Authentic human data for benzoic acid (C_6–C_1) metabolites in urine, plasma, ileal fluid and feces

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Introduction

This document is a compilation of published quantitative data obtained with authentic calibrants for the concentrations of C_6–C_3 metabolites (i.e. 3-phenylpropanoic acids and the associated phase-2 conjugates) in human urine, plasma, ileal fluid and feces. The originating publications were identified by searching Web of Science, PubMed and Google Scholar up to May 2024.

Data originally reported on a mass/day or mass/volume basis have been converted to a molar basis to facilitate comparisons, but some published data were excluded from these tables:

(i) Data originally reported relative to creatinine, the standard clinical practice with spot plasma and urine samples, cannot be accurately converted to a molar basis because creatinine production varies with sex, age and protein intake.

(ii) Data produced by acid or enzymic hydrolysis of phase-2 conjugates have not been tabulated except for glycine or glutamine conjugates when β-glucuronidase and sulfatase hydrolysis has been used.

Similar compilations have been prepared for C_6–C_2 metabolites (phenylacetic acids), C_6–C_3 metabolites (3-phenylpropanoic acids and cinnamic acids) and C_6–C_5 metabolites (5-phenylvaleric acids, 4-hydroxy-5-hydroxyphenylvaleric acids and phenylvalerolactones) and the metabolites have been identified using the nomenclature recommended by Kay *et al*. (Kay et al. 2020) and are numbered consecutively in a single series through the five documents.

Table 74. Benzoic acid											
Free-living Plasma spot value	Feeding Study Plasma C_{max}	Feeding Study Urine	Washout				Fecal water	Ileal fluid	Notes	Reference	N
µmol/l	µmol/l	µmol/24 hours	Washout duration	Plasma spot conc^{n} µmol/l	Urine collection duration	Urine content µmol	µmol/l	µmol/l			
0.194 (0.161–0.378) [a]		**7.51 (1.62–169.3)** [a]							*N*=10, median and IQR. Polyphenol-rich breakfast for 3 days [a]	(Domínguez-Fernández et al. 2021)	10
61.52 ± 22.17 **(58.33 and 22.48)**									Free-living volunteers (*N*=90, mean ± s.d.) (**Median** and IQR)	(Le Sayec et al. 2023)	90
		1.67 ± 0.40 day 1 2.34 ± 0.94 at 1 month	1-day including over-night fast	0.794 ± 0.056 0.932 ± 0.063 0.981 ± 0.072 0.926 ± 0.047					Daily Wild blueberries (726 mg) for 1 month (mean ± s.e., *N*=18).	(Feliciano, Istas, et al. 2016)	18
	2.17 ± 0.61	4.14 ± 0.43	Three days						Daily Cranberry juice (787 mg) for 1 month (mean ± s.e., *N*=10).	(Feliciano, Boeres, et al. 2016)	10
	2.75 ± 0.88		Three days						Daily Cranberry juice (476 mg) (mean ± s.e., *N*=10).	(Feliciano et al. 2017)	10
	2.79 ± 0.95		Three days						Daily Cranberry juice (1238 mg) for (mean ± s.e., *N*=10).		10
	2.33 ± 0.56		Three days						Daily Cranberry juice (1534 mg (mean ± s.e., *N*=10).		10
	4.39 ± 1.99		Three days						Daily Cranberry juice (1910 mg) (mean ± s.e., *N*=10).		10
	826, 1306, 2275								Clinical study Benzoic acid 40, 80 and 160 mg/kg	(Kubota et al. 1988)	1
		2.4 ± 0.7 day 1 1.9 ± 0.6 at 1 month	2-day including over-night fast	0.464 ± 0.129					Day 1 placebo (mean ± s.e., *N*=22) Placebo after 1 month (mean ± s.e., *N*=22)	(Heiss et al. 2022)	22

		2.0 ± 0.5 day 1 2.9 ± 0.9 at 1 month	2-day including over-night fast	0.479 ± 0.181					Day 1 cranberries (525 mg) (mean ± s.e., *N*=23) Cranberries (525 mg) after 1 month (mean ± s.e.), *N*=23)		23
								0.2 ± 0.8	Mangoes (500 µmol) Ileostomists (*N*=10, mean ± s.e.)	Crozier	10
							50.96 ± 47.10		Free-living volunteers (*N*=5, mean ± s.d.)	(Jenner, Rafter, and Halliwell 2005)	5
							24.28 23.16 25.64 24.35		One free-living volunteer over four consecutive days. No increase on hydrolysis		
										9	229

Notes: a) The participants consumed for breakfast for 3 days milled flaxseed (30 g/day), freeze-dried raspberry powder (40 g/day), and soy milk (250 mL/day), providing 300 mg/ day of lignans (300 mg of secoisolariciresinol diglucoside), 150 mg/ day of ellagitannins (118 mg of sanguiin H6, 14.3 mg of lambertianin C, and other minor ellagitannins), and 22 mg of isoflavones/day (20.10 mg of daidzin and 1.8 mg of daidzein).

Table 75. 4-Ethylbenzoic acid										
Feeding Study Plasma C_{max}	Feeding Study Urine	Washout				Fecal water	Ileal fluid	Notes	Reference	N
µmol/l	µmol/24 hours	Washout duration	Plasma spot conc^{n} µmol/l	Urine collection duration	Urine content µmol	µmol/l	µmol/l			
						0.19 ± 0.14		Free-living volunteers (*N*=5, mean ± s.d.)	(Jenner, Rafter, and Halliwell 2005)	5
						0.18 0.21 0.13 0.11		One free-living volunteer over four consecutive days. No increase on hydrolysis		
									[1]	5

Table 76. 2-hydroxyybenzoic acid (Salicylic acid)											
Free-living Plasma spot value	Feeding Study Plasma C_{max}	Feeding Study Urine	Washout				Fecal water	Ileal fluid	Notes	Reference	N
µmol/l	µmol/l	µmol/24 hours	Washout duration	Plasma spot conc^{n} µmol/l	Urine collection duration	Urine content µmol	µmol/l	µmol/l			
0.086 (0.072–0.189) [a]		**0.189 (0.133–0.699)** [a]							*N*=10, median and IQR. Polyphenol-rich breakfast for 3 days [a]	(Domínguez-Fernández et al. 2021)	10
5.90 ± 17.10 **(2.30 and 3.20)**									Free-living volunteers (*N*=90, mean ± s.d.) (**Median** and IQR)	(Le Sayec et al. 2023)	90
		0.362 ± 0.217 day 1 0.130 ± 0.072 at 1 month	1-day including over-night fast	0.080 ± 0.022 0.131 ± 0.060 0.103 ± 0.015 0.106 ± 0.015					Daily Wild blueberries (726 mg) for 1 month (mean ± s.e., *N*=18).	(Feliciano, Istas, et al. 2016)	18
	0.31 ± 0.13	0.029 ± 0.017	Three days						Daily Cranberry juice (787 mg) for 1 month (mean ± s.e., *N*=10).	(Feliciano, Boeres, et al. 2016)	10
	0.66 ± 0.46		Three days						Daily Cranberry juice (476 mg) (mean ± s.e., *N*=10).	(Feliciano et al. 2017)	10
	0.44 ± 0.28		Three days						Daily Cranberry juice (1238 mg) for (mean ± s.e., *N*=10).		10
	0.51 ± 0.27		Three days						Daily Cranberry juice (1534 mg (mean ± s.e., *N*=10).		10
	0.63 ± 0.32		Three days						Daily Cranberry juice (1910 mg) (mean ± s.e., *N*=10).		10
	125 31–242								Aspirin 25 mg/kg underweight children (*N*=11, median and range)	(Lares-Asseff et al. 1999)	11
	49 65–254 ??								Aspirin 25 mg/kg normal weight children (*N*=10, median and range)		10
		0.1 ± 0 day 1	2-day including	0.184 ± 0.025					Day 1 placebo (mean ± s.e., *N*=22) Placebo after 1 month (mean ± s.e., *N*=22)	(Heiss et al. 2022)	22

		0.1 ± 0 at 1 month	over-night fast								
		0.1 ± 0 day 1 0.2 ± 0 at 1 month	2-day including over-night fast	0.266 ± 0.034					Day 1 cranberries (525 mg) (mean ± s.e., *N*=23) Cranberries (525 mg) after 1 month (mean ± s.e.), *N*=23)		23
		0.049 ± 0.020	2-day including over-night fast	0.130 ± 0.035					Mean ± s.e., *N*=7, beans	(Mecha et al. 2020)	7
							1.39 ± 1.70		Free-living volunteers (*N*=5, mean ± s.d.)	(Jenner, Rafter, and Halliwell 2005)	5
							0.24 0.20 0.39 0.41		One free-living volunteer over four consecutive days. No increase on hydrolysis		
										8	241

Notes: a) The participants consumed for breakfast for 3 days milled flaxseed (30 g/day), freeze-dried raspberry powder (40 g/day), and soy milk (250 mL/day), providing 300 mg/ day of lignans (300 mg of secoisolariciresinol diglucoside), 150 mg/ day of ellagitannins (118 mg of sanguiin H6, 14.3 mg of lambertianin C, and other minor ellagitannins), and 22 mg of isoflavones/day (20.10 mg of daidzin and 1.8 mg of daidzein).

Table 77. 3-Hydroxyybenzoic acid											
Free-living Plasma spot value	Feeding Study Plasma C_{max}	Feeding Study Urine	Washout				Fecal water	Ileal fluid	Notes	Reference	N
µmol/l	µmol/l	µmol/24 hours	Washout duration	Plasma spot conc^{n} µmol/l	Urine collection duration	Urine content µmol	µmol/l	µmol/l			
0.015 (0.004–0.123)									Free-living individuals (*N*=255, median 5 and 95% CI)	(Mori et al. 2023)	255
0.019 (0.005–0.123)											255
0.134 (0.106–0.171) [a]		**0.394 (0.239–1.038)** [a]							*N*=10, median and IQR. Polyphenol-rich breakfast for 3 days [a]	(Domínguez-Fernández et al. 2021)	10
2.43 ± 2.63 **(1.74 and 2.17)**									Free-living volunteers (*N*=90, mean ± s.d.) (**Median** and IQR)	(Le Sayec et al. 2023)	90
		0.159 ± 0.050 day 1 0.159 ± 0.036 at 1 month	1-day including over-night fast	0.017 ± 0.003 0.013 ± 0.002 0.021 ± 0.005 0.017 ± 0.003					Daily Wild blueberries (726 mg) for 1 month (mean ± s.e., *N*=18).	(Feliciano, Istas, et al. 2016)	18
	0.066 ± 0.023	0.041 ± 0.007	Three days						Daily Cranberry juice (787 mg) for 1 month (mean ± s.e., *N*=10).	(Feliciano, Boeres, et al. 2016)	10
	0.068 ± 0.022		Three days						Daily Cranberry juice (476 mg) (mean ± s.e., *N*=10).	(Feliciano et al. 2017)	10
	0.086 ± 0.035		Three days						Daily Cranberry juice (1238 mg) for (mean ± s.e., *N*=10).		10
	0.076 ± 0.022		Three days						Daily Cranberry juice (1534 mg (mean ± s.e., *N*=10).		10
	0.096 ± 0.031		Three days						Daily Cranberry juice (1910 mg) (mean ± s.e., *N*=10).		10
		0.1 ± 0 day 1 0.1 ± 0 at 1 month	2-day including over-night fast	0.031 ± 0.005					Day 1 placebo (mean ± s.e., *N*=22) Placebo after 1 month (mean ± s.e., *N*=22)	(Heiss et al. 2022)	22

		0.1 ± 0 day 1 0.1 ± 0 at 1 month	2-day including over-night fast	0.004 ± 0.003					Day 1 cranberries (525 mg) (mean ± s.e., *N*=23) Cranberries (525 mg) after 1 month (mean ± s.e.), *N*=23)		23
		0.070 ± 0.027	2-day including over-night fast						Mean ± s.e., *N*=7, beans	(Mecha et al. 2020)	7
							1.99 ± 1.65		Free-living volunteers (*N*=5, mean ± s.d.)	(Jenner, Rafter, and Halliwell 2005)	5
							5.31 1.67 4.63 5.19		One free-living volunteer over four consecutive days. No increase on hydrolysis		
										9	735

Notes: a) The participants consumed for breakfast for 3 days milled flaxseed (30 g/day), freeze-dried raspberry powder (40 g/day), and soy milk (250 mL/day), providing 300 mg/ day of lignans (300 mg of secoisolariciresinol diglucoside), 150 mg/ day of ellagitannins (118 mg of sanguiin H6, 14.3 mg of lambertianin C, and other minor ellagitannins), and 22 mg of isoflavones/day (20.10 mg of daidzin and 1.8 mg of daidzein).

