FHIS Food & Health Innovation Service

Food & Health Innovation

Potato; A nutritious, tasty but often maligned staple food.

Produced for FHIS by :

Derek Stewart*† and Gordon McDougall*

* Enhancing Crop productivity and Utilisation
The James Hutton Institute
Dundee, DD2 5DA,
Scotland

† School of Life Sciences
Heriot-Watt University
Edinburgh, EH14 1AS
Scotland

The James Hutton Institute

HERIOT WATT UNIVERSITY

What I say is that, if a man really likes potatoes, he must be a pretty decent sort of fellow.
A.A. Milne

Only two things in this world are too serious to be jested on, potatoes and matrimony.
Irish saying

Introduction

Potatoes are intimately linked with our way of life in the developed world. Potato is the third most important food crop in the world after rice and wheat. More than a billion people worldwide eat potatoes, and global crop production exceeds 300 MT. Potato is a critical crop in terms of food security in the face of population growth and increased demand for food. For example, China, the world's biggest consumer of potatoes, expects that 50% of the increased food production it will need to meet demand in the next 20 years will come from potato (Faulkner, 2011). Within Europe, potato is also the major vegetable crop – in 2007 tuber yield was 61 million tonnes on 2.2 million hectares with yield increasing year on year (www.eurocarne.com). Despite this, potato consumption in many parts of the EU is falling. For example, in Denmark consumption has halved during the last generation to 57 kg per year per capita (Seefeldt et al, 2011). There are many reasons for this decline including the time for preparation, competition from rice and pasta as major carbohydrate sources and overfamiliarity with potato. The time is right, therefore, for potato to be reassessed and its position as a nutritious and versatile food crop to be re-established.

Nutrition from Potato

If we consider the potato we can see that it is a significant one-stop-shop for human nutrition (Figure 1, table 1). The apparent disparity between the values in Figure 1 and Table 1 reflects differences between potato varieties and variation in potatoes grown in different geographic areas.

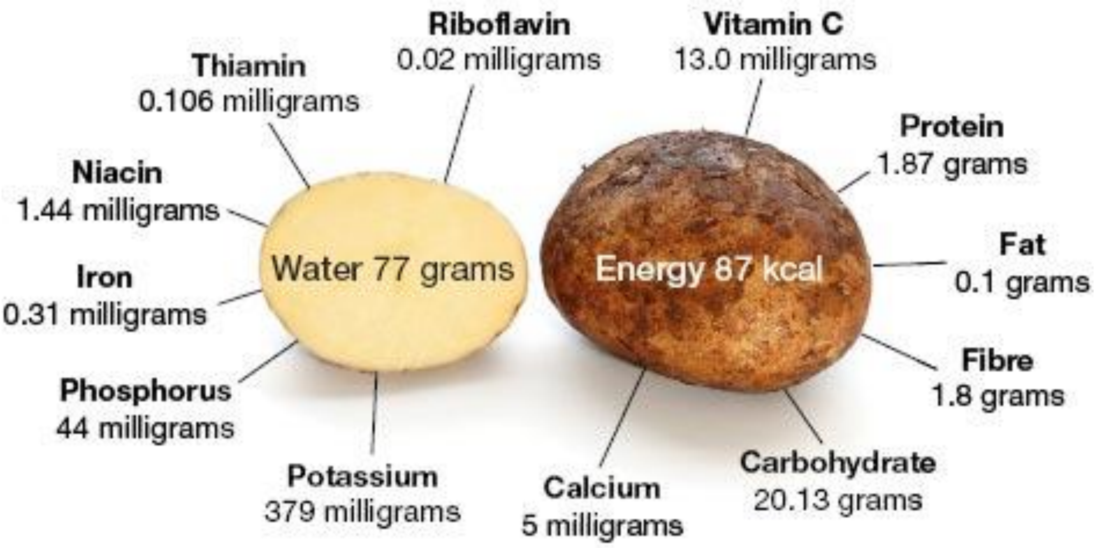

Figure 1. The nutrient content of potatoes, based on 100 g, after boiling and unpeeled.

