

SURPRISING NEW EVIDENCE ABOUT 100% ORANGE JUICE

INTRODUCTION

The presence of the natural sugars in 100% fruit juices (100%FJ) has raised questions about whether they are simply 'sugary drinks' in health terms. However, there is evidence that 100%FJ are either neutral or positive in relation to obesity, glucose control and nutrient delivery.

Furthermore, while excess fructose has been associated with hyperuricemia and the risk of gout¹, again 100%FJ appear to have a different impact. This article will look at these issues in more detail, citing published studies.

PURE FRUIT JUICE IS NOT 'SUGARY WATER'

A new randomised crossover study² conducted in Germany recruited 26 healthy adults who were asked to consume either a caffeine-free sugar-sweetened beverage (SSB) or 100% orange juice (100%OJ). The drinks were matched for total sugar content, providing an average intake of 112 g of sugars per day from drinks alone.

The amount provided was 20% of the participants' daily calorie (energy) requirement, equivalent to around 1.3 l per day. This intake was chosen because 20% of daily energy supply may result from high beverage consumption. In reality, 100%FJ consumption in Europe is less than 100 ml/day on average, while recommended intakes tend to be 150-200 ml/day.

After 2 weeks, and a 1- to 2-week washout period, participants switched to the other beverage for a further 2 weeks. During the study, measurements were taken to evaluate the impact on glycaemic control, uric acid metabolism (a marker for gout risk), body weight and gut microbiota.

The study revealed the following results:

- No statistically significant changes in body weight, gut microbiota or insulin sensitivity (measured by oral glucose tolerance test) after consuming either beverage, indicating no negative impact on these markers;
- Consuming 100%OJ resulted in a significantly smaller area under the curve for glycaemia, increased C-peptide excretion, and tighter daytime glucose variability, indicating more favourable glycaemic control;
- Serum potassium levels were lower after SSB but unchanged after 100%OJ. The latter is a source of potassium which is proven to support normal blood pressure;

- Average blood uric acid levels reduced by 0.43 mg/dl (p<0.01) after daily 100%OJ consumption due to increased uric acid excretion, indicating a more favourable situation in terms of gout risk.

Thus, despite containing natural sugars, 100%OJ at intakes above 1 l daily did not increase the risk of gout nor have any detrimental impact on glycaemic control. The authors concluded that this may be due to other constituents in 100%OJ, such as vitamin C, flavanones and carotenoids, that are not typically found in SSB (see table below).

Per 100 g	100%OJ ^a	Typical SSB ^a
Energy kcal	41	40.6
Total sugars g	9.1	10.8
Calcium mg	11	5.9
Iron mg	0.2	0
Magnesium mg	9.5	1
Phosphorus mg	15.3	29.7
Potassium mg	152	1
Zinc mg	0.1	0
Vitamin C mg	36.4	0
Thiamin mg	0.1	0
Riboflavin mg	0	0
Niacin mg	0.3	0
Folate mcg	21.5	0
Vitamin B6 mg	0.1	0
Vitamin A mcg	4.1	0
Vitamin E mcg	0.2	0
Hesperidin & narirutin mg ³	63	0
Pectin mg ⁴	8-12	0
Glycaemic index	50	63
Glycaemic load ^b	11	21

^a Data from food tables unless stated; ^b calculated from glycaemic index and portion sizes of 250 ml for 100%OJ and 330 ml for SSB.

It is also worth noting that the glycaemic index (GI) and load of 100%OJ are lower than that seen in a typical SSB with an equivalent sugar content. This may be due to the presence of pectin or

bioactive compounds. International GI tables⁵ state that 100% apple juice has a GI of 41, while 100%OJ has a GI of 50 – both categorised as 'low.'

BEST TO DRINK FRUIT JUICE WITH MEALS?

A second new randomised crossover trial⁶ from Germany considered the most favourable time to drink 100%FJ from a metabolic perspective. 26 healthy adults were given a supply of 100%OJ to drink for 2 weeks, either between meals or with meals, i.e. 3 times a day. After this, there was a 1-week washout period before switching to the alternative condition. During the study, other citrus juices were not permitted.

Once again, the amount of 100%OJ consumed was equivalent to 20% of calculated daily energy requirement which was an average intake of 1.3 l per day, including 112 ±19 g per day of natural sugars. This is more than ten times higher than typical intakes in Europe.

The results revealed that drinking 100%OJ with a meal led to a small net decrease in average fat mass of -0.3 kg ($p < 0.05$) while between meal consumption led to a modest net increase in average fat mass of 1.0 kg ($p < 0.05$). Interestingly, the additional energy provided by the 100%OJ equated to 7700 kcal over 2 weeks which would have theoretically increased fat mass by 855 ±150 g. Clearly, in the case of 'with meal' consumption, this theoretical increase in fat mass did not materialise.

Insulin sensitivity, measured by HOMA-IR and Matsuda index, did not differ significantly after either intervention. Neither were differences seen in daylong glycaemia, insulin secretion, change in basal insulin sensitivity or triglyceride levels (all $p > 0.05$). However, a liver function marker (gamma-glutamyl transferase) was significantly lower after the 'with meal' condition indicating a more favourable liver function. This challenges the view that fructose in 100%FJ adversely affects liver function.

The authors concluded that a conventional 3-meal structure served with 100%OJ had a more favourable impact on energy balance and fat mass than between-meal consumption. However, it should be noted that this study was short-term (2 weeks) and used excess intakes of 100%FJ. The results, therefore, need to be confirmed in studies using more typical intakes (150-250 ml).

100%FJ COMPARED WITH OTHER DRINKS

A small number of previous studies have compared 100%FJ with control beverages (typically sweetened) in terms of type 2 diabetes risk, blood lipids or weight gain.

