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Terje Tamme, Mari Reinik, Mati Roasto, Kadrin Juhkam, Toomas Tenno,  
Alida Kiis

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| Complete List of Authors:     | Tamme, Terje; Institute of Veterinary Medicine and Animal Sciences of Estonian Agricultural University, Department of Food Hygiene and Control<br>Reinik, Mari; Health Protection Inspectorate, Tartu Laboratory<br>Roasto, Mati; Institute of Veterinary Medicine and Animal Sciences of Estonian Agricultural University, Department of Food Hygiene and Control<br>Juhkam, Kadrin; Institute of Veterinary Medicine and Animal Sciences of Estonian Agricultural University, Department of Food Hygiene and Control<br>Tenno, Toomas; Tartu University, Institute of Physical Chemistry<br>Kii, Alida; Institute of Veterinary Medicine and Animal Sciences of Estonian Agricultural University, Department of Food Hygiene and Control |
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|                               |  |

## Nitrates and nitrites in vegetables and vegetable-based products and their intakes by the Estonian population

### Abstract

The content of nitrates were determined in 1349 samples of vegetables and ready-made food in 2003 - 2004 as a part of the Estonian food safety monitoring programme and the Estonian Science Foundation grant research activities. The results of manufacturers' analyses carried out for internal monitoring were included in the study. The highest mean values of nitrates were detected in dill, spinach, lettuce and beetroot. The mean concentrations were 2936, 2508, 2167 and 1446 mg kg<sup>-1</sup>, respectively. The content of nitrites in samples was lower than 5 mg kg<sup>-1</sup>. In total, the mean intake of nitrates by the Estonian population was 58 mg day<sup>-1</sup>. The mean content of nitrates in vegetable-based infant foods of Estonian origin was 88 mg kg<sup>-1</sup>. The average daily intake of nitrates by children in the age group of 4 to 6 years was 30 mg. The infants' average daily intake of nitrates from consumption of vegetable-based foods was 7.8 mg.

**Keywords:** nitrate, nitrite, vegetables, intake

### Introduction

Nitrate and nitrite can be found in food as naturally occurring compounds, drinking water and vegetables being substantial sources of nitrate intake. Interest in the dietary intakes of nitrates and nitrites has arisen from the concern about their possible adverse effect on health (Knekt et al.1999; Pegg and Shahidi 2000). An acceptable daily intake

