Supplementary Materials for

Fabrication, Characterization, and Microbial Biodegradation of Transparent Nanodehydrated-Bioplastic (NDBs) Membranes (NDBs) Using Novel Casting, Dehydration, and Peeling Techniques

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Section S1. The management plan for production of the nanodehydrated-bioplastic (NDB) membranes.

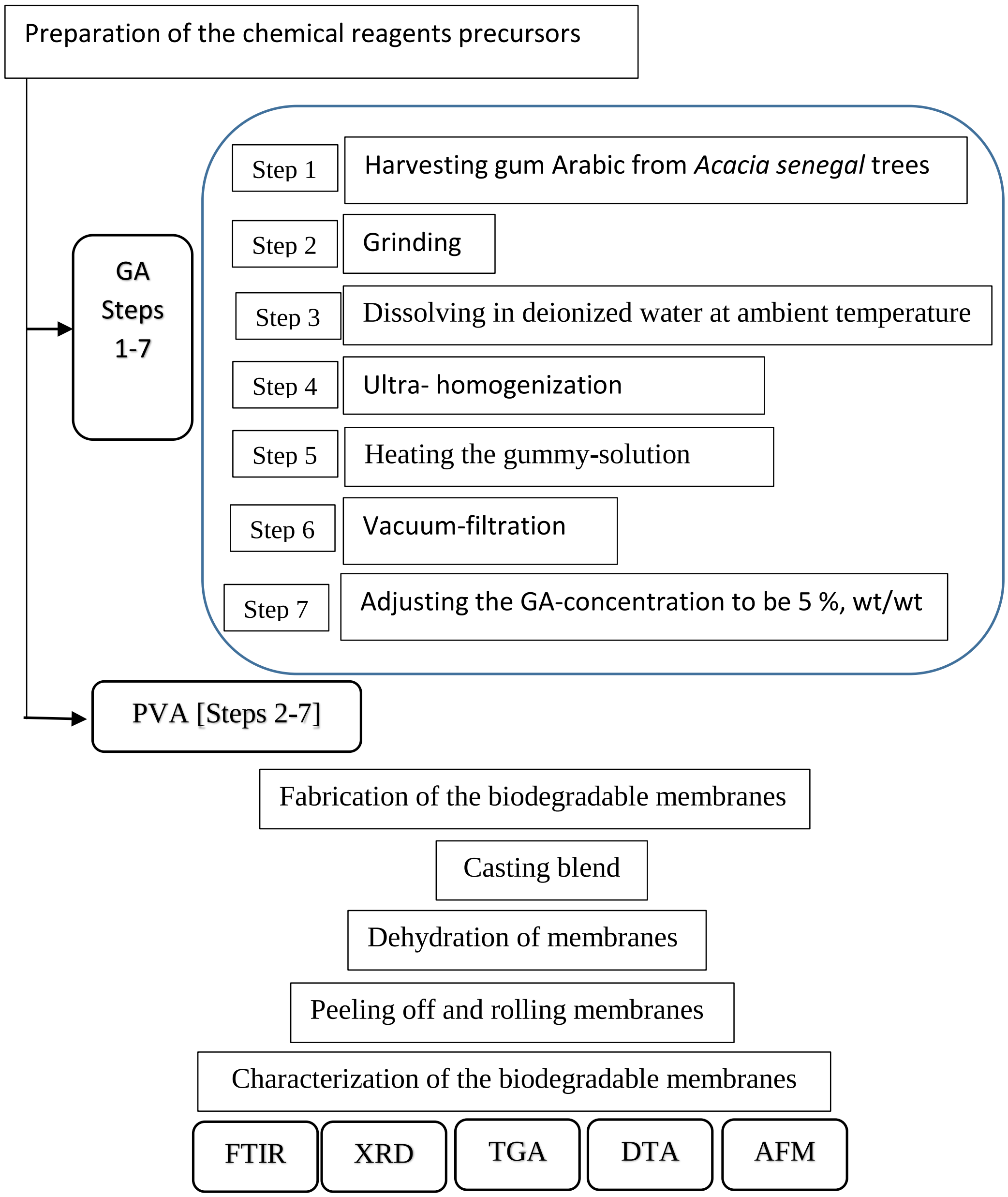

Fig. S1. The management plan performed to study the efficiency of the novel manufacturing processes (vibrational casting, nano-dehydration, and self-electrostatic peeling) on the quality of the NDB membranes.

