



Dietary fibre and carbohydrates in frozen vegetables

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ABSTRACT

Vegetables are an important source of dietary fibre. Diets high in fibre, such as fruits and vegetables, are very beneficial to human health. The EU Regulation on nutrition and health claims for food determines the requirement for the claim that a food is a source of fibre (the food must have 3g/100 g or at least 1.5 g/100 kcal). The fibre content of peas, carrots, potatoes, corn and green beans was analysed. Our results confirmed that peas are the leader in content of dietary fibre; peas contained 6.00% dietary fibre, corn 2.53%, potatoes 2.45%, carrots 2.02% and green beans 1.23%. As far as carbohydrates are concerned, they were far below the recommended daily amount in these vegetables. Vegetables were low in calories and high in fibre. Vegetables can be considered healthy food for human consumption. Studies have indicated that healthy diet including fibre has an important role in the prevention of many diseases.

1. Introduction

Vegetables are an important source of dietary fibre, but also vitamin A, vitamin E, vitamin C, vitamin B6, folate, thiamine, niacin, choline, potassium, copper, magnesium and iron. Select dark-green vegetables contain the most vitamin K, red and orange vegetables contain the most vitamin A and dietary fibre and starchy vegetables contain the most potassium. Dietary fibre is often divided into oligosaccharides and polysaccharides. Oligosaccharides are mainly present in vegetables (U.S. Department of Health and Human Services and U.S. Department of Agriculture, 2015–2020; EFSA, 2010). The dietary fibre of vegetables includes that found in fresh, frozen and cooked vegetables and vegetable juices. In studies by Kunzmann *et al.* (2015) and Xiaosheng *et al.* (2019), a high dietary fibre intake, particularly from cereals, grains and fruit, is associated with a reduced risk of colorectal cancer. A high intake of dietary fibre was

associated with a reduced risk of inflammatory bowel diseases (Crohn's disease and ulcerative colitis) (Ananthakrishnan *et al.*, 2013; Fritsch *et al.*, 2021; Yusuf *et al.*, 2022.) Dietary fibre can be categorized as soluble fibre (β -glucans, mucilage, pectin, and gum) and insoluble fibre (cellulose, hemicellulose, lignin) (Yusuf *et al.*, 2022). Soluble fibre dissolves in water and forms a gel-like material. Soluble fibre is found in oats, peas, beans, apples, citrus fruits, carrots and barley. Insoluble fibre promotes the movement of material through the digestive system. Insoluble fibre is found in whole-wheat flour, wheat bran, nuts, beans and potatoes (Mayo Clinic, 2022). Dietary fibre intake was inversely associated with the risks of dementia (Yamagaishi *et al.*, 2022), stroke and coronary heart disease (Threapleton *et al.*, 2015; Thearpleton *et al.*, 2013).

Carbohydrates can be classified as simple or complex. Simple carbohydrates are monosaccharides (e.g., glucose and fructose) and disaccharides

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(e.g., sucrose and lactose). Complex carbohydrates are starch and fibre. Dietary recommendations suggest moderate carbohydrate intake (45% or 65% kcal) in the diet (Griel et al., 2006). Dietary carbohydrates can influence human disease (obesity, type 2 diabetes mellitus, cardiovascular disease, cancer, gastrointestinal diseases, dental caries and other conditions) (EFSA, 2010, FAO, 1997). The EU Regulation (EC No 1924/2006) on nutrition and health claims for food determines the requirement for food to be labelled as a source of fibre (3g/100 g or at least 1.5 g/100 kcal) or high in fibre (6g/100 g or at least 3g/100kcal).

Diets high in fibre, such as fruits and vegetables, are very beneficial to human health, so the current daily recommended consumption of dietary fibre is between 14–20 g for children, 22–30 g for adolescents and 25–38 g for elderly (FAO/WHO, 2003). Dietary fibre needs to be considered as a part of the carbohydrates in foods.