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4 (ADI) of 0 to 3.7 mg kg<sup>-1</sup> body weight for nitrate and of 0 to 0.06 mg kg<sup>-1</sup> body weight  
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6 for nitrite has been established by EU Scientific Committee for Food ((EU Scientific  
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8 Committee 1995). It has been estimated that vegetables constitute a major source of  
9  
10 human exposure to nitrates contributing approximately 80 to 92% of the average daily  
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12 intake ((Dich et al. 1996).  
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18 Levels of nitrates in vegetables differ to a large extent. According to nitrates content the  
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20 vegetables can be divided into 3 groups:  
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- 23 1. Plants with high nitrate content (> 1000 mg kg<sup>-1</sup>) – beetroot, lettuce, spinach, other  
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25 green leaf vegetables and herbs .;
- 26  
27 2. Plants with average nitrate content (50 to 1000 mg kg<sup>-1</sup>) – potatoes and other  
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29 vegetables;
- 30  
31 3. Plants with low nitrate content (0.5 to 50 mg kg<sup>-1</sup>) – berries, fruits, cereals, pod  
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33 vegetables.  
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40 Nitrate concentration in vegetables depends on the biological properties of the plant  
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42 culture, lightning conditions, type of soil, temperature, humidity, frequency of plants in  
43  
44 the field, plant maturity, vegetation period, harvesting time, size of vegetable unit,  
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46 storage time and source of nitrogen (Muramoto 1999; Fytianos and Zagoriannis 1999).  
47  
48 Even among different samples of the same vegetable varieties, the range of  
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50 concentrations can be manifold. The limit concentrations for nitrates have been  
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52 established in EU for spinach, lettuce and baby foods (European Commission 2002;  
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54 European Commission 2004).  
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4 The nitrate ion has a low level of acute toxicity, but if transformed into nitrite, it may  
5 constitute a health problem. Reduction to nitrite may take place in the presence of  
6 bacteria or enzyme nitrate reductase, and in contact with metals. Nitrite is unstable at  
7 acidic pH values at which it can disproportionate to yield nitrate and nitrogen oxide  
8 and/or react with food components including amines, phenols and thiols (Hill 1996). It  
9 has been estimated that 5 to 8% of the nitrate from the diet may be reduced to nitrite by  
10 the microflora in the oral cavity (Mensinga et al. 2003). Although nitrates and nitrites  
11 have been used for centuries, it has only recently been discovered that nitrate is  
12 manufactured in mammals by the oxidation of nitric oxide and that the nitrate formed  
13 has the potential for disinfecting the food we eat (Benjamin 2000; Archer 2002).  
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30 Nitrite in food is primarily considered to be a health problem because its presence both  
31 in food and body may lead to the formation of carcinogenic nitrosoamines (JECFA  
32 1996; Vermeer et al. 1998) and the clinical symptom of methemoglobinemia (WHO  
33 1995). Although carcinogenicity of N-nitrosoamines in humans cannot be tested,  
34 epidemiological studies have suggested a possible link to the incidence of various  
35 cancers in humans (Pegg and Shahidi 2000). It is possible that other factors such as  
36 intake of vegetables, fruit and nitrosation inhibitors, or some component of cured meat  
37 and salted fish other than N-nitroso compounds could partly be responsible for the  
38 observed associations (Eichholzer and Gutzwiller 2003). Consumption of vegetables  
39 containing high level of nitrates and incorrect storage of home-made vegetable purees  
40 has been found to be potential causes of infant methemoglobinemia (Sanchez-Echaniz  
41 and Benito-Fernández 2001). Processed infant foods may also contain increased levels  
42 of nitrites (Hill 1996).  
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7 Estonian food safety monitoring programme was initiated in 1998 (Reinik et al. 2001).  
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9 Concentrations of food additives and contaminants in main food groups are determined  
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11 annually within the frames of the programme. Obtained data were used for assessment  
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13 of dietary risks connected with consumption of food additives and contaminants.  
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## 18 **Materials and methods**

### 19 *Samples*

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21 Altogether, 1349 samples of vegetables and ready-made food were analyzed in  
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23 2003 - 2004. Samples were collected mainly at the retail level by food inspection  
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25 authorities within the frames of state official surveillance and monitoring programme,  
26  
27 by researchers within activities of the Estonian Science Foundation grant no. 5416, or  
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29 were brought to the laboratory by the farmers with the aim of self-control.  
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31 Approximately 80% of the analyzed vegetables had been grown in Estonia. The  
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33 minimal amount of vegetable sample was 1 kg. Sample collection covered all seasons.  
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35 In addition to raw vegetables, vegetable-based baby foods and ready-made soups were  
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37 analyzed.  
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### 47 *Methods of analysis*

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49 Nitrate concentrations in vegetables were determined by potentiometric method based  
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51 on Russian standard GOST 4228-86 (Gosudarstvennõi agropromõšlennõi komitet  
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53 1986). Prior to analysis non-edible parts of the sample were removed. In case of small  
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55 vegetables the whole sample was chopped. Large sample units (e.g. head cabbage) were  
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57 cut vertically into four pieces, one quarter from each unit was taken for the analysis.  
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4 Vegetable juice was prepared using a juice press. Leafy and low juice-containing  
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6 vegetables were finely chopped. Nitrates were extracted by  $KAl(SO_4)_2$  solution and  
7  
8 determined potentiometrically by ion-selective electrode. The method has been  
9  
10 accredited by Estonian Accreditation Body. Limit of determination was  $30 \text{ mg kg}^{-1}$  and  
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12 measurement uncertainty up to 15 % ( $k=2$ , norm.) depending on the sample matrix.  
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18 The concentration of nitrates and nitrites in infant purees and ready-made food were  
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20 determined by an HPLC method, based on NMKL (Nordic Committee on Food  
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22 Analysis) method no. 165, 2000. Nitrates and nitrites were extracted from the samples  
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24 by hot water. Acetonitrile was added for removal of interfering substances. The filtered  
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26 solution was injected into a Shimadzu LC10 chromatograph, nitrate and nitrite were  
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28 separated by Alltech  $C_{18}$  column and detected by UV-detector at the wavelength of  
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30 205 nm. The limit of quantification for both ions was  $5 \text{ mg kg}^{-1}$ , measurement  
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32 uncertainty (U) at the concentration of  $100 \text{ mg kg}^{-1}$  was  $12 \text{ mg kg}^{-1}$  ( $k=2$ , norm.). The  
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34 method has been accredited by Estonian Accreditation Body. The Tartu Laboratory of  
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36 Estonian Health Protection Inspectorate has successfully participated in collaborative  
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38 study of the method (Merino et al. 2000) and in intercomparison tests.  
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#### 47 ***Method of intake calculation***