Table 78. 4-Hydroxyybenzoic acid											
Free-living Plasma spot value	Feeding Study Plasma C_{max}	Feeding Study Urine	Washout				Fecal water	Ileal fluid	Notes	Reference	N
µmol/l	µmol/l	µmol/24 hours	Washout duration	Plasma spot conc^{n} µmol/l	Urine collection duration	Urine content µmol	µmol/l	µmol/l			
0.278 (0.217–0.398)									Free-living individuals (*N*=255, median 5 and 95% CI)	(Mori et al. 2023)	255
0.272 (0.218–0.378)											255
0.025 (0.0.020–0.0.035) [a]		**6.17 (3.65–10.72)** [a]							*N*=10, median and IQR. Polyphenol-rich breakfast for 3 days [a]	(Domínguez-Fernández et al. 2021)	10
1.10 ± 1.36 **(0.71 and 0.61)**									Free-living volunteers (*N*=90, mean ± s.d.) (**Median** and IQR)	(Le Sayec et al. 2023)	90
		0.695 ± 0.208	Three days		2 hours	0.153 ± 0.044			Maté (1118 µmol) (mean ± s.d., *N*=12)	(Gomez-Juaristi et al. 2018)	12
		3.76 ± 0.70 day 1 2.88 ± 0.043 at 1 month	1-day including over-night fast	0.027 ± 0.008 0.023 ± 0.006 0.018 ± 0.004 0.018 ± 0.003					Daily Wild blueberries (726 mg) for 1 month (mean ± s.e., *N*=18).	(Feliciano, Istas, et al. 2016)	18
	0.042 ± 0.007	2.55 ± 0.43	Three days						Daily Cranberry juice (787 mg) for 1 month (mean ± s.e., *N*=10).	(Feliciano, Boeres, et al. 2016)	10
	0.045 ± 0.012		Three days						Daily Cranberry juice (476 mg) (mean ± s.e., *N*=10).	(Feliciano et al. 2017)	10
	0.061 ± 0.018		Three days						Daily Cranberry juice (1238 mg) for (mean ± s.e., *N*=10).		10
	0.065 ± 0.018		Three days						Daily Cranberry juice (1534 mg (mean ± s.e., *N*=10).		10
	0.103 ± 0.037		Three days						Daily Cranberry juice (1910 mg) (mean ± s.e., *N*=10).		10

		n.d.	2-day including over-night fast	0.003 ± 0					Day 1 placebo (mean ± s.e., *N*=22) Placebo after 1 month (mean ± s.e., *N*=22)	(Heiss et al. 2022)	22
		n.d.	2-day including over-night fast	0.002 ± 0					Day 1 cranberries (525 mg) (mean ± s.e., *N*=23) Cranberries (525 mg) after 1 month (mean ± s.e.), *N*=23)		23
		0.178 ± 0.033	2-day including over-night fast						Mean ± s.e., *N*=7, beans	(Mecha et al. 2020)	7
								0.17 ± 0.05	Mangoes (500 µmol) Ileostomists (*N*=10, mean ± s.e.)	Crozier	10
							2.20 ± 1.22		Free-living volunteers (*N*=5, mean ± s.d.)	(Jenner, Rafter, and Halliwell 2005)	5
							0.99 0.75 10.10 1.66		One free-living volunteer over four consecutive days. No increase on hydrolysis		
										11	757

Notes: a) The participants consumed for breakfast for 3 days milled flaxseed (30 g/day), freeze-dried raspberry powder (40 g/day), and soy milk (250 mL/day), providing 300 mg/ day of lignans (300 mg of secoisolariciresinol diglucoside), 150 mg/ day of ellagitannins (118 mg of sanguiin H6, 14.3 mg of lambertianin C, and other minor ellagitannins), and 22 mg of isoflavones/day (20.10 mg of daidzin and 1.8 mg of daidzein).

Table 79. Benzoic acid-4-sulfate											
Free-living Plasma spot value	Feeding Study Plasma C_{max}	Feeding Study Urine	Washout				Fecal water	Ileal fluid	Notes	Reference	N
µmol/l	µmol/l	µmol/24 hours	Washout duration	Plasma spot conc^{n} µmol/l	Urine collection duration	Urine content µmol	µmol/l	µmol/l			
	0.0218 ± 0.0044	243.1 ± 84.9 [b]							Mean ± s.e., *N*=10 Week 1 low consumption flavanone-rich ingredient	(Muralidharan et al. 2023)	10
	0.0243 ± 0.0047	108.2 ± 29.9 [b]							Mean ± s.e., *N*=10 Week 16 low consumption flavanone-rich ingredient		
	0.0322 ± 0.0077	250.8 ± 29.2 [b]							Mean ± s.e., *N*=9 Week 1 high consumption flavanone-rich ingredient		9
	0.0362 ± 0.0018	162.0 ± 34.2 [b]							Mean ± s.e., *N*=9 Week 16 high consumption flavanone-rich ingredient		
		2381 ± 460 day 1 1910 ± 382 at 1 month	2-day including over-night fast	n.d.					Day 1 placebo (mean ± s.e., *N*=22) Placebo after 1 month (mean ± s.e., *N*=22)	(Heiss et al. 2022)	22
		1664 ± 341 day 1 3739 ± 858 at 1 month	2-day including over-night fast	n.d.					Day 1 cranberries (525 mg) (mean ± s.e., *N*=23) Cranberries (525 mg) after 1 month (mean ± s.e.), *N*=23)		23
										2	64

Notes: b) 48-hour urines

Table 80. 2,3-Dihydroxybenzoic acid											
Free-living Plasma spot value	Feeding Study Plasma C_{max}	Feeding Study Urine	Washout				Fecal water	Ileal fluid	Notes	Reference	N
µmol/l	µmol/l	µmol/24 hours	Washout duration	Plasma spot conc^{n} µmol/l	Urine collection duration	Urine content µmol	µmol/l	µmol/l			
<LOQ [a]		**<LOQ** [a]							*N*=10, median and IQR. Polyphenol-rich breakfast for 3 days [a]	(Domínguez-Fernández et al. 2021)	10
<LOQ									Free-living volunteers (*N*=90, mean ± s.d.) (**Median** and IQR)	(Le Sayec et al. 2023)	90
		42.8 ± 8.8 day 1 39.5 ± 4.7 at 1 month	1-day including over-night fast	8.89 ± 1.55 7.43 ± 1.32 8.07 ± 1.21 8.66 ± 1.64					Daily Wild blueberries (726 mg) for 1 month (mean ± s.e., *N*=18).	(Feliciano, Istas, et al. 2016)	18
	12.02 ± 4.06	8.43 ± 2.18	Three days						Daily Cranberry juice (787 mg) for 1 month (mean ± s.e., *N*=10).	(Feliciano, Boeres, et al. 2016)	10
	7.91 ± 2.30		Three days						Daily Cranberry juice (476 mg) (mean ± s.e., *N*=10).	(Feliciano et al. 2017)	10
	10.26 ± 3.44		Three days						Daily Cranberry juice (1238 mg) for (mean ± s.e., *N*=10).		10
	11.87 ± 3.44		Three days						Daily Cranberry juice (1534 mg (mean ± s.e., *N*=10).		10
	8.94 ± 2.52		Three days						Daily Cranberry juice (1910 mg) (mean ± s.e., *N*=10).		10
		0 ± 0 day 1 0 ± 0 at 1 month	2-day including over-night fast	n.d.					Day 1 placebo (mean ± s.e., *N*=22) Placebo after 1 month (mean ± s.e., *N*=22)	(Heiss et al. 2022)	22
		0 ± 0 day 1 0 ± 0 at 1 month	2-day including over-night fast	n.d.					Day 1 cranberries (525 mg) (mean ± s.e., *N*=23) Cranberries (525 mg) after 1 month (mean ± s.e.), *N*=23)		23
										6	213

Notes: a) The participants consumed for breakfast for 3 days milled flaxseed (30 g/day), freeze-dried raspberry powder (40 g/day), and soy milk (250 mL/day), providing 300 mg/ day of lignans (300 mg of secoisolariciresinol diglucoside), 150 mg/ day of ellagitannins (118 mg of sanguiin H6, 14.3 mg of lambertianin C, and other minor ellagitannins), and 22 mg of isoflavones/day (20.10 mg of daidzin and 1.8 mg of daidzein).

Table 81. 2,4-Dihydroxybenzoic acid											
Free-living Plasma spot value	Feeding Study Plasma C_{max}	Feeding Study Urine	Washout				Fecal water	Ileal fluid	Notes	Reference	N
µmol/l	µmol/l	µmol/24 hours	Washout duration	Plasma spot conc^{n} µmol/l	Urine collection duration	Urine content µmol	µmol/l	µmol/l			
		0.351 ± 0.084 day 1 0.396 ± 0.097 at 1 month	1-day including over-night fast	0.013 ± 0.005 0.011 ± 0.003 0.025 ± 0.007 0.018 ± 0.003					Daily Wild blueberries (726 mg) for 1 month (mean ± s.e., *N*=18).	(Feliciano, Istas, et al. 2016)	18
	0.022 ± 0.004	0.257 ± 0.108	Three days						Daily Cranberry juice (787 mg) for 1 month (mean ± s.e., *N*=10).	(Feliciano, Boeres, et al. 2016)	10
	0.018 ± 0.004		Three days						Daily Cranberry juice (476 mg) (mean ± s.e., *N*=10).	(Feliciano et al. 2017)	10
	0.025 ± 0.004		Three days						Daily Cranberry juice (1238 mg) for (mean ± s.e., *N*=10).		10
	0.030 ± 0.007		Three days						Daily Cranberry juice (1534 mg (mean ± s.e., *N*=10).		10
	0.033 ± 0.007		Three days						Daily Cranberry juice (1910 mg) (mean ± s.e., *N*=10).		10
										3	68

Table 82. 2-hydroxy-4-methoxybenzoic acid											
Free-living Plasma spot value	Feeding Study Plasma C_{max}	Feeding Study Urine	Washout				Fecal water	Ileal fluid	Notes	Reference	N
µmol/l	µmol/l	µmol/24 hours	Washout duration	Plasma spot conc^{n} µmol/l	Urine collection duration	Urine content µmol	µmol/l	µmol/l			
<LOQ [a]		**<LOQ** [a]							*N*=10, median and IQR. Polyphenol-rich breakfast for 3 days [a]	(Domínguez-Fernández et al. 2021)	10
0.209 ± 0.240 **(0.132 and 0.228)**									Free-living volunteers (*N*=90, mean ± s.d.) (**Median** and IQR)	(Le Sayec et al. 2023)	90
										2	100

Notes: a) The participants consumed for breakfast for 3 days milled flaxseed (30 g/day), freeze-dried raspberry powder (40 g/day), and soy milk (250 mL/day), providing 300 mg/ day of lignans (300 mg of secoisolariciresinol diglucoside), 150 mg/ day of ellagitannins (118 mg of sanguiin H6, 14.3 mg of lambertianin C, and other minor ellagitannins), and 22 mg of isoflavones/day (20.10 mg of daidzin and 1.8 mg of daidzein).

