

Table S1. Detailed data on physicochemical properties of extracellular vesicles produced by probiotics.

Bacterial producer	Properties of membrane vesicles			Reference
	Size *	Charge	Amount	
Gram-negative bacteria				
<i>Escherichia coli</i> Nissle 1917	20 – 60 nm (TEM)	ND	ND	[1–3]
	20 – 60 nm (TEM)	ND	1.16 × 10 ⁻³ ± 3.7 × 10 ⁻⁴ relative fluorescence units/colony forming units (spectrophotometry)	[4]
	28.2 ± 9.54 nm (TEM)	ND	ND	[5]
	50 – 150 nm (TEM + SEM) ~99 nm (NTA)	ND	ND	[6]
	149 – 189 nm (NTA)	ND	7.8 × 10 ¹⁰ – 1.9 × 10 ¹² particles/mL (extraction method-dependent; NTA)	[7]
<i>Akkermansia muciniphila</i> ATCC BAA-835	40 – 150 nm (SEM)	ND	ND	[8–11]
	40 – 60 nm (DLS)	ND	ND	[12]
	181.9 ± 42.4 nm (DLS)	ND	ND	[13]
	20 – 200 nm (TEM)	ND	ND	[14]
	30 – 300 nm (TEM)	ND	ND	[15]
Gram-positive bacteria				
<i>Lactiplantibacillus plantarum</i> BGAN8	20 – 140 nm (cryo-TEM)	ND	ND	[16]
<i>Lactiplantibacillus plantarum</i> Q7	70 – 500 nm (DLS)	ND	ND	[17]
<i>Lactiplantibacillus plantarum</i> KCTC 11401BP	20 – 100 nm (TEM)	ND	ND	[18]
<i>Lactiplantibacillus plantarum</i> BCRC 10357	~124 – 130 nm (NTA)	ND	3 – 3.8 × 10 ⁸ particles/mL (NTA)	[19]
<i>Lactiplantibacillus plantarum</i> P8	100 – 150 nm (TEM) ~125 nm (NTA)	ND	ND	[20]
<i>Lactiplantibacillus plantarum</i> NCIMB 8826	50 – 200 nm (cryo-TEM) 116 ± 9 nm (NTA)	–3.3 ± 0.2 mV to –5.6 ± 2.0 mV (DLS)	7.2 × 10 ¹⁰ – 1.7 × 10 ¹² particles/mL (condition-dependent; NTA)	[21]
	117 ± 24 nm (NTA)	ND	6 × 10 ¹¹ particles/mL (NTA)	[22]

Table S1. Cont.

