Supplementary Information (SI) for Food & Function.
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Supplementary Table 1- Characteristics of the acute intervention studies investigating the effect of apples and apple-based products on markers of human health

Reference and Country	Participants	Duration	Study design	Intervention	Apple cultivar	Control
Godycki-Cwirko et al., (2010) Poland[33]	12 healthy non-smoker male subjects (age: 32 ± 5y; BMI: not reported)	Post-prandial	Double-blind placebo-controlled design	Clear apple juice (1L) Composition: Water soluble pectic substances (0mg/L), Saccharose (4.7g/L), Glucose (28.7g/L), Fructose (90.8g/L), Ascorbic acid (0mg/L), Malic acid (3.7g/L), Citric acid (3.2g/L), Total polyphenols (270.4mg/L), Catechin and epicatechin (44mg/L), Oligomeric procyanidins (92.6mg/L), Phloridzin and phloretin xyloglucoside (45.5mg/L), Chlorogenic acid (58.4mg/L), p-Coumarylquinic acid (10.6mg/L), Quercetin glycosides (18.4mg/L), Quercetin (0.9mg/L) Cloudy apple juice (positive control, 1L) Composition: Water soluble pectic substances (833mg/L), Saccharose (7.1g/L), Glucose (28.4g/L), Fructose (88.6g/L), Ascorbic acid	Sampion	Apple juice without polyphenols (placebo, 1L) Composition: Water soluble pectic substances (0mg/L), Saccharose (5.1g/L), Glucose (28g/L), Fructose (88.1g/L), Ascorbic acid (0mg/L), Malic acid (3.9g/L), Citric acid (2.6g/L), Total polyphenols (0mg/L), Catechin and epicatechin (0mg/L), Oligomeric procyanidins (0mg/L), Phloridzin and phloretin xyloglucoside (0mg/L), Chlorogenic acid (0mg/L), p-Coumarylquinic acid (0mg/L), Quercetin glycosides (0mg/L), Quercetin (0mg/L) Water (negative control, 1L)

				(30.1mg/L), Malic acid (4g/L), Citric acid (3.1g/L), Total polyphenols (248mg/L), Catechin and epicatechin (52.1mg/L), Oligomeric procyanidins (81.6mg/L), Phloridzin and phloretin xyloglucoside (16.8mg/L), Chlorogenic acid (81.7mg/L), p-Coumarylquinic acid (11.6mg/L), Quercetin glycosides (4.2mg/L), Quercetin (0mg/L)		
Bondonno et al., (2012) Australia[34]	30 healthy adults (24 F, 6M; age: 47.3± 13.6y; BMI: 23.6± 3.4 kg/m^2)	Post-prandial	Randomized, controlled, crossover design	Apple: High-flavonoid apple active (apple flesh plus skin) and low-nitrate control (rice milk) <u>Composition :</u> quercetin 184 mg, (−)-epicatechin 180 mg, less than 5 mg nitrate Spinach: Low-flavonoid apple control (apple flesh) and nitrate-rich spinach active <u>Composition :</u> quercetin and (−)-epicatechin less than 5 mg, polyphenols 75mg, nitrate 182 mg	Cripps Pink	Control: Low-flavonoid apple control (apple flesh) and low-nitrate control (rice milk) <u>Composition :</u> less than 5 mg quercetin and (−)-epicatechin, less than 5 mg nitrate

				Apple + spinach : High-flavonoid apple active (apple flesh plus skin) and nitrate-rich spinach active <u>Composition :</u> quercetin 184 mg, (−)-epicatechin 180 mg, polyphenols 75mg, nitrate 182 mg		
Vieira et al., (2012) Brazil[35]	9 healthy subjects (sex: F; age: 23.6 y (range, 21-27 y); BMI: 20.6 kg/ m^2 (range, 19.0-23.7 kg/m^2)	Post-prandial	Randomized, crossover design	Apple juice Golden (300mL; equivalent to 5 apples) <u>Composition (100mL):</u> Total sugars 10.32, fructose 5.16g, glucose 1.55g, sucrose 3.61g, total phenolic 108.27mg GAE, total flavanols 16.47mg catechin, total anthocyanins ND, vitamin C 1.96mg, total antioxidant capacity (ABTS 359.63µmol TEAC, FRAP 182.9463µmol TEAC) Apple juice Catarina (300mL; equivalent to 5 apples) <u>Composition:</u> Total sugars 12.35, fructose 6.17g, glucose 1.03g, sucrose 5.15g, total phenolic 163.83mg GAE, total flavanols 30.86mg catechin,	Golden Delicious or Catarina	Water as control (300mL)

				total anthocyanins 1.02mg cy-3-gal, vitamin C 1.30mg, total antioxidant capacity (ABTS 709.70µmol TEAC, FRAP 306.25µmol TEAC)		
Holland et al., (2013) UK[36]	13 healthy subjects (sex: 7F, 6M; age: 56.6 ± 6.4 y; BMI: 25.7 ± 2.7 kg/m2)	Post-prandial	Double blind (except for the apple puree treatment), placebo-controlled, four-phase crossover trial	1) 300 g apple purée (2) 300 g flavoured water containing low flavanol apple extract (3) 300 g flavoured water containing high flavanol apple extract Composition: Apple purée (-) epicatechin 70 mg, (+)-catechin 6.1 mg, procyanidins 200 mg, total quercetin glycosides 5.7 mg, phloridzin 28.5 mg and chlorogenic acid 102.6 mg Drink (low flavanol apple extract) epicatechin 70 mg, (+)-catechin 1.8 mg, procyanidins (flavanol-3-ol oligo- and polymers) 62.8 mg, total quercetin glycosides 7.1 mg, phloridzin 3.2 mg and chlorogenic acid 7.4 mg Drink (high flavanol apple extract)	Not reported	300g flavoured water Composition: No polyphenols

