FIG. 1

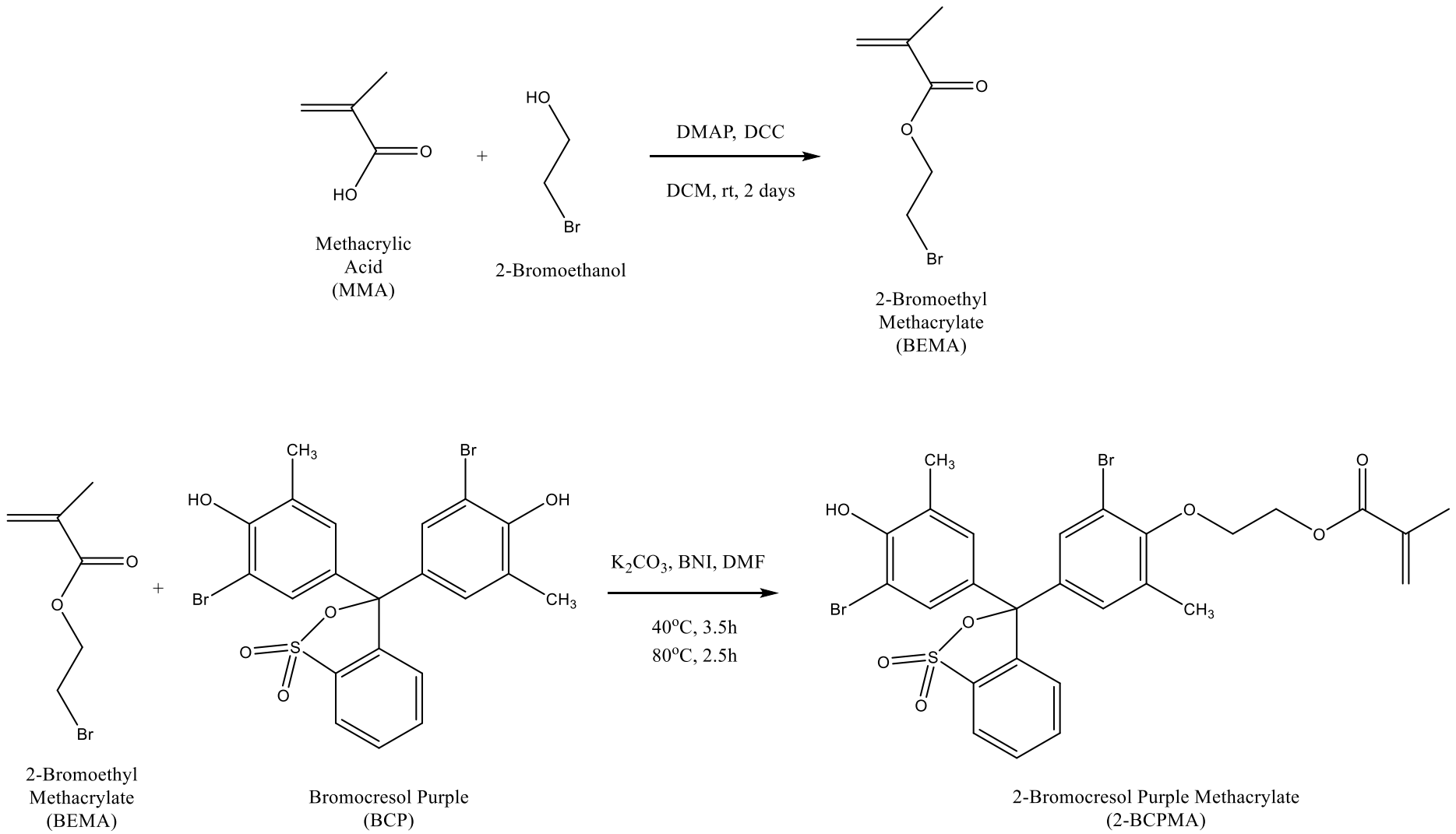
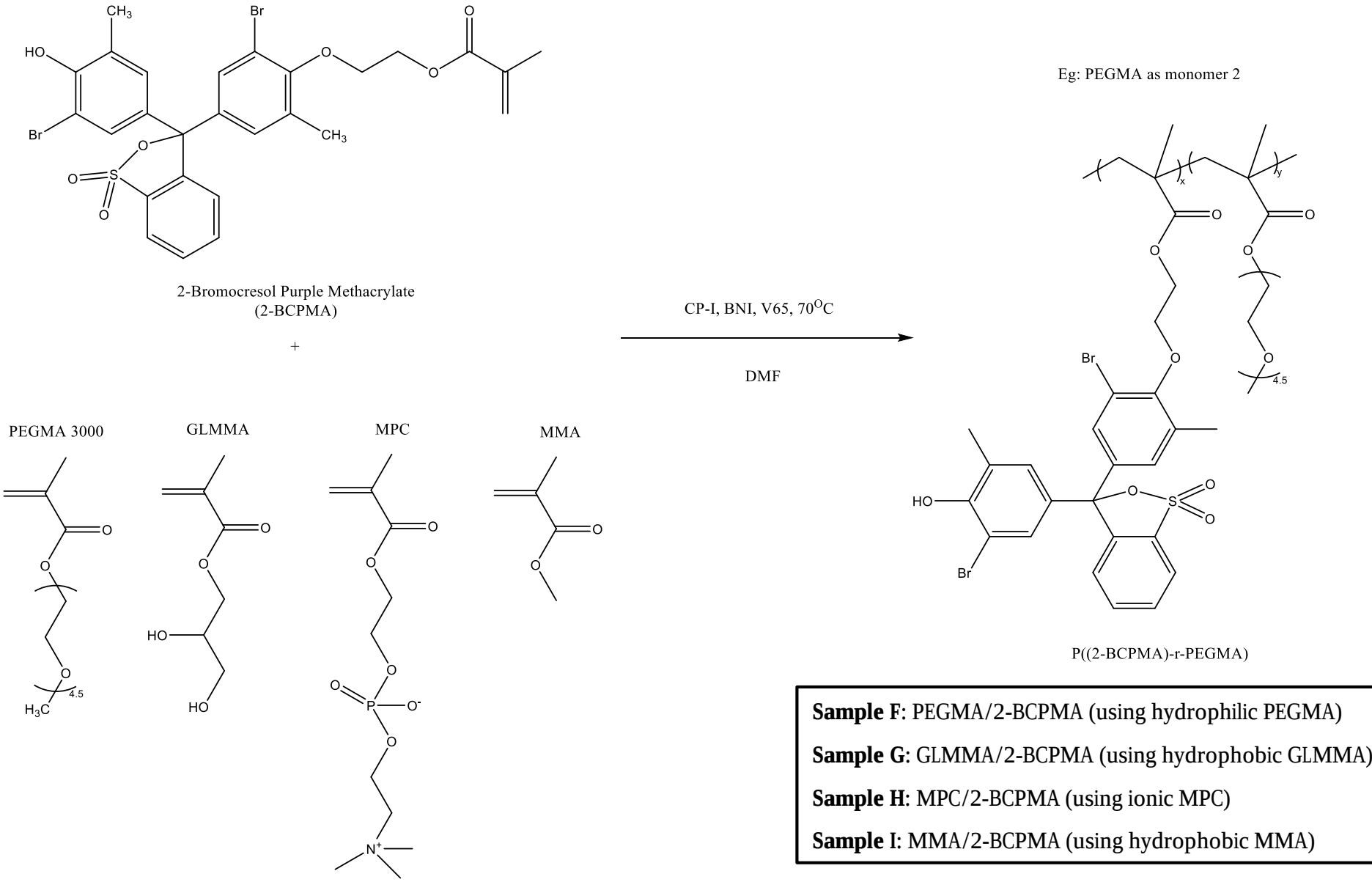

