A nutrition-secure childhood for 6-24 months old infants and young children in South Africa: Does the viscosity of sorghum and other complementary porridge samples limit nutrient intake?

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UNICEF (2013), Improving child nutrition

INTRODUCTION

Meeting nutritional needs of 6 - to 24 month-old children is challenging *(Dewey 2013).*

- Worldwide, **6 M** children below 5 years **die** per year *(Black et al., 2013).*
- **50%** of deaths= **malnutrition** *(UNICEF, 2015).*
- **A further 156 M** (24%) globally are **stunted** *(UNICEF/WHO/World Bank, 2016)*
- In RSA, **27%** of the children under 5 years are **stunted** *(National Department of Health, Statistics SA, South African Medical Research Council, and IFC. (2017).*

PROTEIN-ENERGY MALNUTRITION (PEM)

- The most lethal form of malnutrition *(Bazaz et al, 2016).*
- ***"Inadequate"*** protein and energy in diet.

Causes are multivariate and multifaceted.

➢ Inappropriate viscosity of complementary foods *(Abiose et al., 2015).*

Does sorghum hold potential to promote <u>adequate energy and protein intake</u> in young children to guarantee a nutrition-secure childhood?

BUT…HOW MUCH IS ADEQUATE?

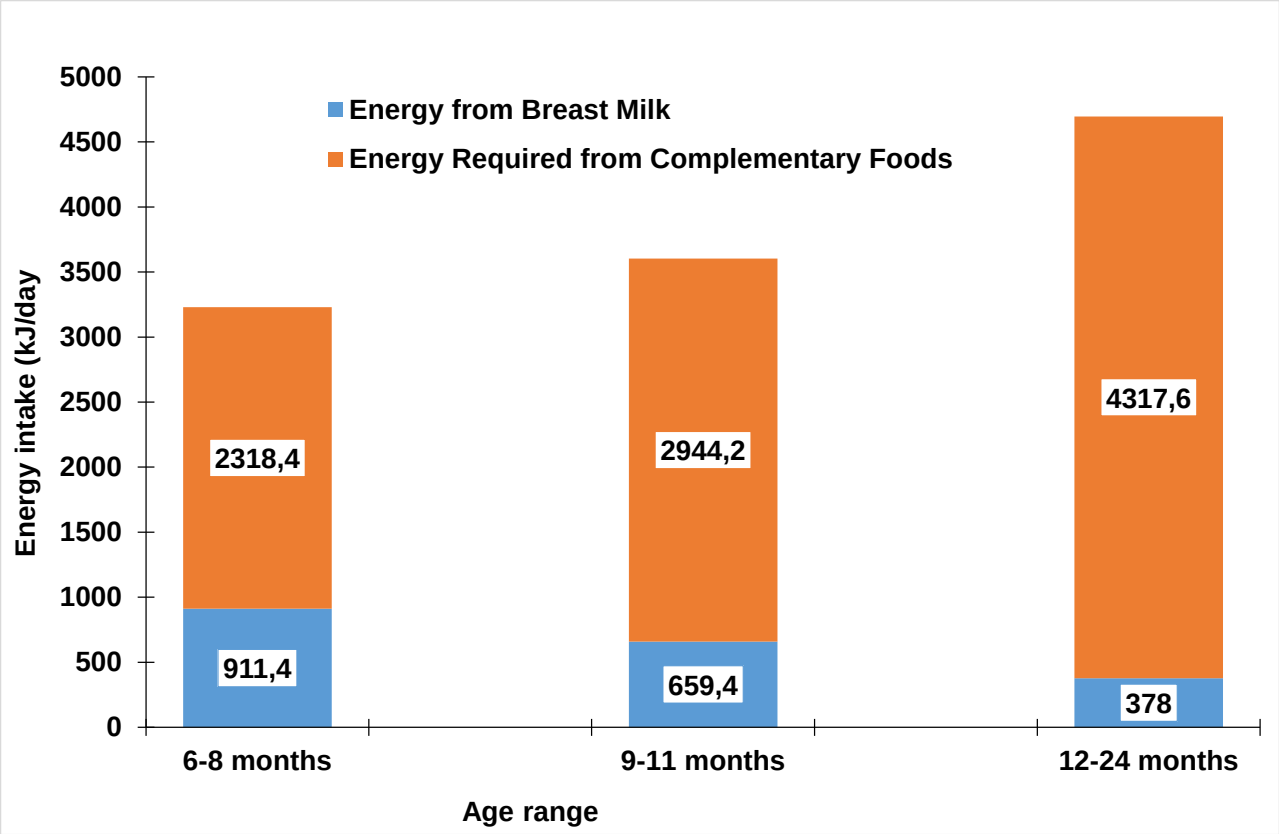
Unpacking the terms of reference

Assumptions (informed by emprical evidence)

