

Online Resource 1

Article: Optimization of passive modified atmosphere packaging to preserve physical and nutritional quality of ready-to-eat immature faba

bean seeds

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Estimated oxygen and carbon-dioxide transmission rates (OTR, CO₂TR) and CO₂TR/OTR ratio (β) of the six BOPP films used in this study, computed as the intrinsic film permeance plus the diffusive transmission through the 100- μ m laser microperforations, the latter modelled as steady-state Fickian diffusion in air (see Section 2.1) [27, 28]. Values are model estimates at ≈ 23 °C and 1 atm; at 5 °C they are ≈ 9 % lower. The per-pore ratio used in the respiratory-quotient calculation (Section 3.1.1) is $\beta = \text{CO}_2\text{TR}/\text{OTR} \approx 0.78$; the values tabulated here are package-level ratios, which include the intrinsic film permeance and therefore increase as the number of perforations decreases.

Film	Perforations	OTR (cm ³ O ₂ d ⁻¹ atm ⁻¹)	CO ₂ TR (cm ³ CO ₂ d ⁻¹ atm ⁻¹)	β (CO ₂ TR/OTR)
A	1 $\times$ 5 mm macro-hole	$\approx 6.7 \times 10^3$ ^a	$\approx 5.3 \times 10^3$ ^a	0.80
B	28	3757	3043	0.81
C	14	1894	1584	0.84
D	9	1229	1063	0.86
E	5	696	646	0.93
F	0 (continuous)	31	125	4.00

^a Film A carries a single 5-mm macro-perforation whose transmission is edge-diffusion-dominated (approximately proportional to perforation diameter); its OTR and CO₂TR are therefore order-of-magnitude estimates about two orders of magnitude above the microperforated films, keeping the headspace near-atmospheric.