

**Table S1.** The ingredients of Comirnaty and Spikevax COVID-19 vaccine.

Ingredients	Comirnaty (original)	Comirnaty (updated)	Spikevax
mRNA	Nucleoside-modified mRNA encoding the S glycoprotein of SARS-CoV-2		Nucleoside-modified mRNA encoding the S glycoprotein of SARS-CoV-2
Lipid	2[(polyethylene glycol (PEG))-2000]-N, N-ditetradecylacetamide		PEG2000-DMG
	1,2-distearoyl-sn-glycero-3-phosphocholine Cholesterol (plant derived) ((4-hydroxybutyl) azanediyl) bis(hexane-6,1-diyl) bis(2-hexyldecanoate)		1,2-distearoyl-sn-glycero-3-phosphocholine BotaniChol® SM-102
Other Ingredients	Dibasic sodium phosphate dihydrate		Sodium acetate
	Monobasic potassium phosphate	Sucrose (table sugar)	Sucrose (basic table sugar)
	Potassium chloride (common food salt)	Tromethamine	Tromethamine
	Sodium chloride (basic table salt)	Tromethamine hydrochloride	Tromethamine hydrochloride
	Sucrose (basic table sugar)		Acetic acid (the main ingredient in white household vinegar)

**Table S2.** Bivalent vaccines.

	Developers (Name)	Dose (mRNA) /Volume	Vaccine Composition	Effectiveness against Omicron sub-variants
Pfizer and BioNTech (Comirnaty) Bivalent Booster	Original/Omicron BA.1 bivalent vaccine	30 µg/0.3 mL	15 µg WT+ 15 µg Omicron BA.1 (mRNA)	Higher neutralization activity against BA.2 and BA.5 compared with WT group Decreased neutralization activity against BA.5 [193]
	Omicron BA.4/BA.5-adapted bivalent vaccine	30 µg/0.3 mL	15 µg WT+ 15 µg Omicron BA.4/BA.5 (mRNA)	Higher neutralizing responses against BA.5-derived sublineages (BA.4.6, BQ.1.1, and XBB.1) and BA.2-derived sublineage (BA.2.75.2) compared with the original monovalent vaccine [194]
	BA.1 Omicron- containing vaccine (mRNA-1273.214)	50 µg/0.5mL	25 µg WT+ 25 µg Omicron BA.1 (mRNA)	Elicited neutralizing antibody responses against omicron that were superior to those with original monovalent vaccine [194]
Moderna (Spikevax) Bivalent Booster	BA.4/BA.5 Omicron-containing vaccine (mRNA-1273.222)	50 µg/0.5mL	25 µg WT+ 25 µg Omicron BA.4/BA.5 (mRNA)	Enhanced neutralizing antibody responses against omicron sublineages (BA.1, BA.2.75.2 and BA.5) compared with original monovalent vaccine [195]

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195. Scheaffer, S.M.; Lee, D.; Whitener, B.; Ying, B.; Wu, K.; Liang, C.-Y.; Jani, H.; Martin, P.; Amato, N.J.; Avena, L.E. Bivalent SARS-CoV-2 mRNA vaccines increase breadth of neutralization and protect against the BA. 5 Omicron variant in mice. *Nature medicine* **2023**, 29, 247-257.