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A comparison of kiwifruit (Actazin / Livaux) to prunes (dried plums)

EXECUTIVE SUMMARY

Clinical studies show kiwifruit performs better overall than prunes in promoting digestive health. Key compositional differences between the fruits include the presence of sorbitol in prunes, and actinidin and higher levels of vitamin C in kiwifruit. Actinidin in kiwifruit helps to reduce bloating, which is not observed with prunes.

FAST FACTS

How does kiwifruit compare to prunes in clinical studies:

Kiwifruit performs better overall than prunes in bowel regularity measures

Kiwifruit improves bloating (not observed in prunes)

Kiwifruit is better tolerated with less adverse effects and is more satisfactory

In a clinical study (Chey et al 2020) directly comparing kiwifruit, prunes and psyllium, whilst all three interventions were found to be effective in improving stool frequency, kiwifruit was found to be more satisfactory with less adverse events and improved bloating compared to prunes and psyllium. Further, a systematic review and meta-analysis of foods, drinks and diets and their effect on chronic constipation (Van der Schoot et al 2024), found kiwifruit to be well-tolerated and improved stool frequency compared to psyllium, whereas prunes were no more effective than psyllium.

KIWIFRUIT

Kiwifruit (*Actinidia chinensis / Actinidia deliciosa*) are known to have a mild laxative effect.

EU Health Claim: 'Consumption of kiwifruit contributes to the maintenance of normal defecation'.[1] Conditions of use: In order to obtain the claimed effect, two large green kiwifruits (i.e. around 200 g of kiwi flesh) should be consumed.

BACKGROUND

Kiwifruit is the fruit of the *Actinidia* genus. The most common variety is the green-fleshed Hayward (*Actinidia chinensis* var. *deliciosa* 'Hayward') which is well known as a nutrient-dense fruit with numerous health benefits, including facilitating laxation. Both the fresh fruit and dried powder variants of kiwifruit have been studied for this effect.

The beneficial effect of Actazin begins in the stomach and extends all the way through to the large intestine. Users feel immediate relief from bloating with improved bowel movements.

1 https://efsa.onlinelibrary.wiley.com/doi/full/10.2903/j.efsa.2021.6641

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Proposed mechanism of action

Kiwifruit and Actazin contain insoluble and soluble fibre, vitamins C and E, actinidin and phenolic compounds to assist with normal bowel function. Bayer et al., 2018, provides a good overview of the potential mechanisms of action.