It is apparent that potato is a useful source of nutrition and can deliver virtually all of the nutrients that the body needs ranging from the macro-components that give energy, good levels of the essential amino acids (Vreugdenhill et al, 2007) to micro-nutrients such as vitamins and minerals.

Vitamins and minerals

What is perhaps surprising from the compositional data is that potato (and here we consider boiled potato) can account for approximately 8% of the RDA for vitamin C. Comparing this with our previous reports on brassicas (Stewart and McDougall, 2012) and soft fruit (McDougall and Stewart, 2012) where the contribution to the RDA was 50-150% and 20-70%, respectively, and the contribution of potato to vitamin C intake seems paltry. However, potato is a staple food which is consumed in larger amounts and is, in certain geographic areas and strata of society, consumed on a daily basis. It is well known that vitamin C is rapidly metabolised and that the body maintains tight control on vitamin C levels (at ~100 µmol/L in the serum; Levine et al, 2011) and excess vitamin C derived from foods is excreted. Therefore, this means that there is a constant and daily demand for dietary vitamin C to replenish levels to maintain optimum health. As a staple food, potato can deliver on this requirement on a daily basis and without seasonal variation in supply.

The value of potato as a source of vitamin C was recently highlighted by Freedman and Keast (2011) who used data from the US National Health and Nutrition Examination Survey 2003-2006 in combination with the US Department of Agriculture food composition data to conduct a secondary analysis of the contribution of potato to the nutritional status and nutritional shortfalls of children and adolescent diets. Their studied considered potato intake as white potatoes (boiled and mash), oven-baked and French fries and concluded that these provided 9% to 12% of total daily energy, 8% to 15% of daily fat (>75% monounsaturated fatty acids + polyunsaturated fatty acids), ≥10% dietary fiber, vitamin B6, and potassium, 5% or greater thiamine, niacin, vitamin K, phosphorus, magnesium, and copper; and less than 5% sodium intake, for all sex and age groups. The combined potato intake (all types) delivered ≥5% vitamin C for all sex and age groups. Furthermore cross-sectional analysis highlighted that potato, in all its forms, provided shortfall nutrients within energy requirements to children and adolescents and, when consumed in moderate amounts, can be part of a more healthy diet.

Another area where potato in the diet could make a difference is thiamine (vitamin B12) deficiency. A lack of the later in the diet can, *in extremis*, lead to beriberi (Goyer and Sweek, 2011) but low levels can have other less severe effects on general health. This deficiency has largely been addressed by fortification of processed foods but with lifestyle changes, with some people moving away from processed food, a thiamine imbalance is a real possibility. Thiamine imbalance can cause problems such as diabetic complications and the development of incipient diabetic nephropathy, neuropathy and retinopathy (Thornalley, 2005). In addition, double-blind studies highlighted that an improvement in thiamine status was associated with improved mood (Benton and Donohoe, 1999).

Further evidence of the nutritive value of potato can be seen in the range of vitamins and minerals it delivers, again for many people on a daily basis (Table 1). In particular, it is worth noting that potato can deliver 5% of the RDA for iron. Iron deficiency can lead to anaemia with the associated symptoms of tiredness, lethargy, and shortness of breath (dyspnoea) and, in longer term cases, gastric tract bleeding. A study by Challand et al. (1990) estimated that 20% and 15% of elderly men and women in the UK have anaemia (predominantly related to iron deficient diets) and this is a case where potato, as part of a balanced diet, can assist in the reducing this deficit.