Section S2. The Casting Technique Steps

Mixing a pre-determined concentrations of GA and PVA via continuous stirring to obtain a homogenous blend solution.

Preparing and cleaning the casting panel and adjusting its slope angle to accelerate fluid movement of the blend solution.

Irradiation of the hydrophobic casting panel (Poly(methyl methacrylate) using UV-waves to: 1) activate its electrostatic charges, and 2) worming up the panel up to 50 ^{o}C

Working vibrational forces on the casting panel.

Pouring the blind onto the vibrated hot casting panel in a definite velocity.

Applying a mild air drying of the molten polymeric membrane to thicken its viscosity.

Performing the accurate novel nano-dehydration technique using the novel stratified air-dryer apparatus.

Peeling off the bioplastic membrane from the casting panels and rolling it.

Fig. S2. The practical procedure used for the novel casting of the bioplastic blends.

Section S3. The machinery of the novel casting method.

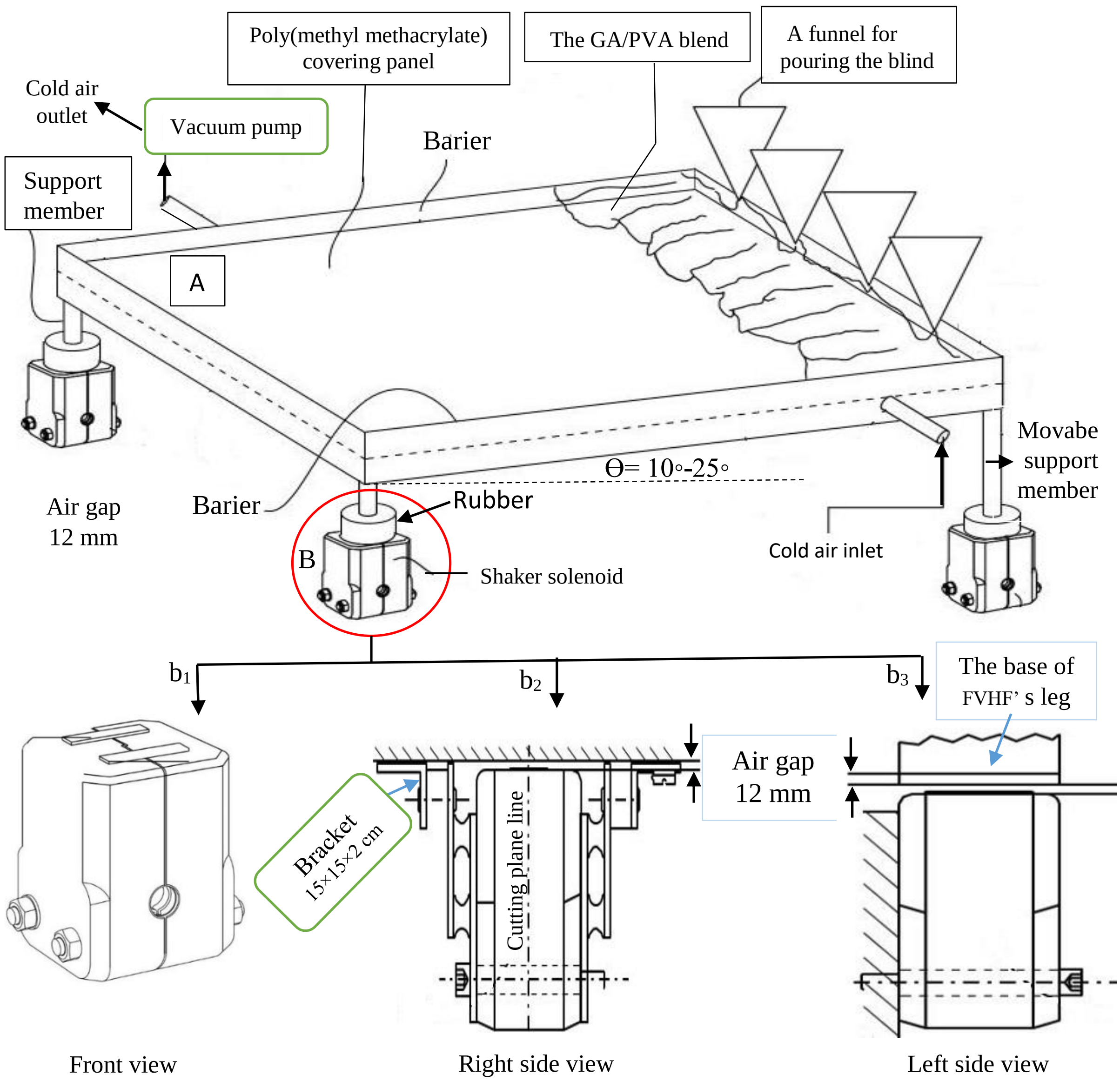

Fig. S3. The casting process of the polymeric blends: A) the novel free vibrated-horizontal flow (FVHF) apparatus, and B) the magnetic vibrating system (shaker solenoid): b_1) front view; b_2) right side view showing the operational air gap (12 mm, thickness); b_3) left side view [57].

Section S4. Chemophysical features of the polymers used in the bioplastic fabrication.

