Rapport 19 – 2010

Potato

- analysis of nutrients

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Content

Summary

During 2009/2010 the Swedish National Food Administration analysed nutritional content in new potatoes, old potatoes and catering potatoes. The nutrient content in potatoes may vary between different varieties and may change during storage and cooking, which was accounted for while sampling and analysing. Potato samples were collected in collaboration with "Swedish Potato Marketing Trade Organisation".

The analyses showed that potatoes can be classified as a source of vitamin C, vitamin B_6 and potassium according to EU definitions. Furthermore, contents of sugar and natural salt in potatoes were low. For potatoes boiled with peel, salt content was low even after boiling with added salt. Boiling reduced vitamin C and thiamine contents by about 20 per cent in potatoes cooked with and without shell.

Between potato varieties concentrations of different nutrients varied with up to 20 per cent. Storage for 5 months reduced vitamin C content by 60 per cent, while content of vitamin B_6 increased by about 20 per cent, possibly due to germination. The content of monosaccharides increased as a result of degradation of disaccharides and starch.

Nutrient content in catering potatoes did not significantly differ from that of potato varieties commonly consumed. One serving of boiled potatoes (175 g) contained more than 20 per cent of the recommended daily intake of vitamin C, niacin, vitamin B_6 and potassium.

The potato analyses were part of the annual analytical projects carried out by the Swedish National Food Agency to update the food composition database with nutritional values of commonly consumed foodstuffs.

Background

The purpose of the Swedish food composition database is to reflect the Swedish food supply. In Sweden, potatoes are one of the most important basic foods, but the values for potatoes in the food composition database were almost 20 years old and missing documentation, such as what varieties were analysed and how long the analysed potatoes were stored before analysis. The analysis project in 2009 was therefore entitled "Potatoes 2009/2010" (ref. no. 2968/2008).

The project group included Veronica Öhrvik, Irene Mattisson and Marianne Arnemo from the Nutrition Department (N) and Christina Åstrand and Anders Staffas from the Science Department, Chemistry Division 2. The analyses were conducted at Chemistry Division 2 by Rasmus Grönholm (fat-soluble and water-soluble vitamins), Anders Staffas (carotenoids), Maria Haglund (sugars), Anders Eriksson (starch), Anna von Malmborg, Anna Hessel and Hanna Sara Strandler (water-soluble vitamins) and Christina Åstrand (metals). Other nutrients were analysed at the National Veterinary Institute (SVA) and AnalyCen Nordic AB. The Head Analysts were Anders Staffas (fat-soluble vitamins and carotenoids), Sören Wretling (sugars, starch and external analyses), Hanna Sara Strandler (water-soluble vitamins) and Lars Jorhem (metals). Veronica Öhrvik and Irene Mattisson (N) planned the analytical project and conducted samplings, calculations and analysis of nutritional values and other information about potatoes. Rikard Åsgård (N) quality controlled compiled data.

Materials and methods

Sampling potatoes

Fresh and autumn potatoes were sampled in collaboration with the trade association Swedish Potatoes (www.svenskpotatis.se) who work to promote potato consumption in Sweden. Potato varieties were chosen based on statistics from the Swedish Board of Agriculture (1) and the industry's idea of future varieties.

Varieties

Swift, early potato

Swift is a very early, somewhat floury potato (2). The seed of swift potatoes doubled, constituting almost 10 per cent of the total early potato seed between 2009 and 2010.

Solist, early potato

Solist is an early, firm potato (2). In 2010, Solist was the most common variety of early potato and represented 13 per cent of the early potatoes.

Asterix, autumn potato

Asterix is a slightly floury potato variety (2) that is becoming increasingly popular. In 2010, this variety accounted for 14 per cent of the autumn potato seed, compared to 7 per cent in 2009. Asterix was thereby the most common potato seed after King Edward.

Figure 1. Asterix (top row, left), almond potato (top row, right), King Edward (bottom, left) and Inova (bottom, right).

Inova, autumn potato

Inova was included in the analytical project as the variety is resistant and, among other things, immune to potato wart disease and nematodes. There is therefore a hope at Swedish Potatoes that Inova will become more common in the future. There are no seed statistics for Inova from 2010.

King Edward, autumn potato
King Edward has been Sweden's most common variety of potato since 1965 and, in 2010, represented almost one third (29 per cent) of the seed potato. King Edward came to Sweden over 100 years ago from Great Britain and is a floury variety of potato (2).

Almond potato, autumn potato
Almond potatoes are the most popular variety of potato in Norrland. Almond potatoes are a floury variety of potato historically farmed in Norrland (2). Of the total autumn potato seed in 2010, almond potatoes accounted for 4 per cent.

Storage
The potatoes that were analysed belonged to the 2009 harvest. In order to get a representative "potato of the year", autumn potatoes were analysed in September (24-29/9, 2009), November (18-20/11, 2009) and February/March (23/2-1/3, 2010). Early potatoes were analysed in June (9-16/6, 2009). In the spring of 2008, a pilot project was conducted with both Asterix and King Edward potatoes.

Geographical distribution
Skåne, Västra Götaland, Halland and Östergötland dominate potato cultivation and represented more than 70 per cent of the country's total potato harvest in 2009 (3). Cultivation of almond potatoes is most prevalent in Västerbotten. In order to get a representative sample collection, potatoes were gathered from all counties that, in 2004-2008, had a potato harvest that constituted at least 10 per cent of the total harvest in Sweden. Detailed geographical distribution of the sample collection is presented in Figure 2.

Catering potato
Bintje, Sava and Fakse were the most common varieties of catering potatoes and accounted for 9 per cent, 3 per cent and 2 per cent respectively of the autumn potato seed in 2010 (1). The choice of catering potatoes are based on information regarding potato consumption from six municipalities (Gothenburg, Malmö, Stockholm, Umeå, Uppsala and Östersund) and large Swedish restaurant chains/wholesalers (Eurest, Servera and Sodexho). In the municipalities, peeled potatoes were the most common, followed by prewashed potatoes. Within the restaurant chains, peeled potatoes were the most common, followed by prewashed and pre-boiled potatoes. The brands for analysis were chosen by popularity among the selected municipalities and restaurant chains, which is why most of the catering potatoes were analysed as a single sample (see Appendix 1).

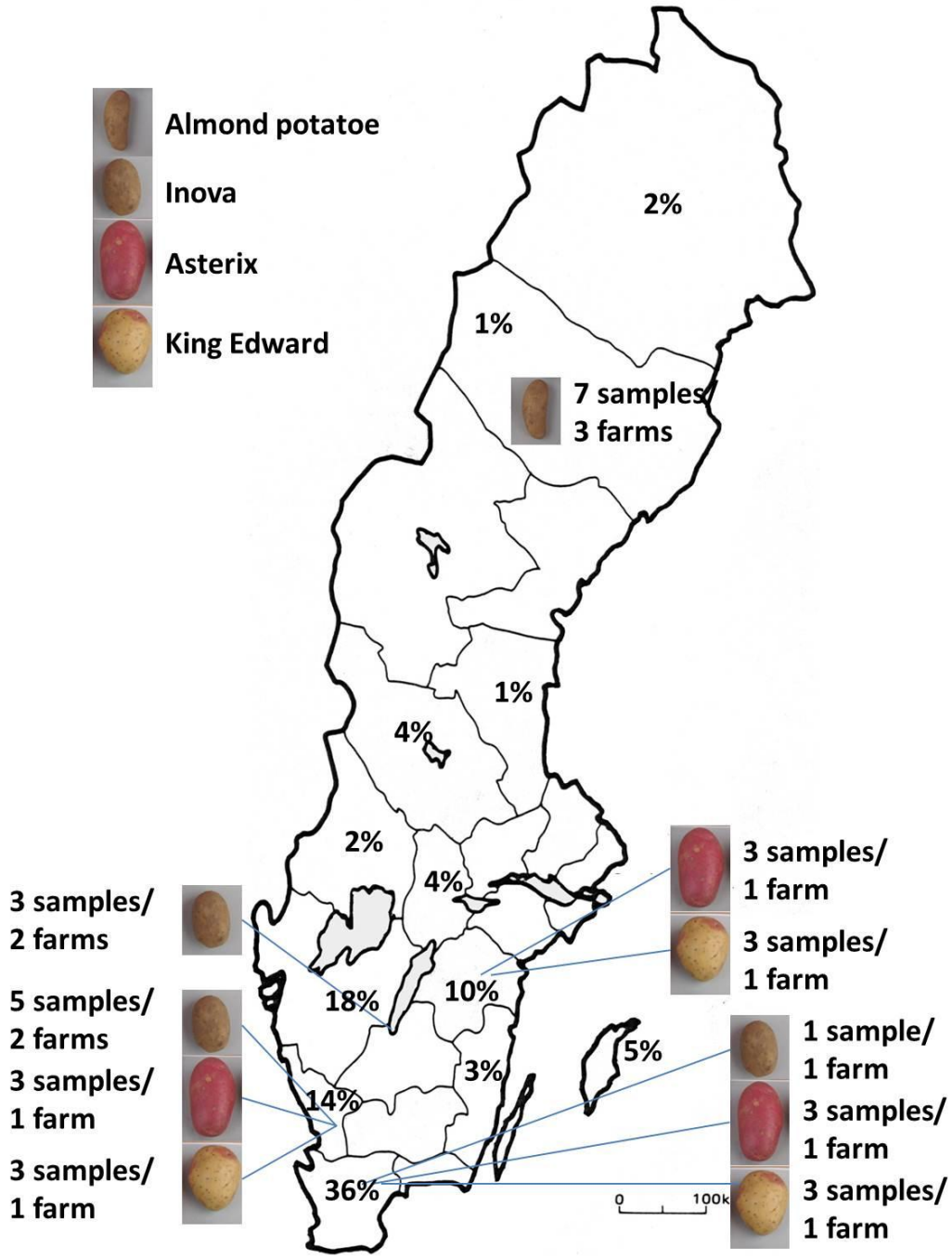

Figure 2. Geographical sample collection of autumn potatoes. The varieties sampled from each province are specified (picture), along with the number of samples of respective varieties and the number of different growers from whom samples were taken. 1 sample corresponds to 10 kg of potatoes. The percentages indicate the province's contribution to the total potato harvest in Sweden in 2009 (3).

Pre-boiled vacuum-packed potatoes
Catering potatoes containing the potato varieties Velox (originating in Holland) and Hansa (originating in Finland), water and salt. The potatoes are pre-boiled/blanched and vacuum-packed. Refrigerated goods to be stored at 2-7 ºC.

Peeled, acid-treated
Catering potatoes of knife-peeled Fakse (originating in Sweden) that are treated with sodium disulphite (E223) and citric acid (E330) to prevent oxidation. Refrigerated goods to be stored at 8 ºC.

Prewashed potatoes, sorted by size
Catering potatoes of the variety Belana (originating in Sweden) that are drum-washed, dried and sorted by size. Refrigerated goods to be stored at 4-6 ºC.

Peeled blanched potatoes
Catering potatoes that contain steam-peeled Bintje (originating in Sweden), water, salt and natural dill aroma. Refrigerated goods to be stored at 6 ºC. Once opened, to be consumed within 1 day.

The analyses are conducted on catering potatoes from the 2009 harvest. The catering potatoes are obtained directly from the company and analysed in October/November (29/10-9/11, 2009) and January/February (26/1-2/2, 2010).

Sample handling

Upon arrival of the samples to the laboratory, each sample was given a unique number, making it possible to trace the samples back to the producers. Swift variety early potatoes, as well as peeled, blanched and prewashed catering potatoes were analysed as individual samples, while other potatoes were analysed as aggregate samples (see Appendix 1).