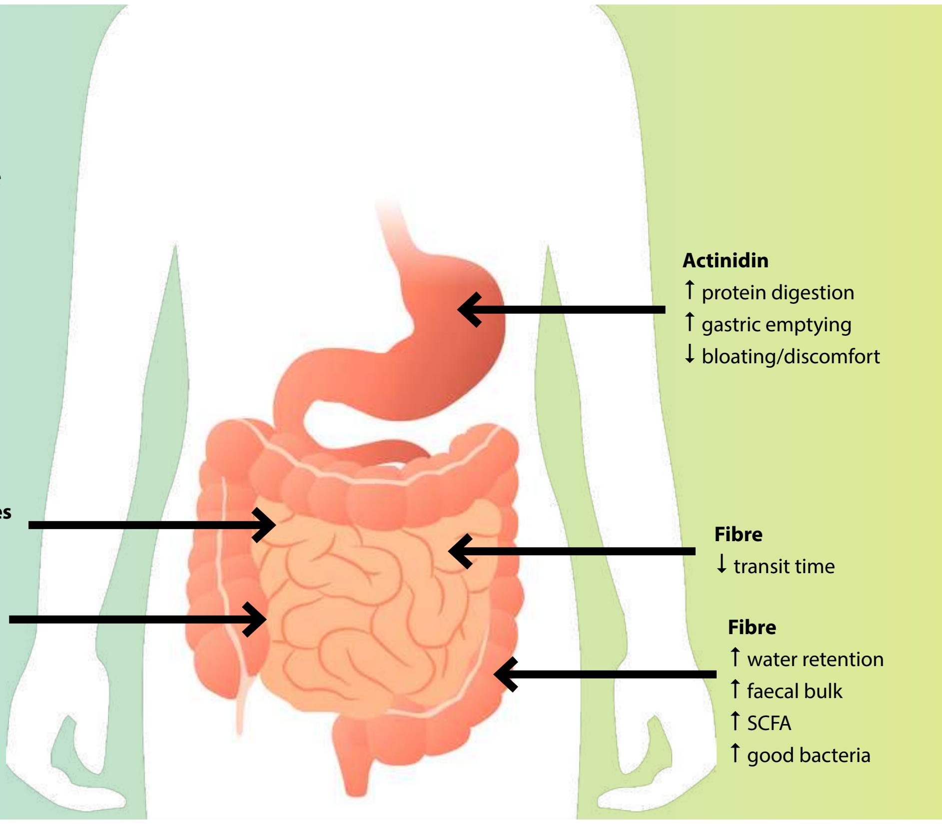

Figure 1: Proposed mechanism of action of kiwifruit components on gut motility.

Dietary fibre

Dietary fibre in kiwifruit is predominately cellulose, hemicelluloses and pectin.
Pectin is a soluble fibre that is **readily fermented** by the colonic microbiota, leading to proliferation of bacterial populations (i.e., *Bifidobacterium* spp.), increase in microbial biomass and fermentation by-products i.e., SCFA., consequently, increasing stool weight/bulk. Pectin also **delays gastric emptying** twofold possibly due to its viscous, gel-forming properties.

Cellulose and **hemicellulose** are insoluble fibres that resist colonic fermentation. They act as **bulking agents**, increasing both size and weight of food remnants, partly attributed to its **high water-binding capacity**. This may lead contribute to faecal bulking and reduced gut transit time.

Polyphenols

The phenolic compounds in kiwifruit, for example procyanidins, epicatechin, quercetin and chlorogenic acids, have been shown to possess **antimicrobial** properties and enhance **inhibition of pathogenic adhesion** to epithelial cells by vitamin C in vitro (Ansell et al., 2013). In addition, the phenolic content of green kiwifruit may increase aquaporins in a manner similar to diphenyls (affecting **water absorption** in the colon), or chlorogenic acids present in green kiwifruit may increase **bile secretion** and affect **serotonin/5-HT** biosynthesis.

Vitamins C and E

Low-level inflammation can alter serotonin signalling, slowing down gastrointestinal motility. Normalisation of the immune profile may also normalise gastrointestinal function. This change to a more anti-inflammatory environment may be induced by adequate levels of vitamins E and C.

Actinidin

Actinidin is a kiwifruit-unique protease which enhances protein digestion in the stomach, affecting gastric emptying, reducing bloating and improving comfort. It is also postulated that actinidin promotes proteolysis of bradykinin to modulate motility.

Amino acids and raphides

Along with dietary fibre, amino acids (e.g. leucine) and raphides present in kiwifruit may affect mucus production in the gut. Mucus, which lines the gastrointestinal tract, is important as a lubricant, helping to ease the passage of stool, and as a barrier to the external environment.

Potassium

Kiwifruit have a very high potassium content. Potassium is an important electrolyte involved in water retention and smooth muscle contraction.

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Summary of clinical data on kiwifruit and kiwifruit supplements

Intervention	Dose and Intervention period	Study design, size	Key Results	Reference

Actazin®	600mg or 2,400 mg/day;
	4 weeks each, 2-week washout
		Randomised, double-blind, placebo-controlled, crossover (RCT)
		
		Healthy (no constipation), n = 19
		Functionally constipated, n = 9
			• In the healthy group:
			  • Significant increase in weekly BM vs washout with high dose (2,400 mg).
			  • Near-significant increase in weekly BM vs washout with low dose (600 mg) in whole group and significant increase in responder sub-group.
			• In the FC group:
			  • Non-significant increase in weekly BM with 600 mg dose in sub-group of responders.
				Ansell et al 2015

