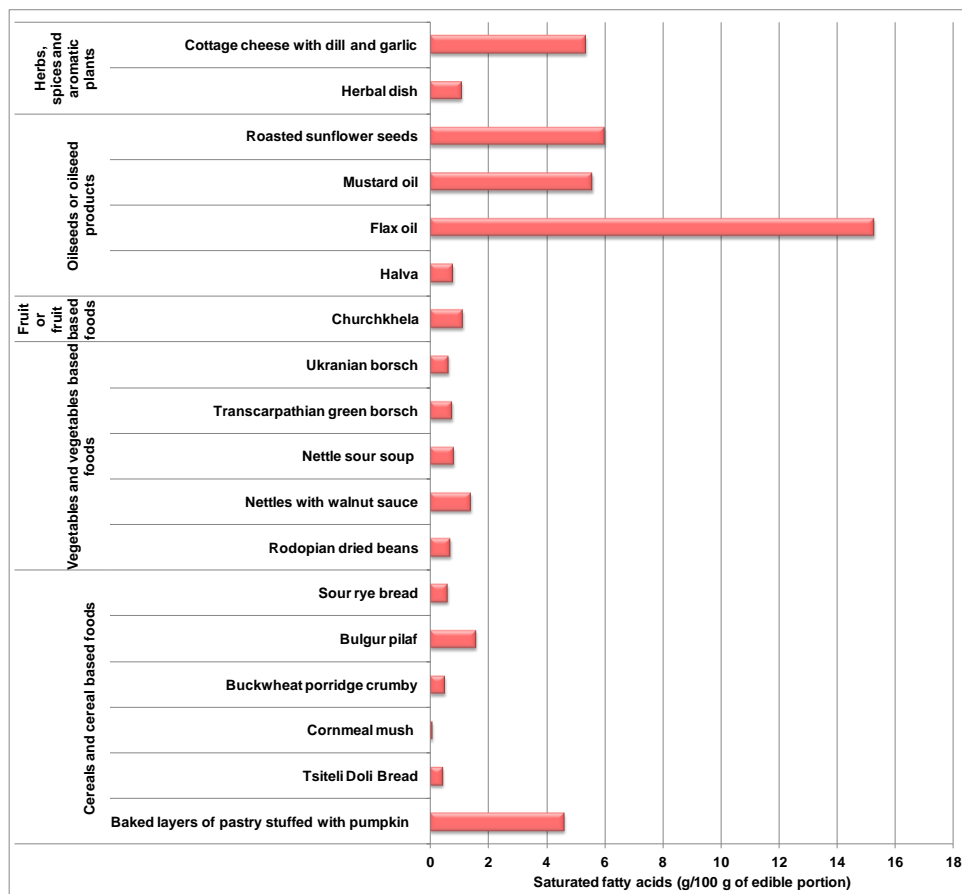
**Fig. 30.** Total fat (g/100 g of edible portion) of the analysed traditional foods.



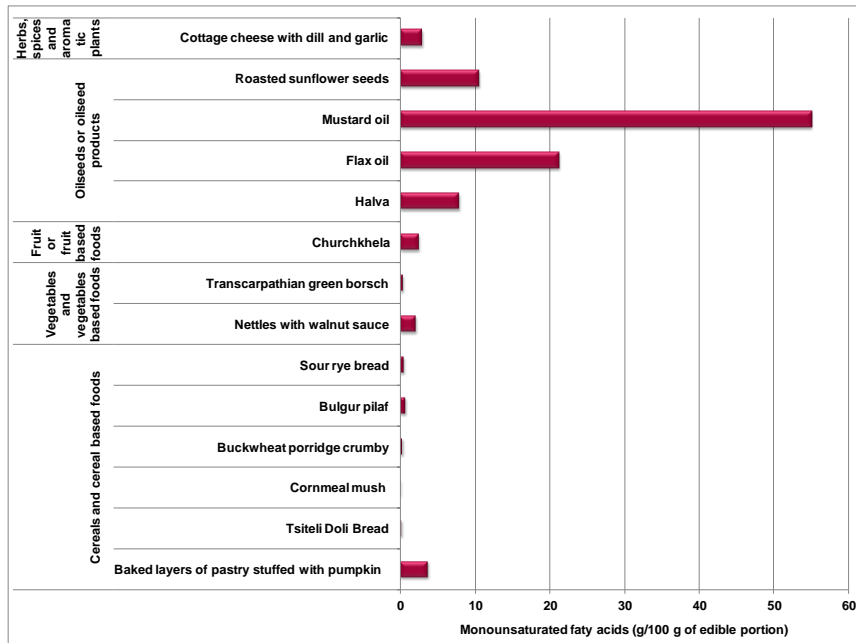
The fat is the main source of energy. The two oils selected for analysis within BaSeFood showed the highest fat content (99.9 g/100 g of edible portion) (Fig. 30). However, roasted sunflower seeds also presented high fat content (58.2 g/100 g of edible portion), followed by halva (30.1 g/100 g of edible portion).

The analysed food with highest saturated fatty acids (SFA) (Fig. 31) and polyunsaturated fatty acids (PUFA) is flax oil (15.3 g/100 g of edible portion and 58.5 g/100 g of edible portion, respectively). Mustard oil showed the highest value for monounsaturated fatty acids (55.1 g/100 g of edible portion) (Fig. 32), although it also has high PUFA content (38 g/100 g of edible portion) (Fig. 33).

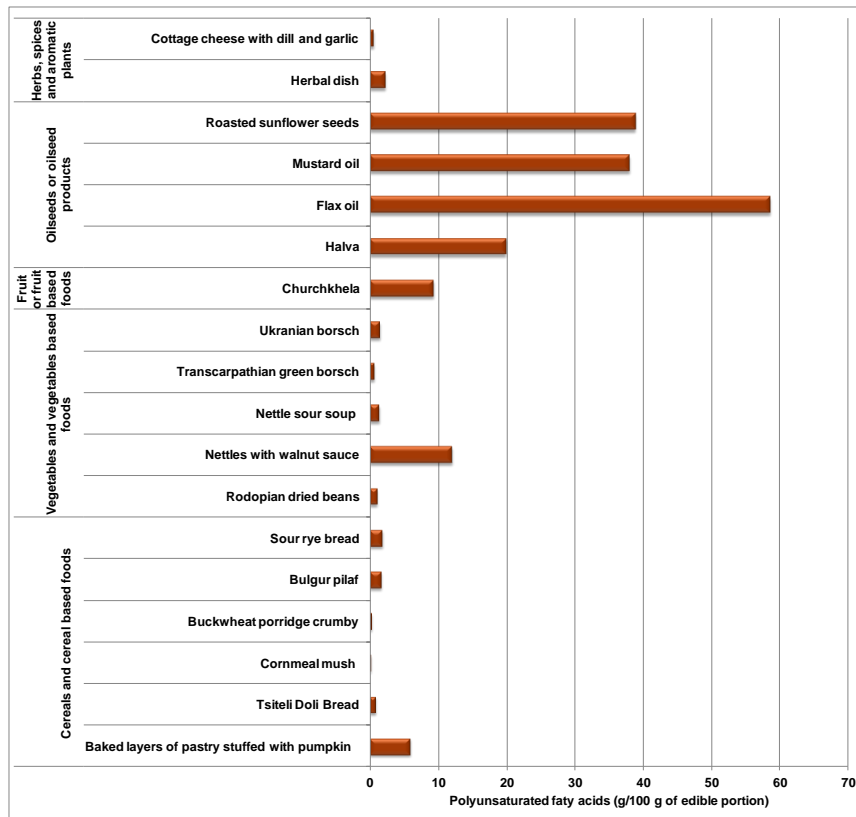
Taking into consideration the DRI for polyunsaturated fatty acids as the sum of the DRI for linoleic and  $\alpha$ -linolenic acids (Table 4), 32 g of flax oil and 49 g of mustard oil are enough for the daily PUFA requirements in a healthy adult male. In the case of an adult female, it would be necessary 22 g of flax oil and 34 g of mustard oil.



**Fig. 31.** Saturated fatty acids content (g/100 g of edible portion) of the analysed traditional foods.

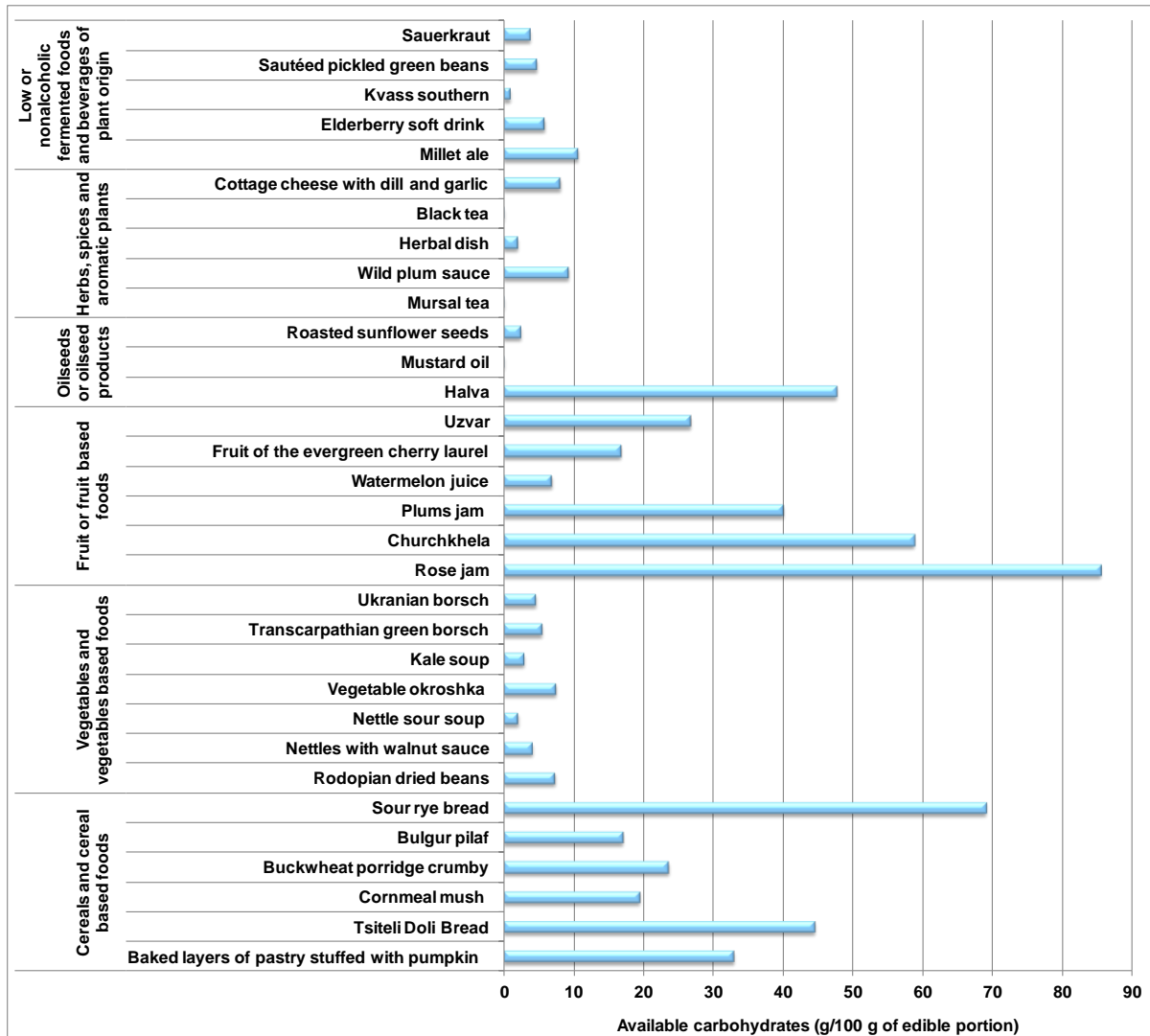


**Fig. 32.** Monounsaturated fatty acids content (g/100 g of edible portion) of the analysed traditional foods.



**Fig. 33.** Polyunsaturated fatty acids content (g/100 g of edible portion) of the analysed traditional foods.

### Available carbohydrates



**Fig. 34.** Available carbohydrates content (g/100 g of edible portion) of the analysed traditional foods.

Carbohydrates are responsible to assure the energy to maintain body weight and are the primary energy source for the brain (Food and Nutrition Board of the Institute of Medicine, National Academy of Sciences, 2002).