The samples were handled as laboratory samples directly after arrival to the laboratory, which means taking into account factors that may affect stability, such as oxygen and temperature. Some analysed substances are also sensitive to certain wavelengths of visible light. The potatoes were packed in their original packaging in a dark refrigerated room at 3 ºC until the analysis.

Early potatoes and autumn potatoes were analysed raw and boiled. 10 kg of each variety of potato were sampled during each round of sampling. The potatoes were sorted by size using a potato sieve (Figure 3). The same number of potatoes were chosen for analysis from each farmer. Potatoes that were to be analysed raw were peeled/scrubbed according to instructions (Appendix 2, in Swedish). Potatoes that were to be analysed boiled were peeled/scrubbed, covered with boiling water and left to boil until the inner temperature was 95 ºC according to instructions (Appendix 3, in Swedish). Catering potatoes were only analysed boiled and were cooked according to instructions on the packaging or the company's website, see instructions (Appendix 3). Weight loss due to peeling and scrubbing is reported as waste (Table 8).

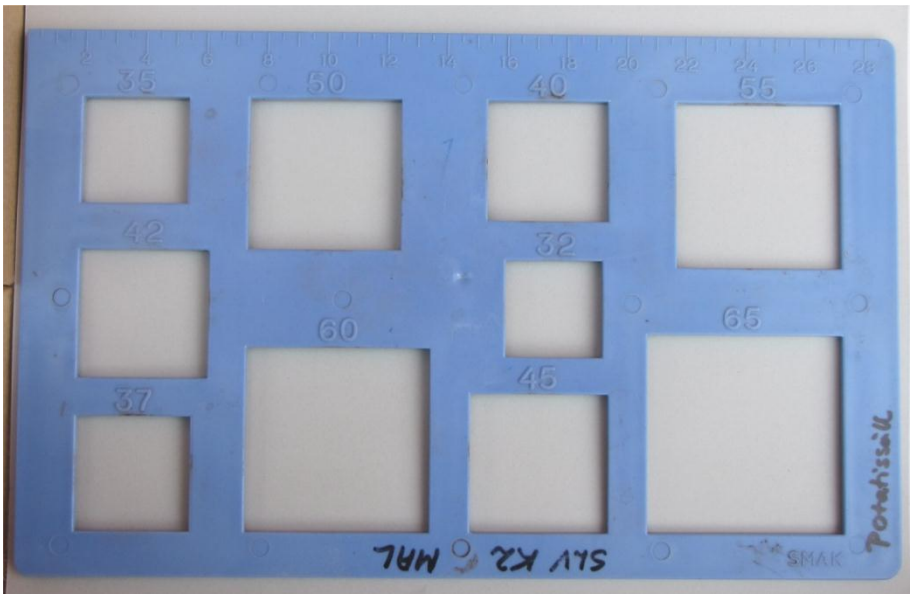

Figure 3. Potato sieve for sorting potatoes by size.

It is essential that the samples for analysis are pulverised and homogenous, therefore a food processor was used during the homogenisation of all samples. Following homogenisation, the samples were divided into different jars based on storage conditions and type of analysis. The samples were stored in a freezer pending analysis, except for the analysis of sugars, starch and water-soluble vitamins, which commenced immediately following the sample's homogenisation. This was done to minimise the impact of the enzymatic degradation of the analytical results. The analyses of tocopherols and carotenoids in raw potatoes were performed directly following homogenisation.

Analyses of ash, nitrogen, water content, sodium, potassium, calcium, magnesium, phosphorus, molybdenium, selenium and iodine were performed at the National Veterinary Institute. Other analyses were conducted at Chemistry Division 2 at the National Food Agency. The principles that apply to the methods used and the methods which were accredited can be found in Appendix 4. A summary of the nutrient levels is found in Appendix 5, Table 1a-5a.

Quality assurance of analytical methods

The laboratory at Chemistry Division 2 has extensive experience, both with the analysis of nutrients and quality assurance. Many of the methods used have been accredited since 1995 by SWEDAC, the Swedish accreditation authority, but improvements in the methods used, accreditation of new methods and/or supplementation of the accreditation is a continuous process. The quality system includes procedures, analytical methods and instructions. The quality of the analysis results is routinely inspected through analysis of internal control samples and, where possible, certified reference material. Recovery tests and analysis of blank samples are part of the quality assurance.

Chemistry Division 2 participates regularly in proficiency testing for laboratories, both with accredited and non-accredited methods, and has also organised proficiency testing for metals, vitamins and macronutrients. As part of the proficiency testing, the same sample was sent to a number of interested laboratories that analysed the sample using customary analytical methods. The analysis results are then compiled by the person responsible for the proficiency

testing and processed statistically. Each participant is then given their own number so that, in the final report, the different results can be compared without the possibility of linking the results to a specific laboratory.

Analysed nutrients

The potato samples were analysed for nutrient content as listed in Table 1. Logical zeros for potato, i.e., nutrients not assumed to be present in potato, were lactose, cholesterol, alcohol, trans-retinol, vitamin B_{12}, vitamin K_2, vitamin D_2 and D_3. The fat content 0.1 g/100 g was borrowed from Galliard (4). Due to the low fat content fatty acids (including trans-fatty acids) are presented as logical zeros according to internal guidelines at the National Food Agency.

Table 1. Analysed nutrients

Macronutrients	Water, nitrogen, ash
Carbohydrates	Starch, glucose and fructose (monosaccharides), sucrose and maltose (disaccharides)
Dietary fibre	Non-starch polysaccharides
Fat-soluble vitamins	Carotenoids, (alpha- and beta-carotene, beta-cryptoxanthin, lutein, lycopene, zeaxanthin), vitamin K_1 and tocopherols (alpha-, beta-, gamma- delta-tocopherol)
Water soluble vitamins	Thiamine (thiamine chloride HCl), riboflavin, niacin (total concentration), vitamin B_6 (free and bound), vitamin C and folate (total concentration)
Trace elements	Phosphorus (P), iodine (I), iron (Fe), calcium (Ca), potassium (K), magnesium (Mg), sodium (Na), selenium (Se), zinc (Zn), copper (Cu), chromium (Cr), manganese (Mn), molybdenum (Mo), nickel (Ni), cobalt (Co), cadmium (Cd), lead (Pb)

Calculation of nutritional values

The results of the analysis were transferred automatically to the Swedish Food System, the National Food Agency's internal IT system for food data. Each value was registered together with information such as the analytical method, laboratory, and reference.

An annual average was calculated and published for each autumn potato, representing an average of the nutritional values of the three analytical sessions. By weighting the different varieties using seed statistics from the Swedish Board of Agriculture in 2010 (1), see Table 2, a "potato", an "autumn potato" and a "early potato" were calculated and published. A "catering potato", where all catering potatoes of equal proportion (0.25) were included, was calculated and published. In cases where results were missing due to missing analysis, for example, niacin levels in autumn potatoes not analysed in February, the annual average was based solely on potatoes analysed in September and November. Calculated aggregate samples of potatoes are presented in Appendix 5, Table 1b-5b.

Energy, protein, total carbohydrates, retinol equivalents and niacin equivalents are calculated, see Table 3. As part of the calculations, the value zero is used for levels "below the detection limit".

Table 2. Proportions for the weighting of potatoes, autumn potatoes and early potatoes

Food name	Asterix	Inova	King Edward	Almond potato	Solist	Swift
Potato raw/boiled	0.26	0	0.56	0.07	0.06	0.04
Autumn potato raw/boiled	0.29	0	0.62	0.08	0	0
Early potato raw/boiled	0	0	0	0	0.58	0.42

Table 3. Calculation of nutritional values

Energy (kJ)	Carbohydrates (g) × 17.0 + protein (g) × 17.0 + Dietary fibre (g) × 8.0 + fat (g) ×37.0
Energy (kcal)	Energy (kJ) × 0.129
Protein (g)	Nitrogen (g) × 6.25[1]
Total carbohydrates (g)	100 - (water (g) + ash (g) + protein (g) + fat (g) + dietary fibre (g))
Retinol equivalents	β-carotene (µg) / 12 + (α-carotene (µg) + β-cryptoxanthin (µg)) / 24
Niacin equivalents	Niacin (mg) + protein (g) × 10 × 1.1[2] / 60
Salt/NaCl (g)	Na (mg) × 2.5 / 1000

[1] Factor for the calculation of nitrogen to protein in fish
[2] Factor for estimating the percentage tryptophan in fish/meat

Food classification

Fish, shellfish and fish products are classified in accordance with LanguaL (www.langual.org). LanguaL is a method employed internationally for the systematic description of food. This information is published with the nutritional values in the NFA's search function 'Search nutrition content' http://www7.slv.se/Naringssok/soklivsmedel.aspx.

Other information regarding potatoes

In addition to nutrients and classifications, images displaying dimensions and pictures from the peeling and cooking are published in the Swedish Food System. Records from the peeling and cooking processes (Appendices 2 and 3), as well as portion weight, are also published in the Swedish Food System.

Quality control of published data

All the inputted data was checked prior to publishing the results from the analysis project, see Table 4.

Table 4. Quality control

Nutrient	Control
Protein	Factor was checked
Niacin equivalents	Factor was checked
Logical zeros	Checked
Carbohydrates	Calculated carbohydrates (g) - (monosaccharides (g) + disaccharides (g) + starch (g)) = 100 ± 4
Macronutrients	Σ (fat + protein + water + carbohydrates + ash) = 100 ± 0.5
Units	Checked
Langual classification	Checked
Nutritional values	Checked
Detailed information on nutritional values	Checked
Portion weight	Checked
Uploaded pictures and records	Checked

Statistics

In order to compare the nutrient content in potatoes before and after cooking, the Wilcoxon-Mann-Whitney signed-rank test was used. The Kruskal-Wallis test was used to assess the effect of storage on nutritive content. Minitab® v. 15.1.0.0 (Minitab Ltd., Coventry, UK) was used for statistical analyses.

Assessment of nutritive content

Assessment of the nutritive content in cooked potatoes was conducted in accordance with Commission Regulation (EC) No 1924/2006 (5), where nutrient levels per 100 grams of food were compared with the conditions for nutrition claims regarding labelling, see Table 5. In assessing vitamin and mineral content, the levels were compared with the RDI values for labelling, see Table 5 and 6.

Table 5. Nutrition claims and conditions of use (selection that apply to potatoes)

Low fat	the product contains no more than 3 g of fat per 100 g for solids
Low sugar	contains no more than 5 g of sugars per 100 g for solids
Low salt	contains no more than 0,12 g of sodium per 100 g for solids
Source of protein	at least 12 % of the energy value of the food is provided by protein
High in protein	at least 20 % of the energy value of the food is provided by protein
Source of vitamins/minerals	at least a significant amount (15 per cent of the recommended daily intake) (see Table 6).
High in vitamins/minerals	at least twice the value of 'source of' (see above as well as Table 6).

In accordance with the supplement of Commission Regulation (EC) No 1924/2006 (5)

Table 6. Vitamins and minerals that may be declared and their recommended daily intake (RDI) (6)

Vitamin / mineral	RDI	~15 % of RDI
Vitamin A (µg) / retinol equivalents	800	120
Vitamin D (µg)	5	0.8
Vitamin E (mg)	12	1.8
Vitamin K (µg)	75	11
Vitamin C (mg)	80	12
Thiamine (mg)	1.1	0.2
Riboflavin (mg)	1.4	0.2
Niacin (mg)	16	2.4
Vitamin B6 (mg)	1.4	0.2
Vitamin B12 (µg)	2.5	0.4
Folate (µg)	200	30
Potassium (mg)	2,000	300
Chloride (mg)	800	120
Calcium (mg)	800	120
Phosphorus (mg)	700	105
Magnesium (mg)	375	56
Iron (mg)	14	2.1
Zinc (mg)	10	1.5
Copper (mg)	1	0.2
Manganese (mg)	2	0.3
Selenium (µg)	55	8
Chromium (µg)	40	6
Molybdenum (µg)	50	8
Iodine (µg)	150	22

Valid per serving for individual packaged portions, otherwise per 100 g

Results

A list of the potatoes analysed can be found in Appendix 1. Concentrations of nutrients per 100 grams of potatoes are presented in Appendix 5, Table 1-5.

