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Data Article

A set of synthetic data, antibacterial evaluation and bacterial interaction with lipid-core nanocapsules containing fusidic acid

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ABSTRACT

A set of synthetic data, of antibacterial evaluation against gram-positive bacteria, as well as, the interaction of bacterial with lipid-core nanocapsules containing fusidic acid is presented here. In this data set, the analytical data are detailed; serial microdilution; nanoparticle tracking analysis; transmission electron microscopy; minimum inhibitory concentration; diameter size and zeta potential, and infra-red of the formulations before and after contact with bacteria.

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Specifications Table

Subject	Chemistry, Pharmacy
Specific subject area	Antimicrobial evaluation using polymeric nanocapsules
Type of data	Tables, images and figures
How data were acquired	HPLC by (Shimadzu HPLC; composed of LC-20AT pump, SIL-20AHT injector, UV/Vis SPD-20A detector and CBM-20A controller), serial microdilution method (Clinical and Laboratory Standards Institute, CLSI (doc. M07-A6) (SpectramaxM5), nanoparticle tracking analysis (NTA - LM10, NanoSight Ltd., Wiltshire, UK), transmission Electron Microscopy (JEOL JEM 1200 EXII microscope), dynamic light scattering and zeta potential (Malvern Zeta sizer instrument-Nano ZS, Malvern Instruments, UK) and Fourier transform infrared spectroscopy (ATR-FTIR) (Perkin Elmer instrument, Spectrum BX, USA) accessory (MIRacle, ZnSe accessory, USA).
Data format	Raw, analyzed
Parameters for data collection	HPLC analyzes were performed to validate and quantify fusidic acid in the samples. Microscopic images, turbidimetry, diameter and zeta potential analyze, and infrared analyzes of the formulations were obtained without pre-treatment of the samples.
Description of data collection	Details of the experimental methodologies used in this study, such as validation and quantification of fusidic acid in the formulations. Antimicrobial evaluation of formulations and effectiveness by microbiological analysis. Analyzes of particle size, zeta potential, FTIR and interactions of bacteria with nanocapsules.
Data source location	Porto Alegre, Brazil
Data accessibility	Data is provided with this article
Related research article	R. Cé, B. Z. Pacheco, T. M. Ciocheta, F. S. Barbosa, A. C. S. Alves, D. R. Dallemole, V. Lavayen, S. S. Guterres, M. Steppe, A. R. Pohlmann, Antibacterial activity against Gram-positive bacteria using fusidic acid-loaded lipid-core nanocapsules, Reactive and Functional Polymers. 162 (2021) 1–13, https://doi.org/10.1016/j.reactfunctpolym.2021.104876.

Value of the Data

- The synthesis of lipid-core nanocapsules containing fusidic acid is innovative for the scientific community.
- Experimental data on antimicrobial evaluation against gram-positive bacteria showed that the formulations were effective in inhibiting microbiological growth.
- The nanocapsules-bacteria interactions data indicated that aggregates were formed; and zeta potential values decreased considerably for chitosan-coated formulations; and the results were confirmed by infrared spectroscopy analysis.

1. Data Description

The data presented in Section 1.1 refer to the results of the analytical validation for the quantification of fusidic acid in the formulations (Table 1). Section 1.2 involves determining the concentrations of fusidic acid, chitosan, concentration of nanocapsules, colony forming unit and the ratio of nanocapsules/colony forming unit used in this microbiological study (Table 2). In the Section 1.3 includes a comparison of the 2D graphs (scattered light intensity vs. diameter) where we observed overlapping point distributions for the formulations (LNC/LNC-FA and LNC/LNC-FA/LNC-FA-CS) (Fig. 1) determined by nanoparticle tracking analysis (NTA). Section 1.4 provides data for determining the thickness of the chitosan coating around the nanocapsules (Fig. 2). The data contained in section 1.5 - 1.7 are related (Figs. 3–5) to the data of the minimum inhibitory concentrations (MICs) of the formulations in contact with the bacteria *Staphylococcus aureus* (1), *Enterococcus faecalis* (2) and (3) *Staphylococcus epidermidis*. In the Section 1.8 shows data regard-

Table 1
Analytical results obtained from linearity, precision and accuracy of the HPLC method validated for determination of fusidic acid in the formulations.

Parameter	Results	
Linearity		
Calibration range	10.0 – 80.0 μg mL^{-1}	
Regression equation	$y = 33242x + 9239.9$	
Correlation coefficient (r)	0.9996	
Standard error of regression	3.6%	
(ANOVA) Linear regression	($F_{calculated} = 4570 > F_{critical} = 4.75$; $p = 0.05$)	
(ANOVA) Deviation the linearity	($F_{calculated} = 0.9 < F_{critical} = 3.49$; $p = 0.05$)	
Cochran C-test	($C_{calculated} = 0.464 < C_{critical} = 0.616$; $p = 0.05$)	
LD and LQ	0.03 μg mL^{-1}; 0.09 μg mL^{-1}	
Precision	Amount%	RSD
Day 1[a]	99.71	1.49
Day 2[a]	100.98	2.07
Interday[b]	100.38	1.90
Accuracy	Mean of recovery (%)[c]	RSD
Spiked level		
Low	101.53	1.89
Medium	100.73	1.69
High	98.49	1.24

[a] Six independent determinations in triplicate.
[b] Mean obtained from precision in different days.
[c] Three replicates for each level.

ing the zeta potential and size diameter profiles, and the polydispersity index of the particles after contact with the bacteria *Staphylococcus aureus* (1), *Enterococcus faecalis* (2) and (3) *Staphylococcus epidermidis* (Fig. 6). Section 1.9 (Figs. 7–9, Tables 3–5) presents infrared spectra data and sample assignments before and after contact with bacteria *Staphylococcus aureus* (1), *Enterococcus faecalis* (2) and (3) *Staphylococcus epidermidis*.

Section 1.1. Analytical results of validation for determination of fusidic acid in the formulations.

Section 1.2. Concentrations of fusidic acid, chitosan, concentration of nanocapsules, colony forming unit and the ratio of nanocapsules/colony forming unit.

Section 1.3. Comparison of the 2D graphs (scattered light intensity vs. diameter) where we observed overlapping point distributions for the formulations (LNC/LNC-FA and LNC/LNC-FA/LNC-FA-CS).

Section 1.4. MET imagens used for determining the thickness of the chitosan coating around the nanocapsules.

Section 1.5–1.7. Data of the minimum inhibitory concentrations (MICs) of the formulations in contact with the bacteria *Staphylococcus aureus, Enterococcus faecalis* and *Staphylococcus epidermidis*.

Section 1.5.

Section 1.6.

Section 1.7.

Section 1.8. Zeta potential and size diameter profiles, and the polydispersion index of the particles after contact with the bacteria *Staphylococcus aureus, Enterococcus faecalis* and *Staphylococcus epidermidis*.

Section 1.9. Infrared spectra data and sample assignments before and after contact with bacteria *Staphylococcus aureus, Enterococcus faecalis* and *Staphylococcus epidermidis*.