The groups with highest carbohydrates content are fruit and fruit based foods and cereal and cereal based foods (Fig. 34).

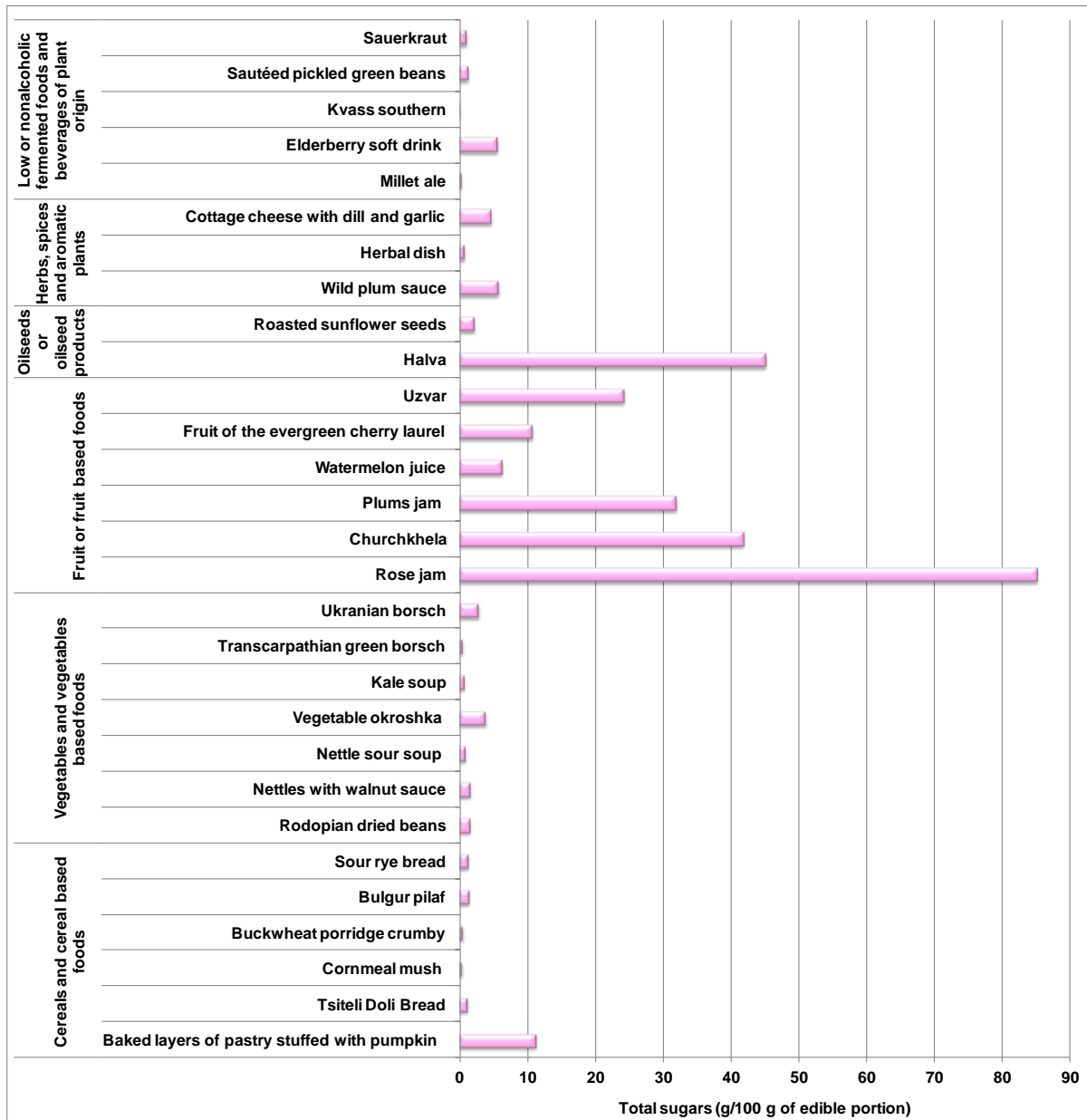
Regarding the individual foods, the one with highest available carbohydrates is rose jam (85.5 g/100 g of edible portion), followed by sour rye bread (69.1 g/100 g of edible portion), churchkhela (58.8 g/100 g of edible portion) and halva (47.7 g/100 g of edible portion). The two major types of carbohydrates are starch and sugar. The natural sources of sugars are fruits and juices, while grains and vegetables are source of starch. In these foods, most of the carbohydrates are sugars with exception of sour rye bread (Fig. 35), where only 1.47 g/100 g of edible portion corresponds to sugars. In this case, most of the carbohydrates correspond to starch (66.3 g/100 g of edible portion) as well as in the case of tsiteli doli



bread (41.3 g/100 g of edible portion) are starch from 44.6 g/100 g of edible portion of available carbohydrates) (Fig. 36).

Considering a consumption of 100 g in one day, rose jam contribute with 66% of the daily carbohydrates requirements, sour rye bread with 53%, churchkhela with 45% and halva with 37% (Table 4).