Results are shown for the analysed (Table 1) and calculated (Table 3) nutrients. Aside from the logical zeros, i.e., lactose, cholesterol, trans-retinol, vitamin D_2 and D_3, vitamin K_2 and vitamin B_{12}, levels of fat and lycopene were not determined. The fat content 0.1 g/100 g was borrowed from Galliard (4). The lycopene content was under the detection limit (2 µg/100 g) in the pilot study and for the early potatoes, and was therefore not quantified in the other potatoes. For maltose, β, γ, and δ-tocopherol, concentrations in all potato samples were below the detection limit (0.01 g/100 g for maltose, 0.01 and 0.02 mg/100 g for tocopherols) and therefore no values for these are shown.

Nutritive content in boiled potatoes

Potatoes generally contained lower levels of macronutrients and minerals, and higher levels of certain vitamins than other staple foods like pasta and rice in a rough comparison of nutrient profiles (Table 7).

Table 7. Nutrients in potatoes compared to pasta, couscous and rice

Lower concentration[1] in potatoes	Higher concentration[2] in potatoes
Protein	Monosaccharides
Fat	Carotenoids
Carbohydrates	Vitamin K_1
Whole grain (not found in potatoes)	Vitamin C (not found in cereals)
Minerals (except potassium)	Vitamin B_6
	Folate
	Potassium

Values for pasta, couscous and rice are taken from the food composition database version 20/08/2010. Pasta is a mean value of cooked pasta types (n = 9) including whole grain pasta, rice is a mean value of cooked polished rice and brown rice (n = 5), bulgur/couscous is a mean value of different kinds of cooked bulgur and couscous (n = 5).

[1] Lower concentration is defined as the nutrient level being at least 50 per cent lower in boiled potatoes than in at least two of the food groups, rice, pasta and bulgur/couscous.

[2] Higher concentrations is defined as the nutrient level being at least 50 per cent higher in boiled potatoes than in at least two of the food groups, rice, pasta and bulgur/couscous.

The water content was highest in early potatoes and lowest in almond potatoes when comparing all potato types. Almond potatoes had the highest levels of carbohydrates, protein and fibre. All potato varieties and catering potatoes had low sugar content (<5 g/100 g), but significant differences were also found between potato types. Almond potatoes, for example, contained more than 60 per cent lower concentrations of monosaccharides and approximately 15 per cent higher levels of starch than the average autumn potato. The lowest starch content was found in the solist early potato, which also contained significantly more monosaccharides than other varieties.

Boiled potatoes were not found to be a source of any fat-soluble vitamins (Appendix 5, Table 3a and 3b). Early potatoes contained higher concentrations of all fat-soluble vitamins when compared to autumn potatoes. The differences were most noticeable for carotenoids, where early potatoes had up to five times higher concentrations.

Boiled potatoes were found to be a source of both vitamin C and vitamin B_6, with concentrations of 17 and 0.20 mg/100 g respectively (Appendix 5, Table 4b). Vitamin B_6 is presented as both total and free concentration, as bioavailability may vary between free and bound vitamin B_6 (pyridoxine glucoside). Early potatoes boiled were found to be a source of both vitamin C and folate, the levels being 19 mg/100 g and 32 µg/100 g, respectively (Appendix 5, Table 4b). Almond potatoes also contained a significant amount of folate (>30 µg/100 g). In the case of water-soluble vitamins, levels varied greatly between the different varieties. For example, Asterix contained more than 20 per cent more folate and 20 per cent less vitamin C when compared to the weighted autumn potatoes.

Potatoes were found to have low natural sodium concentrations and the varieties that were boiled unpeeled, i.e., early potatoes, almond potatoes and prewashed catering potatoes, also had low salt content after boiling, despite the addition of seven grams of salt per litre of water, in accordance with the EU definition. Potatoes were also a source of potassium; almond potatoes presenting the highest concentrations at 35 per cent more than the boiled potatoes published (Appendix 5, Table 5a and 5b).

The cobalt, nickel, chromium and copper concentrations (Appendix 5, Table 5a and 5b) in potatoes were near the detection limits and only a few samples contained selenium, iodine, molybdenum and lead concentrations above the detection limits.

Effect of boiling

The water content was marginally reduced during the boiling of the potatoes, leading to a minor concentration of nutrients after boiling. The concentration is noticeable primarily through the energy content increasing slightly.

Boiling had no effect on the content of most vitamins and minerals, but boiled potatoes had significantly lower levels of vitamin C (5-45 %, $p = 0.001$), thiamine (6-31 %, $p = 0.003$) and potassium (-28-+ 9%, $p < 0.001$) compared to raw potatoes. Boiled potatoes contained significantly higher levels of α-tocopherol ($p = 0.01$).

When the potatoes were boiled with iodised salt, this resulted in the boiled potatoes having higher concentrations of iodine, sodium and salt than the raw potatoes. On one occasion, salt was not added during the boiling of "new almond potatoes" and "prewashed autumn catering potatoes", which explains why the iodine, sodium and salt concentrations in these potatoes are different to the others.

Effect of storage

Storage had no effect on most of the nutrients analysed, but the composition of the carbohydrate components changed during storage. Autumn potatoes analysed in February contained significantly higher levels of monosaccharides than autumn potatoes analysed in September ($p < 0.001$). Despite the effect of storage, the autumn potatoes in February contained lower concentrations of monosaccharides than newly harvested early potatoes.

Apart from vitamin C and vitamin B_6, storage had no effect on vitamin and mineral contents. Potatoes analysed in February showed concentrations of vitamin C in all varieties to be less than half that of the levels in newly harvested potatoes ($p < 0.001$). Vitamin B_6 content was significantly higher in the stored potatoes than in new potatoes ($p = 0.001$).

Catering potato

The content of macronutrients in catering potatoes did not differ from the content in autumn potatoes.

The levels of the nutrients were about the same in autumn potatoes apart from the vitamins α-tocopherol, vitamin K_1, niacin and vitamin C. The concentrations of α-tocopherol and vitamin K_1 were around half that of the autumn potatoes. Catering potatoes were, like autumn potatoes, a source of vitamin C during the autumn, with the exception of steam-peeled and blanched potatoes.

Apart from potassium, the mineral content did not differ between catering potatoes and autumn potatoes. The lowest potassium levels were found in steam-peeled and blanched catering potatoes, probably due to them being packaged in a solution.

Waste

More than 20 per cent of the weight was lost when regular potato peelers were used, see Table 8. No weight loss was measured during the boiling process.

Table 8. Weight loss due to peeling and scrubbing.

Food name	Number	Peel waste %	Number	Boiling loss %
Asterix	30	20.6±5.6	15	0.6±1.6
King Edward	30	23.4±6.4	15	0±1.0
Inova	20	23.0±6.7	10	0±0.6
Almond potato	20	0±1.0	10	0.2±0.4
Solist	8	0±0.3	4	0±1.3
Swift	8	0±0.1	4	0±1.1
Belana, prewashed	6	21.1±5.3	6	0.2±0.6

Discussion

Potatoes are an important and inexpensive staple food in Sweden. In the National Dietary Survey 'Riksmaten 1997/1998' (7), potatoes accounted for at least five per cent of the fibre, carbohydrate, vitamin B_6, vitamin C, folate and potassium intake among Swedish adults. In this project, one portion of boiled potatoes (175 g) was found to be a source of vitamin C, niacin, vitamin B_6, folate and potassium (according to definitions in Commission Regulation (EC) No 1924/2006, see Table 5 and 6 (5)). Potatoes also contained low concentrations of sugars and natural sodium according to the EC Regulation (5). The results are assessed with a focus on those nutrients of nutritional relevance in boiled potatoes, as potatoes are rarely eaten raw.

Variations in the nutritive content

Nutrient levels in potatoes can vary due to many factors, such as variety, cultivation site, fertilisation, storage and weather. In this project, we attempted to take these factors into account through the sampling of different varieties of potato from different growers on repeated occasions (Figure 2). Aside from the biological variations inherent in the sampling, the analytical methods' measurement uncertainty is applied. The measurement uncertainty for the methods used (Appendix 4) is between 7 and 25 per cent. Minor differences in the concentrations of individual nutrients shall therefore be carefully interpreted. However, certain differences between varieties were clear. For example, almond potatoes contained more potassium during all rounds of analysis. Vitamin C levels were highest in new King Edward potatoes and the concentrations of vitamin B_6 were higher in autumn potatoes than in early potatoes.

The growth climate in Sweden varies, with the most number of sunlight hours taking place during the summer in northernmost Sweden. Nordbotten et al (8) have demonstrated that the vitamin C content may differ by more than 100 per cent in the same potato variety depending on the growth zone in Norway. As almond potatoes were the only potato analysed from Norrland and all varieties were analysed as aggregate samples (Appendix 1), we cannot draw conclusions regarding growth zone effects on nutritional values. In order to correct for variations in the nutritional values caused by growth zones, sampling of potatoes from the most important potato farming areas was conducted for this analysis project (see Figure 2).

Potato harvest is greatly affected by the weather during the growing season. The project only involved potatoes harvested in 2009, but the analysis project was preceded by a pilot project in 2008. King Edward and Asterix potatoes were collected in the pilot project from the same grower as in 2009. Since the analytical methods and the grower were the same, the differences in concentrations can tell us something about annual variation. The concentrations of vitamins, minerals and sugars varied by approximately 20 per cent between the years (Appendix 5, Table 2-5a). When compared with 2008, both Asterix and King Edward potatoes in 2009 contained more vitamin C (Appendix 5, Table 4a) and less vitamin K_1 (Appendix 5, Table 3a).

The last time potatoes were analysed at the National Food Agency was in 1992, where four samples were purchased. Compared to the average 1992 potato, the average 2010 potato contained more than 25 per cent more vitamin C, phosphorus, sodium, carotenoids and

vitamin E, as well as around 25 per cent less glucose, fructose, sucrose, riboflavin, copper, zinc and fibre. However, since data is missing in the analyses from 1992 with regard to varieties and cultivation, it is misleading to compare potatoes from 1992 with those from 2010. Modified analytical methods can also, to an extent, explain differences in the levels.

Effects of boiling

During boiling, heat and oxygen sensitive vitamins can be destroyed while water-soluble vitamins and minerals can be lost by leaching into the boiling water. Boiling potatoes with peel did not appear to protect against the leaching of water-soluble vitamins, however, the leaching of potassium and the absorption of sodium and iodine was lower in the varieties boiled with peel.

The concentration of vitamin C was more than 20 per cent lower in boiled potatoes than in raw potatoes, which is in line with previous experiments. Hägg et al (9) found a 30 per cent loss of vitamin C during boiling and Augustin et al (10) reported a 20 per cent loss, with a 26 per loss when boiling potatoes without peel. The boiled potatoes also had significantly lower thiamine levels as previously reported (10) but, as potatoes are not a source of thiamine, it is less relevant from a nutritional perspective. Boiled potatoes had the same folate content as raw potatoes, which was surprising as losses of between 30 per cent (9) and 40 per cent (11) were previously reported. One possible explanation can be that the water is only just covering the potatoes in this experiment (Appendix 3). For example, Stea et al (11) used approximately 7 times more water during boiling, therefore, higher losses due to leakage are not surprising.

