

# POLYPHENOLS AND HEALTH



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**Polyphenols are a hugely diverse range of organic plant compounds, which have gained increasing interest in the scientific community over recent decades. This article considers the benefits of polyphenols on health and asks what impact they have on disease and metabolism either consumed in isolation or in a varied diet.**

There are more than 8000 different types, which are found in an equally diverse range of plant foods: from their roots and leaves to their flowers and edible fruits. They exist in plants naturally to help them survive, acting to protect them from sun damage, pests and disease. It's a happy benefit to humans that they are beneficial to our health, which underscores the importance of including a wide range of plants in the diet.<sup>1</sup>

There are four main categories of polyphenols, based on their structure:<sup>2</sup>

- 1 Phenolic acids. These include caffeic acid, gallic acid and ferulic acid, found in coffee, wholegrains and olives.
- 2 Flavonoids. These are likely to be the most abundant in the diet as they're present in nearly all fruit and vegetables, providing them with their vivid colours. There are various sub-classes including flavonols, isoflavones, flavanones, flavones and anthocyanidins.
- 3 Stilbenes. These are less common and are mostly found in grapes, berries, peanuts and red wine.
- 4 Lignans. These occur in wholegrains, nuts and seeds, with flaxseed and sesame seeds being rich sources.

## DIETARY SOURCES OF POLYPHENOLS

Rich sources of polyphenols include spices and dried herbs, cocoa products, dark-coloured fruits, flaxseed, nuts, some

vegetables (eg, olives and globe artichokes), coffee, soybeans and wholegrains. Table 1 overleaf shows the top 10 food sources of polyphenols, demonstrating how it's not just overall content but the way foods are consumed in the diet which is important.

## POLYPHENOLS AND HEALTH

A growing body of evidence suggests that polyphenols may play a diverse role in human health through the regulation of chronic disease, metabolism and cell proliferation. However, much of the current research is in animal models and in vitro studies, albeit with growing numbers of human studies.

The predominant theory for the benefits seen from polyphenols is the 'biochemical scavenger theory', which suggests that they negate free radicals by forming stabilised chemical complexes, thereby preventing further reactions.<sup>2</sup> Further suggestions include that they might protect against oxidative stress by producing hydrogen peroxide, which can regulate the immune response.

There is growing evidence from randomised controlled trials (RCTs) showing these beneficial effects. For example, one meta-analysis of 32 RCTs using curcumin found a reduction in inflammatory markers.<sup>4</sup> This potential anti-inflammatory and antioxidant capacity of polyphenols means they are linked with many diseases and disorders.

## REFERENCES

Please visit:  
[www.NHDMag.co.uk/article-references.html](http://www.NHDMag.co.uk/article-references.html)

## COVER STORY

Table 1: Top 10 food sources of polyphenols, derived from a 2010 analysis of the polyphenol database<sup>3</sup>

Food	Polyphenol content (mg/100g)	Polyphenol content in a typical serving (mg/portion)
Clove	15,188	159
Peppermint, dried	11,960	120
Star anise	5460	55
Cocoa powder	3448	276
Oregano, dried	2319	70
Celery seed	2094	63
Black chokeberry	1756	1405
Dark chocolate	1664	666
Flaxseed, ground	1528	153
Black elderberry	1359	1088

### METABOLIC DISEASE

A recent meta-analysis of observational studies found that higher intakes of various polyphenols (flavonoids, stilbenes, quercetin) were significantly associated with a decreased risk of metabolic syndrome.<sup>5</sup> However, this association was not found for other types of polyphenols or total polyphenol intake. There is also some suggestion from in vivo studies that polyphenols may slow the breakdown of carbohydrates and increase insulin secretion. Intervention trials show conflicting evidence, however; for example, one pooled analysis of RCTs using extra virgin olive oil found no significant effects on glucose homeostasis.<sup>6</sup>

### CARDIOVASCULAR DISEASE

A recent meta-analysis that included 46 RCTs found that polyphenol-rich foods (but not purified polyphenol extracts) significantly reduced blood pressure and the purified version had beneficial effects on total cholesterol and triglycerides.<sup>7</sup> However, the authors do point out the high heterogeneity and risk of bias of included studies. Another meta-analysis looking at pomegranate juice found significant benefits on blood pressure with consumption. However, this effect was lost after two months, potentially indicating a tailing-off effect.<sup>8</sup> There

is also currently only one EFSA-authorized health claim for a polyphenol, this being that consumption of olive oil polyphenols contributes to the protection of blood lipids from oxidative stress.

