



Comparative Analysis of Fat Particle Size in Commercial Infant and Growing up Formulas in Hong Kong

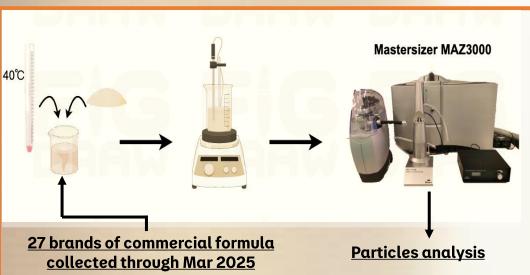
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Background

Human milk (HM) is recognized as the optimal source of nutrition for infants. According to the 'Breastfeeding Survey 2023' by the Department of Health, only 18.2% of infants in Hong Kong are exclusively breastfed at six months¹, suggesting a high prevalence of mixed feeding involving formula. Fat is a crucial energy source in early infancy, yet there are distinct differences in lipids characteristics between HM and infant formula². HM contains large lipid globules, with a mode diameter averaging 3-5 µm surrounded by a complex triple layered phospholipid native membrane³. By contrast, lipids droplets in most conventional formula powders are much smaller, with a mode diameter of 0.5 µm and are mostly protein coated³. This study aims to evaluate the fat particle size in commercially formula powders available in Hong Kong market.

Study design and method



Each brand of formula includes stage 1 infant formula for 0-6 months and stage 3 growing up formula for 1-3 years.

Protein information in milk brands

Intact protein								
No.	Milk brand (Stage 1)	Particle size (µm)	No.	Milk brand (Stage 3)	Particle size (µm)			
1	F 1_stage 1	3.26 ± 0.03	1	F 1_stage 3	3.92 ± 0.01			
2	F 2_stage 1	0.78 ± 0.01	2	F 2_stage 3	0.84 ± 0.01			
3	F 3_stage 1	0.57 ± 0.01	3	F 3_stage 3	0.70 ± 0.03			
4	F 4_stage 1	2.00 ± 0.19	4	F 4_stage 3	1.24 ± 0.03			
5	F 5_stage 1	0.39 ± 0.01	5	F 5_stage 3	0.38 ± 0.01			
6	F 6_stage 1	0.52 ± 0.02	6	F 6_stage 3	0.61 ± 0.01			
7	F 7_stage 1	0.47 ± 0.01	7	F 7_stage 3	0.46 ± 0.01			
8	F 8_stage 1	0.56 ± 0.01	8	F 8_stage 3	0.51 ± 0.01			
9	F 9_stage 1	0.48 ± 0.01	9	F 9_stage 3	0.37 ± 0.01			
10	F 10_stage 1	0.66 ± 0.02	10	F 10_stage 3	0.64 ± 0.02			
11	F 11_stage 1	0.49 ± 0.01	11	F 11_stage 3	0.48 ± 0.01			
12	F 12_stage 1	0.50 ± 0.01	12	F 12_stage 3	0.49 ± 0.01			
13	F 13_stage 1	0.51 ± 0.01	13	F 13_stage 3	0.44 ± 0.01			
14	F 14_stage 1	0.50 ± 0.01	14	F 14_stage 3	0.37 ± 0.01			
15	F 15_stage 1	0.90 ± 0.01	15	F 15_stage 3	1.12 ± 0.05			
16	F 16_stage 1	0.74 ± 0.01	16	F 16_stage 3	0.59 ± 0.01			
17	F 17_stage 1	0.61 ± 0.01	17	F 17_stage 3	0.43 ± 0.01			
18	F 18_stage 1	0.55 ± 0.01	18	F 18_stage 3	0.56 ± 0.01			
19	F 19_stage 1	0.83 ± 0.02	19	F 19_stage 3	0.57 ± 0.01			
20	F 20_stage 1	0.51 ± 0.01	20	F 20_stage 3	1.41 ± 0.01			
			21	F 21_stage 1+	1.36 ± 0.01			
			22	F 21_stage 3+	0.52 ± 0.01			
2Z F 21_stage 3+ 0.32 ± 0.01								

