An assessment of the cleaning properties of the Sinapi Feeding Cup in comparison with normal baby feeding bottles

Dirk U. Bellstedt, Professor in Biochemistry, University of Stellenbosch, South Africa.

Introduction:

The company, Sinapi Biomedical, have recently developed a baby feeding cup to be used instead of the standard baby feeding bottle for feeding human infants with milk. Standard baby bottles are manufactured of polycarbonate whilst the Sinapi feeding cup is made of polypropylene. Besides strength and ease of manufacture, the main reason why standard baby bottles are made of polycarbonate is because of their heat stability which is essential during sterilization and the fact that they are fully translucent allowing unobstructed observation of the contents in the bottle. Polycarbonate, however, possesses strong protein adsorbing properties as a result of which residues can easily be left on the inner bottle surface after cleaning, even in hot water. As opposed to this, polypropylene has far lower protein adsorbtive properties and may be cleaned relatively easily with cold water and mild abrasion.

In this study, trials were performed to compare the effectiveness of different cleaning methods on the polypropylene Sinapi Feeding Cup and the standard polycarbonate baby feeding bottle.

Materials and methods

'Glitterbug Potion' was obtained from Brevis Corporation, USA (www.glitterbug.com) The GlitterBug Potion is formulated firstly as a fluorescent lotion that is used with a UVA lamp making it possible to see how well hands are washed, and secondly as a soluble powder which is used to show bacterial contamination. It is used as a training tool by healthcare providers and the food-handling businesses and provides a valuable tool for teaching proper hand hygiene techniques.

Three groups of unused polypropylene Sinapi Feeding Cups and the standard polycarbonate baby bottles were compared in this experiment. 'Glitterbug Potion' (Brevis Corporation, www.glitterbug.com) was dissolved in full cream milk and the feeding cups and baby bottles were filled to 25% capacity. The containers were then rotated, shaken and inverted to simulate use and then left to dry for 1 hour. Group A was left unwashed, Group B was washed by hand using clean cold water and Group C was washed by hand using warm water, liquid soap, and a dishwashing cloth.

Following this, both the Sinapi Feeding Cups and the standard polycarbonate baby bottles in each of the groups were placed under an 18 W UV fluorescent tube and photographed. As controls unused Sinapi Feeding Cups and baby bottles were inspected under UVA light.

Results

Both the Sinapi Feeding Cups and baby bottles showed fluorescence under a UVA lamp in areas where they were contaminated by bacteria as opposed to unused Sinapi Feeding Cups and baby bottles which showed no fluorescence (photographs of unused Sinapi Feeding Cups and baby bottles not shown).

Those Sinapi Feeding Cups and baby bottles into which milk was placed and that were unwashed are shown in Figure 1 A and Figure 1 B respectively.