				epicatechin 140 mg, (+)-catechin 3.6 mg, procyanidins (flavanol-3-ol oligo- and polymers) 125.6 mg, total quercetin glycosides 14.2 mg, phloridzin 6.4 mg and chlorogenic acid 14.8 mg		
Gasper et al., (2014) UK[64]	25 healthy subjects (sex: 12F, 13M; age: 42 ± 11 y; BMI: 25.9 ± 4.2 kg/m^2)	Post-prandial	Randomized, three-phase crossover design	High flavanol (HF) apple puree : Standard breakfast consisting of 2 slices of white toast (72 g) with spread (10 g) followed by either, 230 g apple puree containing 100 mg epicatechin) <u>Composition:</u> Total hydroxycinnamate–quinic acid esters 0.497 mg/g fresh weight puree; Total flavanols 2.020 mg/g; Total dihydrochalcones 0.067 mg/g; Total flavonols 0.066 mg/g Low flavanol (LF) apple puree: Standard breakfast consisting of 2 slices of white toast (72 g) with spread (10 g) followed by either, 230 g apple puree containing 25 mg epicatechin	Golden Delicious, Mitchalin	Aspirin (ASA): standard breakfast consisting of 2 slices of white toast (72 g) with spread (10 g) followed by either, aspirin (75 mg dispersed in 100 mL water) <u>Composition:</u> No polyphenols

				Composition: Total hydroxycinnamate–quinic acid esters, 0.138 mg/ g fresh weight puree; Total flavanols 1.037mg/g; Total dihydrochalcones, 0.055mg/g; Total flavonols 0.095mg/g		
Marakova et al., (2015) Latvia[37]	6 healthy subjects with CVD and diabetes risk (sex: 6F; age: 45.3 ± 9.7 y; BMI: 27.3 ± 2.4 kg/m2)	Post-prandial	Open-label, randomized, controlled, cross-over study	Unripe apple preparation (25g) + glucose solution (50g) Composition: Glucose 55.48±1.14g/kg, fructose 88.31±1.20g/kg, sucrose 9.65±0.15 g/kg, catechin 2.54±0.05g/kg, epicatechin 2.12 ±0.03g/kg, phloretin-2-O-D-xyloglucoside 1.40±0.02g/kg, phlorezin 12.61±0.15g/kg, Chlorogenic acid 18.90±0.11g/kg, Quercetin glycosides 2.83±0.04g/kg, Water-soluble pectin 27.73±0.51g/kg	Auksis	Glucose solution (50g) Composition: No polyphenols

Wruss et al., (2015) Austria[38]	35 healthy subjects (sex:20F, 15M; age: range 19-42y; BMI: not reported)	Post-prandial	Non-randomized, non-controlled	Unfiltered apple juice (500mL) Composition: Glucose 13g, Fructose 40 g, Total polyphenols 1.08g	Mix of varieties	-
Erickson et al., (2017) United States[39]	40 healthy subjects (sex: not reported; age: 22.7±4.2y; BMI: 23.4±2.8 kg/m^2)	Post prandial	Randomized, double-blind, controlled crossover design	Apple juice (12 oz) Composition: Total sugars (38 g/12oz); sorbitol (1.5g/12oz)	Not reported	White grape juice (12 oz) Composition: Total sugars (52.5 g/12oz); sorbitol (0g/12oz)
Bondonno et al., (2018) Australia[65]	30 healthy subjects with cardiovascular risk (10M, 20F; age: 57.8 ± 10.6y; BMI: 27.5 ± 3.9 kg/m^2)	Post-prandial + 4 weeks	Randomised, controlled, cross-over design	High-flavonoid apple (HFA) (1 whole apple plus the skin + 1 apple blended with water) Composition : total phenolic compounds (306 mg/day); total quercetin glucosides (195.3mg/day) ; Epicatechin (48.0 mg/day); Phloridzin (5.1 mg/day); Chlorogenic acid (52.1mg/day); anthocyanins (6 mg/day)	Cripps Pink	Low-flavonoid apple (LFA) (1 Cripps Pink apple blended with water) Composition: Total phenolic compounds (92 mg/day); total quercetin glucosides (12.5mg/day) ; Epicatechin (25.2 mg/day); Phloridzin (2.2 mg/day); Chlorogenic acid (52.1mg/day); anthocyanins (ND)

