

oranges nutrition and wellness

A report on the health benefits of oranges
by Nutrition Research Australia



Contents

Introduction Dr Emma Beckett	3
Nutrient Composition	4
• Serves and Portions	6
• Nutrient Summary Table	7
The Health Science	10
• Inflammation and immune health	12
• Cardiovascular health	13
• Brain health	14
• Metabolic health and weight management	15
• Skin health	15
• Gut health	16
Culinary applications	17
References	20

Method

This summary report has been prepared by Nutrition Research Australia. A targeted literature search was undertaken to answer each research question. Key words relevant to each research question were used, and platforms searched were Google Scholar and PubMed databases. Relevant peer-reviewed articles were drawn upon to answer the research questions. No data extraction was performed; instead, key methods and findings were described via narrative synthesis in July 2023.



Delicious affordable nutrition

Oranges are a readily available and familiar fruit, but it would be a mistake to take them for granted. ‘Superfoods’ may have the exotic credentials that headline writers crave, but oranges are an affordable, practical, and familiar choice, with just as many nutritional credentials.

Citrus is known for its stellar levels of vitamin C (it is often said in jest that citrus is what the C stands for) and oranges have the highest vitamin C levels in the family, in a sweet and palatable package. Vitamin C is essential for supporting the growth and repair of tissues, which makes it important in so many health conditions, including immune health.

Oranges are so much more than vitamin C. They are a unique package of multiple essential nutrients and health-promoting bioactive compounds.

Oranges are a good source of folate, important for creating and repairing new cells. Oranges also have a unique balance of soluble and insoluble dietary fibres which supports gut health directly through their prebiotic effects, and other organs, like the brain through the activity of the gut-brain axis, as well as having positive effects on blood cholesterol.

In addition to nutrients, oranges are a rich source of bioactive polyphenols. These compounds promote health through multiple functions including antimicrobial, antioxidant, anti-inflammatory, and anticarcinogenic functions. Many of these bioactive polyphenols, particularly the flavonoids hesperidin and naringenin, are not commonly found outside of the citrus family.

Oranges fit into multiple healthy and therapeutic patterns of eating, including the Mediterranean dietary pattern, the DASH (dietary approaches to stopping hypertension) diet and can be incorporated into low GI and LOW FODMAP diets.


An affordable and practical fruit, oranges can be eaten as peeled fruit, zest, juice or even incorporated in cooking as whole fruit. Each has its own culinary uses and benefits, and all can be enjoyed in a variety of ways. They can be part of drinks, main meals, or snacks, and in sweet and savoury dishes, making them a versatile staple. So, no need to waste time and money on expensive, exotic superfoods – instead embrace the humble orange for winter wellness, and healthy eating all year around.

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What's in an orange and how does it meet our needs?





1x 150g serve
of peeled orange
contains:

Dietary Fibre 12% DI

Flavonoids 44.9mg/100g

Vitamin C 1.5x NRV RDI

Folate >20% NRV RDI

Serves and Portions

The Australian Guide to Healthy Eating defines a serve of fruit as around 150 grams of fruit, with a recommendation to eat at least two serves a day for adults and children aged nine years and over.¹

For toddlers, half a serve is recommended, and for children 3-8 years of age, the recommendations range from 1 to 1.5 serves. Conveniently, one serve equates to one average or medium-sized orange. For juice, 125ml of 100% orange juice, consumed occasionally, is considered a standard serve. Although consumed in smaller amounts, the peel can also be eaten as zest, and this will also contribute to the serves of fruit. Standard serves of peeled fruit and 100% orange juice can be incorporated into low GI diets and smaller serves, a tablespoon of zest, 130g of peeled fruit, and 75mL of 100% juice can be incorporated into low-FODMAP eating plans.



150g peeled
orange
=
1 serve



125ml
100% orange juice
=
1 serve

Goodness all Round

Whether it's snacking on orange wedges, using orange zest in dressings or drinking 100% orange juice, every bit of the orange you eat provides health benefits.



▶ Peeled oranges are delicious, easy to prepare and low GI. A source of vitamin C, folate, dietary fibre (particularly soluble prebiotic fibre) and bioactives.

▶ Orange zest is typically eaten in smaller amounts than peeled fruit or juice but is a concentrated source of bioactive compounds. Orange peel makes up about 20% of the fruit.



▶ 100% orange juice is a source of vitamin C, folate and bioactives. It is an affordable and accessible option and some nutrients and bioactives may be more concentrated and bioavailable in juice.

Nutrient Composition Table

The peeled fruit, zest, and juice of oranges each have their own health-promoting nutrient and bioactives.

	1 peeled fruit (150g) ²			1 tablespoon of zest (5g) ³			1 glass 100% juice (125ml) ²		
	Contents	%DI ¹	%SDT	Contents	%DI ¹	%SDT	Contents	%DI ¹	%SDT
Energy (kJ)	263	3	n/a	24.3	0.3	n/a	179	2	n/a
Protein (g)	1.5	3	n/a	0.09	0	n/a	1.12	2.2	n/a
Total Fat (g)	0	0	n/a	0.01	0	n/a	0	0	n/a
Saturated Fat (g)	0	0	n/a	0	0	n/a	0	0	n/a
Total Carbohydrates (g)	12.3	4	n/a	1.5	0.5	n/a	8.5	2.7	n/a
Sugars (g)	12.3	14	n/a	n/a	n/a	n/a	8.5	10	n/a
Dietary Fibre (g) [#]	3.6	>12	>9.5	0.6	>2	>1.6	1.7	5.7	4.4
Sodium (mg) [#]	0	0	n/a	0	0	n/a	1.25	0	n/a
Potassium (mg) [#]	285	>7.5	n/a	12.7	0.3	n/a	210	>5.5	n/a
Thiamin (mg) [^]	0.11	>9.1	n/a	0.007	0.5	n/a	0.11	>9.1	n/a
Folate (µg DFE) [^]	94.5	23.6	15.8	1.8	0.5	0.3	71.3	17.8	11.8
Vitamin C (mg) [^]	78	173	>35.5	8.2	18.2	3.7	75	166	>34.1
Beta carotene (retinol equivalents µg)	105	>11.7	>1.8	1.3	0.1	0	7	0.6	0.1
Water (g) [#]	131.4	>3.9	n/a	4.35	0	n/a	110	>3.2	n/a
Glycaemic Index ^{4,5}	40-50 (LOW)	n/a	n/a	n/a	n/a	n/a	39-48 (LOW)	n/a	n/a