Table 2
Concentrations of fusidic acid (FA – 516.709 g mol^{-1}) and/or chitosan (CS) (50.000 - Mw g mol^{-1}) in µg mL^{-1} and µmol L^{-1}. Particle number density (*PND*) in mL^{-1}. Concentration of nanocapsules in µmol L^{-1}. Colony forming unit (*CFU*) in mL^{-1} and, relation of *PND/CFU*.

Serial microdilution method	Conc of FA (per well) µg mL^{-1}	Conc of FA (per well) µmol L^{-1}	Conc of CS (per well) µg mL^{-1}	Conc of CS (per well) µmol L^{-1}	*PND* (per well) mL^{-1}	Nanocapsule (per well) µmol L^{-1}	*Conc.of CFU (per well)* mL^{-1}	*PND/CFU (per well)*
1	$4.50 \times 10^{+1}$	$8.71 \times 10^{+1}$	$4.00 \times 10^{+1}$	8.00×10^{-1}	$2.13 \times 10^{+11}$	3.53×10^{-4}	$2 \times 10^{+5}$	$1.06 \times 10^{+6}$
2	$2.25 \times 10^{+1}$	$4.35 \times 10^{+1}$	$2.00 \times 10^{+1}$	4.00×10^{-1}	$1.06 \times 10^{+11}$	1.76×10^{-4}	$2 \times 10^{+5}$	$5.31 \times 10^{+5}$
3	$1.13 \times 10^{+1}$	$2.18 \times 10^{+1}$	$1.00 \times 10^{+1}$	2.00×10^{-1}	$5.31 \times 10^{+10}$	8.82×10^{-5}	$2 \times 10^{+5}$	$2.66 \times 10^{+5}$
4	5.63×10^{0}	$1.09 \times 10^{+1}$	5.00×10^{0}	1.00×10^{-1}	$2.66 \times 10^{+10}$	4.41×10^{-5}	$2 \times 10^{+5}$	$1.33 \times 10^{+5}$
5	2.81×10^{0}	5.44×10^{0}	2.50×10^{0}	5.00×10^{-2}	$1.33 \times 10^{+10}$	2.21×10^{-5}	$2 \times 10^{+5}$	$6.64 \times 10^{+4}$
6	1.41×10^{0}	2.72×10^{0}	1.25×10^{0}	2.50×10^{-2}	$6.64 \times 10^{+9}$	1.10×10^{-5}	$2 \times 10^{+5}$	$3.32 \times 10^{+4}$
7	7.03×10^{-1}	1.36×10^{0}	6.25×10^{-1}	1.25×10^{-2}	$3.32 \times 10^{+9}$	5.51×10^{-6}	$2 \times 10^{+5}$	$1.66 \times 10^{+4}$
8	3.52×10^{-1}	6.80×10^{-1}	3.13×10^{-1}	6.25×10^{-3}	$1.66 \times 10^{+9}$	2.76×10^{-6}	$2 \times 10^{+5}$	$8.30 \times 10^{+3}$
9	1.76×10^{-1}	3.40×10^{-1}	1.56×10^{-1}	3.13×10^{-3}	$8.30 \times 10^{+8}$	1.38×10^{-6}	$2 \times 10^{+5}$	$4.15 \times 10^{+3}$
10	8.79×10^{-2}	1.70×10^{-1}	7.81×10^{-2}	1.56×10^{-3}	$4.15 \times 10^{+8}$	6.89×10^{-7}	$2 \times 10^{+5}$	$2.08 \times 10^{+3}$

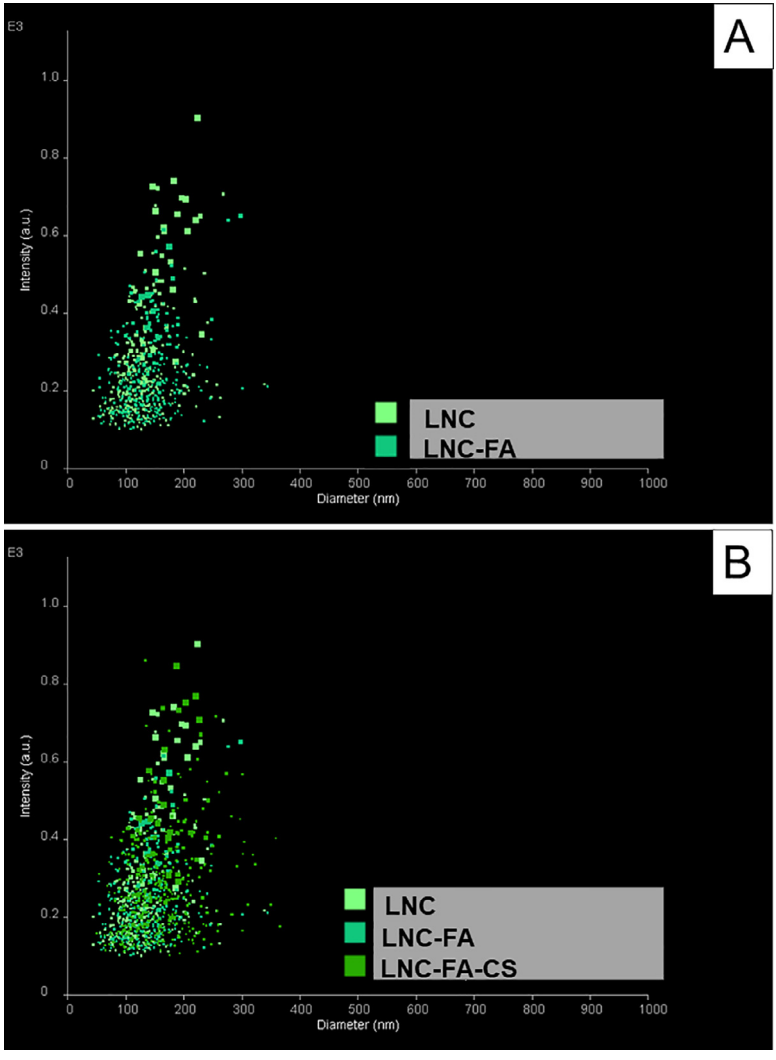

Fig. 1. Nanoparticle Tracking Analysis (NTA) analysis: (A) LNC: lipid-core nanocapsule and LNC-FA: fusidic acid-loaded lipid-core nanocapsule; (B) LNC: lipid-core nanocapsule and LNC-FA: fusidic acid-loaded lipid-core nanocapsule and LNC-FA-CS: chitosan-coated fusidic acid-loaded lipid-core nanocapsule.