Table 83. 2,5-Dihydroxybenzoic acid (Gentisic acid)											
Free-living Plasma spot value	Feeding Study Plasma C_{max}	Feeding Study Urine	Washout				Fecal water	Ileal fluid	Notes	Reference	N
µmol/l	µmol/l	µmol/24 hours	Washout duration	Plasma spot conc^{n} µmol/l	Urine collection duration	Urine content µmol	µmol/l	µmol/l			
<LOQ [a]		**25.5 13.8–31.0** [a]							*N*=10, median and IQR. Polyphenol-rich breakfast for 3 days [a]	(Domínguez-Fernández et al. 2021)	10
5.08 ± 2.62 **(4.29 and 3.93)**									Free-living volunteers (*N*=90, mean ± s.d.) (**Median** and IQR)	(Le Sayec et al. 2023)	90
			12 hours	0.036 ± 0.019 **0.028 (0.014–0.070)**					Breast cancer patients I*N*=19), mean ± s.d., **median**)	(Avila-Galvez et al. 2019)	19
		4.34 ± 0.772 day 1 4.915 ± 0.688 at 1 month	1-day including over-night fast	0.071 ± 0.010 0.054 ± 0.006 0.101 ± 0.010 0.094 ± 0.011					Daily Wild blueberries (726 mg) for 1 month (mean ± s.e., *N*=18).	(Feliciano, Istas, et al. 2016)	18
	0.425 ± 0.137	4.9 ± 0.8	Three days						Daily Cranberry juice (787 mg) for 1 month (mean ± s.e., *N*=10).	(Feliciano, Boeres, et al. 2016)	10
	0.419 ± 0.146		Three days						Daily Cranberry juice (476 mg) (mean ± s.e., *N*=10).	(Feliciano et al. 2017)	10
	0.772 ± 0.241		Three days						Daily Cranberry juice (1238 mg) for (mean ± s.e., *N*=10).		10
	0.834 ± 0.254		Three days						Daily Cranberry juice (1534 mg (mean ± s.e., *N*=10).		10
	1.46 ± 0.62		Three days						Daily Cranberry juice (1910 mg) (mean ± s.e., *N*=10).		10
	3.98 0.40–12.07								Aspirin 25 mg/kg underweight children (*N*=11, median and range)	(Lares-Asseff et al. 1999)	11

	3.91 **0.95–** **25.91**								Aspirin 25 mg/kg normal weight children (*N*=10, median and range)		10
		4.0 ± 0.8 day 1 3.2 ± 0.5 at 1 month	2-day including over-night fast	n.d.					Day 1 placebo (mean ± s.e., *N*=22) Placebo after 1 month (mean ± s.e., *N*=22)	(Heiss et al. 2022)	22
		4.6 ± 0.6 day 1 8.7 ± 1.6 at 1 month	2-day including over-night fast	n.d.					Day 1 cranberries (525 mg) (mean ± s.e., *N*=23) Cranberries (525 mg) after 1 month (mean ± s.e.), *N*=23)		23
							5.14 ± 4.87		Free-living volunteers (*N*=5, mean ± s.d.)	(Jenner, Rafter, and Halliwell 2005)	5
							9.81 6.11 18.84 10.24		One free-living volunteer over four consecutive days. No increase on hydrolysis		
										9	258

Notes: a) The participants consumed for breakfast for 3 days milled flaxseed (30 g/day), freeze-dried raspberry powder (40 g/day), and soy milk (250 mL/day), providing 300 mg/ day of lignans (300 mg of secoisolariciresinol diglucoside), 150 mg/ day of ellagitannins (118 mg of sanguiin H6, 14.3 mg of lambertianin C, and other minor ellagitannins), and 22 mg of isoflavones/day (20.10 mg of daidzin and 1.8 mg of daidzein).

Table 84. 2,6-Dihydroxybenzoic acid											
Free-living Plasma spot value	Feeding Study Plasma C_{max}	Feeding Study Urine	Washout				Fecal water	Ileal fluid	Notes	Reference	N
µmol/l	µmol/l	µmol/24 hours	Washout duration	Plasma spot conc^{n} µmol/l	Urine collection duration	Urine content µmol	µmol/l	µmol/l			
0.105 0.081–0.196 [a]		**25.5 13.8–31.0** [a]							*N*=10, median and IQR. Polyphenol-rich breakfast for 3 days [a]	(Domínguez-Fernández et al. 2021)	10
7.60 ± 4.60 **(5.8 and 4.3)**									Free-living volunteers (*N*=90, mean ± s.d.) (**Median** and IQR)	(Le Sayec et al. 2023)	90
			12 hours	0.057 ± 0.038 **0.042 (0.014–0.152)**					Breast cancer patients I*N*=19), mean ± s.d., **median and IQR**)	(Avila-Galvez et al. 2019)	19
							0.63 ± 0.28		Free-living volunteers (*N*=5, mean ± s.d.)	(Jenner, Rafter, and Halliwell 2005)	5
							0.15 0.14 0.30 0.21		One free-living volunteer over four consecutive days. No increase on hydrolysis		
										3	105

Notes: a) The participants consumed for breakfast for 3 days milled flaxseed (30 g/day), freeze-dried raspberry powder (40 g/day), and soy milk (250 mL/day), providing 300 mg/ day of lignans (300 mg of secoisolariciresinol diglucoside), 150 mg/ day of ellagitannins (118 mg of sanguiin H6, 14.3 mg of lambertianin C, and other minor ellagitannins), and 22 mg of isoflavones/day (20.10 mg of daidzin and 1.8 mg of daidzein).

Table 85. 3,4-Dihydroxyybenzoic acid (Protocatechuic acid)											
Free-living Plasma spot value	Feeding Study Plasma C_{max}	Feeding Study Urine	Washout				Fecal water	Ileal fluid	Notes	Reference	N
µmol/l	µmol/l	µmol/24 hours	Washout duration	Plasma spot conc^{n} µmol/l	Urine collection duration	Urine content µmol	µmol/l	µmol/l			
0.210 (0.179–0.249)									Free-living individuals (*N*=255, median 5 and 95% CI)	(Mori et al. 2023)	255
0.211 (0.178–0.242)											255
<LOQ [a]		**3.57 0.97–5.55** [a]							*N*=10, median and IQR. Polyphenol-rich breakfast for 3 days [a]	(Domínguez-Fernández et al. 2021)	10
0.52 ± 0.48 **(0.39 and 0.58)**									Free-living volunteers (*N*=90, mean ± s.d.) (**Median** and IQR)	(Le Sayec et al. 2023)	90
	11.2 (3.80–18.6)								Blackcurrant Extract 300 mg (*N*=20, mean and 95% CI)	(Costello et al. 2022)	20
	0.039 ± 0.015								Relinqing granules (8 g) (*N*=6, mean ± s.d.)	(Li et al. 2021)	6
	0.035 ± 0.010								Relinqing granules (8 g/day for seven days) (*N*=6, mean ± s.d.)		6
	0.008 ± 0.003								Purple potato extract (*N*=17, mean ± s.d.)	(Jokioja et al. 2021)	17
	3.27 ± 0.73								*N*=16, mean ± s.d. Chicory containing 248 µmol 3,4-diHBA	(Zheng et al. 2019)	16
		0.291 ± 0.063	Three days		2 hours	0.065 ± 0.023			Maté (1118 µmol) (mean ± s.d., *N*=12)	(Gomez-Juaristi et al. 2018)	12
		1.84 ± 0.338 day 1 1.41 ± 0.305 at 1 month	1-day including over-night fast	0.022 ± 0.006 0.018 ± 0.006 0.011 ± 0.004 0.008 ± 0.003					Daily Wild blueberries (726 mg) for 1 month (mean ± s.e., *N*=18).	(Feliciano, Istas, et al. 2016)	18

	0.109 ± 0.045	0.944 ± 0.162	Three days						Daily Cranberry juice (787 mg) for 1 month (mean ± s.e., *N*=10).	(Feliciano, Boeres, et al. 2016)	10
	0.096 ± 0.039		Three days						Daily Cranberry juice (476 mg) (mean ± s.e., *N*=10).	(Feliciano et al. 2017)	10
	0.116 ± 0.052		Three days						Daily Cranberry juice (1238 mg) for (mean ± s.e., *N*=10).		10
	0.092 ± 0.032		Three days						Daily Cranberry juice (1534 mg (mean ± s.e., *N*=10).		10
	0.136 ± 0.060		Three days						Daily Cranberry juice (1910 mg) (mean ± s.e., *N*=10).		10
		1.8 ± 0.3 day 1 1.7 ± 0.2 at 1 month	2-day including over-night fast	0.002 ± 0.001					Day 1 placebo (mean ± s.e., *N*=22) Placebo after 1 month (mean ± s.e., *N*=22)	(Heiss et al. 2022)	22
		1.4 ± 0.2 day 1 1.7 ± 0.2 at 1 month	2-day including over-night fast	0.014 ± 0.004					Day 1 cranberries (525 mg) (mean ± s.e., *N*=23) Cranberries (525 mg) after 1 month (mean ± s.e.), *N*=23)		23
		0.633 ± 0.099	2-day including over-night fast						Mean ± s.e., *N*=7, beans	(Mecha et al. 2020)	7
	3.27 ± 0.73								Chicory (mean ± s.d *N*=16,.)	(Zheng et al. 2019)	16
								1.1 ± 0.3	Mangoes (500 µmol) Ileostomists (*N*=10, mean ± s.e.)	Crozier	10
							0.76 ± 0.49		Free-living volunteers (*N*=5, mean ± s.d.)	(Jenner, Rafter, and Halliwell 2005)	5
							1.33 0.45 1.41 0.57		One free-living volunteer over four consecutive days. No increase on hydrolysis		
										16	758

Notes: a) The participants consumed for breakfast for 3 days milled flaxseed (30 g/day), freeze-dried raspberry powder (40 g/day), and soy milk (250 mL/day), providing 300 mg/ day of lignans (300 mg of secoisolariciresinol diglucoside), 150 mg/ day of ellagitannins (118 mg of sanguiin H6, 14.3 mg of lambertianin C, and other minor ellagitannins), and 22 mg of isoflavones/day (20.10 mg of daidzin and 1.8 mg of daidzein).