%DI = Percentage daily intake, %SDT = Percentage of Suggested Dietary Target, DFE = Dietary Folate Equivalents, N/A = not applicable. %DI for macronutrients based on adult RDI (recommended dietary intake) [^] or AI (adequate intake) [#] and SDT (suggested dietary target) [!]; %DI for macronutrients based on average adult diet 8700kJ and acceptable macronutrient distribution range¹. Data for peeled fruit and 100% juice from the Australian Food composition database via Xyris Foodworks Online²; Data for zest USDA database³; Peeled fruit data average of Valencia and Navel Oranges; 100% juice data average of 100% fresh squeezed and 100% commercial orange juices.

Nutrients

Vitamin C

Oranges are particularly well known for their high vitamin C content. Both juice and the eating portion of the orange are regarded as good sources of vitamin C (contain no less than 25% of the RDI).^{1,2,6} Specifically:

- One standard serve of peeled fruit (150g)⁷ or one glass of 100% juice (125ml)⁷ each provides more than 1.5 times the Nutrient Reference Value RDI of vitamin C (45mg/day for adults)^{1,2,6}
- When the regulatory RDI for adults of 40mg/day is considered, one standard serve of peeled fruit or juice has almost twice the daily requirements (195% for fruit and 188% for juice) for adults

Vitamin C is abundant in a wide variety of plant foods, and therefore some may argue that singling out high-content fruits like oranges is unnecessary. However, the suggested dietary target (SDT) for vitamin C is more than four times the RDI, highlighting how important it is to include foods high in vitamin C in the diet to reduce the risk of chronic disease. Eating one peeled fruit and drinking one glass of juice can fulfil 70% of the SDT for men, and 80% for women.



The suggested dietary target for vitamin C is more than four times higher than the RDI, highlighting how important it is to include foods high in vitamin C in the diet.

Vitamin C has the following functions in the body⁶ and oranges, due to their vitamin C content, can play an important role in each:

- Contributes to iron absorption from food
- Necessary for normal connective tissue structure and function
- Necessary for normal blood vessel structure and function
- Contributes to cell protection from free radical damage
- Necessary for normal neurological function
- Contributes to normal collagen formation for healthy cartilage, bones, teeth, gums and skin
- Contributes to normal energy metabolism
- Contributes to normal psychological function
- Contributes to the normal immune system function
- Contributes to the reduction of tiredness and fatigue
- Contributes to normal growth and development (in children)

Folate

Oranges and orange juice are sources of natural folate. One standard serve of peeled fruit (150g)⁷ provides more than 20% of the RDI and more than 15% of the SDT. One glass of 100% juice (125ml)⁷ provides more than 17% of the RDI and 10% of the SDT.^{1,2,6}

Folate has the following functions in the body⁶ and oranges, due to their folate content, can play an important role in each:

- Necessary for normal blood formation
- Necessary for normal cell division
- Contributes to normal amino acid synthesis
- Contributes to normal homocysteine metabolism
- Contributes to normal psychological function
- Contributes to normal immune system function
- Contributes to the reduction of tiredness and fatigue
- Contributes to normal growth and development (in children)
- Contributes to maternal tissue growth during pregnancy

Dietary Fibre

Oranges are a source of dietary fibre. One standard serve of peeled orange (150g)⁷ contains 3.6g of dietary fibre, which is at least 12% of the adult recommended adequate intake (AI) and almost 10% of the suggested dietary target (SDT).^{1,2,6}

Dietary fibre is important for regular laxation⁶ and beyond their fibre content, oranges have a unique fibre profile.

While most fruits and vegetables contain predominantly insoluble fibres, citrus fruits, including oranges, are unique in having mostly (more than 50%) soluble fibres⁸, including prebiotic fibres, which promote the growth of beneficial gut bacteria.⁹ Citrus fruits, including the zest and peeled fruit of oranges are one of the richest sources of high-quality pectin, a soluble fibre.¹⁰

Soluble fibre can:

- Reduce fat absorption¹¹
- Lower cholesterol¹² and blood sugar levels¹³
- Increase feelings of satiety (fullness)¹⁴

Sugar and Energy

Oranges are relatively low in energy¹⁵ at 263kJ for a standard 150g serve.⁷ This provides 3% of daily energy requirements of the average adult, and accounts for 4% of daily carbohydrates and 14% of daily sugars.^{1,2} One serve of orange juice (125ml)⁷ provides less than 2% of the daily energy requirements of the average adult, and accounts for 2.7% of daily carbohydrates and 10% of daily sugars.^{1,2} Both oranges and orange juice are low Glycemic Index and low Glycemic Load in standard serve sizes.^{4,5} Eating more fruit is linked to improved weight management.¹⁶



Bioactives

Oranges, like other citrus fruits, have a unique profile of bioactive compounds. Also known as phytochemicals and phytonutrients, these are naturally occurring compounds that have health-promoting effects.^{17, 18} Bioactives are a major reason why plant foods are good for us.