Although potato provides a decent portfolio of mineral nutrients, there have been significant efforts to further increase the levels above the average, i.e. biofortification, mainly focussed at improving the health of impoverished populations. Zinc is one such target and this work is a part of the current Scottish Government funded strategic research programme, which involves researchers at the James Hutton Institute (JHI) and the Rowett Institute of Nutrition and Health. It is well accepted that zinc is vitally important for many functions in the body, including cognitive processes. Brown (2008) has shown that zinc levels across a range of potato varieties were 12.5–20 μg/g dry weight, opening up the opportunity, even within cultivated potato varieties, of enhancing zinc levels by breeding. Brown (2008) also reported that iron contents exhibited a range of 18–65 μg/g DW, again identifying potential for varietal improvement. If we couple this with new agronomical techniques, such targeted mineral fertilization (White and Broadley, 2005), then mineral levels could be increased substantially beyond those reported above.

Carotenoids and polyphenols

White potato varieties also contain low but important levels of carotenoids, which have crucial effects on human health (Van der Berg et al., 2000). Certain carotenoids are precursors for vitamin A which is required to form retinal in the retina of the eye, which is essential for normal vision. Other carotenoids are credited with enhancing the immune system and reducing the risk of degenerative diseases, e.g. cancer and cardiovascular disease (Fraser and Bramley, 2004). In particular, potatoes are sources of zeaxanthin and lutein, the major pigments of the yellow spot in the retina of the human eye and may prevent age-related macular degeneration (San Giovanni et al., 2007).

The levels of carotenoids in white potato varieties are low but useful considering the staple nature of potato in the diet. However, the levels can be appreciably higher in yellow fleshed varieties and there is considerable natural variation in potato germplasm for producing varieties with elevated levels (Bradshaw & Ramsay 2005; Brown, 2008). For example, potatoes based on the *Solanum phureja* family, (previously developed at the Scottish Crop Research Institute, now the JHI) have been commercially introduced (http://www.greenvale.co.uk/growers-content/potato-breeding) and these yellow fleshed potatoes have appreciably higher levels of carotenoids (Vreugdenhill et al, 2007; Burgos et al., 2008).

Potatoes also contain a range of polyphenol components which can act as effective antioxidants *in vitro*. The major phenolic component is chlorogenic acid, which has been implicated in certain health benefits (Friedman, 1997). Once again, although the total phenol levels are relatively low in white varieties, there is considerable natural variation in polyphenol content (Vreugdenhill et al, 2007). Certain potato varieties accumulate anthocyanin pigments in their skin and/or flesh and these varieties can have greatly elevated total polyphenol contents (Lachman et al., 2005). Varieties with pigmented flesh can have very high anthocyanin contents and their intake has been shown to have beneficial effects on health including anti-inflammatory effects (Kaspar et al., 2011) and reductions in blood pressure (Vinson et al., 2012).

Potatoes can contain toxic glycoalkaloids (Friedman, 2006) which can have detrimental effects on health. However, modern varieties are screened for accumulation of these components and their intake is generally very low and well within safe levels. On the other hand, glycoalkaloids have also been shown to have anti-cancer activities (e.g. Lee et al., 2004) and may have other beneficial activities at low levels.

Processing potato into some of the UK's favourite foods, chips and crisps, is accompanied by losses of some of the nutrients (Table 1) such as 50% of the vitamin C content but many other nutrients survive through to the processed product. For example, carotenoid content is largely unaffected (Table 1). Obviously the fat content of both of these products has been increased significantly compared to boiled potato but if eaten in moderation and as part of a varied and balanced diet this should not cause a problem. Indeed the shift from saturated to unsaturated oils in the preparation of these processed products can only be a good thing since these oils have, again in moderation, been associated with health benefits (Baum et al, 2012; Vafeiadou et al 2012)

Potato and the glycaemic challenge

Table 1 highlights that one of the major components in potato is starch, and indeed the majority of the dry matter in potato is starch and has been shown to range from ~65-80% depending on cultivar and growth stage (Li et al, 2006). This predominance of starch is both an attractive and negative feature of potato. Potato starch is, along with the cell wall components, responsible in part for the mouthfeel of cooked and processed products, in particular the latter. In addition, starch is a complex but digestible source of glucose, an energy source the body can utilise, and its impact on human nutrition has been the subject of many reviews (Englyst et al, 1987). However, over-consumption of starchy products comes at a cost with an over-availability of glucose which ultimately can lead to obesity and the associated conditions of inflammation, diabetes and cardiovascular heart disease (Aller et al, 2011).

