



Article

Cranberry Arabino-Xyloglucan and Pectic Oligosaccharides Induce *Lactobacillus* Growth and Short-Chain Fatty Acid Production

Arland T. Hotchkiss, Jr. ^{1,*†}, John A. Renye, Jr. ^{1,†}, Andre K. White ¹, Alberto Nunez ¹, Giselle K. P. Guron ¹, Hoa Chau ¹, Stefanie Simon ², Carlos Poveda ³, Gemma Walton ³, Robert Rastall ³ and Christina Khoo ⁴

¹ Dairy & Functional Foods Research Unit, Agricultural Research Service, United States Department of Agriculture, Wyndmoor, PA 19038, USA; john.renye@usda.gov (J.A.R.J.); andre.white@usda.gov (A.K.W.); alberto.nunez@usda.gov (A.N.); giselle.guron@usda.gov (G.K.P.G.); rose.chau@usda.gov (H.C.)

² Sustainable Biofuels and Co-Products Research Unit, Agricultural Research Service, U.S. Department of Agriculture, Wyndmoor, PA 19038, USA; stefanie.simon@usda.gov

³ Department of Food and Nutritional Sciences, The University of Reading, Harry Nursten Building, Pepper Lane, Whiteknights, Reading RG6 6DZ, UK; c.g.povedaturrado@reading.ac.uk (C.P.); g.e.walton@reading.ac.uk (G.W.); r.a.rastall@reading.ac.uk (R.R.)

⁴ Ocean Spray Cranberries, Inc., One Ocean Spray Drive, Lakeville-Middleboro, MA 02349, USA; ckhoo@oceanspray.com

* Correspondence: arland.hotchkiss@usda.gov; Tel.: +1-215-233-6448

† These authors contributed equally to this work.

Supplementary Materials:

Table S1. MALDI-TOF MS Analysis of Cranberry Oligosaccharides in Preparative HPLC Fractions.

<u>m/z (Na⁺)</u>	<u>Structure</u>	<u>m/z(Na⁺)</u>	<u>Structure</u>
761	Pent3Hex2	1315	PentdHexHex3HexA2uHexA
769	Pent3dHexuHexAMe2	1333	Pent6Hex2HexA
785	Pent2dHexuHexAMe	1341	Pent2dHexHexHexA3uHexAAc
789	Pent2dHexHexHexA	1345	dHexHex4HexA2uHexA
791	Pent2Hex3	1357	Pent5dHexHexHexAuHexAMe
815	PentdHexHexHexAuHexA	1363	Pent5Hex3HexA
829	PentdHexHexHexAuHexAMe	1375	PentdHexHex3HexA3Ac
831	Pent2dHexHexHexAAc	1379	Pent4Hex5
833	Pent6 or Pent2Hex3Ac	1393	Pent4Hex5Me
843	PentdHexHexHexAuHexAMe2	1423	Pent3Hex6Me
855	Pent2dHexHexAuHexAAcMe2	1477	PentdHexHex4HexA2uHexA
857	PentdHexHexHexAuHexAAc	1495	Pent6Hex3HexA
923	Pent3Hex3	1507	dHexHex5HexA2uHexA
945	Pent3dHexHexAuHexAMe2	1511	Pent5Hex5
953	Pent2Hex4	1525	Pent5Hex4HexA
959	Pent3dHexHexAuHexAAc	1533	Pent5dHexHex2HexAuHexAMe2
965	Pent7 or Pent3Hex3Ac	1541	Pent2dHex3HexA3uHexAAc2Me2
973	Pent3dHexHexAuHexAAcMe	1555	Pent4Hex6Me
987	Pent3dHexHexAuHexAAcMe2	1571	PentdHex3HexHexA3uHexAAc2Me2
989	Pent2dHexHexHexAuHexAAc	1579	Pent3dHexHex3HexA2uHex
995	Pent6Hex	1669	dHexHex6HexA2uHexA
		1673	Pent3dHex3HexA3uHexAAc2Me2