There is a diverse range of bioactives in foods, and they work through unique and overlapping pathways. Their benefits are likely to be enhanced by diversity due to different mechanisms and synergistic effects,^{17, 18} which means promoting a variety of bioactives in the diet is likely to be as important as quantity in health promotion.¹⁹

Bioactives are abundant in all parts of the orange, particularly the peel²⁰ and are high in the bioactive class polyphenols, with an average of 278.59mg/100g.²¹

Of the polyphenols, oranges are particularly high in flavonoids, especially flavanones and flavones, with 44.92mg/100g.^{21, 22}

Flavonoids have multiple health-promoting bioactive functions including antibacterial, antiviral, antioxidant, anti-inflammatory, antimutagenic, and anticarcinogenic, antihypertensive activities.²³ This means they can help reduce risks of a wide array of diseases including cardiovascular, neurodegenerative and inflammatory diseases, and some cancers.²⁴

Citrus flavonoids include hesperidin, hesperetin, naringenin, naringin, narirutin, diosmin, quercetin, rutin, nobiletin, and tangeretin.²² Many of these, particularly hesperidin and naringenin, are not common in fruits other than citrus.²⁵ In fact, oranges are a major source of flavonoids in the Australian diet, and are the richest dietary source of the flavanones hesperetin and naringenin.²⁷ Importantly, bioactives remain in 100% juice and may be more concentrated and bioavailable.²⁶



Oranges are a major source of flavonoids in the Australian diet, and are the richest dietary source of flavanones hesperetin and naringenin.

The health science



Immunity booster



Improved cardio health



Improved cognition



Low GI



Healthier skin



Good for the gut







Inflammation and Immune Health

Several human intervention studies have shown that drinking orange juice improves inflammatory profiles.²⁸⁻³¹ This could indicate fewer infections or improved inflammatory control. In a meta-analysis of interventions, inflammatory markers were lower with orange juice.³²

Good immune and inflammatory health involves maintaining the structures that prevent the entry of infection, the recognition and elimination of pathogens and controlling inflammation to prevent damage to tissues and organs. Oranges offer a unique package of nutrients and bioactive compounds to support immune health, including vitamin C, folate, dietary fibre and bioactives.



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Vitamin C

Vitamin C is critical for many inflammation and immune-related functions and it is well-established to be related to improved immune outcomes in meta-analyses of randomised controlled trials (the highest level of evidence).

For common colds regular vitamin C supplementation of 250 to 8000mg/day reduced duration and severity of the common cold³³ and decreased cold incidence in those under short-term physical stress.³³ For pneumonia, 200mg vitamin C daily for two and four weeks reduced severity scores in the more severe patients with low vitamin C,³⁴ 500 to 1600mg/day reduced duration of hospital stays and reduced the duration of symptoms³⁵ and 100-1000mg/day reduced risk of disease.³⁶

The biological functions of vitamin C that protect against infection and damaging inflammation include:³⁷

- Supporting barrier function and wound healing by promoting the formation of collagen, important to reduce the risk of infections
- Supporting function of white blood cells and chemotaxis to recruit immune cells to target (pathogens and damage), helping fight infections
- Antioxidant activity and anti-inflammatory activity, limiting damage to tissues
- Enhancing iron absorption – iron deficiency impairs immune function³⁸

Folate

Folate is essential for the creation of new cells, which makes it vital to immune system function,³⁹ to create immune cells to respond to infection and to maintain barriers to prevent the entry of infectious agents. Inadequate levels of folate can impair immune responses.³⁹

Dietary Fibres

Dietary fibres can have both direct and indirect effects on the immune system.⁴⁰ Soluble fibres support intestinal barrier function and interact with pathogen-sensing receptors on immune cells and gut cells, reducing the release of inflammatory mediators. In addition, dietary fibres fermented by the gut microbiota produce metabolites such as short chain fatty acids, which are absorbed into the blood stream potentially benefitting the immune system.

Bioactives

Emerging scientific evidence suggests that bioactive citrus flavonoids can help support immune function in three main ways:³⁷

- Anti-microbial activities, observed in cell culture studies^{37,41}
- Antioxidant functions via direct absorption and neutralisation of damaging free radicals, inhibition of enzymes associated with generating reactive oxygen species and enhancing the activities of antioxidant enzymes, observed in cell culture studies^{41,42}
- Anti-inflammatory and immunomodulatory roles, observed in cell-culture studies,^{37,43} animal models³⁷ and in human trials³⁷

Summary

Immune health and infection risk are complicated – but a healthy diet can contribute to immune and inflammatory health. Oranges are a unique package of nutrients and bioactive compounds to support immune health.



Cardiovascular Health

Oranges are suitable for inclusion in heart-healthy dietary patterns such as the Mediterranean diet, the DASH (dietary approaches to stopping hypertension) diet and plant-based eating patterns.

Citrus fruits and juice (including orange as the most common citrus consumed) reduce risk for poor cardiovascular health outcomes. This has been observed in a range of studies.

In two large cohorts followed long-term (the Nurses Health Study and the Health Professionals Follow-Up Study) citrus fruits (including juice) had one of the strongest protective links against ischaemic stroke of all fruit and vegetables.⁴⁴ The researchers found that one serve per day of citrus fruits reduced risk by 19% and citrus juice reduced risk by 25%.⁴⁴

In a pooled meta-analysis of randomised controlled trials, drinking 250-750mL/day of 100% orange juice lowered total cholesterol and LDL-cholesterol (low-density lipoprotein cholesterol aka “bad” cholesterol).³² A two-week intervention with a daily serve of 500ml of 100% orange juice lowered blood pressure by more than 5%.⁴⁵ An intervention study of a 60-day supplementation with 300ml of orange juice, reduced LDL-cholesterol (-16%) and triglycerides (-30%).⁴⁶ This was also linked to improved gut microbiota profiles.

High folate is associated with low homocysteine levels, which reduces the risk of cardiovascular disease (CVD). In the Framingham Heart Study cohort, regularly drinking orange juice was associated with higher blood folate and lower homocysteine levels.⁴⁷ Long-term orange juice drinking was associated with lower LDL-cholesterol and apolipoprotein B (a marker of ‘bad’ cholesterol levels) when consumers (240-720ml/day for at least 12 months) were compared to non-consumers.⁴⁸



In two large cohort studies, citrus juice was found to reduce risk of ischaemic stroke by 25%, one of the strongest protective links of all fruits and vegetables.