The rise of the glycaemic index (GI) concept saw potato becoming viewed as a less healthy dietary option although this has since been revised. In essence, GI is a research tool that ranks the impact of a serving of any food containing 50 grams of carbohydrate on blood sugar levels (Jenkins et al, 1981). Through numerous studies undertaken on a wide range of foods since then, a consensus was reached that foods with GI values of ≥70, 56–69 and ≤55 were to be classified as high, medium and low GI (Anon, 2010). Following on from this, studies with a range of potato cultivars using both in vivo and in vitro methods indicated that cooked potatoes exhibited a high GI (Atkinson, Foster-Powell, & Brand-Miller, 2008) and were a source of rapidly digested starch (Leeman, Barstrom & Bjorck, 2005). This led to nutritionists recommending that potato should be substituted in the diet by carbohydrate foodstuffs with lower GI values.

However, the story is not as gloomy as it seems and the reassessment of potato is under way.

Post-harvest processing can have a major effect on the GI values of potato with different cooking processes (baking, microwaving, boiling & frying) gelatinising starch to different degrees and altering digestibility. One of the processes shown to effectively reduce GI was that of serving the potatoes cold after cooking or at least letting the product cool before reheating. In some cases, this procedure reduced the GI value by 25% (Tahvonen et al, 2006). This effect seems to be caused by the retrogradation of starch to a gel format that is more resistant to digestion (Englyst et al, 1992).

Other ways of manipulating cooked potato is to add condiments such as vinegar, mayonnaise, olive oil etc. These approaches can reduce the GI by 43% compared to 26% by cooling alone (Liljeberg and Bjorck, 1998; Leeman et al, 2005). In fact, co-ingestion of fats (via sauces and toppings) have also been reported to lower the potato GI by 58% bringing them, in that specific meal format, into the low GI category.

It should be borne in mind that although considered to have a high GI, cooked potatoes do have a comparatively high water content, regardless of the preparation method and this allows them to provide bulk to a meal which consequentially means that potatoes are reportedly *the most satiating food per 1000 kj of energy among 40 foods* (Holt 1995), including fruits, snacks, dairy and meat products etc. Also when comparing potatoes to other starchy foods, such as pasta and rice (which are regarded as low GI) on an equivalent serving basis, potatoes have a lower total available carbohydrate content. In addition, potatoes provide a reasonable level of dietary fibre particularly if the tubers are not peeled.

Back on the positive health agenda: A route forward for potato in Scotland

It is incorrect to think that potato is in trouble in a global sense. In fact, as pointed out in the introduction, potato is the third most important food crops in the world after rice and wheat with more than a billion people worldwide reported to eat potato. Indeed, China, the world's biggest consumer of potatoes, expects that 50% of the increased food production it will need to meet demand in the next 20 years will come from potato (Faulkner, 2011). Furthermore, potato has been highlighted by the FAO as a crucial crop for overcoming future global problems of food security and demand (http://www.fao.org/ag/magazine/0611sp1.htm). This view is shared across the world from Zimbabwe (The Zimbabwe Herald, May 2012) to Columbia (Anon, 2012).

Potato's position in the global economy and in the struggle for a sustainable secure and nutritious food source is increasingly becoming assured. It has been, and increasingly so, a target for research into delivering solutions to increase yield, improve sustainability (water, nutrients, pathogen control; He et al 2012), improve storage, nutritional enhancement and biofortification (Vreugdenhill et al, 2007). The recent publication of the potato genome (Huang et al, 2011) has revealed the code underpinning potato development and responses to abiotic and biotic stimuli and the exploitation of this new knowledge provides a game-changing opportunity to improve potato to meet future needs.

The exploitation of the genome to address the challenges of increasing potato nutritive value, or even decreasing anti-nutritional value, such as reducing glycoalkaloid content (Friedman, 2006) are well within our grasp. Indeed, such an approach is being taken by Shepherd et al (2010) at the James Hutton Institute to future proof the potato industry potato against the current concern over acrylamide-forming potential in high temperature cooked potato products.