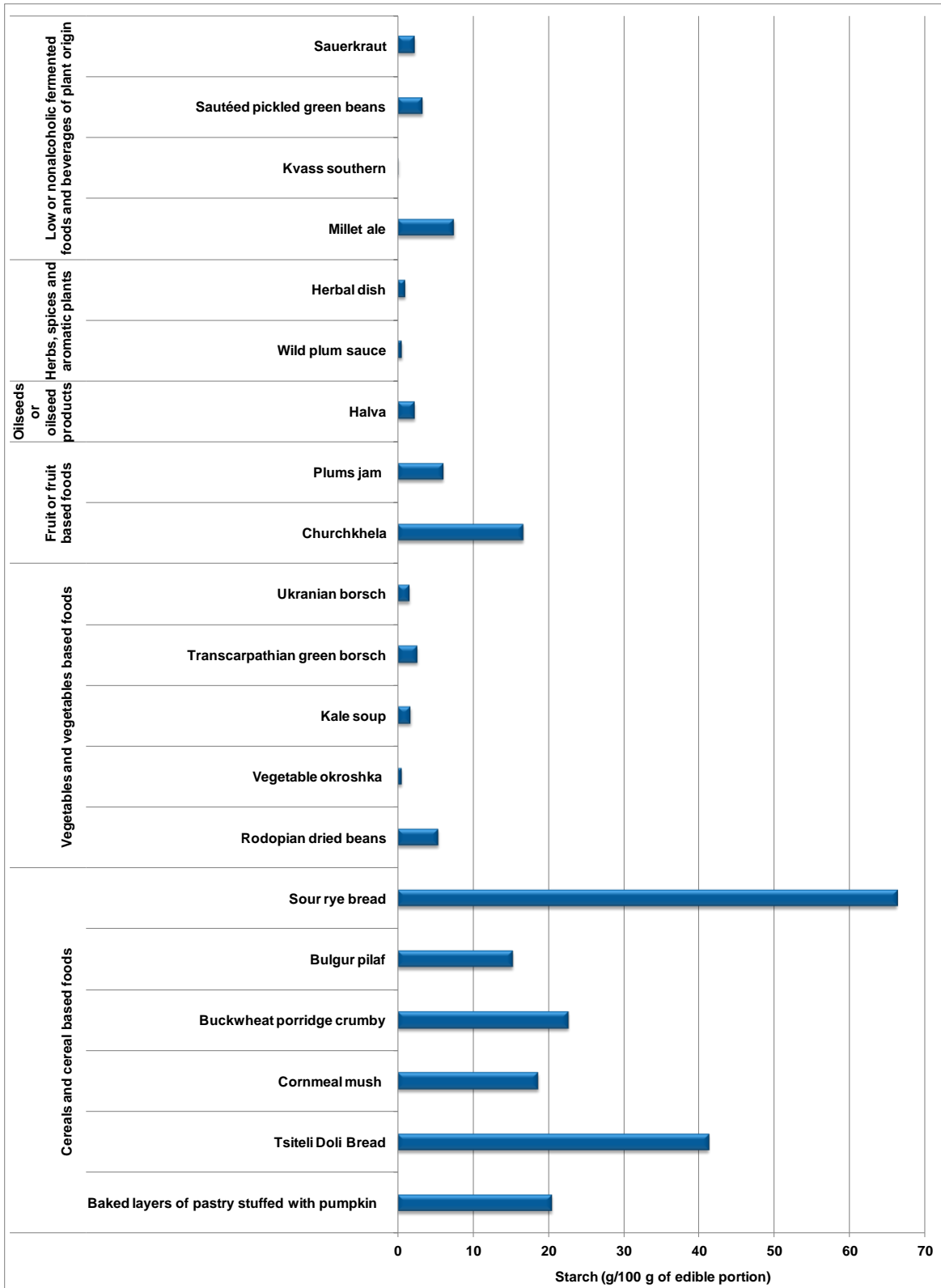
**Total sugars**



**Fig. 35.** Total sugars content (g/100 g of edible portion) of the analysed traditional foods.



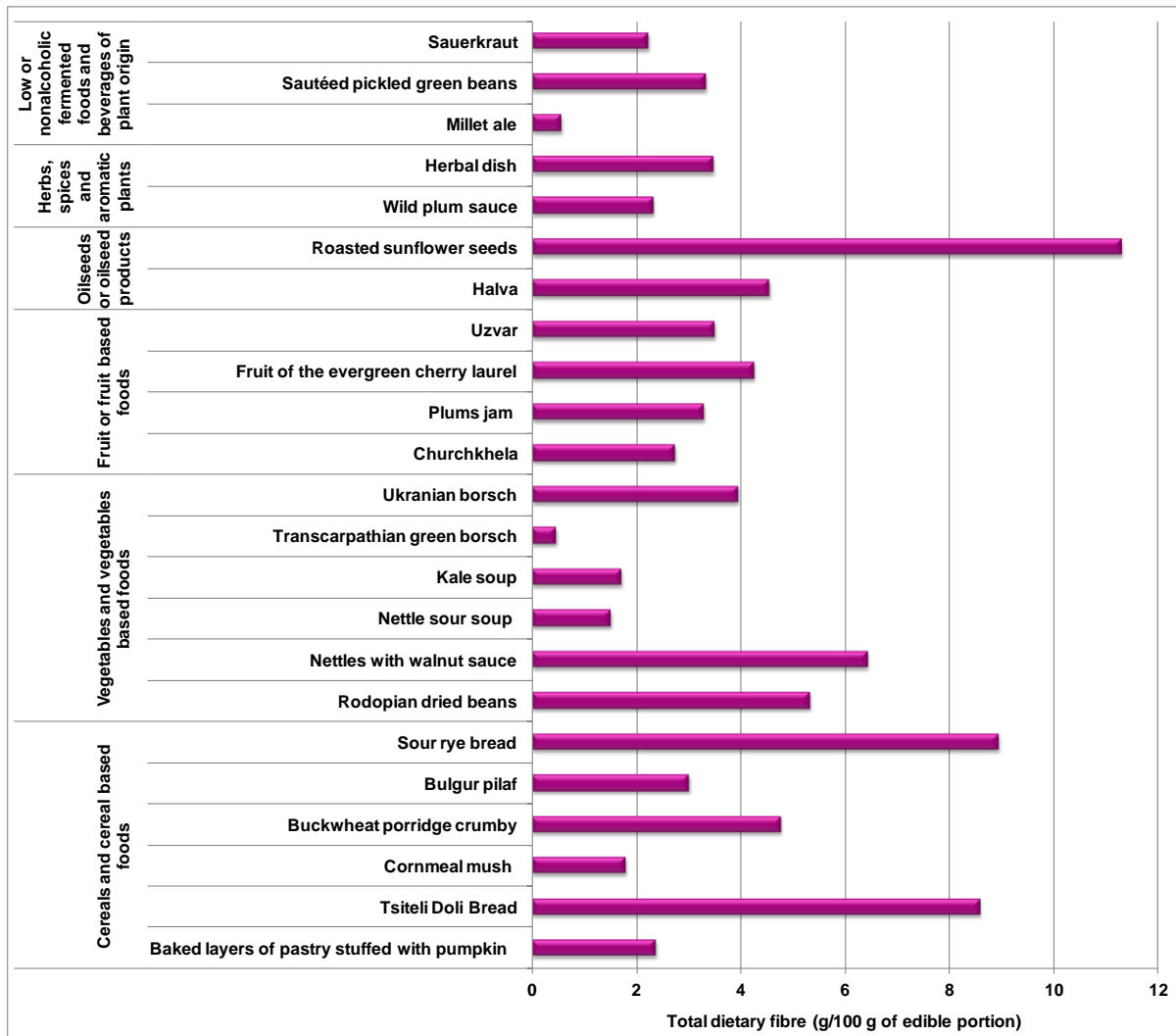
## Starch



**Fig. 36.** Starch content (g/100 g of edible portion) of the analysed traditional foods.



### Total dietary fibre



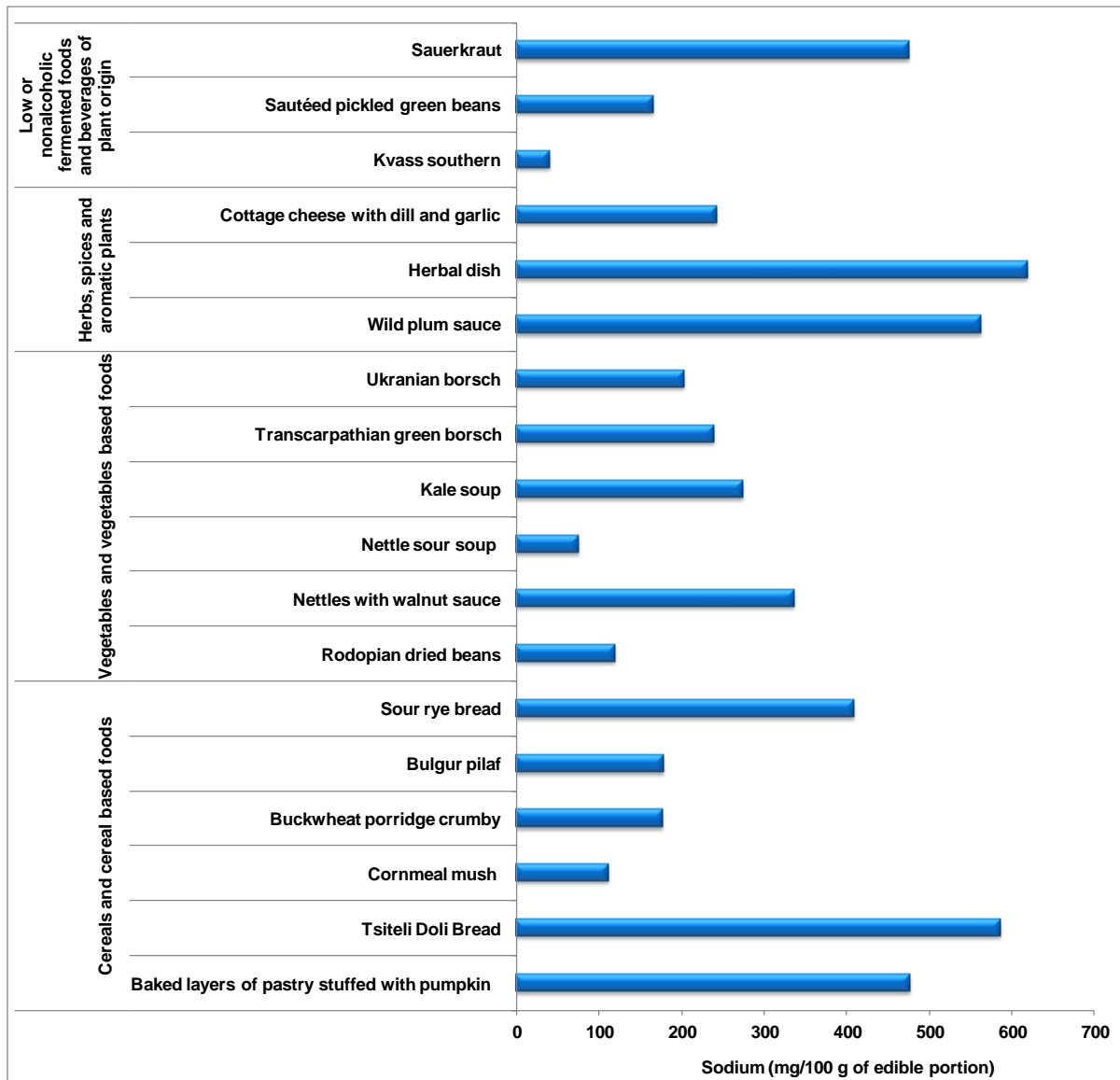
**Fig. 37.** Total dietary fibre content (g/100 g of edible portion) of the analysed traditional foods.

Dietary fibre improves laxation and maintains normal blood glucose levels, reducing the risk of coronary heart disease (Food and Nutrition Board of the Institute of Medicine, National Academy of Sciences, 2002). From the analysed foods within BaSeFood, the only one with more than 10 g/100 g of edible portion of total dietary fibre is roasted sunflower seeds (11.3 g/100 g of edible portion) (Fig. 37). The two analysed breads (sour rye bread and tsiteli doli bread) are also good sources of dietary fibre (about 9 g/100 g of edible portion each). Ten foods have total dietary fibre contents between 2 and 4 g/100 g of edible portion.

Considering a consumption of 100 g in one day, roasted sunflower seeds can contribute with 30% of the daily total fibre requirements, sour rye bread with 24% and tsiteli doli bread with 23%, in the case of an adult male. In the case of an adult female, roasted sunflower seeds contribute with 45% of the daily total fibre requirements, sour rye bread with 36% and tsiteli doli bread with 34% (Table 4).



## Sodium



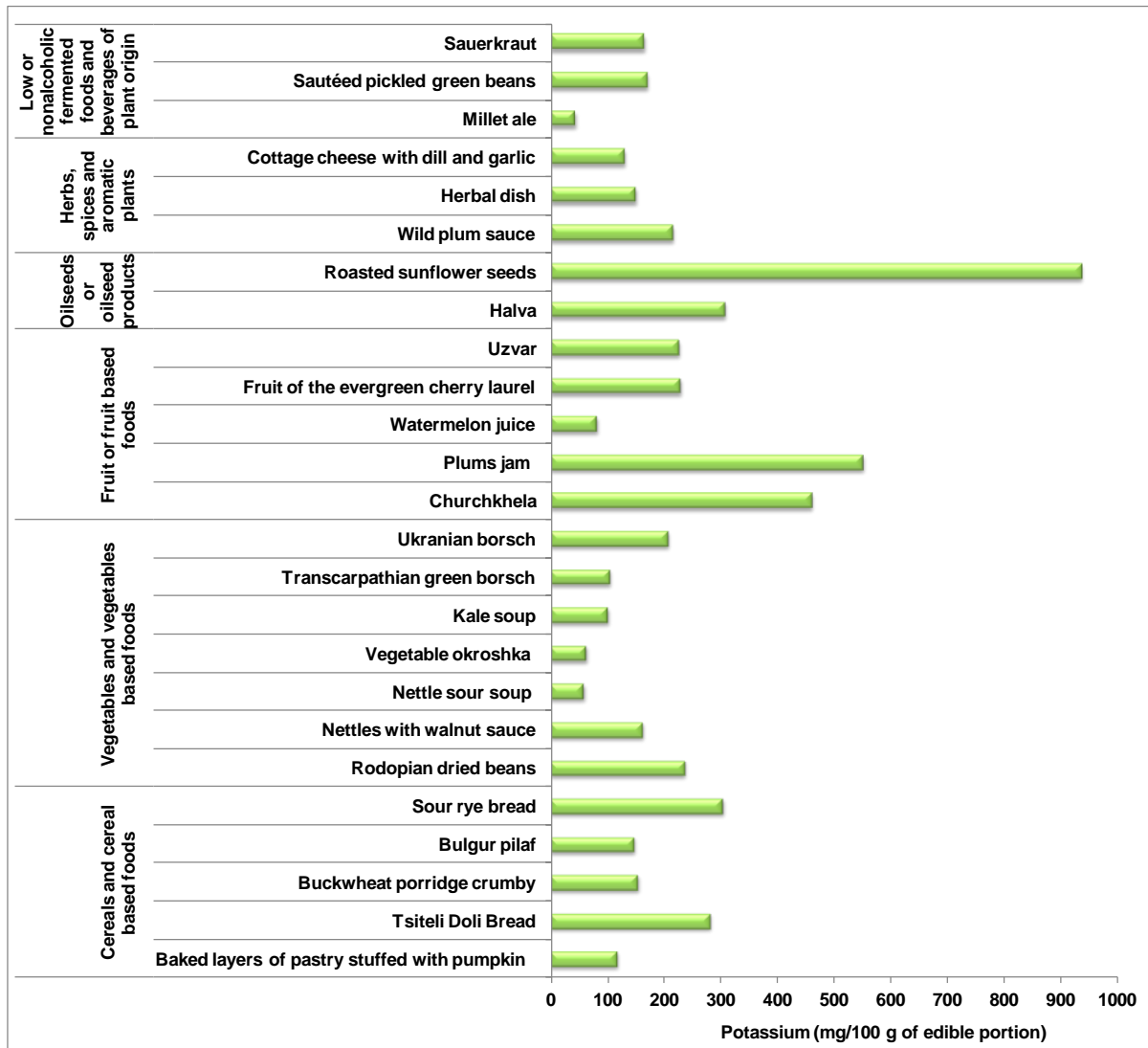
**Fig. 38.** Sodium content (mg/100 g of edible portion) of the analysed traditional foods.

Sodium (Na) maintains fluid volume outside of cells and thus normal cell function (Food and Nutrition Board of the Institute of Medicine, National Academy of Sciences, 2002). Na was determined in all 33 foods and 18 of these traditional foods had contents above the limit of quantification (Fig. 38). Three foods presented Na content higher than 500 mg/100 g of edible portion (herbal dish, tsiteli doli bread and wild plum sauce).

Considering a consumption of 100 g in one day, herbal dish can contribute with 41% of the daily Na requirements, tsiteli doli bread with 39% and wild plum sauce with 37% for Na DRI (Table 4).

## Potassium

Potassium (K) maintains normal cell function through regulation of the cells fluid volume (Food and Nutrition Board of the Institute of Medicine, National Academy of Sciences, 2002).



**Fig. 39.** Potassium content (mg/100g edible portion) of the analysed traditional foods.

Regarding K, this mineral was found in 25 BSAC traditional foods (Fig. 39). The sample with highest K content is roasted sunflower seeds (938 mg/100 g of edible portion).