The antioxidant activity of vitamin C and citrus bioactives may reduce risk for CVD by reducing oxidation and damage of LDL-cholesterol, which causes heart attack or stroke.⁴⁹ High dietary vitamin C intake was associated with reduced coronary heart disease risk in a meta-analysis of prospective cohort studies (top third of intake vs. lowest third of intake).⁵⁰ Vitamin C enhances iron absorption and iron levels are commonly reduced in those with CVD.⁵¹

High intake of flavonoids is associated with reduced risk of CVD risk in a systematic review and meta-analysis.⁵¹ The review found that for each 10mg/day of flavanols, risk was reduced by 5%⁵² and when the highest vs. lowest categories of intakes were compared, flavonoids reduced risk for CVD by 12%.

Diets high in dietary fibre are also linked to reduced risk of CVD.⁵³ Soluble fibre intake lowers total and LDL-cholesterol levels¹² and reduces fat absorption.¹¹

Summary

Oranges can be an important part of diets to reduce risk for cardiovascular diseases:

- **vitamin C and bioactives protect against the damage to LDL-cholesterol that causes disease**
- **folate reduces harmful homocysteine levels**
- **dietary fibre can lower cholesterol levels and fat absorption**



Brain health

Oranges and orange juice may improve cognitive performance and reduce rates of cognitive decline.

In a cross-sectional study of more than 2000 older adults, one of the strongest positive associations with cognitive performance of all plant foods was citrus fruits.⁵⁴

In randomised controlled trials, drinking flavonoid-rich orange juice improved cognitive performance in healthy adults. Researchers found greater psychomotor speed after two hours, and improved executive function and subjective alertness six hours after consuming 240ml of juice.⁵⁵ These improvements coincided with increased flavonoid levels in the blood. Improved global cognitive function in older adults, after consuming 500mL orange juice daily.⁵⁶



An orange a day may just keep the doctor away. In a six year follow-up study, one serve of citrus a day reduced dementia risk by 23%.⁵⁷

Oranges and orange juice may reduce risk of dementia and cognitive decline in the elderly. In a prospective cohort study, citrus fruits were associated with reduced incidence of dementia. In a six year follow-up, one serve of citrus three to four times a week was associated with an 18% reduced risk of dementia and a daily serve was associated with a 23% reduced risk.⁵⁷

In analyses of long-term (18-30 year) follow-ups of large prospective cohorts, oranges and their juices were associated with better cognitive function in older age. Flavonoids (flavones, flavanones and flavonols) were associated 25-49% reduced risk of subjective cognitive decline. Eating oranges or drinking orange juice were the top food sources of flavones and flavanones in the diet of those studied.⁵⁸ Men who drank orange juice daily had 47% lower odds of having poor subjective cognitive performance, compared to those drinking it once a month or less.⁵⁹

The combination of vitamin C, soluble fibre and flavonoids in oranges may protect against cognitive decline.

Meta-analysis indicates that high vitamin C intakes (over 121mg/day) are associated with a reduced risk of Alzheimer's and dementia. Vitamin C deficiency is linked to increased occurrence of depression and reduced cognitive performance.⁶⁰ In addition, vitamin C may play a role by enhancing iron absorption, with iron deficiency associated with a reduction in cognitive function.⁶¹

Fibre, particularly soluble fibre, has been associated with a reduced risk of dementia in a large prospective cohort study.⁶²

Long-term (18-30 years) follow-ups of large prospective cohorts found better cognitive function in older age in those who ate more flavones (highest vs. lowest). There were 38% lower odds of subjective cognitive decline for the highest intakes compared to the lowest. This was estimated to be the equivalent to being three to four years younger.⁵⁸

Flavonoids can move from the blood into the brain⁶³ and may have neuroprotective effects via antioxidant activity and reduction in inflammation, which are key contributors to brain disease. Animal studies suggest that flavonoids increase levels of beneficial proteins in the brain.⁶⁴

Both flavonoids⁶⁵ and soluble fibres⁸ have prebiotic effects, feeding the gut microbiota and increasing the production of short chain fatty acids.

Summary

Oranges are a stand out for flavonoids and soluble fibres – these can promote brain health directly or through prebiotic effects on the microbiome influencing the gut-brain axis.



Metabolic health and weight management

Health science indicates oranges can improve metabolic health and play a valuable role in weight management beyond the satiety benefits of dietary fibre.^{13,14,15,32,46,66} Oranges are relatively low in energy¹⁵ and eating more fruit is linked to improved weight management.¹⁶

In a pooled meta-analysis of randomised controlled trials, orange juice positively influenced blood glucose and insulin levels, and HOME-IR an index of blood sugar control.³²

An intervention study of a 60 day supplementation with 300ml of orange juice reduced blood glucose (-6.5%), insulin (-33%), and insulin resistance (-44%).⁴⁶ This was linked to improved gut microbiota profiles. Extracts from oranges have been used as weight-loss supplements in human clinical⁶⁶ and animal trials⁶⁷ and improved insulin resistance in an animal model of obesity.⁶⁷



Skin health

The vitamin C, folate and flavonoids in oranges may also be beneficial for skin health.

Vitamin C is important for skin health with high concentrations accumulating in normal skin.⁷¹ It is essential for collagen synthesis, which is needed for wound repair and maintenance of skin barriers and its antioxidant functions can help protect against the damage from exposure to the sun and environmental toxins.

Folate is essential for DNA synthesis and repair and so may help protect against sun damage and risk for skin cancer.⁷²

The flavonoids found in oranges are well-known for their antioxidant and anti-inflammatory properties and can assist in the maintenance of overall skin health and reducing the impacts of sun and toxin exposures, the promotion of wound healing and anti-melanoma effects.⁷³





Gut health

Orange juice and the major contents of oranges have been linked to improved gut health outcomes. Drinking 300ml 100% orange juice daily for 60 days has been linked to improvement in gut microbiota profiles⁴⁶ and citrus bioactives, including hesperidin and naringin, can improve balance of the gut microbiota.

