Effect of Commercially Available Thickening Agents on Ready to Feed Infant Formulas

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Introduction

- Infants may have difficulty swallowing (**dysphagia**) due to prematurity, congenital anomalies, and/or diseases that affect the nervous, respiratory, or digestive systems[1]
- A common treatment strategy for infants with dysphagia is to **thicken** the formula or breastmilk they consume[2]
- Thickening increases the viscosity of the liquid, and slows the flow of the liquid through the upper aerodigestive tract and may result in **improved swallowing function**[3]
- Liquid is usually thickened with **starch or gum based thickening agents** to a **Nectar** or **Honey** consistency[4]
- Previous research demonstrates that achieving the appropriate therapeutic consistency (nectar or honey) is difficult[4]
- **Time, temperature, base fluid, and thickening agent** have been shown to affect the resulting consistency of the fluid [4-9]
- Fluid that is **thinner** than recommended may not effectively remediate the swallowing problem and fluid that is **thicker** than recommended may cause the infant to fatigue and not finish their feeding[4]

* Due to the importance of providing the appropriate fluid consistency for effective treatment of swallowing problems in infants, **this project sought to determine the effects of three commercially available thickening agents on the resulting thickened consistencies of commonly prescribed, ready to feed infant formulas** *

Methods

Formula	Manufacturer	Cal/oz	Protein Source	Hypoallergenic	Lactose
Pregestimil	Mead Johnson	20	Hydrolyzed Casein and 3 amino acid supplements	Y	N
Enfamil A.R.	Mead Johnson	20	20:80 Whey Casein	N	Y
Enfamil 20	Mead Johnson	20	20: 80 Casein Whey	N	Y
Enfamil 24	Mead Johnson	24	20: 80 Casein Whey	N	Y
Enfamil 30	Mead Johnson	30	20: 80 Casein Whey	N	Y
Similac Advance	Abbott	19	20: 80 Casein Whey	N	Y
Similac Soy	Abbott	19	Soy	N	N
Similac Special Care	Abbott	20	20: 80 Casein Whey	N	Y
Neosure	Abbott	22	20: 80 Casein Whey	N	Y

Thickening Agent	Active Thickening Ingredient	Nectar	Honey
Gerber Single Grain Oatmeal Cereal	Whole Grain Oat Flour and Oat Flour, Calcium Carbonate	1.75 teaspoons of oatmeal per 1 ounce of formula	2.5 teaspoons of oatmeal per 1 ounce of formula
NUTRA/Balance Thik & Clear	Cellulose Gum standardized with Maltodextrin	5 grams thickener to 4 ounces of formula	7 grams thickener to 4 ounces of formula
Gelmix	Tapioca Maltodextrin, Carob Bean Gum, Calcium Carbonate	2.4 grams of thickener to 4 ounces of formula	4.8 grams of thickener to 4 ounces of formula

- The Mini-Temp FS Infrared Thermometer was utilized to provide measurements of temperature
- Thickeners mixed with formula per manufacturer's instructions following strict protocol for reliability and consistency of mixing
- Formula and thickener mixed in a Pyrex measuring cup with a wire whisk
- Bolus flow was measured with a standard line spread test (LST)
- LST results have been shown to distinguish therapeutically relevant categories of thickened liquids (i.e. nectar and honey thick)[4,10]
- LST performed on a countertop confirmed as level with use of a carpenter's level
- Liquids prepared as described and measured via graduated syringe into 50-mL boluses and plunged into center cylinder
- Mean of these 4 measures was calculated as a measure of bolus flow
- Process completed 10 times for each formula and each thickness category (thin, nectar, and honey)
- Between each sample, the bolus was wiped off the plexiglass overlay with a slightly damp cloth- no chemicals or soap were used in the cleaning of the plexiglass overlay

