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가

California, Davis 2000 10 9 2001 10 7 1
 (Bio. & Agric. Engin.) Dr. John M. Krochta
 (biopolymer) / 가
 Packaging & Biopolymer Film Lab. 10 가
 (whey proteins) /
 가 가 whey protein films
 whey protein coating 가

1.

가

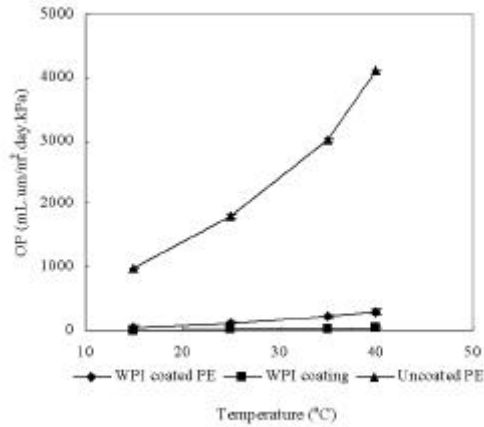
가

가

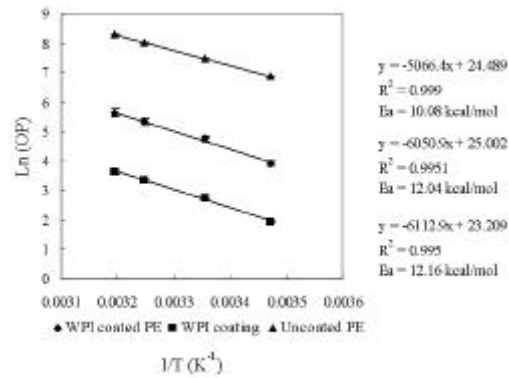
2.

가 . . . 가
 가 . . . 가 polyolefin
 가 polyethylene (LDPE) polypropylene
 (PP) whey protein isolate (WPI) whey
 protein concentrate (WPC)
 가 가
 coating 2
 가 가 . . . coating
 , , (loose-fill) 가 .
 10% WPI 33.3%() glycerol
 가 가 , 90 30 가
 가 LDPE
 .
 가 WPI coated LDPE .
 (coating) 가 polyolefin
 가 WPI 가
 LDPE
 가 whey proteins WPI 가 가 ,
 coating (surface energy) 73
 coating laminating dyne/cm PE 31 dyne/cm
 .
 (laminated/composite films) 가 , 가
 ethylene vinyl alcohol corona
 (EVOH), polyvinylidene chloride copolymers discharge, flame treatment, ozone treatment
 (PVDC), nylon (Ny) .
 whey protein corona discharge가
 .
 whey protein 10% WPI 33.3% glycerol
 , 가 가 90 30 가
 coating/lamination , 25-30 kV/cm, 4-5 MHz
 corona discharge LDPE PP
 whey protein 가
 0.254 mm Bird type applicator

, corona discharge polyolefin (adhesion) whey protein coated film 가 whey protein coated plastic film , 10% WPI 33.3% glycerol sorbitol, sucrose, propylene glycol (PG), polyethylene glycol (PEG) 가 LDPE PP whey protein coating , , , haze 가 가 33.3% 가 coating sorbitol sucrose가 가 mole 0.6 M whey protein 가 coating film whey protein coated plastic WPI coated plastic film (1-3), . 15 40 WPI coated LDPE film 가 Arrhenius 가 50.26 kJ/mol (Table 1). , 가 10 가 가 2 가 가 WPI coated plastic film 가 , 30% 85% 가



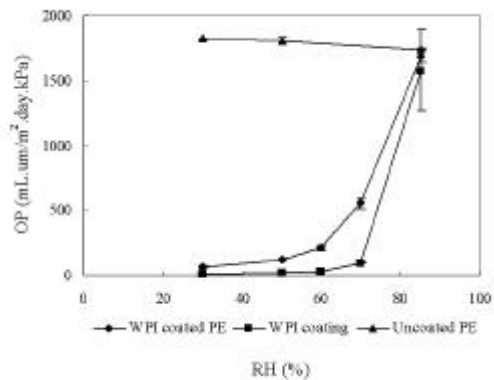
1.