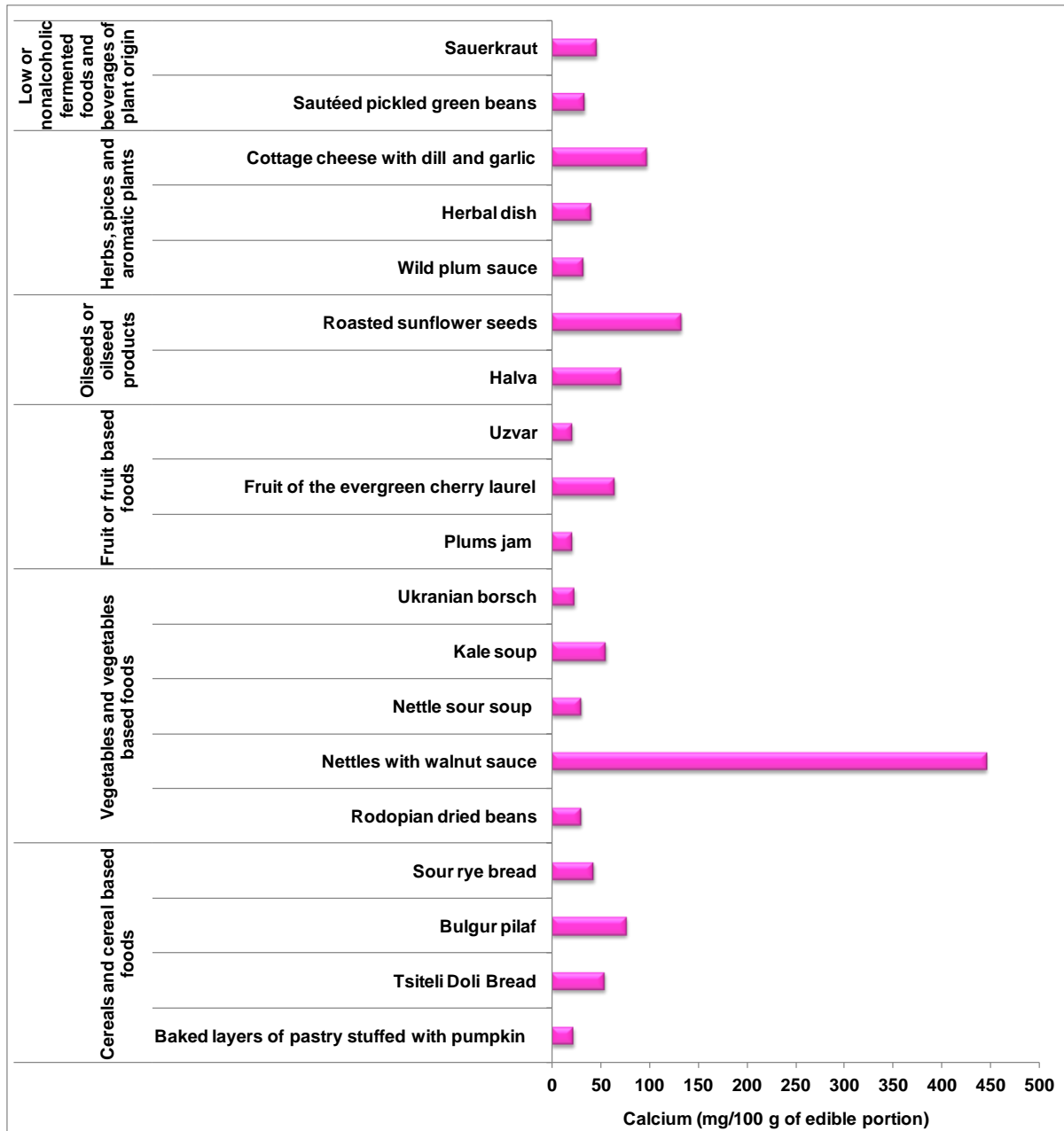
Despite being much lower, plums jam and churchkhela have also considerable amounts of K (553 and 462 mg/100 g of edible portion, respectively).

Considering a consumption of 100 g in one day, roasted sunflower seeds may contribute with 20% of the daily K requirements, plums jam with 12% and churchkhela with 10% for Na DRI (Table 4).



### Calcium

The most common mineral in the human body is calcium (Ca). About 99% is found in bones and teeth, while just 1% is found in the blood and soft tissue. The levels of calcium in the blood and fluid surrounding the cells (extracellular fluid) must be maintained within a very narrow concentration range for normal physiological functioning (Linus Pauling Institute, 2007).



**Fig. 40.** Calcium content (mg/100g of edible portion) of the analysed traditional foods.

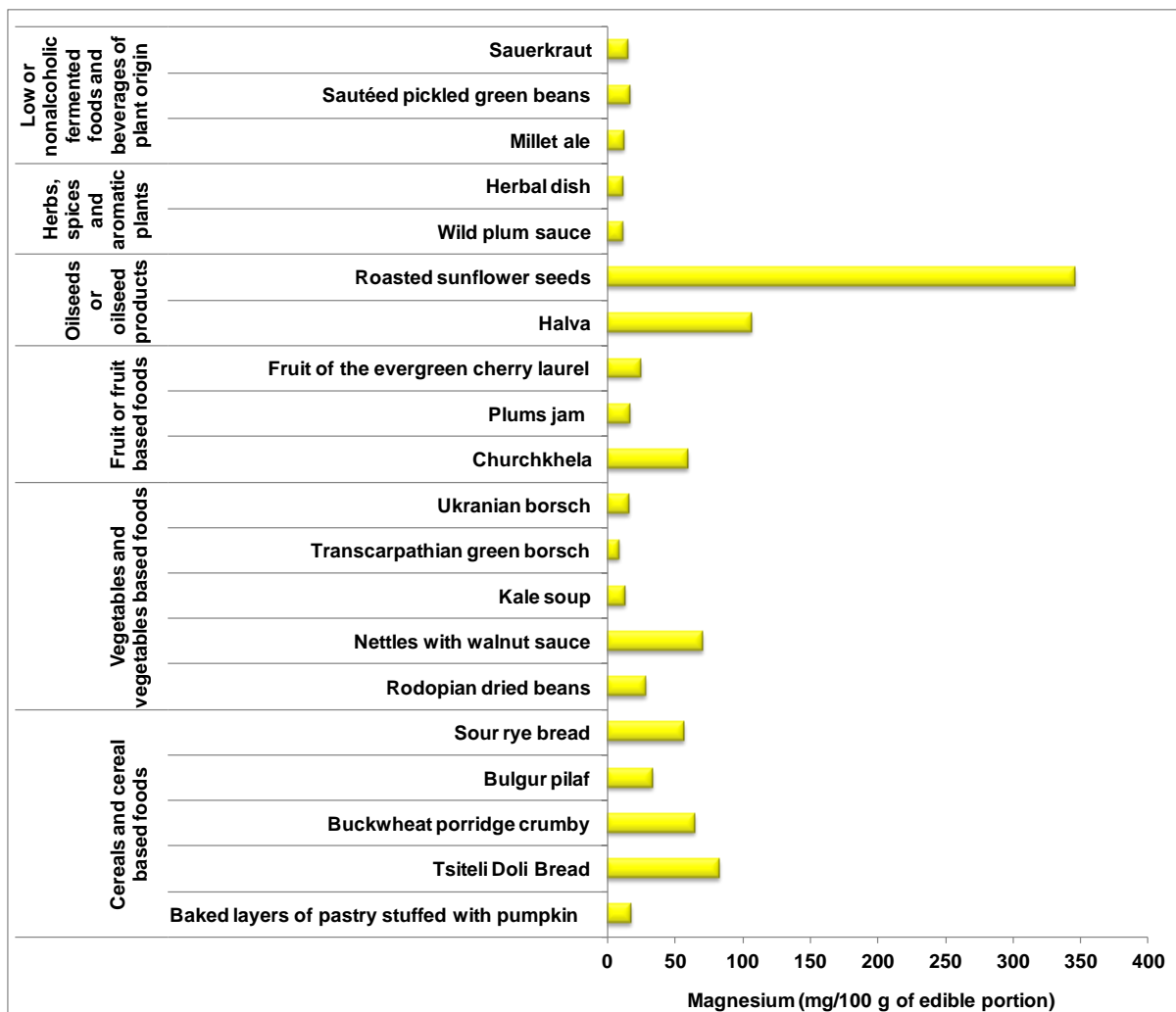


Ca was determined in the 33 selected traditional foods and in 18 of the traditional foods, the content was mostly between 20 and 140 mg/100 g of edible portion (Fig. 40). The sample with an outstanding value of Ca is nettles with walnut sauce (446 mg/100 g of edible portion).

Considering a consumption of 100 g in one day, nettles with walnut sauce can contribute with 45% of the daily Ca requirements (Table 4).

### **Magnesium**

Magnesium (Mg) participates in the structure and the function of the human body (Linus Pauling Institute, 2007). Most of the Mg in the body is found in the skeleton, about 27% is found in muscle, 6-7% is found in other cells, and less than 1% is found outside of cells.



**Fig. 41.** Magnesium content (mg/100 g of edible portion) of the analysed traditional foods.

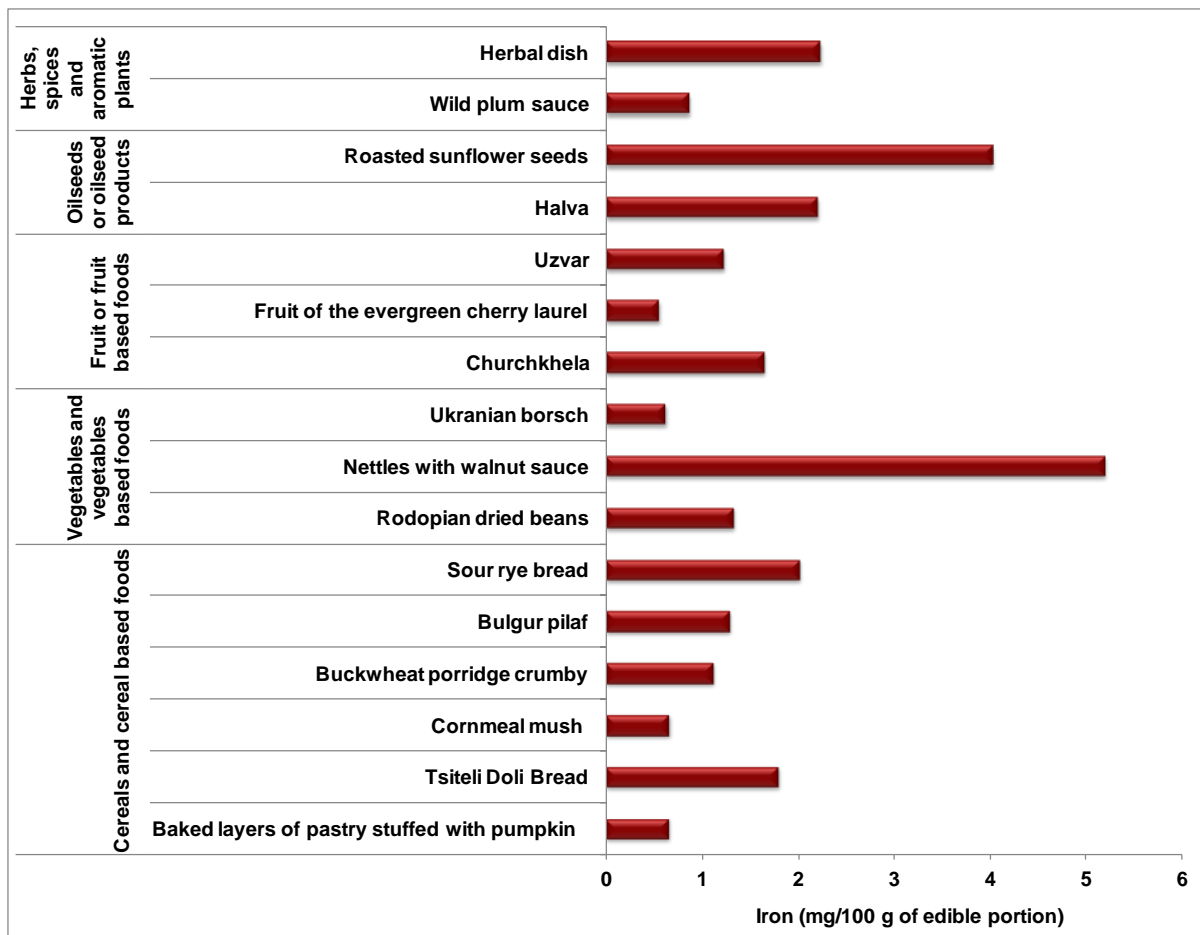


Twenty of the selected traditional foods showed Mg values above the limit of quantification, although 10 samples have Mg contents lower than 20 mg/100 g of edible of portion (Fig. 41). Roasted sunflower seeds have a considerable Mg content of 346 mg/100 g of edible portion.

Considering a consumption of 100 g in one day, roasted sunflower seeds can contribute with 82% of the daily Mg requirements, in the case of adult males (Table 4). In the case of adult females, the consumption of 100 g roasted sunflower seeds exceeds the Mg DRI (108%).

