AUSTRALIAN onions

The Onion Report

A SUMMARY OF THE SCIENCE ON THE HEALTH AND NUTRITION BENEFITS OF ONIONS

Contents

Introduction

This comprehensive report summarises more than 80 studies over nearly 30 years on the nutrition and health benefits of onions, providing a solid rationale as to why Australians should increase onion consumption beyond the current average of two serves per person, per week.[1]

It also explores recent scientific research on the continually emerging health benefits of their high levels of phytochemicals including quercetin, sulfoxides and anthocyanins.

Key findings include that onion consumption is associated with:

- a reduction in body weight, BMI, waist circumference, triglyceride levels, fat mass and obesity prevention;
- diabetes prevention and management;
- the elimination of cancer-causing substances and prevention of tumour growth;
- improved intestinal health and increased bacteria populations;
- improved cardiometabolic parameters, a reduced risk of cardiovascular disease, heart disease and stroke;
- improved bone density and osteoporosis prevention;
- improved memory and protection against neurodegeneration; and
- scar prevention and improved wound healing.

The report also includes practical information on how to select, store and prepare onions to encourage their consumption at maximum antioxidant levels.

Onions offer a versatile, nutrient-packed, health-promoting ingredient that deserves to take centre stage in meals.

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Accredited Practising Dietitian

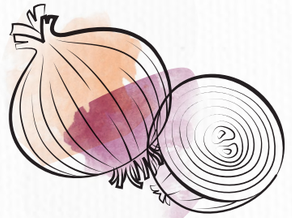
What's in an onion?

Brown, white and red onions are all members of the *Allium cepa* family of plants, along with garlic, leeks and shallots. The nutritional composition of onions varies depending on the variety and whether they are raw or cooked.

This report includes the nutrition breakdown for brown, white and red onions, raw and cooked, as well as an average across the three varieties.

What's a serve?

Half a medium onion (75g) is a serve of vegetables. The minimum recommendation for daily serves of vegetables is 6 for men, 5 for women (+7 if breastfeeding), 4 1/2 - 5 1/2 for children aged 4-18 years and 2 1/2 for children aged 2-3 years.



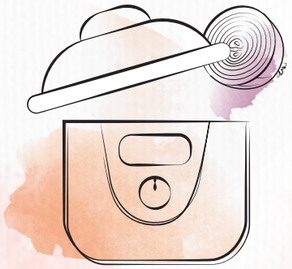
The nutritional composition of onions varies depending on onion variety and whether they are raw or cooked.

75g serve of raw onion provides...

Brown – Source of fibre, folate and vitamin C; Contains antioxidants, including polyphenols, quercetin, kaempferol

Red – Contains antioxidants including polyphenols, anthocyanins, quercetin and kaempferol

White – Source of vitamin C and folate; Contains antioxidants, including polyphenols and quercetin



75g serve of cooked onion provides...

Brown – Source of fibre, folate and vitamin C; contains potassium

Red – Source of vitamin C

White – Source of fibre, folate, and vitamin C; contains potassium

NUTRITION INFORMATION RAW ONION (AVERAGE)
SERVING SIZE: 75g RAW (1/2 MEDIUM ONION)

	Brown (raw)		White (raw)		Red (raw)		Average (brown, white, red raw)	
	per serve	per 100g	per serve	per 100g	per serve	per 100g	per serve	per 100g
Energy (kJ)	104 (25kcal)	139 (33kcal)	96 (23kcal)	128 (30kcal)	85 (20kcal)	113 (27kcal)	95 (23kcal)	126 (30kcal)
Protein, total (g)	1.0	1.3	1.3	1.7	0.6	0.8	1.0	1.3
Fat, total (g)	0	0	0.1	0.1	0	0	0	0
– saturated (g)	0	0	0	0	0	0	0	0
– trans (g)	0	0	0	0	0	0	0	0
– polyunsaturated (g)	0	0	0	0	0	0	0	0
– monounsaturated (g)	0	0	0	0	0	0	0	0
Carbohydrate, total (g)	4.4	5.8	3.5	4.7	4.1	5.5	4.0	5.3
– sugars (g)	4.4	5.8	3.5	4.7	4.1	5.5	4.0	5.3
Dietary fibre (g)	2.0	2.7	1.6	2.1	1.1	1.4	1.6	2.1
Fructans^ (g)	1.6	2.1	1.4	1.8	1.4	1.8	1.4	1.9
Sodium (mg)	6	8	10	13	4	5	7	9
Potassium (mg)	135	180	126	168	105	140	122	163
Folate (µg)	26.3 (13% RDI)	35	26.3 (13% RDI)	35	1.5	2	18	24
Vitamin C (mg)	5.3 (13% RDI)	7	4.5 (11% RDI)	6	3.8	5	4.5 (11% RDI)	6.0
Total polyphenols* (mg)	47	63	4	5	105	140	52	69
Anthocyanins* (mg)	0	0	0	0	7	9	7	9
Quercetin* (mg)	38	51	4	5	91	121	44	59
Kaempferol^^ (mg)	0.5	0.7	0	0	0.5	0.7	0.3	0.5
Cysteine Sulfoxides~ (mg)	n/a	n/a	n/a	n/a	n/a	n/a	41	55
Gluten	0	0	0	0	0	0	0	0