HO
O
HO
Methacrylic Acid (MMA)
+
HO
Br
2-Bromoethanol
DMAP, DCC
DCM, rt, 2 days
O
O
Br
2-Bromoethyl Methacrylate (BEMA)
O
O
Br
2-Bromoethyl Methacrylate (BEMA)
+
CH3
Br
HO
OH
Br
CH3
O
O
S
O
Bromocresol Purple (BCP)
K2CO3, BNI, DMF
40°C, 3.5h
80°C, 2.5h
CH3
Br
HO
O
O
Br
CH3
O
O
S
O
2-Bromocresol Purple Methacrylate (2-BCPMA)

FIG. 2



Sample F: PEGMA/2-BCPMA (using hydrophilic PEGMA)

Sample G: GLMMA/2-BCPMA (using hydrophobic GLMMA)

Sample H: MPC/2-BCPMA (using ionic MPC)

Sample I: MMA/2-BCPMA (using hydrophobic MMA)

FIG. 3

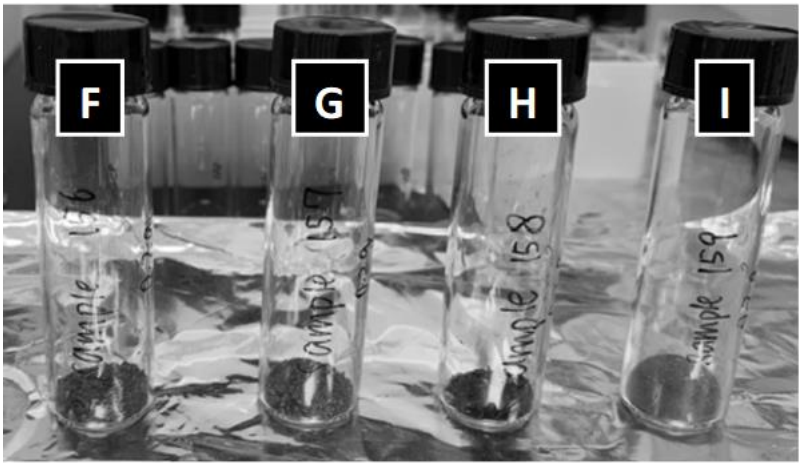


FIG. 4

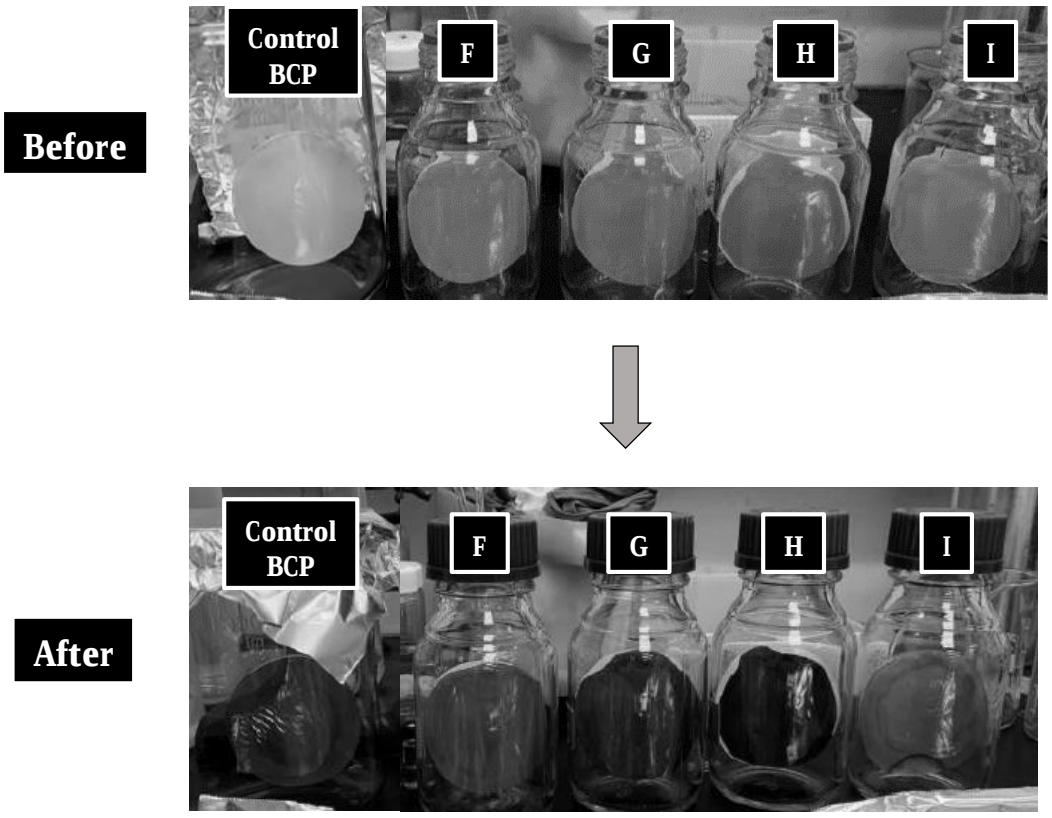


FIG. 5

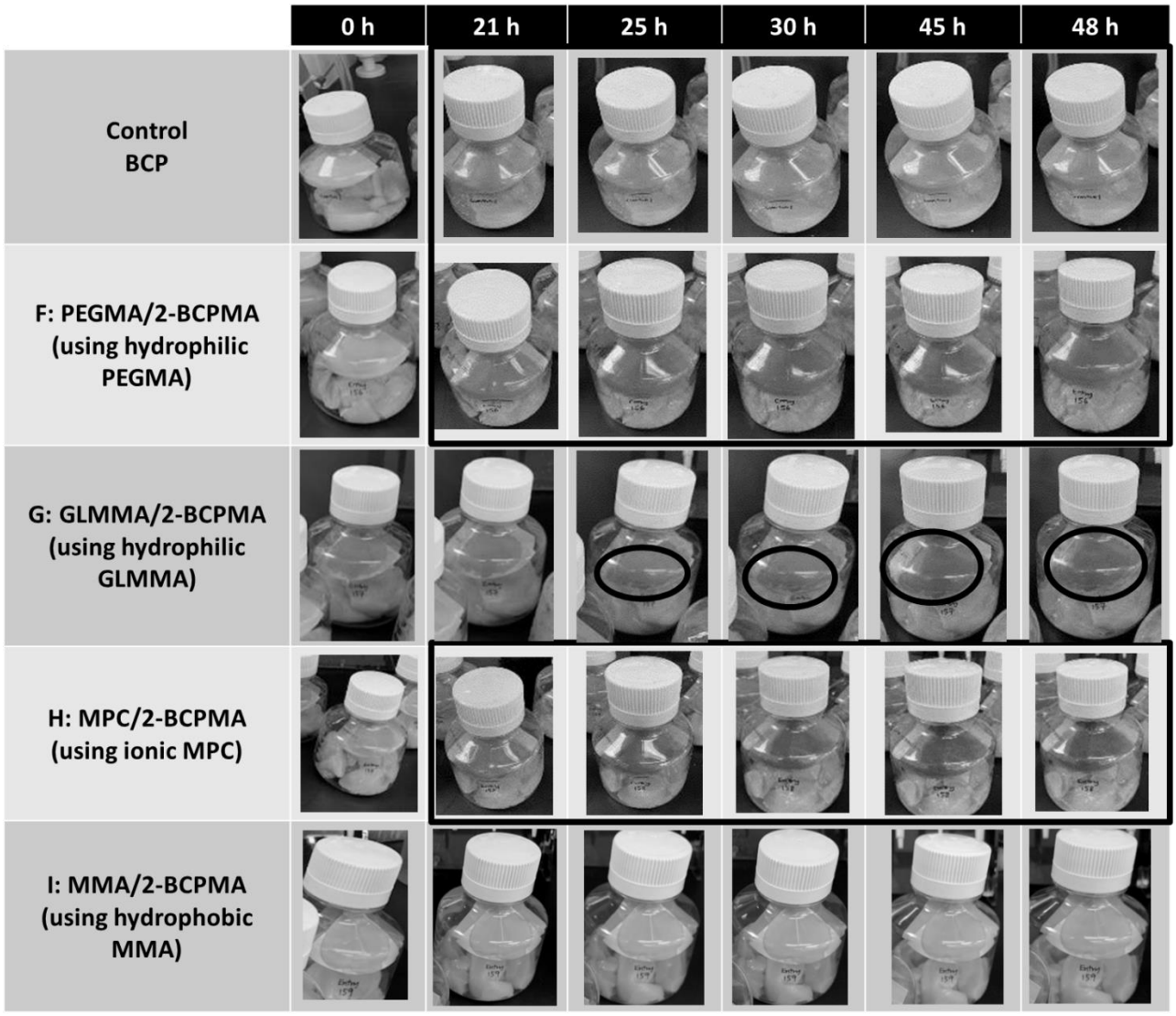

0 h
21 h
25 h
30 h
45 h
48 h
Control
BCP
F: PEGMA/2-BCPMA
(using hydrophilic
PEGMA)
G: GLMMA/2-BCPMA
(using hydrophilic
GLMMA)
H: MPC/2-BCPMA
(using ionic MPC)
I: MMA/2-BCPMA
(using hydrophobic
MMA)