Studies in humans over seven days and two months showed increased levels of bacteria linked to improved health and reduced levels of bacteria linked to poor health outcomes.⁷⁴⁻⁷⁶

Orange juice also increases the production of beneficial short-chain fatty acids, which can improve the health of the gut, and travel to other organs to improve a broad range of health outcomes.⁷⁴

The dietary fibres found in oranges can promote gut health:

- Insoluble dietary fibres are thought to protect against colon cancer by absorbing carcinogens in the gastrointestinal tract. These absorbed carcinogenic agents can then be carried out of the body, minimising their potential for carcinogenesis.¹⁰
- Soluble dietary fibres such as pectin are fermented by gut microbes to produce short-chain fatty acids, primary acetate, propionate and butyrate, which can be absorbed into the gut wall and into the bloodstream.¹⁰ Short-chain fatty acids help maintain normal bowel function by regulating acid levels, which helps create the environment that promotes the growth of positive bacteria and inhibits the growth of pathogens. Acids can also help neutralise some toxins.¹⁰

The folate in oranges may also play a role in their gut health benefits. Folate contributes to gut barrier functions and immune cell responses, preventing infection and reducing harmful inflammation.³⁷



Culinary nutrition

Oranges are a practical and diverse choice for everyday eating

Available all Year Round

There are two main varieties of oranges grown in Australia – sweet Navel oranges, which are the preferred table fruit, and the more tart-tasting Valencia oranges, which produce great juice. These varieties have complementary seasons – Navel trees bear fruit from June to October and Valencia trees bear from November to February. Both varieties are sources of vitamin C, folate, other essential nutrients, and bioactive compounds.

Affordable and Nutrient-Dense

Oranges are an affordable and practical source of vitamin C and other nutrients. They are typically only a few dollars a kilogram, which makes them low cost relative to their nutrient density.⁷⁹ Their juice (100% orange juice) is a practical, nutrient-dense choice that increases the shelf life and can make their benefits more accessible.⁷⁹ The ability to use the zest of orange peel in addition to the peeled fruit and flesh helps reduce waste as the whole fruit can be used. Oranges are simple to prepare, compared to other common plant sources of folate, like green leafy vegetables, cruciferous vegetables, and legumes, and can be a great way to add sweetness and flavour to less palatable high-fibre dishes with vegetables and whole grains.

Get creative with oranges



▶ **Fresh or frozen**
Oranges are a low energy snack and a great replacement for discretionary foods which can contribute to overweight and obesity.⁷⁸



▶ **In drinks**
Add an orange slice fresh or dried to water, tea or other drinks.



▶ **For breakfast**
With cereal or porridge.



▶ **As juice**
Look for 100% juice to avoid added sugars or juice your own at home. Try freezing juice in ice blocks to enjoy on a hot day.



Easy and versatile

Oranges are familiar, affordable, and easy to use and prepare in a variety of ways, with versatility across meal occasions and types of dishes.

Oranges add colour variety to meals with a unique sweet-sour combination that may improve palatability, particularly in cases of loss of smell that impacts flavour perception during illness or aging.⁷⁷ Oranges can be enjoyed a wide range of people, all year round.

In salads

Try orange with carrot, halloumi and green leaves; fennel and almonds; beetroot, feta and mint; or goats cheese, honey, radish and walnuts.



In soups

You can add the whole fruit or juice and zest to your favourite soups. Try it with carrot and ginger soup; cauliflower soup; tomato soup; thyme and beef soup; or pumpkin soup.



In savoury dishes

Baking, grilling and barbecuing oranges brings out the sweetness. They make a great addition to meat, fish and chicken dishes and can be used as juice, sauce, or served as wedges.



To zest up dressings and marinades

Try orange vinaigrette or orange juice marinade with thyme or spices.