### Iron

Iron (Fe) is a key element in the metabolism of almost all living organisms (Linus Pauling Institute, 2007). In humans, iron is an essential component of many proteins and enzymes.



**Fig. 42.** Iron content (mg/100g of edible portion) of the analysed traditional foods.

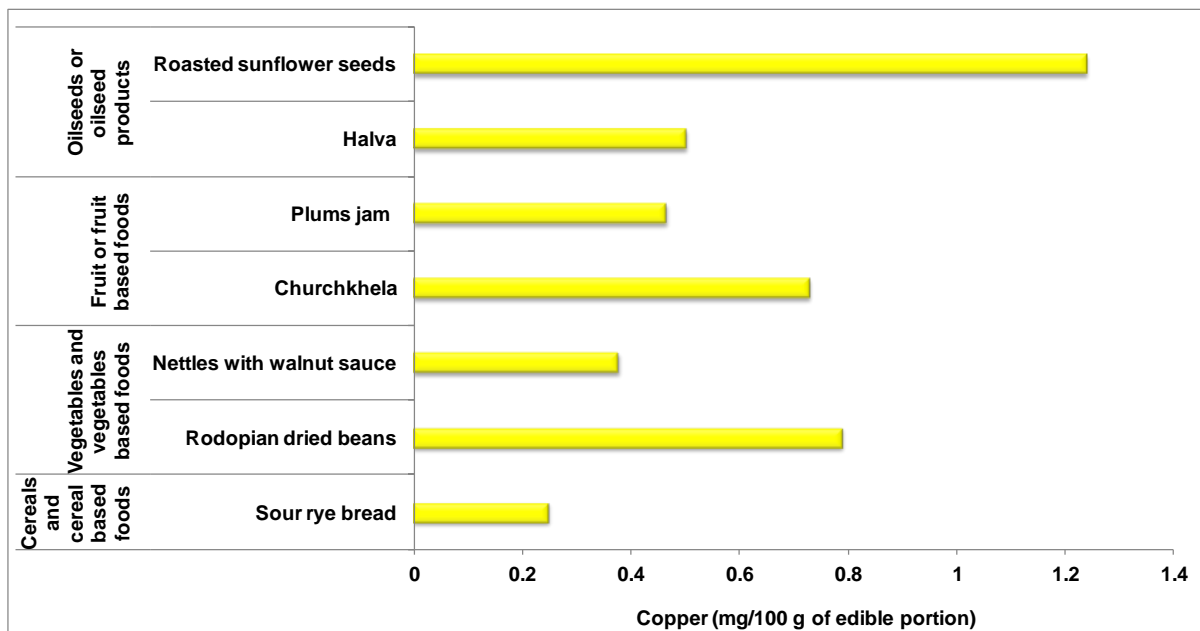


Quantification values for iron content were found in 17 traditional foods (Fig. 42). Nettles with walnut sauce is the sample with highest Fe content (5.2 mg/100 g of edible portion) followed by roasted sunflower seeds (4.0 mg/100 g of edible portion).

Considering a consumption of 100 g in one day, nettles with walnut sauce contribute with 65% of the daily Fe requirements in the case of an adult male and 29% in the case of an adult female between 19 and 50 years old (Table 4). In the case of roasted sunflower seeds, 100 g contribute with 50% of the daily Fe requirements in the case of an adult male and 22% in the case of an adult female between 19 and 50 years old (Table 4).

### Copper

Copper (Cu) is an essential trace element for humans and animals (Linus Pauling Institute, 2007). It has an important role in oxidation-reduction (redox) reactions and in scavenging free radicals. It is also an essential component of a number of essential enzymes known as cuproenzymes.



**Fig. 43.** Copper content (mg/100 g of edible portion) of the analysed traditional foods.

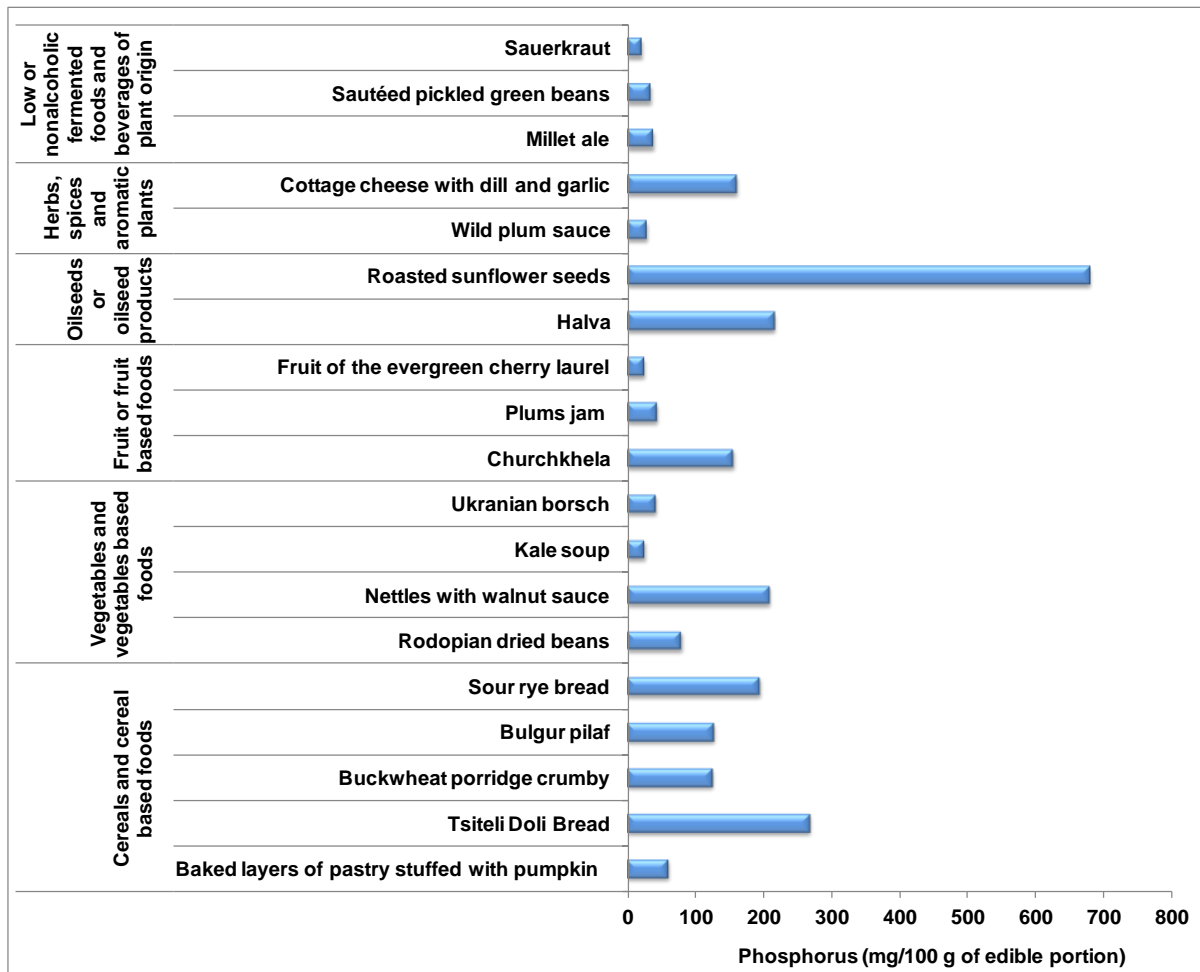
Copper was only found (above the limit of quantification) in 7 of the selected BSAC traditional foods (Fig. 43). Roasted sunflower seeds was the sample with highest Cu content (1.24 mg/100 g of edible portion), followed by rodopean dried beans (0.79 mg/100 g of edible portion) and churchkhela (0.73 mg/100 g of edible portion).

In roasted sunflower seeds, 73 g are enough to contribute for the Cu daily requirement. On the other hand, rodopean dried beans can contribute with 88% of the daily Cu requirements and churchkhela with 81% for Na DRI (Table 4).



## Phosphorus

Phosphorus is required by every cell in the body for normal function (Linus Pauling Institute, 2007). The majority of the phosphorus in the body is found as phosphate (PO<sub>4</sub>). Phosphorus is a major structural component of bone in the form of a calcium phosphate salt, called hydroxyapatite.



**Fig. 44.** Phosphorus content (mg/100 g of edible portion) of the analysed traditional foods.

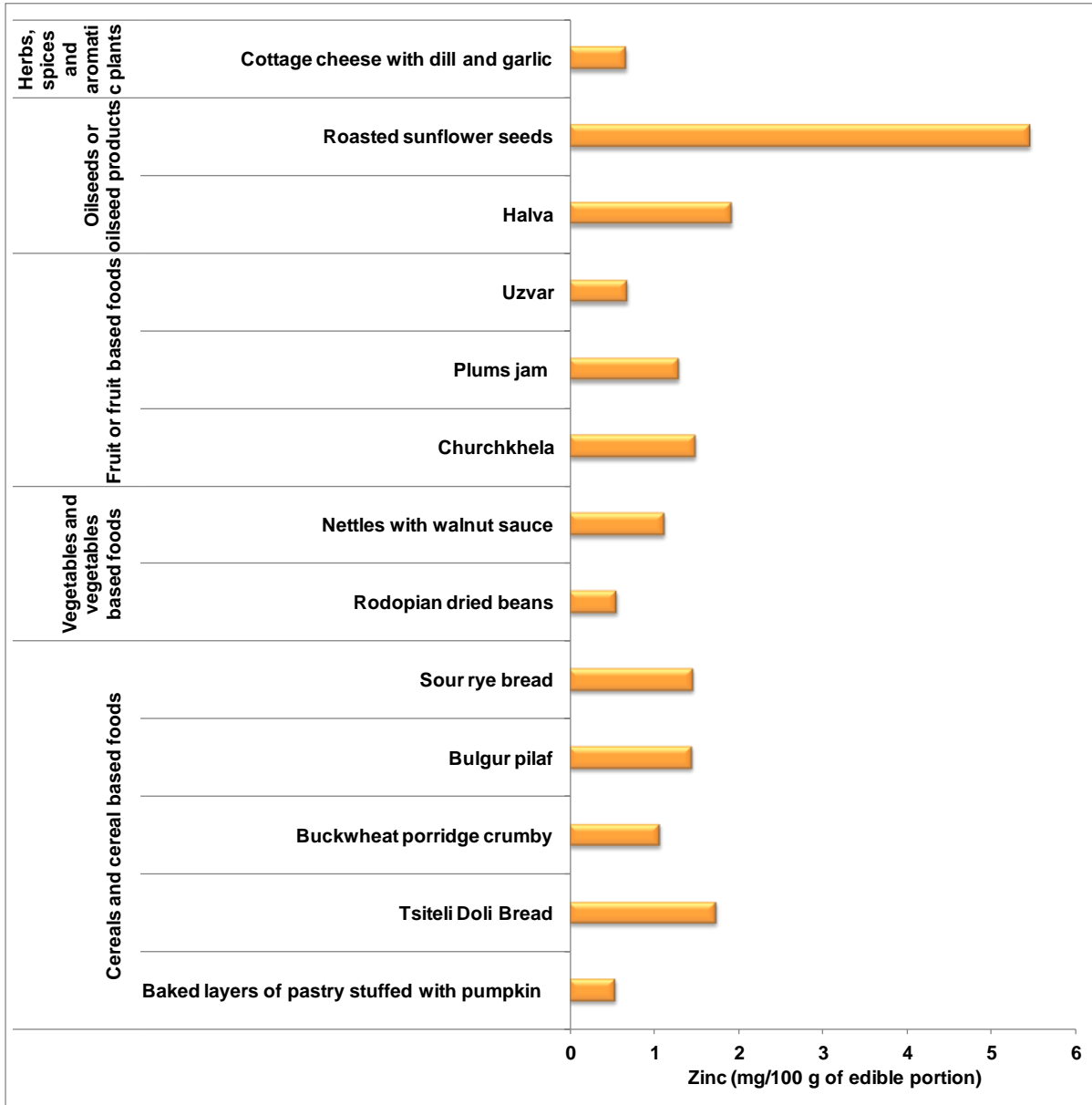
Nineteen of the selected BSAC traditional foods had a phosphorous content above the limit of quantification (Fig. 44). Roasted sunflower seeds was the sample with highest P (681 mg/100 g of edible portion).