Table 86. 4-hydroxybenzoic acid-3-sulfate (Protocatechuic acid-3-sulfate)											
Free-living Plasma spot value	Feeding Study Plasma C_{max}	Feeding Study Urine	Washout				Fecal water	Ileal fluid	Notes	Reference	N
µmol/l	µmol/l	µmol/24 hours	Washout duration	Plasma spot conc^{n} µmol/l	Urine collection duration	Urine content µmol	µmol/l	µmol/l			
0.009 0.007–0.010 [a]		**2.07 0.73–3.71** [a]							*N*=10, median and IQR. Polyphenol-rich breakfast for 3 days [a]	(Domínguez-Fernández et al. 2021)	10
0.077 ± 0.100 **(0.050 and 0.072)**									Free-living volunteers (*N*=90, mean ± s.d.) (**Median** and IQR)	(Le Sayec et al. 2023)	90
	0.015 ± 0.008								Purple potato extract (*N*=16, mean ± s.d.)	(Jokioja et al. 2021)	16
		n.d.	2-day including over-night fast	0.001 ± 0.000					Day 1 placebo (mean ± s.e., *N*=22) Placebo after 1 month (mean ± s.e., *N*=22)	(Heiss et al. 2022)	22
		n.d.	2-day including over-night fast	0.001 ± 0					Day 1 cranberries (525 mg) (mean ± s.e., *N*=23) Cranberries (525 mg) after 1 month (mean ± s.e.), *N*=23)		23
										4	161

Notes: a) The participants consumed for breakfast for 3 days milled flaxseed (30 g/day), freeze-dried raspberry powder (40 g/day), and soy milk (250 mL/day), providing 300 mg/ day of lignans (300 mg of secoisolariciresinol diglucoside), 150 mg/ day of ellagitannins (118 mg of sanguiin H6, 14.3 mg of lambertianin C, and other minor ellagitannins), and 22 mg of isoflavones/day (20.10 mg of daidzin and 1.8 mg of daidzein).

Table 87. 3-hydroxybenzoic acid-4-sulfate (Protocatechuic acid-4-sulfate)											
Free-living Plasma spot value	Feeding Study Plasma C_{max}	Feeding Study Urine	Washout				Fecal water	Ileal fluid	Notes	Reference	N
µmol/l	µmol/l	µmol/24 hours	Washout duration	Plasma spot conc^{n} µmol/l	Urine collection duration	Urine content µmol	µmol/l	µmol/l			
0.0026 0.0022–0.0030 [a]		**2.48 1.06–6.02** [a]							*N*=10, median and IQR. Polyphenol-rich breakfast for 3 days [a]	(Domínguez-Fernández et al. 2021)	10
0.125 ± 0.124 **(0.105 and 0.058)**									Free-living volunteers (*N*=90, mean ± s.d.) (**Median** and IQR)	(Le Sayec et al. 2023)	90
	0.015 ± 0.008								Purple potato extract (*N*=16, mean ± s.d.)	(Jokioja et al. 2021)	16
		n.d.	2-day including over-night fast	0.002 ± 0.001					Day 1 placebo (mean ± s.e., *N*=22) Placebo after 1 month (mean ± s.e., *N*=22)	(Heiss et al. 2022)	22
		n.d.	2-day including over-night fast	0.004 ± 0.001					Day 1 cranberries (525 mg) (mean ± s.e., *N*=23) Cranberries (525 mg) after 1 month (mean ± s.e.), *N*=23)		23
										4	161

Notes: a) The participants consumed for breakfast for 3 days milled flaxseed (30 g/day), freeze-dried raspberry powder (40 g/day), and soy milk (250 mL/day), providing 300 mg/ day of lignans (300 mg of secoisolariciresinol diglucoside), 150 mg/ day of ellagitannins (118 mg of sanguiin H6, 14.3 mg of lambertianin C, and other minor ellagitannins), and 22 mg of isoflavones/day (20.10 mg of daidzin and 1.8 mg of daidzein).

Table 88. 4-hydroxybenzoic acid-3-glucuronide (Protocatechuic acid-3-glucuronide)											
Free-living Plasma spot value	Feeding Study Plasma C_{max}	Feeding Study Urine	Washout				Fecal water	Ileal fluid	Notes	Reference	N
µmol/l	µmol/l	µmol/24 hours	Washout duration	Plasma spot conc^{n} µmol/l	Urine collection duration	Urine content µmol	µmol/l	µmol/l			
<LOQ [a]		**<LOQ** [a]							*N*=10, median and IQR. Polyphenol-rich breakfast for 3 days [a]	(Domínguez-Fernández et al. 2021)	10
<LOQ									Free-living volunteers (*N*=90, mean ± s.d.) (**Median** and IQR)	(Le Sayec et al. 2023)	90
		0.6 ± 0.2 [b]							Mean ± s.e., *N*=10 Week 1 low consumption flavanone-rich ingredient	(Muralidharan et al. 2023)	10
		0.3 ± 0.1 [b]							Mean ± s.e., *N*=10 Week 16 low consumption flavanone-rich ingredient		
		0.4 ± 0.1 [b]							Mean ± s.e., *N*=9 Week 1 high consumption flavanone-rich ingredient		9
		0.6 ± 0.2 [b]							Mean ± s.e., *N*=9 Week 16 high consumption flavanone-rich ingredient		
		0.2 ± 0 day 1 0.1 ± 0 at 1 month	2-day including over-night fast	0.001 ± 0.000					Day 1 placebo (mean ± s.e., *N*=22) Placebo after 1 month (mean ± s.e., *N*=22)	(Heiss et al. 2022)	22
		0.1 ± 0 day 1 0.2 ± 0 at 1 month	2-day including over-night fast	0.027 ± 0.002					Day 1 cranberries (525 mg) (mean ± s.e., *N*=23) Cranberries (525 mg) after 1 month (mean ± s.e.), *N*=23)		23
										4	164

Notes:

Notes: a) The participants consumed for breakfast for 3 days milled flaxseed (30 g/day), freeze-dried raspberry powder (40 g/day), and soy milk (250 mL/day), providing 300 mg/ day of lignans (300 mg of secoisolariciresinol diglucoside), 150 mg/ day of ellagitannins (118 mg of sanguiin H6, 14.3 mg of lambertianin C, and other minor ellagitannins), and 22 mg of isoflavones/day (20.10 mg of daidzin and 1.8 mg of daidzein).

b) 48-hour urines

Table 89. 3-hydroxybenzoic acid-4-glucuronide (Protocatechuic acid-4-glucuronide)											
Free-living Plasma spot value	Feeding Study Plasma C_{max}	Feeding Study Urine	Washout				Fecal water	Ileal fluid	Notes	Reference	N
µmol/l	µmol/l	µmol/24 hours	Washout duration	Plasma spot conc^{n} µmol/l	Urine collection duration	Urine content µmol	µmol/l	µmol/l			
	0.0211 ± 0.0038	0.4 ± 0.1 [b]							Mean ± s.e., *N*=10 Week 1 low consumption flavanone-rich ingredient	(Muralidharan et al. 2023)	10
	0.0105 ± 0.0015	0.3 ± 0.1 [b]							Mean ± s.e., *N*=10 Week 16 low consumption flavanone-rich ingredient		
	0.0100 ± 0.0012	1.0 ± 0.7 [b]							Mean ± s.e., *N*=9 Week 1 high consumption flavanone-rich ingredient		9
	0.0117 ± 0.0021	0.5 ± 0.4 [b]							Mean ± s.e., *N*=9 Week 16 high consumption flavanone-rich ingredient		
										1	19

Table 90. Methyl 3,4-Dihydroxyybenzoate (Methyl protocatechuate)											
Free-living Plasma spot value	Feeding Study Plasma C_{max}	Feeding Study Urine	Washout				Fecal water	Ileal fluid	Notes	Reference	N
µmol/l	µmol/l	µmol/24 hours	Washout duration	Plasma spot conc^{n} µmol/l	Urine collection duration	Urine content µmol	µmol/l	µmol/l			
	0.0018 ± 0.0011								Purple potato extract (*N*=17, mean ± s.d.)	(Jokioja et al. 2021)	17
										1	17

Table 91. 3,4-methylenedioxybenzoic acid (Piperonylic acid)											
Free-living Plasma spot value	Feeding Study Plasma C_{max}	Feeding Study Urine	Washout				Fecal water	Ileal fluid	Notes	Reference	N
µmol/l	µmol/l	µmol/24 hours	Washout duration	Plasma spot conc^{n} µmol/l	Urine collection duration	Urine content µmol	µmol/l	µmol/l			
0.018–0.566 [a]			—						Free-living volunteers (*N*=10, min, max) GLUCURONIDASE	(Shafaei et al. 2019)	10
										1	10

Notes: a) samples hydrolysed with enzymes but absence of free hydroxyl means there are no susceptible phase-2 conjugates

Table 92. 4-Hydroxy-3-methoxybenzoic acid (Vanillic acid)											
Free-living Plasma spot value	Feeding Study Plasma C_{max}	Feeding Study Urine	Washout				Fecal water	Ileal fluid	Notes	Reference	N
µmol/l	µmol/l	µmol/24 hours	Washout duration	Plasma spot conc^{n} µmol/l	Urine collection duration	Urine content µmol	µmol/l	µmol/l			
0.105 (0.079–0.167)									Free-living individuals (*N*=255, median 5 and 95% CI)	(Mori et al. 2023)	255
0.104 (0.079–0.177)											255
<LOQ [a]		**3.13 1.78–8.54** [a]							*N*=10, median and IQR. Polyphenol-rich breakfast for 3 days [a]	(Domínguez-Fernández et al. 2021)	10
0.101 ± 0.092 **(0.081 and 0.102)**									Free-living volunteers (*N*=90, mean ± s.d.) (**Median** and IQR)	(Le Sayec et al. 2023)	90
	3.21 (0.95–7.32)								Blackcurrant Extract 300 mg (*N*=20, mean and 95% CI)	(Costello et al. 2022)	20
	0.092 ± 0.038								Purple potato extract (*N*=12, mean ± s.d.)	(Jokioja et al. 2021)	12
		1.57 ± 0.52 day 1 1.30 ± 0.21 at 1 month	1-day including over-night fast	0.290 ± 0.048 0.397 ± 0.053 0.644 ± 0.122 0.730 ± 0.109					Daily Wild blueberries (726 mg) for 1 month (mean ± s.e., *N*=18).	(Feliciano, Istas, et al. 2016)	18
	0.410 ± 0.115	0.423 ± 0.136	Three days						Daily Cranberry juice (787 mg) for 1 month (mean ± s.e., *N*=10).	(Feliciano, Boeres, et al. 2016)	10
	0.311 ± 0.084		Three days						Daily Cranberry juice (476 mg) (mean ± s.e., *N*=10).	(Feliciano et al. 2017)	10
	0.667 ± 0.223		Three days						Daily Cranberry juice (1238 mg) for (mean ± s.e., *N*=10).		10
	0.726± 0.229		Three days						Daily Cranberry juice (1534 mg (mean ± s.e., *N*=10).		10
	0.952 ± 0.305		Three days						Daily Cranberry juice (1910 mg) (mean ± s.e., *N*=10).		10

		27.1 ± 4.6 day 1 26.2 ± 5.0 at 1 month	2-day including over-night fast	n.d.					Day 1 placebo (mean ± s.e., *N*=22) Placebo after 1 month (mean ± s.e., *N*=22)	(Heiss et al. 2022)	22
		20.2 ± 3.8 day 1 37.1 ± 7.3 at 1 month	2-day including over-night fast	n.d.					Day 1 cranberries (525 mg) (mean ± s.e., *N*=23) Cranberries (525 mg) after 1 month (mean ± s.e.), *N*=23)		23
							0.57 ± 0.46		Free-living volunteers (*N*=5, mean ± s.d.)	(Jenner, Rafter, and Halliwell 2005)	5
							0.69 0.47 1.37 0.72		One free-living volunteer over four consecutive days. No increase on hydrolysis		
										10	760

Notes: a) The participants consumed for breakfast for 3 days milled flaxseed (30 g/day), freeze-dried raspberry powder (40 g/day), and soy milk (250 mL/day), providing 300 mg/ day of lignans (300 mg of secoisolariciresinol diglucoside), 150 mg/ day of ellagitannins (118 mg of sanguiin H6, 14.3 mg of lambertianin C, and other minor ellagitannins), and 22 mg of isoflavones/day (20.10 mg of daidzin and 1.8 mg of daidzein).

