Fact Sheet – Fibre from Vegetables

What is the product?

Dietary fibre (DF) is defined as "the remnants of plant cells resistant to hydrolysis (digestion) by the alimentary enzymes of man". DF is classified as either soluble or insoluble according to how readily it can be extracted from the plant cells.

The beneficial effects of fibre to human health have been known as far back as Hippocrates in 400BC. Diets rich in DF have been associated with reduced rates of cancer (especially colon cancer), cardiovascular disease, constipation, irritable colon and diabetes.

The main effects of insoluble fibre come from bulking faeces and moving food faster through the digestive system. Soluble fibre can decrease cholesterol, lower blood glucose and affect metabolism of fats. Both types of DF have been shown to absorb carcinogens and potentially increase the effects of anti-oxidants.

In addition to its effects on human health, DF is a useful ingredient in many processed foods. It can be used as a calorie free-bulking agent, to increase moisture content, to add structure to foods or improve stability, as a fat replacer and as a gelling agent. As DF promotes a feeling of fullness it is a useful part of weight loss programs.

Modern diets are often deficient in dietary fibre. The average recommended intakes of DF are 25g/day for women and 30g/day for men, approximately 25% of which should be soluble fibre . Most people only consume half this amount, while young people may consume as little as 20% of the recommended intake As a result, there is great interest in fortifying foods with additional DF.

The Australian Food Standards Code allows the following claims with regard to dietary fibre;

"A good source of dietary fibre"
Contains at least 4g DF per serving

"An excellent source of dietary fibre"
Contains at least 7g DF per serving

"Contains increased dietary fibre"
Contains at least 25% more DF than a reference food, which itself contains at least 2g DF per serving

In 2011 the global demand for DF reached 96,400 t with a total value of $1,440 million. This is expected to increase to 216,000 t by 2017, a corrected annual growth approaching 14%. The greatest demand is for soluble fibre, which can be worth 2-3 times more than insoluble fibre.

	Total DF (g/100g dry weight)
Vegetables	
Beans	34
Beetroot	24
Broccoli	30
Brussels sprouts	27
Cabbage	23
Carrot	24
Cauliflower	27
Kale	33
Lettuce	21
Peas	21
Spinach	29
Sweet potato	7
Pulses	
Kidney beans (canned)	21
Lentils (dried, cooked)	16
Cereals	
Rolled oats	10
Whole wheat bread	9

What is the benefit to vegetable growers?

As public understanding of the health benefits of DF has increased, so has demand for natural sources with healthy properties. Many vegetables are high in DF, containing levels similar to those found in pulses such as lentils and kidney beans and even that in cereals.

Crop residues and product trimmings can be especially good sources of fibre. For example, corn cores contain around 15-20% DF.

Most of the fibre products currently on the market come from cereal crops. Bulk quantities of these products are available cheaply as the DF is extracted from what is effectively waste. However, most DF extracted from these sources is insoluble fibre, mainly useful for increasing the rate at which food passes through the digestive system.

Fruit and vegetables, in contrast, contain more soluble fibres such as pectins. Soluble fibres are the most valuable type of DF for food fortification.

For example, carrot pomace (the material left after juicing)

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contains 63% DF, of which 13.5% is soluble fibre. Other good sources of soluble fibre include beetroot, beans and bitter melon, which contain 2.4g, 2.1g and 3.1g soluble fibre per 100g portion (fresh weight) respectively. In the case of beetroot, this means that 31% of its DF content is soluble.

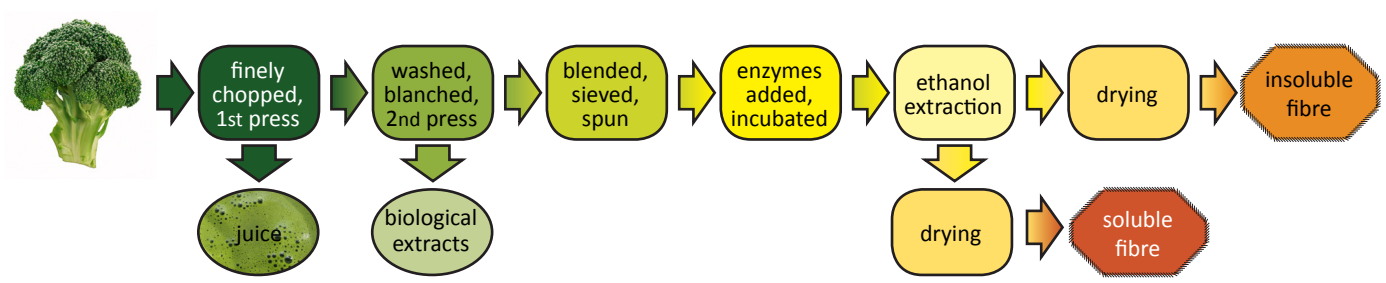
Fibre extracted from some vegetable waste sources can have additional advantages due to their content of other bio-active compounds. These include sulforafane in cabbage, carotenoids in carrots, betalains in beetroot and glucosinolates in cauliflower.

Materials and equipment required

In general, the process to extract dietary fibre from plant materials is relatively simple and inexpensive. However, more complex methods may be required if it is important to preserve particular phytochemicals or to extract both soluble and insoluble DF.

Recovery of soluble fibre can be increased by adding specific enzyme preparations under controlled pH and temperature. Insoluble fibre is essentially the cell wall materials left after all other processes.

Example of a process for recovering DF from vegetables



Economic viability

Economic viability will vary between different crops. For example, if beetroot wastes were used as feedstock, their total DF content of 7.7g/100g fresh weight would be split between soluble and insoluble fibre production.

Although costs of recovering the soluble fraction are likely to be higher, they are worth significantly more on the international market. Moreover, they would likely contain betalains, a potent (soluble) antioxidant. This could further enhance their market value as an additive to functional foods.

Simplot recently conducted a study on the feasibility of extracting DF from corn cores. In this case, they only aimed to recover insoluble DF so the process was relatively simple. Based on capital costs and sale prices for DF at the time, it was conservatively estimated that the project would be cash positive after 3 – 4 years operation.

There is good evidence that the market for natural DF remains strong. An Australian Company "Kfibre" recently opened a plant in Ayr, Queensland producing insoluble DF from sugar cane. A key point of difference for this product is that it is totally natural, whereas wheat fibre is chemically modified to enable extraction. The company currently sells the product for $4.50/kg wholesale and claims a 39% return on investment.

Indicative economics for processing corn core waste into DF. Data from HAL report MT06053 Innovative approaches to adding value to vegetable waste - Phase II, M. Heap, Simplot Australia 2008.

Capital costs	
Total equipment budget	$1,800,000
Installation, engineering and electrical costs	$810,000
Contingency budget	$360,000
total	$2,970,000
Operating costs	
Labour	$220,000
Drying and power	$210,000
Overheads, maintenance, lab analysis	$56,000
Packaging and sales	$100,000
total	$586,000
Income	
Total corn fibre produced	1,080 t
Total value (@$1.85/kg)	$1,998,000
Gross return assuming 80% of product sold	$1,598,400
Annual profit	$1,012,400
break even point	3-4 years

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