



# Apple cider vinegar

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**A**pple cider vinegar (ACV) is commonly used as vinegar in salad dressings, marinades and sauces. ACV is produced by a two-step fermentation process where yeast and bacteria are added to the juice from pulverised apples, first converting sugars to alcohol and then to acetic acid, giving the vinegar its characteristic sour taste. Reportedly used as a healing elixir as far back as 3300 B.C. for wound disinfection, infections, insect bites, warts, scurvy, and for overall health, power and strength, more recent claims for ACV include treatment of dermatological conditions (eg acne, eczema, dandruff), dyslipidaemia, obesity, dyspepsia, gastroparesis, nephrolithiasis, osteoporosis, glucose control in diabetes, slowing ageing and cognitive decline, and improving athletic performance. Consumer interest in ACV has risen with COVID-19 due to supposed immune-stimulating effects.

**COMMON NAMES:** ACV, cider vinegar, apple vinegar

**PREPARATIONS:** Available as vinegar, liquid drops, tablets, capsules, powder, gummies, and topical preparations such as face peels, creams, salve, body wash, and shampoo.

Considerable variation has been found between commercially available ACV tablets with acetic acid ranging between 1–10.6% and citric acid between 0–18.5%. Some products may also contain malic and lactic acid.

**MANUFACTURERS CLAIMS:** Apple cider vinegar is claimed to increase satiety and assist in weight loss, lower blood sugar and cholesterol, improve insulin sensitivity, promote pH balance, improve digestion, and aid in detoxification.

**ACTIVE CONSTITUENTS:** Acetic acid and polyphenolic compounds are the main active constituents of ACV. Other organic acid compounds include succinic, ascorbic, formic, citric, and oxalic and citric acid. ACV is also likely to contain pectin, vitamins B and C, and small quantities of sodium, potassium, calcium, iron, phosphorous, and magnesium.

**EVIDENCE FOR EFFICACY:** A recent systematic review and meta-analysis has found consumption of ACV to be associated with greater glycaemic control in patients with type 2 diabetes compared with other vinegar products. In healthy individuals,

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## Summary message

Some evidence supports the antiglycaemic, antihyperlipidemic, and antiobesogenic properties of apple cider vinegar. Although findings may be positive, the majority of results come from animal and *in vitro* studies. Human trials are restricted by serious limitations including low participant numbers and short study duration; hence more high-quality, long-term clinical studies are warranted before health claims can be substantiated. Although generally well tolerated, large quantities and topical application of ACV may be unsafe. Patients with allergies to apples and pectin should avoid the use of ACV. Use is not recommended in pregnancy and lactation due to insufficient evidence. Caution is advised with concomitant use of hypoglycaemics and medicines that reduce potassium due to possible synergistic effects, and in patients with diabetic gastroparesis due to possible delayed gastric emptying rate.

Herbal medicines are a popular health care choice, but few have been tested to contemporary standards. **POTION OR POISON?** summarises the evidence for the potential benefits and possible harms of well-known herbal medicines.

antiglycaemic effects of acetic acid are more pronounced when ingested immediately before a starchy and high glycaemic index (GI) meal; an effect not seen with monosaccharide dextrose and low GI meals. Over 8 weeks, 20 mL ACV daily caused significant changes in fasting blood glucose and other glycaemic indices. In type 2 diabetes subjects, a 0.16% reduction in HbA1c was seen with two tablespoons ACV (1400 mg acetic acid) twice daily over 12 weeks, while those taking an ACV tablet (15 mg acetic acid) exhibited an increase of 0.06%. Discrepancies in study findings suggest dosage, acidity, the timing of ingestion, meal content, and GI as well as the level of insulin secretion and resistance may play a role in the effectiveness of ACV. Although the mechanism of antiglycaemic activity is unclear, several studies have proposed this could be due to activation of the AMPK pathway, delayed gastric emptying, suppression of disaccharidase activity in the small intestine, increase in insulin sensitivity, and improved post-prandial satiety.

The effect of ACV on lipid metabolism and obesity is less clear. Few human trials are available and exhibit important study limitations. ACV has shown to reduce serum triglyceride levels, total cholesterol and LDL-c in both animal and human trials, while an increase in HDL has only been seen in animal studies. Effects on bodyweight and lipid metabolism may be by activation of the AMPK pathway, increasing lipolysis, reducing lipogenesis, promoting faecal excretion of bile acid, and increasing satiety and energy expenditure. Although a reduction of 1.6 kg was seen in obese

participants compared to controls over 12 weeks, BMI, weight and waist circumference returned to baseline values 4 weeks after stopping vinegar consumption.

**ADVERSE EFFECTS:** In quantities typically consumed in foods, and short-term for medicinal purposes, ACV is generally well tolerated. Larger quantities and topical application may be unsafe. Although serious adverse effects are rare, hypokalaemia, hyperreninemia, and osteoporosis were reported in a 26-year old woman who consumed 250 mL ACV daily for 6 years. Oesophageal injury has occurred with a lodged ACV tablet and topical application has resulted in skin irritation and chemical burns. The acidity of undiluted ACV may destroy tooth enamel.

**INTERACTIONS:** Caution is advised with concomitant use of hypoglycaemics due to possible additive effects and with medicines or other herbal preparations that lower potassium (eg digoxin, insulin and potassium-depleting diuretics) due to the theoretic risk of hypokalaemia.

## Key references

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