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49 Different methods can be used for the estimation of additive and contaminant intake  
50  
51 from food: food supply data, published tables of the mean consumption of dietary items,  
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53 duplicate portion analysis, dietary survey among the individuals, probabilistic and  
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55 worse case screening models. Depending on the method used, intake estimates can  
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57 differ to a large extent (Kroes et al. 2002).  
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7 In this work food consumption data from the Board of Statistics were used in the  
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9 calculation of average intake for the whole population. Intake of nitrates by children  
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11 was estimated using the consumption data from kindergarten menus and nutrition  
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13 recommendations for infants. Consumed amounts of vegetables were reduced, taking  
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15 into account the effect of peeling, cleaning and removing of non-edible parts. Nitrate  
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17 concentrations of the commodities were corrected for cooking loss.  
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## 23 **Results and discussion**

### 24 *Concentration of nitrates in vegetables*

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26 Limit values for nitrate concentration in several vegetables including potato, cabbage,  
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28 carrot, beetroot, onion, cucumber etc. had been valid in Estonia before joining the EU in  
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30 2004. Due to the existing legal limits, a lot of samples were analyzed annually within  
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32 the framework of official control. Maximum permitted concentrations were exceeded in  
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34 17% of the samples, most frequently for cucumber in winter period, spring onion,  
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36 cabbage, turnip and beetroot. Exceedance of the EU permitted concentrations were not  
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38 detected, although the nitrate concentration was close to the MRL in one spinach  
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40 sample.  
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50 The results for nitrate analyses in all vegetables are shown in Table I. As seen from the  
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52 table, the highest mean values of nitrates were detected in dill, spinach, lettuce and  
53  
54 beetroot. The mean concentrations were 2936, 2508, 2167 and 1446 mg kg<sup>-1</sup>,  
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56 respectively. The lowest mean values of nitrates were detected in tomato, onion and  
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58 potato, the contents being 41, 55 and 94 mg kg<sup>-1</sup>, respectively. In vegetables of Estonian  
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4 origin, the content of nitrites was lower than 5 mg kg<sup>-1</sup>- the detection limit of the  
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6 method. As in Estonia potatoes are consumed in large amounts, the number of the  
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8 studied samples is the largest. Statistical difference between nitrate content of early, late  
9  
10 and stored potatoes was not observed. Average nitrate concentration in imported  
11  
12 potatoes was 200 mg kg<sup>-1</sup>, significantly higher than that of domestic tubers. Similar  
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14 nitrate concentrations have also been detected in other countries (Table II), with the  
15  
16 exception of nitrates content in spinach and potato, according to the data of Chung et al.  
17  
18 (2003). The contents of nitrate in spinach grown in Korea and Japan were 1.5 to 2.0 fold  
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20 higher. The nitrate content in potatoes of Estonian and Finnish origin was 94 and 82 mg  
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22 kg<sup>-1</sup>, in those of Korean and Japanese origin it was 452 mg kg<sup>-1</sup> and 713 mg kg<sup>-1</sup>,  
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28 respectively (Penttilä 1995; Chung et al. 2003).  
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33 [Insert Table I and II about here]  
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38 Leafy vegetables accumulate high amounts of nitrates, concentrations reaching up to  
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40 6000 mg kg<sup>-1</sup>. Nitrate concentration in some salad crops of different varieties during  
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42 summer and winter seasons were screened by Escobar-Gutierrez (2002): nitrate  
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44 concentration showed great variability between cultivars and also varieties within one  
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46 cultivar, exceeding of limit concentrations was more frequent in summer season than in  
47  
48 winter. In the present study the nitrate content of lettuce was lower in summer (average  
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50 1952 mg kg<sup>-1</sup>) than in winter (average 3024 mg kg<sup>-1</sup>), exceeding of limit concentrations  
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52 was not detected.  
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4 Significantly higher nitrate content was found in Italian organically grown green salad  
5 and rocket than in those conventionally produced (De Martin and Restani 2003). On the  
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Significantly higher nitrate content was found in Italian organically grown green salad and rocket than in those conventionally produced (De Martin and Restani 2003). On the contrary, US investigation (Worthington 2001) states that organic crops contained significantly less nitrates than conventional crops. The review of literature conducted by Heaton (2001) found 14 studies showing lower nitrate content (50%) in organically grown crops and two studies showing insignificant differences.