Sansone et al., (2018) United States[40]	21 healthy, normal-weight subjects (sex: 20F, 1M; age: 26.8 ± 4.7 y; BMI: 22.5 ± 2.2 kg/m^2)	Post-prandial	Randomized, crossover design	Dried apple (equivalent to 55g carbohydrates) + water (220 mL) <u>Composition:</u> Calories (225 kcal), fat (0g), carbohydrates (55g), protein (0.8g), fiber (7g), ascorbic acid (1195.4µg equivalent/g), total phenolics (732µg gallic acid equivalent/g), total flavonoids (172 µg catechin equivalent/g), ferrous ion chelating activity (1718.9µg EDTA equivalent/g), ferric reducing power (1195.4µg ascorbic acid equivalent/g), ABTS radical scavenging activity (464.9µg Trolox equivalent/g)	Not reported		Muffin (equivalent to 55g carbohydrates) + water (220 mL) <u>Composition:</u> Calories (241 kcal), fat (0g), carbohydrates (55g), protein (4g), fiber (0g), ascorbic acid (217.2µg equivalent/g), total phenolics (0µg gallic acid equivalent/g), total flavonoids (0 µg catechin equivalent/g), ferrous ion chelating activity (240.4µg EDTA equivalent/g), ferric reducing power (217.2µg ascorbic acid equivalent/g), ABTS radical scavenging activity (0µg Trolox equivalent/g)
White et al., (2018) New Zealand[41]	64 healthy subjects Apple group (n=23; sex:15F, 5M; age:22±6y; BMI: 23±4kg/m^2) Apple juice group (n=21; sex:15F, 5M; age:24±7y; BMI: 23±3kg/m^2) Control group (n=20; sex:15F, 5M; age:21±2y; BMI:	Post-prandial	Randomized, controlled, parallel design	Large apple serving (2 apples, 410g) <u>Composition :</u> Fructose 26.7g, (21.3 g free fructose, 4.5 g free glucose),Sucrose 10.7g (5.35 g glucose and 5.35 g fructose) Small serving (1 apple 205g) <u>Composition:</u> Half of the large	Royal Gala	Control treatment Soda water (600mL) containing 26.7g glucose Control treatment Soda water (600mL) containing 26.7g fructose

	23±2kg/m^2)			serving Large juice serving (340mL) <u>Composition :</u> Free fructose 25.2 g, free glucose 7.8 g, sucrose 3.1 g (comprising 1.55 g glucose and 1.55 g fructose) Small juice serving (170mL) <u>Composition:</u> Half of the full serving		
Lu et al., (2019) China[42]	18 healthy young subjects (sex: F; age: 23.6±1.1y; BMI: 20.3±2.6 kg/m^2	Post-prandial	Randomized crossover design	Co-ingestion of apple and rice (A+R ; 142.8g +115.7g Polished rice) <u>Composition :</u> Energy 227kcal, Starch 35g, Glucose 6.7g, Fructose 8.3g, Protein 4.7g, Fat 0.9g, Dietary fiber 1.4g Apple preload and rice (PA+R ; 142.8g +115.7g Polished rice) <u>Composition :</u> Energy 227kcal, Starch 35g, Glucose 6.7g, Fructose 8.3g, Protein 4.7g, Fat 0.9g, Dietary fiber 1.4g	Red fuji	Glucose solution <u>Composition :</u> Energy 200kcal, 50g glucose Rice meal (176g Polished rice) <u>Composition :</u> Energy 228kcal, Starch 50g, Protein 6.2g, Fat 0.5g, Dietary fiber 0.7g Rice (115g Polished rice) with sugar solution preload (same sugar profile as in apple) (PSS+R) <u>Composition :</u> Energy 220.8kcal, Starch 35g, Glucose 6.7g, Fructose 8.3g, Protein 4.3g, Fat 0.4g, Dietary fiber 0.5g

Zhao et al., (2020) China[43]	15 subjects (Sex: F; age: 23.6±1.1y; BMI: 20.3±1.6 kg/m^2)	Post-prandial	Randomised, crossover, design	Dried apple + rice (DA+R) (20.9g dried apple and rice 115.7g) Composition: Energy 935.6 kj, Starch 35g, Sucrose 1.9g, Glucose 5.0g, Fructose 8.1g, Protein 4.9g, Fat 0.4g, Dietary fiber 1.0g, Tannin 778.08 mg TAE/100g DA, total polyphenols 437.14 mg GAE/100g, total flavone 540.37 mg GAE/100g, pectin 4.30g/100g Preload dried apple + rice (PDA+R) (20.9g dried apples and rice, 115.7g) Composition: Energy 935.6 kj, Starch 35g, Sucrose 1.9g, Glucose 5.0g, Fructose 8.1g, Protein 4.9g, Fat 0.4g, Dietary fiber 1.0g, Tannin 778.08 mg TAE/100g DA, total polyphenols 437.14 mg GAE/100g, total flavone 540.37 mg GAE/100g, pectin 4.30g/100g Vinegar, dried apple + rice (VDA+R) (30g vinegar, 20.9g dried apples and rice, 115.7g) Composition:	Red Fuji	Glucose (50.0 g of Glucolin dissolved in 203 g of water) Composition: Energy content (837.4 kj) Rice (176 g Polished rice) Composition: Energy 957.8 kj, Starch 50g, Protein 6.2g, Fat 0.5g, Dietary fiber 0.7g PSS+R (preload sugar solution + rice) Composition : Energy 924.7 kj, Starch 35g, Sucrose 1.9g, Glucose 5.0g, Fructose 8.1g, Protein 4.3g, Fat 0.4g, Dietary fiber 0.5g

