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MICROENCAPSULATION OF PEANUT SKIN POLYPHENOLS: APPLICATION OF PEANUT PROTEIN ISOLATE AS ENCAPSULATING AGENT

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INTRODUCTION & AIM

Peanut skin is a rich source of polyphenols, and the expeller enables protein isolate (PPI) production. Combining maltodextrin (MD) with proteins may improve encapsulation performance. Although PPI has several applications, its use as an encapsulating agent remains unexplored. This study assessed the physicochemical properties of microcapsules containing peanut skin polyphenols, using MD and PPI as encapsulating agents.

METHOD

Peanut skin extract (PSE) was obtained via ethanol–water maceration (70:30 v/v). MD and PPI were mixed for 1 h at ratios of 100:0 (F1), 0:100 (F2), 50:50 (F3), 25:75 (F4), and 75:25 (F5), then combined with PSE (20% w/w), homogenized at 10,000 rpm (Ultra Turrax T25), and spray-dried (pump 10%, aspirator 100%, 160 °C inlet, 400 L/h airflow, Mini Spray Dryer Büchi B-290) (**Figure 1**).

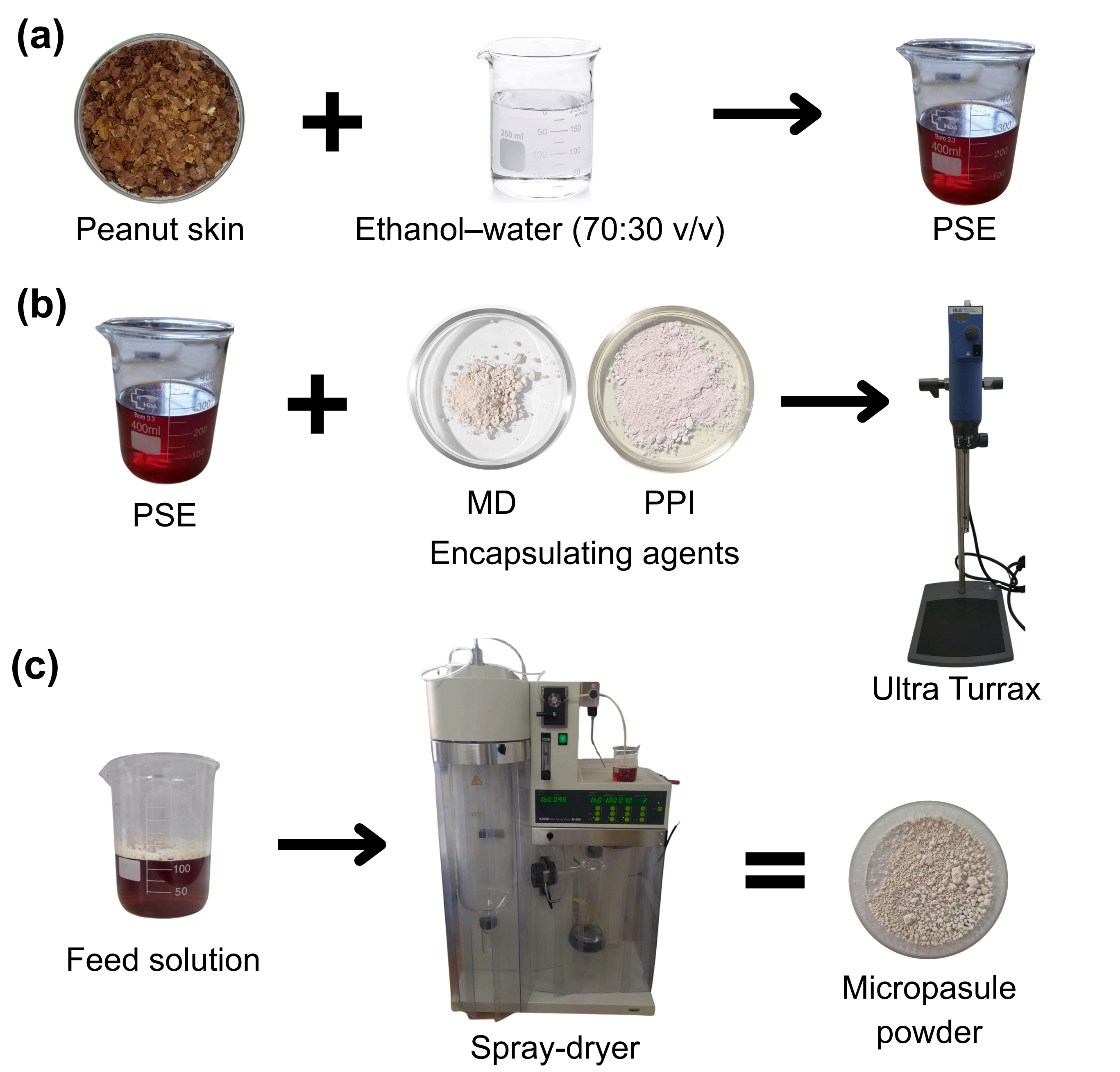

Figure 1. Schematic procedure for the preparation of the microcapsule formulations: **(a)** preparation of PSE; **(b)** preparation of feed solutions; **(c)** spray-drying process.

RESULTS & DISCUSION

F1 showed the highest DY% and solubility, followed by F5, with significant reductions as PPI increased, reaching the lowest values in F2. EE% was highest in F1 and F5 ($p < 0.05$), but all formulations exceeded 88%, indicating acceptable performance[1]. Bulk density decreased with more PPI, while F4 and F1 showed the highest particle densities and porosities. Wettability increased from 7.28 min (F1) to 33.17 min (F2), and F3 had the highest hygroscopicity. This results were similarly reported by Mahdi et al.