Considering a consumption of 100 g in one day, roasted sunflower seeds contribute with 97% of the daily P requirements (Table 4).



## Zinc

Zinc (Zn) plays important roles in growth and development, the immune response, neurological function, and reproduction (Linus Pauling Institute, 2007).



**Fig. 45.** Zinc content (mg/100 g of edible portion) of the analysed traditional foods.

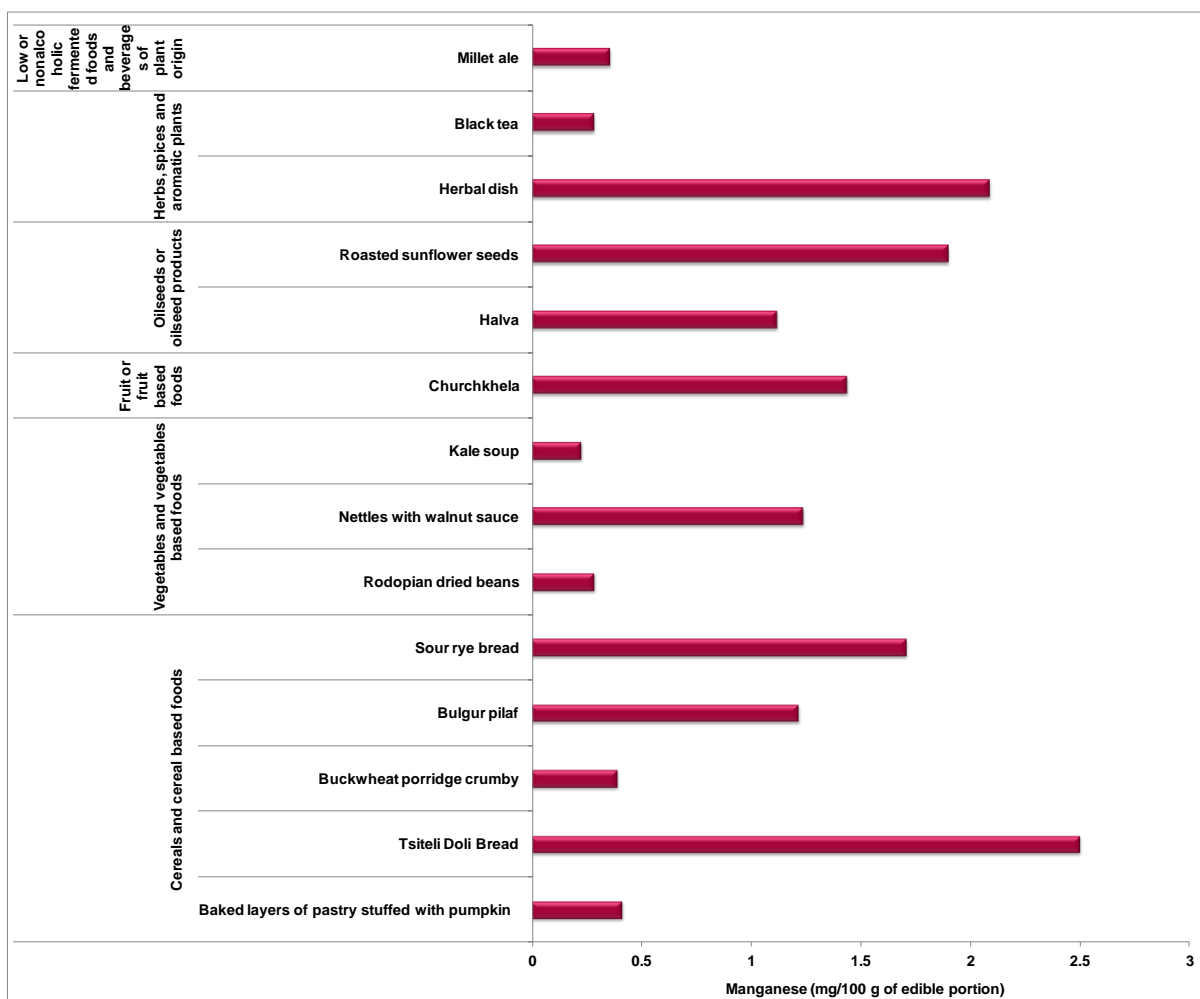
From the 33 analysed traditional foods, zinc was found in 13 of them (Fig. 45). Roasted sunflower seeds was the sample with the highest Zn content (5.47 mg/100 g of edible portion). Considering a consumption of 100 g in one day, roasted sunflower seeds contribute with 50% and 68 % of the daily Zn requirements in the case of adult males and adult females, respectively (Table 4).



## Manganese

Manganese (Mn) plays an important role in several physiologic functions, as a constituent of numerous enzymes and an activator of other enzymes (Linus Pauling Institute, 2007).

Fourteen of the selected BSAC traditional foods had manganese values above the limit of quantification (Fig. 46). The foods that presented higher contents of Mn were: tsiteli doli bread (2.5 mg/100 g of edible portion), herbal dish (2.1 mg/100 g of edible portion), roasted sunflower seeds (1.9 mg/100 g of edible portion) and sour rye bread (1.7 mg /100 g of edible portion).



**Fig. 46.** Manganese content (mg/100g of edible portion) of the analysed traditional foods.

In order to achieve the Mn daily requirements and in the case of an adult male, it would be necessary to consume 92 g of tsiteli doli bread, 110 g of herbal dish, 121 g of roasted sunflower seeds and 135 g of sour rye bread. In the case of an adult female, it would be necessary to achieve the Mn daily requirements to consume 72, 86, 95 and 106 g of tsiteli doli bread, herbal dish, roasted sunflower seeds and sour rye bread, respectively.



### ***Selenium***

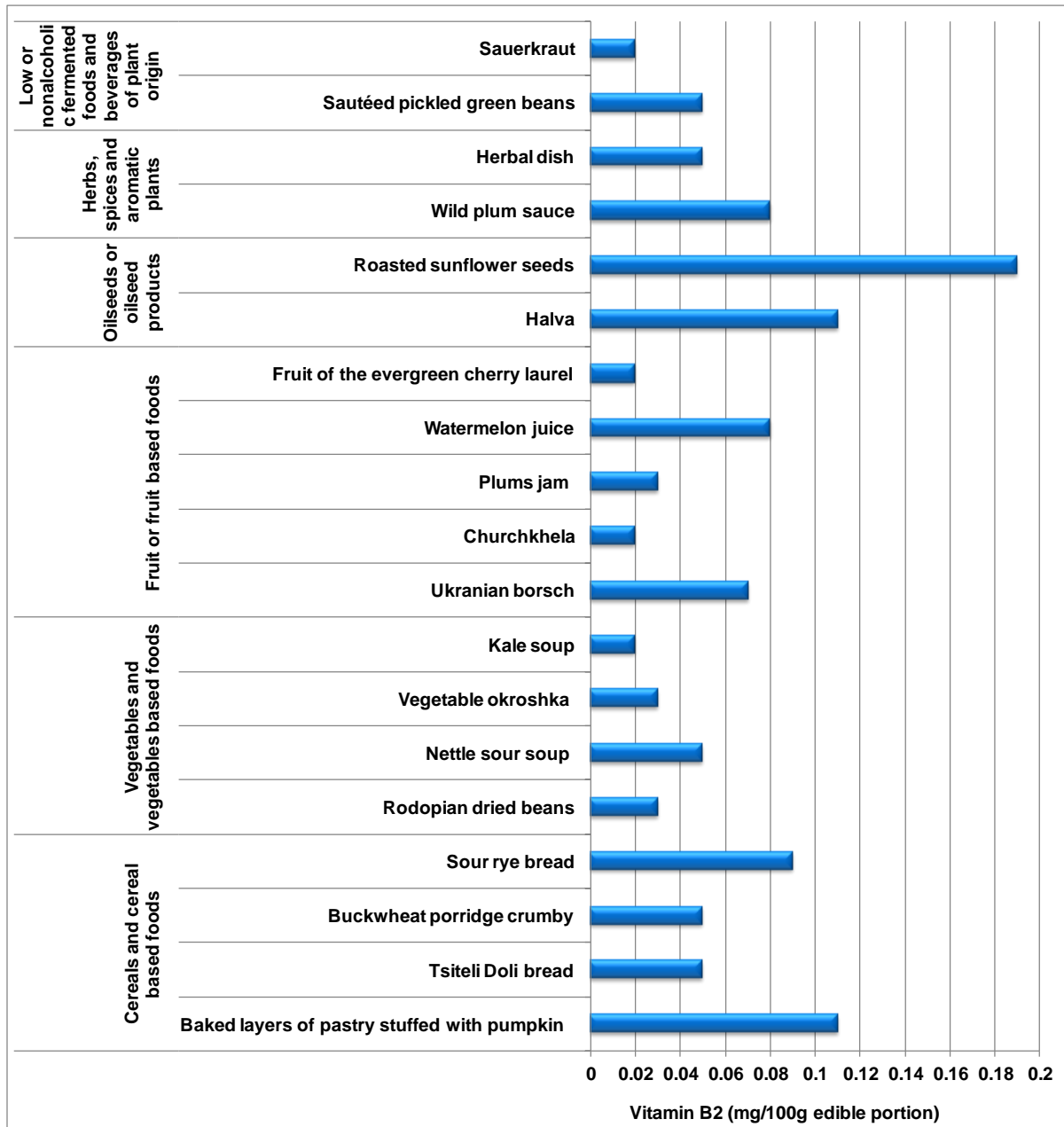
Selenium (Se) is an essential trace element required for the function of a number of selenium-dependent enzymes, also known as selenoproteins (Linus Pauling Institute, 2007).

All the analysed traditional foods have Se content lower than the limit of quantification, with the exception of plums jam (43.7 µg/100 g of edible portion), churchkhela (31.7 µg/100 g of edible portion) and roasted sunflower seeds (24.0 µg/100 g of edible portion). Considering a consumption of 100 g in one day, roasted sunflower seeds contribute with 44% of the daily selenium requirements (Table 4).

### ***Vitamin B<sub>2</sub>***

Vitamin B<sub>2</sub> is a water-soluble vitamin, also known as riboflavin. In the body, riboflavin is primarily found as a component of the coenzymes, flavin adenine dinucleotide (FAD) and flavin mononucleotide (FMN) (Linus Pauling Institute, 2007).

The analysed traditional food from BSAC with higher vitamin B<sub>2</sub> content was roasted sunflower seeds (0.19 mg/100 g of edible portion) (Fig. 47). The majority of the foods belonging to the groups of fruit and fruit based foods, vegetables and vegetables based foods and cereals and cereals based foods presented vitamin B<sub>2</sub>.



**Fig. 47.** Vitamin B<sub>2</sub> content (mg/100 g of edible portion) of the analysed traditional foods.

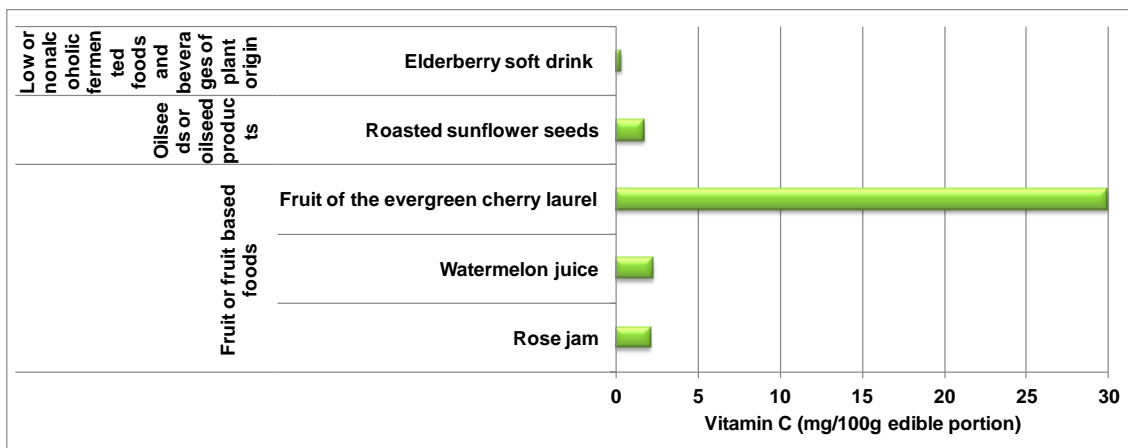
Considering a consumption of 100 g in one day, roasted sunflower seeds can contribute with 15% of the daily vitamin B<sub>2</sub> requirements, in the case of an adult male and 17% in the case of an adult female (Table 4).