### COGNITIVE FUNCTION

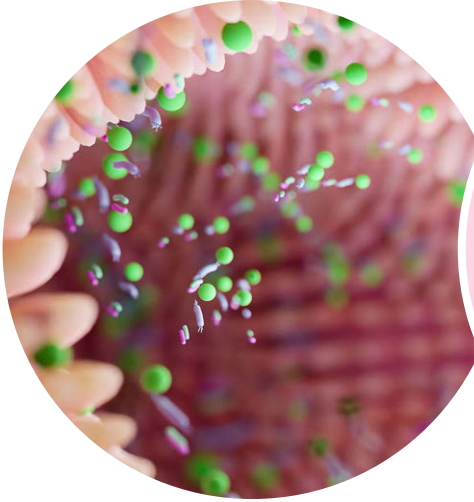
Some evidence suggests that polyphenols may play a role in delaying cognitive decline; a recent meta-analysis of RCTs, which included 2336 older adults, found a positive effect of chronic polyphenol intake (most notably flavonoids) on immediate memory retrieval.<sup>9</sup>

### CANCER

Two Japanese studies funded by World Cancer Research Fund have found that phenolic acids found in high quantities of coffee are significantly associated with a lower risk of colon cancer and that women who drink three or more cups of coffee per day have a lower risk of invasive colon cancer.<sup>10,11</sup> This may be because these polyphenols suppress metastasis and act as anti-inflammatory factors.

### GUT HEALTH

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exerting prebiotic effects.<sup>12</sup> In addition, since polyphenols often remain unabsorbed in the small intestine because of their complex structures, gut microbes can also convert polyphenols into bioactive metabolites, amplifying their beneficial effects.

The use of polyphenols in many other disorders is also increasing, including in non-alcoholic fatty liver disease, polycystic ovary syndrome, kidney disease and inflammatory bowel disease, as well as performance and exercise recovery.

#### FOOD PROCESSING AND POLYPHENOLS

The amount and type of polyphenols in food depend on where the food comes from, the ripeness and production methods such as transport and preparation. Processing methods have been shown to both help retain polyphenol content and reduce it. In one study, canning or freezing apricots led to an increase in polyphenols, while in another, boiling onions degraded flavanol content.<sup>13,14</sup> Coffee which is ground to a finer consistency is thought to give a slightly higher dose of polyphenols as well.<sup>15</sup>

Enhancing the polyphenol content of foods is a current area of interest in the food industry. For example, one new study suggests that a new juicing method could help to retain the levels of polyphenols in apple juice by up to almost four times.<sup>16</sup>

#### POTENTIAL HARMS

The food matrix is the best way to consume naturally occurring levels of polyphenols and the evidence on isolated versions, which deliver much higher doses, is mixed and inconclusive. However, concentrated, isolated extracts are increasingly used in food products and marketing. Adverse outcomes have been reported from the use of polyphenolic botanical extracts in drinks, especially for those living with a chronic condition.<sup>2</sup> High levels of polyphenols may also act in the digestive system to inhibit uptake of essential nutrients like thiamine, iron and folic acid and there may be drug interactions that either inhibit or increase bioavailability of drugs, depending on circumstances.

### CONCLUSION

Although specific evidence of benefits from individual polyphenols appears to be lacking or at times is conflicting, the observational evidence that including more polyphenol-containing foods in the diet is beneficial to health and risk of disease is substantial. Encouraging the consumption of a wide range of plant foods to obtain the most potential benefits from polyphenols seems beneficial while communicating the potential negative effects of isolated versions.