Table 93. 3-Methoxybenzoic acid-4-glucuronide (Vanillic acid-4-glucuronide)											
Free-living Plasma spot value	Feeding Study Plasma C_{max}	Feeding Study Urine	Washout				Fecal water	Ileal fluid	Notes	Reference	N
µmol/l	µmol/l	µmol/24 hours	Washout duration	Plasma spot conc^{n} µmol/l	Urine collection duration	Urine content µmol	µmol/l	µmol/l			
		3.1 ± 1.2 [b]							Mean ± s.e., *N*=10 Week 1 low consumption flavanone-rich ingredient	(Muralidharan et al. 2023)	10
		3.0 ± 1.3 [b]							Mean ± s.e., *N*=10 Week 16 low consumption flavanone-rich ingredient		
		8.1 ± 5.7 [b]							Mean ± s.e., *N*=9 Week 1 high consumption flavanone-rich ingredient		9
		5.8 ± 3.8 [b]							Mean ± s.e., *N*=9 Week 16 high consumption flavanone-rich ingredient		
										1	19

Notes: b) 48-hour urines

Table 94. 3-Methoxybenzoic acid-4-sulfate (Vanillic acid-4-sulfate)											
Free-living Plasma spot value	Feeding Study Plasma C_{max}	Feeding Study Urine	Washout				Fecal water	Ileal fluid	Notes	Reference	N
µmol/l	µmol/l	µmol/24 hours	Washout duration	Plasma spot conc^{n} µmol/l	Urine collection duration	Urine content µmol	µmol/l	µmol/l			
<LOQ [a]		**18.10 5.13–20.92** [a]							*N*=10, median and IQR. Polyphenol-rich breakfast for 3 days [a]	(Domínguez-Fernández et al. 2021)	10
0.463 ± 0.393 **(0.379 and 0.305)**									Free-living volunteers (*N*=90, mean ± s.d.) (**Median** and IQR)	(Le Sayec et al. 2023)	90
		1.58 ± 0.42 day 1 1.64 ± 0.59 at 1 month	1-day including over-night fast	0.030 ± 0.006 0.029 ± 0.006 0.034 ± 0.006 0.034 ± 0.006					Daily Wild blueberries (726 mg) for 1 month (mean ± s.e., *N*=18).	(Feliciano, Istas, et al. 2016)	18
	1.05 ± 0.27	0.288 ± 0.087	Three days						Daily Cranberry juice (787 mg) for 1 month (mean ± s.e., *N*=10).	(Feliciano, Boeres, et al. 2016)	10
	0.814 ± 0.302		Three days						Daily Cranberry juice (476 mg) (mean ± s.e., *N*=10).	(Feliciano et al. 2017)	10
	1.36 ± 0.34		Three days						Daily Cranberry juice (1238 mg) for (mean ± s.e., *N*=10).		10
	1.53 ± 0.42		Three days						Daily Cranberry juice (1534 mg (mean ± s.e., *N*=10).		10
	1.58 ± 0.37		Three days						Daily Cranberry juice (1910 mg) (mean ± s.e., *N*=10).		10
		7.8 ± 3.0 [b]							Mean ± s.e., *N*=10 Week 1 low consumption flavanone-rich ingredient	(Muralidharan et al. 2023)	10
		7.6 ± 3.6 [b]							Mean ± s.e., *N*=10 Week 16 low consumption flavanone-rich ingredient		
		21.7 ± 13.8 [b]							Mean ± s.e., *N*=9 Week 1 high consumption flavanone-rich ingredient		9
		14.8 ± 9.4 [b]							Mean ± s.e., *N*=9 Week 16 high consumption flavanone-rich ingredient		

		42.3 ± 5.8 day 1 28.2 ± 3.8 at 1 month	2-day including over-night fast	0.012 ± 0.003					Day 1 placebo (mean ± s.e., *N*=22) Placebo after 1 month (mean ± s.e., *N*=22)	(Heiss et al. 2022)	22
		38.2 ± 6.7 day 1 2.45 ± 4.2 at 1 month	2-day including over-night fast	0.041 ± 0.007					Day 1 cranberries (525 mg) (mean ± s.e., *N*=23) Cranberries (525 mg) after 1 month (mean ± s.e.), *N*=23)		23
		0.750 ± 0.121	2-day including over-night fast	0.089 ± 0.002					Mean ± s.e., *N*=7, beans	(Mecha et al. 2020)	7
										8	239

Notes: a) The participants consumed for breakfast for 3 days milled flaxseed (30 g/day), freeze-dried raspberry powder (40 g/day), and soy milk (250 mL/day), providing 300 mg/ day of lignans (300 mg of secoisolariciresinol diglucoside), 150 mg/ day of ellagitannins (118 mg of sanguiin H6, 14.3 mg of lambertianin C, and other minor ellagitannins), and 22 mg of isoflavones/day (20.10 mg of daidzin and 1.8 mg of daidzein).

b) 48-hour urines

Table 95. 3-Hydroxy-4-methoxybenzoic acid (Isovanillic acid)											
Free-living Plasma spot value	Feeding Study Plasma C_{max}	Feeding Study Urine	Washout				Fecal water	Ileal fluid	Notes	Reference	N
µmol/l	µmol/l	µmol/24 hours	Washout duration	Plasma spot conc^{n} µmol/l	Urine collection duration	Urine content µmol	µmol/l	µmol/l			
		0.404 ± 0.059 day 1 0.411 ± 0.077 at 1 month	1-day including over-night fast	0.429 ± 0.051 0.447 ± 0.058 0.426 ± 0.046 0.430 ± 0.057					Daily Wild blueberries (726 mg) for 1 month (mean ± s.e., *N*=18).	(Feliciano, Istas, et al. 2016)	18
	0.220 ± 0.044	1.24 ± 0.23	Three days						Daily Cranberry juice (787 mg) for 1 month (mean ± s.e., *N*=10).	(Feliciano, Boeres, et al. 2016)	10
	0.231 ± 0.052		Three days						Daily Cranberry juice (476 mg) (mean ± s.e., *N*=10).	(Feliciano et al. 2017)	10
	0.235 ± 0.066		Three days						Daily Cranberry juice (1238 mg) for (mean ± s.e., *N*=10).		10
	0.232 ± 0.056		Three days						Daily Cranberry juice (1534 mg (mean ± s.e., *N*=10).		10
	0.340 ± 0.110		Three days						Daily Cranberry juice (1910 mg) (mean ± s.e., *N*=10).		10
		11.0 ± 2.2 day 1 5.1 ± 0.9 at 1 month	2-day including over-night fast	n.d.					Day 1 placebo (mean ± s.e., *N*=22) Placebo after 1 month (mean ± s.e., *N*=22)	(Heiss et al. 2022)	22
		7.1 ± 1.2 day 1 8.6 ± 2.1 at 1 month	2-day including over-night fast						Day 1 cranberries (525 mg) (mean ± s.e., *N*=23) Cranberries (525 mg) after 1 month (mean ± s.e.), *N*=23)		23
							0.17 ± 0.20		Free-living volunteers (*N*=5, mean ± s.d.)	(Jenner, Rafter, and Halliwell 2005)	5
							0.21 0.32 0.14 0.29		One free-living volunteer over four consecutive days. No increase on hydrolysis		
										5	118

Table 96. 4-Methoxybenzoic acid-3-glucuronide (Isovanillic acid-3-glucuronide)											
Free-living Plasma spot value	Feeding Study Plasma C_{max}	Feeding Study Urine	Washout				Fecal water	Ileal fluid	Notes	Reference	N
µmol/l	µmol/l	µmol/24 hours	Washout duration	Plasma spot conc^{n} µmol/l	Urine collection duration	Urine content µmol	µmol/l	µmol/l			
		0.4 ± 0.1 [b]							Mean ± s.e., *N*=10 Week 1 low consumption flavanone-rich ingredient	(Muralidharan et al. 2023)	10
		0.3 ± 0.1 [b]							Mean ± s.e., *N*=10 Week 16 low consumption flavanone-rich ingredient		
		0.8 ± 0.3 [b]							Mean ± s.e., *N*=9 Week 1 high consumption flavanone-rich ingredient		9
		1.4 ± 0.8 [b]							Mean ± s.e., *N*=9 Week 16 high consumption flavanone-rich ingredient		
										1	19

Notes: b) 48-hour urines

Table 97. 4-Methoxybenzoic acid-3-sulfate (Isovanillic acid-3-sulfate)											
Free-living Plasma spot value	Feeding Study Plasma C_{max}	Feeding Study Urine	Washout				Fecal water	Ileal fluid	Notes	Reference	N
µmol/l	µmol/l	µmol/24 hours	Washout duration	Plasma spot conc^{n} µmol/l	Urine collection duration	Urine content µmol	µmol/l	µmol/l			
0.256 0.202–0.700 [a]		**0.551 0.303–0.742** [a]							*N*=10, median and IQR. Polyphenol-rich breakfast for 3 days [a]	(Domínguez-Fernández et al. 2021)	10
2.09 ± 0.74 **(2.26 and 0.88)**									Free-living volunteers (*N*=90, mean ± s.d.) (**Median** and IQR)	(Le Sayec et al. 2023)	90
		0.4 ± 0.1 [b]							Mean ± s.e., *N*=10 Week 1 low consumption flavanone-rich ingredient	(Muralidharan et al. 2023)	10
		0.4 ± 0.1 [b]							Mean ± s.e., *N*=10 Week 16 low consumption flavanone-rich ingredient		
		0.5 ± 0.2 [b]							Mean ± s.e., *N*=9 Week 1 high consumption flavanone-rich ingredient		9
		0.7 ± 0.5 [b]							Mean ± s.e., *N*=9 Week 16 high consumption flavanone-rich ingredient		
										3	119

Notes: a) The participants consumed for breakfast for 3 days milled flaxseed (30 g/day), freeze-dried raspberry powder (40 g/day), and soy milk (250 mL/day), providing 300 mg/ day of lignans (300 mg of secoisolariciresinol diglucoside), 150 mg/ day of ellagitannins (118 mg of sanguiin H6, 14.3 mg of lambertianin C, and other minor ellagitannins), and 22 mg of isoflavones/day (20.10 mg of daidzin and 1.8 mg of daidzein).

b) 48-hour urines

Table 98. 3,4-Dimethoxybenzoic acid (veratric acid)										
Feeding Study Plasma C_{max}	Feeding Study Urine	Washout				Fecal water	Ileal fluid	Notes	Reference	N
µmol/l	µmol/24 hours	Washout duration	Plasma spot conc^{n} µmol/l	Urine collection duration	Urine content µmol	µmol/l	µmol/l			
								Free-living volunteers (*N*=5, mean ± s.d.)	(Jenner, Rafter, and Halliwell 2005)	5
						0.06 0.11 0.09 0.04		One free-living volunteer over four consecutive days. No increase on hydrolysis		
									1	5