				Energy 974.5 kj, Starch 35g, Sucrose 1.9g, Glucose 5.0g, Fructose 8.1g, Protein 5.5g, Fat 0.4g, Dietary fiber 1.0g, Tannin 778.08 mg TAE/100g DA, total polyphenols 437.14 mg GAE/100g, total flavone 540.37 mg GAE/100g, pectin 4.30g/100g		
Lin et al., (2020) Canada[44]	26 healthy overweight/obese subjects (17F, 9M; age: 45·5±3·1 y (sem); BMI: 34·1± 1·2 kg/m^2 (sem))	Post-prandial	Randomised, crossover design	Oral fat tolerance test meal (500 mL) + apples (200 g) <u>Composition :</u> Energy content (906.7–1638 kcal), Fat (71.6–154g), Sugars (41–42), Protein (15.8g), Acetaminophen (1.5g), Pectin (2.2g), Total polyphenols (200mg)	Gala	Oral fat tolerance meal (500 mL) <u>Composition :</u> Energy content (792.7–1524 kcal), Fat (71.6–154g), Sugars (20.3–21.5g), Protein (14.6g), Acetaminophen (1.5g), Pectin (0g), Total polyphenols (0g)
Cheng et al., (2022) China[45]	18 healthy subjects (12F, 6M; age: 22.5±2·2 y; BMI: 20·7± 1·72 kg/m2)	Post-prandial	Randomized, crossover design	Apple (222g of flesh) Composition: 1g (fructose 0.110 g (free fructose 0.096 g, glucose 0.041 g, sucrose 0.0311 g)	Red Fuji apples	Pure fructose powder (25g)
Pushpass et al., (2023) Ireland[66]	61 volunteers (sex: 46F, 15M ; age: 52±12 y; BMI 24.8±3.4 kg/m^2)	Post-prandial	4 arms, randomized, parallel design	Apple treatment (2 Renetta Canada apples with 2 placebo capsules) consumed daily for breakfast (high fat chocolate drink)	Renetta Canada	Control treatment (Cornflakes 40 g with 180 mL semi-skimmed milk and 2 placebo capsules) consumed daily for breakfast (high fat chocolate drink)

		Composition: Apple: (Energy 234kcal, Carbohydrates 63.5g, (sugars 44g), Protein 1.1g, Fat 0.7g, Fiber 8.5g, vitamin C 21mg, sum of all individual polyphenols and oligomeric PAs (DP > 2) 990 mg per daily portion (mainly oligomeric Pas and chlorogenic acid)) Test Breakfast Apples: (Energy 845kcal, Carbohydrates 88.8g, (sugars 69g), Protein 19.3g, Fat 50.1g, Fiber 8.5g)	Composition: Test Breakfast Control: (Energy 852kcal, Carbohydrates 86g, (sugars 46.6g), Protein 19.2g, Fat 50.3g, Fiber 1.4g) Probiotic treatment (Cornflakes 40g with 180 mL semi-skimmed milk and 2 probiotic capsules containing the BSH positive strain of L. reuteri NCIMB 30242, >2.5 billion CFU per capsule) consumed daily for breakfast (high fat chocolate drink) Composition: Test Breakfast Probiotic: (Energy 852kcal, Carbohydrates 86g, (sugars 46.6g), Protein 19.2g, Fat 50.3g, Fiber 1.4g) Oats treatment (Jumbo whole rolled oats 40 g with 180 mL semi-skimmed milk and 2 placebo capsules) consumed daily for breakfast (high fat chocolate drink) Composition: Test Breakfast Oats: (Energy 864kcal, Carbohydrates 88.1g, (sugars 63.1g), Protein 19.8g, Fat 49.6g, Fiber 3.6g)	

Legend: ABTS: 2,2'-azinobis(3-ethylbenzothiazoline-6-sulfonic acid); BMI: body mass index; F: female; FRAP: Ferric Reducing Antioxidant Power; M: male; TEAC: Trolox Equivalent Antioxidant Capacity

Supplementary Table 2- Characteristics of the medium-long term intervention studies investigating the effect of apples and apple-based products on markers of human health

Reference and Country	Participants	Duration	Study design	Intervention	Apple cultivar	Control
Remington et al., (2010) United States[46]	21 institutionalized individuals with moderate-to severe Alzheimer Disease (sex: not reported; age: 82 + 5 y; BMI: not reported)	1 month	Pre-to-post intervention	2 4-oz glasses of apple juice per day Composition: not reported	Not reported	None
Auclair et al., (2010) France[47]	30 hypercholesterolemic volunteers (sex: not reported; age: 52.6±5.5 y, BMI: 25.7±2.6 kg/m^2)	4 weeks	Randomized, double-blinded, crossover design	two bags of lyophilized apples per day, corresponding approximately to 2 fresh apples of 135 g Composition: Low polyphenol apple (Fibers 3.93g, procyanidins 78mg, total hydroxycinnamic acid 11mg, total flavan-3-ol-monomers 8mg, total dihydrochalcones 7.3mg, total flavonols 1mg, nitrogen 39mg, starch 19 mg, glucose 1.7g, fructose 7.80g, sucrose 3.8g, malic acid 386mg) High polyphenol apple (Fibers 3.87g, procyanidins 521mg, total hydroxycinnamic acid 126mg, total flavan-3-ol-monomers 55mg, total dihydrochalcones 12.4mg, total	Golden Delicious (low polyphenols) Marie Ménard (high polyphenols)	None

				flavonols 6.3mg, nitrogen 40mg, starch 600mg, glucose 1.66g, fructose 7.52g, sucrose 3.74g, malic acid 220mg)		
Shinohara et al., (2010) Japon[48]	8 healthy male subjects (age range: 21-60y; BMI: not reported)	2 weeks	Pre-to-post intervention	2 apples/day (amount not reported) Composition: not reported	not reported	None
Vafa et al. (2011) Iran[49]	46 hyperlipidemic, overweight men Intervention group (N=23) Age: 41.08 ± 4.19 y; BMI: 27.02 ± 1.39 kg/m^2) Control group (N= 23) Age: 41.65 ± 3.79y; BMI: 26.72 ± 1.83 kg/m^2)	8 weeks	Randomized, controlled, parallel design	Apple (300 g) Composition: Total polyphenols 485 mg/kg and fibers 4.03 g/100g	Golden delicious	Regular diet Composition: n.a.
Barth et al., (2012) Germany[50]	68 overweight and obese subjects (sex: not reported; age: 23-69 y; BMI: >27 kg/m^2)	4 weeks	Randomized, controlled, parallel design	Polyphenol-rich cloudy apple juice (CloA) (750 mL) Composition: Glucose 21.2g/L; Fructose 67g/L; Saccharose 36.2g/L; L-malic acid 9.8 g/L; Citric acid 0.1 g/L; Ascorbic acid 311 mg/L; Potassium 1217 mg/L; Calcium 68 mg/L; Magnesium 57mg/L; Total phenols 1070mg/L	Not reported	Isocaloric control beverage (CB) (750 mL) Composition: Glucose 21.4g/L; Fructose 63.8g/L; Saccharose 32.4g/L; L-malic acid 5.9 g/L; Citric acid 2.6 g/L; Ascorbic acid 253 mg/L; Potassium 1023 mg/L; Calcium 57 mg/L; Magnesium 61mg/L; Total phenols 0mg/L
Chai et al. (2012) United States[51]	100 healthy postmenopausal	12 months	Randomized, controlled, parallel	Dried apples (75g)	Not reported	Dried plum (100g)