Age-group of young children	**6-8 Months**	**9-11 Months**	**12-24 Months**
Assumed functional gastric capacity *(Based on 30g/kg reference body weight)*	249g/meal *(8,3kg)*	285g/meal *(9,5kg)*	345g/meal *(11,5kg)*
Energy density of complementary food (kJ/g)	**Number of meals/day**		
2,5	3,7	4,1	5,0
3,4	2,8	3,1	3,7
4,2	2,2	2,5	3,0

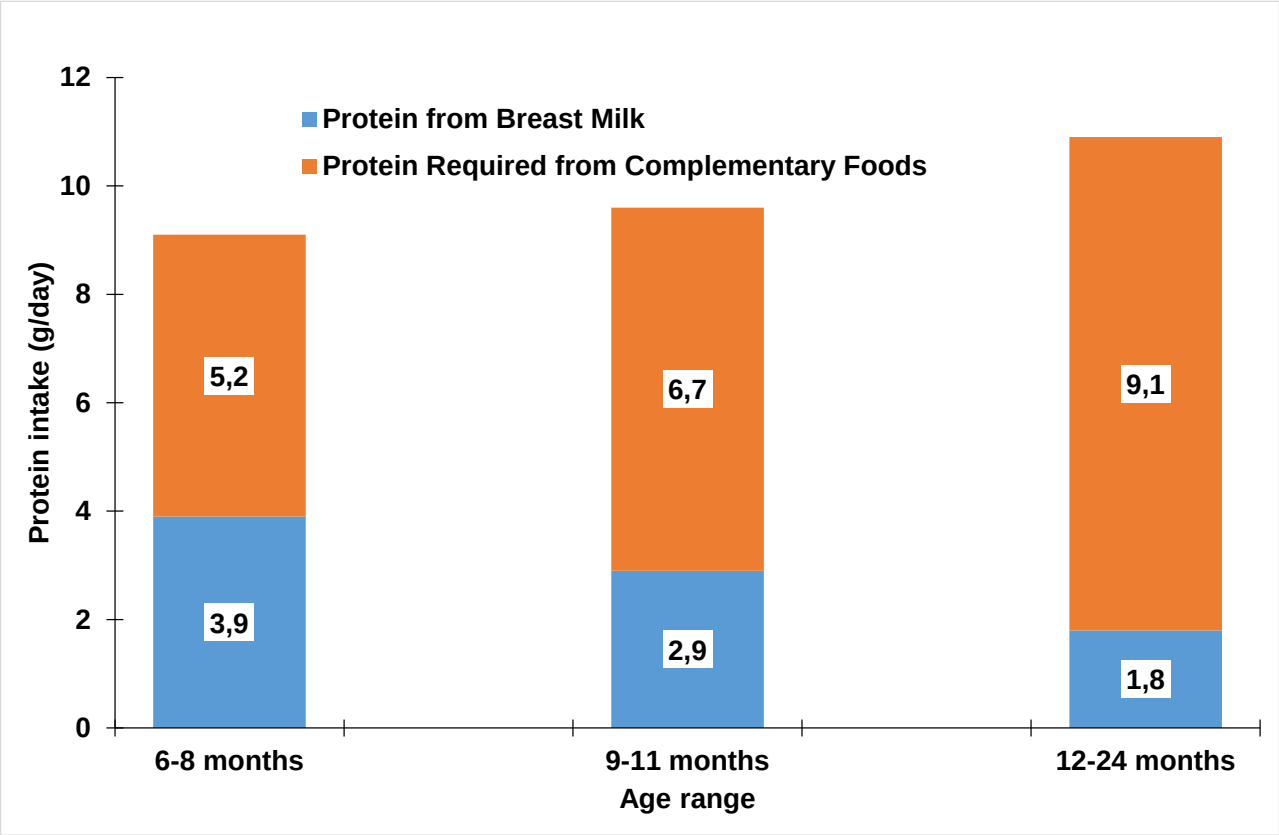
WHO/UNICEF (1998); Dewey and Brown (2003)