FIG. 6

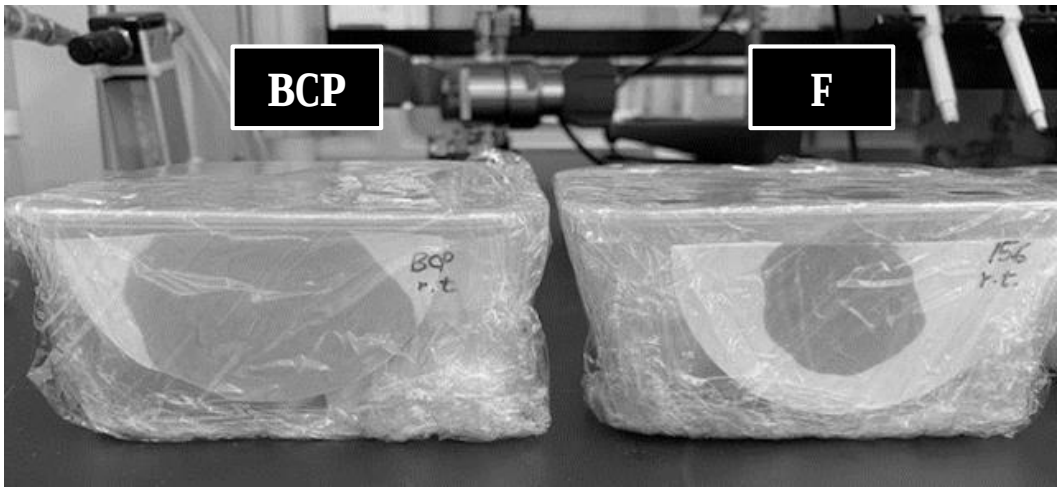


FIG. 7

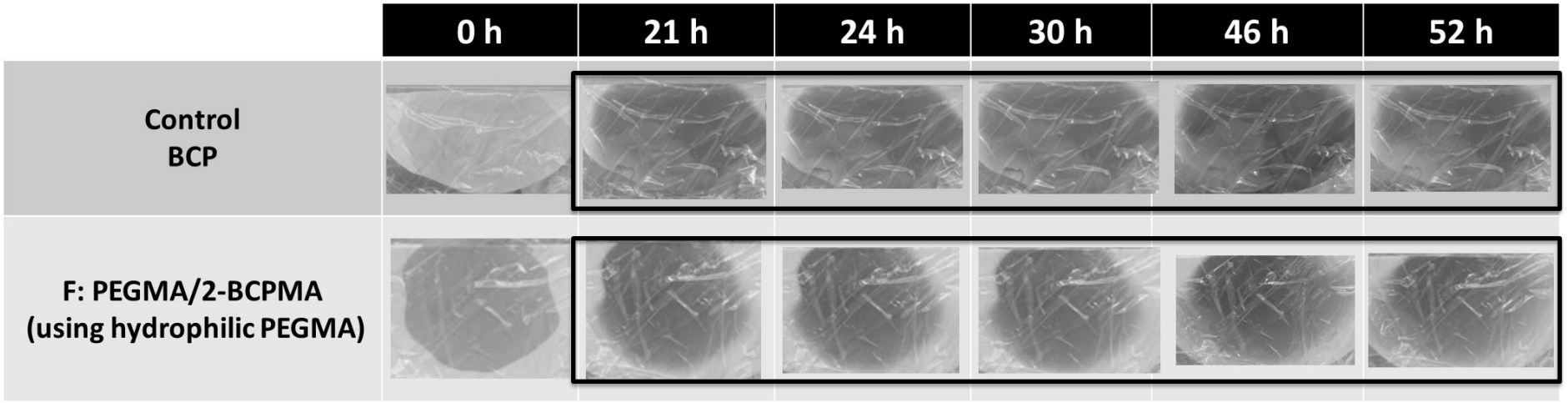
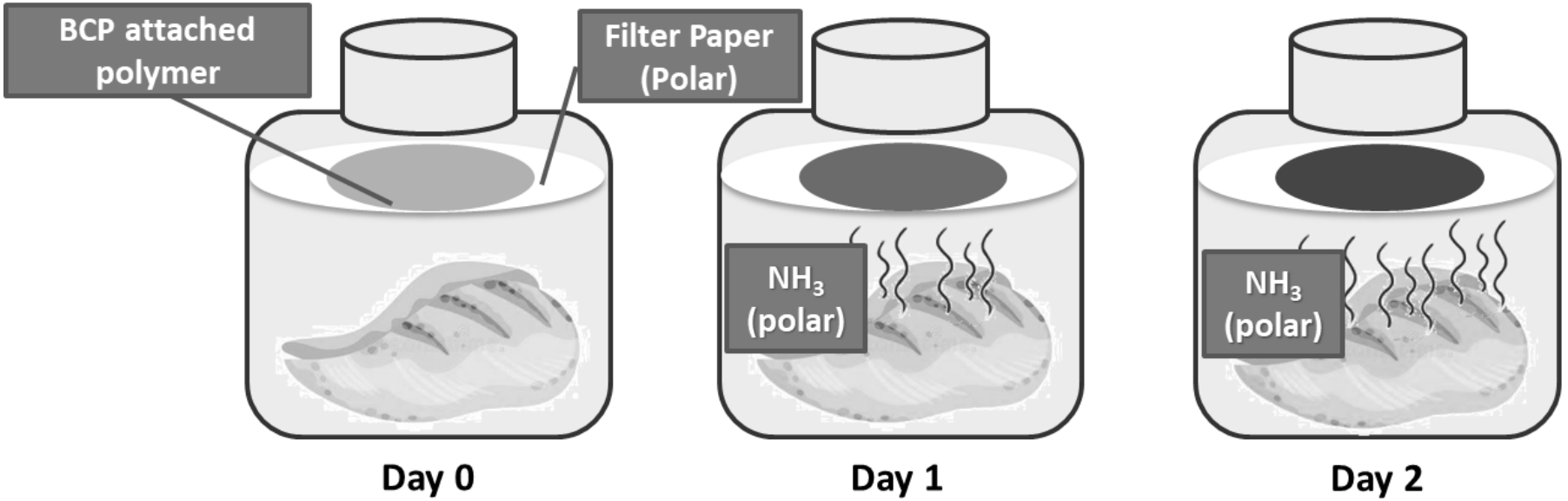