## Vitamin C

Vitamin C is a water-soluble vitamin and is also known as ascorbic acid. Vitamin C must be obtained through our diet because humans do not have the ability to produce it. Vitamin C is also a highly effective antioxidant. Moreover, it is required for the synthesis of collagen, and plays an important role in the synthesis of the neurotransmitter, norepinephrine, and the molecule carnitine, that is essential for the transport of fat into cellular organelles called mitochondria. Research also suggests that vitamin C is involved in the metabolism of cholesterol to bile acids, which may have implications for blood cholesterol levels (Linus Pauling Institute, 2007).

From the analysed foods, only five presented vitamin C, and from these three belong to the group of fruit or fruit based foods (Fig. 48). The foodstuff with the highest vitamin C content was fruit of the evergreen cherry laurel (29.9 mg/100 g of edible portion).



**Fig. 48.** Vitamin C content (mg/100 g of edible portion) of the analysed traditional foods.

Considering a consumption of 100 g in one day, fruit of the evergreen cherry laurel can contribute with 33% of the daily vitamin C requirements in the case of an adult male and 40% in the case of an adult female (Table 4).

## Vitamin E

Vitamin E describes a family of eight antioxidants: four tocopherols and four tocotrienols.  $\alpha$ -tocopherol is the only form of vitamin E that is actively maintained in the human body. Therefore, it is the one found in the largest quantities in blood and tissues. The main function of  $\alpha$ -tocopherol in humans appears to be as antioxidant (Linus Pauling Institute, 2007).

Seventeen BSAC traditional foods presented vitamin E. Roasted sunflower seeds presented the highest level (6 mg/100 g of edible portion) followed by churchkhela (2.5 mg/100 g of edible portion) and plums jam (2.1 mg/100 g of edible portion) (Fig. 49).



Considering a consumption of 100 g in one day, roasted sunflower seeds contribute with 40% of the daily vitamin E requirements, churchkhela with 17% and plums jam with 14% for vitamin E DRI (Table 4).

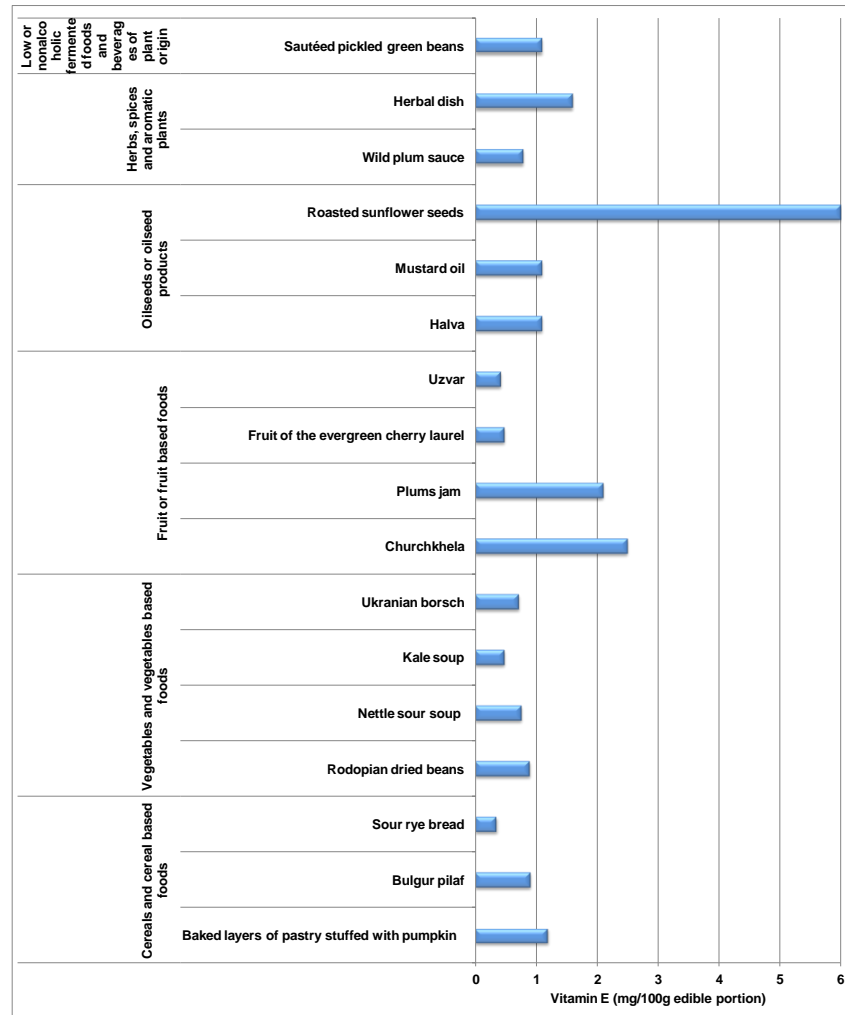


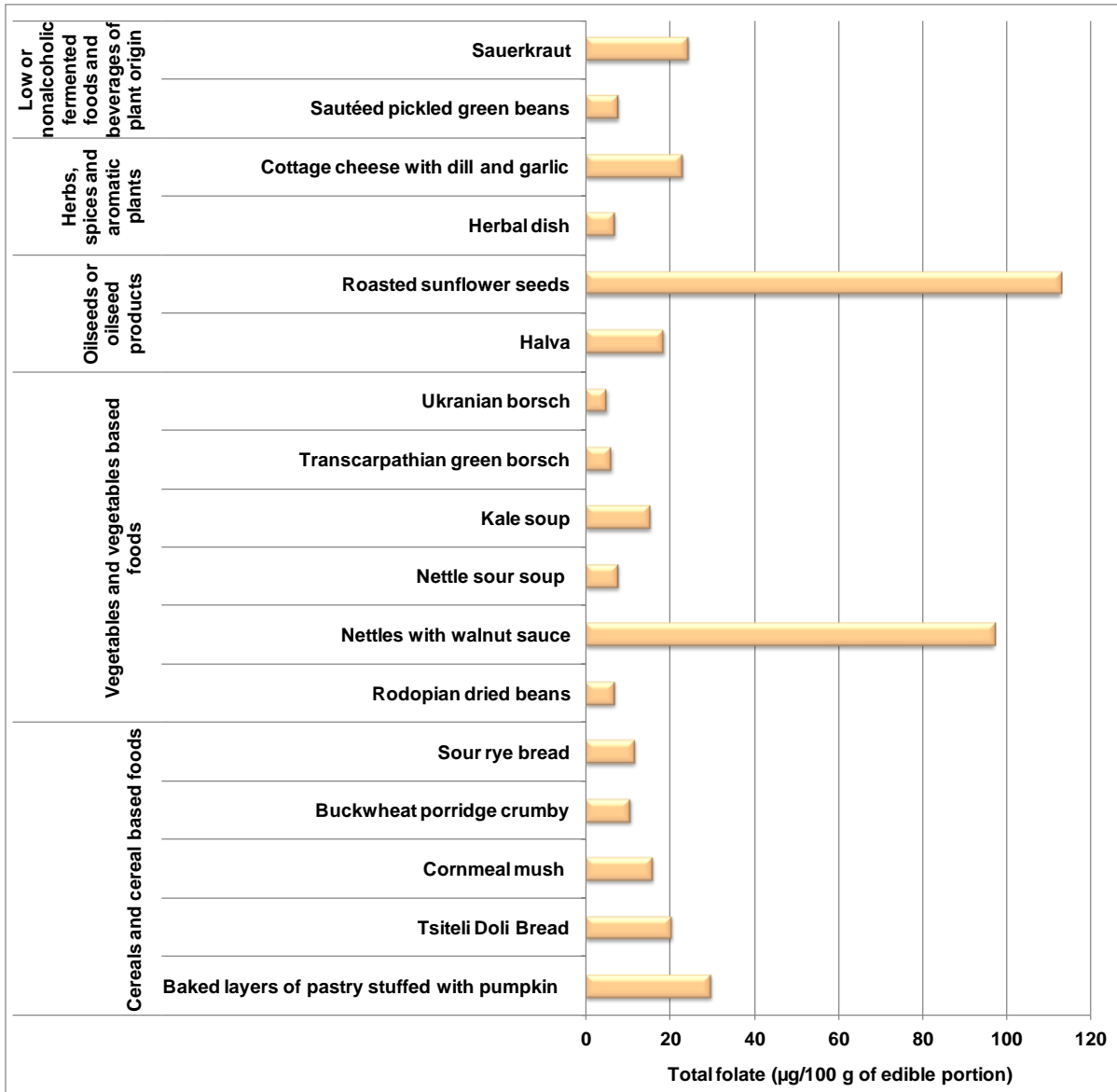
Fig. 49. Vitamin E content (g/100 g of edible portion) of the analysed traditional foods.

### Total folate

Folates occur naturally as a variety of polyglutamates, with different biological activity. Folate is a generic term for a water-stable vitamin from B-complex, which exists in many chemical forms. It is essential for many of the methylation reactions involved in the synthesis of DNA and RNA, and hence plays a crucial role in cell division. The recommended daily allowance (RDA) is 400 µg/day (for both men and women) of dietary folate equivalents. Food folates have approximately 50% lower bioavailability than folic acid. The ingestion of a supplement of folic acid during the periconceptional period significantly reduces the risk of giving birth to a child with a neural tube defect.



Roasted sunflower seeds (113 µg/100 g of edible portion) and nettles with walnut sauce (97.2 µg/100 g of edible portion) were the foods with the highest total folate content (Fig. 50). All the analysed foods belonging to the group of vegetables and vegetable based foods and cereals and cereal based foods presented total folate.