g = gram, mg = milligram, µg= microgram - RDI - Recommended Dietary Intake (FSANZ regulatory RDI for adults) - Anthocyanins (red onions only)

Sources
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*Phenyl Explorer database 3.6. http://phenol-explorer.eu
^ Muir JG, Shepherd SJ, Rosella O, et al. Fructan and free fructose content of common Australian vegetables and fruit. J Agric Food Chem. 2007;55(16):6619-6627. doi:10.1021/jf070623x
^^Onion flavonoid content USDA release 3.3 (2018) https://www.ars.usda.gov/ARSUserFiles/80400525/Data/Flav/Flav_R03-1.pdf
~ Kubec R, Dadáková E. Chromatographic methods for determination of S-substituted cysteine derivatives--a comparative study. J Chromatogr A. 2009 Oct 9;1216(41):6957-63

NUTRITION INFORMATION COOKED ONION (AVERAGE)
SERVING SIZE: 75g COOKED (1/3 CUP COOKED)

	Brown (cooked)		White (cooked)		Red (cooked)		Average (brown, white, red cooked)	
	per serve	per 100g	per serve	per 100g	per serve	per 100g	per serve	per 100g
Energy (kJ)	168 (40kcal)	224 (53kcal)	152 (36kcal)	203 (48kcal)	137 (33kcal)	183 (44kcal)	153 (36kcal)	203 (48kcal)
Protein, total (g)	1.6	2.1	2.0	2.7	0.9	1.2	1.5	2.0
Fat, total (g)	0	0	0.2	0.2	0	0	0	0
– saturated (g)	0	0	0	0	0	0	0	0
– trans (g)	0	0	0	0	0	0	0	0
– polyunsaturated (g)	0	0	0	0	0	0	0	0
– monounsaturated (g)	0	0	0	0	0	0	0	0
Carbohydrate, total (g)	7.1	9.4	5.6	7.5	6.7	8.9	6.5	8.6
– sugars (g)	7.1	9.4	5.6	7.5	6.7	8.9	6.5	8.6
Dietary fibre (g)	3.3	4.4	2.5	3.3	1.7	2.2	2.5	3.3
Sodium (mg)	9	12	16	21	6	8	10	14
Potassium (mg)	218	290	200	267	170	226	196	261
Folate (µg)	34.5 (17% RDI)	46	33.8 (17% RDI)	45	1.5	2	23.3 (12% RDI)	31
Vitamin C (mg)	7.5 (19% RDI)	10	6.0 (15% RDI)	8	4.5 (11% RDI)	6	6.0 (15% RDI)	8
Gluten	0	0	0	0	0	0	0	0

Sources
AFCD (Australian Food Composition Database) (Cooked onion - fried no fat) 2022 https://afcd.foodstandards.gov.au

Onions & their health benefits

GUT HEALTH

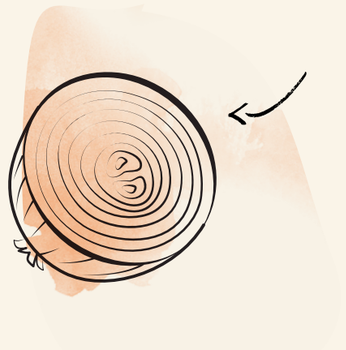
The dietary fibre, prebiotic fibre, organosulfur compounds and quercetin found in onions are beneficial for gut health.