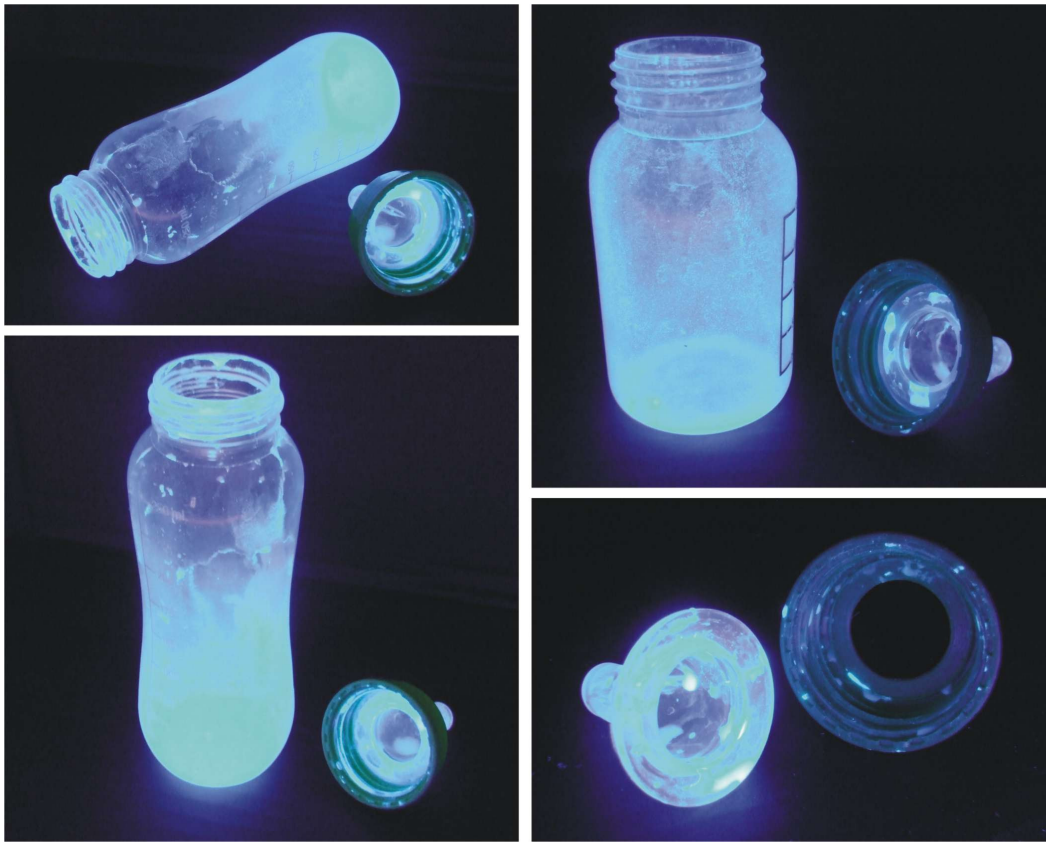

Figure 1 A: Baby bottles into which full cream milk containing ‘Glitter Potion’ was added, allowed to dry and then photographed under UVA light.

Figure 1 B: Sinapi Feeding Cups into which full cream milk containing ‘Glitter Potion’ was added, allowed to dry and then photographed under UVA light.

High fluorescence indicated high numbers of bacteria adhering to the bottom half of both the Sinapi Feeding Cups and baby bottles.

Those Sinapi Feeding Cups and baby bottles into which milk containing ‘Glitter Potion’ was added and that were washed with cold water by hand are shown in Figure 2 A and Figure 2 B respectively.

Figure 2 A: Baby bottles into which full cream milk containing ‘Glitter Potion’ was added, allowed to dry, washed with cold water by hand and then photographed under UVA light.

Figure 2 B: Sinapi Feeding Cups into which full cream milk containing ‘Glitter Potion’ was added, allowed to dry, washed with cold water by hand and then photographed under UVA light.

Lower levels of fluorescence indicate lower yet significant numbers of bacteria adhering to the baby bottles that were washed with cold water by hand. With the exception of

occasional small spots, no fluorescence can be seen in the Sinapi feeding cups that were washed with cold water and hand action only indicating very low levels of bacterial contamination.

Those Sinapi Feeding Cups and baby bottles that were washed with warm water using a cloth by hand are shown in Figure 3 A and Figure 3 B respectively.