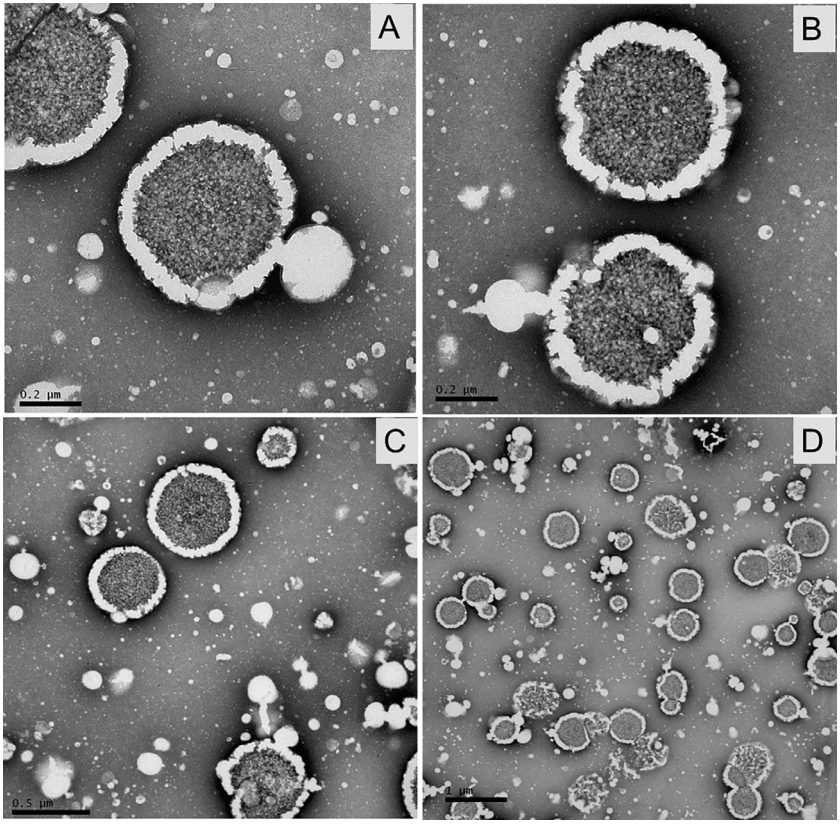

Fig. 2. Transmission electron microscopy analysis: Photomicrograph of LNC-FA-CS (chitosan-coated fusidic acid-loaded lipid-core nanocapsule) (A and B) (bar = 200 nm), (C) (bar = 500 nm) and (D) ((bar = 1000 nm).

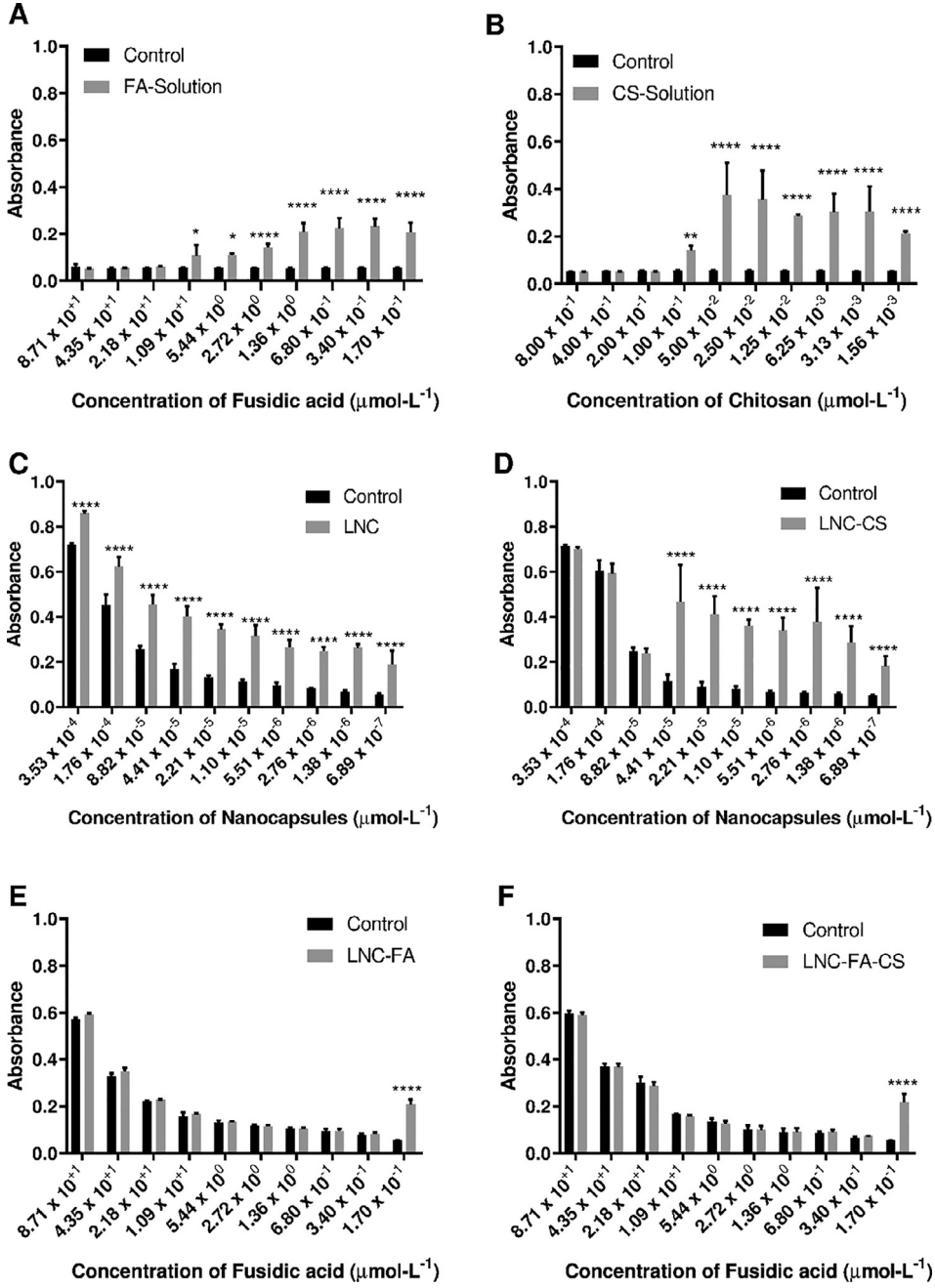

Fig. 3. MIC results from for *Staphylococcus aureus:* FA-Solution: aqueous solution of fusidic acid (A); CS-Solution: aqueous solution of chitosan (B); LNC: lipid-core nanocapsule (C); LNC–CS: chitosan-coated lipid-core nanocapsule (D); LNC-FA: fusidic acid-loaded lipid-core nanocapsule (E) and (F) LNC-FA-CS: chitosan-coated fusidic acid-loaded lipid-core nanocapsule. All control refers to absorbance read at 625 nm before incubation. * Indicate significant diferences $p < 0.0370$. ****Indicate significant diferences $p < 0.0001$.