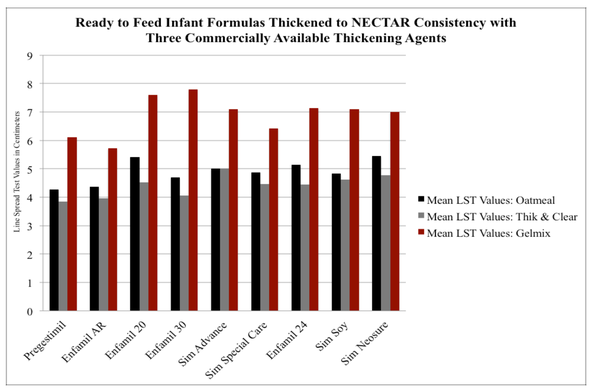
Results

	Pregestimil		Enfamil AR		Enfamil 20		Enfamil 24		Enfamil 30	
	Thin = 6.03 (0.69)		Thin = 6.14 (0.26)		Thin = 6.31 (0.11)		Thin = 6.91 (0.34)		Thin = 6.33 (0.66)	
	Nectar	Honey	Nectar	Honey	Nectar	Honey	Nectar	Honey	Nectar	Honey
Oatmeal	4.26 (0.40)	3.26 (0.16)	4.38 (0.21)	3.28 (0.34)	5.41 (0.27)	3.55 (0.35)	5.14 (0.41)	3.89 (0.29)	4.69 (0.49)	3.03 (0.44)
Thik & Clear	3.85 (0.47)	3.40 (0.11)	3.95 (0.27)	3.11 (0.23)	4.53 (0.20)	4.10 (0.13)	4.45 (0.15)	3.81 (0.24)	4.06 (0.18)	3.41 (0.46)
Gel Mix	6.11 (0.72)	5.38 (0.29)	5.71 (0.47)	3.71 (0.75)	7.60 (1.30)	5.46 (0.54)	7.14 (0.66)	5.63 (0.28)	7.79 (0.81)	4.78 (0.15)

*Mean (Standard Deviation); All measurements in cm

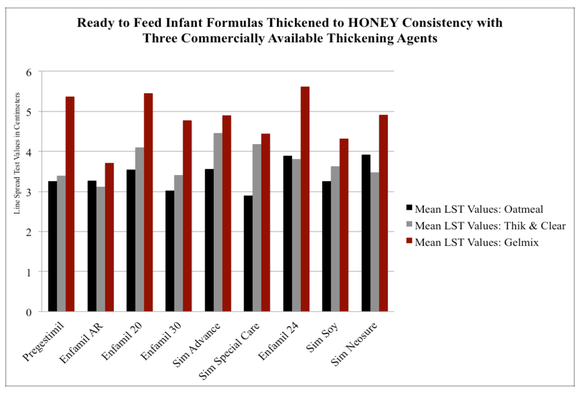
	Similac Advance 19		Similac Soy 19		Similac Special Care 20		Similac Neosure 22	
	Thin = 6.44 (0.52)		Thin = 7.29 (1.62)		Thin = 6.60 (0.38)		Thin = 7.49 (2.44)	
	Nectar	Honey	Nectar	Honey	Nectar	Honey	Nectar	Honey
Oatmeal	5.00 (0.26)	3.56 (0.33)	4.83 (0.33)	3.25 (0.16)	4.87 (0.32)	2.90 (0.33)	5.45 (0.41)	3.91 (0.49)
Thik & Clear	5.00 (0.48)	4.46 (0.27)	4.61 (0.11)	3.63 (0.44)	4.46 (0.32)	4.19 (0.31)	4.77 (0.35)	3.48 (0.32)
Gel Mix	7.10 (0.68)	4.90 (0.23)	7.10 (.66)	3.63 (0.44)	6.43 (0.33)	4.45 (0.18)	7.00 (2.20)	4.91 (0.31)

*Mean (Standard Deviation); All measurements in cm



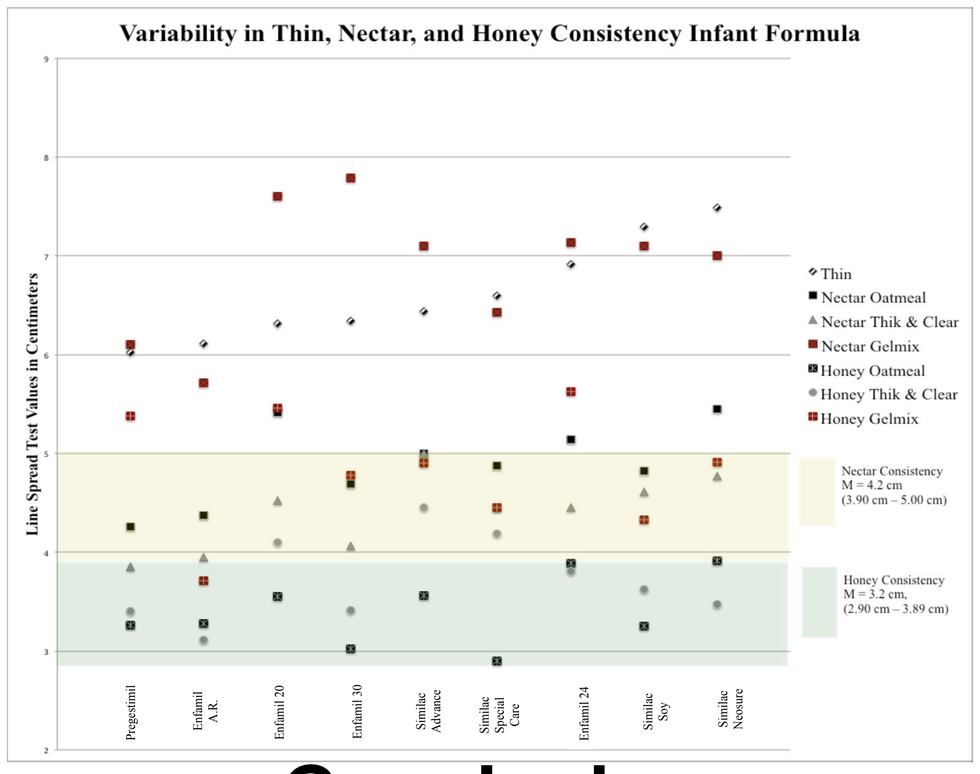
- LST values were statistically significantly different between the three thickening agents for the NECTAR thick consistency, Welch's F (2, 167.042) = 203.41, p < .0005
- LST values increased as follows:

Thickener	Mean(SD)
Thik n Clear	4.41(0.46)
Oatmeal	4.89(0.52)
GelMix	6.84(1.04)



- LST values were statistically significantly different between the three thickening agents for the HONEY thick consistency, Welch's F (2, 174.056) = 158.100, p < .0005
- LST values increased as follows:

Thickener	Mean(SD)
Oatmeal	3.39(0.45)
Thik n Clear	3.84(0.56)
GelMix	4.85(0.64)



- Games-Howell post-hoc analysis revealed that there were statistically significant differences in thickness between all three thickening agents for both NECTAR and HONEY
- Clinically significant difference noted for GelMix

Conclusions

- **The choice of thickening agent impacts the resulting thickness of ready to feed infant formulas**
- Gelmix consistently produced thickened formula outside of desired therapeutic range
  - Differences in thickness likely due to the need to heat the formula prior to mixing with Gelmix
  - Temperature is a known variable for resulting thickness, with an increase in temperature known to cause a decrease in thickness[4,7]
- Formula mixed with Oatmeal and Thik & Clear mixed at room temperature (76° F (25.56° C) ± 2°)
- Formula mixed with Gelmix had to be heated to 100 – 120° F (37.78 – 48.89° C) and then cooled to 96 – 100° F (35.56 – 37.78° C)
- Average Gelmix Nectar thick sample temperature was 98.35° F (36.86° C) and Gelmix Honey thick sample temperature was 98.12° F (36.73° C), more than 22° warmer than the Nectar and Honey thick samples prepared with Oatmeal and Thik & Clear
- **Limitations**: limited formula representation, use of LST vs viscometer/rheometer, use of in vitro testing environment
- **Future research** should explore the usefulness of more user friendly methods of testing thickened fluids, such as the syringe test, to facilitate clinical decision making of appropriate thickening agent to meet the individual needs of infants' with dysphagia

References:

1) Tutor, J. D., & Gosa, M. M. (2012). Dysphagia and aspiration in children. *Pediatric pulmonology*, *47*(4), 321-337.
2) Gosa, M., Schooling, T., & Coleman, J. (2011). Thickened liquids as a treatment for children with dysphagia and associated adverse effects: A systematic review. *ICAN: Infant, Child, & Adolescent Nutrition*, *3*(6), 344-350.
3) Steele, C. M., Alsanei, W. A., Ayanikalath, S., Barbon, C. E., Chen, J., Cichero, J. A., ... & Hanson, B. (2015). The influence of food texture and liquid consistency modification on swallowing physiology and function: a systematic review. *Dysphagia*, *30*(1), 2-26.
4) Gosa, M. M., & Dodrill, P. (2016). Effect of Time and Temperature on Thickened Infant Formula. *Nutrition in Clinical Practice*, 0884533616662991.
5) Adeleye, B., & Rachal, C. (2007). Comparison of the rheological properties of ready-to-serve and powdered instant food–thickened beverages at different temperatures for dysphagic patients. *Journal of the American Dietetic Association*, *107*(7), 1176-1182.
6) Bhattacharyya, N. (2015). The prevalence of pediatric voice and swallowing problems in the United States. *The Laryngoscope*, *125*(3), 746-750.
7) Garcia, J. M., Chambers, E., Matta, Z., & Clark, M. (2008). Serving temperature viscosity measurements of nectar-and honey-thick liquids. *Dysphagia*, *23*(1), 65-75.
8) Dewar, R. J., & Joyce, M. J. (2006). Time-dependent rheology of starch thickeners and the clinical implications for dysphagia therapy. *Dysphagia*, *27*(4), 264-269.
9) Garcia, J. M., Chambers, E., Matta, Z., & Clark, M. (2005). Viscosity measurements of nectar-and honey-thick liquids: product, liquid, and time comparisons. *Dysphagia*, *20*(4), 325-335.
10) Nicosia, M. A., & Robbins, J. (2007). The usefulness of the line spread test as a measure of liquid consistency. *Dysphagia*, *22*(4), 306-311.

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