The fact that α-tocopherol and vitamin K_1 levels were higher in boiled potatoes is probably not dependent on the current content of these vitamins, but rather on the analyses. These vitamins began oxidising immediately after homogenisation, i.e., the first stage of sample preparation. Both oxygen and enzymes contribute to oxidation. Enzymes, amongst other things, are inactivated (denatured) in boiled potatoes, which may explain why α-tocopherol and vitamin K_1 oxidised slower in potatoes that have been homogenised boiled. Since there are no high concentrations of fat-soluble vitamins in potatoes, it is considered less relevant from a nutritional perspective.

As potatoes contained low levels of selenium, iodine, molybdenum, cobalt, nickel, chromium and copper, near the detection limits, these values are more uncertain. It is therefore difficult to draw conclusions regarding the effects of boiling and storage on mineral content in potatoes, apart from potassium levels which decreased by around 20 per cent.

Effects of storage

In addition to the visible effects of storage, such that potatoes stored in an dry environment shrivel, chemical processes take place in stored potatoes. We therefore chose also to analyse stored potatoes.

Despite monosaccharide levels rising during storage (Appendix 5, Table 2), all varieties had low sugar content even after storage (according to definitions in Commission Regulation (EC) No 1924/2006, see Table 5 and 6 (5)), which is in line with previous storage experiments (9). The lower the temperature of the potato storage area, the greater the increase in monosaccharide concentration (1).

Due to the fact that vitamin C was oxidised and destroyed while in storage, none of the potato varieties analysed in the spring were found to be a source of vitamin C. The concentration of vitamin B_6 increased significantly during the storage period. As we have used potatoes from the same grower and employed the same analytical methods, it is probably not external factors that explain this increase. One theory could be that sprouting increases the concentration of vitamin B_6. The potatoes analysed in February/March had partly begun to sprout. The effect of sprouting on B vitamin levels has previously been shown (12, 13). In order to determine whether this is true for vitamin B_6, further studies are required.

Catering potato

Catering potatoes, like other potatoes, were found to be a source of vitamin C, vitamin B_6 and potassium, and had low concentrations of sugars and fat (5). However, catering potatoes were not a source of niacin which is mainly due to the King Edward being so dominant in the potato crop and thus, in the weighted potatoes, having a much higher content of niacin than most other potato varieties.

Declared nutritional values on catering potato packaging are consistent with the findings of this analysis project. In the case of prewashed and pre-boiled potatoes, a fibre content of 3 g was declared, which was more that the approximate 2 g that our analysis have shown. However, as concentrations can vary between years and varieties, the specified values are considered reasonable. Blanched potatoes that were not vacuum-packed and were stored in solution contained lower concentrations of vitamin C and potassium, probably due to oxidation and leakage.

Conclusions

There was a demand for new nutritional values for potatoes since potatoes are one of our most important staple foods and the NFA had previously only conducted random sampling analyses of nutrients in potatoes. As part of the analytical project, comprehensive data on different potato varieties and average potatoes was produced, which was used to supplement the food composition database.

The concentrations of different nutrients in potatoes varied significantly between the various varieties, but only the levels of monosaccharides, vitamin C, thiamine, vitamin B_6 and potassium were significantly affected by the external factors of boiling and storage. The vitamin C content more than halved during six months of storage, while vitamin B_6 was 20 per cent higher in stored potatoes. Boiled potatoes had approximately 20 per cent lower concentrations of vitamin C and thiamine than raw potatoes. The cooking water should be minimised in order to avoid the leakage of water-soluble vitamins such as folate. Boiling unpeeled potatoes appears to hinder the leakage of potassium. The nutritive content in catering potatoes did not differ significantly from other autumn potato varieties. However, due to the risk of leaching of vitamin C and potassium, storage in solution should be avoided.

One portion of boiled potatoes (175 g) contained more than 20 per cent of the recommended daily intake of vitamin C, niacin, vitamin B_6 and potassium.

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Appendices

Appendix 1. Potato samples
Appendix 2. Instructions for raw potatoes
Appendix 3. Instructions for boiled potatoes
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Appendix 1. Potato samples

English name	Swedish name	Sample type	Potato variety	Farmer/origin (distribution in per cent)
Old potatoe	Höstpotatis	Composite sample	King Edward	Varalövs gård (33 %) Bjälbo (33 %) Gamlegården (33 %)
		Composite sample	Asterix	Varalövs gård (33 %) Bjälbo (33 %) Köpinge (33 %)
		Composite sample	Inova	Gästgivaregården (33 %) S Andersson Laholm (33 %) A Hansson Kullahalvön (33 %)
		Composite sample	Mandelpotatis	T Pettersson, Skellefteå (33 %) Br Andersson, Kåddis (33 %) A Forsgren, Grubbe (33 %)
New potatoe	Färskpotatis	Composite sample	Solist	Jonas Gustavsson (50 %) Mäsinge lantbruk AB (50 %)
		Single sample	Swift	Clas Gunnarsson (100 %)
Catering potatoe preboiled	Storkökspotatis pre-boiled	Composite sample	Velox Hansa	JEPO (50 %) Aviko Norden (50 %)
Catering potatoe peeled and acidified	Storkökspotatis skalad syrad	Single sample	Fakse	3N (100 %)
Catering potatoe pre-washed	Storkökspotatis tvättad	Single sample	Belana	Farmaren (100 %)
Catering potatoe peeled and blanched	Storkökspotatis skalad blancherad	Single sample	Bintje	Alströmer Primus potatis (100 %)

Appendix 2. Instructions for raw potatoes

Protokoll rå höstpotatis

Datum: _____

Potatis, sort: _____ Potatissåll: _____

Potatis, vikt oskalad: _____ Antal: _____

Potatis, vikt skalad: _____

Egna anteckningar:

_____

_____

_____

_____

Protokoll rå mandelpotatis och färskpotatis

Datum:_____

Potatis, sort: _____ Potatissåll: _____

Potatis, vikt **oskrubbad**: _____ Antal: _____

Potatis, vikt **skrubbad**: _____

Egna anteckningar:

_____

_____

_____

_____

Appendix 3. Instructions for raw potatoes

Protokoll kokt höstpotatis

Datum: _____

Utrustning:	**Bocka av:**
Kastrull, volym 3,0 liter, diameter 21 cm.	☐
Termoelement, E.T.I. LTD 2002 thermometer	☐
Köksvåg, PTI FP-095	☐
Potatissticka	☐
Litermått	☐
Potatissåll	☐

Potatis, sort : _____ Potatissåll: _____

Potatis, vikt oskalad: _____ (Totalt cirka 1 kg) Antal: _____

Potatis, vikt skalad: _____

Potatis, vikt kokt: _____

Vatten, dl: 2 dl+ _____ (Totalt cirka1 liter, så att potatisen precis täcks)

Joderat salt, g: _____ (1 tsk (7 g)/ liter vatten)

Arbetsbeskrivning **Ev. avvikelser från arbetsbeskrivningen**

- Välj ut potatisar av liknande storlek _____
- Väg upp cirka 1 kg potatis _____
- Skala _____
- Placera termometern i två av potatisarnas mittpunkt _____
- Ställ kastrullen på spisen med plattan på 12 (alt 6) och koka upp 2 dl vatten _____
- Koka samtidigt upp resten av vattnet i vattenkokaren _____
- Lägg i potatisen _____
- Häll därefter det kokande vattnet i kastrullen så att _____

  potatisen precis täcks. _____
- Tillsätt salt (7 gram/L) _____
- Låt vattnet koka upp ordentligt _____
- Vrid ner plattan till 6 (alt 3) och lägg på lock _____
- Låt koka till innertemperaturen är 95 º C, _____
- Känn efter med potatisstickan om potatisen känns färdig _____

Egna anteckningar:

_____

_____

_____

Appendix 4. Analytical methods

Water
Samples are dried in a heating cabinet at 102 °C ± 3 °C to constant weight. Water is determined gravimetrically as the sample's weight loss. Accredited method (SWEDAC).

Ash
Samples are burned up in an oven at 650 °C ± 25 °C to constant weight. Ash is defined as the gravimetric residue when water and organic material have been burned up. Accredited method (SWEDAC).

Protein
Nitrogen is determined in accordance with Kjeldahl. NMKL nr. 6, 3 Ed. 1976. The sample is subjected to wet digestion in sulphuric acid and organic nitrogen is converted to ammonium ions. Sodium hydroxide is added and the ammonia formed is titrated with hydrochloric acid. Protein is calculated from the nitrogen using a conversion factor. Accredited method (SWEDAC).

Starch
Starch is determined enzymatically with a modified method of NMKL No. 145 2 Ed., 1997. The starch is hydrolysed in the oven for 30 minutes with Termamyl ® at pH 5.0 and at a temperature of 90°C. The starch is then determined enzymatically using a commercial test (Boehringer Mannheim / R-Biopharm Cat. No. 10 207 748 035). The amount of NADPH formed is measured photometrically and is proportional to the amount of starch. The method was not accredited for fish products at the time of analysis. Validation was performed during the project and accreditation for fish products was obtained retrospectively.

Sugars
Monosaccharides and disaccharides are determined by gas chromatography using an in-house validated method. (Swedish J. Agric. Res. 4:49-52, 1974). Carbohydrates are converted to trimethylsilyl (TMS-ethers) after extraction with 80 per cent ethanol and analysed on a gas chromatograph with a flame ionisation detector. Carbohydrates are quantitatively determined by the calibration curve with phenyl-β-D-glucoside as an internal standard. The method was not accredited for fish products at the time of analysis. Validation was performed during the project and accreditation for fish products was obtained retrospectively.

Dietary fibre
Dietary fibre are determined gravimetrically, after enzymatic degradation, as total dietary fibre according to AOAC 985.29/NMKL 129, 2 Ed. 2003. The samples are degraded with the enzymes Termamyl®, protease and amyloglucosidase. The samples are filtered, washed, dried and weighed. Total dietary fibre are determined gravimetrically as the residues (after correction for ash and nitrogen content). Accredited method (SWEDAC).

Metals
Sodium, potassium, calcium, magnesium, phosphorus and molybdenum are determined by ICP-AES (Inductively Coupled Plasma-Atomic Emission Spectrometry) after wet digestion. In-house method accredited for calcium, magnesium and molybdenum in food. Sodium, potassium and phosphorus are accredited for feed (SWEDAC).

Other metals are determined by a closed microwave method in nitric and hydrochloric acid at 190°C. After dilution with water, the sample solutions are analysed by ICP-MS (Inductively Coupled Plasma-Mass Spectrometry). The method, which is based on EN 15763:2009, was

not accredited for food at the time of analysis. Validation was performed during the project and accreditation was obtained retrospectively.

Selenium
Selenium was determined by hydrid-ICP-AES after wet digestion. Accredited method (SWEDAC).

Iodine
Iodine was determined spectrophotometrically according to Gig. Sanit. 1971, 36(4), 67-69. Accredited method (SWEDAC).

Vitamin C
Method for quantitative determination of vitamin C in foods as L-(+) ascorbic acid (AA) and L-dehydroascorbic acid (DHAA). The limit of detection is 0.03 mg ascorbic acid/100g and 0.7 mg dehydroascorbic acid/100g, respectively. Ascorbic acid is extracted from the sample using 2 % metaphosphoric acid and 0.1 % oxalic acid. Ascorbic acid and dehydroascorbic acid is separated using a C18-column (250×4,6 mm i.d., 5 µm), followed by quantification of ascorbic acid using HPLC-EC (+0,85 V vs Ag/AgCl). L-dehydroascorbic acid is derivatised post-column and quantified using HPLC-FL (excitation at 350 nm and emission at 430 nm). Vitamin content is determined using peak-area and external calibration. Accredited method (SWEDAC).

