

The culinary power of crucifers

Your Mum always told you to eat your broccoli – now we know why... **Katia Demekhina** shares her nutrition insights for supporting our detox pathways and recovery mechanisms through delicious cooking methods.



Acai, goji berries, maca, lucuma, spirulina... Most of us have heard of these so-called miracle superfoods that we should include in our diet. However, we don't have to look to exotic sources or pay high prices to benefit from superfoods. Cruciferous vegetables can proudly stand up to any superfood out there. This family of vegetables includes broccoli, cauliflower, rocket, cabbage, chard, bok choy, Brussels sprouts, collard and mustard greens, horseradish, kohlrabi, radish, daikon, kale, turnip, wasabi, Swiss chard and watercress.

While all vegetables are a great source of micronutrients and fibre, what makes brassicas such a prominent player in human health and disease prevention is their content of non-nutrient molecules called glucosinolates. Cruciferous vegetables contain the highest levels of these health-promoting compounds as compared to other vegetables. Although there are different types of glucosinolates in nature, sulforaphane (SFN) is most extensively researched for its health-promoting properties and currently has the strongest evidence for beneficial effects.

What is so special about sulforaphane?

While there are close to forty distinct mechanisms of action that 2,400 published papers have discussed since the discovery of SFN in the 1990s, one of the most important and best-described mechanisms of SFN action is its ability to modulate gene expression by activating Nrf2 (nuclear factor erythroid 2-related factor 2). Nrf2 is a transcription factor which regulates our protective cellular enzymes and proteins, including many with antioxidant, detoxification and anti-inflammatory functions (1). In simple terms, this allows our cells to protect themselves from various stressors and insults, such as ageing, disease and everyday stressors including pollution, toxins, diet and lifestyle, and normal metabolic processes. Through its ability to increase the body's capacity to protect itself against potentially harmful factors, SFN consumption has been linked to many aspects of health, including mitochondrial function, balance of inflammation, exercise performance, hormone balancing, brain function, reduced risk of chronic disease, healthy ageing, and so much more.

SFN is not only the most potent natural activator of Nrf2 that we currently know, but also

stands out among other therapeutic nutrients due to its high bioavailability (body's ability to use this substance) and the magnitude of impact on gene expression that it can induce. The bioavailability of SFN is considered to be 80 per cent or more, compared to only two to twenty per cent from other polyphenols. And its effect on the expression of genes involved in antioxidant defences and detoxification has been reported to be 13.5-fold greater than that of curcumin and 105-fold greater than that of resveratrol (2).

Sulforaphane and athletic performance

While SFN has typically been associated with supporting female hormonal health and preventing certain cancers, over the last five years there is accumulating clinical evidence to support its effect on athletic performance and recovery.

In animal models, SFN increases muscle strength, improves exercise capacity, and protects muscles and organs from oxidative damage and inflammation. For example, Oh and colleagues injected mice with SFN over three days and then subjected them to exhaustive treadmill tests. They found that pre-treatment with SFN protected against muscle damage and improved exercise endurance



Green smoothie

Ingredients:

- 200-250ml unsweetened iced green tea
- ½ cup spinach leaves
- ½ cup broccoli sprouts
- ½ banana
- ¼ avocado
- 1 tsp chia seeds
- 1 scoop plant protein powder
- Lemon juice to taste

Method:

Add ingredients to a high-powered blender and blend until smooth. You can make this smoothie thicker or runnier simply by adding more or less liquid. Serve immediately.

Vegetable fried rice

Ingredients:

- 2 cups cauliflower florets, finely 'riced' in a blender or grated
- 1 cup cooked brown rice
- 1 tsp turmeric powder
- ½ onion finely chopped
- 2 cups diced vegetables (such as carrot, courgette, bell pepper)
- 1-2 tbsp extra virgin olive oil

Method:

In a large frying pan, heat the oil and fry the onions until soft. Add the 'riced' cauliflower and diced vegetables and stir fry until soft, for about 3 minutes. Add the cooked rice and briefly cook to heat through. Great served with sunny side up eggs, dahl, or your choice of protein to make a complete and comforting meal.