### ***Concentration of nitrates and nitrites in vegetable-based products for infants***

Thirty one samples of canned infant food and 10 carrot juice samples were analyzed for obtaining data for intake calculations. Nitrate contents close to EU limit concentration of 200 mg kg<sup>-1</sup> were detected in two samples. Nitrate concentration was the highest in the purees containing carrot and pumpkin: 62 to 148 mg kg<sup>-1</sup> and 124 to 162 mg kg<sup>-1</sup>, respectively. The highest nitrate content, 251 mg kg<sup>-1</sup>, was detected in fresh carrot juice, which is frequently fed to babies (Table III). Similar results have been reported in a Spanish study (Hardisson et al. 1996), where nitrate concentrations exceeding the level of 250 mg kg<sup>-1</sup> were found in baby foods in which the main ingredient was carrot (Table III). The mean contents of nitrates in vegetable-based infant foods of Estonian and Spanish origin were 88 and 92 mg kg<sup>-1</sup>, respectively. Nitrites were not detected in samples of infant and ready-made food of Estonian origin.

[Insert Table III about here]

### ***Intake calculation***

Intake of nitrates has been evaluated, using the data from three different consumption surveys in Estonia (see Tables IV, V and VI). Data were collected from the household

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4 consumption survey made by the National Board of Statistics in Estonia. Data include  
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6 the number of population and monthly average amounts of consumed vegetables by  
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8 Estonian population in 2000-2002. Calculations of the mean daily intake of vegetables  
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10 were made according to the data of the whole population.  
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16 In Table IV the amounts of vegetables consumed daily are presented. Consumed  
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18 amounts of vegetables were reduced, taking into account the effect of peeling, cleaning  
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20 and removing of non-edible parts. Nitrate concentrations of the commodities were  
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22 corrected for cooking loss.  
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28 The consumption data in the tables were obtained in 2005 from the menu of two  
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30 kindergartens. During the year, the consumption data according to the menu and amount  
31  
32 of supplied vegetables were taken into account. The mean consumed amounts of  
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34 vegetable-based foods by children in the age group of 1 to 6 years were calculated  
35  
36 taking into consideration the average number of children (n=335).  
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42 The data for consumption levels in Table V were corrected for cooking and peeling loss  
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44 for mean nitrate content in  $\text{mg kg}^{-1}$ . The consumption data in Table VI were calculated  
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46 on the basis of the infant menu recommended by Estonian paediatricians. The  
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48 recommended infant menu of the age group of 6 to 12 months should contain 50% of  
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50 vegetable based foods and 50% of fruit based foods in addition to breast-feeding.  
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56 [Insert Tables IV-VI about here]  
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4 The average content of nitrates in each vegetable commodity or vegetable based food  
5 has been used in all calculations of the intake. The average body weight used for  
6 comparison of the results with ADI (Acceptable Daily Intake) was 60 kg. Estonian and  
7 foreign products were not differentiated in the survey from the National Board of  
8 Statistics of Estonia, both white and red cabbages were included in the consumed  
9 amounts of cabbage (Table IV).  
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21 The highest intakes of nitrates by Estonian population were obtained from consuming of  
22 cabbage and potato: 14 and 12 mg day<sup>-1</sup>, respectively (Table IV). The following highest  
23 intakes were obtained by consuming of cucumber and beetroot: 8.2 and 7.3 mg day<sup>-1</sup>,  
24 respectively. The mean total intake of nitrate per person in Europe ranges between 50  
