Iranian J Publ Health, Vol. 43, No.12, Dec 2014, pp.1716-1717

Letter to the Editor

Is a Plastic or Glass Feeding Bottle Easier to Be Cleaned?

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(Received 21 Sep 2014; accepted 27 Nov 2014)

Dear Editor-in-Chief

The cleanliness of feeding bottles is vital for child health (1, 2). Because of versatile, light, sturdy, reusable, and cost-efficient, plastic bottles, rather than conventional glass bottles are increasingly being utilized in the reusable feeding bottles. Although the machine cleaning of bottles in the food industry has been established (3, 4), the results may not pertain to the cleaning conducted by people because the mechanical and manual cleaning are highly varied. Therefore, we recruited eight participants to perform a simulated bottle shaking test and found that the glass bottles filled with rinsing water to 2/3 their capacity (among 1/3, 1/2, and 2/3 the capacity of a bottle) reveal the most efficient cleaning performance, whereas the plastic bottles exhibit a relatively poor cleaning result under an identical condition. As expected, the bottle material is a crucial variable for bottle cleaning

The different affinity between formula constituents and bottle materials resulted in different quantities of formula residue remaining in the bottle after a feeding. Organic formula constituents (e.g., proteins, hydrocarbons, and lipids) possess similar hydrophobic properties as PP material does, and the same relationship exists between inorganic formula constituents (e.g., Na^+ Cl^-, K^+, and Fe^{3+}) and glass. Compounds with similar properties are prone to aggregate and repel compounds with opposite properties (5). Both water and inorganic formula constituents are polar compounds; therefore, residual inorganic constituents are soluble in water irrespective of the bottle material. However, the organic cleanliness between the glass and the PP bottles revealed significantly different. The test results corroborated that in the PP bottles; the organic constituents were not only repelled from water because of relatively high hydrophobicity, but also tended to accumulate on the PP bottle interior because of the aggregation of compounds with similar properties. Because of the limit of saturated solubility, higher water volumes caused a greater mass of inorganic constituents to be rinsed from the bottles. The residual organic formula constituents were hydrophobic and difficult to dissolve in water. Therefore, increasing the water volume could promote organic cleanliness in both glass and PP bottles.

If a bottle was intensively used, scratches gradually occurred on the surface of the bottle interior. To gain insight into the morphology of a bottle's interior, the new and used bottles were cut open and observed using an optical microscope (Lien-Sheng 0916014 with Olympus lens UIS2), as shown in Fig. 1. New glass (Fig. 1a) and PP (Fig. 1c) bottles exhibited irregular defects on the interior surface, which were probably incurred during the production process. The used glass bottle had the same irregularities as the new glass bottle did, as demonstrated in Fig. 1b. However, the used PP bottle exhibited numerous scratches on its surface (Fig. 1d). The observation indicated that glass is more scour-resistant than is PP. Both original defects and scouring scratches could trap formula constituents and thus hinder the cleaning process. The extra scratches on the used PP bottle could be one of the reasons that the PP bottle was more difficult to be cleaned than the glass bottle.

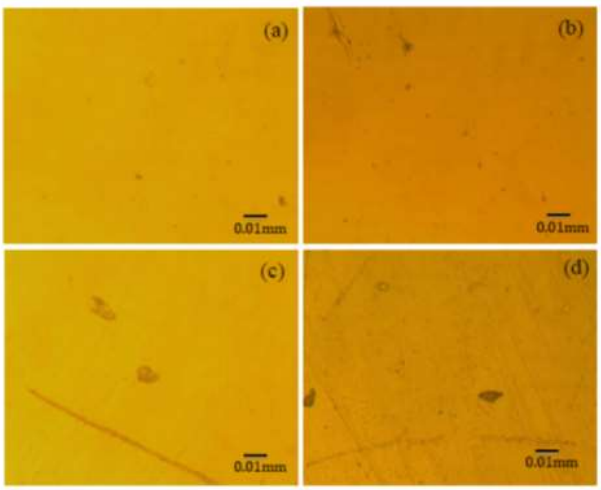

Fig. 1: EM photographs of the interiors of the bottles: (a) new glass bottle, (b) used glass bottle, (c) new PP bottle, and (d) used PP bottle

The bottle material is a crucial variable in the manual water cleaning of bottles. In our test, the glass bottle was superior to the PP bottle in both organic and inorganic cleanliness and organic constituents were more difficult to be rinsed out from the bottle than the inorganic constituents were. Therefore, we suggest that filling glass bottles with water to two-thirds their capacity is the optimal capacity for manual cleaning. Because some formula constituents remained after the simple manual cleaning, we suggested that an auxiliary cleaning tool could be indispensable for child health during nursing.

Acknowledgements

The authors declare that there is no conflict of interests.

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