Onions are a natural source of **fibre and fructans** - a prebiotic fibre that is resistant to digestion. For most people, fructans are beneficial for the gut microbiome and promote the growth of healthy bacteria such as bifidobacteria.[2,3]

The **organosulfur compounds** in onions have been widely studied for their benefits on intestinal health. Studies have shown that these compounds have a positive impact on the gut microbiome composition, increasing beneficial bacteria populations.[4]

Quercetin has been shown to promote intestinal homeostasis in animal studies by changing the intestinal flora,[5,6] and has been shown to play a role in the prevention and treatment of inflammatory bowel disease.[7]

On average, 100g of onions contain 59mg of quercetin, compared to 40mg for 100g of blueberry, 7mg for 100g of apple and 8mg for 100g of broccoli.[8] The quercetin content of red onion is 14 times as much of that of garlic and twice as much as that of white onion.[9]



HEART HEALTH

Onions can play a protective role in cardiovascular health through their antioxidant, anti-inflammatory, antiapoptotic, and antihypertension effects.[10,11]

Cholesterol and blood pressure

A 2023 systematic review and meta-analysis of 14 randomised controlled trials found that onion supplementation significantly improved cardio-metabolic parameters including improved body fat percentage, total and low-density lipoprotein (LDL) cholesterol and blood pressure.[12]

Onion supplementation has also been shown to control dyslipidaemia (abnormal levels of lipids in the bloodstream). A 2021 meta-analysis of 10 randomised controlled clinical trials with 446 patients found that onion supplementation was beneficial for plasma levels of high-density lipoprotein (HDL), LDL and total cholesterol as well as blood pressure. Subjects received between 100-1000mg per day of onion or onion peel extract. Pooled evaluation of the trials indicated that onion supplementation significantly improved HDL and LDL cholesterol levels (mean difference 2.29mg/dl and -6.65mg/dl respectively).[13]

Heart disease and hypertension

Epidemiological evidence suggests onion eaters have a reduced risk of mortality and reduced risk of developing heart disease and hypertension. A Finnish study of 5,133 men and women found those eating 5g of onion a day reduced their risk of total mortality and death from coronary heart disease by 29% and 35% respectively, compared to those who didn't eat onion.[14]

Another European study found that Italians who ate more than one 80g portion of onion a week had a 22% reduced risk of myocardial infarction compared to non-onion eaters.[15]

Lastly, a longitudinal study that followed 3,052 adults for six years found those who habitually ate garlic and onion had a 64% reduced risk of cardiovascular disease and 26% decreased risk of developing hypertension.[16]

Quercetin and heart health

Numerous studies have shown that dietary flavonoids, such as quercetin, can minimise oxidative stress by mopping up free radicals, thereby reducing the risk of heart disease and stroke.[17]

The cardioprotective effects of a quercetin-rich onion skin extract has been observed in two randomised double-blinded placebo-controlled studies.

One study looked at 70 obese and overweight women with pre-hypertension and stage 1 hypertension. Hypertensive participants taking 162mg a day of quercetin from onion skin extract powder saw a reduction in blood pressure.[18]

A second study investigated the effect of quercetin on endothelial function in 72 healthy obese and overweight individuals when taking 100mg of quercetin via onion peel extract per day for 12 weeks. The study concluded that onion peel extract improved endothelial function, with improvement in flow-mediated dilation and circulating endothelial progenitor cells.[19]

Quercetin is metabolised in 24 hours, so it is necessary to consume it daily to maintain the body's antioxidant capacity.[20]

WEIGHT MANAGEMENT

Obesity markers

A 2023 systematic review and meta-analysis of five clinical trials (using onions and onion skin) found body weight, body mass index (BMI), waist circumference and triglyceride levels were all significantly reduced in those who consumed onion compared to the placebo groups. The effects were greater with onion peels, which has a higher quercetin content.[21]

Similarly, another 2023 systematic review and meta-analysis of 14 randomised clinical trials found intakes of more than 300g a day of onion significantly improved weight, waist circumference and BMI.[22]

Fat mass

A 12-week randomised, double-blind, placebo controlled clinical trial found steamed onion supplementation reduced total body fat, notably abdominal visceral fat, with positive changes of the clinically relevant metabolic parameters serum triglycerides and C-peptide.[23]