Thiamine and riboflavin
Method for analysis of thiamine content (vitamin B1) and riboflavin (vitamin B2) in enriched and non-enriched foods. The detection limit is 0.005 mg/100 g for vitamin B1 and 0.026 mg/100 g for vitamin B2. The common sample treatment begins with an acidic and an enzymatic hydrolysis. Riboflavin is then determined and quantified by isocratic chromatographic separation on a C18-column and fluorescence detection. Thiamine is oxidised in a highly alkaline solution to thiochrome, which fluoresces under ultraviolet light. Potassium hexacyanoferrate is used as an oxidising agent. The derivatisation takes place automatically prior to the injection time by using a liquid handling robot (Gilson ASPEC). Thiamine (thiochrome) is then determined and quantified by isocratic chromatographic separation on a C18-column and fluorescence detection. EN 14122 and EN 14152. Accredited methods (SWEDAC).

Folate
Method for analysis of the total folate concentration in enriched and non-enriched foods. The determination is performed using microbiological assay and turbidimetric detection of the growth of Lactobacillus casei, subsp. Rahmnosus (L. rahmnosus, Culture Collection of the University of Gothen¬burg, CCUG 21452, equivalent to L. casei American Type Culture Collection, ATCC 7469). The detection limit is 3.3 µg/100 g. Homogenised samples are suspended in the phosphate buffer and autoclaved to facilitate extraction from the sample matrix. Further extraction is then performed with the help of enzymes. As L. casei cannot use polyglutamate forms of vitamins for growth, an enzymatic deconjugation is also required prior to analysis. The sample extract is diluted with a basal medium containing all necessary growth factors other than folate. Following the addition of L. casei, the samples are incubated at +37 ºC for 22 hours, after which growth is measured turbidimetrically. By comparing the growth in the sample extract with that of the calibration solution, the vitamin content can be determined. EN14131. AACC 86-47. Accredited method (SWEDAC).

Appendix 4. Analytical methods

Niacin

Method for analysis of the total niacin content in food, both in enriched products and naturally occurring nicotinic acid and nicotinamide. The determination is performed using microbiological assay and turbidimetric detection of the growth of Lactobacillus plantarum (L. plantarum) (ATCC 8014). The detectio¬n limit is 0.03 mg/100 g (weighed sample amount is 5 g). Homogenised samples are suspended in sulphuric acid and autoclaved to facilitate extraction from the sample matrix. The sample extract is diluted with a basal medium containing all necessary growth factor¬s other than niacin. Following the addition of L. plantarum, the samples are incubated at +37 ºC for 22 hours, after which growth is measured turbidi¬metrically. By comparing the growth in the sample extract with that of the calibration solution, the vitamin content can be determined. Accredited method (SWEDAC).

Vitamin B6

Method for analysis of vitamin B6 in foods of animal and vegetable origin. Vitamin B6 is specified as pyridoxine hydrochloride. The detection limit is 0.009 mg pyridoxine hydrochloride/100 g if the weighed amount is 5 g. Samples are hydrolysed with 0.1 M HCl while heated. If the samples contain phosphate esters of pyridoxine, pyridoxal or pyridox¬amine, the samples are then treated with acid phosphatase. The vegetable samples can be conjugated as pyridoxine glucoside. Therefore, a portion of the vegetable sample extract is also treated with beta-glucosidase to determine the total concentration of the vitamin. B6 vitamins pyridoxine, pyridoxal and pyridoxamine are determined and quantified by isocratic chromatographic separation on a C18-column and fluorescence detection. The sum of the vitamins is reported as vitamin B6. Accredited method (SWEDAC).

Tocopherols (vitamin E)

The sample is hydrolysed in an alkaline environment, wherein tocopherol esters are converted into tocopherols. Hydrolysates with low fat content are then extracted with n-hexane on a Kiselguhr-based column (Chem Elut). Extraction in a separatory funnel is used instead for samples with high fat content. Following isocratic liquid chromatographic separation on an amino column, tocopherols are detected with a fluorescence detector. The quantitative evaluation is based on a comparison with an external standard. Correction of the alpha-tocopherol content is made for a recovery of 90 per cent, while the levels of beta-, gamma- and delta-tocopherol are corrected for recoveries of 93 per cent, 91 per cent and 85 per cent. The detection limit is 0.006 mg/100 g for alpha-, beta- and gamma-tocopherol, and 0.008 mg/100 g for delta-tocopherol. Accredited method (SWEDAC).

Vitamin K

An internal standard (menaquinone-8) is added to the sample and mixed with 70 per cent ethanol after which the fat-soluble components are extracted in heptane during reflux. The sample is evaporated and analysed using reversed phase liquid chromatography (C-18) with a fluorescence detector. Vitamin K is reduced in a reduction column filled with zinc powder, which means that the vitamin may be detected fluorimetrically. The quantitative evaluation is based on comparison with an external standard, but correction is made for the recovery of the internal standard. The detection limit is 0.3 µg/100 g for both vitamin K_1 and K_2.

Appendix 4. Analytical methods

Carotenoids

The analyses for alpha- and beta-carotene, beta-cryptoxanthin, lutein and zeaxanthin have been performed with an extraction method which includes alkaline hydrolysis. The sample is first dissolved in ethanol and then hydrolysed using potassium hydroxide. It is then neutralised and extracted with tetrahydrofuran and cyclohexane. Using this method, you get both free carotenoids and carotenoids in ester form as the result. Trans-lycopene has instead been analysed with a direct extraction method without hydrolysis, where the sample is first extracted with ethanol and then with dichloromethane. In both methods, the sample is evaporated to a small volume after extraction, dissolved in dichloromethane and methanol and then analysed by reversed phase liquid chromatography (C-30) with a diode-array detector.

When employing hydrolysis, carotenoids break down to some extent and therefore a recovery correction has been made for a recovery of 87 % for all carotenoids analysed by hydrolysis. No recovery correction was made for trans-lycopene. The detection limit is 2 µg/100 g for all analysed carotenoids.

Appendix 5. Nutritional values

Table 1a. Energy and macronutrients, analytical results

No	Food name	Energy[1] kJ	Energy[1] kcal	Carbohydrates[1] g	Protein[1] g	Nitrogen g	Fibre g	Water g	Ash g
4377	Asterix raw newly harvested	310	74	14.8	1.7	0.27	3.2	79.4	0.8
4380	Asterix raw autumn	296	71	13.5	2.0	0.32	3.6	80.1	0.7
4381	Asterix raw spring	321	77	15.7	1.8	0.28	2.5	79.0	0.9
4387	Inova raw newly harvested	244	58	11.3	2.1	0.33	1.7	84.0	0.8
4389	Inova raw autumn	283	68	13.7	1.8	0.29	1.9	81.8	0.8
4392	Inova raw spring	295	71	14.3	1.9	0.31	1.9	80.8	0.9
4373	King Edward raw newly harvested	355	85	18.2	1.8	0.29	1.4	77.6	0.9
4374	King Edward raw autumn	333	80	16.8	1.7	0.28	1.7	78.7	0.9
4375	King Edward raw spring	352	84	17.9	1.8	0.28	1.8	77.4	1.1
4388	Almond potato raw newly harvested	360	86	17.5	2.2	0.35	2.7	76.5	1.0
4390	Almond potato raw autumn	363	87	17.5	2.2	0.35	3.0	76.2	1.0
4391	Almond potato raw spring	391	94	19.3	2.3	0.37	2.5	74.7	1.1
4385	Solist raw	265	63	13.6	1.0	0.16	1.6	82.8	0.9
4386	Swift raw	223	53	11.0	1.1	0.18	1.6	85.4	0.8
4412	Asterix boiled newly harvested	346	83	17.1	1.9	0.30	2.5	77.5	0.9
4413	Asterix boiled autumn	318	76	15.9	1.7	0.28	1.8	79.6	0.9
4414	Asterix boiled spring	349	83	17.0	2.1	0.33	2.6	77.2	1.0
4417	Inova boiled newly harvested	291	70	14.4	1.5	0.24	2.1	81.1	0.9
4418	Inova boiled autumn	317	76	15.4	2.0	0.31	2.3	79.4	0.8
4419	Inova boiled spring	326	78	16.1	1.9	0.30	2.1	78.9	1.0
4408	King Edward boiled newly harvested	341	81	17.0	1.8	0.29	2.2	78.0	0.9
4409	King Edward boiled autumn	361	86	18.4	1.8	0.29	1.7	77.2	0.9
4410	King Edward boiled spring	360	86	18.3	1.7	0.28	2.0	76.9	1.0
4420	Almond potato boiled newly harvested	421	101	21.0	2.4	0.38	2.4	73.2	1.0
4421	Almond potato boiled autumn	428	102	21.4	2.4	0.38	2.5	72.6	1.1
4422	Almond potato boiled spring	425	102	21.0	2.4	0.38	2.9	72.5	1.1
4415	Solist boiled	322	77	16.4	1.4	0.22	1.9	79.3	0.9
4416	Swift boiled	258	62	12.5	1.5	0.24	2.1	83.0	0.8

Appendix 5. Nutritional values

No	Food name	Energy[1] kJ	Energy[1] kcal	Carbohydrates[1] g	Protein[1] g	Nitrogen g	Fibre g	Water g	Ash g
4394	Catering potato pre-boiled autumn	327	78	16.5	1.7	0.27	1.7	79.2	0.9
4398	Catering potato pre-boiled spring	318	76	15.7	1.6	0.26	2.5	79.2	0.9
4396	Catering potato peeled acid-treated autumn	286	68	14.5	1.4	0.22	1.5	81.7	0.8
4397	Catering potato peeled acid-treated spring	277	66	13.5	1.7	0.26	1.9	81.9	0.9
4393	Catering potato washed autumn	319	76	15.7	1.9	0.30	2.0	79.4	0.9
4399	Catering potato washed spring	338	81	16.9	1.8	0.29	2.0	78.3	0.9
4395	Catering potato peeled blanched autumn	351	84	17.7	1.6	0.25	2.5	77.3	0.9
4400	Catering potato peeled blanched spring	325	78	16.1	1.6	0.25	2.6	78.8	0.8
4376	Asterix raw spring pilot	335	80	16.6	1.6	0.26	2.7	78.1	0.9
4261	King Edward raw spring pilot	341	82	17.3	1.7	0.27	1.8	78.2	0.9
4411	Asterix boiled spring pilot	328	79	15.5	2.2	0.35	3.0	78.3	0.9
4407	King Edward boiled spring pilot	335	80	16.5	2.0	0.32	2.1	78.4	0.9

[1] Calculated using analysed values.

Appendix 5. Nutritional values

Table 1b. Energy and macronutrients, published results

No	Food name	Energy[1] kJ	Energy[1] kcal	Carbohydrates[1] g	Protein[1] g	Nitrogen g	Fibre g	Water g	Ash g
4457	Potato raw	328	78	16.4	1.7	0.28	2.1	78.8	0.9
230	Autumn potato raw	338	81	16.8	1.8	0.29	2.2	78.2	0.9
4512	Early potato raw	247	59	12.5	1.1	0.17	1.6	83.9	0.8
4445	Asterix raw	309	74	14.8	1.8	0.29	3.1	79.5	0.8
4513	Inova raw	274	66	13.1	1.9	0.31	1.8	82.2	0.8
4514	King Edward raw	347	83	17.7	1.8	0.28	1.6	77.9	1.0
4515	Almond potato raw	371	89	18.1	2.2	0.36	2.7	75.8	1.0
4385	Solist raw	265	63	13.6	1.0	0.16	1.6	82.8	0.9
4386	Swift raw	223	53	11.0	1.1	0.18	1.6	85.4	0.8
4458	Potato boiled w salt	349	83	17.5	1.8	0.29	2.1	77.6	0.9
231	Autumn potato boiled w salt	355	85	17.8	1.9	0.30	2.1	77.2	0.9
4511	Early potato boiled w salt	295	71	14.8	1.4	0.23	2.0	80.9	0.8
4518	Asterix boiled w salt	340	81	16.8	1.9	0.30	2.3	78.1	0.9
4519	Inova boiled w salt	311	74	15.4	1.8	0.29	2.2	79.8	0.9
4520	King Edward boiled w salt	354	85	18.0	1.8	0.28	2.0	77.4	0.9
4521	Almond potato boiled w salt	424	101	21.2	2.4	0.38	2.6	72.8	1.1
4415	Solist boiled w salt	322	77	16.4	1.4	0.22	1.9	79.3	0.9
4416	Swift boiled w salt	258	62	12.5	1.5	0.24	2.1	83.0	0.8
4516	Catering potato boiled w salt	318	76	15.8	1.7	0.26	2.1	79.5	0.9

[1] Calculated using analysed values.

