What is THICK?

- Rheology - the study of the flow of matter
- Viscosity - a measure of the resistance of a fluid to deformation
- Yield Stress - the stress beyond which a liquid flows
- Shear Stress - a fluid’s stress transmitted during flow
- Shear Rate - rate at which the fluid is being sheared
- Density - mass per unit volume
- Newtonian - describes a fluid whose behavior is dependent upon temperature and pressure, not the forces acting upon it
- Non-Newtonian - describes a fluid whose behavior is dependent upon temperature, pressure, and applied stress

How to test THICKNESS?

- Viscometer - measures the viscosity of a fluid under one flow condition
- Rheometer - measures the way in which a liquid flows in response to applied forces

*Both of the above options are expensive, require specialized training, and are not available in most clinical settings

- Eyeball thickness
- Line Spread Test

A Story of Clinical Variability: Thickened formula is unpredictable and does not appear to approximate barium test consistencies. What to do?? Compare one type of infant formula thickened with several different types of thickening agents to determine how closely they approximate test consistencies.

Hypotheses:

- Variation in flow rates would be demonstrated when the standard and hand-thickened infant formulas were compared to liquid barium consistencies used during infant VFSS procedures

- Variation in flow rates would be demonstrated when hand-thickened formula (thickened with various types of thickening agents) were compared after 5 mins of stand time and after 30 minutes of stand time

- Variation in flow rates would be demonstrated when hand-thickened formula (thickened with various types of thickening agents) were compared after 5 mins of stand time and after 3hr refrigeration and stand time
Results:
1) Variation in flow rates were demonstrated when the thickened infant formulas were compared to liquid barium consistencies used during infant VFSS procedures

- No significant difference between Thin Barium and Good Start Formula
- No significant difference between Nectar Barium and Good Start Formula thickened to nectar consistency with rice cereal
- Significantly faster flow rates (thinner) observed between Nectar Barium and Good Start Formula thickened to nectar consistency with powder and gel thickeners
- No significant difference between Honey Barium and Good Start Formula thickened to honey consistency with gel thickener
- Significantly slower flow rates (thicker) observed between Honey Barium and Good Start Formula thickened to honey consistency with rice cereal and powder thickener

2) Variation in flow rates were demonstrated when hand-thickened formula (thickened with various types of thickening agents) were compared after 5 minutes of stand time and after 30 minutes of stand time

- Significant difference between the following Nectar fluids at 5 and 30 mins
  - Rice cereal – Thinner (separated)
  - Powder thickener- Thicker
  - Gel thickener– Thicker

- Significant difference between the following Honey fluids at 5 and 30 mins
  - Rice cereal – Thinner (separated)
  - Powder thickener – Thicker
  - Gel thickener – Thicker

3) Variation in flow rates were demonstrated when hand-thickened formula (thickened with various types of thickening agents) were compared after 5 minutes of stand time and after reheating following 3 hrs of refrigeration and stand time

- Significant difference between the following Nectar fluids at 5 mins and 3 hrs
  - Rice cereal – Thinner (separated)
  - Powder thickener- Thicker
  - Gel thickener– Thicker

- Significant difference between the following Honey fluids at 5 mins and 3 hrs
  - Rice cereal – Thinner (separated)
  - Powder thickener – Thicker
Discussion:

- The flow rate of Nectar and Honey Barium is hard to reproduce in standard infant formula with common thickening agents.

- Nectar and Honey thickened infant formula undergo significant changes in flow rates within 30 minutes of preparation.

- Nectar and Honey thickened infant formula prepared ahead of time that is refrigerated and reheated has a significantly different flow rate from infant formula that is thickened and served within 5 minutes of preparation, as well as from standard barium consistencies.

Conclusions:

- Clinicians need to be aware of potential variation in the viscosity of hand-thickened infant formulas.

- Infants may be consuming liquids more or less viscous than assumed.

- Be alert to clinical signs of fatigue and/or aspiration demonstrated during feeding, which may indicate fluid is too thick or thin.

Notes:

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Effect of Time and Temperature on Thickened Infant Formula
Gosa and Dodrill
ASHA-New Orleans, LA 2009