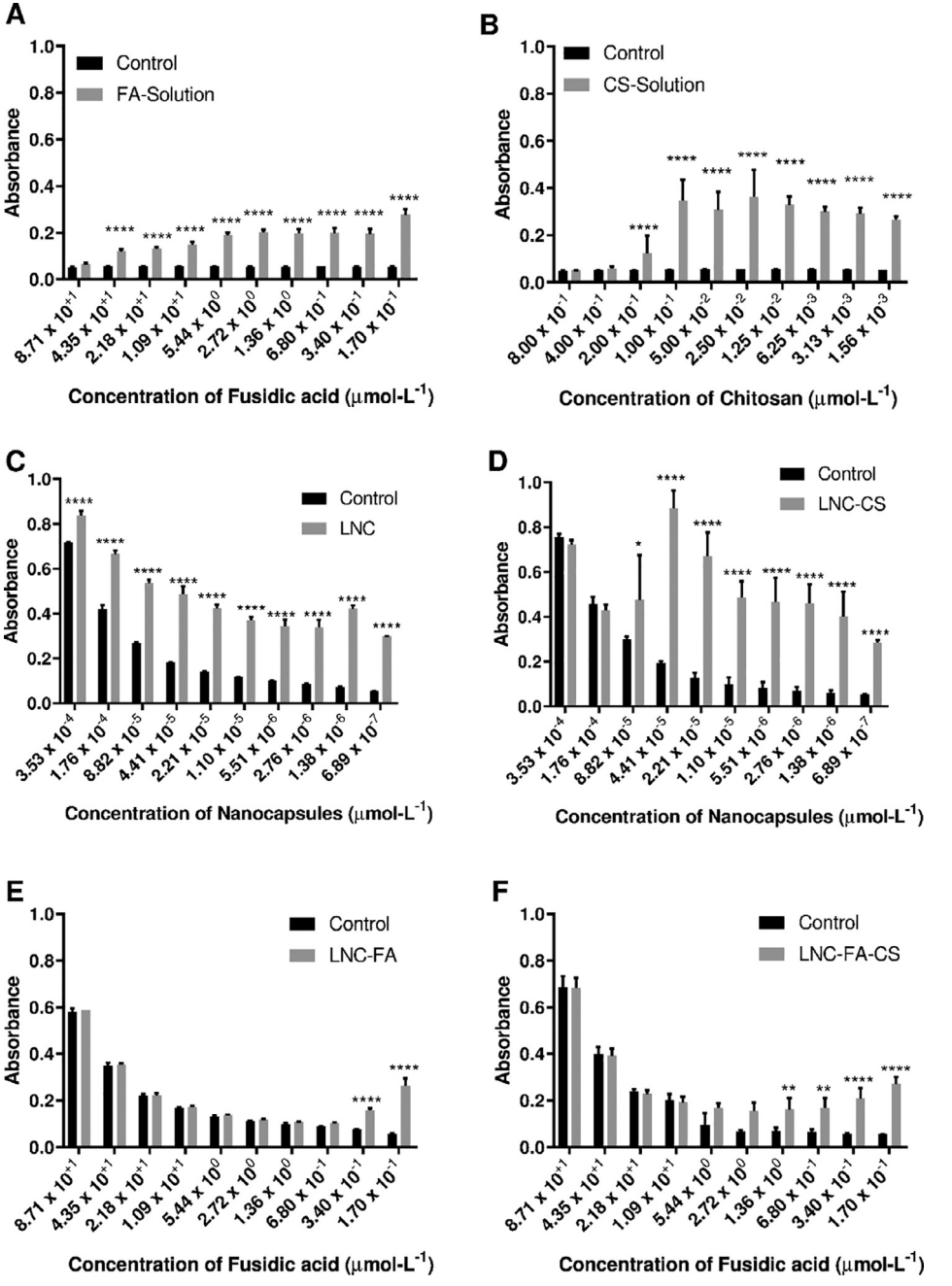

Fig. 4. MIC results from for *Enterococcus faecalis:* FA-Solution: aqueous solution of fusidic acid (A); CS-Solution: aqueous solution of chitosan (B); LNC: lipid-core nanocapsule (C); LNC–CS: chitosan-coated lipid-core nanocapsule (D); LNC-FA: fusidic acid-loaded lipid-core nanocapsule (E) and (F) LNC-FA-CS: chitosan-coated fusidic acid-loaded lipid-core nanocapsule. All control refers to absorbance read at 625 nm before incubation. * Indicate significant diferences $p < 0.0352$. ** Indicate significant diferences $p < 0.0059$. **** Indicate significant diferences $p < 0.0001$.