Appendix 5. Nutritional values

Table 2a. Carbohydrates, analytical results

No	Food name	Monosaccharides[1]	Disaccharides[1]	Glucose	Fructose	Saccharose	Starch
		g	g	g	g	g	g
4377	Asterix raw newly harvested	0.2	0.2	0.1	0.1	0.2	15.0
4380	Asterix raw autumn	0.5	0.2	0.3	0.2	0.2	13.5
4381	Asterix raw spring	1.1	0.3	0.6	0.5	0.3	14.7
4387	Inova raw newly harvested	0.3	0.2	0.2	0.1	0.2	12.0
4389	Inova raw autumn	0.8	0.2	0.4	0.4	0.2	12.0
4392	Inova raw spring	0.9	0.2	0.5	0.4	0.2	12.5
4373	King Edward raw newly harvested	0.1	0.3	0.1	0.0	0.3	15.9
4374	King Edward raw autumn	0.3	0.3	0.2	0.1	0.3	14.8
4375	King Edward raw spring	0.5	0.1	0.3	0.2	0.1	15.3
4388	Almond potato raw newly harvested	0.1	0.3	0.1	0.0	0.3	16.7
4390	Almond potato raw autumn	0.1	0.2	0.1	0.0	0.2	17.6
4391	Almond potato raw spring	0.3	0.2	0.2	0.1	0.2	17.0
4385	Solist raw	1.2	1.5	0.8	0.5	1.5	10.2
4386	Swift raw	2.8	0.1	1.8	1.0	0.1	8.5
4412	Asterix boiled newly harvested	0.2	0.2	0.1	0.1	0.2	15.4
4413	Asterix boiled autumn	0.6	0.1	0.3	0.3	0.1	14.2
4414	Asterix boiled spring	0.8	0.2	0.4	0.4	0.2	15.5
4417	Inova boiled newly harvested	0.4	0.2	0.3	0.1	0.2	13.6
4418	Inova boiled autumn	0.6	0.2	0.3	0.3	0.2	13.0
4419	Inova boiled spring	1.1	0.2	0.6	0.5	0.2	14.1
4408	King Edward boiled newly harvested	0.1	0.3	0.1	b.d.	0.3	15.7
4409	King Edward boiled autumn	0.2	0.4	0.1	0.1	0.4	14.7
4410	King Edward boiled spring	0.4	0.2	0.3	0.2	0.2	16.7
4420	Almond potato boiled newly harvested	0.1	0.3	0.1	b.d.	0.3	17.6
4421	Almond potato boiled autumn	0.1	0.3	0.1	b.d.	0.3	18.0
4422	Almond potato boiled spring	0.3	0.2	0.2	0.1	0.2	19.1
4415	Solist boiled	1.3	1.7	0.8	0.5	1.7	11.3
4416	Swift boiled	2.8	0.4	1.8	0.9	0.4	9.5

Appendix 5. Nutritional values

No	Food name	Monosaccharides[1] g	Disaccharides[1] g	Glucose g	Fructose g	Saccharose g	Starch g
4394	Catering potato pre-boiled autumn	0.8	0.2	0.4	0.4	0.2	17.9
4398	Catering potato pre-boiled spring	1.2	0.2	0.6	0.6	0.2	14.0
4396	Catering potato peeled acid-treated autumn	1.0	0.1	0.5	0.4	0.1	16.8
4397	Catering potato peeled acid-treated spring	1.1	0.1	0.6	0.5	0.1	12.0
4393	Catering potato washed autumn	1.0	0.3	0.5	0.5	0.3	15.1
4399	Catering potato washed spring	0.7	0.2	0.4	0.3	0.2	15.8
4395	Catering potato peeled blanched autumn	0.1	0.1	0.1	0.0	0.1	16.6
4400	Catering potato peeled blanched spring	0.6	0.2	0.3	0.3	0.2	14.4
4376	Asterix raw spring pilot	0.8	0.2	0.4	0.3	0.2	15.0
4261	King Edward raw spring pilot	0.6	0.1	0.4	0.2	0.1	14.6
4411	Asterix boiled spring pilot	0.8	0.2	0.4	0.3	0.2	15.4
4407	King Edward boiled spring pilot	0.5	0.1	0.3	0.2	0.1	15.5

[1] Sum of analytical values

Appendix 5. Nutritional values

Table 2b. Carbohydrates, published results

No	Food name	Monosaccharides[1]	Disaccharides[1]	Glucose	Fructose	Saccharose	Starch
		g	g	g	g	g	g
4457	Potato raw	0.5	0.3	0.3	0.2	0.3	14.6
230	Autumn potato raw	0.4	0.3	0.2	0.1	0.3	15.2
4512	Early potato raw	1.9	0.9	1.2	0.7	0.9	9.5
4445	Asterix raw	0.6	0.2	0.3	0.3	0.2	14.4
4513	Inova raw	0.7	0.2	0.4	0.3	0.2	12.2
4514	King Edward raw	0.3	0.3	0.2	0.1	0.3	15.3
4515	Almond potato raw	0.2	0.2	0.1	0.1	0.2	17.1
4385	Solist raw	1.2	1.5	0.8	0.5	1.5	10.2
4386	Swift raw	2.8	0.1	1.8	1.0	0.1	8.5
4458	Potato boiled w salt	0.5	0.3	0.3	0.2	0.3	15.2
231	Autumn potato boiled w salt	0.3	0.2	0.2	0.1	0.2	15.7
4511	Early potato boiled w salt	1.9	1.1	1.2	0.7	1.1	10.6
4518	Asterix boiled w salt	0.5	0.2	0.3	0.2	0.2	15.0
4519	Inova boiled w salt	0.7	0.2	0.4	0.3	0.2	13.8
4520	King Edward boiled w salt	0.2	0.3	0.1	0.1	0.3	15.7
4521	Almond potato boiled w salt	0.2	0.3	0.1	0.1	0.3	18.2
4415	Solist boiled w salt	1.3	1.7	0.8	0.5	1.7	11.3
4416	Swift boiled w salt	2.8	0.4	1.8	0.9	0.4	9.5
4516	Catering potato boiled w salt	0.8	0.2	0.4	0.4	0.2	15.3

[1] Sum of analytical values

Appendix 5. Nutritional values

Table 3a. Fatsoluble vitamins, analytical results

No	Food name	RE[1]	α-carotene µg	ß-carotene µg	ß-crypto-xanthin µg	Lutein µg	Zea-xanthin µg	α-tocopherol mg	Vitamin K_1 µg
4377	Asterix raw newly harvested	0	2	3	<LOQ	52	1	0.06	0.6
4380	Asterix raw autumn	0	<LOQ	2	<LOQ	47	1	0.05	0.5
4381	Asterix raw spring	0	<LOQ	2	<LOQ	51	1	0.11	0.4
4387	Inova raw newly harvested	0	<LOQ	1	<LOQ	20	2	0.05	0.8
4389	Inova raw autumn	0	<LOQ	1	<LOQ	30	3	0.04	0.7
4392	Inova raw spring	0	<LOQ	3	<LOQ	43	2	0.06	0.7
4373	King Edward raw newly harvested	1	<LOQ	7	<LOQ	25	<LOQ	0.05	1.1
4374	King Edward raw autumn	1	<LOQ	6	<LOQ	25	<LOQ	0.06	1.3
4375	King Edward raw spring	1	<LOQ	5	<LOQ	28	<LOQ	0.09	1.8
4388	Almond potato raw newly harvested	1	1	16	<LOQ	168	<LOQ	0.06	1.8
4390	Almond potato raw autumn	0	<LOQ	5	<LOQ	126	<LOQ	0.04	1.8
4391	Almond potato raw spring	1	<LOQ	7	1	151	1	0.07	1.7
4385	Solist raw	3	<LOQ	33	<LOQ	85	2	0.08	1.5
4386	Swift raw	2	1	18	<LOQ	58	<LOQ	0.07	0.9
4412	Asterix boiled newly harvested	0	<LOQ	3	1	60	9	0.11	0.9
4413	Asterix boiled autumn	0	<LOQ	2	<LOQ	42	6	0.11	0.7
4414	Asterix boiled spring	0	<LOQ	2	1	51	5	0.11	0.5
4417	Inova boiled newly harvested	0	<LOQ	1	<LOQ	32	12	0.11	1.3
4418	Inova boiled autumn	0	<LOQ	<LOQ	<LOQ	23	7	0.06	0.9
4419	Inova boiled spring	0	<LOQ	2	1	56	11	0.06	0.9
4408	King Edward boiled newly harvested	1	<LOQ	6	<LOQ	25	3	0.13	1.5
4409	King Edward boiled autumn	1	<LOQ	6	<LOQ	25	2	0.14	2.3
4410	King Edward boiled spring	0	<LOQ	5	<LOQ	24	1	0.10	1.3
4420	Almond potato boiled newly harvested	2	1	21	1	233	30	0.07	2.2
4421	Almond potato boiled autumn	0	<LOQ	4	<LOQ	121	11	0.08	1.9
4422	Almond potato boiled spring	1	<LOQ	8	1	196	21	0.12	2.3
4415	Solist boiled	3	<LOQ	32	<LOQ	126	28	0.22	2.1

Appendix 5. Nutritional values

No	Food name	RE[1]	α-carotene µg	ß-carotene µg	ß-crypto-xanthin µg	Lutein µg	Zea-xanthin µg	α-tocopherol mg	Vitamin K_1 µg
4416	Swift boiled	2	<LOQ	21	<LOQ	91	17	0.15	1.2
4394	Catering potato pre-boiled autumn	0	<LOQ	<LOQ	<LOQ	28	14	0.07	0.8
4398	Catering potato pre-boiled spring	0	<LOQ	2	1	47	18	0.11	0.3
4396	Catering potato peeled acid-treated autumn	0	<LOQ	<LOQ	<LOQ	49	13	0.06	1.3
4397	Catering potato peeled acid-treated spring	0	<LOQ	1	1	54	7	0.03	1.4
4393	Catering potato washed autumn	1	<LOQ	10	<LOQ	118	19	0.08	0.6
4399	Catering potato washed spring	0	<LOQ	4	<LOQ	84	18	0.07	0.3
4395	Catering potato peeled blanched autumn	0	<LOQ	<LOQ	<LOQ	23	4	0.07	0.5
4400	Catering potato peeled blanched spring	0	<LOQ	<LOQ	<LOQ	31	4	0.10	0.3
4376	Asterix raw spring pilot	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	0.13	0.5
4261	King Edward raw spring pilot	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	0.10	2.5
4411	Asterix boiled spring pilot	0	<LOQ	<LOQ	<LOQ	47	5	0.15	0.6
4407	King Edward boiled spring pilot	0.4	<LOQ	5	<LOQ	29	<LOQ	0.11	2.6

RE – retinol equivalents; [1] Calculated using analysed values
<LOQ – below limit of quantification
n.a. – not analysed