This reduction in body weight, BMI and waist circumference was also seen in a 12-week trial that used onion peel extracts rich in quercetin.[24]

A twin study, of 2,734 healthy female twins aged 18-83 years old, compared the intake of flavonoid antioxidants and fat mass, finding that those who ate more flavanol rich foods, including 60g of onion, had reduced fat mass and reduced central adiposity.[25]

Quercetin and weight management

Quercetin has been shown to play a role in preventing obesity.[26]

A randomised, double blind, placebo-controlled study with 72 overweight and obese Korean subjects found onion peel extract, containing 50mg of quercetin, 65mg of total flavonoids and 119.2mg of total polyphenols, prevented fat accumulation in various body parts and had beneficial effects on obesity.[27]

While a study on 70 healthy Japanese women did not find a significant difference in for visceral fat reduction for subjects receiving 9g of onion powder a day for 12 weeks, it did find the subset of those with lower HDL cholesterol levels had significantly reduced visceral fat, suggesting a role for onions in preventing obesity in some groups.[28]

The studies on onion quercetin and obesity management have contradicting or mixed results and further research is needed to determine the opportunity for therapeutic application.

Conditions linked to obesity

A substantial number of studies have proven the efficacy of onions in the treatment of pathological conditions linked to obesity, such as hyperlipidaemia, diabetes, hypertension, cardiovascular disease and inflammatory state.[26]

DIABETES

Numerous studies have shown onions are beneficial for diabetes prevention and management due to their phytonutrient antioxidants and fibre content.

Blood glucose management

Onions are strongly associated with helping lower blood glucose levels, managing diabetes and reducing complications associated with diabetes.[29,30]

One study of 28 people with diabetes concluded that onions could provide hypoglycemic effects, suggesting its use as a dietary supplement for Type 1 and Type 2 diabetes. Participants consumed 100g of sliced onion and saw significantly reduced blood glucose levels four hours after a test meal.[31]

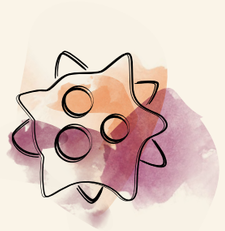
Significant decreases in fasting blood glucose, insulin levels as well as improvements in insulin sensitivity and improved insulin resistance was observed in a study of 56 breast cancer patients consuming a high amount (100-160g a day) of onion over eight weeks.[32]

Onion skin extract has been shown to delay glucose uptake through the inhibition of the enzyme sucrose in the intestinal tract.[33]

Quercetin and diabetes

Studies specifically on quercetin have shown it may have a role in reducing the risk of Type 2 diabetes.[34] Quercetin antioxidant acts on multiple targets of diabetes and regulates key signalling pathways which improve the symptoms as well as the complications of Type 2 diabetes.[35]

In addition to human studies, nine animal studies also found onions, onion juice or extracts rich in quercetin, delivered a reduction of blood glucose levels and improvements in insulin resistance through regulation of glucose transport in cells and reduced oxidative stress.[36-44]



CANCER

The organosulfur and flavonoid antioxidants found in onions have been shown to have anti-cancer benefits.[45-48]

Studies have also shown that the **organosulfur compounds** present in onions are powerful anticarcinogens, thanks to their ability to activate detoxifying enzymes that can eliminate cancer-causing substances.[45]

Onion flavonoids (specifically quercetin,[46,47] fisetin and luteolin[48]) are powerful flavonoid antioxidants that may hold promise as an adjunct to cancer treatment drugs. These flavonoids have been shown to induce cell apoptosis, inhibit inflammation, oxidative stress and cell proliferation, which in turn inhibits the growth of cancer cells.

More than 13 studies have concluded that high onion eaters have less cancer risk than no or low onion eaters.[49-61]

While the mechanisms to explain this are still being investigated, the natural chemical compounds in onions – such as amino acid sulfoxides and their breakdown derivatives – appear to induce liver detoxification enzyme systems, and influence cancer arrest cycles and apoptosis (or cell death) in cancer cell models.[60]

Another hypothesis is that the vitamin C in onions inhibits cell mutation, which contributes to the growth of tumours in the intestinal tract.[53]

In addition to the benefits of eating onion to reduce cancer risk, there is also a benefit in consuming onions when undergoing cancer treatment. A systematic review of 19 studies sought to determine what food or beverages consumed during cancer treatment might prevent recurrence, subsequent malignancies, treatment-related toxicity, or death. Onions, as well as nuts and specific grape varieties, were shown to be modestly beneficial in lessening side effects and improving prognosis during cancer treatment.[61]

Emerging health science

There are several emerging areas in the scientific literature where onion consumption has shown a positive health impact, including antimicrobial capacity, bone and brain health and wound healing.