Actazin®	600 mg/day; 4 weeks each	Multi-centered, randomized, double-blind, placebo-controlled, parallel study (RCT) Healthy with constipation, n = 43	• Significantly softer stools vs placebo and baseline ($p < 0.05$) • Significant increase in weekly CSBM, +1.44 (at endpoint, $p < 0.001$ vs baseline) • Significant improvements in abdominal, rectal and stool symptoms and quality of life scores ($p < 0.01$ vs baseline)	Graham et al 2024
Kiwifruit powder (water extract)	Freeze-dried water extract of green kiwifruit skin and flesh (Digesten), 1,000 mg /day; 3-weeks, 3-9 week washout	Randomised, double-blind, placebo-controlled, crossover (RCT) Healthy, constipated, n = 32	• Significant increase in weekly BM +2.12 ($p < 0.05$ vs pre-trial frequency) • Significant improvement in gastrointestinal symptoms score (vs baseline)	Kindleysides et al 2015
Kiwifruit powder (freeze-dried)	Freeze-dried green kiwifruit powder (Zyactinase), 2,160 mg / day 1-week	Randomised, double-blind, placebo-controlled, parallel (RCT) Healthy, constipated, n = 28	• Significant increase in weekly BM +2.6 ($p < 0.01$vs baseline and placebo) • Significant improvements in abdominal discomfort ($p<0.01$)	Weir et al 2018
Kiwifruit powder (freeze-dried)	Freeze-dried green kiwifruit powder (Zyactinase), 2 capsules x 3/ day; *No dose info reported.* 4-weeks	Open-label, non-randomised, uncontrolled (Experimental study) Elderly, constipated, n = 41	• Significant increase in weekly BM +1.4 (day 21, $p < 0.05$ vs baseline) • Significant improvement in feeling of abdominal lightness	Uebaba et al 2009
Kiwifruit powder (freeze-dried)	Freeze-dried green kiwifruit with skins (Actiphen / Phenactiv), 3,000 mg / day; 6-weeks	Randomised, double-blind, placebo-controlled, parallel (RCT) Healthy, gastrointestinal symptoms, n = 11	• No significant changes in the number of bowel movements or stool consistency • Significant improvement in gastrointestinal symptoms score ($p<0.05$)	Briskey et al 2023
Kiwifruit powder (freeze-dried)	Freeze-dried green kiwifruit powder (Kivia/Zyactinase), 5.5 g / day; 4-weeks	Randomised, double-blind, placebo-controlled, parallel (RCT) Healthy, constipated, n = 39	• Significant increase in weekly BM +2.24 ($p = 0.000$ vs baseline) • Significant improvements in bloating and abdominal discomfort	Udani & Bloom 2013
Whole green kiwifruit	Low-flatulogenic diet plus 2 x whole fresh green kiwifruit / day; 2-weeks	Randomised, crossover, single-blind Healthy, n = 11	• Near-significant improvement in BSS + 0.5 ($p = 0.072$ vs no kiwifruit) • Significantly higher BM frequency compared to control group (+2.1 BM/week, $p = 0.001$)	Caballero et al 2020
Whole green kiwifruit vs psyllium	2 x whole fresh green kiwifruit / day; 4-weeks, 4-week washout Psyllium as positive control	Multi-centred, randomised, single-blind, crossover (RCT) Functionally constipated, n = 60 IBS-C, n = 61 Healthy, n = 63	• Consumption of green kiwifruit was associated with clinically relevant and significant increase in CSBM (>1.5 CSBM per week) and significantly improved measures of GI comfort. • Kiwifruit consumption resulted in significantly softer stools, BSS +0.6 (FC + IBS-C, $p < 0.0001$ vs baseline)	Gearry et al 2022
Whole green kiwifruit vs psyllium and prunes	2 x whole fresh green kiwifruit / day; 4-weeks Compared to psyllium (12 g/ day) and prunes (100 g/day)	Parallel, partially randomized, exploratory trial Functionally constipated and IBS-C, n = 79	• Significant increase in weekly CSBM rate with all 3 treatments ($P \leq 0.003$) • Stool consistency significantly improved with kiwifruit ($p=0.01$) and prunes ($p=0.049$) • Straining significantly improved with kiwifruit ($P = 0.003$), prunes ($P < 0.001$), and psyllium ($P= 0.04$). • Patients in kiwifruit group reported significant improvement in bloating scores ($p=0.02$) • Adverse events most common in psyllium and least common in kiwifruit. • At the end of treatment, a smaller proportion of patients were dissatisfied with kiwifruit compared with prunes or psyllium ($P = 0.02$).	Chey et al 2020
Whole green kiwifruit	1 x whole fresh green kiwifruit per 30 kg body weight (2-3 fruit) / day; 6-weeks, no washout	Randomised, uncontrolled, crossover (preliminary study) Healthy elderly, n = 48	• Significant improvement (14%) in consistency ($p < 0.0001$; NB: not BSS) • Near-significant increase in weekly BM +0.54 ($p = 0.06$ vs no kiwifruit) • Significant improvement in ease ($p < 0.0001$ vs no kiwifruit)	Rush et al 2002
Whole green kiwifruit	1 x whole fresh green kiwifruit per 30 kg body weight (2-3 fruit) / day; 3-weeks, no washout	Randomised, uncontrolled, crossover (Experimental study) Healthy elderly, n= 38	• Significant improvement (12%) in consistency ($p < 0.0001$; NB: not BSS) • Significant increase in weekly BM +0.91 ($p = 0.012$ vs no kiwifruit) • Significant improvement in ease ($p < 0.0001$ vs no kiwifruit)	Rush et al 2002
Whole green kiwifruit	2 x whole fresh green kiwifruit twice daily; 3 days, 2-week washout	Randomised, crossover Healthy, n = 14	• Kiwifruit significantly increased stool frequency ($p = 0.034$), colon volumes ($p = 0.004$), and stool form ($p = 0.011$) vs control	Wilkinson-Smith et al 2019