	women Intervention group (N=45) (age: 55.6 ± 5.0 y; BMI: 24.8 ± 4.1 kg/m^2) Control group (N= 55) Age: 57.5 ± 4.01y; BMI: 24.9 ± 4.6 kg/m^2)		design	Composition : Energy 240 Kcal; Total carbohydrates 58.5g; Protein 1.5g; Fat 0.43g ; Fiber 6g		Composition: Energy 239 Kcal; Total carbohydrates 62.7g; Protein 2.61g; Fat 0.52g ; Fiber 7.10g
Zhao et al., (2013) USA[52]	51 healthy subjects Apples group (n=17; sex: 14F, 3M; age: 49±4y; BMI: not reported) Apple polyphenols group (n=16; sex: 12F, 4M; age: 49±4y; BMI: not reported) Placebo group (n=18; sex: 13F, 5M; age: 46±4y; BMI: not reported)	4 weeks	3-arm, randomized, controlled, parallel design	Apple (1 per day; an equal mixture of two varieties) Composition: Polyphenols 194 mg /day Apple polyphenol extract (two capsules/day) Composition: Polyphenols 194 mg /day	Red Delicious and Golden Delicious apples	Placebo (two capsules/day) Composition: 650 mg gelatin per capsule
Ravn-Haren et al. (2013) Denmark[53]	23 healthy subjects (sex: 9M/14F; age: 36.2 ± 17.9 y; BMI: 22.3 ± 2.59 kg/m^2)	4 weeks	Randomised, single-blinded, crossover study	Apples (550g/day) Composition: Total polyphenols 239 mg/day; Catechin 5.1 mg, Epicatechin 60 mg, Procyanidin dimers 81 mg, Phloretin xyloglucoside 6.2 mg Phloridzin 6.6 mg, Chlorogenic acid 36 mg, p-coumaroylquinic acid 4 mg, Quercetin	Shanpion	Restricted diet

glycosides 41 mg, Quercetin 0 mg, Total pectin 2.87 g/day

Apple pomace (22mg/day)

Composition:
Total polyphenols 75 mg/day; Catechin 0.8 mg, Epicatechin 9 mg, Procyanidin dimers 7 mg, Phloretin xyloglucoside 1.7 mg Phloridzin 8.3 mg, Chlorogenic acid 1 mg, p-coumaroylquinic acid 0.1 mg, Quercetin glycosides 46 mg, Quercetin 0.2 mg, Total pectin 2.12 g/day

Cloudy apple juice (500 mL/day)

Composition:
Total polyphenols 145 mg/day; Catechin 4.4 mg, Epicatechin 27 mg, Procyanidin dimers 55 mg, Phloretin xyloglucoside 5.4 mg Phloridzin 5.1 mg, Chlorogenic acid 40 mg, p-coumaroylquinic acid 3.2 mg, Quercetin glycosides 4 mg, Quercetin 0 mg, Total pectin 0.47 g/day

				Clear apple juice (500 mL/day) <u>Composition:</u> Total polyphenols 108 mg/day; Catechin 2.3 mg, Epicatechin 19 mg, Procyanidin dimers 35 mg, Phloretin xyloglucoside 7.5 mg Phloridzin 8.7 mg, Chlorogenic acid 27 mg, p-coumaroylquinic acid 3 mg, Quercetin glycosides 4.2 mg, Quercetin 0.4 mg, Total pectin 0.03 g/day		
Gasper et al., (2014) UK[64]	25 healthy subjects (sex: 12F, 13M; age: 42 ± 11 y; BMI: 25.9 ± 4.2 kg/m^2)	4 weeks	Randomized, three-phase crossover design	High flavanol (HF) apple puree: Standard breakfast consisting of 2 slices of white toast (72 g) with spread (10 g) followed by either, 230 g apple puree containing 100 mg epicatechin) <u>Composition:</u> Total hydroxycinnamate–quinic acid esters 0.497 mg/g fresh weight puree; Total flavanols 2.020 mg/g; Total dihydrochalcones 0.067 mg/g; Total flavonols 0.066 mg/g Low flavanol (LF) apple puree: Standard	Golden Delicious, Mitchalin	Aspirin (ASA): standard breakfast consisting of 2 slices of white toast (72 g) with spread (10 g) followed by either, aspirin (75 mg dispersed in 100 mL water) <u>Composition:</u> No polyphenols