DIETARY ENERGY REQUIREMENTS FOR CHILDREN HAVING LOW BREAST MILK ENERGY INTAKE



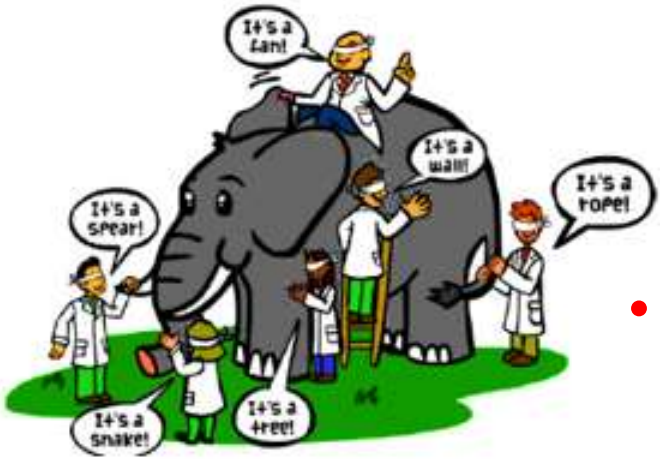
WHO/UNICEF (1998); Dewey and Brown (2003). ***1kcal = 4,2kJ.***

DIETARY PROTEIN REQUIREMENTS FOR CHILDREN HAVING LOW BREAST MILK ENERGY INTAKE



WHO/UNICEF (1998); Dewey and Brown (2003).

SO.. IS THE VISCOSITY OF SORGHUM (AND OTHER INDIGENOUS) COMPLEMENTARY PORRIDGE SAMPLES REALLY A CONCERN?



1. Temperature & Time
2. Chemical composition
3. Force, shear rate
4. oral conditions

- Porridge viscosity characterisation is elusive
- Sorghum porridge thickness relates to flow properties ***(Engmann &Burbidge 2013).***
- Too thick or too thin? Spoon-thick: 1–3 Pa.s (But *at what shear rate?*) ***(Thaoge et al., 2003; Oyarekua, 2011).***
  - A single shear rate or a range? ***(Nicosia, 2013; He et al., 2016; Chambers et al., 2017).***

RESEARCH QUESTION

Does the viscosity of sorghum and other complementary porridge samples commonly consumed by 6-24 months old infants and young children in South Africa limit nutrient intake?

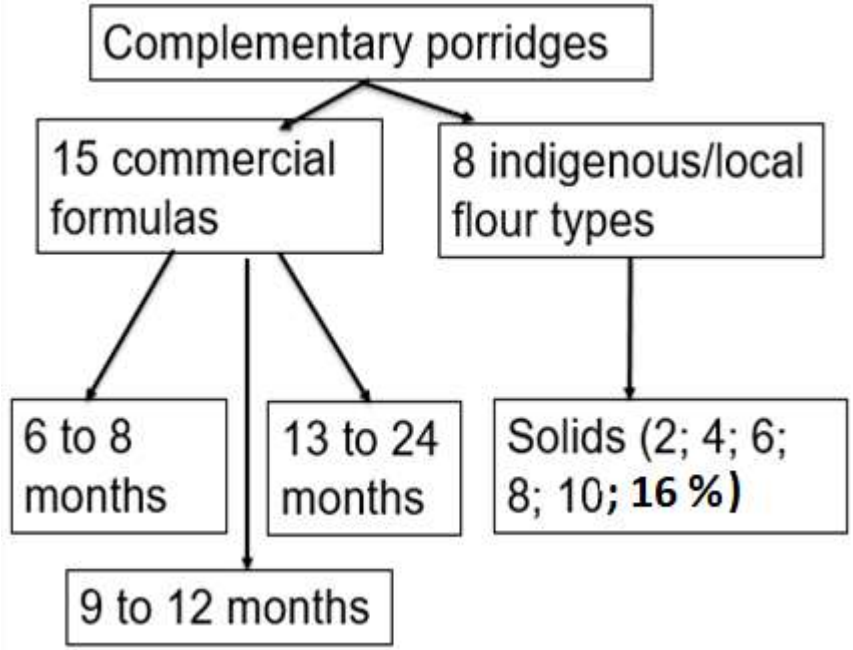
Objective

To *determine* the *flow properties (dynamic viscosity), protein and energy content* of commercial and locally available complementary porridge samples for 6 to 24 months children in South Africa, -