References



- 1 <https://www.eatforhealth.gov.au/nutrient-reference-values>.
- 2 Foodworks.online. V1.0 Professional. Brisbane: Xyris Pty Ltd, 2023.
- 3 <https://fdc.nal.usda.gov/>.
- 4 Atkinson, F. S., Brand-Miller, J. C., Foster-Powell, K., Buyken, A. E. and Goletzke, J. International tables of glycemic index and glycemic load values 2021: a systematic review. *The American Journal of Clinical Nutrition* **114**, 1625-1632 (2021). <https://doi.org/10.1093/ajcn/nqab233>
- 5 Atkinson, F. S., Foster-Powell, K. & Brand-Miller, J. C. International Tables of Glycemic Index and Glycemic Load Values: 2008. *Diabetes Care* **31**, 2281-2283 (2008). <https://doi.org/10.2337/dc08-1239>
- 6 Australia New Zealand Food Standards Code – Schedule 4 – Nutrition, health and related claims - <https://www.legislation.gov.au/Series/F2015L00474>.
- 7 <https://www.eatforhealth.gov.au/food-essentials/five-food-groups/fruit>.
- 8 Slavin, J. L. & Lloyd, B. Health Benefits of Fruits and Vegetables. *Advances in Nutrition* **3**, 506-516 (2012). <https://doi.org/https://doi.org/10.3945/an.112.002154>
- 9 Guan, Z. W., Yu, E. Z. & Feng, Q. Soluble Dietary Fiber, One of the Most Important Nutrients for the Gut Microbiota. *Molecules* **26** (2021). <https://doi.org/10.3390/molecules26226802>
- 10 Silalahi, J. Anticancer and health protective properties of citrus fruit components. *Asia Pacific Journal of Clinical Nutrition* **11**, 79-84 (2002). <https://doi.org/https://doi.org/10.1046/j.1440-6047.2002.00271.x>
- 11 Cohn, J. S., Kamili, A., Wat, E., Chung, R. W. & Tandy, S. Reduction in intestinal cholesterol absorption by various food components: mechanisms and implications. *Atherosclerosis Supplements* **11**, 45-48 (2010).
- 12 Ghavami, A. et al. Soluble Fiber Supplementation and Serum Lipid Profile: A Systematic Review and Dose-Response Meta-Analysis of Randomized Controlled Trials. *Advances in Nutrition* **14**, 465-474 (2023). <https://doi.org/https://doi.org/10.1016/j.advnut.2023.01.005>
- 13 Brennan, C. S. Dietary fibre, glycaemic response, and diabetes. *Molecular Nutrition & Food Research* **49**, 560-570 (2005). <https://doi.org/https://doi.org/10.1002/mnfr.200500025>
- 14 Salleh, S. N., Fairus, A. A. H., Zahary, M. N., Bhaskar Raj, N. & Mhd Jalil, A. M. Unravelling the Effects of Soluble Dietary Fibre Supplementation on Energy Intake and Perceived Satiety in Healthy Adults: Evidence from Systematic Review and Meta-Analysis of Randomised-Controlled Trials. *Foods* **8** (2019). <https://doi.org/10.3390/foods8010015>
- 15 Dreher, M. L. Whole Fruits and Fruit Fiber Emerging Health Effects. *Nutrients* **10**, 1833 (2018).
- 16 Rolls, B. J., Ello-Martin, J. A. & Tohill, B. C. What Can Intervention Studies Tell Us about the Relationship between Fruit and Vegetable Consumption and Weight Management? *Nutrition Reviews* **62**, 1-17 (2004). <https://doi.org/10.1111/j.1753-4887.2004.tb00001.x>
- 17 Samtiya, M., Aluko, R. E., Dhewa, T. & Moreno-Rojas, J. M. Potential Health Benefits of Plant Food-Derived Bioactive Components: An Overview. *Foods* **10** (2021). <https://doi.org/10.3390/foods10040839>
- 18 Richards, L. A. et al. Phytochemical diversity and synergistic effects on herbivores. *Phytochemistry Reviews* **15**, 1153-1166 (2016). <https://doi.org/10.1007/s11101-016-9479-8>
- 19 Blumfield, M. et al. "Should We Eat a Rainbow?" An Umbrella Review of the Health Effects of Colorful Bioactive Pigments in Fruits and Vegetables. *Molecules* **27**, 4061 (2022).
- 20 Saini, R. K. et al. Bioactive Compounds of Citrus Fruits: A Review of Composition and Health Benefits of Carotenoids, Flavonoids, Limonoids, and Terpenes. *Antioxidants (Basel)* **11** (2022). <https://doi.org/10.3390/antiox11020239>
- 21 <http://phenol-explorer.eu/>.
- 22 Gattuso, G., Barreca, D., Gargiulli, C., Leuzzi, U. & Caristi, C. Flavonoid composition of Citrus juices. *Molecules* **12**, 1641-1673 (2007). <https://doi.org/10.3390/12081641>
- 23 Roy, A. et al. Flavonoids a Bioactive Compound from Medicinal Plants and Its Therapeutic Applications. *Biomed Res Int* **2022**, 5445291 (2022). <https://doi.org/10.1155/2022/5445291>