Scotland has a significant part to play in the future of potato on the global stage and its use as a source of nutrition. We have a vibrant potato seed industry that operates a high health status, something that most other countries struggle to achieve. We have an internationally recognised centre for potato research at JHI and together this industry-research collective are working globally with the multi-national potato production and processing companies. With this aligned effort, the future for potato looks promising.

Acknowledgements

We acknowledge funding from a range of funders too numerous to mention here. Special thanks go to The Scottish Government's Rural and Environment Science and Analytical Services Division (RESAS) for their Strategic research programme funding (http://www.scotland.gov.uk/Topics/Research/About/EBAR/StrategicResearch/future-research-strategy/Themes).

References

- Aller, EE., Abete, I., Astrup, A., Martinez, JA., van Baak, MA. (2011) Starches, sugars and obesity. *Nutrients* 3: 341-69.
- Anon. (2010) International Standards Organisation, ISO 26,642. Food products – Determination of the glycaemic index (GI) and recommendation for food classification, International Standards Organisation, 2010.
- Anon (2012) Improving potato production for increased food security of indigenous communities in Colombia. Canadian International Food Security Research Fund. (http://www.idrc.ca/EN/Programs/Agriculture_and_the_Environment/Canadian_International_Food_Security_Research_Fund/Documents/106926-Colombia.pdf).
- Atkinson, FS., Foster-Powell, K., Brand-Miller, JC. (2008) International tables of glycemic index and glycemic load values: 2008. *Diabetes Care*: 31, 2281–2283.
- Baum SJ, Kris-Etherton PM, Willett WC, Lichtenstein AH, Rudel LL, Maki KC, Whelan J, Ramsden CE, Block RC. (2012) Fatty acids in cardiovascular health and disease: a comprehensive update. *J. Clin. Lipidol.* 6, 216-34.
- Benton D., Donohoe RT (1999) The effects of nutrients on mood. Public Health Nutr. 2: 403-9.
- Bradshaw, JE.. Ramsay G (2005) Utilisation of the Commonwealth Potato Collection in potato breeding. *Euphytica* 146: 9-19
- Brown, CR. (2008). Breeding for phytonutrient enhancement of potato. *Am. J. Potato Res.* 85: 298–307.
- Burgos, G., Salas, E., Amoros, W., Auqui, M ., Muñoa, L., Kimura, M., Bonierbale, M. (2009) Total and individual carotenoid profiles in *Solanum phureja* of cultivated potatoes: I. Concentrations and relationships as determined by spectrophotometry and HPLC. *J. Food Composition and Analysis* 22: 503–508
- Challand, GS., Michaeloudis, A., Watfa, RR., Coles, SJ., Macklin, JL. (1990) Distribution of haemoglobin in patients presenting to their general practitioner, and its correlation with serum ferritin. *Annals Clin. Biochem*. 27: 15-20.
- Englyst, HN., Kingman, SM., Cummings, JH. (1992). Classification and measurement of nutritionally important starch fractions. *Eur. J. Clin. Nutr.* 46: S33–S50.
- Englyst, HN., Trowell, H., Southgate, DAT., Cummings, JH. (1987). Dietary fibre and resistant starch. *Amer. J. Clin. Nutr.* 46: 873–874.
- Faulkner, G. (2011) Essential trends in World Potato Markets. Europatat Congress, Taormina 9-11th June, (http://www.europatatcongress.eu/docs/Taormina/Europatat_Congress_-_Guy_Faulkner.pdf).
- Fraser, PD., Bramley, PM (2004) The biosynthesis and nutritional uses of carotenoids. *Prog. Lipid Res*. 43: 228-265.
- Freedman, MR., Keast, DR. (2011) White potatoes, including french fries, contribute shortfall nutrients to children's and adolescents' diets. *Nutr. Res*. 31, 270-277.
- Friedman, M. (1997) Chemistry, biochemistry, and dietary role of potato polyphenols. A review. *J. Agric. Food Chem*. 45: 1523-1540.
- Friedman, M. (2006) Potato glycoalkaloids and metabolites: Roles in the plant and in the diet. *J. Agric. Food Chem*. 54: 8655-81.
- Goyer, A., Sweek, K. (2011) Genetic diversity of thiamine and folate in primitive cultivated and wild potato (*Solanum*) species. *J. Agric. Food Chem*. 59: 13072-80.
- He, Z., Larkin, R., Honeycutt, W. (Eds.) (2012) Sustainable Potato Production: Global Case Studies , Springer, London, UK.
- Holt, SHA., Miller, JCB., Petocz, P., Farmakalidis, E. (1995). A satiety index of common foods. *Eur. J. Clin. Nutr*. 49: 675–690.
- Huang et al., (2011) Genome sequence and analysis of the tuber crop potato. *Nature* 475: 189-197.