1003	Pent2dHexHexHexAuHex-AAcMe	1703	Pent2dHex3HexHexA3uHexAAc2Me2
1009	Pent6HexA	1805	Pent2dHex3Hex2HexA3uHexAAc2Me2
1017	Pent2dHexHexHexAuHex-AAcMe2	1835	Pent4dHex3HexA3uHexAAc2Me2
1055	Pent4Hex3	1865	Pent3dHex3HexHexA3uHexAAc2 Me2
1069	Pent4Hex2HexA	1937	Pent5dHex3HexA3uHexAAc2Me2
1085	Pent3Hex4	1967	Pent4dHex3HexHexA3uHexAAc2Me2
1097	Pent8 or Pent4Hex3Ac	1997	Pent3dHex3Hex2HexA3uHexAAc2Me2
1099	Pent3Hex4Me	2069	Pent6dHex3HexA3uHexAAc2Me2
1123	Pent2dHexHexHexA2uHexA	2099	Pent5dHex3HexHexA3uHexAAc2 Me2
1135	Pent3dHexHexHexAuHex-AAcMe	2129	Pent4dHex3Hex2HexA3uHexAAc2Me2
1153	PentdHexHex2HexA2uHexA	2159	Pent3dHex3Hex3HexA3uHexAAc2Me2
1149	Pent3dHexHexHexAuHex-AAcMe2	2231	Pent6dHex3HexHexA3uHexAAc2Me2
1171	Pent6HexHexA	2261	Pent5dHex3Hex2HexA3uHexAAc2Me2
1183	dHexHex3HexA2uHexA	2291	Pent4dHex3Hex3HexA3uHexAAc2Me2
1201	Pent5Hex2HexA	2321	Pent3dHex3Hex4HexA3uHexAAc2Me2
1211	Pent4dHexHexHexAuHexA	2393	Pent6dHex3Hex2HexA3uHexAAc2Me2
1217	Pent4Hex4	2423	Pent5dHex3Hex3HexA3uHexAAc2Me2
1229	Pent9	2453	Pent4dHex3Hex4HexA3uHexAAc2Me2
1247	Pent3Hex5	2525	Pent7dHex3Hex2HexA3uHexAAc2Me2
1253	Pent4dHexHexHexAuHexAAc	2555	Pent6dHex3Hex3HexA3uHexAAc2Me2
1261	Pent3Hex5Me	2585	Pent5dHex3Hex4HexA3uHexAAc2Me2
1281	Pent4dHexHexHexAuHex-AAcMe2	2717	Pent6dHex3Hex4HexA3uHexAAc2Me2
1313			
Pent2dHexHex3HexAuHexAAc			

Table S2. *Lactobacillus* and *Bifidobacterium* species in used in this study.

Bacteria	Source¹
<i>L. acidophilus</i> LA1	DFF
<i>L. acidophilus</i> LA 6	DFF
<i>L. acidophilus</i> LA 8	DFF
<i>L. acidophilus</i> LA 10	DFF
<i>L. acidophilus</i> LA 15	DFF
<i>L. acidophilus</i> LA 30	DFF
<i>L. acidophilus</i> B1912	NRRL
<i>L. acidophilus</i> RP32	DFF
<i>L. amylophilus</i> B4437	NRRL
<i>L. amylophilus</i> B4481	NRRL
<i>L. amylovorus</i> B4540	NRRL
<i>L. amylovorus</i> B4548	NRRL
<i>L. animalis</i> B14176	NRRL
<i>L. animalis</i> B14177	NRRL
<i>L. arabinosis</i> B787	NRRL
<i>L. brevis</i> B4527	NRRL
<i>L. brevis</i> B1127	NRRL
<i>L. brevis</i> 3057	DFF
<i>L. brevis</i> 1836	DFF
<i>L. buchneri</i> LB5	DFF
<i>L. buchneri</i> B1838	NRRL
<i>L. buchneri</i> B1860	NRRL