Appendix 5. Nutritional values

Table 3b. Fatsoluble vitamins, published results

No	Food name	RE [1]	α-carotene µg	ß-carotene µg	ß-crypto-xanthin µg	Lutein µg	Zea-xanthin µg	α-tocopherol mg	Vitamin K_1 µg
4457	Potato raw	1	0	8	0	46	0	0.07	1.2
230	Autumn potato raw	0	0	5	0	43	0	0.07	1.2
4512	Early potato raw	2	0	27	0	74	1	0.08	1.3
4445	Asterix raw	0	1	2	0	50	1	0.07	0.5
4513	Inova raw	0	0	2	0	31	2	0.05	0.7
4514	King Edward raw	1	0	6	0	26	0	0.07	1.4
4515	Almond potato raw	1	0	9	0	148	0	0.05	1.8
4385	Solist raw	3	0	33	0	85	2	0.08	1.5
4386	Swift raw	2	0	18	0	58	0	0.07	0.9
4458	Potato boiled w salt	1	0	8	0	53	7	0.12	1.5
231	Autumn potato boiled w salt	0	0	5	0	46	5	0.12	1.4
4511	Early potato boiled w salt	2	0	27	0	111	23	0.19	1.7
4518	Asterix boiled w salt	0	0	2	1	51	7	0.11	0.7
4519	Inova boiled w salt	0	0	1	0	37	10.	0.08	1.0
4520	King Edward boiled w salt	0	0	6	0	25	2	0.12	1.7
4521	Almond potato boiled w salt	1	0	11	1	183	21	0.09	2.1
4415	Solist boiled w salt	3	0	32	0	126	28	0.22	2.1
4416	Swift boiled w salt	2	0	21	0	91	17	0.15	1.2
4516	Catering potato boiled w salt	0	0	2	0	54	12	0.07	0.7

[1] Calculated using analysed values

Appendix 5. Nutritional values

Table 4a. Watersoluble vitamins, analytical results

No	Food name	Thiamine mg	Riboflavin mg	Vitamin C mg	Niacin mg	Niacin-equivalents[1]	Vitamin B_6 total mg	Vitamin B_6 free mg	Folate µg
4377	Asterix raw newly harvested	0.08	0.03	22.8	1.53	1.81	0.21	0.10	22.2
4380	Asterix raw autumn	0.09	0.03	18.5	1.78	2.12	0.21	0.10	19.1
4381	Asterix raw spring	n.a.	n.a.	12.7	n.a.	-	0.23	0.11	27.1
4387	Inova raw newly harvested	0.06	0.02	26.1	1.20	1.54	0.20	0.11	24.0
4389	Inova raw autumn	0.06	0.02	23.0	1.24	1.55	0.20	0.10	14.0
4392	Inova raw spring	n.a.	n.a.	11.9	n.a.	-	0.26	0.13	17.0
4373	King Edward raw newly harvested	0.06	0.03	43.9	2.42	2.72	0.22	0.09	13.8
4374	King Edward raw autumn	0.06	0.02	24.9	2.16	2.45	0.21	0.09	14.1
4375	King Edward raw spring	n.a.	n.a.	10.7	n.a.	-	0.24	0.11	13.8
4388	Almond potato raw newly harvested	0.05	0.03	25.1	2.12	2.49	0.19	0.10	35.6
4390	Almond potato raw autumn	0.04	0.03	23.9	2.47	2.84	0.23	0.12	26.2
4391	Almond potato raw spring	n.a.	n.a.	n.a.	n.a.	-	0.23	0.12	26.7
4385	Solist raw	0.04	0.09	23.2	1.02	1.19	0.15	0.08	24.9
4386	Swift raw	0.03	0.04	18.7	1.43	1.62	0.13	0.06	36.5
4412	Asterix boiled newly harvested	0.07	0.03	17.9	1.43	1.74	0.16	0.08	22.9
4413	Asterix boiled autumn	0.06	0.03	12.4	1.39	1.68	0.19	0.09	19.8
4414	Asterix boiled spring	n.a.	n.a.	9.9	n.a.	-	0.21	0.10	25.3
4417	Inova boiled newly harvested	0.04	0.02	21.9	1.03	1.29	0.17	0.08	23.3
4418	Inova boiled autumn	0.05	0.02	15.6	1.17	1.50	0.18	0.09	14.1
4419	Inova boiled spring	n.a.	n.a.	8.1	n.a.	-	0.22	0.11	16.4
4408	King Edward boiled newly harvested	0.05	0.02	28.5	2.02	2.32	0.18	0.07	15.9
4409	King Edward boiled autumn	0.05	0.02	18.1	1.97	2.27	0.20	0.08	16.1
4410	King Edward boiled spring	n.a.	n.a.	8.8	n.a.	-	0.21	0.09	13.5
4420	Almond potato boiled newly harvested	0.04	0.03	22.6	2.05	2.45	0.21	0.10	32.6
4421	Almond potato boiled autumn	0.04	0.03	19.4	2.73	3.12	0.23	0.11	30.5
4422	Almond potato boiled spring	n.a.	n.a.	n.a.	n.a.	-	0.24	0.12	28.5
4415	Solist boiled	0.03	0.09	20.0	0.94	1.17	0.14	0.07	28.5
4416	Swift boiled	0.03	0.03	17.5	1.30	1.55	0.12	0.05	37.0

Appendix 5. Nutritional values

No	Food name	Thiamine mg	Riboflavin mg	Vitamin C mg	Niacin mg	Niacin-equivalents[1]	Vitamin B_6 total mg	Vitamin B_6 free mg	Folate µg
4394	Catering potato pre-boiled autumn	0.02	0.03	12.6	1.09	1.38	0.15	0.08	12.0
4398	Catering potato pre-boiled spring	0.04	0.02	3.6	0.95	1.22	0.19	0.08	15.7
4396	Catering potato peeled acid-treated autumn	0.02	0.03	11.9	0.76	0.99	0.14	0.07	12.2
4397	Catering potato peeled acid-treated spring	0.02	0.03	7.9	1.05	1.33	0.18	0.07	12.7
4393	Catering potato washed autumn	0.05	0.02	21.1	1.36	1.68	0.16	0.08	15.0
4399	Catering potato washed spring	0.05	0.02	15.5	1.60	1.90	0.20	0.07	10.6
4395	Catering potato peeled blanched autumn	0.04	0.03	6.1	1.02	1.28	0.11	0.05	15.5
4400	Catering potato peeled blanched spring	0.05	0.02	2.3	1.14	1.40	0.14	0.06	15.2
4376	Asterix raw spring pilot	0.08	0.03	9.4	1.60	1.87	0.22	0.10	24.8
4261	King Edward raw spring pilot	0.06	0.02	8.4	2.51	2.79	0.24	0.11	13.0
4411	Asterix boiled spring pilot	0.06	0.03	7.3	1.54	1.90	0.21	0.09	25.0
4407	King Edward boiled spring pilot	0.05	0.02	5.5	2.28	2.61	0.23	0.10	15.0

[1] Calculated using analysed values

n.a. – not analysed

Appendix 5. Nutritional values

Table 4b. Watersoluble vitamins, published results

No	Food name	Thiamine mg	Riboflavin mg	Vitamin C mg	Niacin mg	Niacin-equivalents[1]	Vitamin B_6 total mg	Vitamin B_6 free mg	Folate µg
4457	Potato raw	0.06	0.03	23.6	2.01	2.30	0.21	0.10	19.1
230	Autumn potato raw	0.07	0.02	23.8	2.10	2.41	0.22	0.10	17.8
4512	Early potato raw	0.04	0.07	21.3	1.19	1.37	0.14	0.07	29.7
4445	Asterix raw	0.08[2]	0.03[2]	18.0	1.66[2]	1.97[2]	0.21	0.10	22.8
4513	Inova raw	0.06[2]	0.02[2]	20.3	1.22[2]	1.55[2]	0.22	0.11	18.3
4514	King Edward raw	0.06[2]	0.02[2]	26.5	2.29[2]	2.59[2]	0.22	0.10	13.9
4515	Almond potato raw	0.05[2]	0.03[2]	24.5[2]	2.30[2]	2.67[2]	0.22	0.11	29.5
4385	Solist raw	0.04	0.09	23.2	1.02	1.19	0.15	0.08	24.9
4386	Swift raw	0.03	0.04	18.7	1.43	1.62	0.13	0.06	36.5
4458	Potato boiled w salt	0.05	0.03	17.4	1.77	2.08	0.19	0.08	20.1
231	Autumn potato boiled w salt	0.05	0.02	17.2	1.86	2.16	0.20	0.09	18.6
4511	Early potato boiled w salt	0.03	0.06	19.0	1.09	1.33	0.13	0.06	32.0
4518	Asterix boiled w salt	0.07	0.03	13.4	1.41	1.71	0.19	0.09	22.7
4519	Inova boiled w salt	0.04	0.02	15.2	1.10	1.40	0.19	0.09	17.9
4520	King Edward boiled w salt	0.05	0.02	18.5	2.00	2.30	0.20	0.08	15.2
4521	Almond potato boiled w salt	0.04	0.03	21.0[2]	2.39	2.79	0.23	0.11	30.5
4415	Solist boiled w salt	0.03	0.09	20.0	0.94	1.17	0.14	0.07	28.5
4416	Swift boiled w salt	0.03	0.03	17.5	1.30	1.55	0.12	0.05	37.0
4516	Catering potato boiled w salt	0.04	0.02	10.1	1.12	1.40	0.16	0.07	13.6

[1] Calculated using analysed values

[2] Missing value in February therefore published value is average value of the content in September and November

Appendix 5. Nutritional values

Table 5a. Minerals analytical results

No	Food name	P mg	I mg	Fe mg	Ca mg	K mg	Mg mg	Na mg	NaCl[1] g	Se µg	Zn mg
4377	Asterix raw newly harvested	41	<LOQ	0.41	4	384	26	3	0.01	<LOQ	0.28
4380	Asterix raw autumn	44	<LOQ	0.39	3	390	26	3	0.01	<LOQ	0.28
4381	Asterix raw spring	39	0.2	0.35	8	338	23	3	0.01	<LOQ	0.27
4387	Inova raw newly harvested	40	<LOQ	0.39	5	335	20	3	0.01	<LOQ	0.26
4389	Inova raw autumn	37	<LOQ	0.30	2	337	25	2	0.01	<LOQ	0.25
4392	Inova raw spring	33	0.9	0.28	4	330	23	2	0.01	<LOQ	0.26
4373	King Edward raw newly harvested	44	<LOQ	0.39	4	396	20	4	0.01	<LOQ	0.21
4374	King Edward raw autumn	44	<LOQ	0.37	2	369	20	3	0.01	<LOQ	0.20
4375	King Edward raw spring	49	0.3	0.33	6	385	20	3	0.01	<LOQ	0.18
4388	Almond potato raw newly harvested	44	<LOQ	0.44	4	415	27	2	0.01	1.0	0.36
4390	Almond potato raw autumn	46	<LOQ	0.43	6	451	29	4	0.01	1.0	0.29
4391	Almond potato raw spring	44	0.1	0.44	7	444	26	3	0.01	<LOQ	0.32
4385	Solist raw	37	1.2	0.64	4	340	19	7	0.02	<LOQ	0.18
4386	Swift raw	32	1.5	0.49	7	328	21	3	0.01	<LOQ	0.18
4412	Asterix boiled newly harvested	41	3.7	0.34	3	331	24	69	0.17	<LOQ	0.24
4413	Asterix boiled autumn	41	12.0	0.36	3	281	19	102	0.25	<LOQ	0.21
4414	Asterix boiled spring	43	8.7	0.31	5	326	23	83	0.21	<LOQ	0.21
4417	Inova boiled newly harvested	34	6.1	0.35	4	268	17	75	0.19	<LOQ	0.22
4418	Inova boiled autumn	48	6.3	0.24	3	369	30	101	0.25	<LOQ	0.20
4419	Inova boiled spring	35	9.5	0.25	4	313	24	97	0.24	<LOQ	0.22
4408	King Edward boiled newly harvested	38	5.0	0.35	3	296	15	72	0.18	<LOQ	0.18
4409	King Edward boiled autumn	42	11.6	0.37	2	310	17	111	0.28	<LOQ	0.19
4410	King Edward boiled spring	47	9.7	0.33	7	329	18	93	0.23	<LOQ	0.17
4420	Almond potato boiled newly harvested	47	<LOQ	0.45	6	428	30	5	0.01	<LOQ	0.33
4421	Almond potato boiled autumn	58	2.7	0.44	9	463	26	32	0.08	<LOQ	0.32
4422	Almond potato boiled spring	49	4.2	0.43	8	432	28	47	0.12	<LOQ	0.31
4415	Solist boiled	38	2.1	0.78	4	348	20	43	0.11	<LOQ	0.20
4416	Swift boiled	35	2.7	0.44	5	282	18	42	0.11	<LOQ	0.16