Bacterial producer	Properties of membrane vesicles			Reference
	Size *	Charge	Amount	
<i>Lactiplantibacillus plantarum</i> WCFS1	30 – 200 nm (TEM)	ND	ND	[23]
	31 – 200 nm (NTA)			
	108 ± 0.8 nm (NTA)	–27.2 ± 2.03 mV (NTA)	ND	[24]
	127 nm (NTA)	~ –10 mV (NTA)	ND	[25]
<i>Lactiplantibacillus plantarum</i> APsulloc 331261	72 – 84 nm (DLS)	ND	2.95 – 5.75 × 10 ¹⁰ particles/mL (TRPS)	[26]
	104 ± 42.4 nm (ultracentrifugation-purified; DLS)	ND	2.45 – 3.06 × 10 ¹⁰ particles/mL (both extraction methods; TRPS)	[27]
	83 ± 20.3 nm (density-purified; DLS)			
<i>Lactiplantibacillus plantarum</i> YW11	66.96 ± 5.83 nm (NTA)	ND	ND	[28]
<i>Lactiplantibacillus plantarum</i> **	126.5 ± 56.4 nm (NTA)	ND	9.1 × 10 ⁹ particles/mL (NTA)	[29]
<i>Lacticaseibacillus casei</i> BL23	13 – 28 nm (TEM)	ND	ND	[30]
	~24 nm (DLS)			
	47 ± 3 nm (DLS)	–8.7 ± 1.9 mV (DLS)	ND	[31]
	48 ± 3 nm (SEM)			
<i>Lacticaseibacillus casei</i> ATCC 393	33 ± 3 nm (AFM)			
	10 – 300 nm (AFM)	~ –17 mV (DLS)	3 × 10 ⁹ to 1 × 10 ¹⁰ particles/mL (NTA)	[32]
	143 ± 52 nm (NTA)			
	~70 nm and ~250 nm (DLS)			
<i>Lacticaseibacillus casei</i> DSMZ 20011	140.7 ± 20.3 nm (SEM)	–0.5 mV (DLS)	ND	[33]
	~ 227.3 nm (DLS)			
	50 – 200 nm (cryo-TEM)	–6.3 ± 0.7 mV to ~ –13 mV (DLS)	3.3 × 10 ¹¹ – 4.4 × 10 ¹² particles/mL (condition-dependent; NTA)	[21]
	116 ± 5 nm (NTA)			
<i>Lacticaseibacillus rhamnosus</i> GG	113 ± 12 nm (NTA)	ND	2 × 10 ¹² particles/mL (NTA)	[22]
	30 – 100 nm (TEM)	ND	ND	[34]
	161.9 ± 54.8 nm (DLS)	ND	ND	[35]
	50 – 150 nm (TEM)	ND	ND	[36]

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Bacterial producer	Properties of membrane vesicles			Reference
	Size *	Charge	Amount	
<i>Lactacaseibacillus rhamnosus</i> JB-1	~130 nm (NTA)	ND	3.1×10^{11} particles/mL (NTA)	[37]
	~130 nm (NTA)	ND	$2.3 - 2.6 \times 10^{10}$ particles/mL (NTA)	[38]
<i>Lactacaseibacillus paracasei</i> PC-H1	~ 200 nm (NTA)	ND	ND	[39]
<i>Lactacaseibacillus paracasei</i> **	20 – 100 nm (TEM)	ND	ND	[40]
<i>Lactobacillus gasseri</i> JCM 1131 ^T	~ 130 nm (TEM)	ND	ND	[41]
<i>Lactobacillus gasseri</i> BC12 and BC13	~ 135 nm (NTA)	ND	5.87×10^{10} to 1.32×10^{11} particles/mL (NTA)	[42]
<i>Lactobacillus acidophilus</i> ATCC 53544	10 – 300 nm (AFM) ~142 ± 64 nm (NTA) ~35 nm and ~200 nm (DLS)	~ -11 mV (DLS)	3×10^9 to 1×10^{10} particles/mL (NTA)	[32]
<i>Lactobacillus johnsonii</i> N6.2	95.8 ± 46.5 nm (TEM) 99.2 ± 48.3 nm (cryo-TEM) 96.3 ± 58.6 (SEM) ~124 nm (NTA)	ND	1.45×10^9 particles/mL (NTA)	[43]
<i>Lactobacillus crispatus</i> BC3 and BC5	~ 130 – 140 nm (NTA)	ND	$1.18 - 3.26 \times 10^{10}$ particles/mL (NTA)	[42]
<i>Limosilactobacillus reuteri</i> DSM 17938	50 – 150 nm (TEM) ~210 – 240 nm (DLS) ~210 – 240 nm (NTA)	~13.4 mV for biofilm vesicles (DLS) ~39.8 mV for planktonic vesicles (DLS)	$1.1 - 2.0 \times 10^9$ particles/mL (NTA)	[44]
	130.7 – 388.11 nm (planktonic vesicles; DLS) 2753 nm (biofilm vesicles; DLS)	~36.6 ± 0.4 mV (planktonic vesicles; DLS) ~24.6 ± 2.2 mV (biofilm vesicles; DLS)	3.38×10^7 planktonic vesicles/mL (flow cytometry) 4.48×10^7 biofilm vesicles/mL (flow cytometry)	[45]
	156.3 ± 2.1 nm (NTA)	ND	ND	[46]
<i>Limosilactobacillus reuteri</i> ATCC 23272	10 – 300 nm (AFM) 143 ± 55 nm (NTA) ~150 nm (DLS)	~ -8 mV (DLS)	3×10^9 to 1×10^{10} particles/mL (NTA)	[32]
<i>Limosilactobacillus reuteri</i> BBC3	50 – 150 nm (TEM + SEM) 60 – 250 nm (NTA)	ND	ND	[47]