- Jenkins, DJ., Wolever, TM., Taylor, RH., Barker, H., Fielden, H., Baldwin, JM., Bowling, AC., Newman, HC., Jenkins, AL., Goff, DV. (1981). Glycemic index of foods: A physiological basis for carbohydrate exchange. *Am. J. Clin. Nutr*. 34: 362–366.
- Lachman, J., Hamouz, K. (2005) Red and purple coloured potatoes as a significant antioxidant source in human nutrition – a review. *Plant Soil Environ.* 51: 2005 (11): 477–482.Kaspar, KL., Park, JS., Brown, CR., Mathison, BD., Navarre, DA., Chew BP (2011) Pigmented potato consumption alters oxidative stress and inflammatory damage in men. *J. Nutr.* 141: 108-111.
- Lee, KR., Kozukue, N., Han, J-S., Park, J-H., Chang, E-Y., Baek, E-J., Chang, J-S., Friedman M. (2004) Glycoalkaloids and metabolites inhibit the growth of human colon (HT29) and liver (HepG2) cancer cells. *J. Agric. Food Chem*. 52: 2832-9.
- Leeman, AM., Barstrom, LM., Bjorck, IME. (2005). In vitro availability of starch in heat-treated potatoes as related to genotype, weight and storage time. *J. Sci. Food Agric.* 85: 751–756
- Leeman, AM., Ostman, E., & Bjorck, IME. (2005). Vinegar dressing and cold storage of potatoes lowers postprandial glycaemic and insulinaemic responses in healthy subjects. *Eur. J. Clin. Nutr.* 59: 1266–1271.
- Levine, M., Padayatty, SJ., Espey, MG (2011) Vitamin C: A concentration-function approach yields pharmacology and therapeutic discoveries. *Adv. Nutr.* 2: 78-88.
- Li, X., Scanlon, MG., Liu, Q., Coleman, W. K. (2006). Processing and value addition. In J. Gopal & A. M. P. Khurana (Eds.), Potato production improvement and post-harvest management (pp. 523–555). New York: Haworth Press.
- Liljeberg, H. Bjorck, I. (1998). Delayed gastric emptying rate may explain improved glycaemia in healthy subjects to a starchy meal with added vinegar. *Eur. J. Clin. Nutr.* 52: 368–371.
- McDougall, GJ., Stewart, D (2012) Berries and Health: A review of the evidence. A Food and health Innovation Service Report. http://www.foodhealthinnovation.com/media/5637/berries_august_2012.pdf
- Vreugdenhil, D., Bradshaw, D., Gebhardt, C., Govers, F., Mackerron, DKL., Taylor, MA. and HA. Ross (Eds.) (2007) Potato Biology and Biotechnology: Advances and Perspectives. Elsevier, Amsterdam, The Netherlands
- San Giovanni, JP., Chew EY., Clemons TE., *et al.* (2007). The relationship of dietary carotenoid and vitamin A, E, and C intake with age-related macular degeneration in a case-control study: AREDS Report No. 22. *Arch. Ophthalmol.* 125**:** 1225–32.
- Seefeldt, HF., Tønning, E., Wiking, L., Thybo, AK. (2011) Appropriateness of culinary preparations of potato (*Solanum tuberosum* L.) varieties and relation to sensory and physicochemical properties. *J. Sci. Food. Agric.* 91: 412-420
- Shepherd, LVT., Bradshaw, JE., Dale, MFB., McNicol, JW., Pont, SDA., Mottram, DS., Davies, HV. (2010). Variation in acrylamide producing potential in potato: Segregation of the trait in a breeding population. *Food Chemistry* 123: 568-573.
- Stewart, D., McDougall, GJ. (2012) The Brassicas – An Undervalued Nutritional and Health Beneficial Plant Family. A Food and health Innovation Service Report. http://www.foodhealthinnovation.com/media/5563/brassicas_report_.pdf
- Tahvonen, R., Hietanen, RM., Sihvonen, J., Salminen, E. (2006). Influence of different processing methods on the glycemic index of potato (Nicola). *J.Food Composition and Analysis* 19: 372–378.
- The Zimbabwe Herald_May 2012 - http://www.herald.co.zw/index.php?option=com_content&view=article&id=41857:potato-declared-strategic-food-security-crop&catid=47:agriculture&Itemid=139)
- Thornalley, PJ. (2005) The potential role of thiamine (vitamin B1) in diabetic complications. *Curr. Diabetes Rev*. 1: 287-98.
- Vafeiadou, K., Weech, M., Sharma, V., Yaqoob, P., Todd, S., Williams, CM., Jackson, KG., Lovegrove, JA. (2012) A review of the evidence for the effects of total dietary fat, saturated, monounsaturated and n-6 polyunsaturated fatty acids on vascular function, endothelial progenitor cells and microparticles. *Brit. J. Nutr*. 107: 303-24.