25 and 140 mg per day and in the USA about 40 to 100 mg per day (Mensinga et al. 2003;  
26 Ysart et al. 1999). Mean daily intake of nitrates by Estonian 1- to 6-year-old children  
27 was calculated on the basis of the consumption survey from the menus and amounts of  
28 supplied vegetables of two kindergartens. Table V indicates the daily intakes of nitrates  
29 and the intake percentage from ADI value by children in the age group of 4 to 6 years,  
30 consuming vegetable-based foods. The intake of nitrates by 4- to 6- years-old children  
31 was 30 mg (40% of ADI), the average body weight of 20 kg was used in the  
32 calculations. The obtained results indicated that although the mean nitrate intakes did  
33 not exceed ADI, the maximum intakes were several times higher than mean values. The  
34 menu of the age group of 1- to 3-years-old was similar to 4- to 6-years-old children  
35 group with the difference of 15% less consumed food amount. According to the  
36 calculations, the intake of nitrates by this age group was 26 mg day<sup>-1</sup> (52% of ADI). For  
37 calculation of intakes, the average body weight of 15 kg was used. The daily nitrate  
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4 intake by Finnish adolescents and children was 47.9 mg day<sup>-1</sup> (Penttilä 1995). In a  
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6 Polish study (Wawrzyniak et al. 2003), nitrates intake for 1- to 6-years-old children  
7  
8 exceeded ADI twice and the main food source of nitrates were vegetables (90%).  
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14 The mean daily intake of nitrate among Estonian infants aged 6 to 12 months was  
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16 calculated on the basis of the recommended infant menu. Table VI indicates the  
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18 recommended daily consumption amounts of vegetable-based purees and juices for  
19  
20 infants. The mean contents of nitrates in infant foods are presented in Table III with the  
21  
22 average content of 88 mg kg<sup>-1</sup>. Table VI confirms that older infants get higher amounts  
23  
24 of nitrates compared to younger ones. For instance, a 6 months old infant gets 4.4 mg  
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26 and a 12 months old infant 11 mg nitrates per day. An infant's average daily intake of  
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28 nitrates from consumption of vegetable-based infant foods was 7.8 mg (22% of ADI).  
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### 35 **Conclusions**

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37 In the present investigation, the mean values and contents of nitrates and nitrites in  
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39 vegetables and vegetable products were determined. In Estonia for the first time the  
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41 daily intake of nitrates, obtained from vegetables by children and the whole population,  
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43 was estimated. According to the EU legislation on food contaminants, exceedance of the  
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45 permitted limits for nitrates in vegetables and infant food were not detected. The  
46  
47 possible reason for low levels of nitrates in vegetables and infant foods was probably  
48  
49 related with relatively low use of fertilizers in Estonia. The results showed that cabbage  
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51 and potato were the main sources of nitrate intake. The mean intake of nitrates from  
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53 vegetables by Estonian population was 58 mg per day, calculated on the basis of body  
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55 weight of 60 kg, which made up 26% of ADI value. Nitrate intake by 1- to 6-years-old  
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4 children was found to be 28 mg per day (46 % of ADI). The mean nitrates intake from  
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6 infant food by children aged 6 to 12 months was 7.8 mg per day, calculated on the basis  
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8 of body weight of 15 kg (22% of ADI). Considering the toxicity of nitrates and the  
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10 possibility of their transformation to nitrite and carcinogenic N-nitrosoamines, the  
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12 importance of information on daily intake by children is obvious.  
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### 15 16 17 18 **Acknowledgements**