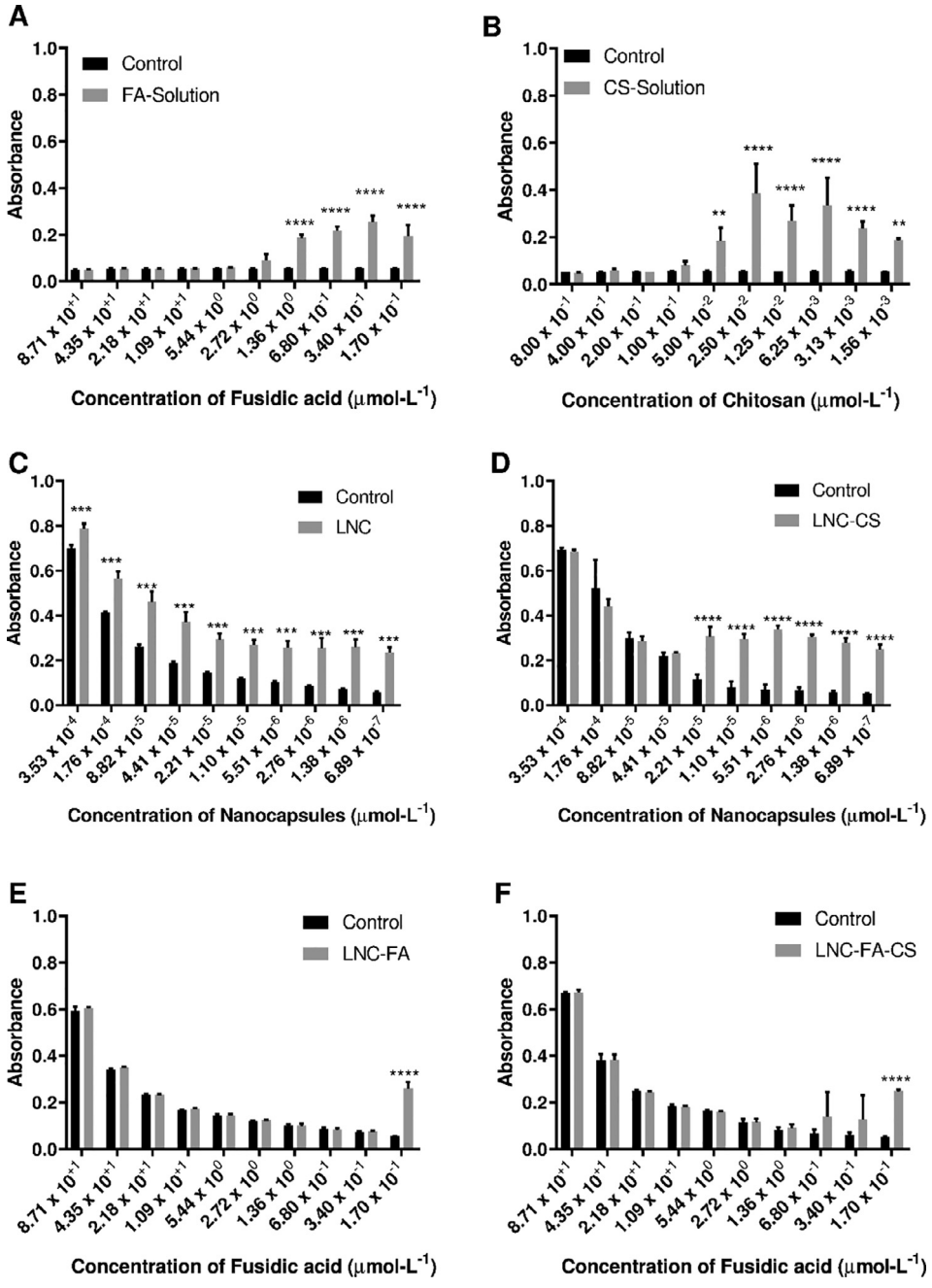

Fig. 5. MIC results from for *Staphylococcus epidermidis:* FA-Solution: aqueous solution of fusidic acid (A); CS-Solution: aqueous solution of chitosan (B); LNC: lipid-core nanocapsule (C); LNC–CS: chitosan-coated lipid-core nanocapsule (D); LNC-FA: fusidic acid-loaded lipid-core nanocapsule (E) and (F) LNC-FA-CS: chitosan-coated fusidic acid-loaded lipid-core nanocapsule. All control refers to absorbance read at 625 nm before incubation. ** Indicate significant diferences $p < 0.0089$. ****Indicate significant diferences $p < 0.0001$.

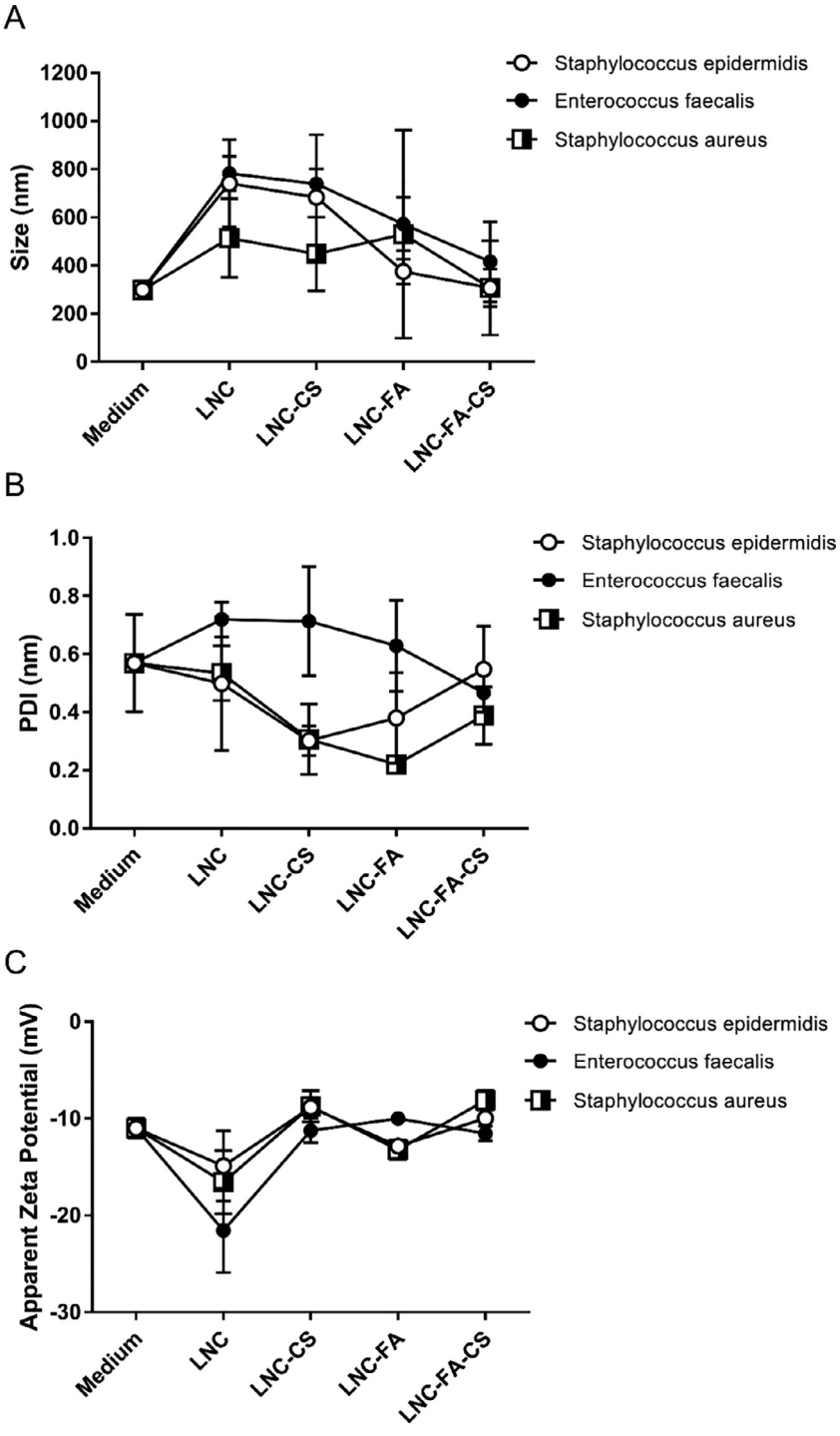

Fig. 6. Diameter size (A), PDI (B) and (C) zeta potential profiles of formulations in contact with bacteria. Medium: MH Broth; LNC: lipid-core nanocapsule; LNC–CS: chitosan-coated lipid-core nanocapsule; LNC-FA: fusidic acid-loaded lipid-core nanocapsule and LNC-FA-CS: chitosan-coated fusidic acid-loaded lipid-core nanocapsule.