- van den Berg, H., Faulks, R., Granado,HF., Hirschberg, J., Olmedilla, B., Sandmann, B., Southon, S., Stahl, W. (2000) The potential for the improvement of carotenoid levels in foods and the likely systemic effects. *J. Sci. Food Agric.* 80: 880–912
- Vinson, JA., Demkosky, CA., Navarre, DA., Smyda, MA. (2012) High-antioxidant potatoes: Acute in vivo antioxidant source and hypotensive agent in humans after supplementation to hypertensive subjects. *J. Agric. Food Chem*. 60: 6749–675
- White, PJ., Broadley, MR. (2005) Biofortifying crops with essential mineral elements. *Trends Plant Sci*., 10, 586–593.

November 2012

Nutrition and Health Foresighting
Free From
Reformulation
Functional Ingredients

Table 1. The nutrients present in raw and processed potato. Values for selected cereals are shown for comparison.

Nutrient factor	Potato (Raw)	Potato boiled	Chips (French fries)	Crisps (Potato Chips)	Maize (dried grain)	Rice whole grain	Wheat, crushed grain	RDA*
MACRO-COMPONENTS								
Energy, (kj (kcal))	271 (65)	319 (76)	1038 (248)	2273 (543)	1479 (353)	1401 (335)	1239 (296)	2000-2500 kJ
Carbohydrate (g)	13.2	15.5	44.2	53.0	55.4	71.3	52.9	≤50% of energy total
Fat, total (g)	0.2	0.2	5.3	33.0	6.7	0.7	2.2	55-95 (g)
Protein, total (g)	1.6	1.9	4.5	5.3	12.7	6.1	10.6	55 (g)
CARBOHYDRATE-COMPONENTS								
Starch, total (g)	12.7	14.9	43.6	52.6	54.4	70.0	50.3	≤39% of energy total
Sugars, total (g)	0.5	0.6	0.6	0.4	1.0	1.4	2.6	≤11% of energy total
Fibre, total (g)	0.9	1.0	1.0	4.7	9.2	7.4	9.9	≤18% of energy total
Fibre, water-insoluble (g)	0.9	1.0	1.0	3.7	8.4	6.3	9.5	
FATS								
Fatty acids, total, calculated as TAG equivalents (g)	< 0.1	< 0.1	5.5	29.9	5.4	0.3	1.4	≤35% of energy total
Fatty acids, total (g)	< 0.1	< 0.1	5.3	28.6	7.3	0.3	1.3	
Fatty acids, total saturated (g)	< 0.1	< 0.1	2.1	4.7	0.7	< 0.1	0.2	
Fatty acids, total monounsaturated cis (g)	< 0.1	< 0.1	2.1	12.2	1.9	0.1	0.3	
Fatty acids, total polyunsaturated (g)	< 0.1	< 0.1	0.8	11.7	2.6	0.1	0.9	