Non-Intact protein								
Milk brand (Stage 1)	Particle size (µm)	No.	Milk brand (Stage 3)	Particle size (µm)				
F 22_stage 1	0.78 ± 0.01	1	F 22_stage 3	0.84 ± 0.01				
F 23_stage 1	0.79 ± 0.01	2	F 23_stage 3	0.72 ± 0.01				
F 24_stage 1	0.91 ± 0.01	3	F 24_stage 3	0.70 ± 0.01				
F 25_stage 1	1.04 ± 0.01	4	F 25_stage 3	0.72 ± 0.01				
F 26_stage 1	0.79 ± 0.01	5	F 26_stage 3	0.49 ± 0.01				
F 27_stage 1	0.86 ± 0.01	6	F 27_stage 3	1.16 ± 0.02				
	F 22_stage 1 F 23_stage 1 F 24_stage 1 F 25_stage 1 F 26_stage 1	Milk brand (Stage 1)Particle size (μm)F 22_stage 1 0.78 ± 0.01 F 23_stage 1 0.79 ± 0.01 F 24_stage 1 0.91 ± 0.01 F 25_stage 1 1.04 ± 0.01 F 26_stage 1 0.79 ± 0.01	Milk brand (Stage 1)Particle size (μm)No.F 22_stage 1 0.78 ± 0.01 1F 23_stage 1 0.79 ± 0.01 2F 24_stage 1 0.91 ± 0.01 3F 25_stage 1 1.04 ± 0.01 4F 26_stage 1 0.79 ± 0.01 5	Milk brand (Stage 1)Particle size (μm)No.Milk brand (Stage 3)F 22_stage 1 0.78 ± 0.01 1F 22_stage 3F 23_stage 1 0.79 ± 0.01 2F 23_stage 3F 24_stage 1 0.91 ± 0.01 3F 24_stage 3F 25_stage 1 1.04 ± 0.01 4F 25_stage 3F 26_stage 1 0.79 ± 0.01 5F 26_stage 3				

Result

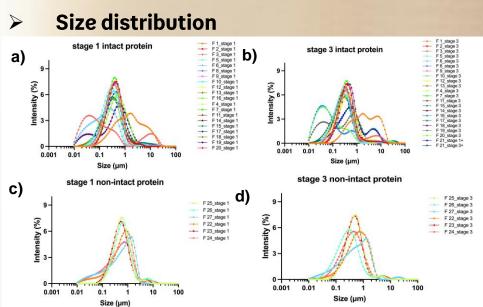


Figure 1: Particle size distribution of commercially available formula powders. a) Stage 1 with intact protein; b) Stage 3 with intact protein; c) Stage 1 with non-intact protein; d) Stage 3 with non-intact protein

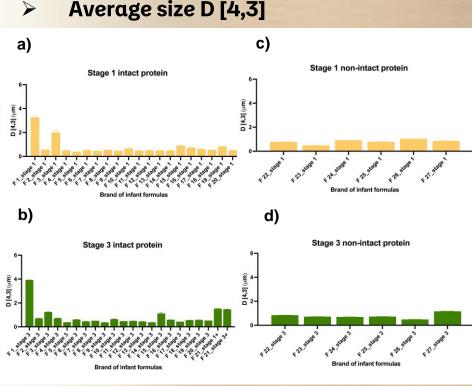


Figure 2: Particle average size of commercially available formula powders. a) Stage 1 with intact protein; b) Stage 3 with intact protein; c) Stage 1 with non-intact protein; d) Stage 3 with non-intact protein

Conclusion

Most commercial formulas contain small lipid particles, with the exception for one brand (F 1) that utilizes a patented controlled process (Nuturis)* resulting in larger lipid size, which is closer to the reported size of human milk fat globule⁴.

^{*} A technology that mimics the 3D lipid globules, larger in size and with phospholipid-coated membrane