19  
20 The study was supported by the Estonian Science Foundation, Grant no. 5416.  
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Table I Nitrate contents of Estonian vegetables in 2003-2005

| Commodity                  | No. of samples | Minimum nitrate content, mg kg <sup>-1</sup> | Maximum nitrate content, mg kg <sup>-1</sup> | Average nitrate content, mg kg <sup>-1</sup> |
|----------------------------|----------------|--|--|--|
| Potato                     | 449            | <30  | 360  | 94   |
| Carrot                     | 202            | <30  | 525  | 148  |
| Cabbage                    | 168            | 74   | 1138   | 437  |
| Beetroot                   | 130            | 214  | 3556   | 1446   |
| Cucumber                   | 130            | <30  | 1236   | 160  |
| Turnip                     | 58             | 64   | 1062   | 307  |
| Chinese cabbage            | 36             | 232  | 2236   | 1243   |
| Tomato                     | 25             | <30  | 100  | 41   |
| Onion                      | 21             | 30   | 92   | 55   |
| Spring onion               | 15             | 160  | 920  | 477  |
| Lettuce                    | 14             | 397  | 3230   | 2167   |
| Pumpkin                    | 8              | <30  | 445  | 174  |
| Radish                     | 6              | 670  | 1500   | 1309   |
| Dill                       | 5              | 2236   | 3267   | 2936   |
| Rhubarb                    | 4              | 55   | 376  | 201  |
| Celery                     | 4              | 256  | 830  | 565  |
| Parsley                    | 4              | 674  | 1588   | 966  |
| Strawberry                 | 3              | <30  | 111  | 55   |
| Cauliflower                | 3              | 104  | 404  | 287  |
| Zucchini                   | 2              | 330  | 511  | 421  |
| Watermelon                 | 1              | 95   | 95   | 95   |
| Spinach                    | 1              | 2508   | 2508   | 2508   |
| Carrot juice               | 10             | 76   | 251  | 136  |
| Infant purees              | 31             | 26   | 208  | 83   |
| Ready-made salads          | 14             | 80   | 474  | 259  |
| Ready-made vegetable soups | 5              | 588  | 740  | 639  |

Table II Comparison of mean nitrate contents of vegetables ( $\text{mg kg}^{-1}$ ) in different countries (Penttilä 1995; Dejonckheere et al., 1994; Petersen & Stoltze, 1999; Belitz & Grosch, 1999; Chung et al., 2003).

| Vegetable commodity | Finland | Great Britain | Belgium | Denmark | United States | Korea | Japan | Germany |
|---------------------|---------|---------------|---------|---------|---------------|-------|-------|---------|
| Potato              | 82      | 150           | 154     | 182     |               | 452   | 713   | 93      |
| Carrots             | 264     | 274           | 278     |         |               | 316   | 193   | 232     |
| Lettuce             | 1835    | 2330          | 2782    |         | 1489          | 2430  |       | 1489    |
| Chinese cabbage     | 1057    |               |         | 1859    |               | 1740  | 1040  |         |
| Cabbage             | 607     | 712           |         | 333     | 451           | 725   |       | 451     |
| Turnip              | 908     |               |         |         |               |       |       |         |
| Tomato              | 170     |               | 36      |         |               |       |       | 27      |
| Sweet pepper        | 140     |               | 93      |         |               |       |       |         |
| Cucumber            | 240     | 151           | 344     |         |               | 212   | 384   |         |
| Onion               | 140     | 235           | 59      |         |               | 23    |       |         |
| Beetroot            | 1800    |               |         | 1505    |               |       |       | 1630    |
| Green beans         | 455     |               | 585     |         |               |       |       |         |
| Radish              |         | 2600          | 2136    |         |               | 1878  | 1060  | 2030    |
| Spinach             |         | 2470          | 2297    | 1783    | 965           | 4259  | 3560  | 965     |
| Leek                |         |               | 841     | 284     |               | 56    |       |         |
| Spring onion        |         |               |         |         |               | 436   | 145   |         |
| Garlic              |         |               |         |         |               | 124   | 455   |         |
| Green pepper        |         |               |         |         |               | 76    | 99    |         |

Table III Comparison of the concentrations of nitrates in vegetable-based infant food

| Description of food         | Nitrate, mg kg <sup>-1</sup> |                              |                                  |
|-----------------------------|------------------------------|------------------------------|----------------------------------|
|                             | Estonia (this study)         | Spain (Hardisson et al.1996) | Germany (Belitz and Grosch 1999) |
| Vegetable purees            | 19-208                       |                              |                                  |
| Vegetable and meat purees   | 32-148                       | 20-204                       |                                  |
| Vegetable and cereal purees | 24-162                       | 382                          |                                  |
| Carrots, carrot juice       | 76-251                       | 104                          |                                  |
| average                     | 88 (n = 41)                  | 92                           | 81                               |