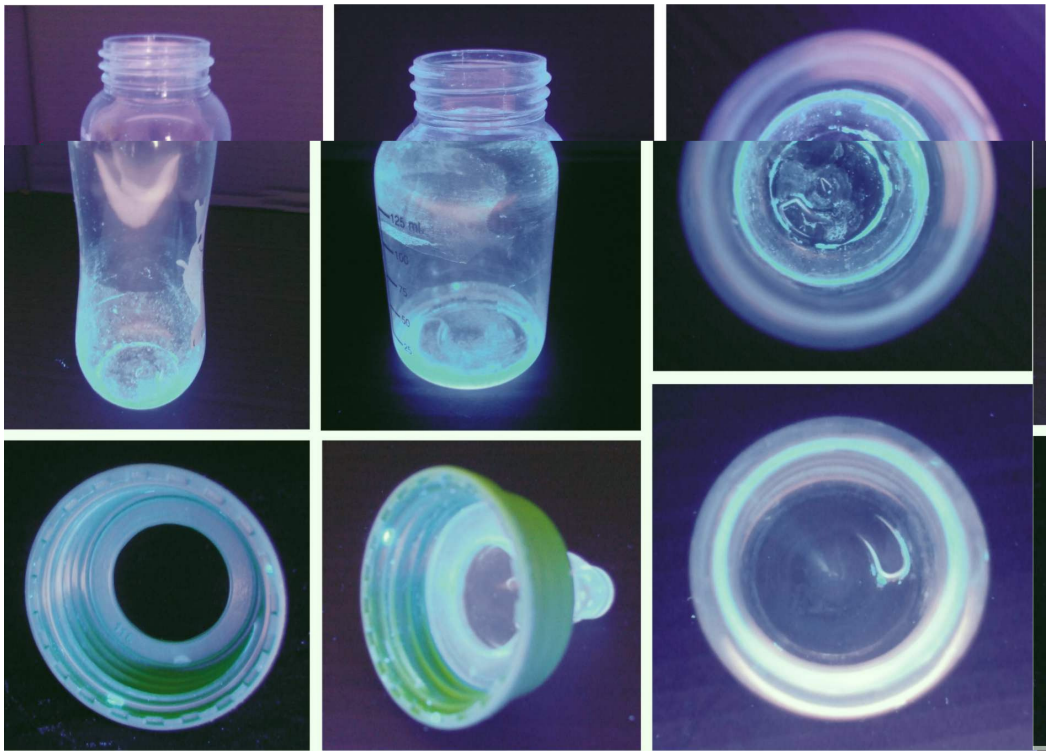

Figure 3 A: Baby bottles into which full cream milk containing 'Glitter Potion' was added, allowed to dry, washed with warm water using a cloth by hand and then photographed under UVA light.

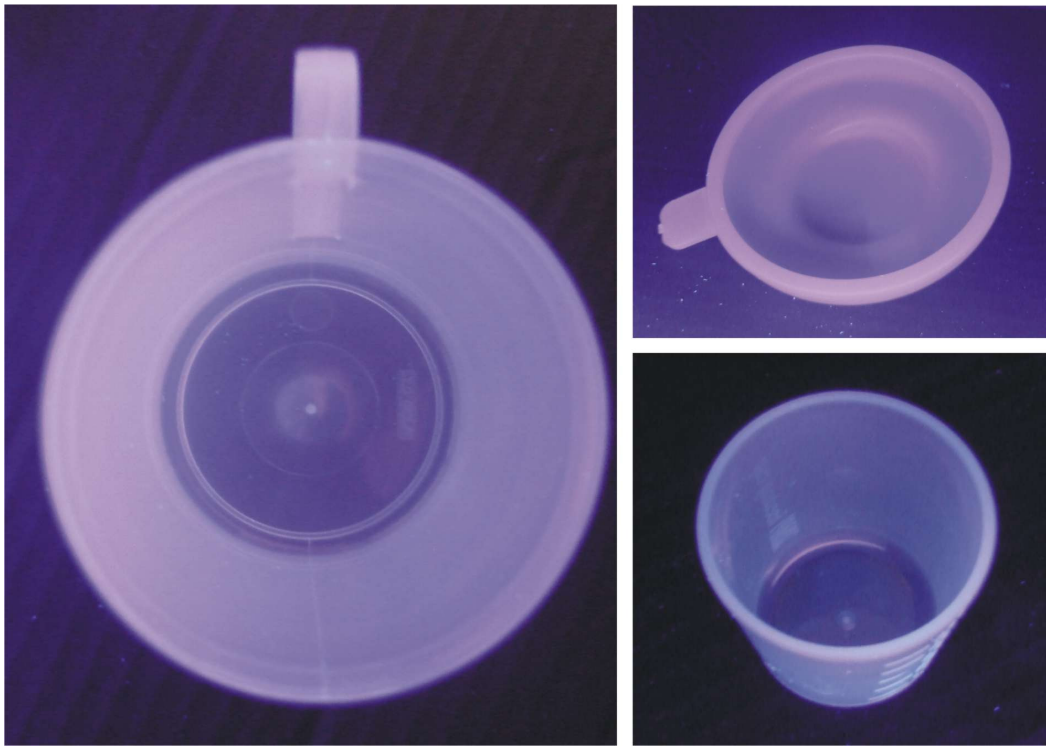

Figure 3 B: Sinapi Feeding Cups into which full cream milk containing 'Glitter Potion' was added, allowed to dry, washed with warm water using a cloth by hand and then photographed under UVA light.