- 24 Chandrasekara, A. & Shahidi, F. Herbal beverages: Bioactive compounds and their role in disease risk reduction - A review. *Journal of Traditional and Complementary Medicine* **8**, 451-458 (2018). [https://doi.org:https://doi.org/10.1016/j.jtcme.2017.08.006](https://doi.org/https://doi.org/10.1016/j.jtcme.2017.08.006)
- 25 Robards, K. & Antolovich, M. Analytical chemistry of fruit bioflavonoids A review. *Analyst* **122**, 11R-34R (1997).
- 26 Clemens, R., Drewnowski, A., Ferruzzi, M. G., Toner, C. D. & Welland, D. Squeezing fact from fiction about 100% fruit juice. *Adv Nutr* **6**, 236s-243s (2015). <https://doi.org:10.3945/an.114.007328>
- 27 Somerset, S. M. & Johannot, L. Dietary flavonoid sources in Australian adults. *Nutr Cancer* **60**, 442-449 (2008). <https://doi.org:10.1080/01635580802143836>
- 28 Morand, C. et al. Hesperidin contributes to the vascular protective effects of orange juice: a randomized crossover study in healthy volunteers. *The American journal of clinical nutrition* **93**, 73-80 (2011).
- 29 Milenkovic, D., Deval, C., Dubray, C., Mazur, A. & Morand, C. Hesperidin displays relevant role in the nutrigenomic effect of orange juice on blood leukocytes in human volunteers: a randomized controlled cross-over study. *PLoS One* **6**, e26669 (2011).
- 30 Buscemi, S. et al. Effects of red orange juice intake on endothelial function and inflammatory markers in adult subjects with increased cardiovascular risk. *The American journal of clinical nutrition* **95**, 1089-1095 (2012).
- 31 Asgary, S. et al. Effect of fresh orange juice intake on physiological characteristics in healthy volunteers. *International Scholarly Research Notices* **2014** (2014).
- 32 Alhabeeb, H. et al. Impact of orange juice consumption on cardiovascular disease risk factors: a systematic review and meta-analysis of randomized-controlled trials. *Crit Rev Food Sci Nutr* **62**, 3389-3402 (2022). <https://doi.org:10.1080/10408398.2020.1865263>
- 33 Hemilä, H. & Chalker, E. Vitamin C for preventing and treating the common cold. *Cochrane Database of Systematic Reviews* (2013). <https://doi.org:10.1002/14651858.CD000980.pub4>
- 34 Hunt, C., Chakravorty, N., Annan, G., Habibzadeh, N. & Schorah, C. The clinical effects of vitamin C supplementation in elderly hospitalised patients with acute respiratory infections. *International journal for vitamin and nutrition research* **64**, 212-219 (1994).
- 35 Mochalkin, N. Ascorbic acid in the complex therapy of acute pneumonia. *Voенно-Meditsinskii Zhurnal* **9**, 17-21 (1970).
- 36 Hemilä, H. & Louhiala, P. Vitamin C for preventing and treating pneumonia. *Cochrane Database of Systematic Reviews* (2013). <https://doi.org:10.1002/14651858.CD005532.pub3>
- 37 Miles, E. A. & Calder, P. C. Effects of Citrus Fruit Juices and Their Bioactive Components on Inflammation and Immunity: A Narrative Review. *Frontiers in Immunology* **12** (2021). <https://doi.org:10.3389/fimmu.2021.712608>
- 38 Ni, S., Yuan, Y., Kuang, Y. & Li, X. Iron Metabolism and Immune Regulation. *Frontiers in Immunology* **13** (2022). <https://doi.org:10.3389/fimmu.2022.816282>
- 39 Mikkelsen, K. & Apostolopoulos, V. in *Nutrition and Immunity* (eds Maryam Mahmoudi & Nima Rezaei) 103-114 (Springer International Publishing, 2019).
- 40 Venter, C. et al. Role of dietary fiber in promoting immune health—An EAACI position paper. *Allergy* **77**, 3185-3198 (2022). <https://doi.org:https://doi.org/10.1111/all.15430>
- 41 Stevens, Y. et al. The effects of citrus flavonoids and their metabolites on immune-mediated intestinal barrier disruption using an in vitro co-culture model. *Br J Nutr* **128**, 1917-1926 (2022). <https://doi.org:10.1017/s0007114521004797>
- 42 Lv, X. et al. Citrus fruits as a treasure trove of active natural metabolites that potentially provide benefits for human health. *Chem Cent J* **9**, 68 (2015). <https://doi.org:10.1186/s13065-015-0145-9>
- 43 Liu, W. et al. Citrus fruits are rich in flavonoids for immunoregulation and potential targeting ACE2. *Natural Products and Bioprospecting* **12**, 4 (2022). <https://doi.org:10.1007/s13659-022-00325-4>
- 44 Joshipura, K. J. et al. Fruit and Vegetable Intake in Relation to Risk of Ischemic Stroke. *JAMA* **282**, 1233-1239 (1999). <https://doi.org:10.1001/jama.282.13.1233>
- 45 Asgary, S. & Keshvari, M. Effects of Citrus sinensis juice on blood pressure. *ARYA Atheroscler* **9**, 98-101 (2013).
- 46 Fidélis, M., Milenkovic, D., Sivieri, K. & Cesar, T. Microbiota modulation and effects on metabolic biomarkers by orange juice: a controlled clinical trial. *Food Funct* **11**, 1599-1610 (2020). <https://doi.org:10.1039/c9fo02623a>
- 47 Tucker, K. L., Selhub, J., Wilson, P. W. & Rosenberg, I. H. Dietary Intake Pattern Relates to Plasma Folate and Homocysteine Concentrations in the Framingham Heart Study. *The Journal of Nutrition* **126**, 3025-3031 (1996). <https://doi.org:https://doi.org/10.1093/jn/126.12.3025>
- 48 Aptekmann, N. P. & Cesar, T. B. Long-term orange juice consumption is associated with low LDL-cholesterol and apolipoprotein B in normal and moderately hypercholesterolemic subjects. *Lipids in Health and Disease* **12**, 119 (2013). <https://doi.org:10.1186/1476-511X-12-119>
- 49 Morelli, M. B., Gambardella, J., Castellanos, V., Trimarco, V. & Santulli, G. Vitamin C and Cardiovascular Disease: An Update. *Antioxidants (Basel)* **9** (2020). <https://doi.org:10.3390/antiox9121227>
- 50 Ye, Z. & Song, H. Antioxidant vitamins intake and the risk of coronary heart disease: meta-analysis of cohort studies. *European Journal of Cardiovascular Prevention & Rehabilitation* **15**, 26-34 (2008). <https://doi.org:10.1097/HJR.0b013e3282f11f95>
- 51 Naito, Y., Masuyama, T. & Ishihara, M. Iron and cardiovascular diseases. *Journal of Cardiology* **77**, 160-165 (2021). <https://doi.org:https://doi.org/10.1016/j.jjcc.2020.07.009>
- 52 Wang, X., Ouyang, Y. Y., Liu, J. & Zhao, G. Flavonoid intake and risk of CVD: a systematic review and meta-analysis of prospective cohort studies. *Br J Nutr* **111**, 1-11 (2014). <https://doi.org:10.1017/s000711451300278x>

