

Supplemental Material - Kim and Hu 2022

Soohwan Kim¹ and David L. Hu^{1,2}

¹Schools of Mechanical Engineering, Georgia Institute of Technology

²School of Biology, Georgia Institute of Technology

In the main text, we presented fermentation experiments with salted cabbage. In the supplement, we include experimental results with unsalted cabbage. For unsalted cabbage, respiration comes primarily from plant cells rather than fermentation by bacteria.

6 Supplementary Figures

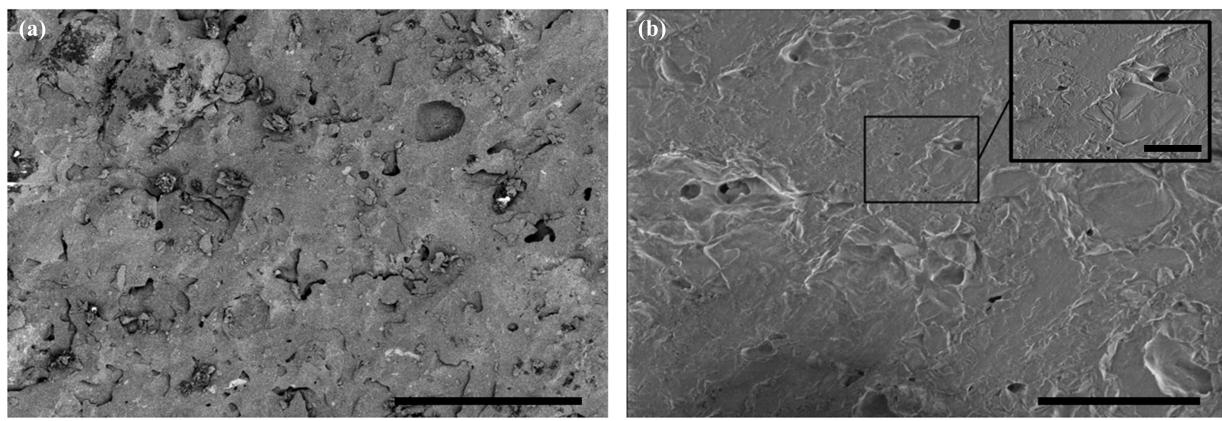


Figure S1: Additional cross-sectional SEM views of micro-pores in onggi. (a) The left sample is prepared using a rough electric saw (scale bar, 100 μm) and (b) the right sample was prepared with a diamond wafering blade (scale bar 50 μm and scale bar in the inset in 10 μm).

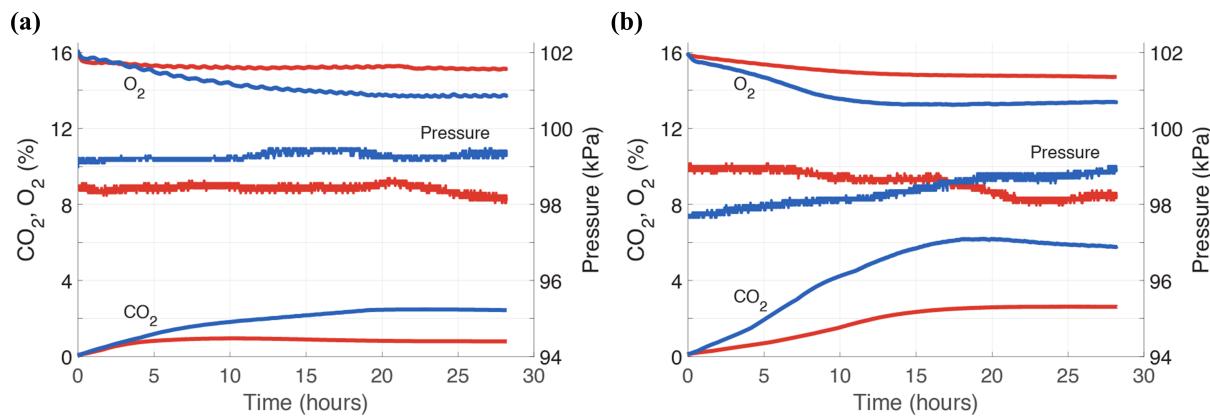


Figure S2: Headspace measurement raw data of carbon dioxide, oxygen, and pressure during (a) respiration of unsalted Napa cabbage and (b) fermentation of salted cabbage (red: onggi, blue: glass).