0 h
21 h
24 h
30 h
46 h
52 h
Control
BCP
F: PEGMA/2-BCPMA
(using hydrophilic PEGMA)

FIG. 8



Sample F : PEGMA/2-BCPMA (using hydrophilic PEGMA)

Sample G: GLMMA/2-BCPMA (using hydrophilic GLMMA)

Sample H: MPC/2-BCPMA (using ionic MPC)

Sample I: MMA/2-BCPMA (using hydrophobic MMA)

FIG. 9

Co-polymer	Water Contact Angle (From Lit. Search)	Colour changes observed on spoilt chicken breast
F: PEGMA/2-BCPMA (using **hydrophilic** PEGMA)	5.4° – 39.8°	✓
G: GLMMA/2-BCPMA (using **hydrophilic** GLMMA)	44°	✓
H: MPC/2-BCPMA (using **ionic** MPC)	0°	✓
I: MMA/2-BCPMA (using **hydrophobic** MMA)	67.8°	X

FIG. 10

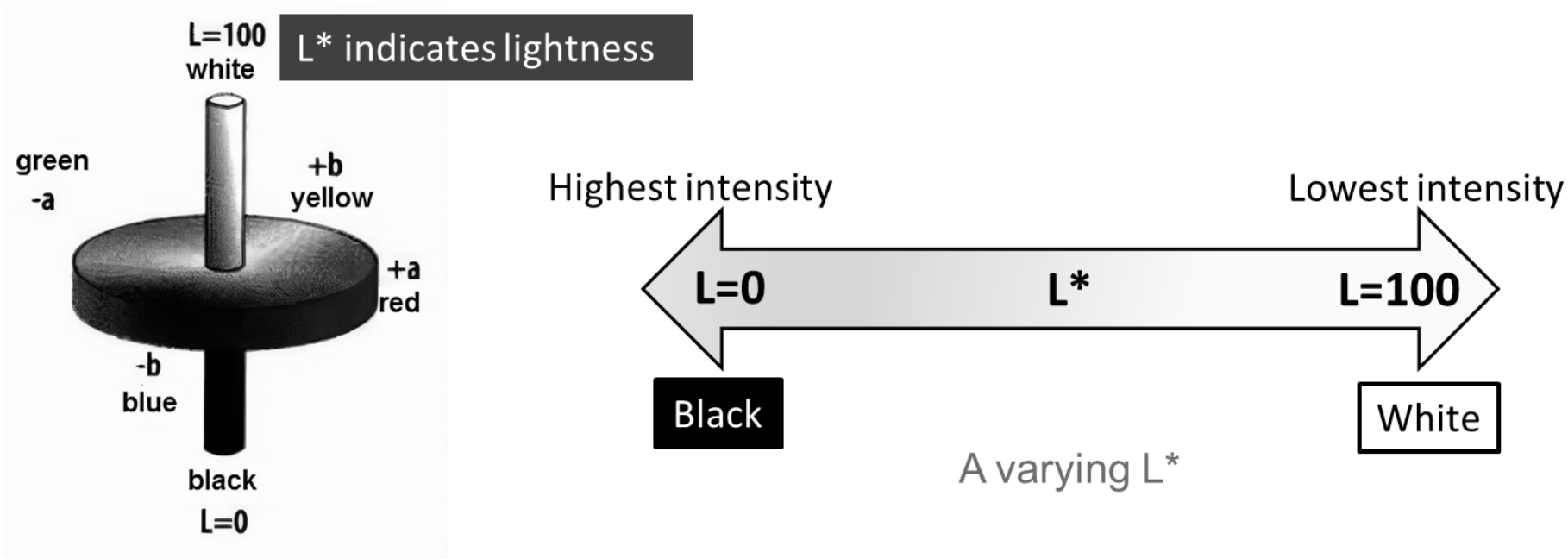
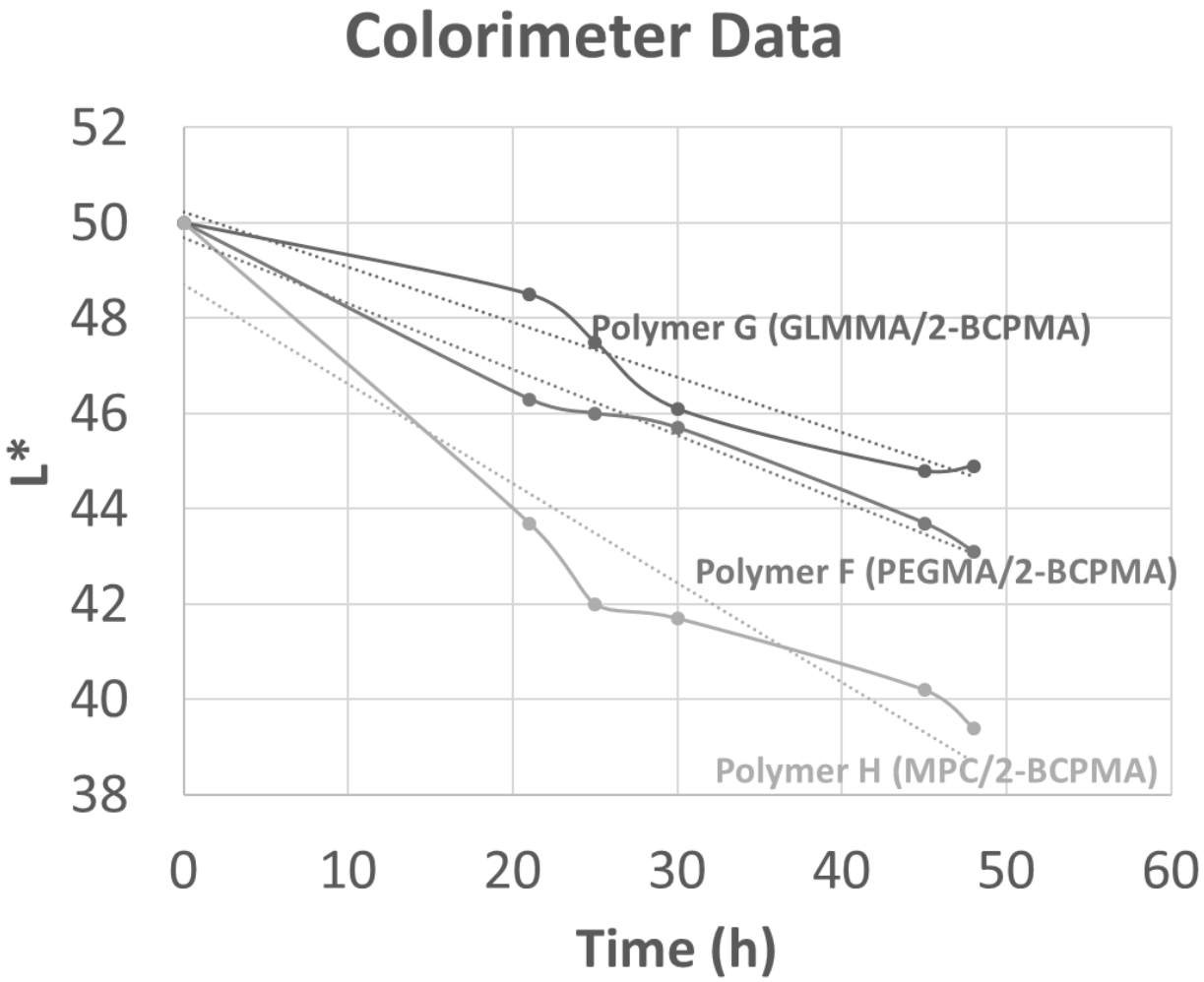

