Electronic Supplementary Material (ESI) for Food & Function.

Supplementary data

Storage stability

Storage stability of βC-NLs and βC-GNLs was monitored by measuring retention rate, size, ZP and PDI. Storage stability was accessed at two different temperatures (refrigerated storage: 4 °C and room temperature: 25 °C) for 28 days (Figure 3). After 7 days of storage the retention rate (RR) of βC in NLs reduced from 81±5% to 76±3 and from 81±5 to 61±1.7% at 4°C and 25°C, respectively. However, in βC-GNLs retention rate (RR) reduced by only 2% from 92±6.1 to 90± 1.9 % at 4°C and 92±6.1 to 89 ±0.94 at 25°C respectively (Figure 3-A). After 28-days storage at 4 °C or 25 °C, the retention rate of βC in βC-NLs decreased to about 36±1.4% and 32±1.1% respectively. While in GNLs, the retention rate of βC at 4°C was 76 ± 5%. Even at higher temperature (25 °C) 65± 2.2% of βC was retained by GNLs. Overall, the retention rate of βC in all systems was lower at the higher storage temperature, which was in accordance with the known impact of temperature on βC [38]. However, this effect was significantly less in GNLs than NLs. Another reason behind the lower RR of βC-NLs could be the weak noncovalent interaction between βC and phospholipids bilayer, due to this weak interaction βC is more prone to leakage from liposomal vesicles. Our results suggest that coating with beta-glucan on NLs improves the RR% of encapsulated carotene by 50% under both storage temperatures and this coating provides stability against degradation and rapid leakage of the encapsulated agent. The average size, ZP and PDI of the samples were also measured, and the results are presented in Figures 3-B, C and D. The particle size of uncoated NLs increased to 478±11nm and 449±8nm after 28 days at 25 and 4°C, respectively. This increase in size indicates the aggregation of the NLs during storage [60]. Additionally, an increase in PDI values of βC-NLs at both temperatures to 0.4, even after one week of storage also indicates the presence of non-homogeneous particle size distribution. On the other hand, after 4 weeks the size of glucan-coated NLs changed from 179±2nm to 337±11nm at 4°C and to 394±6nm at 25°C. PDI of βC-GNLs whether stored at 4 °C or 25 °C, remain <0.3 indicating that the vesicles could keep uniform particle size distribution even after 28 days of storage. A continuous decrease in Zeta potential (ZP) values of both coated and uncoated NLs was observed, however, ZP values of GNLs remained above ± 30mV throughout the storage period. All these results showed that β-glucan (βG) modification is beneficial to the stability of NL storage. Similar results were observed previously where the author suggests that coating with different polymers improves the stability of βC loaded liposomes [61].

Figure S1. Storage stability study of beta-glucan coated (βC-GNLs) and uncoated nanoliposomes (βC-NLs) at 4 °C and 25 °C under dark (A) retention rate, (B) Size, (C) Zeta potential, and (D) Polydispersity index. Values are the means ± SD (n = 6). Open cycle and square represent 25°C, close circle and square 4°C, purple color for uncoated while pink represents the dietary fiber (DF) coated liposomes.