with the aim of optimising protein and energy intake in young children to improve their nutritional status.

EXPERIMENTAL DESIGN

Independent

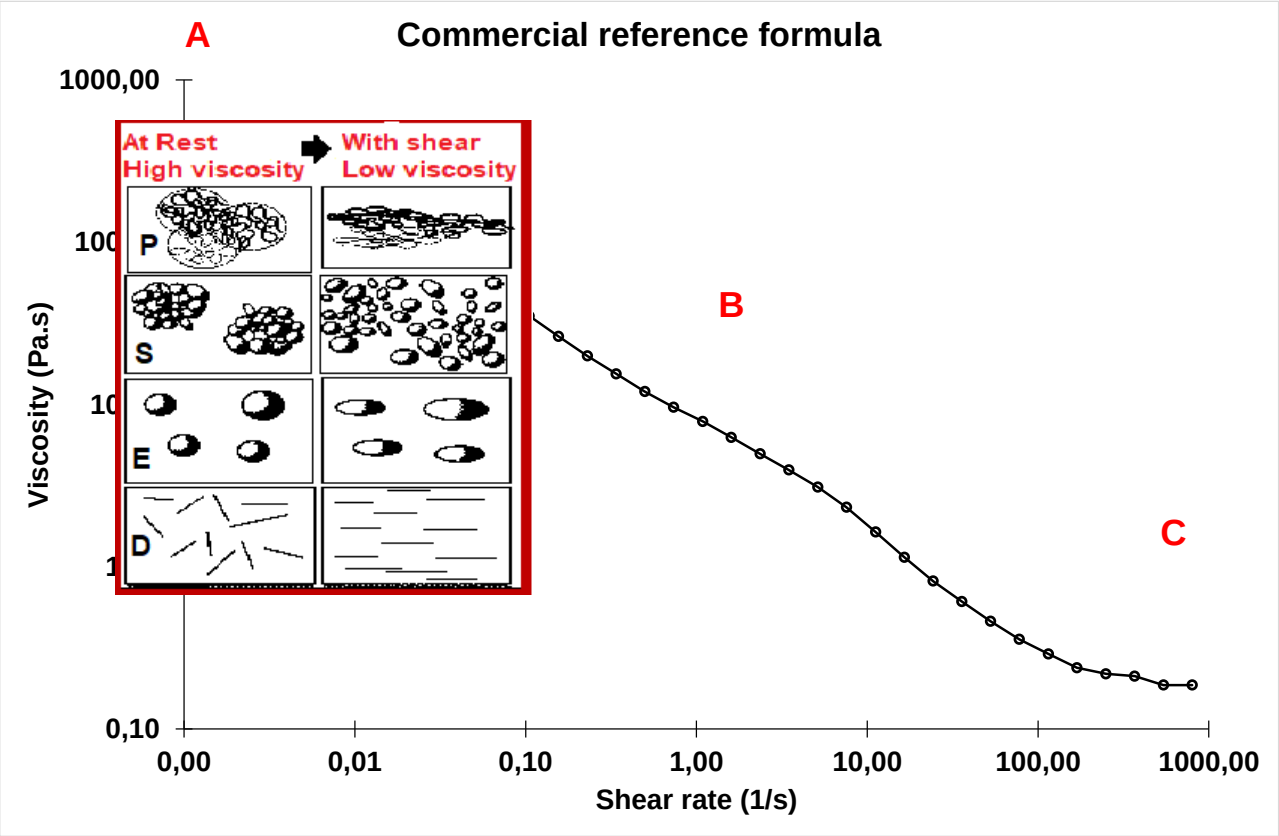


Dependent

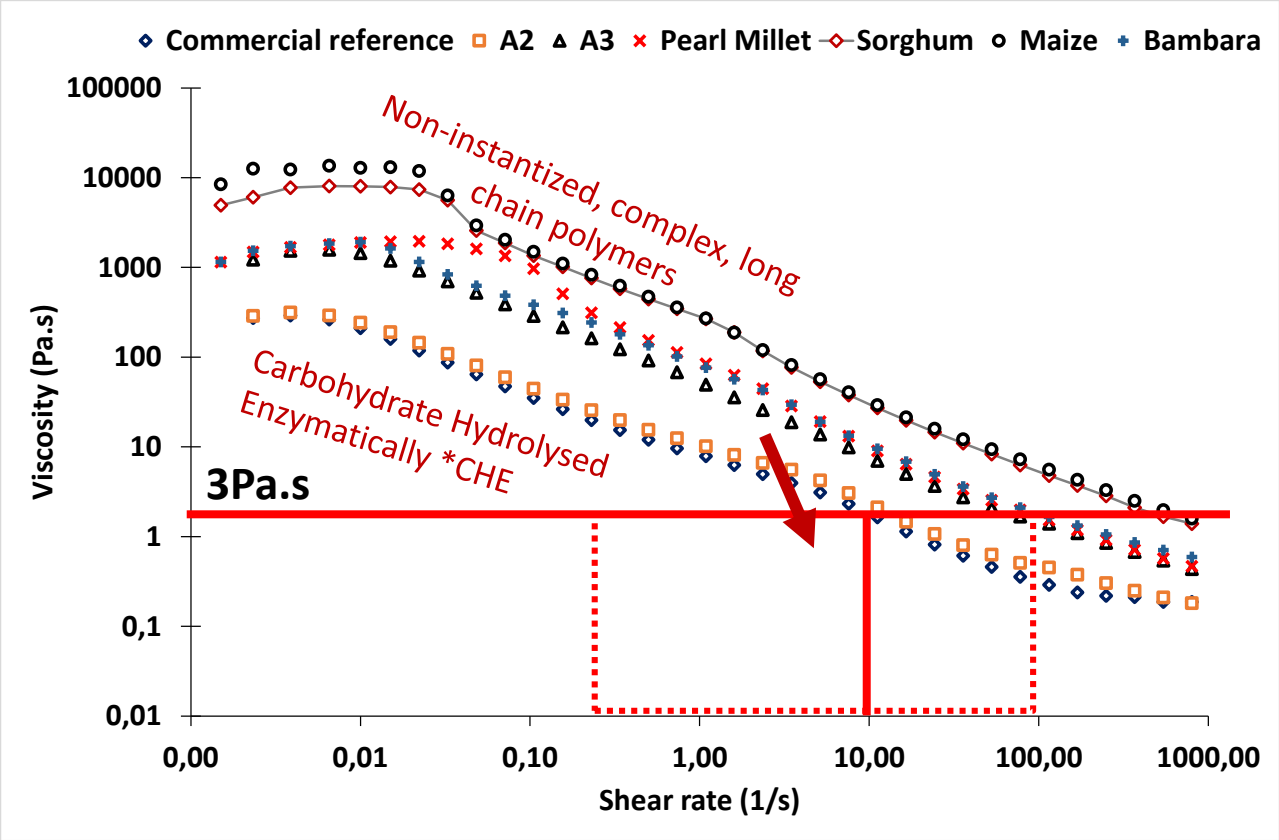
Viscosity (40°C)

- Protein content
  - ➢ Protein intake/day
- Energy content
  - ➢ Energy intake/day

DECREASE IN THE VISCOSITY OF A COMPLEMENTARY PORRIDGE WITH INCREASING SHEAR RATE (MEASURED AT 40°C).



VISCOSITY PROFILE OF A SORGHUM AND OTHER PORRIDGE TYPES CONSUMED BY YOUNG CHILDREN OF AGE 6-24 MONTHS IN SOUTH AFRICA.



*Commercial formulas prepared as per manufacturer instructions at 25% solids. Indigenous porridge samples at 10% solids

PROTEIN AND ENERGY INTAKES FROM SORGHUM AND OTHER COMMON PORRIDGE SAMPLES FOR 6-8 MONTHS-OLD CHILDREN IN SOUTH AFRICA.