Table 99. 3,5-Dihydroxyybenzoic acid											
Free-living Plasma spot value	Feeding Study Plasma C_{max}	Feeding Study Urine	Washout				Fecal water	Ileal fluid	Notes	Reference	N
µmol/l	µmol/l	µmol/24 hours	Washout duration	Plasma spot conc^{n} µmol/l	Urine collection duration	Urine content µmol	µmol/l	µmol/l			
0.016 (0.009–0.033)									Free-living individuals (*N*=255, median 5 and 95% CI)	(Mori et al. 2023)	255
0.016 (0.009–0.029)											255
2.57 ± 3.88 **(0.99 and 1.05)**									Free-living volunteers (*N*=90, mean ± s.d.) (**Median** and IQR)	(Le Sayec et al. 2023)	90
	0.069 (0.059, 0.082)		—						Rye bran low dose (85 µmol) (mean and 95% C.I., *N*=15)	(Marklund et al. 2014)	15
	0.134 (0.094, 0.190)		—						Rye bran medium dose (170 µmol) (mean and 95% C.I., *N*=15)		
	0.214 (0.168, 0.271)		—						Rye bran high dose (342 µmol) (mean and 95% C.I., *N*=15)		
							0.10 ± 0.07		Free-living volunteers (*N*=5, mean ± s.d.)	(Jenner, Rafter, and Halliwell 2005)	5
							0.26 0.25 0.14 0.14		One free-living volunteer over four consecutive days. No increase on hydrolysis		
										4	620

Table 100. 3,4,5-Trihydroxybenzoic acid (Gallic acid)											
Free-living Plasma spot value	Feeding Study Plasma C_{max}	Feeding Study Urine	Washout				Fecal water	Ileal fluid	Notes	Reference	N
µmol/l	µmol/l	µmol/24 hours	Washout duration	Plasma spot conc^{n} µmol/l	Urine collection duration	Urine content µmol	µmol/l	µmol/l			
0.038 (0.006–0.160)									Free-living individuals (*N*=255, median 5 and 95% CI)	(Mori et al. 2023)	255
0.041 (0.011–0.157)											255
0.0084 0.0078–0.0091 [a]		**0.329 0.171–0.680** [a]							*N*=10, median and IQR. Polyphenol-rich breakfast for 3 days [a]	(Domínguez-Fernández et al. 2021)	10
0.019 ± 0.015 **(0.015 and 0.018)**									Free-living volunteers (*N*=90, mean ± s.d.) (**Median** and IQR)	(Le Sayec et al. 2023)	90
		4.2 ± 0.9							Mangoes (500 µmol) (*N*=8, mean ± s.e.)	Crozier	8
		4.8 ± 0.9						3.6 ± 0.8	Mangoes (500 µmol) Ileostomists (*N*=10, mean ± s.e.)		10
	11.0 (7.30–14.8)								Blackcurrant Extract 300 mg (*N*=20, mean and 95% CI)	(Costello et al. 2022)	20
	0.818 ± 0.291								Relinqing granules (8 g) (*N*=6, mean ± s.d.)	(Li et al. 2021)	6
	0.694 ± 0.232								Relinqing granules (8 g/day for seven days) (*N*=6, mean ± s.d.)		6
		0.011 ± 0.006 day 1 0.006 ± 0.0 at 1 month	1-day including over-night fast	n.d. n.d. n.d. n.d.					Daily Wild blueberries (726 mg) for 1 month (mean ± s.e., *N*=18).	(Feliciano, Istas, et al. 2016)	18
	1.2 ± 1.0		Two days						(*N*=14, mean ± s.d., placebo corrected) Black tea 2.65 g powder	(van der Pijl et al. 2015)	14
		0.0 ± 0 day 1 0.0 ± 0 at 1 month	2-day including over-night fast	n.d.					Day 1 placebo (mean ± s.e., *N*=22) Placebo after 1 month (mean ± s.e., *N*=22)	(Heiss et al. 2022)	22

		0.1 ± 0 day 1 0.1 ± 0.1 at 1 month	2-day including over-night fast	n.d.					Day 1 cranberries (525 mg) (mean ± s.e., *N*=23) Cranberries (525 mg) after 1 month (mean ± s.e.), *N*=23)		23
							0.68 ± 0.58		Free-living volunteers (*N*=5, mean ± s.d.)	(Jenner, Rafter, and Halliwell 2005)	5
							0.77 0.42 4.29 4.24		One free-living volunteer over four consecutive days. No increase on hydrolysis		
										10	742

Notes: a) The participants consumed for breakfast for 3 days milled flaxseed (30 g/day), freeze-dried raspberry powder (40 g/day), and soy milk (250 mL/day), providing 300 mg/ day of lignans (300 mg of secoisolariciresinol diglucoside), 150 mg/ day of ellagitannins (118 mg of sanguiin H6, 14.3 mg of lambertianin C, and other minor ellagitannins), and 22 mg of isoflavones/day (20.10 mg of daidzin and 1.8 mg of daidzein).

Table 101. 3,4-Dihydroxy-5-methoxybenzoic acid (3-methylgallic acid)

Feeding Study Plasma C_{max}	Feeding Study Urine	Washout				Fecal water	Ileal fluid	Notes	Reference	N
µmol/l	µmol/24 hours	Washout duration	Plasma spot conc^{n} µmol/l	Urine collection duration	Urine content µmol	µmol/l	µmol/l			
						0.90 ± 0.74		Free-living volunteers (*N*=5, mean ± s.d.)	(Jenner, Rafter, and Halliwell 2005)	5
						2.38 0.89 2,62 1.84		One free-living volunteer over four consecutive days. No increase on hydrolysis		
									1	5

Table 102. 3,5-Dihydroxy-4-methoxybenzoic acid (4-methylgallic acid)											
Free-living Plasma spot value	Feeding Study Plasma C_{max}	Feeding Study Urine	Washout				Fecal water	Ileal fluid	Notes	Reference	N
µmol/l	µmol/l	µmol/24 hours	Washout duration	Plasma spot conc^{n} µmol/l	Urine collection duration	Urine content µmol	µmol/l	µmol/l			
	1.3 ± 0.8		Two days						(*N*=14, mean ± s.d., placebo corrected) Black tea 2.65 g powder	(van der Pijl et al. 2015)	14
		5.1 ± 0.7							Mangoes (500 µmol) (*N*=8, mean ± s.e.)	Crozier	8
		n.d.						0.03 ± 0.00	Mangoes (500 µmol) Ileostomists (*N*=10, mean ± s.e.)		10
							0.26 ± 0.34		Free-living volunteers (*N*=5, mean ± s.d.)	(Jenner, Rafter, and Halliwell 2005)	5
							0.18 0.21 0.13 0.11		One free-living volunteer over four consecutive days. No increase on hydrolysis		
										3	37

Table 103. 3-Hydroxy-4-methoxybenzoic acid-5-sulfate (4-methylgallic acid-3-sulfate, 4-methylgallic acid-5-sulfate)											
Free-living Plasma spot value	Feeding Study Plasma C_{max}	Feeding Study Urine	Washout				Fecal water	Ileal fluid	Notes	Reference	N
µmol/l	µmol/l	µmol/24 hours	Washout duration	Plasma spot conc^{n} µmol/l	Urine collection duration	Urine content µmol	µmol/l	µmol/l			
0.0049 0.0036–0.0287 [a]		**4.95 1.36–8.58** [a]							*N*=10, median and IQR. Polyphenol-rich breakfast for 3 days [a]	(Domínguez-Fernández et al. 2021)	10
0.723 ± 0.990 **(0.222 and 0.786)**									Free-living volunteers (*N*=90, mean ± s.d.) (**Median** and IQR)	(Le Sayec et al. 2023)	90
		0.68 ± 0.20 day 1 0.52 ± 0.18 at 1 month	1-day including over-night fast	0.043 ± 0.028 0.048 ± 0.011 0.028 ± 0.007 0.058 ± 0.015					Daily Wild blueberries (726 mg) for 1 month (mean ± s.e., *N*=18).	(Feliciano, Istas, et al. 2016)	18
	0.275 ± 0.082	0.297 ± 0.074	Three days						Daily Cranberry juice (787 mg) for 1 month (mean ± s.e., *N*=10).	(Feliciano, Boeres, et al. 2016)	10
	0.018 ± 0.004		Three days						Daily Cranberry juice (476 mg) (mean ± s.e., *N*=10).	(Feliciano et al. 2017)	10
	0.025 ± 0.004		Three days						Daily Cranberry juice (1238 mg) for (mean ± s.e., *N*=10).		10
	0.397 ± 0.113		Three days						Daily Cranberry juice (1534 mg (mean ± s.e., *N*=10).		10
	0.472 ± 0.139		Three days						Daily Cranberry juice (1910 mg) (mean ± s.e., *N*=10).		10
		3.1 ± 0.5 day 1 1.9 ± 0.3 at 1 month	2-day including over-night fast	n.d.					Day 1 placebo (mean ± s.e., *N*=22) Placebo after 1 month (mean ± s.e., *N*=22)	(Heiss et al. 2022)	22
		3.5 ± 0.7 day 1 4.8 ± 1.1 at 1 month	2-day including over-night fast	n.d.					Day 1 cranberries (525 mg) (mean ± s.e., *N*=23) Cranberries (525 mg) after 1 month (mean ± s.e.), *N*=23)		23
										6	213

Notes: a) The participants consumed for breakfast for 3 days milled flaxseed (30 g/day), freeze-dried raspberry powder (40 g/day), and soy milk (250 mL/day), providing 300 mg/ day of lignans (300 mg of secoisolariciresinol diglucoside), 150 mg/ day of ellagitannins (118 mg of sanguiin H6, 14.3 mg of lambertianin C, and other minor ellagitannins), and 22 mg of isoflavones/day (20.10 mg of daidzin and 1.8 mg of daidzein).

Table 104. 2,3,4-Trihydroxybenzoic acid											
Free-living Plasma spot value	Feeding Study Plasma C_{max}	Feeding Study Urine	Washout				Fecal water	Ileal fluid	Notes	Reference	N
µmol/l	µmol/l	µmol/24 hours	Washout duration	Plasma spot conc^{n} µmol/l	Urine collection duration	Urine content µmol	µmol/l	µmol/l			
<LOQ [a]		**<LOQ** [a]							*N*=10, median and IQR. Polyphenol-rich breakfast for 3 days [a]	(Domínguez-Fernández et al. 2021)	10
0.130 ± 0.074 **(0.114 and 0.096)**									Free-living volunteers (*N*=90, mean ± s.d.) (**Median** and IQR)	(Le Sayec et al. 2023)	90
							0.19 ± 0.21		Free-living volunteers (*N*=5, mean ± s.d.)	(Jenner, Rafter, and Halliwell 2005)	5
							0.40 0.30 0.55 0.48		One free-living volunteer over four consecutive days. No increase on hydrolysis		
										3	105

Notes: a) The participants consumed for breakfast for 3 days milled flaxseed (30 g/day), freeze-dried raspberry powder (40 g/day), and soy milk (250 mL/day), providing 300 mg/ day of lignans (300 mg of secoisolariciresinol diglucoside), 150 mg/ day of ellagitannins (118 mg of sanguiin H6, 14.3 mg of lambertianin C, and other minor ellagitannins), and 22 mg of isoflavones/day (20.10 mg of daidzin and 1.8 mg of daidzein).