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Bacterial producer	Properties of membrane vesicles			Reference
	Size *	Charge	Amount	
<i>Lentilactobacillus kefir</i> KCTC 3611 <i>Lentilactobacillus kefirnofaciens</i> KCTC 5075 <i>Lentilactobacillus kefirgranum</i> KCTC 5086	80 – 400 nm (cryo-TEM)	ND	ND	[48]
<i>Latilactobacillus sakei</i> NBRC15893	30 – 400 nm (TEM)	ND	ND	[49]
<i>Ligilactobacillus animalis</i> ATCC 35046	118.8 ± 49.5 nm (NTA)	ND	3.7 – 4.6 × 10 ¹⁰ particles/mL (NTA)	[50]
<i>Leuconostoc holzapfelii</i> GFC1203H	~104.6 nm (NTA)	ND	2.03 × 10 ¹¹ particles/mL (NTA)	[51]
<i>Pediococcus pentosaceus</i> **	~325 – 425 nm (DLS)	–35 to –45 mV (DLS)	ND	[52]
<i>Lactococcus lactis</i> FM-YL11	50 – 300 nm (TEM)	ND	ND	[53]
<i>Lactococcus lactis</i> **	60 – 100 nm (DLS)	ND	ND	[54]
<i>Bifidobacterium longum</i> NCC2705	50 – 80 nm (TEM)	ND	ND	[55]
<i>Bifidobacterium longum</i> **	126 ± 3.78 nm (NTA)	–10.8 ± 1.53 mV (NTA)	ND	[24]
	109 nm (NTA)	~ –8 mV (NTA)	ND	[25]
<i>Propionibacterium freudenreichii</i> CIRM-BIA 129	~85 nm (NTA)	ND	ND	[56]
	100.9 ± 3.2 nm or 117.9 ± 7.9 nm (medium-dependent; NTA)	ND	9.4 × 10 ¹¹ to 2.2 × 10 ¹² particles/mL (medium-dependent; NTA)	[57]
<i>Bacillus subtilis</i> 168	142 ± 14 nm (DLS) 52 ± 3 nm (SEM) 310 ± 5 nm (AFM)	–18.2 ± 1.7 mV (DLS)	ND	[31]
	115 ± 27 nm (NTA)	ND	ND	[58]
<i>Faecalibacterium prausnitzii</i> A2-165	20 – 200 nm (TEM)	ND	ND	[14]

Table S1. Cont.

Bacterial producer	Properties of membrane vesicles			Reference
	Size *	Charge	Amount	
<i>Clostridium butyricum</i> **	152 nm (NTA)	~ -10 mV (NTA)	ND	[25]
<i>Clostridium butyricum</i> MIYAIRI II 588	149.3 ± 50.9 nm (NTA)	ND	ND	[59]
	30 – 200 nm (NTA)	ND	ND	[60]

Abbreviations: ND, no data; TEM, Transmission electron microscopy; cryo-TEM, Cryogenic transmission electron microscopy; SEM, Scanning electron microscope; AFM, Atomic force microscopy; DLS, Dynamic light scattering; NTA, Nanoparticle tracking analysis; TRSP, Tunable resistive pulse sensing. * In case of the data determining the size of membrane vesicles using DLS or NTA the reported values constitute the highest reading peak. ** Bacterial strain was not reported.

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