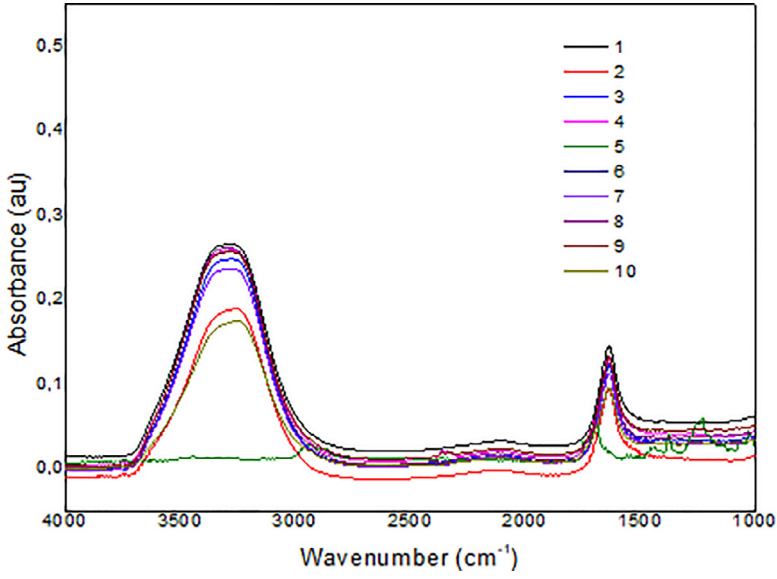

Fig. 7. Infrared spectra of samples before and after contact with *Staphylococcus aureus* on the interval 4000 – 1000 cm^{-1}. (1) Control Negative (MH Broth); (2) Control Positive (MH Broth + bacteria); (3) CS (chitosan) - solution after contact with bacteria; (4) CS (chitosan) - solution before contact with bacteria; (5) FA (fusidic acid) - solution after contact with bacteria; (6) FA (fusidic acid) - solution before contact with bacteria; (7) LNC-FA (fusidic acid-loaded-lipid-core nanocapsules) after contact with bacteria; (8) LNC-FA (fusidic acid-loaded-lipid-core nanocapsules) before contact with bacteria; (9) LNC-FA-CS (chitosan-coated fusidic acid-loaded-lipid-core nanocapsules) after contact with bacteria and (10) LNC-FA-CS (chitosan-coated fusidic acid-loaded-lipid-core nanocapsules) before contact with bacteria.

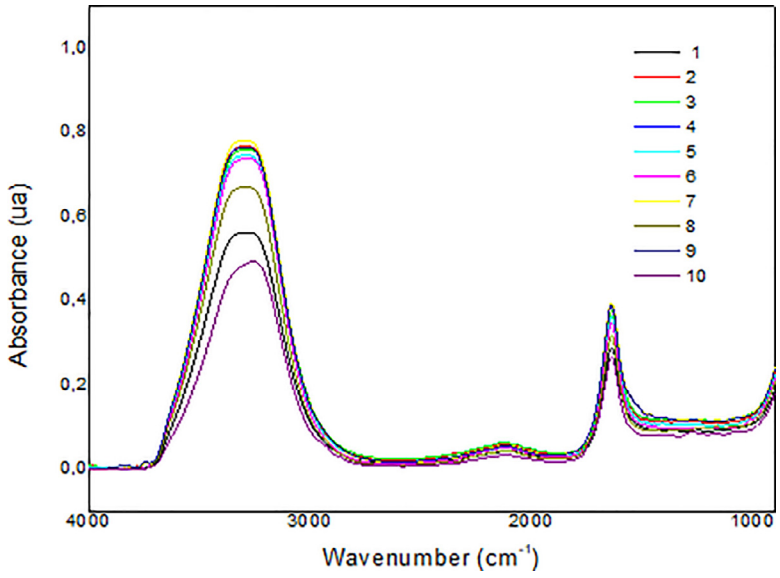

Fig. 8. Infrared spectra of samples before and after contact with *Enterococcus faecalis* on the interval 4000 – 1000 cm^{-1}. (1) Control Negative (MH Broth); (2) Control Positive (MH Broth + bacteria); (3) CS (chitosan) - solution after contact with bacteria; (4) CS (chitosan) - solution before contact with bacteria; (5) FA (fusidic acid) - solution after contact with bacteria; (6) FA (fusidic acid) - solution before contact with bacteria; (7) LNC-FA (fusidic acid-loaded-lipid-core nanocapsules) after contact with bacteria; (8) LNC-FA (fusidic acid-loaded-lipid-core nanocapsules) before contact with bacteria; (9) LNC-FA-CS (chitosan-coated fusidic acid-loaded-lipid-core nanocapsules) after contact with bacteria and (10) LNC-FA-CS (chitosan-coated fusidic acid-loaded-lipid-core nanocapsules) before contact with bacteria.

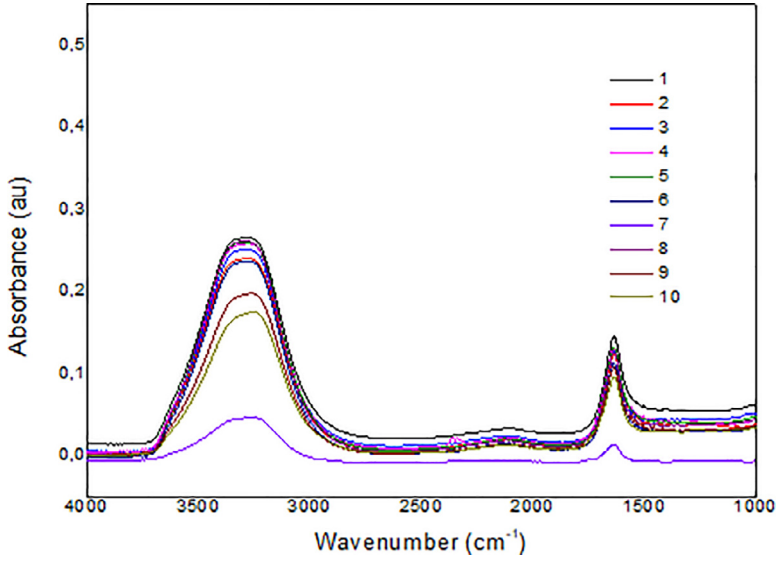

Fig. 9. Infrared spectra of samples before and after contact with *Staphylococcus epidermidis* on the interval 4000 – 1000 cm^{-1}. (1) Control Negative (MH Broth); (2) Control Positive (MH Broth + bacteria); (3) CS (chitosan) - solution after contact with bacteria; (4) CS (chitosan) - solution before contact with bacteria; (5) FA (fusidic acid) - solution after contact with bacteria; (6) FA (fusidic acid) - solution before contact with bacteria; (7) LNC-FA (fusidic acid-loaded-lipid-core nanocapsules) after contact with bacteria; (8) LNC-FA (fusidic acid-loaded-lipid-core nanocapsules) before contact with bacteria; (9) LNC-FA-CS (chitosan-coated fusidic acid-loaded-lipid-core nanocapsules) after contact with bacteria and (10) LNC-FA-CS (chitosan-coated fusidic acid-loaded-lipid-core nanocapsules) before contact with bacteria.

Table 3
Infrared assignment of the samples before and after contact with *Staphylococcus aureus*.