The method of measuring total dietary fibre includes correction of the residue for undigested protein and mineral contamination (AOAC, 1995). Total dietary fibre includes lignin, resident starch and other indigestible carbohydrates. The calculation of carbohydrates is by difference (sugars — mono and disaccharides), oligosaccharides and polysaccharides. Polysaccharides fall into two significant categories, the α -glucans (starch, starch hydrolysis product and glycogen) and non- α -glucans (non-starch polysaccharides — NSPs, which are constituent of dietary fibre) (Greenfield and Southgate, 2003). This paper aimed to estimate the contents of dietary carbohydrates and dietary fibre in frozen vegetables, because these are of great importance for human nutrition.

2. Materials and methods

2.1. Samples

Peas, carrots, potatoes, corn and green beans were taken for analysis. The vegetables were frozen and defrosted and three samples of each were taken for analysis. Samples were homogenized in a laboratory blender (CombiMax 600, Braun, Germany).

2.2. Methods

Total carbohydrates were calculated by difference: (proteins, total fat moisture, ash) minus the sum of dietary fibre. Total dietary fibre was determined according to the standard method (AOAC, 1995). Dietary fibre in g/100 kcal was calculated according to the estimated energy value of the tested vegetables. The amount of carbohydrates derived from the vegetables was calculated concerning the reference intake of 2,000 kcal. The rules on labelling and advertising in Serbia (*Official Gazette of the Republic of Serbia*, 2017–2022) recommend a daily intake of carbohydrates of 260 g day⁻¹ (per 2000 kcal). Calculation of total carbohydrate daily intake was performed by dividing carbohydrate content, expressed in 100 g of product.

2.3. Statistical analysis

Analysis of variance was used to compare different vegetables. Mean values of vegetables for fibre and carbohydrates content were compared using Tukey-Kramer HSD test. Statistical analyses were conducted using JMP 10.0 software (SAS Institute Inc., NY, USA).

Table 1. Dietary fibre and carbohydrates in vegetables

	Dietary fibre, %	Dietary fibre g/100 kcal	Carbohydrates, %	Reference intake of carbohydrates, %
Peas	6.00±0.16 ^A	5.71	15.50±0.59 ^B	5.96
Carrots	2.02±0.02 ^B	4.28	9.54±0.26 ^C	3.67
Potatoes	2.45±0.29 ^B	3.43	14.75±0.91 ^B	5.67
Corn	2.53±0.74 ^B	3.12	21.37±0.30 ^A	8.23
Green beans	1.23±0.58 ^B	3.92	4.64±0.11 ^D	1.78

Means in the same column sharing different superscript letters were statistically significant ($P < 0.05$)

3. Results and discussion

Table 1 shows the mean dietary fibre and carbohydrate (percent with standard deviation) in the different vegetables.

According to *European Commission Regulation* (2006), vegetables can be labelled as a source of fibre if they contain at least 3g of fibre per 100 kcal. Our results confirmed that peas are the leader in content of dietary fibre. However, all the vegetables were low in calories and high in fibre. Therefore, these vegetables can be considered healthy food for human consumption. In the vegetable types listed in Table 1, the proportions of carbohydrates ranged from 4.64±0.11% in green beans to 15.50±0.59 in peas. These amounts of carbohydrates are far below the recommended amount. Adding fibre to breakfast cereals, breads, cakes, cookies and meat products was reported with favourable results (*Bajčić et al.*, 2019). Our results were similar to other data reported in vegetables by *Selvendran and Robertson*

(1994) (1.5–2.5 g/100 g of dry weight). Total dietary fibre was, in green peas 1.9%, in peas 3.5% and in potatoes 1.30% (*Dhingra et al.* 2012), while in carrots, it was 1.5% and in corn, 0.3% (*Cho and Dreher*; 2001). In potatoes after cooking, the soluble fibre content was 2.8% (*Khanum et al.*, 2000).

4. Conclusion

Vegetables can be considered healthy foods for human consumption. Dietary intake of fibre was inversely associated with risk of many diseases including colorectal cancer, inflammatory bowel disease, dementia etc. Studies have indicated that healthy diet including fibre has an important role in the prevention of these diseases. Vegetables, i.e., peas, carrots, potatoes, corn and green beans, were analysed for the presence of dietary fibre. Our results confirmed that peas were the leader in content of dietary fibre.

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