**Fig. 50.** Total folate content (µg/100 g of edible portion) of the analysed traditional foods.

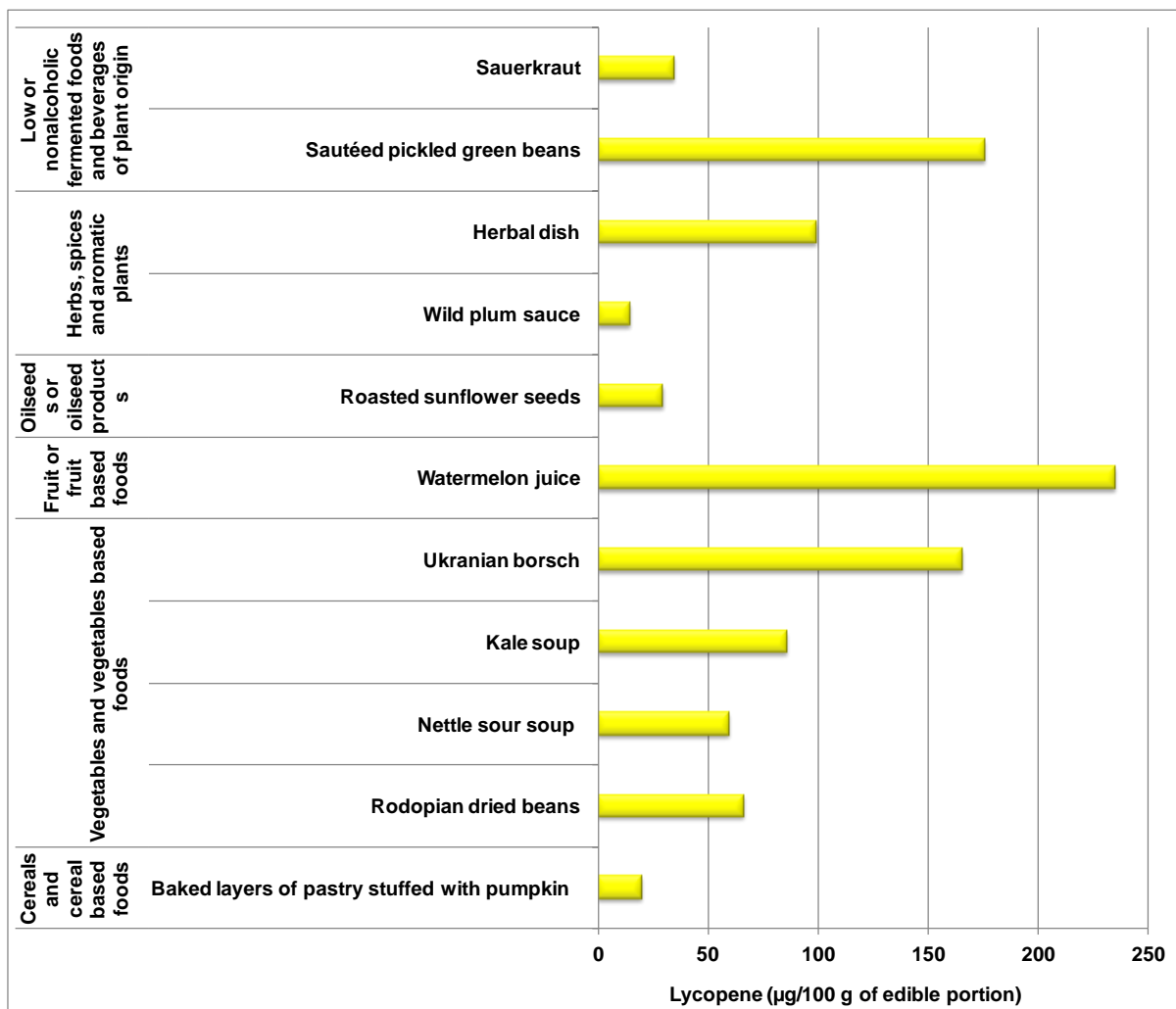
Considering a consumption of 100 g in one day, roasted sunflower seeds can contribute with 28% of the daily total folate requirements and nettles with walnut sauce with 24% for total folate DRI (Table 4).



## Lycopene

Lycopene gives for example in tomatoes, pink grapefruit and watermelon guava their red color. Lycopene is not a provitamin A carotenoid, meaning the body cannot convert lycopene to vitamin A (Linus Pauling Institute, 2007).

From the analysed BSAC foods, eleven presented lycopene (Fig. 51). The three foods with highest lycopene content were: watermelon juice, sautéed pickled green beans and Ukrainian borsch (235, 176 and 166  $\mu\text{g}/100\text{ g}$  of edible portion, respectively). Most of the foods containing lycopene belong to the group of vegetables and vegetables based foods.

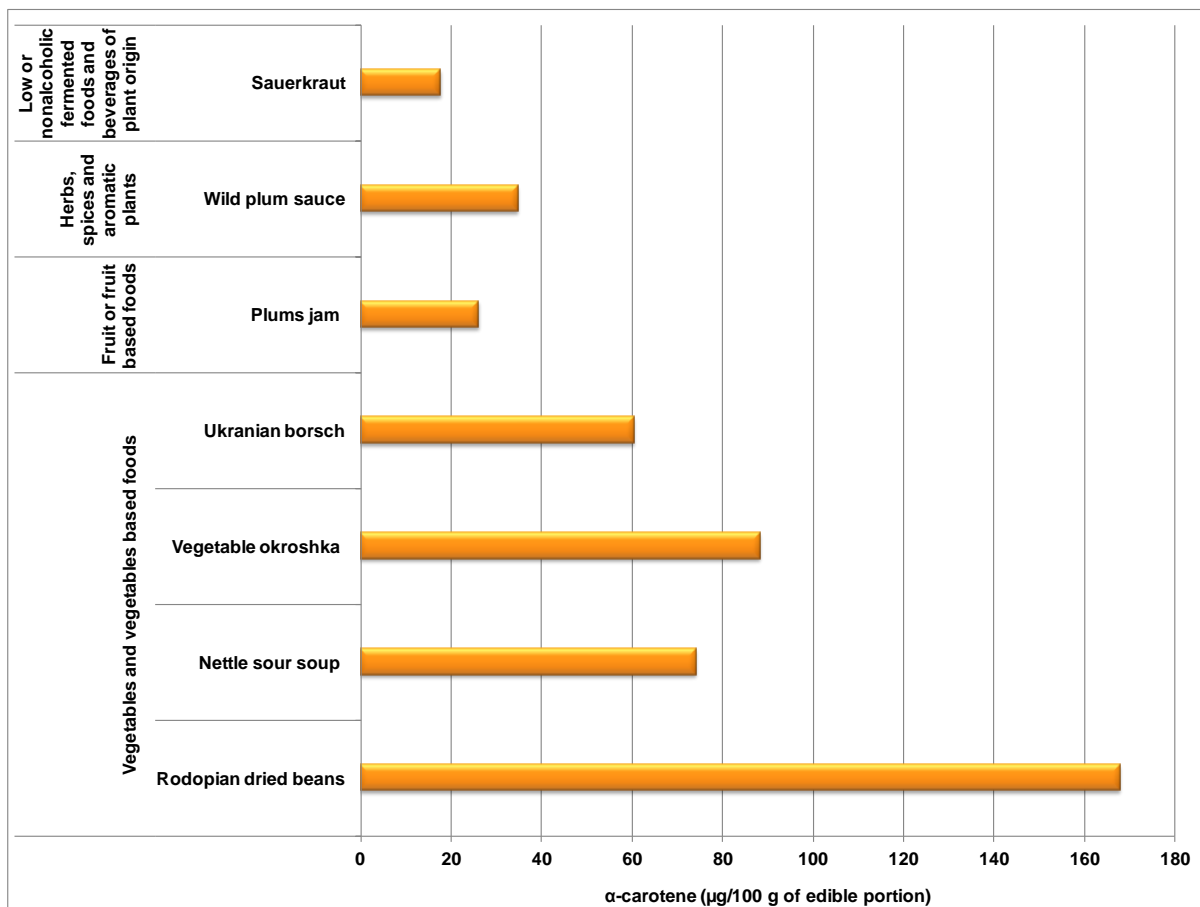


**Fig. 51.** Lycopene content ( $\mu\text{g}/100\text{ g}$  of edible portion) of the analysed traditional foods.

### ***α and β-carotenes***

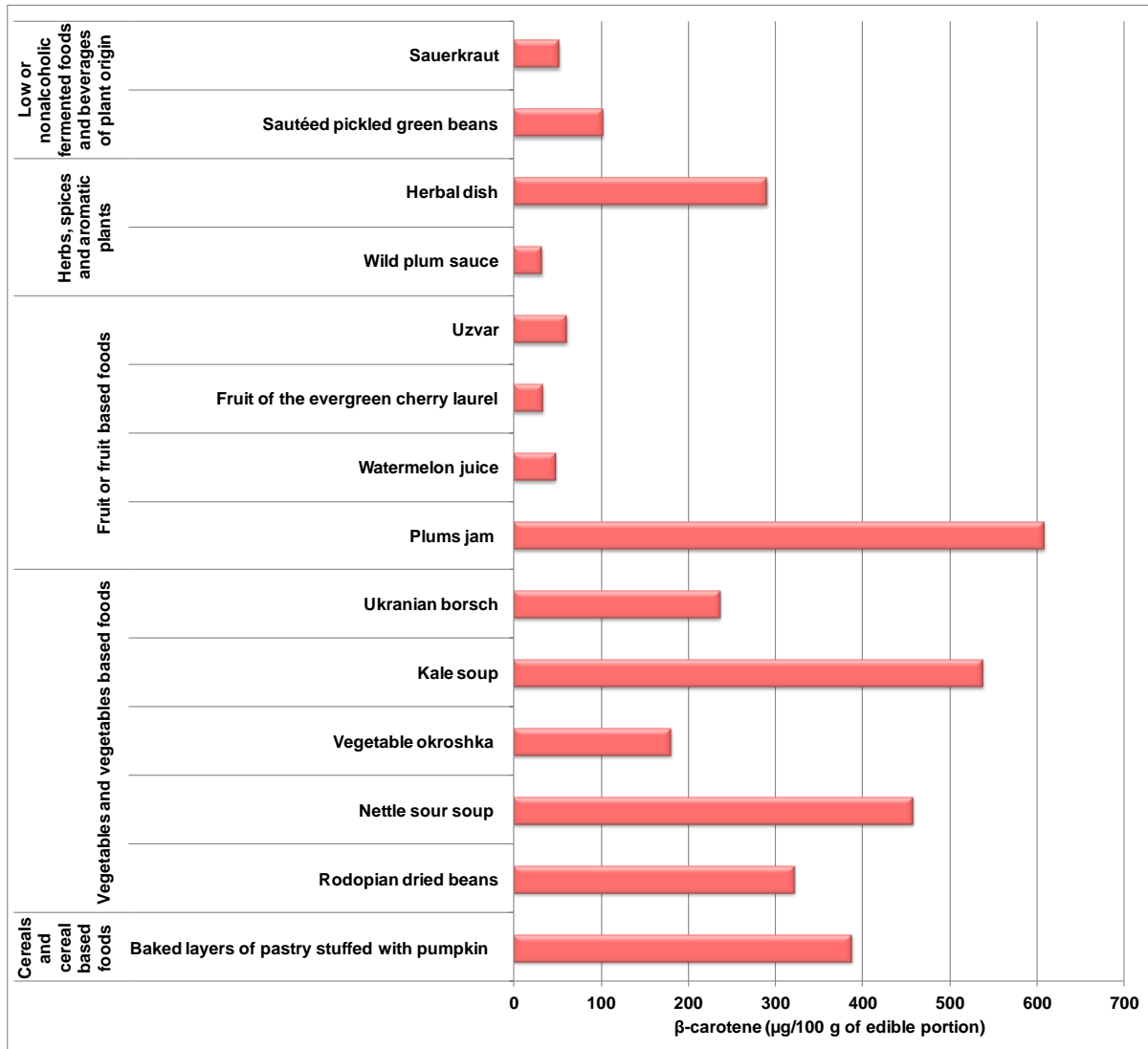
α-carotene and beta-carotene are provitamin A carotenoids, meaning they can be converted in the body to vitamin A (Linus Pauling Institute, 2007).

Most of the analysed foods containing α-carotene belong to the group of vegetables and vegetables based foods (Fig. 52). Rodopian dried beans presented the highest α-carotene content (167.8 μg/100 g of edible portion) followed by vegetable okroshka (88.2 μg/100 g of edible portion).



**Fig. 52.** α-carotene content (μg/100 g of edible portion) of the analysed traditional foods.

From the analysed traditional foods, fourteen presented β-carotene (Fig. 53). Plums jam was the traditional food with the highest β-carotene content (608 μg/100 g of edible portion) followed by kale soup (538 μg/100 g of edible portion) and nettle sour soup (458 μg/100 g of edible portion). The group of vegetables and vegetables based foods was the one that most contributed for β-carotene content.



**Fig. 53.** β-carotene content (µg/100 g of edible portion) of the analysed traditional foods.

### Conclusion

Great variability in components content was found in the analysed BSAC traditional foods, in the frame of BaSeFood project. The results presented in this deliverable will allow knowing better the dietary patterns of the Black Sea Area countries and therefore, provide accurate dietary advice to improve health and well-being.

From all the analysed traditional foods, roasted sunflower seeds may be highlighted due to their high content in some vitamins and minerals. In fact, a consumption of 100 g of this traditional food may contribute with 37% of protein, 30% of dietary fibre, 20% of K, 13% of Ca, 138% of Cu, 97% of P, 48% of vitamin E and 28% of total folate daily requirements. Moreover, 100 g of roasted sunflower seeds can also contribute with 82% of Mg, 50% of Fe, 50% of Zn and 83% of Mn daily requirements, in the case of an adult male, and 108% of Mg, 22% of Fe, 68% of Zn and 106% of Mn daily requirements, in the case of an adult female.



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