A meta-analysis⁷ of 4 cohorts of adults found that consumption of fruit juices with added sugars was significantly associated with an increased risk of type 2 diabetes (RR=1.28) while consumption of 100%FJ was not associated (RR=1.03, $p = 0.62$). For regulatory reasons, 100%FJ never contain added sugars.

In a randomised, single-blinded, placebo-controlled clinical study⁸, 36 overweight healthy participants received either 250 ml daily of 100%OJ or sweetened flavoured water for 12 weeks. Compared with the control, 100%FJ had no significant impact on fasting blood glucose and insulin sensitivity markers, suggesting that 100%FJ have a neutral effect overall on markers of glycaemic control. Nor did 100%FJ have any adverse effects on blood lipid profile.

Another study⁹ on blood lipids recruited adults with elevated or normal cholesterol levels to drink either 750 ml daily of 100%OJ from concentrate for 60 days versus a 'no juice' control. Low density lipoprotein cholesterol was significantly reduced by the end of the trial amongst those subjects with elevated cholesterol levels at baseline, whilst high density lipoprotein cholesterol was raised. These findings suggest that 100%OJ may facilitate free cholesterol transfer to high density lipoprotein cholesterol, which is a favourable effect in terms of normal heart health.

There is a belief that 100%FJ contribute to weight gain, despite a lack of support from high quality intervention studies. In a recent trial¹⁰, 78 obese people were randomised to drink 500 ml daily of either 100%OJ or a control drink over 12 weeks as part of an energy-reduced diet. Both groups lost similar amounts of weight, despite one group consuming high intakes of 100%OJ. In addition, vitamin C and folate intakes increased by 62% and 39% respectively in the 100%OJ group, but not in the control group. Daily energy intakes were unaffected by the drinks, suggesting energy compensation. Significant improvements in insulin and lipid profiles were seen in the 100%OJ group relative to the control.

These findings support other meta-analyses of randomised controlled trials^{11,12} which have found a neutral impact of regular 100%FJ consumption on long-term glycaemic control, even at intakes of 400 ml daily¹³.

EXPLAINING THE DIFFERENCES

As discussed, the nutritional composition of 100%FJ is markedly different to that of SSB. Whilst sugar and, thus, energy levels are similar, the micronutrient composition is far richer in 100%FJ. In the cases of potassium, vitamin C and folate, levels in 100%OJ are such that on-pack 'source' claims can be made.

100%OJ also contains bioactive flavanones such as hesperidin and narirutin, which have been associated with health effects¹⁴. Polyphenol compounds in 100%FJ have been proposed to have an important role in glucose-insulin regulation by inhibiting glucose absorption, stimulating insulin secretion and glucose uptake by cells, and modulating cell signalling pathways as well as gene expression⁷.

Bioactive constituents in 100%OJ have been linked with other health effects. For example, in an 8-week trial¹⁵ volunteers drank 100% red OJ (high in lycopene) daily. Compared with the control group, 100%OJ intake led to statistically reduced blood pressure and insulin resistance.

In a randomised controlled trial¹⁶, 24 overweight men drank 500 ml of 100%OJ or a control drink with added hesperidin, or a placebo drink over 4 weeks. The results showed that both 100%OJ and the hesperidin drink significantly reduced diastolic blood pressure, and improved endothelium-dependent microvascular reactivity (an indicator of how well the lining of blood vessels constrict or relax). This suggests that the vascular benefits of oranges and 100%OJ may be due to hesperidin.

Other work¹⁷ has found that 100%OJ consumption can lead to the short-term elevation in plasma of 8 different flavanones and 15 phenolic compounds. Flavanones are soluble compounds which are found in the juice cloud, rather than in cell walls, which explains their increased bioavailability in juice compared with whole fruits³. Studies have also confirmed a high bioavailability of carotenoids in 100%OJ¹⁸.

It is well-recognised that eating a diet rich in fruit and vegetables is associated with lower mortality and risk of chronic diseases¹⁹. Given these findings, it would appear that including a daily serving of 100%FJ as part of the fruit and vegetable component would complement this.

CONCLUSIONS

100%FJ cannot be classified as SSB due to their more complex matrix, directly impacted by the nutritional composition of the juiced natural fruit, without added sugars. Specifically:

- 100%FJ, especially 100%OJ, are a valuable source of nutrients such as potassium, folate and vitamin C;
- 100%FJ contain bioactive compounds, including carotenoids and flavanones, which are bioavailable;
- Despite a similar sugars content, 100%FJ have a lower than anticipated GI.

Controlled trials and meta-analyses suggest that, compared with control drinks, consumption of 100%FJ, especially 100%OJ, is associated with the following effects:

- No demonstrable impact on body composition, even when consumed in large amounts by overweight adults, with or without an energy-reduced diet;
- Higher potassium levels. Potassium is proven to support normal blood pressure;
- Significantly lower blood uric acid levels. Raised uric acid is a risk factor for gout;
- A neutral effect on blood glucose or insulin levels, and no statistically significant association with risk of type 2 diabetes;
- Favourable effects on total and LDL-c and other markers of metabolic syndrome.

A new randomised controlled trial⁶ suggests that drinking 100%FJ with meals may have more favourable effects on fat mass (net decrease) than drinking it between meals (net increase). However, this study was relatively short-term and used an intake of 100%FJ that is more than 10 times typical consumption. The study should be repeated using intakes of around 150-250 ml.

Disclaimer: Every effort has been made to ensure that the information contained in this document is reliable and has been verified. The information is intended for non-commercial communication to healthcare professionals only. The information given in this dossier does not constitute dietary advice.

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