<i>L. bulgaricus</i> LB1	DFF
<i>L. bulgaricus</i> LB6	DFF
<i>L. bulgaricus</i> LB11	DFF
<i>L. bulgaricus</i> LB12	DFF
<i>L. bulgaricus</i> LB15	DFF
<i>L. bulgaricus</i> LB21	DFF
<i>L. bulgaricus</i> YB1	DFF
<i>L. bulgaricus</i> B440	NRRL
<i>L. casei</i> 4646	ATCC
<i>L. casei</i> LC2	DFF
<i>L. casei</i> 393	ATCC
<i>L. casei</i> B1922	NRRL
<i>L. casei</i> B441	NRRL
<i>L. casei</i> LC3	DFF
<i>L. casei</i> B1255	NRRL
<i>L. rhamnosus</i> EV2	DFF
<i>L. rhamnosus</i> B442	NRRL
<i>L. coryniformis</i> ssp. <i>torquens</i> B4390	NRRL
<i>L. curvatus</i> B4562	NRRL
<i>L. delbrueckii</i> ssp. <i>lactis</i> B735	NRRL
<i>L. delbrueckii</i> B443	NRRL
<i>L. delbrueckii</i> B1658	NRRL
<i>L. delbrueckii</i> ssp. <i>lactis</i> B736	NRRL
<i>L. delbrueckii</i> ssp. <i>lactis</i> B1844	NRRL
<i>L. delbrueckii</i> ssp. <i>lactis</i> B1930	NRRL
<i>L. delbrueckii</i> ssp. <i>lactis</i> B4523	NRRL
<i>L. fermentum</i> B4525	NRRL
<i>L. farciminis</i> LF 25 (B4566)	NRRL
<i>L. fermentum</i> B585	NRRL
<i>L. fermentum</i> B1925	NRRL
<i>L. fermentum</i> B14171	NRRL
<i>L. fructosus</i> 2041	DFF
<i>L. gasserii</i> 1912	DFF
<i>L. gasserii</i> 4240	DFF
<i>L. gasserii</i> 14175	DFF
<i>L. helveticus</i> B4526	NRRL
<i>L. helveticus</i> EV1	DFF
<i>L. helveticus</i> B1842	NRRL
<i>L. helveticus</i> B1935	NRRL
<i>L. helveticus</i> B1942	NRRL
<i>L. helveticus</i> B1929	NRRL
<i>L. lactis</i> FARR	OSU
<i>L. mali</i> B4563	NRRL
<i>L. paracasei</i> B4564	NRRL
<i>L. paraplantarum</i> B23115	NRRL
<i>L. plantarum</i> 14917	ATCC
<i>L. plantarum</i> NCDO955	DFF
<i>L. plantarum</i> B4496	NRRL
<i>L. plantarum</i> B1846	NRRL
<i>L. plantarum</i> B1926	NRRL
<i>L. plantarum</i> TSH076	NRRL
<i>L. plantarum</i> BAA793	ATCC
<i>L. reuteri</i> 23272	ATCC
<i>L. rhamnosus</i> GG	ATCC
<i>L. rhamnosus</i> B176	NRRL
<i>L. rhamnosus</i> B1914	NRRL
<i>L. rhamnosus</i> B1937	NRRL
<i>L. rhamnosus</i> BLCR1	DFF
<i>L. ruminus</i> 14583	DFF
<i>L. salivarius</i> ssp. <i>salivarius</i> B1949	NRRL

<i>L. salivarius</i> ssp. <i>salicinus</i> B1950	NRRL
<i>L. sharpeae</i> B14855	NRRL
<i>L. (Weissella) viridescens</i> B1951	NRRL
<i>L. (Weissella) confusa</i> B1064	NRRL
<i>L. acidophilus</i> 1426	Luchansky
<i>L. reuteri</i> 1428	Luchansky
<i>Bifidobacterium breve</i> 2141 (ATCC 15698)	Luchansky
<i>Bifidobacterium longum</i> subsp. <i>infantis</i> 3300 (ATCC 15697)	Luchansky