Table IV Mean daily nitrate intake in Estonia, calculated on the basis of the consumption survey from the National Board of Statistics

| Commodity                     | Consumption, g per day | Mean nitrate content, mg kg <sup>-1</sup> (cooking and peeling losses taken into account) | Mean nitrate intake, mg per day | % of ADI |
|-------------------------------|------------------------|---|---------------------------------|----------|
| Potato                        | 206                    | 57  | 12                              | 5.3      |
| Cabbage                       | 36                     | 382   | 14                              | 6.2      |
| Carrot                        | 24                     | 129   | 3.1                             | 1.4      |
| Beetroot                      | 6.7                    | 1085  | 7.3                             | 3.3      |
| Turnip                        | 4                      | 269   | 1.1                             | 0.5      |
| Tomato                        | 21                     | 41  | 0.9                             | 0.4      |
| Cucumber                      | 51                     | 160   | 8.2                             | 3.7      |
| Onion                         | 14                     | 55  | 0.8                             | 0.4      |
| Lettuce                       | 2.8                    | 2167  | 6.1                             | 2.7      |
| Pumpkin and Zucchini          | 2.6                    | 260   | 0.7                             | 0.3      |
| Radish                        | 0.4                    | 1300  | 0.5                             | 0.2      |
| Ready-made salads             | 2.9                    | 259   | 0.8                             | 0.3      |
| Ready-made soups              | 1.8                    | 639   | 1.2                             | 0.5      |
| Frozen vegetables             | 1.6                    | 148   | 0.2                             | 0.1      |
| Herbs (celery, parsley, dill) | 0.9                    | 1489  | 1.3                             | 0.6      |
| Total                         | 376                    |   | 58                              | 26       |

ADI – Acceptable Daily Intake

Table V Mean daily nitrate intake of Estonian children, calculated on the basis of the consumption survey from the menu of kindergartens

| Commodity                         | Consumption, g per day | Mean nitrate content, mg kg <sup>-1</sup> (cooking and peeling losses taken into account) | Mean nitrate intake, mg per day | % of ADI |
|-----------------------------------|------------------------|---|---------------------------------|----------|
| Potato                            | 150                    | 57  | 8.6                             | 11       |
| Cabbage                           | 17                     | 382   | 6.5                             | 8.6      |
| Carrot                            | 21                     | 129   | 2.7                             | 3.6      |
| Beetroot                          | 7                      | 1085  | 7.6                             | 10       |
| Turnip                            | 5.7                    | 269   | 1.5                             | 2.0      |
| Tomato                            | 4.3                    | 41  | 0.2                             | 0.2      |
| Cucumber                          | 8.5                    | 160   | 1.4                             | 1.8      |
| Onion                             | 10                     | 55  | 0.6                             | 0.7      |
| Spring onion                      | 0.5                    | 477   | 0.2                             | 0.3      |
| Frozen vegetables                 | 1.6                    | 148   | 0.2                             | 0.3      |
| Herbs                             | 0.7                    | 1489  | 1.0                             | 1.4      |
| Total, 4- to 6-years-old children | 226                    |   | 30                              | 40       |
| Total, 1- to 3-years-old children | 198                    |   | 26                              | 52       |

ADI – Acceptable Daily Intake



Table VI Mean daily nitrate intake of infants, calculated on the basis of the recommended infant menu

| Age       | Body weight, kg | Recommended consumption of vegetable purees, g | Mean nitrate intake, mg per day | % of ADI |
|-----------|-----------------|--|---------------------------------|----------|
| 6 months  | 7.8             | 50   | 4.4                             | 15       |
| 7 months  | 8.5             | 70   | 6.2                             | 20       |
| 8 months  | 9               | 80   | 7.0                             | 21       |
| 9 months  | 9.4             | 90   | 7.9                             | 23       |
| 10 months | 9.8             | 100  | 8.8                             | 24       |
| 11 months | 10.3            | 110  | 9.7                             | 25       |
| 12 months | 10.6            | 120  | 11                              | 27       |
| Average   | 9.3             | 89   | 7.8                             | 22       |

ADI – Acceptable Daily Intake

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