Broccoli soup topped with sprouts

Ingredients:

- 1 small onion, chopped
- 2 cloves of garlic, grated
- 1 cm piece of ginger, grated
- A head of broccoli (florets and stem) cut into small chunks
- 1 cup watercress
- 1 can full-fat coconut milk (400g)
- 1 cup chicken or vegetable stock
- 1 tbsp tahini
- Sea salt and pepper to taste
- Broccoli sprouts to serve

Method:

Sauté onion, garlic and ginger in olive oil until translucent. Add broccoli, coconut milk and stock. Bring to boil, reduce the heat and simmer for 3 minutes until broccoli is soft enough to blend. Add watercress and season with salt and pepper. Once watercress has wilted, add tahini and blend until a creamy consistency. Serve topped with broccoli sprouts.

(3). In a 2020 rodent study by Ruhee et al, SFN pre-treatment protected rodents' livers from exhaustive exercise-induced inflammation (4). Finally, in the past year, two research teams in Japan have separately shown that giving mice SFN just two hours before exhaustive exercise reduces organ damage by lowering inflammation and up-regulating antioxidant defences (1,5).

It is encouraging to see that human studies have been able to replicate the findings of animal research. In 2019, López-Chillón and colleagues instructed 40 overweight, but otherwise healthy, adults to eat 30 grams of raw broccoli sprouts per day for a period of ten weeks. While no exercise was performed in this study, after ten weeks of supplementing the diet with broccoli sprouts, inflammation was significantly reduced, and remained so for 90 days after the last intake of sprouts (6).

When it comes to SFN and exercise, in 2021 Sato et al asked ten healthy men to perform three sets of eight repetitions of bench-press at a weight set at 85 per cent of their one-repetition maximum. After a months break, the same individuals were

put on 30 mg/day of SFN supplementation for four weeks and then performed the same heavy resistance exercise. What the researchers found was that SFN intake reduced markers of inflammation and suppressed oxidative stress, preventing exercise-induced muscle damage (7). In the same year, Komine and colleagues put eight healthy men without exercise habits on two weeks of SFN supplementation (in the

form of 30 mg/day of SGS, an SFN precursor) and another eight volunteers with the same characteristics were used as a control group. After two weeks, both groups performed six sets of five repetitions of eccentric bicep curls of the non-dominant arm. Not only did SFN decrease delayed onset muscle soreness, but when participants blood was analysed, a significant increase in the NQO1 gene activity (a target

- Nrf2 gene) was observed, combined with a suppression of oxidative stress as measured by lipid peroxidation (8).

How to get sulforaphane from the diet

So how much SFN do cruciferae contain? The immediate answer is none. Brassicas' cells contain two biologically inactive compounds – glucoraphanin (GPR) and an enzyme myrosinase (MYR) – which are compartmentalised into separate 'sacs'. It is only when these two substances are combined when the plant is cut or chewed, that a chemical reaction takes place, producing SFN (9).

Among cruciferous vegetables, broccoli has the highest content of compounds needed for SFN production, followed by turnip, red cabbage, radish and kale (10). However, by far the best SFN yield is produced from the three-day old broccoli sprouts which provide anywhere between ten to 100 times higher levels of the bioactive compounds than mature plants (11). Because the broccoli sprouts are so much more concentrated than the mature vegetable, as little as 10 grams of broccoli sprouts per day can decrease oxidative stress by almost 20 per cent, increase total antioxidant capacity by 14 per cent, and also decrease inflammation (12). Adding broccoli sprouts to a post-workout smoothie is

Brussels slaw with mustard dressing

Salad ingredients:

- 400-500 grams raw Brussel sprouts, shaved thin on a mandolin
- 1 medium shallot, minced
- 1 apple, cored and diced small
- ½ cup walnuts
- ½ cup pomegranate seeds

Dressing ingredients:

- 2 tsp Dijon mustard
- 2 tsp whole grain mustard
- 2 tsp maple syrup
- 1/3 cup apple cider vinegar
- ½ cup extra virgin olive oil
- Pinch sea salt
- 1 tsp oregano or mixed Italian herbs



Method:

Mix all the dressing ingredients in a jar and shake vigorously. Put shaved Brussel sprouts, shredded kale, minced shallot and diced apple into a large bowl and add the dressing. Top the salad with crushed walnuts and serve with your choice of protein.

therefore a great way to benefit from SFN.