DRIED PLUMS (PRUNES)

Prunes are dried plums, fruits of *Prunus domestica* L (Rosaceae). Prunes have a sweet flavour and mild laxative effect (Maria Stacewicz-Sapuntzakis et al., 2001).

EU Health Claim: Dried plums/prunes contribute to normal bowe function.[2] Conditions of use: used for food which provides daily intake of 100 g of dried plums (prunes).

BACKGROUND

Today plums are known to grow in many countries, but it is in the region of Asia where most are produced, followed by Europe and North America (Watson & Preedy, 2010). Most dried plums are produced form cultivar d'Agen, especially in California and France. After harvest, prune-making plums are dehydrated in hot air at 85 to 90 degrees for 18h, the further processed into prune juice, puree, or other prune products. Both prune and prune juice demonstrate a laxative effect (Maria Stacewicz-Sapuntzakis et al., 2001).

PROPOSED MECHANISM OF ACTION

Dried prunes contain insoluble and soluble fibre plus sorbitol and phenolic compounds to assist with normal bowel function.

Sorbitol

Sorbitol is a sugar alcohol (and fermentable carbohydrate) that acts as an osmotic laxative due to its humectant quality[3] , retaining water by osmotic gradient in the intestinal lumen, and thus increasing intraluminal pressure. This distends the intestine and stimulates a contractile response, therefore accelerating colon transit. Additionally, sorbitol has stool softening effects (Emmett et al., 1995).

Dietary fibre

Prunes contain plant wall polysaccharides including cellulose, hemicelluloses and pectin.
Pectin is a soluble fibre that is **readily fermented** by the colonic microbiota, leading to proliferation of bacterial populations (i.e., *Bifidobacterium* spp.), increase in microbial biomass and fermentation by-products i.e., SCFA., consequently, increasing stool weight/bulk. Pectin also **delays gastric emptying** twofold possibly due to its viscous, gel-forming properties (Lever et al., 2019).

