

# Beneforté Broccoli

## Super broccoli with cancer-fighting nutrients

Many people know that broccoli is a healthy vegetable. Thanks to British scientists, a healthier variety of broccoli is available in the the United Kingdom and the United States. This broccoli contains up to three times more of the nutrient glucoraphanin than normal broccoli. Scientific studies indicate that this nutrient may offer protection against cancer and cardiovascular diseases.

‘Producers and retailers in Great Britain are enthusiastic about super broccoli and want to continue selling it,’ says Jan Chojecki, Managing Director of Plant Bioscience Limited (PBL). PBL is the technology transfer company that helped in protecting and commercialising the new broccoli variety. The Beneforté Broccoli, as the super broccoli is called, was launched in British supermarkets in October 2012. ‘In the United States, Walmart daughter, Sam’s Club, stock this broccoli as their only kind of floreted broccoli,’ says Chojecki. ‘Probably this summer, the Beneforté Broccoli will become available in Scandinavia and other European countries.’

### Wild brassicas

The Beneforté Broccoli project emerged from the research of Professor Richard Mithen. He went to the south of Italy to collect wild brassica species as a PhD student in the early 1980s at the University of East Anglia. Then he began analysing chemicals in these wild brassicas which were thought to protect the plants from pathogen and insect attack. Mithen

found that the levels of these ‘glucosinolates’ in wild plants were elevated compared to the cultivated brassica species like broccoli.

- **Product name:** Beneforté Broccoli, broccoli with extra nutrients
- **Research institutes:** John Innes Centre and the Institute of Food Research Norwich (United Kingdom). Both institutes are funded by the Biotechnology and Biological Sciences Research Council.
- **Marketed by:** Plant Bioscience Limited, Norwich (United Kingdom), Monsanto Vegetable Seeds (United States)
- **On the market since:** June 2011 (United States), October 2012 (United Kingdom)



Later, various research projects around the world showed that a particular compound sulforaphane, derived from the glucosinolate glucoraphanin, could prove beneficial to human health. It was associated with certain anti-cancer effects. Glucoraphanin is converted in the gut into the bioactive compound sulphoraphane, which circulates in the bloodstream. In 1990 Mithen was appointed as a research leader at the John Innes Centre (JIC), Norwich, the United Kingdom. ‘I wanted to investigate the genetics of the wild brassicas to understand how these plants boost their levels of glucosinolates,’ says Mithen. ‘By finding the answer, we would be able to boost the levels of glucoraphanin in cultivated brassica species.’

### Partnership

To discuss his idea of developing broccoli with a high content of glucosinolates, Mithen went to Plant Bioscience Limited (PBL) also located on the Norwich Research Park. This technology transfer company was established by JIC and others in 1994 and specialises in plant, food and microbial science. ‘It is always difficult to predict whether there is chance of success or not with every new idea but the broccoli project looked promising,’ says Chojecki. In 1996 one of Mithen’s PhD students, Kathy Faulkner, started exploring the genetics of glucosinolates with funding from a Biotechnology and Biological Sciences Research Council studentship award. She also started developing broccoli breeding lines with high levels of these compounds. ‘After we filed a patent on high glucosinolate broccoli in 1998, we started talking to seed companies. We also gauged the opinion of experts in the field about the end product – the fresh vegetable. Developing a fresh vegetable for the market containing an elevated amount of a health-related nutrient was unprecedented at that time and still is,’ says Chojecki.



**decade** The intensive breeding programme to develop commercially acceptable varieties took ten years.



**form** When designing new crops, even the shape of the head of the broccoli is important.

### In the spotlight: A high-profile patent case

The stakes in the field of plant/vegetable development are very high for plant breeding companies. Patents can sometimes be challenged by competitive companies. This also happened with PBL's granted European patent on Beneforté Broccoli. In 2003 plant breeding companies Syngenta and Limagrain opposed this patent. 'The patent consists of two sets of claims. One is the high glucosinolate broccoli itself. The other is the method of breeding it. In European patent law "essentially biological processes" are excluded from patenting. Syngenta and Limagrain want clarity about why our method of breeding is not excluded from patenting. The matter is still with the European Patent Office,' Chojecki explains.

'We needed a partner with the means, experience and commitment to develop our broccoli ready for the market. It had to be a major partner because the development of exactly the right broccoli types to guarantee year-round supply and meet all the needs of growers, retailers and consumers takes many years.'

Chojecki explains, 'You need at least two or three varieties to supply produce of reliable quality in every month of the year in different growing areas. In addition, a feature such as the shape of the head of the broccoli is important. This determines how produce fits in a crate. You have to get all these

things right. Otherwise, your product will have little chance to make it to the market. This is simply how the food industry works.'

In 2000 PBL teamed up with Seminis, one of the major vegetable seed companies, which at the time accounted for almost half of the global broccoli seed market. Seminis did the intensive breeding programme to develop commercially-acceptable varieties – a process that took another ten years. Looking back, the collaboration with PBL was crucial to the success, Mithen says. 'I could not have managed without PBL. They secured the IP, found a major partner, stayed critical in all discussions and are still helping in the ongoing patent discussions, as well as assisting current interactions with growers and retailers.'

### 'A fresh vegetable with a high amount of health-related nutrients is still unprecedented'

'Many academic innovations are at such an early stage that most companies do not want to take the risk of spending money on something that might never reach the market. To bridge that gap, you need a skilled technology transfer organisation (TTO) with the ability to invest in and develop immature innovations. It is still a tough job to decide which inventions could become a success and which will not. It is a kind of a lottery, but so far we are doing pretty well. In the last eight years about 40% of our projects makes some kind of revenue. Technology transfer has become more and more popular in the last decade and most funding agencies require that their projects should deliver something that creates revenues or has social impact.' Chojecki continues.

### Health effects

Apart from marketing the Beneforté Broccoli, Mithen has undertaken more research into the health effects of its nutrient glucoraphanin. 'I wanted to demonstrate that high-glucosinolate broccoli indeed has claimed health effects. It meant changing from research in plant science to research in human health and nutrition,' says Mithen, who now does his research at the Institute of Food Research in Norwich.

'This was a big step, because you don't see it often that scientists leave the comfort zone of their own discipline and experience. However, even in these completely new areas, he managed to continue publishing in top journals,' Chojecki adds. Mithen and colleagues first showed that the high level of sulforaphane delivered by the new broccoli to the gut was indeed absorbed into the systemic circulation. This established that the body takes it up rather than just excreting it.

Collaborating with the Norfolk and Norwich University Hospital, Mithen showed that men with early signs of prostate cancer who were put on a broccoli-rich diet showed changes in gene expression metabolites consistent with reductions in the risk of cancer developing later.

A study is also being carried out by the Institute of Food Research to examine the effects of a broccoli-rich diet on cardiovascular disease. Differences between a diet of regular and Beneforté Broccoli will also be investigated. 'We hope to publish some of the results later this year. Moreover, we have recently commenced a further study on the effect of the super broccoli on prostate cancer with support from the United States Prostate Cancer Foundation,' adds Mithen.

Although Mithen and his team and also other researchers have accumulated more evidence about the positive health effects of broccoli, the

possibilities of advertising these facts as claims on the product are still very limited. 'The regulations governing food health claims are new and very strict about this: product claims of health benefits require a substantial body of evidence and approval of the European Food Standards Agency, which takes time. Science is usually far ahead of legislation and approvals. Still, despite these limited statements currently made on the food product, the sale of Beneforté Broccoli is doing very well,' Chojecki explains. 



**health effects** Professor Richard Mithen wanted to demonstrate that the high glucosinolate broccoli indeed has the claimed health effects.