Appendix 5. Nutritional values

No	Food name	P mg	I mg	Fe mg	Ca mg	K mg	Mg mg	Na mg	NaCl[1] g	Se µg	Zn mg
4394	Catering potato pre-boiled autumn	76	5.2	0.38	2	252	21	66	0.17	<LOQ	0.29
4398	Catering potato pre-boiled spring	45	4.8	0.34	4	258	17	83	0.21	<LOQ	0.25
4396	Catering potato peeled acid-treated autumn	23	6.4	0.19	2	277	16	73	0.18	<LOQ	0.21
4397	Catering potato peeled acid-treated spring	29	6.7	0.33	3	298	15	63	0.16	<LOQ	0.24
4393	Catering potato washed autumn	28	<LOQ	0.19	3	322	23	5	0.01	<LOQ	0.21
4399	Catering potato washed spring	27	0.5	0.22	4	361	24	70	0.17	<LOQ	0.25
4395	Catering potato peeled blanched autumn	34	<LOQ	0.29	4	207	14	160	0.4	<LOQ	0.18
4400	Catering potato peeled blanched spring	35	1.1	0.32	7	176	10	130	0.33	<LOQ	0.17
4376	Asterix raw spring pilot	34	0.9	0.35	8	347	22	3	0.01	<LOQ	0.24
4261	King Edward raw spring pilot	44	0	0.49	4	383	20	3	0.01	<LOQ	0.24
4411	Asterix boiled spring pilot	32	6.2	0.32	7	270	16	61	0.15	<LOQ	0.20
4407	King Edward boiled spring pilot	41	6.6	0.4	7	308	17	75	0.19	<LOQ	0.19

[1] Calculated using analysed values.
Iodized salt was added during boiling.
<LOQ – below limit of quantification

Appendix 5. Nutritional values

Table 5a. Minerals analytical results cont.

No	Food name	Cu mg	Cr µg	Mn mg	Mo µg	Ni µg	Co µg	Cd µg
4377	Asterix raw newly harvested	0.06	1.9	0.14	<LOQ	<LOQ	0.4	2
4380	Asterix raw autumn	0.08	0.8	0.15	25	<LOQ	<LOQ	2
4381	Asterix raw spring	<LOQ	<LOQ	0.14	<LOQ	1.1	<LOQ	2
4387	Inova raw newly harvested	<LOQ	0.9	0.14	<LOQ	4.5	0.5	1
4389	Inova raw autumn	0.07	0.5	0.13	<LOQ	<LOQ	<LOQ	1
4392	Inova raw spring	<LOQ	0.5	0.14	<LOQ	<LOQ	<LOQ	1
4373	King Edward raw newly harvested	0.06	0.6	0.16	<LOQ	2.4	0.9	1
4374	King Edward raw autumn	0.08	0.8	0.16	<LOQ	1.1	<LOQ	1
4375	King Edward raw spring	<LOQ	0.8	0.15	<LOQ	0.9	<LOQ	1
4388	Almond potato raw newly harvested	0.10	0.8	0.22	<LOQ	6.1	1.1	2
4390	Almond potato raw autumn	0.08	0.6	0.18	<LOQ	3.3	<LOQ	1
4391	Almond potato raw spring	0.07	0.6	0.21	<LOQ	5.2	<LOQ	2
4385	Solist raw	<LOQ	0.5	0.11	<LOQ	<LOQ	0.3	1
4386	Swift raw	0.06	0.8	0.15	<LOQ	4.9	0.5	1
4412	Asterix boiled newly harvested	<LOQ	<LOQ	0.13	<LOQ	<LOQ	<LOQ	2
4413	Asterix boiled autumn	0.08	<LOQ	0.12	64	<LOQ	<LOQ	2
4414	Asterix boiled spring	<LOQ	<LOQ	0.12	<LOQ	<LOQ	<LOQ	2
4417	Inova boiled newly harvested	0.09	1.4	0.12	<LOQ	7.4	0.3	1
4418	Inova boiled autumn	<LOQ	<LOQ	0.10	35	<LOQ	<LOQ	0
4419	Inova boiled spring	<LOQ	<LOQ	0.13	<LOQ	<LOQ	<LOQ	1
4408	King Edward boiled newly harvested	<LOQ	<LOQ	0.14	<LOQ	<LOQ	0.6	1
4409	King Edward boiled autumn	0.09	<LOQ	0.15	<LOQ	<LOQ	<LOQ	1
4410	King Edward boiled spring	<LOQ	<LOQ	0.16	<LOQ	<LOQ	<LOQ	1
4420	Almond potato boiled newly harvested	0.10	<LOQ	0.23	<LOQ	4.5	0.7	1
4421	Almond potato boiled autumn	0.09	<LOQ	0.22	<LOQ	4.5	<LOQ	2
4422	Almond potato boiled spring	0.08	0	0.20	<LOQ	3.8	<LOQ	2
4415	Solist boiled	0.07	0.6	0.12	<LOQ	<LOQ	0.3	1
4416	Swift boiled	0.08	0.6	0.14	<LOQ	1.8	<LOQ	1

Appendix 5. Nutritional values

No	Food name	Cu mg	Cr µg	Mn mg	Mo µg	Ni µg	Co µg	Cd µg
4394	Catering potato pre-boiled autumn	0.10	<LOQ	0.13	<LOQ	1.6	0.9	1
4398	Catering potato pre-boiled spring	0.11	<LOQ	0.11	<LOQ	1.4	<LOQ	1
4396	Catering potato peeled acid-treated autumn	0.09	<LOQ	0.10	<LOQ	<LOQ	0.8	1
4397	Catering potato peeled acid-treated spring	<LOQ	<LOQ	0.13	<LOQ	<LOQ	<LOQ	2
4393	Catering potato washed autumn	<LOQ	0.4	0.09	<LOQ	1.7	0.5	2
4399	Catering potato washed spring	<LOQ	<LOQ	0.09	<LOQ	<LOQ	<LOQ	1
4395	Catering potato peeled blanched autumn	0.09	<LOQ	0.09	<LOQ	2.0	<LOQ	2
4400	Catering potato peeled blanched spring	<LOQ	<LOQ	0.09	<LOQ	1.4	<LOQ	2
4376	Asterix raw spring pilot	0	0.9	0.11	0	1.0	0	2
4261	King Edward raw spring pilot	0.06	0.3	0.13	0	0	0	1
4411	Asterix boiled spring pilot	0	0	0.12	0	0	0	1
4407	King Edward boiled spring pilot	0	0.4	0.13	0	0	0.4	1

<LOQ – below limit of quantification

Appendix 5. Nutritional values

Table 5b. Minerals published results

No	Food name	P mg	I mg	Fe mg	Ca mg	K mg	Mg mg	Na mg	NaCl[1] g	Se µg	Zn mg
4457	Potato raw	43	0	0	4	379	22	3	0.01	0	0.22
230	Autumn potato raw	44	0	0	4	384	22	3	0.01	0	0.22
4512	Early potato raw	35	1	1	5	335	19	5	0.01	0	0.18
4445	Asterix raw	41	0	0	5	370	25	3	0.01	0	0.27
4513	Inova raw	37	0	0	4	334	23	2	0.01	0	0.25
4514	King Edward raw	45	0	0	4	383	20	3	0.01	0	0.20
4515	Almond potato raw	45	0	0	6	437	28	3	0.01	1	0.33
4385	Solist raw	37	1	1	4	340	19	7	0.02	0	0.18
4386	Swift raw	32	2	0	7	328	21	3	0.01	0	0.18
4458	Potato boiled w salt	42	7	0	4	322	19	80	0.20	0	0.20
231	Autumn potato boiled w salt	43	8	0	4	323	19	85	0.21	0	0.20
4511	Early potato boiled w salt	37	2	1	5	320	19	43	0.11	0	0.19
4518	Asterix boiled w salt	42	8	0	4	313	22	85	0.21	0	0.22
4519	Inova boiled w salt	39	7	0	4	316	24	91	0.23	0	0.21
4520	King Edward boiled w salt	42	9	0	4	312	17	92	0.23	0	0.18
4521	Almond potato boiled w salt	51	2	0	8	441	28	28	0.07	0	0.32
4415	Solist boiled w salt	38	2	1	4	348	20	43	0.11	0	0.20
4416	Swift boiled w salt	35	3	0	5	282	18	42	0.11	0	0.16
4516	Catering potato boiled w salt	37	3	0	3	269	18	81	0.20	0	0.23

[1] Calculated using analysed values

Iodized salt was added during boiling.

Appendix 5. Nutritional values

Table 5b. Minerals published results cont.

No	Food name	Cu mg	Cr µg	Mn mg	Mo µg	Ni µg	Co µg	Cd µg
4457	Potato raw	0.05	0.8	0.15	2	1.5	0	0
230	Autumn potato raw	0.05	0.8	0.16	2	1.4	0	0
4512	Early potato raw	0.03	0.6	0.13	0	2.0	0	0
4445	Asterix raw	0.05	0.9	0.14	8	0.4	0	0
4513	Inova raw	0.02	0.6	0.14	0	1.5	0	0
4514	King Edward raw	0.05	0.7	0.16	0	1.5	0	0
4515	Almond potato raw	0.08	0.7	0.20	0	4.9	0	0
4385	Solist raw	0.00	0.5	0.11	0	0.0	0	0
4386	Swift raw	0.06	0.8	0.15	0	4.9	1	0
4458	Potato boiled w salt	0.04	0.1	0.15	6	0.4	0	0
231	Autumn potato boiled w salt	0.03	0.0	0.15	6	0.4	0	0
4511	Early potato boiled w salt	0.07	0.6	0.13	0	0.7	0	0
4518	Asterix boiled w salt	0.03	0.0	0.13	21	0.0	0	0
4519	Inova boiled w salt	0.03	0.5	0.12	12	2.5	0	0
4520	King Edward boiled w salt	0.03	0.0	0.15	0	0.0	0	0
4521	Almond potato boiled w salt	0.09	0.0	0.22	0	4.3	0	0
4415	Solist boiled w salt	0.07	0.6	0.12	0	0.0	0	0
4416	Swift boiled w salt	0.08	0.6	0.14	0	1.8	0	0
4516	Catering potato boiled w salt	0.05	0.1	0.10	0	1.0	0	0

Rapporter som utgivits 2009

1. Nedkylning av slaktkroppar (nöt) på gårdsnära slakterier – Kartläggning och utvärdering av ny metodik av R Lindqvist och J-E Eriksson.
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10. Proficiency Testing – Drinking Water Microbiology, March 2009:1 by T Slapokas, A Jenzten and M Olsson.
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1. Proficiency Testing – Food Chemistry, Lead and cadmium extracted from ceramics by C Åstrand and Lars Jorhem.
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ISSN 1104-7089