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	Assignment
3778	3778	3778	3778		3778	3371	3371	3371	3371	ν (NH)
3215	3215	3215	3215		3215	3215	3215	3215	3215	ν (OH)
				2970						
							2958	2951	2959	νas (CH_3)
2934				2939						
		2910		2910				2914		
				2926				2926	2925	νas (CH_2)
	2868	2861		2861						νs (CH_3)
				2853			2858	2854	2852	νs (CH_2)
	2829									
				1740						ν (C = O) ketone, carboxylate dimer
				1707	1692					ν (C = O) Carboxyl FA
		1669		1667						
		1650			1649	1651	1651	1651	1651	ν (C = O) II, amide I / ν ($C = O$) of COO^-
1640		1638	1643		1642	1639	1639	1639		ν (C = O) III, amide I
		1634			1636	1634	1634	1634	1635	ν (C = O) / ν (C = O) (amide I)
		1622	1628		1622	1620	1620	1620	1620	ν (C = C) FA
		1590								δ (NH2)
				1549	1549					ν (NH), amide II
1463	1463					1460	1460	1460	1460	δas (CH2), δas (CH3) / FA
		1448				1443	1443	1443		δ(CH2) / FA
		1428								
				1376						ν (C = C) aromatic FA
				1233						νas (PO2-), ν (CO), FA
1150	1145									ν (C–O), γ (COH)
	1129									
1008				1020	1008					ν *in-plane* (C–H), FA
					983					ν (C–O), ν (C–C), FA
					967		954			FA
							944		947	ν (COP) / δ *out-of-plane* (OH), FA
					909					ν (COP)
		813						809		ν *out-of-plane* (N–H)
	759				785					FA
		737		742		703				ρ *out-of-plane* (-C-H), FA

(1) Control Negative (MH Broth); (2) Control Positive (MH Broth + bacteria); (3) CS (chitosan) - solution after contact with bacteria; (4) CS (chitosan) - solution before contact with bacteria; (5) FA (fusidic acid) - solution after contact with bacteria; (6) FA (fusidic acid) - solution before contact with bacteria; (7) LNC-FA (fusidic acid-loaded-lipid-core nanocapsules) after contact with bacteria; (8) LNC-FA (fusidic acid-loaded-lipid-core nanocapsules) before contact with bacteria; (9) LNC-FA-CS (chitosan-coated fusidic acid-loaded-lipid-core nanocapsules) after contact with bacteria and (10) LNC-FA-CS (chitosan-coated fusidic acid-loaded-lipid-core nanocapsules) before contact with bacteria.
(ν) stretching mode; (δ) bending mode; (ρ) rocking band; (as) asymmetrical band; (s) symmetrical band.

Table 4
Infrared assignment of the samples before and after contact with *Enterococcus faecalis*.

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	Assignment
3778		3778								
3380										$\nu_{(NH)}$
3216	3216	3126	3216	3216	3216					$\nu_{(OH)}$
2934		2965					2958		2958	νas (CH_3)
2926		2926				2925	2926	2925	2926	νas (CH_2)
		2861								νs (CH_3)
		2851					2853		2853	νs (CH_2)
		1739							1738	$\nu_{(C=O)}$, carboxylic acid
						1653	1647	1653		$\nu_{(C=O)}$ of COO^-
1640		1642	1643			1645	1642	1645	1640	$\nu_{(C=O)}$
		1635				1635	1635	1635		$\nu_{(C=O)}$ (amide I)
1620		1625	1628			1626	1620	1626	1622	δ scissoring N–H
						1551		1551		$\nu_{(NH)}$ amide II
1463			1464							δas $_{(CH2)}$, δas $_{(CH3)}$
		1369				1395			1395	$\nu_{(C=O)}$ of COO^-/δC–O-H CS
		1274					1243		1276	ν C–O CS
		1157				1157	1161	1149	1159	νas $_{(C–O)}$, CO–O-C- ester bonds
1150						1148				$\nu_{(C–O)}$, $\gamma_{(COH)}$
		1103							1105	
		1096				1089	1101		1095	$\nu_{(C–N)}$
		1084		1084						FA
				1051			1053		1059	$\nu_{(COH)}$, FA
				1036		1038		1038		FA
1008					1010				1018	ν *in-plane* $_{(C–H)}$, FA
					958				954	FA
					943				941	δ *out-of-plane* $_{(OH)}$, FA
814			814			813				ν *out-of-plane* $_{(N–H)}$
767			743			741				δ *out-of-plane* $_{(C–H)}$, FA
								712		ρ *out-of-plane* $_{(-C–H)}$, FA

(1) Control Negative (MH Broth); (2) Control Positive (MH Broth + bacteria); (3) CS (chitosan) - solution after contact with bacteria; (4) CS (chitosan) - solution before contact with bacteria; (5) FA (fusidic acid) - solution after contact with bacteria; (6) FA (fusidic acid) - solution before contact with bacteria; (7) LNC-FA (fusidic acid-loaded-lipid-core nanocapsules) after contact with bacteria; (8) LNC-FA (fusidic acid-loaded-lipid-core nanocapsules) before contact with bacteria; (9) LNC-FA-CS (chitosan-coated fusidic acid-loaded-lipid-core nanocapsules) after contact with bacteria and (10) LNC-FA-CS (chitosan-coated fusidic acid-loaded-lipid-core nanocapsules) before contact with bacteria.
(ν) stretching mode; (δ) bending mode; (ρ) rocking band; (as) asymmetrical band; (s) symmetrical band.

Table 5
Infrared assignment of the samples before and after contact with *Staphylococcus epidermidis*.

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	Assignment
3380	3380	3380	3380	3380	3380	3369	3369	3369	3369	ν (NH)
3219	3219	3219	3219	3219	3219	3214	3214	3214	3214	ν (OH)
							2957		2957	νas (CH_3)
2926		2929			2924	2926	2924	2926	2925	νas (CH_2)
			2904			2862			2860	νs (CH_3)
	2853			2850		2854	2856	2857	2852	νs (CH_2)
	2843		2841							
						1745	1745	1751		ν (C = O) ketone, carboxylic
							1731		1738	ν (C = O)
						1664				ν (C = O) carboxylic acid FA
1651	1648	1649		1650	1649		1650	1655	1649	ν (C = O), amide I / $\nu(C = O)$ of COO^-
1643	1641	1640	1643	1641	1641	1646	1641	1643	1642	ν (C = O)
	1634	1633	1626	1634	1634	1630	1632	1627	1633	ν (C = O), amide I
1620	1622		1623	1624			1621		1623	δ scissoring (N–H)
			1549							δ (N–H)+ν(C–N) / ν (NH) amide II
1469		1469	1471	1464		1468	1471	1465		ν (C = C), FA
1460	1459	1459		1459	1459		1459		1460	δ (CH2), δas (CH3)
1443		1443	1443		1444					FA
1428				1428		1431			1426	ν (C–N) aromatic, FA
1405			1405							ν (C–N), CS/ν (C = O) of COO^-, FA
						1381				ν (C = C) aromatic
						1372				δ (CH)
							1002			ν (C = C)
			970			955				
						944				γ ring ν (C–C)
				814			835			N-H *out-of-plane* motion, FA
	757	736		743		737	755	748	740	ρ *out-of-plane* (-C-H)

(1) Control Negative (MH Broth); (2) Control Positive (MH Broth + bacteria); (3) CS (chitosan) - solution after contact with bacteria; (4) CS (chitosan) - solution before contact with bacteria; (5) FA (fusidic acid) - solution after contact with bacteria; (6) FA (fusidic acid) - solution before contact with bacteria; (7) LNC-FA (fusidic acid-loaded-lipid-core nanocapsules) after contact with bacteria; (8) LNC-FA (fusidic acid-loaded-lipid-core nanocapsules) before contact with bacteria; (9) LNC-FA-CS (chitosan-coated fusidic acid-loaded-lipid-core nanocapsules) after contact with bacteria and (10) LNC-FA-CS (chitosan-coated fusidic acid-loaded-lipid-core nanocapsules) before contact with bacteria.
(ν) stretching mode; (δ) bending mode; (ρ) rocking band; (as) asymmetrical band; (s) symmetrical band.