Table 105. Ethyl 3,4,5-Trihydroxybenzoate (Ethyl gallate)											
Free-living Plasma spot value	Feeding Study Plasma C_{max}	Feeding Study Urine	Washout				Fecal water	Ileal fluid	Notes	Reference	N
µmol/l	µmol/l	µmol/24 hours	Washout duration	Plasma spot conc^{n} µmol/l	Urine collection duration	Urine content µmol	µmol/l	µmol/l			
0.0002 (0.0002–0.0013)									Free-living individuals (*N*=255, median 5 and 95% CI)	(Mori et al. 2023)	255
0.0002 (0.0002–0.0011)											255
<LOQ [a]		**<LOQ** [a]							*N*=10, median and IQR. Polyphenol-rich breakfast for 3 days [a]	(Domínguez-Fernández et al. 2021)	10
0.0053 ± 0.0041 **(0.0044 and 0.0004)**									Free-living volunteers (*N*=90, mean ± s.d.) (**Median** and IQR)	(Le Sayec et al. 2023)	90
										3	410

Notes: a) The participants consumed for breakfast for 3 days milled flaxseed (30 g/day), freeze-dried raspberry powder (40 g/day), and soy milk (250 mL/day), providing 300 mg/ day of lignans (300 mg of secoisolariciresinol diglucoside), 150 mg/ day of ellagitannins (118 mg of sanguiin H6, 14.3 mg of lambertianin C, and other minor ellagitannins), and 22 mg of isoflavones/day (20.10 mg of daidzin and 1.8 mg of daidzein).

Table 106. 4-Hydroxy-3,5-dimethoxybenzoic acid (Syringic acid)											
Free-living Plasma spot value	Feeding Study Plasma C_{max}	Feeding Study Urine	Washout				Fecal water	Ileal fluid	Notes	Reference	N
µmol/l	µmol/l	µmol/24 hours	Washout duration	Plasma spot conc^{n} µmol/l	Urine collection duration	Urine content µmol	µmol/l	µmol/l			
<LOQ [a]		**0.244 0.121–0.530** [a]							*N*=10, median and IQR. Polyphenol-rich breakfast for 3 days [a]	(Domínguez-Fernández et al. 2021)	10
5.21 ± 3.77 **(4.57 and 3.87)**									Free-living volunteers (*N*=90, mean ± s.d.) (**Median** and IQR)	(Le Sayec et al. 2023)	90
		0.434 ± 0.106 day 1 0.383 ± 0.101 at 1 month	1-day including over-night fast	0.004 ± 0.001 0.008 ± 0.002 0.009 ± 0.003 0.011 ± 0.003					Daily Wild blueberries (726 mg) for 1 month (mean ± s.e., *N*=18).	(Feliciano, Istas, et al. 2016)	18
	0.008 ± 0.006	0.249 ± 0.031	Three days						Daily Cranberry juice (787 mg) for 1 month (mean ± s.e., *N*=10).	(Feliciano, Boeres, et al. 2016)	10
	0.0 ± 0.0		Three days						Daily Cranberry juice (476 mg) (mean ± s.e., *N*=10).	(Feliciano et al. 2017)	10
	0.009 ± 0.009		Three days						Daily Cranberry juice (1238 mg) for (mean ± s.e., *N*=10).		10
	0.012 ± 0.008		Three days						Daily Cranberry juice (1534 mg (mean ± s.e., *N*=10).		10
	0.023 ± 0.012		Three days						Daily Cranberry juice (1910 mg) (mean ± s.e., *N*=10).		10
		5.4 ± 1.0 day 1 2.8 ± 0.6 at 1 month	2-day including over-night fast	0.101 ± 0.041					Day 1 placebo (mean ± s.e., *N*=22) Placebo after 1 month (mean ± s.e., *N*=22)	(Heiss et al. 2022)	22
		7.1 ± 1.9 day 1 4.1 ± 1 at 1 month	2-day including over-night fast	0.545 ± 0.078					Day 1 cranberries (525 mg) (mean ± s.e., *N*=23) Cranberries (525 mg) after 1 month (mean ± s.e.), *N*=23)		23

							0.63 ± 0.28		Free-living volunteers (*N*=5, mean ± s.d.)	(Jenner, Rafter, and Halliwell 2005)	5
							1.19 1.52 1.43 2.89		One free-living volunteer over four consecutive days. No increase on hydrolysis		
										7	228

Notes: a) The participants consumed for breakfast for 3 days milled flaxseed (30 g/day), freeze-dried raspberry powder (40 g/day), and soy milk (250 mL/day), providing 300 mg/ day of lignans (300 mg of secoisolariciresinol diglucoside), 150 mg/ day of ellagitannins (118 mg of sanguiin H6, 14.3 mg of lambertianin C, and other minor ellagitannins), and 22 mg of isoflavones/day (20.10 mg of daidzin and 1.8 mg of daidzein).

Table 107. Hippuric acid (Benzoyl-glycine)											
Free-living Plasma spot value	Feeding Study Plasma C_{max}	Feeding Study Urine	Washout				Fecal water	Ileal fluid	Notes	Reference	N
µmol/l	µmol/l	µmol/24 hours	Washout duration	Plasma spot conc^{n} µmol/l	Urine collection duration	Urine content µmol	µmol/l	µmol/l			
11.84 5.96–23.58 [a]		**949 631–1364** [a]							*N*=10, median and IQR. Polyphenol-rich breakfast for 3 days [a]	(Domínguez-Fernández et al. 2021)	10
387 ± 243 **(345 and 244)**									Free-living volunteers (*N*=90, mean ± s.d.) (**Median** and IQR)	(Le Sayec et al. 2023)	90
8.6 ± 7.1 **(7.2 and 3.8) Pearson = 0.592**									Mean ± s.d. (**Median and IQR)** *N*=31 healthy free-living controls	(Nowak et al. 2017)	31
		1182 ± 171	2-day and overnight fast		12-hours	733 ± 56			Mangoes (500 µmol) (*N*=8, mean ± s.e.)	Crozier	8
		349 ± 17	2-day and overnight fast		12-hours	455 ± 26			Mangoes (500 µmol) Ileostomists (*N*=10, mean ± s.e.)		10
	4.65 ± 1.29								Purple potato extract (*N*=17, mean ± s.d.)	(Jokioja et al. 2021)	17
		312 ± 39 day 1 351 ± 48 at 1 month	1-day including over-night fast	17.4 ± 3.7 12.4 ± 2.5 32.5 ± 5.3 29.6 ± 5.6					Daily Wild blueberries (726 mg) for 1 month (mean ± s.e., *N*=18).	(Feliciano, Istas, et al. 2016)	18
	42.93 ± 12.28	69.7 ± 13.7	Three days						Daily Cranberry juice (787 mg) for 1 month (mean ± s.e., *N*=10).	(Feliciano, Boeres, et al. 2016)	10
	54.6 ± 15.4		Three days						Daily Cranberry juice (476 mg) (mean ± s.e., *N*=10).	(Feliciano et al. 2017)	10
	63.0 ± 20.9		Three days						Daily Cranberry juice (1238 mg) for (mean ± s.e., *N*=10).		10

	51.9 ± 15.3		Three days						Daily Cranberry juice (1534 mg (mean ± s.e., *N*=10).		10
	90.6 ± 40.4		Three days						Daily Cranberry juice (1910 mg) (mean ± s.e., *N*=10).		10
	6.5 ± 4.4		Two days						(*N*=14, mean ± s.d., placebo corrected) Black tea 2.65 g powder	(van der Pijl et al. 2015)	14
	262, 245, 327								Clinical study Benzoic acid 40, 80 and 160 mg/kg	(Kubota et al. 1988)	1
		391 ± 121 [b]							Mean ± s.e., *N*=10 Week 1 low consumption flavanone-rich ingredient	(Muralidharan et al. 2023)	10
		390 ± 109 [b]							Mean ± s.e., *N*=10 Week 16 low consumption flavanone-rich ingredient		
		557 ± 178 [b]							Mean ± s.e., *N*=9 Week 1 high consumption flavanone-rich ingredient		9
		480 ± 113 [b]							Mean ± s.e., *N*=9 Week 16 high consumption flavanone-rich ingredient		
		115.3 ± 16.6 day 1 91.5 ± 14.5 at 1 month	2-day including over-night fast	0.561 ± 0.100					Day 1 placebo (mean ± s.e., *N*=22) Placebo after 1 month (mean ± s.e., *N*=22)	(Heiss et al. 2022)	22
		101.0 ± 12.6 ± 0 day 1 98.3 ± 14.1 at 1 month	2-day including over-night fast	0.464 ± 0.084					Day 1 cranberries (525 mg) (mean ± s.e., *N*=23) Cranberries (525 mg) after 1 month (mean ± s.e.), *N*=23)		23
		28.0 ± 4.7	2-day including over-night fast	1.80 ± 0.26					Mean ± s.e., *N*=7, beans	(Mecha et al. 2020)	7
										13	320

Notes: a) The participants consumed for breakfast for 3 days milled flaxseed (30 g/day), freeze-dried raspberry powder (40 g/day), and soy milk (250 mL/day), providing 300 mg/ day of lignans (300 mg of secoisolariciresinol diglucoside), 150 mg/ day of ellagitannins (118 mg of sanguiin H6, 14.3 mg of lambertianin C, and other minor ellagitannins), and 22 mg of isoflavones/day (20.10 mg of daidzin and 1.8 mg of daidzein).

b) 48-hours urines

Table 108. 2′-Hydroxy-hippuric acid (2-hydroxybenzoyl-glycine; salicyluric acid)											
Free-living Plasma spot value	Feeding Study Plasma C_{max}	Feeding Study Urine	Washout				Fecal water	Ileal fluid	Notes	Reference	N
µmol/l	µmol/l	µmol/24 hours	Washout duration	Plasma spot conc^{n} µmol/l	Urine collection duration	Urine content µmol	µmol/l	µmol/l			
0.035 0.018–0.085 [a]		**20.59 10.84–46.45** [a]							*N*=10, median and IQR. Polyphenol-rich breakfast for 3 days [a]	(Domínguez-Fernández et al. 2021)	10
0.995 ± 2.532 **(0.283 and 0.653)**									Free-living volunteers (*N*=90, mean ± s.d.) (**Median** and IQR)	(Le Sayec et al. 2023)	90
		3.34 ± 0.19 day 1 2.85 ± 1.52 at 1 month	1-day including over-night fast	0.005 ± 0.002 0.009 ± 0.004 0.008 ± 0.002 0.008 ± 0.002					Daily Wild blueberries (726 mg) for 1 month (mean ± s.e., *N*=18).	(Feliciano, Istas, et al. 2016)	18
	0.007 ± 0.002	0.811 ± 0.172	Three days						Daily Cranberry juice (787 mg) for 1 month (mean ± s.e., *N*=10).	(Feliciano, Boeres, et al. 2016)	10
	0.009 ± 0.003		Three days						Daily Cranberry juice (476 mg) (mean ± s.e., *N*=10).	(Feliciano et al. 2017)	10
	0.010 ± 0.003		Three days						Daily Cranberry juice (1238 mg) for (mean ± s.e., *N*=10).		10
	0.013 ± 0.005		Three days						Daily Cranberry juice (1534 mg (mean ± s.e., *N*=10).		10
	0.202 ± 0.192		Three days						Daily Cranberry juice (1910 mg) (mean ± s.e., *N*=10).		10
	13.01 0.406–31.60								Aspirin 25 mg/kg underweight children (*N*=11, median and range)	(Lares-Asseff et al. 1999)	11
	8.45 0.84–50.38								Aspirin 25 mg/kg normal weight children (*N*=10, median and range)		10

		17.6 ± 4.4 day 1 13.0 ± 2.2 at 1 month	2-day including over-night fast	0.168 ± 0.030					Day 1 placebo (mean ± s.e., *N*=22) Placebo after 1 month (mean ± s.e., *N*=22)	(Heiss et al. 2022)	22
		15.7 ± 2.2 day 1 39.1 ± 8.6 at 1 month	2-day including over-night fast	0.399 ± 0.050					Day 1 cranberries (525 mg) (mean ± s.e., *N*=23) Cranberries (525 mg) after 1 month (mean ± s.e.), *N*=23)		23
										7	234

Notes: a) The participants consumed for breakfast for 3 days milled flaxseed (30 g/day), freeze-dried raspberry powder (40 g/day), and soy milk (250 mL/day), providing 300 mg/ day of lignans (300 mg of secoisolariciresinol diglucoside), 150 mg/ day of ellagitannins (118 mg of sanguiin H6, 14.3 mg of lambertianin C, and other minor ellagitannins), and 22 mg of isoflavones/day (20.10 mg of daidzin and 1.8 mg of daidzein).