L=100
white
L* indicates lightness
green
-a
+b
yellow
+a
red
-b
blue
black
L=0
Highest intensity
Lowest intensity
L=0
L*
L=100
Black
White
A varying L*

FIG. 11



Colour changing degree

Polymer C > Polymer A > Polymer B

FIG. 12

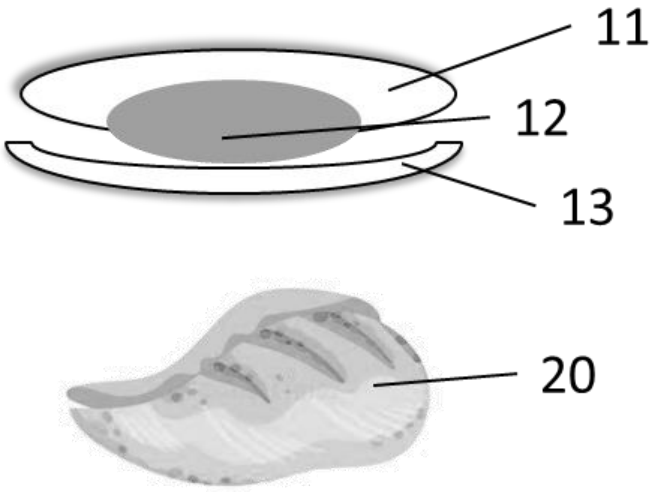


FIG. 13





Dried in oven at 50°C until it is completely dried

Wrap it with PE Plastic

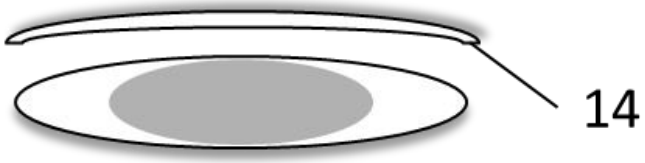


FIG. 14

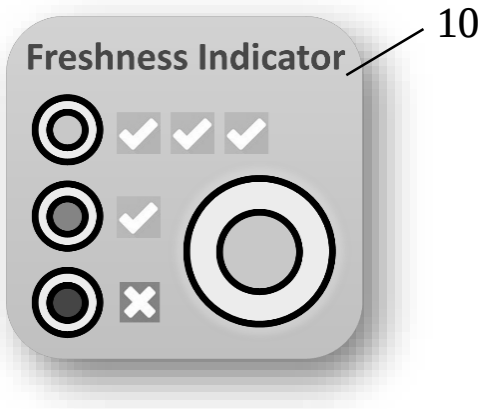

Freshness Indicator
10

FIG. 15

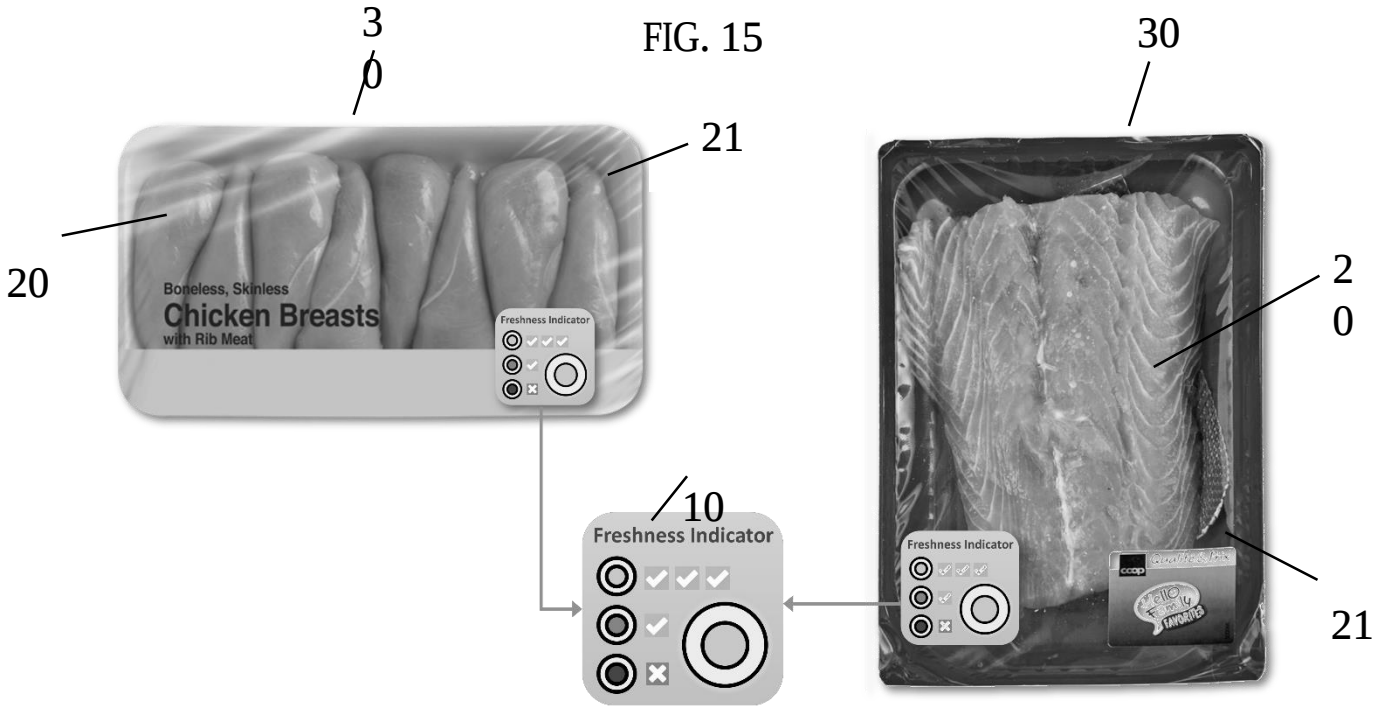

3
0
21
20
Boneless, Skinless
Chicken Breasts
with Rib Meat
Freshness Indicator
10
Freshness Indicator
30
2
0
Freshness Indicator
21