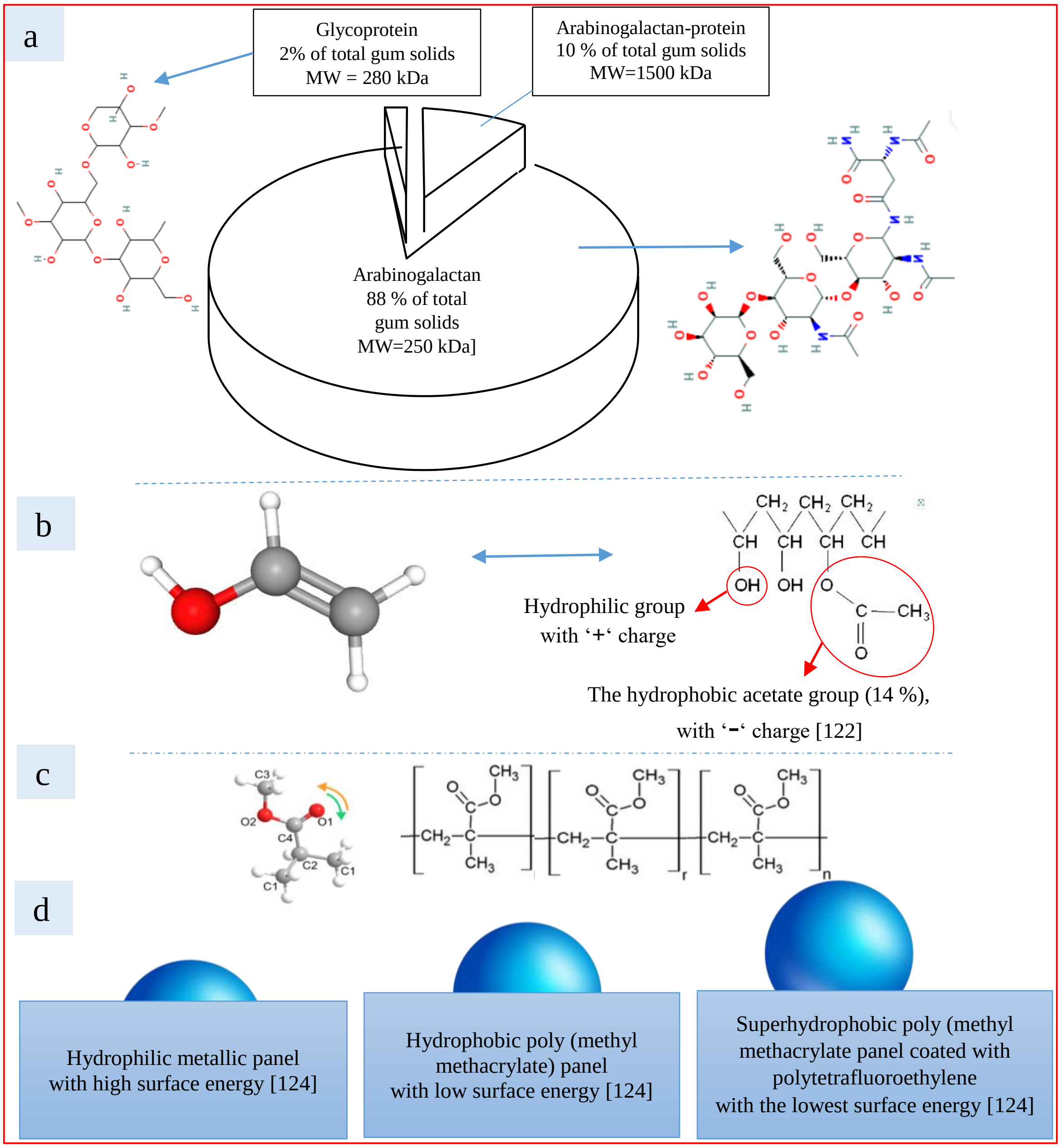

Figure S4. Chemical and physical features of the polymers used in manufacturing the NDB-membranes: a) gum Arabic (GA) precursor, b) polyvinyl alcohol (PVA) precursor, c) [poly(methyl methacrylate), PMMA] [57,93,122,114-118].

Section S5. Wettability of different types of plastics.

Table S5. Surface energy and contact angle of the most important industrial polymers [124].

Polymer abbreviation	Polymer name	Surface energy dynes/cm	Contact angle degree^{-1}
PVCp	Polyvinyl chloride, plasticized	53	89
PPO	Polyphenytene oxide	47	75
PES	Polyethersulfone	46	90
PC	Polycarbonate	46	75
PET	Polyethylene terephthalate	42	76
PMMA	Poly (methyl methacrylate)	41	82
Pes	Polyester	41	70
SAN	Styrene acrylonitrile	40	74
PI	Polyimide	40	83
PVCr	Polyvinyl chloride, rigid	39	90
PPS	Polyphenylene sulfide	38	87
PU	Polyurethane	38	85
PVA	Polyvinyl alcohol	37	10
ABS	Acrylonitrile butadiene styrene	35	82
PS	Polystyrene	34	72
PBT	Polybutylene teraphthalate	32	88
PP	Polypropylene	30	88
PE	Polyethylene fluoride	30	88
PDMS	Polydimethyl siloxane (silicone elastomer)	23	98
NR	Natural rubber	24	n.d.
PVDF	Polyvinytidene fluoride	25	80
FEP	Fluorinated ethylene propylene	20	98
PTFE	Polytetrafluoroethytene	19	120

n.d.: not defined.

Section S6. Thermogravimetric analysis (TGA) nanodehydrated-bioplastic (NDM) membranes

Table S6. Calculating [1-3] means [4,5] of mass loss (M_L) of the NDB membranes blended from gum Arabic (GA) and polyvinyl alcohol (PVA) in the six ratios and different temperature zones (T-zones).