2.

Arrhenius

plot



3.

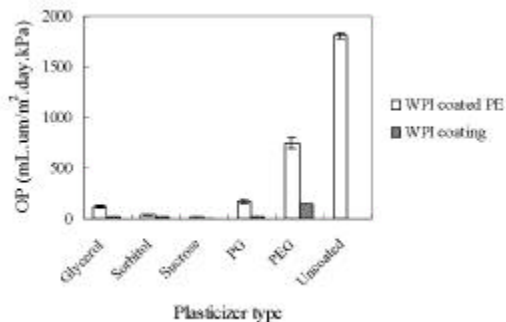
Table 1. Activation energy (E_a), Arrhenius constant (P_0), and determination coefficient (r^2) values calculated by fitting the Arrhenius model to oxygen permeability of LDPE, WPI coated LDPE, and WPI coating films

Film	Thickness ^a (μm)	E_a ^b (kJ/mol)	P_0 ^b $\times 10^9$ ($\text{mL} \cdot \mu\text{m}/\text{m}^2 \cdot \text{day} \cdot \text{kPa}$)	r^2
Uncoated LDPE	53.7 ± 0.9	42.1 ± 0.6	18.8 ± 3.8	0.999
WPI coated LDPE	61.3 ± 0.9	50.3 ± 2.3	31.3 ± 18.7	0.995
WPI coating ^c	8.2 ± 0.9	50.8 ± 1.5	5.2 ± 2.4	0.995

^a Mean values \pm standard deviation.

^b Estimated values \pm standard error (95% confidence interval).

^c Plasticized with 33.3% of glycerol (WPI : glycerol = 2 : 1).

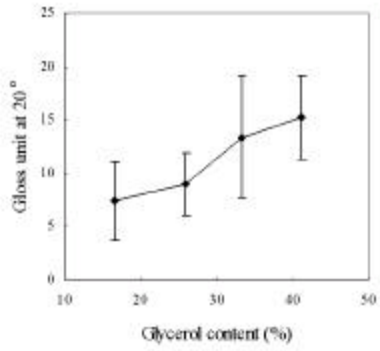


4. 가

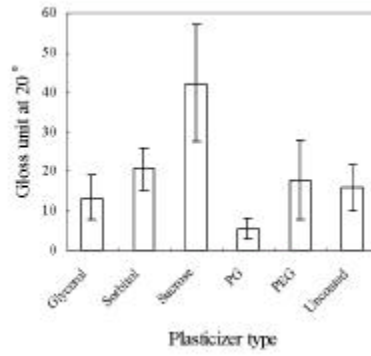
가 WPI coated plastic film (4), sucrose가 가 25, 50% 50.8 μm LDPE 가 1,800 $\text{mL} \cdot \mu\text{m}/\text{m}^2 \cdot \text{day} \cdot \text{kPa}$, 17.8 $\pm 4.9 \mu\text{m}$ sucrose plasticized WPI coating LDPE 10 $\text{mL} \cdot \mu\text{m}/\text{m}^2 \cdot \text{day} \cdot \text{kPa}$ 가 sucrose, sorbitol, glycerol, PG, PEG WPI coating

WPI coated plastic film (gloss) micro-TRI-gloss meter 20, 60. (5-6), 가

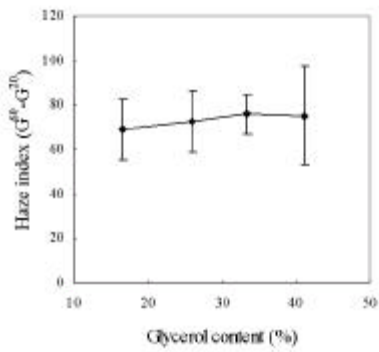
WPI coated plastic film 가 (lamination) 가 가 가 , 가 가



