Optimize Infant Oral Feeding Outcomes with *Zero-Resistance*™ Bottle System

A report on the difference between typical disposable feeding systems and Dr. Brown's® vacuum-free, controlled-flow bottle system.

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Background

While it is universally recognized that breastfeeding is the most preferred method of infant feeding, many NICU infants continue to feed from bottles during their hospitalization. Research over the past 5 years remains focused on nipple flow rates with minimal information on the physics of bottle feeding and how to best support infants. As studies by Lau (2000) and Fucile (2009) have speculated, the presence of sub-atmospheric pressure in a bottle system may have negative effects on an infant's feeding and may validate an infant will expend more energy making each feeding experience less efficient.

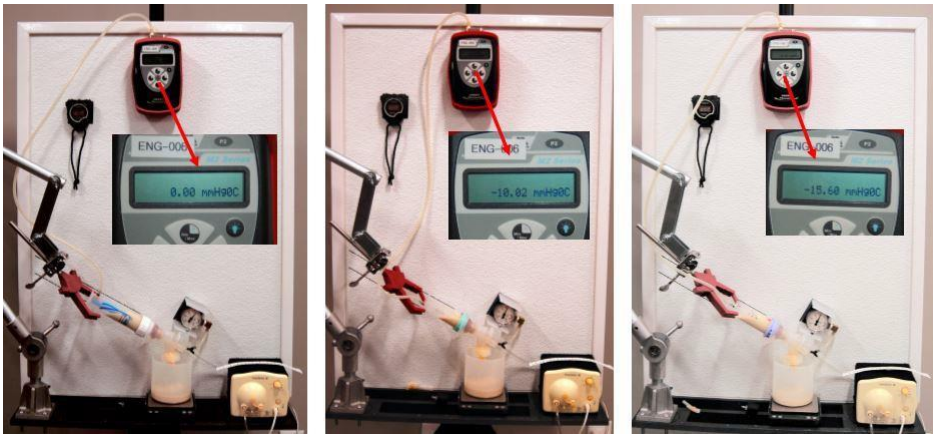
Purpose

The intention of this internal study is to establish if and how much negative pressure (sub-atmospheric pressure) exists in "typical bottle-nipple units" (units) used to feed hospitalized infants (premature, late-preterm and/or medically compromised infants) when suction for liquid extraction is applied to the unit.

Methodology

The method used in this study was designed to test typical bottle-nipple units under standardized and controlled conditions to compare the amount of sub-atmospheric pressure in each unit during the extraction of 60 mls of formula using a breast pump.

1. On the bottom or side of each bottle vessel (Volu-Feed®, Dr. Brown's® Accu-Feed, Dr. Brown's® 2 oz and Dr. Brown's® 4 oz) a hole was bored, and a brass compression connector fitting was secured in each hole.
2. Tubing from an M2 Series SMART Manometer, Model M200-C10015 made by Meriam Process Technologies was attached to the exterior connector on the fitting to record the pressure inside the bottle vessel during liquid extraction.



Dr. Brown's® Enfamil® nfant®

3. Each unit (Table 1 below) was attached to the breast shield of a breast pump. A layer of plastic paraffin film followed by a silicone-based polymer was used to create a seal. The unit was held at a 30° angle with a mechanical arm (to assure consistency when holding each bottle-nipple unit during the testing).

TABLE 1	Bottle -Nipple Units Tested
5	Abbott Volu-Feed® with nfant® very slow-flow nipples
5	Abbott Volu-Feed® with nfant® slow-flow nipples
5	Abbott Volu-Feed® with nfant® standard nipples
5	Abbott Volu-Feed® with Similac® infant nipples (white collars)
5	Abbott Volu-Feed® with Similac® slow nipples (yellow collars)
5	Abbott Volu-Feed® with Enfamil® preemie nipples (blue collars)
5	Abbott Volu-Feed® with Enfamil® slow-flow nipples (turquoise/teal collars)
5	Dr. Brown's® bottle system with Ultra-Preemie™ nipple
5	Dr. Brown's® bottle system with Preemie nipple
5	Dr. Brown's® bottle system with Level 1 nipple
(Of note, the Dr. Brown's bottle-nipple units were all tested with the venting system in place as intended for use. The venting system comprises the cream-colored vent insert and the blue vent reservoir.)	

- A Pump-In- Style Advanced breast pump (Medela Inc.) was used for the liquid extraction.