T-zones °C	Mass loss (%)					
	GA/PVA ratio					
	1:0	1:0.25	1:0.5	1:0.75	1:1	0:1
50°-100°	I_W[6]. 15.64 F_W[7]. 13.5 M_L. 13.68	I_W. 9.62 F_W. 9.18 M_L. 4.57	I_W. 16.5 F_W. 15.7 M_L. 4.85	I_W. 15.95 F_W. 15.15 M_L. 5.02	I_W. 12.24 F_W. 11.6 M_L.5.23	I_W. 12.99 F_W. 12.25 M_L. 5.69
100°-150°	I_W. 13.5 F_W. 12 M_L. 11.11	I_W. 9.18 F_W. 8.6 M_L. 6.32	I_W. 15.7 F_W. 14.7 M_L. 6.37	I_W. 15.15 F_W. 14.1 M_L. 6.93	I_W. 11.6 F_W. 10.85 M_L. 6.47	I_W. 12.25 F_W. 11.15 M_L. 8.98
150-200°	I_W. 12 F_W. 11.5 M_L. 4.18	I_W. 8.6 F_W. 8.18 M_L. 4.88	I_W. 14.7 F_W. 13.75 M_L. 6.46	I_W. 14.1 F_W. 13.5 M_L. 4.26	I_W. 10.85 F_W. 10.5 M_L. 3.23	I_W. 11.15 F_W. 10.25 M_L. 8.07
200°-250°	I_W. 11.5 F_W. 10.7 M_L. 6.96	I_W. 8.18 F_W..7.64 M_L. 8.18	I_W. 13.75 F_W. 12.9 M_L. 6.18	I_W. 13.5 F_W. 13 M_L. 3.7	I_W. 10.5 F_W. 9.9 M_L. 5.71	I_W. 10.25 F_W. 9.85 M_L.3.9
250°-300°	I_W. 10.7 F_W. 9.9 M_L. 7.48	I_W. 7.64 F_W. 6.5 M_L.14.9	I_W. 12.9 F_W. 11.3 M_L. 7.36	I_W. 13 F_W. 11.6 M_L. 10.77	I_W. 9.9 F_W. 8.75 M_L. 11.62	I_W. 9.85 F_W. 8.85 M_L. 10.15
300°-350°	I_W. 9.9 F_W. 7.7 M_L. 22.2	I_W. 6.5 F_W. 5.68 M_L.12.62	I_W. 11.3 F_W. 9.5 M_L. 15.93	I_W. 11.6 F_W. 9 M_L. 22.41	I_W. 8.75 F_W. 6.25 ML. 28.57	I_W. 8.85 F_W. 7.25 M_L. 18.08
350°-400°	I_W. 7.7 F_W. 6.3 M_L. 18.2	I_W. 5.68 F_W.4.48 M_L.21.13	I_W. 9.5 F_W. 7 M_L. 26.32	I_W. 9 F_W. 6 M_L. 33.3	I_W. 6.25 F_W. 4.1 M_L. 34.4	I_W. 7.25 F_W. 4.05 M_L. 44.14
400°-450°	I_W. 6.3 F_W. 4.5 M_L. 28.6	I_W. 4.48 F_W. 3.24 M_L.27.68	I_W. 7 F_W. 4.1 mg M_L. 41.43	I_W. 6 F_W. 3.65 M_L. 39.17	I_W. 4.1 F_W. 2.2 M_L. 46.34	I_W. 4.05 F_W. 0.85 M_L. 79.01
450°-500°	I_W. 4.5 F_W. 3.8 M_L. 15.6	I_W. 3.24 F_W. 2.64 M_L.18.52	I_W. 4.1 F_W. 3.2 M_L. 21.95	I_W. 3.65 F_W. 2.75 M_L. 24.66	I_W. 2.2 F_W. 1.2 M_L. 45.5	I_W. 0.85 F_W. 0.35 M_L. 58.82

[1] Using the following formula: M_L, %= [{(I_W-F_W)/I_W}×100], where
[2] Initial starting weight per mg of the GABM sample.
[3] Final starting weight per mg of the GABM sample.
[4] Each value is an average of 3 samples.
[5] Based on original oven-dry weight.

Section S7. Estimation of pore diameter of the bioplastic membranes.