ANTIMICROBIAL

Allium vegetables have long been known for their **antimicrobial activity** against various microorganisms, such as gram-positive and gram-negative bacteria.[62]

Onions have shown to be effective in the treatment of various infectious diseases (for instance, urinary tract infections)[63], and many fungi, bacteria and viruses have been found to be vulnerable to components of Allium cepa,[64] with red onions shown to possess more antibacterial properties relative to other onion varieties.[65]

The antiomicrobial benefits of onions also have food safety implications. Onion skin extract has been shown to have antimicrobial effects against bacteria that commonly cause food poisoning (bacillus cereus),[66] as well as against E. coli[66], and salmonella.[65]

BONE HEALTH

Onions have been used to treat multiple osteoporosis-based disorders.[67,68]

Research shows onions may help older women protect their bones. Peri– or post-menopausal women over 50 years of age who ate onions at least once a day had an overall **bone density** 5% greater than those who ate onions once a month or less ($P<0.03$). Compared to those who never ate onions, older women who ate onions the most frequently had a 20% **reduced risk of hip fracture.**[69]

BRAIN HEALTH

Healthy ageing

Onions are rich in flavonols, which are associated with slower decline in cognition and cognitive abilities associated with older age.[70]

A 2023 study found the cognitive score of people who ate the most flavonols (15mg a day) declined more slowly than those who ate the fewest flavonols (5mg a day).[71]

Another study found that people with the highest daily flavonoid intakes were 19% less likely to report trouble with memory and thinking, compared with the lowest flavonol intakes. Strawberries, spinach and onions were among the specific flavonol containing foods that topped the list of scores in the memory questionnaire.[72]

In both studies, the results held even after adjusting for other factors that can affect memory, such as age, weight, sex, alcohol intake, physical activity and smoking.

Quercetin flavonoid is associated with a reduction in age-related cognitive decline. A 24-week randomised double blind placebo-controlled trial of 70 healthy Japanese subjects (aged 60 to 79 years), showed significant improvements in cognitive tests in the group consuming quercetin-rich onion, equivalent to 50mg quercetin per day.[73]

Alzheimer's disease

The protective role of onion against neurodegeneration and Alzeheimer's disease can be attributed to active ingredients such as flavonoids, and quercetin in particular.[74]

Quercetin improves antioxidant capacity and regulation of gene expression patterns, and is associated with a slower decline in global cognition and memory loss.[71]

WOUND HEALING

Onions may be beneficial for wound healing.

A systematic review on anti-scarring agents showed positive outcomes from onion peel and its effectiveness against hypertrophic scars and keloid prevention.[75]

In a study of 60 subjects who had cosmetically unacceptable lesions removed from their bodies, an application of an onion gel treatment to the surgical scars significantly improved its softness, redness, texture and appearance after 4-6 weeks, compared to the control group.[76]

Onion peel

Onion peels contain 20 times more flavonoids than onion flesh, however, the peel is usually discarded as waste.[77] A 2021 review of in vitro and in vivo studies found that onion peel extracts exhibit antimicrobial and neuroprotective properties, as well as offer protective roles against cancer (cervical, breast and liver cancer cells), hyperglycaemia, hypercholesterolemia, obesity and erectile dysfunction.[78]

Onion peel can be considered to provide a cost-effective replacement for other medicinal compounds and supplements.[79] For example, onion peel can be used for the preparation of capsules that provide an anti-obesity effect and cardioprotective activity.[80] Substantial research has validated that onion peels are a concentrated source of bioactive compounds that offer many therapeutic benefits.