Analysis done at temperature of 40 ^{o} C, shear rate of 50 s^{-1} and a critical - viscosity limit of 3Pa.s.

Total nutrient requirements/ day	*BM intake level	Required from #CP	**Porridge type and solids content [%]						
			A1 [25]	A2 [25]	A3 [25]	S [8,4]	M [8,1]	PM [11,1]	B [10,7]
Energy (3229,8 kJ/day)	Low	***2318***	2658	2658	2658	1046	1121	1494	1345
	Average	***1495***							
Protein (9,1 g/day)	Low	***5***	23	23	23	4	5	11	17
	Average	***2***							
Viscosity (Pa.s)		**3**	**0,3**	**0,5**	**1,4**	**3**	**3**	**3**	**3**

**Breast milk; #Complementary porridge; **A1, A2 and A3 are commercial; - S (sorghum), M (maize), PM (pearl millet) and B (bambara) are indigenous.*

PROTEIN AND ENERGY INTAKES FROM SORGHUM AND OTHER COMMON PORRIDGE SAMPLES FOR 9-11 MONTHS-OLD CHILDREN IN SOUTH AFRICA.

Analysis done at temperature of 40 ^{o} C, shear rate of 50 s^{-1} and a critical - viscosity limit of 3Pa.s.

Total nutrient requirement/day	*BM intake level	Required from #CF	**Porridge type and solids content (%)						
			A1 [25]	A2 [25]	A3 [25]	S [8,4]	M [8,1]	PM [11,1]	B [10,7]
Energy (3603,6 kJ/day)	Low	***2944***	2658	2658	2658	1197	1283	1710	1239
	Average	***2012***							
Protein (9,6 g/day)	Low	***7***	23	23	23	5	5	13	20
	Average	***3***							
Viscosity (Pa.s)		**3**	**0,3**	**0,5**	**1,4**	**3**	**3**	**3**	**3**

**Breast milk; #Complementary porridge; **A1, A2 and A3 are commercial; - S (sorghum), M (maize), PM (pearl millet) and B (bambara) are indigenous.*

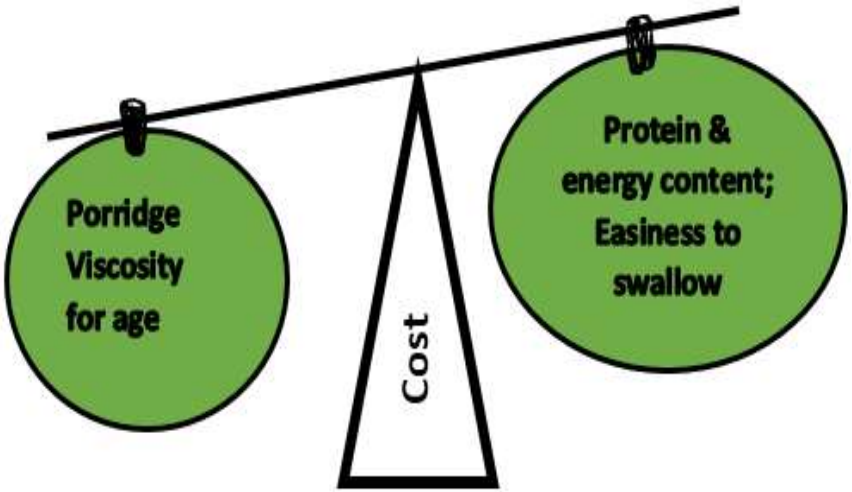
PROTEIN AND ENERGY INTAKES FROM SORGHUM AND OTHER COMMON PORRIDGE SAMPLES FOR 12-24 MONTHS-OLD CHILDREN IN SOUTH AFRICA.

Analysis done at temperature of 40 ^{o} C, shear rate of 50 s^{-1} and a critical - viscosity limit of 3Pa.s.