FIG. 16

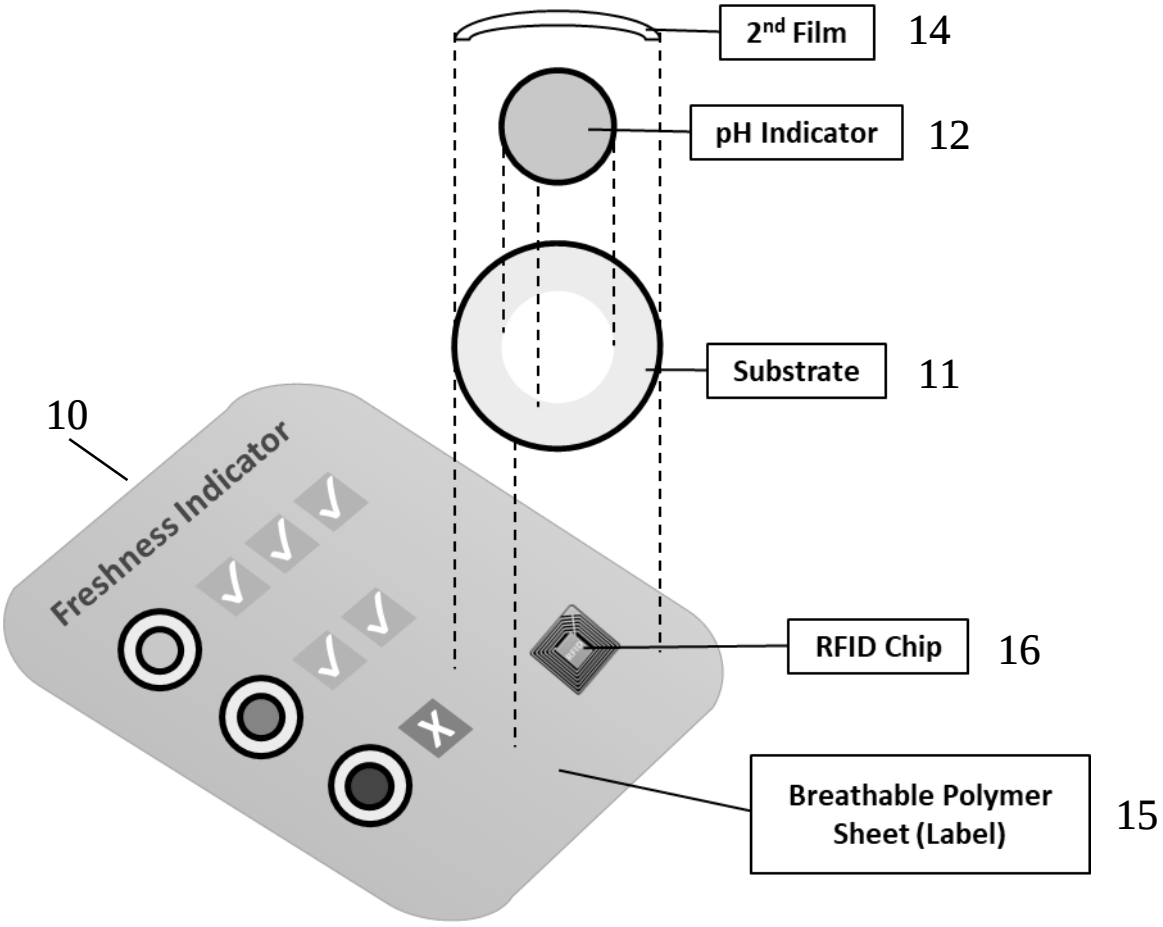

2nd Film
14
pH Indicator
12
Substrate
11
10
Freshness Indicator
RFID Chip
16
Breathable Polymer Sheet (Label)
15

FIG. 17

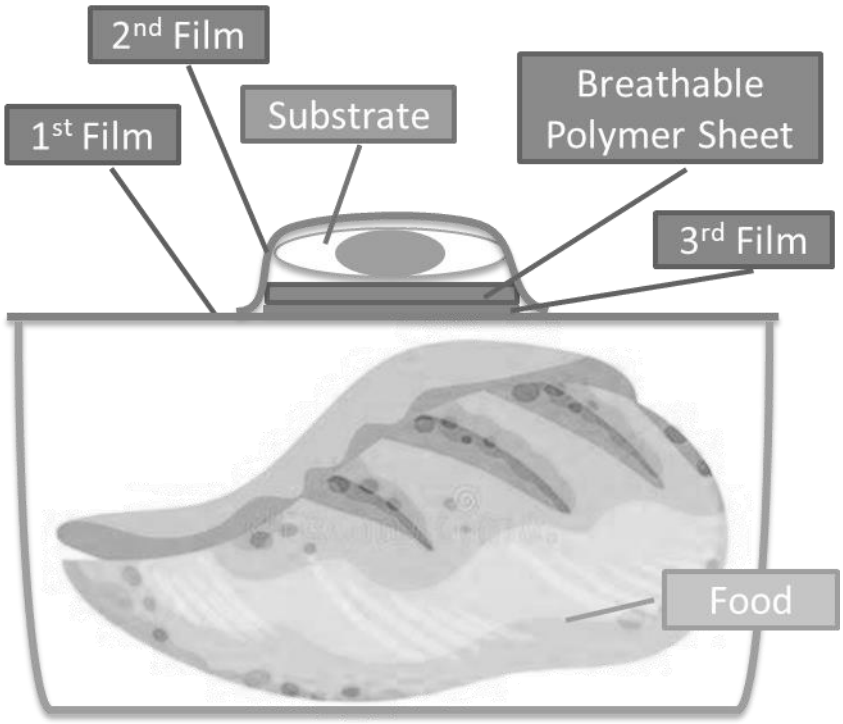