When including brassicas in your diet, use the freshest vegetables available to you, as after only three days of open-air storage (such as during transportation and in retail environments), up to 55 per cent of bioactive compounds can be lost. Storage in plastic bags at room temperature results in similar losses over seven days (2). If eating brassicas raw, SFN yield can be increased by adding vinegar or lemon juice to the dressing as the reduction in pH reduces the activity of ESP (epithiospecifier protein), an inhibitor of MYR activity present in cruciferous vegetables. Research shows that adding acidic elements to raw brassicas can increase SFN yield two-fold compared to non-acidified vegetables (13). The Brussels slaw salad recipe provides an example of how you can do this in practice. Or try a kale and cabbage salad with a creamy cashew dressing as another great way to introduce raw brassicas into your diet.

When cooking brassicas, an easy trick to increase their nutrient density is to add such sources of MYR as mustard, horseradish or watercress, which can raise SFN yield three to five times (14). This principle is used in the broccoli soup recipe.

Another important consideration when cooking your brassicas is not to boil them (unless making soup) because nutrients can leak into the cooking water (14). It is also important not to overcook your vegetables as MYR, an enzyme essential for SFN synthesis, is easily destroyed during prolonged the cooking process (13). And while our colonic bacteria are capable of limited MYR activity, the enzymatic conversion to SFN when the plant MYR is preserved can be three times greater than when MYR has been heat-inactivated and we have to rely on colonic bacteria (9).

While long heat treatment of brassicas can be detrimental to the resulting SFN yield, briefly cooking these vegetables not only maintains MYR content, but can actually enhance SFN yield by deactivating ESP, an inhibitor of MYR activity (14). My vegetable fried rice recipe is an easy way to incorporate briefly heat-treated cauliflower (as

well as plenty of other vegetables) into a nutrient-dense side dish.

When one does not have access to fresh brassicas or broccoli sprouts, powdered broccoli sprouts can provide a source of SFN. However, many available broccoli sprout supplements are MYR-inactive extracts, limiting their ability to deliver bioactive SFN. As the conversion to SFN by the colonic microflora is inefficient, clinical trials using MYR-inactive broccoli sprout extract frequently do not achieve statistical significance (2). Therefore, when choosing broccoli sprouts powder, ensure you go for the brands that retain MYR in their formulations or contain stabilised SFN. Additionally, remember to consume powdered broccoli sprouts as soon as they are mixed with water; once the chemical reaction between MYR and GPR produces SFN, it is only stable for a short period of time (2).

Conclusion

No multivitamin supplement can substitute for the enormous diversity of phytochemicals present in a balanced human diet, as is evident in the health benefits of brassicas that go beyond their nutritional value. By exerting coordinated action on both detoxification and antioxidant enzymes, and reducing inflammation, cruciferous vegetables may not only help support athletic performance and recovery goals, but overall health. **fsn**

• References available on request.

ABOUT THE AUTHOR



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is one of the first UK-trained nutritional therapists in Hong Kong. She is also an NLP practitioner and holds an ALM in Psychology from Harvard University, allowing her to integrate nutritional and lifestyle knowledge with a psychological

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Creamy kale and cabbage salad

Salad ingredients:

- Large bunch of curly kale, stems discarded and leaves julienned thinly
- ¼ head white cabbage, julienned thinly
- A handful of pumpkin seeds
- A handful of dried cranberries

Dressing ingredients:

- ¼ cup cashew nuts, soaked in water for 15 minutes and rinsed
- 1 tsp Dijon mustard
- 1 tsp honey
- 1 tbsp apple cider vinegar
- 3-4 tbsp extra virgin olive oil
- Sea salt to taste

Method:

Process all the dressing ingredients in a blender until smooth and creamy consistency. Briefly massage the kale and cabbage with the dressing to soften the vegetables. Fold in pumpkin seeds and cranberries, and serve with your choice of protein.

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