Fatty acids, total trans (g)	0	0	0.3	0	0	0	0	
Fatty acid 18:2 cis,cis n-6 (linoleic acid) (mg)	29	35	709	9689	4036	111	792	
Fatty acid 18:3 n-3 (alpha-linolenic acid) (mg)	25	29	91	2014	209	3	61	
Cholesterol (mg)	0.3	0.3	0.6	2.0	0	0	0	<300
Sterols, total (mg)	4.4	5.2	50.4	90.4	89.5	72.3	74.4	

RDA - Recommended Dietary Allowance; All data was extracted from the FINELI database - http://www.fineli.fi

Table 1. (Cont.) The nutrients present in raw and processed potato. Values for selected cereals are shown for comparison.

Nutrient factor	Potato (Raw)	Potato boiled	Chips (French fries)	Crisps (Potato Chips)	Maize (dried grain)	Rice whole grain	Wheat, crushed grain	RDA*
MINERALS								
Sodium (mg)	0.9	1.0	1.0	560.0	1.0	6.0	2.0	600
Salt (mg)	2.2	2.5	2.6	1426.9	2.5	15.3	5.1	6000
Potassium (mg)	425.0	340.0	501.4	1190.0	270.0	260.0	390.0	2000
Magnesium (mg)	20.4	24.0	24.2	56.0	72.0	110.0	127.0	375
Calcium (mg)	4.8	5.6	6.8	28.0	0.4	11.0	26.0	1000
Phosphorus (mg)	38.3	45.0	46.6	158.0	170.0	250.0	350.0	700
Iron, total (mg)	0.6	0.7	0.7	1.8	1.5	3.6	4.5	14
Zinc (mg)	0.3	0.3	0.3	0.8	1.4	1.6	3.6	10
Iodide (iodine) (µg)	0.9	1.0	1.0	0	5.0	5.0	5.0	150
Selenium, total (µg)	0.5	0.6	0.6	3.8	2.7	23.0	9.5	55
VITAMINS								
Vitamin A (retinol activity equivalents) mg)	0.5	0.6	0.6	0.4	46.5	0	0.4	800
Vitamin E (mg)	<0.1	<0.1	1.9	5.2	0.5	0.6	1.0	12
Vitamin K, total (µg)	0.88	1.04	10.37	10.00	2.00	0.80	2.60	75
Vitamin C (mg)	8.5	6.5	2.9	3.0	0	0	0	80
Folate (Vit B9) (µg)	19.7	16.2	12.2	41.0	20.0	20.0	50.0	400
Niacin equivalents, total (Vit B3) (mg)	0.5	0.5	1.4	5.5	3.0	5.9	7.7	16
R (Vit B2) (mg)	0.03	0.02	0.03	0.07	0.28	0.03	0.15	1.4
Thiamin (vitamin B1) (mg)	0.18	0.16	0.21	0.21	0.53	0.05	0.40	1.1
Vitamin B6 (constituents) (mg)	0.10	0.12	0.12	0.62	1.07	0.61	0.36	1.4
Carotenoids, total (µg)	57.7	67.9	68.0	47.5	5689.0	0	224.1	-

RDA - Recommended Dietary Allowance; All data was extracted from the FINELI database - http://www.fineli.fi