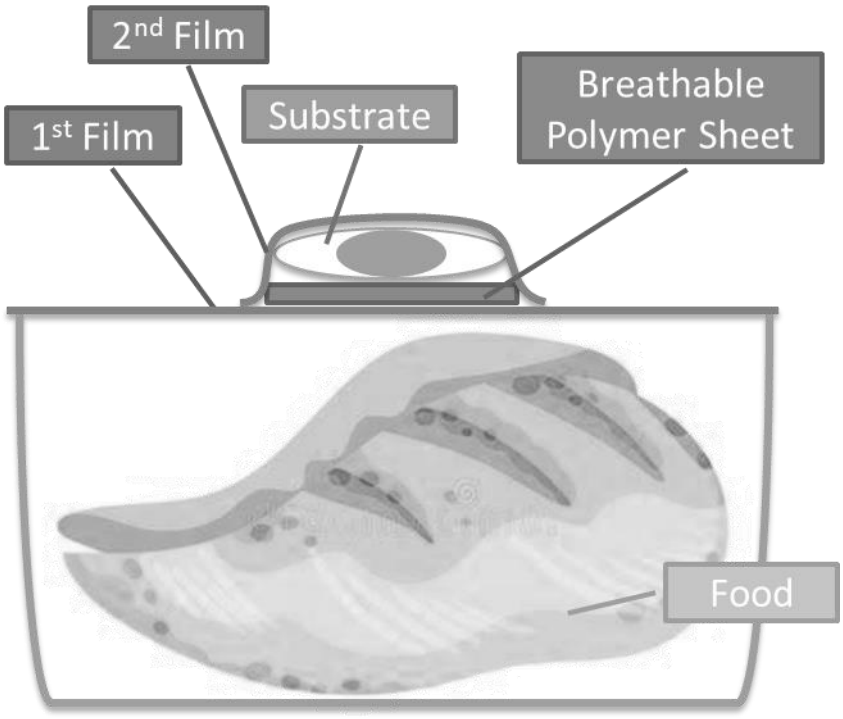

2nd Film
1st Film
Substrate
Breathable Polymer Sheet
3rd Film
Food

FIG. 18


2nd Film
1st Film
Substrate
Breathable Polymer Sheet
Food