Cellulose and **hemicellulose** are insoluble fibres that resist colonic fermentation. They act as **bulking agents**, increasing both size and weight of food remnants, partly attributed to its **high water-binding capacity**. This may lead contribute to faecal bulking and reduced gut transit time.

Polyphenols

In vivo studies shows that **chlorogenic acid** induces an **increase in serotonin/5-HT biosynthesis** of the enterochromaffin cells in the colon. In vitro studies indicate it may do so by regulating related metabolism of microbes, producing metabolites that promote colonic 5-HT biosynthesis e.g mainly Clostridia, or Corynebacterium, streptococcus (Wu et al., 2018). This increases peristalsis in the intestines aiding bowel function – but may not have a significant effect on the production of 5-HT enzymes or their activation in gut microbes.

In subjects with healthy colons, chlorogenic acid is hydrolysed into **caffeic** and **quinic acid** by the colonic microflora. Caffeic acid has been shown to stimulate *bifidobacteria* in vitro (Lever et al., 2019).

Diphenyls

Prunes contain **diphenylisatin**, which is a diphenol similar to **oxyphenisatine** – a known laxative. Diphenylisatin acts on the colon by increasing **prostaglandin E2 (PGE2) production** in intestinal epithelial cells. Epithelium cells in response increase expression of **aquaporin 3**, limiting water absorption of the colon. PGE2 also inhibits the Na+-K+-ATPase. It may also activate macrophages, which produce pro-inflammatory cytokines.

Potassium

Dried prunes have a very high potassium content. Potassium is an important electrolyte involved in water retention and smooth muscle contraction.

2 https://efsa.onlinelibrary.wiley.com/doi/epdf/10.2903/j.efsa.2014.3892
3 Humectant quality – contains hydroxyl groups which allow them to participate in hydrogen bonding with water.

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Summary of clinical data on prunes

Intervention	Dose and Intervention period	Study design, size	Key Results	Reference
Prunes	83.6g/day (100kcal) Low-fat cookies (64g/day) as energy matched control 2 weeks treatment + 2 weeks wash out period	Randomised crossover trial 26 healthy females	• Dried plums promoted softer stool consistency vs usual energy and nutrient intake ($P \leq 0.05$) • No significant differences on stool frequency or gut symptoms (pain, straining feeling of constipation) between groups	Howarth et al., 2010
Prunes	100g/day Grape juice (360 ml) as *a low fibre control)* 8-week study: 4-week treatment each	randomised, crossover study 41 males with mild cholesterolaemia	• Wet and dry stool weight increased by 114g (22%) and 20g (16%) respectively, after prune intervention compared to comparator (p=0.001) • No significance difference in stool water (%), stool frequency, consistency and flatulence between groups	Tinker et al., 1991
Prunes (plus 300ml/d water)	80g/d prunes (+300ml/d water) Or 120 g/d prunes (+300ml/d water) vs Control = no prunes + 300ml/d water 9-week study; 4 week treatment	Single centre, 3-arm, parallel group, randomised control trial 120 healthy individuals with infrequent stool habits (3-6 stools/wk) and low fibre intake	• Dried plums significantly increased stool weight in both the 80g/d (mean + 22.2g/d) and 120g/d group (+32.8g/d) compared with control (-0.8g/d) (p=0.026) • Dried plums significantly increased stool frequency in both the 80g/d (mean 6.8 bowel movements/wk) and 120g/d group (5.6) compared with control (5.4) (p=0.023) • Whole gut transit time unchanged, SCFA and stool pH unaffected • No significant differences in bacteria measured, except for greater increase in bifido spp. (p=0.046)	Lever et al., 2019
Prunes vs kiwifruit and psyllium	Prunes 100 g/day Green kiwifruit 2/day Psyllium fibre 12g/day 8 week study; 2 week baseline + 4 week intervention + 2 week follow up	Parallel, randomised clinical trial 79 participants with chronic constipation Kiwifruit (n=29) Prunes (n=24) Psyllium (n=22)	• Significant increase in weekly CSBM rate with all 3 treatments ($P \leq 0.003$) • Stool consistency significantly improved with kiwifruit (p=0.01) and prunes (p=0.049) • Straining significantly improved with kiwifruit (P = 0.003), prunes ($P < 0.001$), and psyllium (P= 0.04). • Patients in kiwifruit group reported significant improvement in bloating scores (p=0.02) • Adverse events most common in psyllium and least common in kiwifruit. • At the end of treatment, a smaller proportion of patients were dissatisfied with kiwifruit compared with prunes or psyllium (P = 0.02).	Chey et al., 2020
Prunes and dried apples	100g/day prunes or dried apples 3-month period	Randomised, crossover trial 58 healthy females	• No significant differences in stool bulk between groups or between baselines.	Lucas et al., 2004
Prunes and psyllium	50g dried plums (prunes) twice daily (100 g total) Or 22 g/day psyllium 14-week period: 3 weeks per active treatment with wash out period	Single-blind, randomised, crossover study, University of Iowa 40 patients with chronic constipation Dried plums (n=20) Psyllium (n=20)	• Dried plum significantly improved stool frequency, compared to psyllium • (plum 3.6 vs 2.8 baseline, psyllium 2.9 vs 2.7, P =0.001) • Dried plums produced softer stool consistency compared to psyllium (3.2 vs. 2.8, P = 0.02). • Rated as palatable – mean taste score of 6.5.	Attaluri et al., 2011