- The stimulation-phase suction pattern with a suction pressure of 180 mmHg was used for all testing. A pressure manometer with 180 mmHg indicated with a red marking was secured to assure 180 mmHg was applied during each extraction.
- The pressure inside the bottle system was consistently measured by the SMART manometer during the extraction of 60 ccs of Similac Advance Stage 1 (20 cal/oz) ready-to-feed formula (Abbott Laboratories, Abbott Park, IL). [1]
- A consistent pressure of 180 mmHg was applied via the Medela breast pump until all the liquid was extracted from 5 different bottle-nipple units within the same bottle-nipple unit combination.
- To assure consistency during the assembly of each bottle-nipple unit, 15 in/lb of torque was applied to each collar. Pressure recording was documented in writing every 5 ccs of formula extracted as well as each test was video-recorded to confirm measurements obtained.
- Similac Advance Ready-To-Use formula (Abbott Laboratories, Abbott Park, IL) was used as the liquid for all testing. The formula was changed after 1 hour of exposure to prevent increased viscosity as a result of denaturation of proteins from prolonged exposure to air. The manufacturer recommends using formula within 1 hour of opening or mixing. In addition, using the ready-to-feed formula reduced the potential for variability in milk thickness due to differences in formula preparation over time. All formula was disposed after 1 hour of opening and new formula was used to assure testing consistency.

[1]Measurement method similar to methods used in the 2015 Pados article on nipple flow rates.

Conclusions:

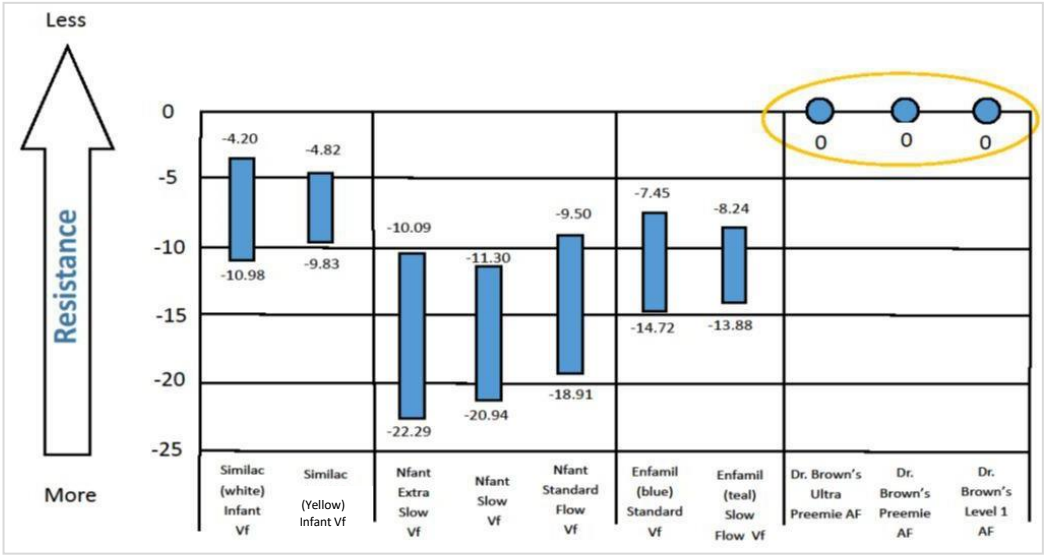
Dr. Brown's® bottle system (unit) with the internal vent system consistently measured Zero (0) sub-atmospheric pressure during the extracting of 60 mls of formula as measured according to the stated methodology.

Units widely used in hospitals exhibit the presence of sub-atmospheric (negative) pressure during the extraction of formula (while suction is applied). It is speculated the increase in the amount of resistance in each unit presumably increases the amount of energy an infant exerts while feeding.

Implications for practice

1. During bottle feeding in the NICU, the bottle-nipple units and how they function should be considered.
2. Should a system with *Zero-Resistance*™ be considered when feeding infants in the NICU? With this report implicating the presence of sub-atmospheric pressure in a "typical bottle-nipple unit" while an infant is feeding, as Lau postulates, an infant could be expending more energy during a feed resulting in less efficient feeds.
3. It is understood infants feed with varying suction capabilities and the amount of pressure exerted will vary accordingly. The pressures established by this method are not indicative of the individual pressure of an infant. Further testing will be required to better establish an individual infant's suction capability and how it affects the sub-atmospheric pressure in a bottle-nipple unit.

Sub-Atmospheric Pressure Changes During 60 cc Formula Extraction



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- Pados B, Park Jinhee, & Dodrill P. Know the flow Milk flow rates from bottle nipples used in the hospital and after discharge. *Advances in Neonatal Care* 2018;00(0):1-20.

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