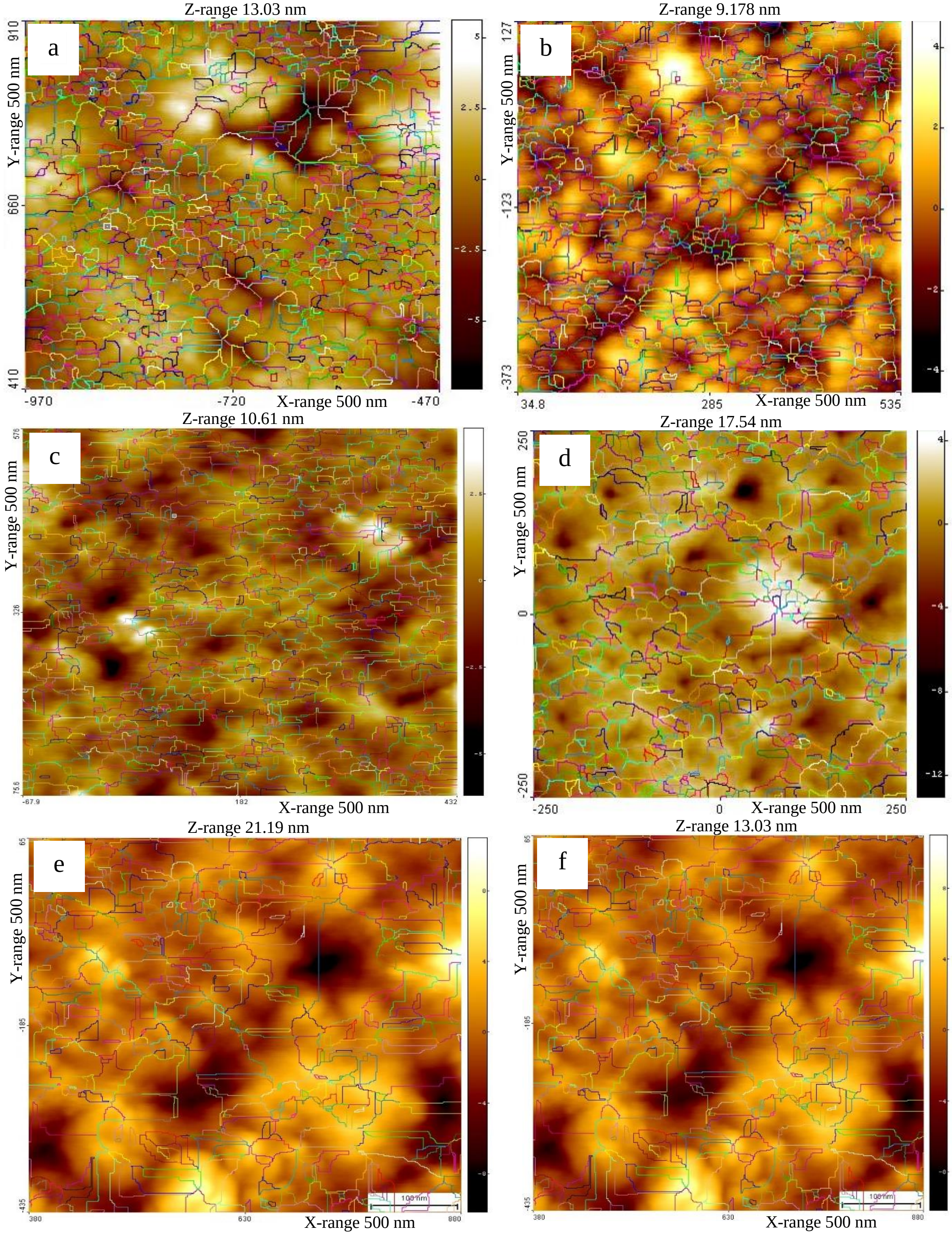

Figure S7. Visualization analysis of pore diameter (PO) of the six nanodehydrated-bioplastic (NDB) membranes (NBMs): a) GA (100%), b) GA/PVA=1:0.25, c) GA/PVA=1:0.5, d), e) GA/PVA=1:0.75, and f) GA/PVA=1:1, and (PVA=100%) based on AFM-image analysis.