If Figure 2 A and Figure 3 A are compared lower levels of fluorescence in Figure 3 A in comparison to Figure 2 A indicate lower numbers of bacteria adhering to the baby bottles that were washed with warm water using a cloth in comparison to those washed with cold water by hand. Significant areas showing fluorescence in the baby bottles that were washed with warm water using a cloth show that even with this stronger washing bacterially contaminated areas still remain. By comparison, as shown in Figure 3B, the Sinapi feeding cups that were washed with warm water using a cloth show no fluorescence indicating that bacterial contamination could not be detected.

Discussion

These trials show that standard baby bottles into which full cream milk was placed and that have been washed by hand with cold water in comparison with unwashed standard baby bottles show high levels of bacterial contamination. If these bottles are washed with warm water with a dishwashing cloth, lower yet significant levels of bacterial contamination can still be found in the bottom of the bottle. It can therefore be deduced that the chances of bacterial contamination in standard baby bottles is significant and that sterilization is difficult even if hot water is used for cleaning. This is also the reason why boiling is recommended by health practitioners for the effective cleaning of baby bottles. For the rural environment in South Africa and other third world countries where such facilities are not available, standard baby bottles therefore pose a significant risk of bacterial contamination to the infant that is fed with them.

The trials in which the Sinapi Feeding Cup into which full cream milk was placed and that was washed by hand with cold water in comparison with unwashed standard baby bottles

showed that almost undectable levels of bacterial contamination remain. If these cups are washed with warm water by hand no bacterial contamination can be detected at all. This means that the Sinapi Feeding Cup can be cleaned much more easily than the standard baby feeding bottle making it much better suited for infant feeding in the rural environment in South Africa and other third world countries and that the risk of bacterial transmission to the infant that is fed with them is significantly reduced.

The reason why the Sinapi Feeding Cup shows lower levels of bacterial contamination can be attributed firstly to its design, which allows better physical cleaning, and secondly, to the fact that it is made of polypropylene. The design of the cup which is open, not so deep and possesses a smooth surface allows much easier cleaning, even if only cleaned with cold water by hand. In contrast, the design of the standard baby bottle makes cleaning much more difficult, and polycarbonate, which is used for the manufacture of standard baby bottles, possesses a surface which contains charged groups allows proteins to adsorb to it with relative ease. This property of polycarbonate is specifically exploited in techniques in which protein binding to plastic surfaces is required, such as in solid phase immunoassays (Tijssen, 1986). Protein binding to polycarbonate membranes used for ultrafiltration is also known to cause membrane fouling due to the large amounts of proteins that bind relatively easily to polycarbonate (Chen and Chan, 2004). As bacteria adhere readily to the proteins adhering to the polycarbonate, polycarbonate is therefore actually poorly suited as a material from which baby bottles are to be manufactured and necessitates sterilization by boiling. Polypropylene, by comparison, does not possess charged groups on its surface and rather has a hydrophobic surface from which water and charged protein molecules are repelled.

In conclusion, it can be deduced that through its better design and the material from which it is manufacted, i.e. polypropylene, the Sinapi Feeding Cup as opposed to the standard polycarbonate baby bottle has major advantages in terms of a significant reduction of bacterial transmission. Particularly in rural environments in which poor hygiene is commonplace, the Sinapi Feeding Cup is therefore ideally suited for infant feeding under such circumstances.

References

Chen R and Chan V (2004) Characterization of protein fouling on membranes: opportunities and challenges. Journal of Membrane Science, 242, 169-188.

Tijssen, P (1985) In “Practice and Theory of Enzyme Immunoassays” in the series “Laboratory Techniques in Biochemistry and Molecular Biology”, Volume 15, Eds R H Burdon and P H van Knippenberg, pp 301-314.