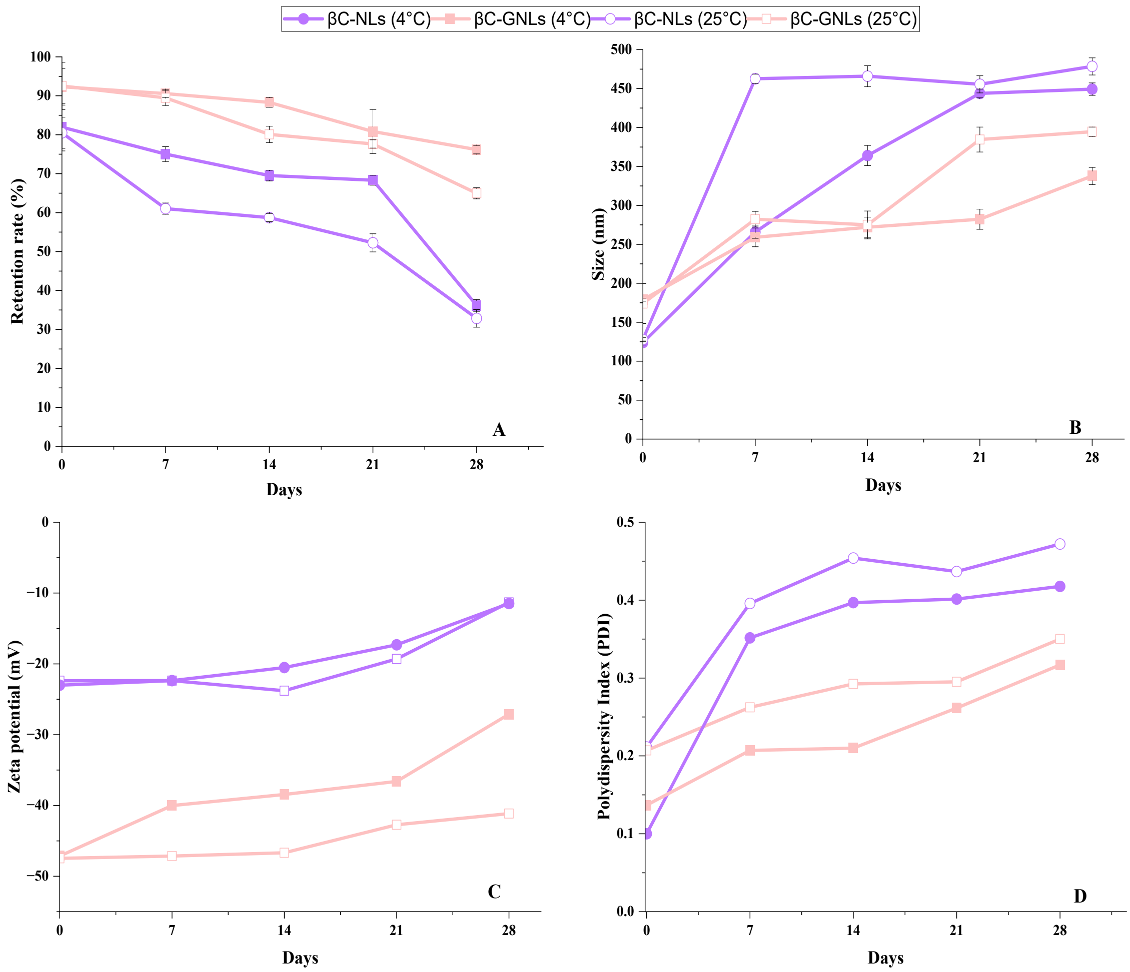
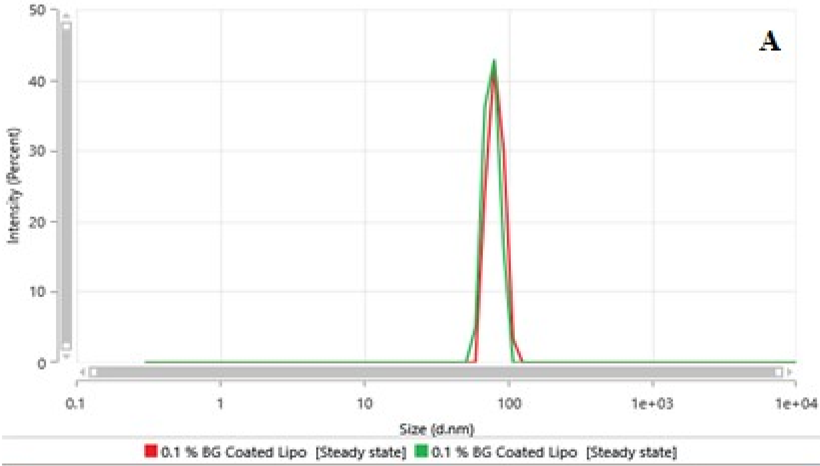
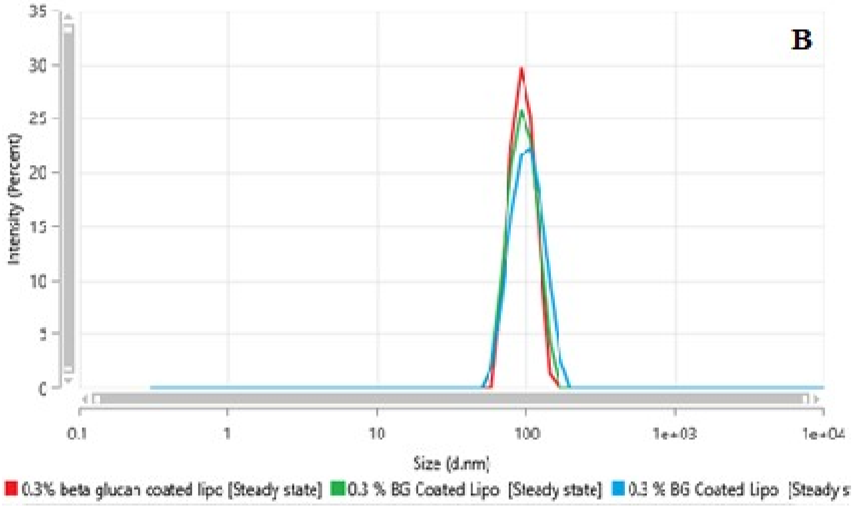