[2]. Moisture (4.28-5.31%) and tapped density (0.31-0.42 g cm^{-3}) did not show significant differences ($p > 0.05$) (**Table 1**).

Table 1. Physicochemical characterization of microcapsules.

Sample	Drying yield (DY%)	Encapsulation efficiency (EE%)	Bulk density (g cm^{-3})	Particle density (g cm^{-3})
F1	80.51±0.33c	99.26±0.43d	0.31±0.01d	2.51±0.00c
F2	39.92±3.20a	91.80±1.95ab	0.20±0.00a	1.25±0.00a
F3	30.67±0.04a	88.09±0.27a	0.25±0.00c	1.26±0.00b
F4	39.59±7.78a	94.08±3.45bc	0.23±0.00b	2.51±0.00c
F5	68.99±2.22b	97.61±0.28cd	0.26±0.01c	1.25±0.00a

Sample	Porosity (%)	Wettability (min)	Solubility (%)	Hygroscopicity (%)
F1	83.12±0.38b	7.28±0.25a	91.44±1.14 e	11.39±0.47a
F2	76.98±4.01ab	33.17±0.41d	33.51±0.59a	11.64±0.65ab
F3	70.32±6.14a	27.58±0.63c	69.80±0.70c	13.01±0.05c
F4	87.59±0.82b	28.33±0.21c	52.62±2.31b	11.92±0.37ab
F5	67.91±6.19a	20.90±0.54b	77.79±1.28d	12.57±0.04bc

Different letter within column indicate significant differences (ANOVA, Fisher's LSD test, $\alpha = 0.05$).

CONCLUSION

MD exhibited the most favorable encapsulation properties. Using PPI alone affected key technological parameters, while MD:PPI blends showed acceptable encapsulation performance. These findings highlight their potential as antioxidant delivery systems for food preservation.

REFERENCES

[1] Zhao, M., et al. (2022). *Front. Nutr.*, 9, 1007863.
[2] Mahdi, A. A., et al. (2020). *Int. J. Biol. Macromol.*, 152, 1125–1134.