2. Experimental Design, Materials and Methods

2.1. FA quantification by liquid chromatography (HPLC)

HPLC instrument (Shimadzu HPLC; composed of LC-20AT pump, SIL-20AHT injector, UV/Vis SPD-20A detector and CBM-20A controller) was used to quantify folic acid in the fomrulations. The analysis was carried out using a column LiChroCART® 250 - 4 and LiChrospher® 100 RP - 18 (5 µm) and a mobile phase consisting of acetonitrile:water:acetic acid (70:29:1 v/v/v). The injection volume was 50 µL, and the flow rate 1 mL min^{-1}. FA was detected at 210 nm with a retention time of 10 min. The methodology was validated using an FA stock solution and respective dilutions in terms of specificity, linearity, precision, accuracy, limit of detection and quantification. All measures were carried in triplicate ($n = 3$).

The total concentration of FA in the nanocapsule formulation was determined after extraction using acetonitrile. A sample of the formulation (500 µL) was added in a volumetric flask with 10 mL of capacity. Then, the volume was adjusted with acetonitrile. The solution was sonicated (RMS unique ultrasonic, Brazil) for 120 min. An aliquot was filtered (Filter, SartoriusStedim, 0.45 µm, Biotech, Germany) and injected for analysis (HPLC).

The encapsulation efficiency was determined after determining the total concentration and the concentration in the ultrafiltrate (non-encapsulated FA). The latter was measured after ultrafiltration-centrifugation. A sample (400 µL) of each formulations (LNC-FA or LNC-FA-CS) were separately inserted into ultrafiltration units (10 kDa, Amicon® Ultra – 0.5 mL, Ireland) and centrifuged (1870 × *g*) for 5 min. After centrifugation, each ultrafiltrate (LNC-FA or LNC-FA-CS) was directly injected (50 µL) for analysis (HPLC).

2.2. Nanoparticle tracking analysis

Nanoparticle tracking analysis was carried out using a LM10 instrument (NanoSight, NanoSight Ltd., Wiltshire, UK). Samples of the nanocapsule formulations were diluted (10,000x) in pre-filtered (0.45 µm, Millipore®) ultrapure water. Each diluted solution was injected into the chamber and analyzed (10 s) at 22–25 °C. Light scattered by individual nanocapsules in Brownian motion is observed and recorded using a CCD camera coupled to the microscope. The video is analyzed by *NTA Analytical Software* (NanoSight Ltd., Wiltshire, UK) providing size distribution curves, mean diameters and particle number density (*PND*) (particles mL^{-1}).

2.3. Transmission electron microscopy

The nanocapsule formulations were analyzed using the JEM 1200 EXII microscope (JEOL, Japan) at the Microscopy and Microanalysis Center of the Federal University of Rio Grande do Sul (CMM-UFRGS, Porto Alegre, Brazil). The images were recorded operating with a voltage of 80 kV. Previously, samples of the formulations were diluted in water (1:10, v/v) and deposited (20 µL) on copper grids (400 mesh) (Formvar/Carbon film). A negative contrast consisting of 2% uranyl acetate solution was dropped on each grid. The excess of solution was removed with a paper filter. Subsequently, the grids were maintained in a desiccator under vacuum (24 h). The photomicrographs images were processed on a computer using the public domain NIH Image program (developed at the U.S. National Institutes of Health and available on the Internet at http://rsb.info.nih.gov/nih-image/) Using *ImageJ*, we also determined the thickness of the chitosan coating around of the nanocapsules in nm.

2.4. Minimum inhibitory concentration

The serial microdilution method was used in liquid growth medium MH at 37 °C for 24 h, in 96-well plates. The minimum inhibitory concentration (MIC) of FA (µmol L^{-1}) were determined

in *Staphylococcus aureus* (*S. aureus*) (ATCC 25,923), *Enterococcus faecalis (E. faecalis)* (ATCC 29,212) and a *Staphylococcus epidermidis* (*S. epidermidis*) strain resistant to antibiotics, including gentamicin, erythromycin, ciprofloxacin, norfloxacin, cefoxitin and sulfamethoxazole/trimethoprim. Bacterial growth (BG) was determined by the measurements of absorbance (at 625 nm) to access turbidity of the medium before (T0) and after 24 h (T24) of incubation.

2.5. Mean diameter, polydispersity index and zeta potential of formulations after contact with bacteria

Mean diameter, polydispersity index and zeta potential of formulations were investigated after contact with bacteria (*S. aureus, E. faecalis* and *S. epidermidis*). The formulations (0.2 mL) were added into the culture medium containing the microorganisms (96-well plates). After a period of contact (24 h), an aliquot (0.02 mL) was withdrawn and diluted (500x) in water to determine the particle size distribution. In parallel, an aliquot (0.02 mL) was withdrawn and diluted (500x) in 10 mmol L^{-1} NaCl aqueous solution to determine the zeta potential. All results were carried in triplicate ($n = 3$). Formulations were used at MIC and bacterial concentrations were fixed at 2×10^5 CFU mL^{-1}.

2.6. Infrared spectroscopy

The vibrational spectra of the nanocapsules at MIC concentrations after contact with bacteria (*S. aureus, E. faecalis* and *S. epidermidis*) were studied by attenuated total reflectance Fourier transform infrared spectroscopy (ATR-FTIR). The spectra of the formulations in contact (or not) with bacteria in the MH broth were obtained using a Perkin Elmer instrument (Spectrum BX, USA) equipped with attenuated transmission reflectance accessory (MIRacle, ZnSe accessory, USA). Each measurement was performed by adding an aliquot (10 - 20 μL) of sample in the equipment unit. After that, measurements were performed in the range from 4000 to 600 cm^{-1}, 64 scans with a resolution of 4.0 cm^{-1}. The spectrum baseline was corrected and the noise smoothed using the Savizky-Golay function. The derived function was used to start the analysis.

Ethics Statement

All authors have been personally and actively involved in substantial work leading to the paper, and take public responsibility for its content.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships which have or could be perceived to have influenced the work reported in this article.

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Supplementary Materials

Supplementary material associated with this article can be found in the online version at doi:10.1016/j.dib.2021.107089.

Further Reading

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