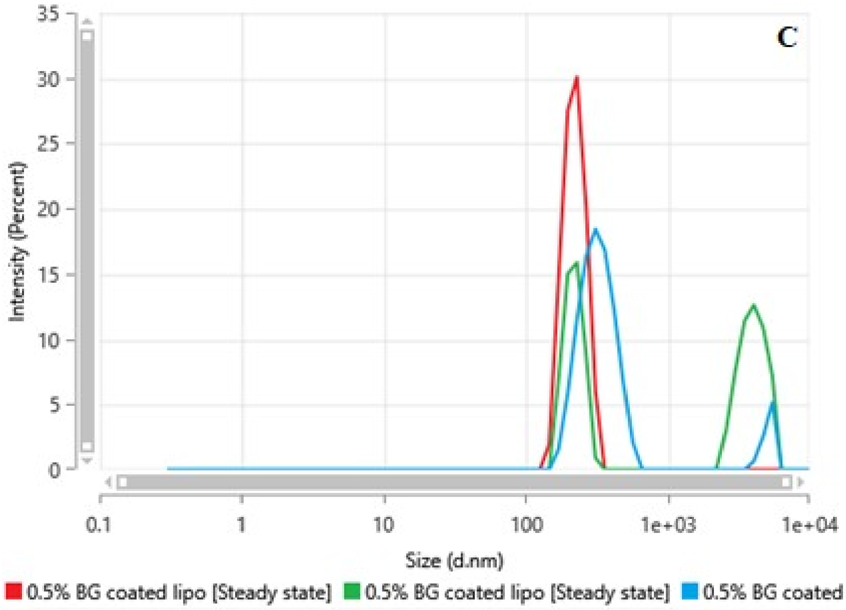
Figure S2: DLS data for beta glucan coated nanoliposomes with different concentration of beta glucan.) 0.1% βG (A), 0.3% βG (B) and 0.5% βG (C).



Name	Mean	Standard Deviation	RSD	Minimum	Maximum
Z Average Mean	249	12.6	5.04	240	258
Polydispersity	0.363	0.0306	8.41	0.342	0.385
Peak One Mean	79.4	3.6	4.53	76.9	82
Peak One Area	100	0	0	100	100



Name	Mean	Standard Deviation	RSD	Minimum	Maximum
Z Average Mean	155	21.8	14.1	133	177
Polydispersity	0.288	0.0352	12.2	0.253	0.323
Peak One Mean	99.5	4.57	4.59	96.4	105
Peak One Area	100	0	0	100	100



Name	Mean	Standard Deviation	RSD	Minimum	Maximum
Z Average Mean	429	30	6.98	400	460
Polydispersity	0.563	0.186	33	0.451	0.778
Peak One Mean	1.52E+03	2.16E+03	142	223	4.01E+03
Peak One Area	81.5	25.2	30.9	52.8	100
Peak Two Mean	2.67E+03	3.47E+03	130	219	5.12E+03
Peak Two Area	27.8	27.5	98.9	8.35	47.2