Table 109. 3'-Hydroxy-hippuric acid (3-hydroxybenzoyl-glycine)											
Free-living Plasma spot value	Feeding Study Plasma C_{max}	Feeding Study Urine	Washout				Fecal water	Ileal fluid	Notes	Reference	N
µmol/l	µmol/l	µmol/24 hours	Washout duration	Plasma spot conc^{n} µmol/l	Urine collection duration	Urine content µmol	µmol/l	µmol/l			
0.334 0.161–0.948 [a]		**123 73–155** [a]							*N*=10, median and IQR. Polyphenol-rich breakfast for 3 days [a]	(Domínguez-Fernández et al. 2021)	10
9.189 ± 8.614 **(6.490 and 6.064)**									Free-living volunteers (*N*=90, mean ± s.d.) (**Median** and IQR)	(Le Sayec et al. 2023)	90
n.d.									Mean ± s.d. (**Median and IQR)** *N*=31 healthy free-living controls	(Nowak et al. 2017)	31
		36 ± 5.2	2-day and overnight fast		12-hours	34 ± 4			Mangoes (500 µmol) (*N*=8, mean ± s.e.)	Crozier	8
		1.6 ± 0.1	2-day and overnight fast		12-hours	1.8 ± 0.08			Mangoes (500 µmol) Ileostomists (*N*=10, mean ± s.e.)		10
		29.4 ± 4.8 day 1 32.0 ± 5.7 at 1 month	1-day including over-night fast	0.290 ± 0.072 0.320 ± 0.084 0.708 ± 0.159 0.416 ± 0.087					Daily Wild blueberries (726 mg) for 1 month (mean ± s.e., *N*=18).	(Feliciano, Istas, et al. 2016)	18
	0.045 ± 0.007	1.48 ± 0.27	Three days						Daily Cranberry juice (787 mg) for 1 month (mean ± s.e., *N*=10).	(Feliciano, Boeres, et al. 2016)	10
	0.041 ± 0.007		Three days						Daily Cranberry juice (476 mg) (mean ± s.e., *N*=10).	(Feliciano et al. 2017)	10
	0.042 ± 0.006		Three days						Daily Cranberry juice (1238 mg) for (mean ± s.e., *N*=10).		10
	0.041 ± 0.007		Three days						Daily Cranberry juice (1534 mg (mean ± s.e., *N*=10).		10
	0.049 ± 0.010		Three days						Daily Cranberry juice (1910 mg) (mean ± s.e., *N*=10).		10

		61 ± 16 [b]							Mean ± s.e., *N*=10 Week 1 low consumption flavanone-rich ingredient	(Muralidharan et al. 2023)	10
		34 ± 10 [b]							Mean ± s.e., *N*=10 Week 16 low consumption flavanone-rich ingredient		
		55 ± 11 [b]							Mean ± s.e., *N*=9 Week 1 high consumption flavanone-rich ingredient		9
		48 ± 13 [b]							Mean ± s.e., *N*=9 Week 16 high consumption flavanone-rich ingredient		
		114.1 ± 24.1 day 1 59.8 ± 12.1 at 1 month	2-day including over-night fast	0.001 ± 0					Day 1 placebo (mean ± s.e., *N*=22) Placebo after 1 month (mean ± s.e., *N*=22)	(Heiss et al. 2022)	22
		90.9 ± 16.8 ± 0 day 1 88.7 ± 19.6 at 1 month	2-day including over-night fast	0.001 ± 0					Day 1 cranberries (525 mg) (mean ± s.e., *N*=23) Cranberries (525 mg) after 1 month (mean ± s.e.), *N*=23)		23
		2.43 ± 0.32	2-day including over-night fast	0.124 ± 0.030					Mean ± s.e., *N*=7, beans	(Mecha et al. 2020)	7
										10	288

Notes: a) The participants consumed for breakfast for 3 days milled flaxseed (30 g/day), freeze-dried raspberry powder (40 g/day), and soy milk (250 mL/day), providing 300 mg/ day of lignans (300 mg of secoisolariciresinol diglucoside), 150 mg/ day of ellagitannins (118 mg of sanguiin H6, 14.3 mg of lambertianin C, and other minor ellagitannins), and 22 mg of isoflavones/day (20.10 mg of daidzin and 1.8 mg of daidzein).

b) 48-Hour urines

Table 110. 4′-Hydroxy-hippuric acid (4-hydroxybenzoyl-glycine)											
Free-living Plasma spot value	Feeding Study Plasma C_{max}	Feeding Study Urine	Washout				Fecal water	Ileal fluid	Notes	Reference	N
µmol/l	µmol/l	µmol/24 hours	Washout duration	Plasma spot conc^{n} µmol/l	Urine collection duration	Urine content µmol	µmol/l	µmol/l			
0.077 0.048–0.143 [a]		**20.4 10.1–46.0** [a]							*N*=10, median and IQR. Polyphenol-rich breakfast for 3 days [a]	(Domínguez-Fernández et al. 2021)	10
6.738 ± 3.330 **(6.041 and 2.631)**									Free-living volunteers (*N*=90, mean ± s.d.) (**Median** and IQR)	(Le Sayec et al. 2023)	90
3.9 ± 1.6 **(3.7 and 1.6) Pearson 0.375**									Mean ± s.d. (**Median and IQR)** *N*=31 healthy free-living controls	(Nowak et al. 2017)	31
		645 ± 112	2-day and overnight fast		12-hours	40 ± 3			Mangoes (500 µmol) (*N*=8, mean ± s.e.)	Crozier	8
		160 ± 22	2-day and overnight fast		12-hours	25 ± 1			Mangoes (500 µmol) Ileostomists (*N*=10, mean ± s.e.)		10
		2.46 ± 0.59 day 1 2.04 ± 0.58 at 1 month	1-day including over-night fast	0.077 ± 0.012 0.059 ± 0.008 0.076 ± 0.012 0.064 ± 0.008					Daily Wild blueberries (726 mg) for 1 month (mean ± s.e., *N*=18).	(Feliciano, Istas, et al. 2016)	18
	0.592 ± 0.157	19.5 ± 6.6	Three days						Daily Cranberry juice (787 mg) for 1 month (mean ± s.e., *N*=10).	(Feliciano, Boeres, et al. 2016)	10
	0.658 ± 0.334		Three days						Daily Cranberry juice (476 mg) (mean ± s.e., *N*=10).	(Feliciano et al. 2017)	10
	0.898 ± 0.318		Three days						Daily Cranberry juice (1238 mg) for (mean ± s.e., *N*=10).		10
	0.624 ± 0.205		Three days						Daily Cranberry juice (1534 mg (mean ± s.e., *N*=10).		10

	0.860 ± 0.208		Three days						Daily Cranberry juice (1910 mg) (mean ± s.e., *N*=10).		10
		109 ± 27 [b]							Mean ± s.e., *N*=10 Week 1 low consumption flavanone-rich ingredient	(Muralidharan et al. 2023)	10
		56 ± 9 [b]							Mean ± s.e., *N*=10 Week 16 low consumption flavanone-rich ingredient		
		129 ± 18 [b]							Mean ± s.e., *N*=9 Week 1 high consumption flavanone-rich ingredient		9
		131 ± 25 [b]							Mean ± s.e., *N*=9 Week 16 high consumption flavanone-rich ingredient		
		61.0 ± 8.9 day 1 44.7 ± 5.5 at 1 month	2-day including over-night fast	0.028 ± 0.007					Day 1 placebo (mean ± s.e., *N*=22) Placebo after 1 month (mean ± s.e., *N*=22)	(Heiss et al. 2022)	22
		47.7 ± 7.1 ± 0 day 1 53.1 ± 11.4 at 1 month	2-day including over-night fast	0.097 ± 0.013					Day 1 cranberries (525 mg) (mean ± s.e., *N*=23) Cranberries (525 mg) after 1 month (mean ± s.e.), *N*=23)		23
		5.53 ± 0.95	2-day including over-night fast	0.060 ± 0.010					Mean ± s.e., *N*=7, beans	(Mecha et al. 2020)	7
										10	288

Notes: a) The participants consumed for breakfast for 3 days milled flaxseed (30 g/day), freeze-dried raspberry powder (40 g/day), and soy milk (250 mL/day), providing 300 mg/ day of lignans (300 mg of secoisolariciresinol diglucoside), 150 mg/ day of ellagitannins (118 mg of sanguiin H6, 14.3 mg of lambertianin C, and other minor ellagitannins), and 22 mg of isoflavones/day (20.10 mg of daidzin and 1.8 mg of daidzein).

b) 48-Hour urines

Table 111. α-Hydroxy-hippuric acid											
Free-living Plasma spot value	Feeding Study Plasma C_{max}	Feeding Study Urine	Washout				Fecal water	Ileal fluid	Notes	Reference	N
µmol/l	µmol/l	µmol/24 hours	Washout duration	Plasma spot conc^{n} µmol/l	Urine collection duration	Urine content µmol	µmol/l	µmol/l			
<LOQ									Free-living volunteers (*N*=90, mean ± s.d.) (**Median** ± IQR)	(Le Sayec et al. 2023)	90
		25.1 ± 6.1 day 1 19.8 ± 5.4 at 1 month	1-day including over-night fast	0.485 ± 0.066 0.385 ± 0.043 0.539 ± 0.082 0.463 ± 0.062					Daily Wild blueberries (726 mg) for 1 month (mean ± s.e., *N*=18).	(Feliciano, Istas, et al. 2016)	18
	2.94 ± 0.59	74.5 ± 20.6	Three days						Daily Cranberry juice (787 mg) for 1 month (mean ± s.e., *N*=10).	(Feliciano, Boeres, et al. 2016)	10
	2.37 ± 0.53		Three days						Daily Cranberry juice (476 mg) (mean ± s.e., *N*=10).	(Feliciano et al. 2017)	10
	4.62 ± 1.28		Three days						Daily Cranberry juice (1238 mg) for (mean ± s.e., *N*=10).		10
	4.58 ± 0.91		Three days						Daily Cranberry juice (1534 mg (mean ± s.e., *N*=10).		10
	4.99 ± 1.10		Three days						Daily Cranberry juice (1910 mg) (mean ± s.e., *N*=10).		10
		625.1 ± 86.5 day 1 519.1 ± 53.7 at 1 month	2-day including over-night fast	0.467 ± 0.075					Day 1 placebo (mean ± s.e., *N*=22) Placebo after 1 month (mean ± s.e., *N*=22)	(Heiss et al. 2022)	22
		517.9 ± 71.6 ± 0 day 1 656.2 ± 122.7 at 1 month	2-day including over-night fast	1.18 ± 0.14					Day 1 cranberries (525 mg) (mean ± s.e., *N*=23) Cranberries (525 mg) after 1 month (mean ± s.e.), *N*=23)		23
										5	203

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