				breakfast consisting of 2 slices of white toast (72 g) with spread (10 g) followed by either, 230 g apple puree containing 25 mg epicatechin <u>Composition:</u> Total hydroxycinnamate–quinic acid esters, 0.138 mg/ g fresh weight puree; Total flavanols 1.037mg/g; Total dihydrochalcones, 0.055mg/g; Total flavonols 0.095mg/g		
Mehrabani et al., (2014) Iran[54]	34 obese childrens (age: 11.14±0.8y; BMI: above the 95th percentile based on WHO BMI-for-age charts, 27.62±2.7 kg/m^2)	2 days	Randomized, crossover design	Apple juice (240mL) <u>Composition:</u> Energy content (411.44 kcal), protein (11.3g) fat (13g), carbohydrates (65.2g), fiber (1.02g), glycemic index (42.5), glycemic load (27.70) Low fat milk (240mL) <u>Composition:</u> Energy content (401.24 kcal), protein (19.1g) fat (15.4g), carbohydrates (49.1g), fiber (0.46g), glycemic index (40.2), glycemic load (19.70)	not reported	Water (240mL) <u>Composition:</u> Energy content (297.74 kcal), protein (10.9g) fat (12.8g), carbohydrates (37.2g), fiber (0.5g), glycemic index (44.38), glycemic load (16.50)
Soriano-Maldonado et al., (2014) Spain[55]	20 (12F, 8M) healthy subjects	4 weeks	Randomized, cross-over design	Apple juice (500 mL/day)	Cox Orange, Jonagold, Elstar, Gala, Braeburn,	None

	Polyphenol-rich apple juice group: (sex: not reported; age: 23.7±2.3 y; BMI: 21.8±2.1 kg/m^2) Vitamin C-rich apple juice group: (sex: not reported age: 23.3±2.0y; BMI: 22.4±2.0 kg/m^2)			<u>Composition:</u> Polyphenol-rich apple (PR) juice (Sugar: 11.0g/100g; Fiber: 0.2g/100g; vitamin C: 22mg/L; chlorogenic acid: 79.7 mg/L, Epicatechin: 33.5 mg/L; Procyanidin B2: 41.5 mg/L; Phloretin-2'-O-xyloglucoside: 34.3mg/L; Phloretin-2'-O-glucoside: 30.1mg/L) Vitamin C-rich apple (VCR) juice (Sugar: 10.8g/100g; Fiber: 0.1g/100g; vitamin C: 60 mg/L; chlorogenic acid: 83.8 mg/L, Epicatechin: 15.1 mg/L; Procyanidin B2: 17.3 mg/L; Phloretin-2'-O-xyloglucoside: 17.6mg/L; Phloretin-2'-O-glucoside: 13.3mg/L)	Delicious and Idared	
Rago et al. (2015) Denmark[56]	Healthy subjects 23 (9M/14F) subjects (Age: 36.2 ± 17.9 y; BMI: 22.3 ± 2.59 kg/m2)	4 weeks	Randomised, single-blinded, crossover study	Apples (550g/day) <u>Composition:</u> Total polyphenols 239 mg/day; Catechin 5.1 mg, Epicatechin 60 mg, Procyanidin dimers 81 mg, Phloretin xyloglucoside 6.2 mg Phloridzin 6.6 mg, Chlorogenic acid 36 mg, p-coumaroylquinic acid 4 mg, Quercetin	Shanpion	Restricted diet

glycosides 41 mg, Quercetin 0 mg, Total pectin 2.87 g/day

Apple pomace (22mg/day)

Composition:
Total polyphenols 75 mg/day; Catechin 0.8 mg, Epicatechin 9 mg, Procyanidin dimers 7 mg, Phloretin xyloglucoside 1.7 mg Phloridzin 8.3 mg, Chlorogenic acid 1 mg, p-coumaroylquinic acid 0.1 mg, Quercetin glycosides 46 mg, Quercetin 0.2 mg, Total pectin 2.12 g/day

Cloudy apple juice (500 mL/day)

Composition:
Total polyphenols 145 mg/day; Catechin 4.4 mg, Epicatechin 27 mg, Procyanidin dimers 55 mg, Phloretin xyloglucoside 5.4 mg Phloridzin 5.1 mg, Chlorogenic acid 40 mg, p-coumaroylquinic acid 3.2 mg, Quercetin glycosides 4 mg, Quercetin 0 mg, Total pectin 0.47 g/day

				Clear apple juice (500 mL/day) <u>Composition:</u> Total polyphenols 108 mg/day; Catechin 2.3 mg, Epicatechin 19 mg, Procyanidin dimers 35 mg, Phloretin xyloglucoside 7.5 mg Phloridzin 8.7 mg, Chlorogenic acid 27 mg, p-coumaroylquinic acid 3 mg, Quercetin glycosides 4.2 mg, Quercetin 0.4 mg, Total pectin 0.03 g/day		
Bondonno et al., (2018) Australia[65]	30 healthy subjects with cardiovascular risk (10M, 20F; age: 57.8 ± 10.6y; BMI: 27.5 ± 3.9 kg/m^2)	4 weeks	Randomised, controlled, cross-over design	High-flavonoid apple (HFA) (1 whole apple plus the skin + 1 apple blended with water) <u>Composition :</u> total phenolic compounds (306 mg/day); total quercetin glucosides (195.3mg/day) ; Epicatechin (48.0 mg/day); Phloridzin (5.1 mg/day); Chlorogenic acid (52.1mg/day); anthocyanins (6 mg/day)	Cripps Pink	Low-flavonoid apple (LFA) (1 Cripps Pink apple blended with water) <u>Composition:</u> Total phenolic compounds (92 mg/day); total quercetin glucosides (12.5mg/day) ; Epicatechin (25.2 mg/day); Phloridzin (2.2 mg/day); Chlorogenic acid (52.1mg/day); anthocyanins (ND)
Eisner et al., (2019) United States[57]	38 overweight or obese children (sex: both but info not reported; age range: 10-16 years;	8 weeks	Randomized, controlled, parallel design	Dried apple (equivalent to 120 kcal twice per day)	Not provided	Snack (muffin, equivalent to 120 kcal twice per day)