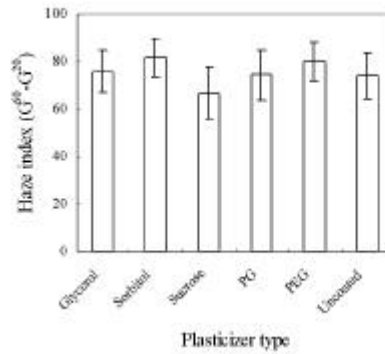
5. 가



6. 가



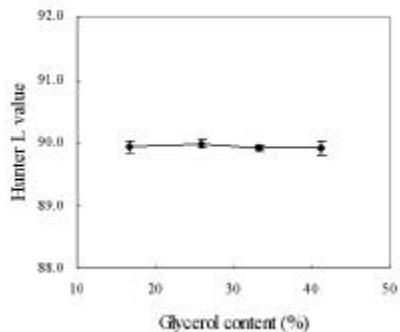
7. Haze 가



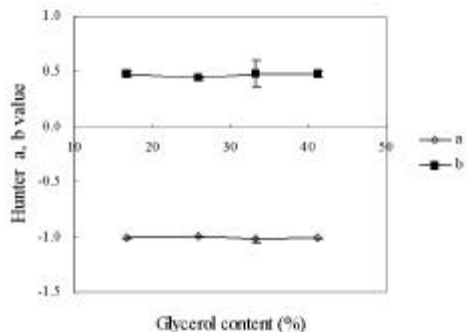
8. Haze 가

sucrose가 plastic film . ASTM D4039 60. 20. ($G^{60}-G^{20}$) haze (7-8), WPI coating 가 . PP WPI coating 가

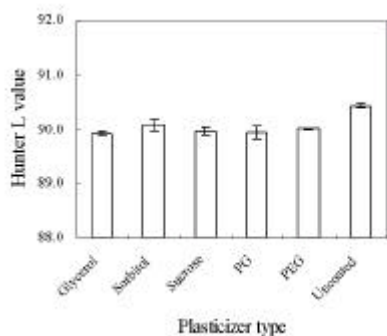
20. 100 G.U. , (double reflection) 가 WPI coating (colorimeter) WPI coated plastic film Hunter L, a, b (9-12), 가 Hunter L, a, b chroma WPI coating hue angle



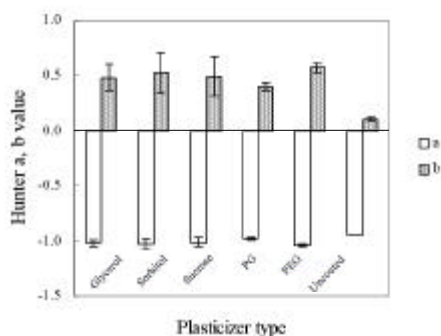
9. 가



10. 가



11. 가



12. 가

가
coating

coating
whey

WPI

WPC
가 WPI

WPI

WPI 가
EVOH

WPC

WPC coated PP film

PP film

WPI coating
Arrhenius

가

80% WPC
가 가 pH

가 gel
WPC coating
corona PP

Bird type applicator

WPC coated

가 가
가

가 48.72 kJ/mol (total
 , 30%-85% RH color difference, ΔE)
 가 가 WPI
 coating WPC coating coated film 1.0 WPC
 WPC 가 coating
 . WPC 가 .
 가 5.0
 sucrose 가 가 , 12.0
 WPI
 WPC coated film Whey protein coated plastic film
 , WPC 가 NaOH
 가 coated film (15 × 15 mm) 23
 가 bicinchoninic acid (BSA)
 WPC coated film , copper sulfate protein assay
 가 WPC kit . 가
 . 가 가 , 0.5 N
 , 20. NaOH coated film whey
 WPC coated film 75 G.U. protein 가 PP
 . 가 15 , LDPE
 가 sucrose 30 90%
 가 WPC coating 가 . 가 1
 , 가 sucrose가 가가
 (n²⁰; glycerol: 1.4746, whey protein
 PG: 1.4324, PEG: 1.4590, sorbitol: 1.5105,
 sucrose: 1.5376)
 .
 , , 3.
 ,
 WPC coating 가 WPI 가
 가 whey proteins
 . Coating haze coating
 WPC 가 가 coating laminating
 , sucrose 가
 WPI WPC coating . Whey
 . WPC coated film protein 가 가 가
 corona discharge