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KIWIFRUIT VS PRUNES

COMPOSITION

The key chemical components of prunes and kiwifruit are presented in the table below. As a partially dried fruit, prunes contain less water and correspondingly higher amounts of carbohydrates, dietary fibre and potassium per 100 g than kiwifruit. Prunes also contain sorbitol, which is not found in kiwifruit.

Kiwifruit contain much higher levels of vitamin C and they contain actinidin, a proteolytic enzyme unique to kiwifruit. Polyphenol analysis shows kiwifruit contain predominately epicatechin, procyanidins, quercetins and caffeoyl glucosides. Prunes predominately contain neochlorogenic and chlorogenic acids.

Chemical composition of prunes, kiwifruit and Actazin (per 100 g)

Component	Dried prunes	Kiwifruit	Actazin
Water, g	32.4	83.5	3.5
Carbohydrates, g	62.7	9.1	70
Protein, g	2.6	1.2	4
Fat, g	0.5	0.7	2.3
Sugars, g			
Glucose	23.1	4.1	22.1
Fructose	13.1	4.4	25.6
Sucrose	0.6	0.1	0.9
Sorbitol	14.7	-	-
Total dietary fibre, g	6.1	3	13.9
Pectin	2.1	0.7	0.8
Cellulose	0.9	1	12.5
Hemicellulose	3	0.3	1.4
Lignin	0.2	-	-
Amino acids, g			
Total	0.53	1.058	3.4
Aspartic acid	0.3	0.126	0.48
Minerals, mg			
Calcium	51	34	125
Potassium	745	312	1750
Vitamins, mg			
Ascorbic acid	3.3	85.1	343.5
α-Tocopherol	1.76	0.86	4.5
Carotenoids, µg			
Lutein	120	122	270
β-Carotene	140	54	117
Organic acids, g			
Total	1.5	2.9	7.0
Malic acid	1.1	0.26	0.6
Quinic acid	0.4	1.3	3.2

CLINICAL COMPARISON

One clinical study has been conducted which directly compares prunes and kiwifruit. In this study (Chey et al 2020), both kiwifruit and prunes were effective in significantly increasing weekly CSBM (complete spontaneous bowel movements), improving stool form and reducing straining. However, only those taking kiwifruit reported significant improvements in bloating, adverse events were more common with prunes than kiwifruit and at the end of the treatment period, those taking kiwifruit were the most satisfied.

A recent systematic review and meta-analysis investigating the effect of foods, drinks and diets on chronic constipation in adults (Van der Schoot et al 2024), found kiwifruit to be well-tolerated and improved stool frequency compared to psyllium, whereas prunes were no more effective than psyllium.

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