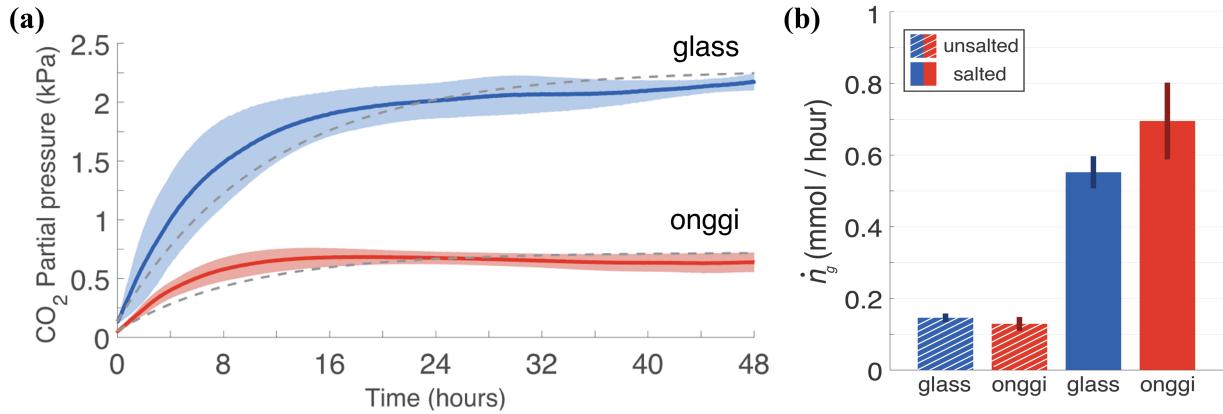


Figure S3: (a) Time course of the carbon dioxide partial pressure for 200 g of unsalted cabbage stored in glass (in blue) and onggi (in red). Solid lines are from the experiment and the dashed lines are from fitting. Unsalted cabbage generates carbon dioxide through respiration while salted cabbage generates carbon dioxide through fermentation. (b) Comparison of carbon dioxide generation rates across experiments. Salted cabbage generated 4-5 times more carbon dioxide than its unsalted counterpart.

7 Supplementary Tables

Geometric parameters		
	Onggi	Glass
V , volume of container (m ³)	4.60×10^{-3}	1.90×10^{-3}
A , side surface area of container (m ²)	6.28×10^{-2}	4.71×10^{-2}
d , thickness of container wall (m)	0.005	0.005
R , radius of container mouth (m)	0.09	0.1
z_r , water level for evaporation test (m)	0.1	-
r , representative pore radius (μm)	5	-
d_p , representative pore diameter (μm)	10	-
ϵ , porosity (%)	4.72	-
Fluid properties		
ρ_{water} , water density (kg/m ³)	997	
μ_{water} , water viscosity (Pa·s)	1.00×10^{-3}	
ρ_{CO_2} , carbon dioxide density (kg/m ³)	1.87	
μ_{CO_2} , carbon dioxide viscosity (Pa·s)	1.47×10^{-5}	
σ , water surface tension (N/m)	7.20×10^{-2}	
θ , water contact angle (°)	30	
Atmospheric conditions		
P_0 , ambient pressure (kPa)	101.325	
T_0 , ambient temperature (°C)	25	
R_0 , gas constant (Pa·m ³ /mol·K)	8.314	
$C_{\text{CO}_2,0}$, initial concentration of carbon dioxide (ppm)	925 ± 452	
p_{out} , initial partial pressure of carbon dioxide (kPa)	0.094 ± 0.046	

Table S1: Geometric parameters, fluid properties, and atmospheric conditions used in the analysis

⁸ **Supplementary Movies**

⁹ **Supplementary Movie 1** Time lapse of kimchi fermentation for 7 days ($\times 30,000$). Scale bar 30
¹⁰ mm. A dramatic volume change accompanied by carbon dioxide bubble formation was observed.
¹¹ [link here](#)

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¹³ **Supplementary Movie 2.** Time-lapse of salt flower for 24 hours ($\times 10,000$) in a macroscopic view.
¹⁴ Scale bar 50 mm. A layer of white salt crystals appears on the outer surface and intensifies over
¹⁵ time. [link here](#)

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¹⁷ **Supplementary Movie 3.** Time-lapse of salt flower for 2 days ($\times 10,000$) in a microscopic view.
¹⁸ Scale bar 200 μm . Onggi piece is immersed in salty water at the bottom, while the top is exposed
¹⁹ to air. Salty water flows through the pores, driven by surface tension. The salt crystals form at
²⁰ the top surface as the liquid evaporates. [link here](#)

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²² **Supplementary Movie 4.** Time-lapse of salt flower for 24 hours ($\times 3,000$) in a microscopic view.
²³ Scale bar 500 μm . Onggi piece is immersed in salty water at the bottom, while the top is exposed
²⁴ to air. [link here](#)

²⁵
²⁶ **Supplementary Movie 5.** 3D model of an onggi piece with numerous pores using CT scan (scale
²⁷ bar, 1 mm). [link here](#)