	BMI: >85th percentile for overweight, and >95th percentile for obese)			Composition: 240 kcal energy, 0 g fat, 59 g carbohydrate, 0.8 g protein, and 8 g fiber. 732 µg gallic acid equivalent per gram		Composition: 240 kcal energy, 0 g fat, 55 g carbohydrate, 4 g protein, and 0 g fiber
Tenore et al., (2019) Italy[58]	90 subjects with cardiovascular risk factors lfAAP group (sex: 12W, 18M; Age: 45.8 ± 11.1 y; BMI: not reported) AAP group (sex: 13W, 17M; Age: 46.9 ± 10.6 y; BMI: not reported) LAB group (sex: 14W, 16M; Age: 47.6 ± 10.4 y; BMI: not reported)	90 days	3-arm, randomized, parallel design	lfAAP, 125g/day) Composition: Chlrogenic acid 10.78mg, [+]-Catechin 1.52mg, [-]-Epicatechin 3.48mg, Procyanidin B1 1.01mg, Procianidin B2 2.58, Procyanidin trimer 1.87mg, Cyanidin-3-O-galactoside 0.05mg, Rutin (Quercetin-3-O-rutinoside) 1.08mg, Hyperin (Quercetin-3-O-galactoside) 12.1mg, Isoquercitrin (Quercetin-3-O-glucoside) 4.75mg, Reynoutrin (Quercetin-3-O-xyloside) 2.75mg, Guajaverin (Quercetin 3-O-arabinopyranoside) 2.35mg, Avicularin (Quercetin 3-O-arabinofuranoside) 5.35mg, Quercetin-O-pentoside 1.65mg, Quercitrin (Quercetin-3-O-ramnoside) 3.16mg, Phloretin-2-O-xyloglucoside 3.78mg, Phloridzin	Annurca	Probiotic alone (LAB, 1 capsule/day) Composition: Lactobacillus rhamnosus (3.0×10^8 CFU).

(phloretin-2-O-glucoside) 4.23mg, Total polyphenols 62.40mg

Unfermented apple puree (AAP, 125g/day)

Composition:
Chlrogenic acid 8.98mg, [+]-Catechin 1.20mg, [-]-Epicatechin 2.80mg, Procyanidin B1 0.70mg, Procyanidin B2 1.78, Procyanidin trimer 1.28mg, Cyanidin-3-O-galactoside 0.04mg, Rutin (Quercetin-3-O-rutinoside) 0.80mg, Hyperin (Quercetin-3-O-galactoside) 8.90mg, Isoquercitrin (Quercetin-3-O-glucoside) 3.52mg, Reynoutrin (Quercetin-3-O-xyloside) 2.04mg, Guajaverin (Quercetin 3-O-arabinopyranoside) 1.74mg, Avicularin (Quercetin 3-O-arabinofuranoside) 3.96mg, Quercetin-O-pentoside 1.22mg, Quercitrin (Quercetin-3-O-ramnoside) 2.34mg, Phloretin-2-O-xyloglucoside 2.70mg, Phloridzin (phloretin-2-O-

				glucoside) 3.02mg, Total polyphenols 47.02mg		
Giaretta et al., (2019) Brazil[59]	16 haemodialysis subjects (10M, 6F; age: 54.4 ± 11.5y; BMI: 28.6 ± 4.1 kg/m^2)	1 week	Pre-to-post intervention	2 apples (~360 g/day) Composition : total phenolic (88mg/ equivalent gallic acid), total flavanol (15mg/ mg eq. Catechin), total monomeric anthocyanin (4mg/ cyanidin 3-glucoside), FRAP (168.77mg/ equivalent gallic acid), DPPH (58.28mg/equivalent gallic acid)	Fuji	none
Koutsos et al., (2020) UK[4]	40 healthy mildly hypercholesterolemic subjects (sex: 23F,17M; age: 51±11 y; BMI: 25.3±3.7 kg/m^2)	8 weeks	Randomized, controlled, crossover design	Apples (n=2, 340g daily serving without the core including skin) Composition: Energy 221 kcal, fat 0.7g, protein 1g, total carbohydrates 58g, total sugars 44g, total dietary fiber 8.5g, vitamin C 21mg, sum of all individual polyphenols and oligomeric PAs (DP > 2) 990 mg per daily portion (mainly oligomeric Pas and chlorogenic acid)	Renetta Canada	Control beverage (100-mL) + water 400 mL daily serving (sugar-matched control) Composition: Energy 167 kcal, fat <0.1g, protein <0.1g, total carbohydrates 42g, total sugars 41g, total dietary fiber <0.5g, vitamin C <0.3mg, sum of all individual polyphenols and oligomeric PAs (DP > 2) 2.5 mg per daily portion (mainly oligomeric Pas and chlorogenic acid)
Barnett et al., (2021) New Zealand[60]	30 healthy volunteers (25F, 5M; age range	2 weeks	Randomized, placebo-controlled,	Dried slice of red-fleshed apple (one	Test apples : plant-food selection	Dried slice of placebo apples with pale skin