- 53 Threapleton, D. E. *et al.* Dietary fibre intake and risk of cardiovascular disease: systematic review and meta-analysis. *BMJ : British Medical Journal* **347**, f6879 (2013). <https://doi.org/10.1136/bmj.f6879>
- 54 Nurk, E. *et al.* Cognitive performance among the elderly in relation to the intake of plant foods. The Hordaland Health Study. *Br J Nutr* **104**, 1190-1201 (2010). <https://doi.org/10.1017/s0007114510001807>
- 55 Alharbi, M. H. *et al.* Flavonoid-rich orange juice is associated with acute improvements in cognitive function in healthy middle-aged males. *European Journal of Nutrition* **55**, 2021-2029 (2016). <https://doi.org/10.1007/s00394-015-1016-9>
- 56 Kean, R. J. *et al.* Chronic consumption of flavanone-rich orange juice is associated with cognitive benefits: an 8-wk, randomized, double-blind, placebo-controlled trial in healthy older adults. *The American Journal of Clinical Nutrition* **101**, 506-514 (2015). <https://doi.org/https://doi.org/10.3945/ajcn.114.088518>
- 57 Zhang, S., Tomata, Y., Sugiyama, K., Sugawara, Y. & Tsuji, I. Citrus consumption and incident dementia in elderly Japanese: the Ohsaki Cohort 2006 Study. *British Journal of Nutrition* **117**, 1174-1180 (2017). <https://doi.org/10.1017/S000711451700109X>
- 58 Yeh, T. S. *et al.* Long-term Dietary Flavonoid Intake and Subjective Cognitive Decline in US Men and Women. *Neurology* **97**, e1041-e1056 (2021). <https://doi.org/10.1212/wnl.00000000000012454>
- 59 Yuan, C. *et al.* Long-term intake of vegetables and fruits and subjective cognitive function in US men. *Neurology* **92**, e63-e75 (2019). <https://doi.org/10.1212/wnl.00000000000006684>
- 60 Plevin, D. & Galletly, C. The neuropsychiatric effects of vitamin C deficiency: a systematic review. *BMC Psychiatry* **20**, 315 (2020). <https://doi.org/10.1186/s12888-020-02730-w>
- 61 Pivina, L., Semenova, Y., Doşa, M. D., Dauletarova, M. & Björklund, G. Iron Deficiency, Cognitive Functions, and Neurobehavioral Disorders in Children. *J Mol Neurosci* **68**, 1-10 (2019). <https://doi.org/10.1007/s12031-019-01276-1>
- 62 Yamagishi, K. *et al.* Dietary fiber intake and risk of incident disabling dementia: the Circulatory Risk in Communities Study. *Nutr Neurosci* **26**, 148-155 (2023). <https://doi.org/10.1080/1028415x.2022.2027592>
- 63 Figueira, I. *et al.* Polyphenols journey through blood-brain barrier towards neuronal protection. *Scientific Reports* **7**, 11456 (2017). <https://doi.org/10.1038/s41598-017-11512-6>
- 64 Rendeiro, C. *et al.* Dietary levels of pure flavonoids improve spatial memory performance and increase hippocampal brain-derived neurotrophic factor. *PLoS One* **8**, e63535 (2013). <https://doi.org/10.1371/journal.pone.0063535>
- 65 Cheatham, C. L., Nieman, D. C., Neilson, A. P. & Lila, M. A. Enhancing the Cognitive Effects of Flavonoids With Physical Activity: Is There a Case for the Gut Microbiome? *Frontiers in Neuroscience* **16** (2022). <https://doi.org/10.3389/fnins.2022.833202>
- 66 Cardile, V., Graziano, A. C. E. & Venditti, A. Clinical evaluation of Moro (Citrus sinensis (L.) Osbeck) orange juice supplementation for the weight management. *Natural Product Research* **29**, 2256-2260 (2015). <https://doi.org/10.1080/14786419.2014.1000897>
- 67 Lee, Y. S. *et al.* Nobiletin improves obesity and insulin resistance in high-fat diet-induced obese mice. *J Nutr Biochem* **24**, 156-162 (2013). <https://doi.org/10.1016/j.jnutbio.2012.03.014>
- 68 Cairns, A. M., Watson, M., Creanor, S. L. & Foye, R. H. The pH and titratable acidity of a range of diluting drinks and their potential effect on dental erosion. *Journal of Dentistry* **30**, 313-317 (2002). [https://doi.org/https://doi.org/10.1016/S0300-5712\(02\)00044-1](https://doi.org/https://doi.org/10.1016/S0300-5712(02)00044-1)
- 69 Murererehe, J., Uwitonze, A. M., Nikuze, P., Patel, J. & Razzaque, M. S. Beneficial Effects of Vitamin C in Maintaining Optimal Oral Health. *Front Nutr* **8**, 805809 (2021). <https://doi.org/10.3389/fnut.2021.805809>
- 70 Akikusa, J., Garrick, D. & Nash, M. Scurvy: Forgotten but not gone. *Journal of Paediatrics and Child Health* **39**, 75-77 (2003). <https://doi.org/https://doi.org/10.1046/j.1440-1754.2003.00093.x>
- 71 Pullar, J. M., Carr, A. C. & Vissers, M. C. M. The Roles of Vitamin C in Skin Health. *Nutrients* **9** (2017). <https://doi.org/10.3390/nu9080866>
- 72 Williams, J. D., Jacobson, E. L., Kim, H., Kim, M. & Jacobson, M. K. Folate in skin cancer prevention. *Subcell Biochem* **56**, 181-197 (2012). https://doi.org/10.1007/978-94-007-2199-9_10
- 73 Sebghatollahi, Z. *et al.* Citrus Flavonoids: Biological Activities, Implementation in Skin Health, and Topical Applications: A Review. *ACS Food Science & Technology* **2**, 1417-1432 (2022). <https://doi.org/10.1021/acsfoodscitech.2c00165>
- 74 Lima, A. C. D. *et al.* Effect of Daily Consumption of Orange Juice on the Levels of Blood Glucose, Lipids, and Gut Microbiota Metabolites: Controlled Clinical Trials. *Journal of Medicinal Food* **22**, 202-210 (2019). <https://doi.org/10.1089/jmf.2018.0080>
- 75 Domínguez-Avila, J. A. *et al.* Phenolic Compounds Promote Diversity of Gut Microbiota and Maintain Colonic Health. *Digestive Diseases and Sciences* **66**, 3270-3289 (2021). <https://doi.org/10.1007/s10620-020-06676-7>
- 76 Pereira-Caro, G. *et al.* In vitro colonic catabolism of orange juice (poly) phenols. *Molecular Nutrition & Food Research* **59**, 465-475 (2015).
- 77 Sergi, G., Bano, G., Pizzato, S., Veronese, N. & Manzato, E. Taste loss in the elderly: Possible implications for dietary habits. *Critical Reviews in Food Science and Nutrition* **57**, 3684-3689 (2017). <https://doi.org/10.1080/10408398.2016.1160208>
- 78 Almorae, N. M. *et al.* Snacking patterns throughout the life span: potential implications on health. *Nutrition Research* **91**, 81-94 (2021). <https://doi.org/https://doi.org/10.1016/j.nutres.2021.05.001>
- 79 Darmon, N., Darmon, M., Maillot, M. & Drewnowski, A. A Nutrient Density Standard for Vegetables and Fruits: Nutrients per Calorie and Nutrients per Unit Cost. *Journal of the American Dietetic Association* **105**, 1881-1887 (2005). <https://doi.org/https://doi.org/10.1016/j.jada.2005.09.005>





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