Selecting, storing & enjoying

SELECT

- When selecting, opt for onions that are clean, firm and have shiny tissue-thin skins
- The 'neck' should be tight and dry
- They shouldn't be overly dry, discoloured or have soft wet spots

STORE

- Keep onions in a cool, dark, yet dry area in a bag or container that enables air circulation
- Don't store onions with potatoes as they accelerate spoilage
- Store at room temperature – cold storage decreases flavonoid content[81]

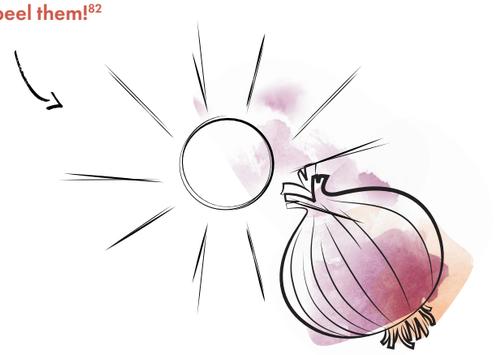
PREPARING ONIONS FOR MAXIMUM ANTIOXIDANTS AND VITAMINS

- Avoid over peeling onions, the outer layers have higher antioxidant levels[82]
- Cook onions soon after cutting, rather than cutting and storing
- Avoid soaking in water unless the water is included in the cooking, and consume liquids as well as part of the dish
- Bake, grill or stir fry onions to maximise the bioavailability of health-promoting phenolic compounds such as quercetin[83,84]
- Try fermenting onions with other vegetables

Using a variety of cooking methods, as well as enjoying some onion raw, will help maximise nutrient levels available for absorption and maintain antioxidant capacity.[85,86]

A review of cooking methods (baking, grilling, frying) onions found that cooking increased the number of phenolic compounds compared to raw onion, with baking and grilling producing the highest amount available for digestion.[86]

Sunlight boosts quercetin in the outer layers of the onion, so don't over-peel them![82]



TEAR-FREE CHOPPING

Onion roots absorb sulfur from the soil and store it as an amino acid sulfoxide. When an onion is cut, it releases enzymes, which set off a chain reaction, and gasses find their way into the eyes. When these gasses are mixed with water in the eyes they form sulphenic acid. Nerves in the cornea react to the irritant sending a message to the brain to activate the tear glands. Tears form to wash the chemical out of the eye, which is why onions can cause people to cry.[87,88]

For tear-free chopping, try putting onions in the fridge or freezer for a short time before cutting them. Another tip is to add vinegar to the chopping board as the acid denatures the enzymes.

For more usage tips and recipe ideas visit **www.australianonions.com.au**

Did you know?

Onions make you cry due to a chemical reaction that starts in the ground.

ONIONS & LOW FODMAP DIETS

A low FODMAP diet is often used to help people with Irritable Bowel Syndrome (IBS) symptoms. It has three stages – elimination, reintroduction and personalisation. It is complex and should be accompanied by dietitian- or doctor-led education.

Whilst this diet excludes eating onion in the elimination phase, the flavour of onion can still be enjoyed in oil-based dishes by cooking with large pieces of onion and simply removing before consuming. Do however avoid adding to water-based dishes, such as soups and casseroles.

After the elimination phase is completed, onions can be used as a test food to determine if they cause a reaction. Many people with IBS can tolerate small amounts of onion and will benefit from the fibre and nutrients in onions that support gut health.

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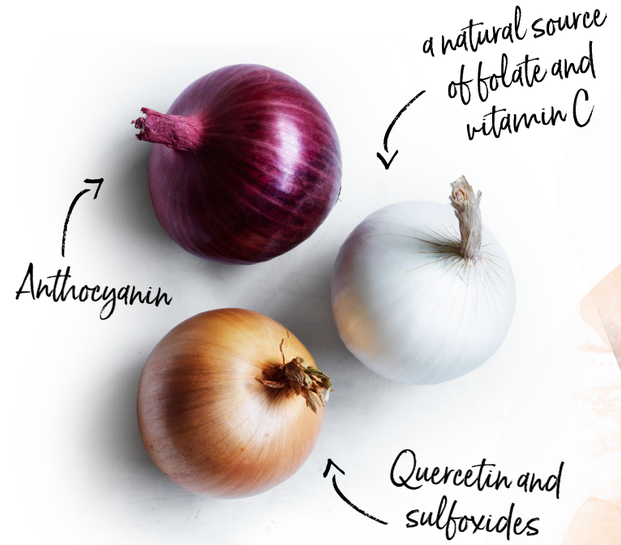

Hort Innovation ONION FUND

This project has been funded by Hort Innovation using the onion research and development levy and funds from the Australian Government. For more information on the fund and strategic levy investment visit **horticulture.com.au**