	20-61y; BMI range 19.4–30.8 kg/m^2)		crossover intervention trial	apple/day)	A194R31T068, A236R02T092, and A358R02T100 Placebo apples : PremA153	and white flesh
Liddle et al., (2021) Canada[61]	44 overweight and obese subjects (sex:30F, 14M; age: 45.4±2.2y; BMI: 33.4±0.9 kg/m^2)	6 weeks	Randomized, controlled, parallel-arm design	Apple fruit (3 x day; ~200 g edible parts) <u>Composition :</u> Energy 115 kcal, Carbohydrates 27.5 g (3.3 g glucose, 11.9 g fructose, 5.6 g sucrose), Protein 1.2 g, Fat 0 g, Pectin 2.2g, Total polyphenols 200mg	Gala	Habitual diet without apples
Pushpass et al., (2023) Ireland[66]	61 volunteers (sex: 46F, 15M ; age: 52±12 y; BMI 24.8±3.4 kg/m^2)	8 weeks	4 arms, randomized, parallel design	Apple treatment (2 Renetta Canada apples with 2 placebo capsules) consumed daily for breakfast (high fat chocolate drink) <u>Composition:</u> Apple: (Energy 234kcal, Carbohydrates 63.5g, (sugars 44g), Protein 1.1g, Fat 0.7g, Fiber 8.5g, vitamin C 21mg, sum of all individual polyphenols and oligomeric PAs (DP > 2) 990 mg per daily portion (mainly oligomeric Pas and chlorogenic acid)) Test Breakfast Apples: (Energy 845kcal, Carbohydrates 88.8g,	Renetta Canada	Control treatment (Cornflakes 40 g with 180 mL semi-skimmed milk and 2 placebo capsules) consumed daily for breakfast (high fat chocolate drink) <u>Composition:</u> Test Breakfast Control: (Energy 852kcal, Carbohydrates 86g, (sugars 46.6g), Protein 19.2g, Fat 50.3g, Fiber 1.4g) Probiotic treatment (Cornflakes 40g with 180 mL semi-skimmed milk and 2 probiotic capsules containing the BSH positive strain of L. reuteri NCIMB

				(sugars 69g), Protein 19.3g, Fat 50.1g, Fiber 8.5g)		30242, >2.5 billion CFU per capsule) consumed daily for breakfast (high fat chocolate drink) <u>Composition:</u> Test Breakfast Probiotic: (Energy 852kcal, Carbohydrates 86g, (sugars 46.6g), Protein 19.2g, Fat 50.3g, Fiber 1.4g) Oats treatment (Jumbo whole rolled oats 40 g with 180 mL semi-skimmed milk and 2 placebo capsules) consumed daily for breakfast (high fat chocolate drink) <u>Composition:</u> Test Breakfast Oats: (Energy 864kcal, Carbohydrates 88.1g, (sugars 63.1g), Protein 19.8g, Fat 49.6g, Fiber 3.6g)
Alexender et al., (2023) United States[62]	90 healthy adults (77F, 23M; age range: 18-61y; BMI range:17.9-47.1 kg/m^2)	4 weeks	Randomized, double-blinded, placebo-controlled, parallel design	Apple juice 16oz or apple juice (16oz) + apple pomace (10g) <u>Composition :</u> Apple juice (0 g fibre/d) Apple juice + apple pomace (10 g fibre/d)	not reported	none

Alzoufairi et al., (2025) Ireland[63]	59 healthy volunteers Apple group: (sex: 12F, 3M ; age: 54±3 y; BMI 25.5±0.9 kg/m^2) Oat group: (sex: 12F, 3M ; age: 50±3 y; BMI 25.5±0.9 kg/m^2) Probiotic group: (sex: 11F, 4M ; age: 53±3 y; BMI 24.2±0.9 kg/m^2) Control group: (sex: 10F, 4M ; age: 50±3 y; BMI 24.7±0.9 kg/m^2)	8 weeks	4 arms, randomized, parallel design	Apple treatment (2 Renetta Canada apples with 2 placebo capsules) consumed daily for breakfast (high fat chocolate drink) Composition: Apple: (Energy 234kcal, Carbohydrates 63.5g, (sugars 44g), Protein 1.1g, Fat 0.7g, Fiber 8.5g, vitamin C 21mg, sum of all individual polyphenols and oligomeric PAs (DP > 2) 990 mg per daily portion (mainly oligomeric Pas and chlorogenic acid)) Test Breakfast Apples: (Energy 845kcal, Carbohydrates 88.8g, (sugars 69g), Protein 19.3g, Fat 50.1g, Fiber 8.5g)	Renetta Canada	Control treatment (Cornflakes 40 g with 180 mL semi-skimmed milk and 2 placebo capsules) consumed daily for breakfast (high fat chocolate drink) Composition: Test Breakfast Control: (Energy 852kcal, Carbohydrates 86g, (sugars 46.6g), Protein 19.2g, Fat 50.3g, Fiber 1.4g) Probiotic treatment (Cornflakes 40g with 180 mL semi-skimmed milk and 2 probiotic capsules containing the BSH positive strain of L. reuteri NCIMB 30242, >2.5 billion CFU per capsule) consumed daily for breakfast (high fat chocolate drink) Composition: Test Breakfast Probiotic: (Energy 852kcal, Carbohydrates 86g, (sugars 46.6g), Protein 19.2g, Fat 50.3g, Fiber 1.4g) Oats treatment (Jumbo whole rolled oats 40 g with 180

						mL semi-skimmed milk and 2 placebo capsules) consumed daily for breakfast (high fat chocolate drink) <u>Composition:</u> Test Breakfast Oats: (Energy 864kcal, Carbohydrates 88.1g, (sugars 63.1g), Protein 19.8g, Fat 49.6g, Fiber 3.6g)

Legend: BMI: body mass index; F: female; M, male;