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## **Supporting Information**

## Development of casein-based nanonutraceuticals by entrapping anthocyanin derived from secondary-agricultural residues: A step towards functional food additives

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**Supplemental Table 1.** Encapsulation efficiency of black plum, wheat bran and blueberry-based A-CNPs.

S.No.	Sample	EE (%)
1.	BP@ACNPs	83.18±0.14 a
2.	WB@ACNPs	72.26±0.15 b
3.	BB@ACNPs	92.32±1.92 c

Data were expressed as mean  $\pm$  standard deviation (n = 3). Means values with different superscripts (a-c) present statistically significant differences (p < 0.05).



**Supplemental Fig. 1.** Anthocyanin extraction yield from black plum (BP), black wheat bran (WB), and blueberry (BB). Data were expressed as mean  $\pm$  standard deviation (n = 3). Data bars with different superscripts A-C present statistically significant differences (p < 0.05).



Supplemental Fig. 2. Particle size (a) bare CNPs, (b) BP@ACNPs, (c) WB@ACNPs, (d) BB@ACNPs, and Zeta potential of (e) bare CNPs, (f) BP@ACNPs, (g) WB@ACNPs, (h) BB@ACNPs.



Supplemental Fig. 3. FTIR spectrum of (a) casein, BP ACN, and BP@ACNPs, (b) casein, WB ACN, and WB@ACNPs, and (c) casein, BB ACN, and BB@ACNPs.



**Supplemental Fig. 4.** HPLC chromatogram of (a) delphinidin 3-glucoside (b) petunidin 3 (c) BP@A-CNPs (d) WB@A-CNPs (e) BB@A-CNPs.

As mentioned in section **3.2.5.**, delphinidin and petunidin are the major anthocyanins in BP, BB, and WB. We have run the standards of these compounds. The ACN was also released from CNPs by the previously mentioned method. The filtered release content was also analyzed by employing HPLC. The observation of major peaks corresponding to delphinidin and minor peaks of petunidin represents the successful encapsulation of anthocyanins in CNPs. Similarly, these peaks were also observed in case of WB.



**Supplemental Fig. 5.** Storage stability study of (a) bare CNPs, (b) BP@ACNPs, (c) WB@ACNPs, and (d) BB@ACNPs at room temperature. Data were expressed as mean  $\pm$  standard deviation (n = 3). Data bars with different superscripts (a-b) present statistically significant differences (p < 0.05).



0 h

1 h

2 h



3 h

5 h

Supplemental Fig. 6. Purified anthocyanin heated at 80 °C for different time intervals



0 h

1 h

2 h



Supplemental Fig. 7. ACNPs heated at 80 °C for different time intervals



Supplemental Fig. 8. Purified anthocyanins exposed to light for 16 h for 28 days at room temperature



0 day

1 day





7 days



14 days



21 days



28 days

Supplemental Fig. 9. ACNPs exposed to light for 16 h for 28 days at room temperature



Supplemental Fig. 10. Purified anthocyanin at different pH incubated in dark for 6 h at 4°C



Supplemental Fig. 11. ACNPs at different pH incubated in dark for 6 h at 4°C