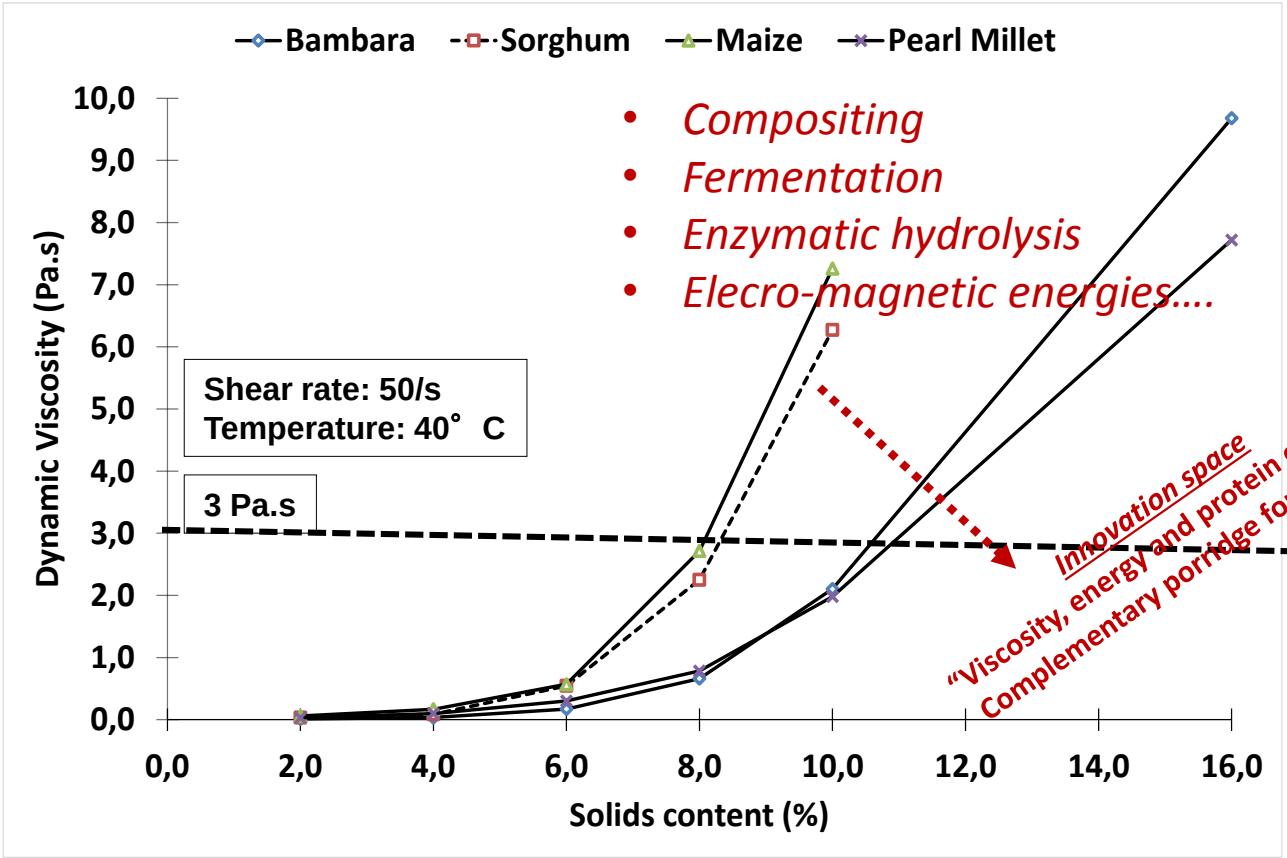
Total nutrient requirement/day	***BM intake level**	**Required from #CF**	****Porridge type and solids content (%)**						
			A1 [25]	**A2** [25]	**A3** [25]	**S** [8,4]	**M** [8,1]	**PM** [11,1]	**B** [10,7]
Energy (4695,6kJ/day)	Low	***4318***	2658	2658	2658	1449	1253	2070	1863
	Average	***3242***							
Protein (10,9 g/day)	Low	***9***	23	23	23	6	6	16	24
	Average	***5***							
Viscosity (Pa.s)		**3**	**0,3**	**0,5**	**1,4**	**3**	**3**	**3**	**3**

**Breast milk; #Complementary porridge; **A1, A2 and A3 are commercial; - S (sorghum), M (maize), PM (pearl millet) and B (bambara) are indigenous.*

WE NEED TO FIND THE CRITICAL BALANCE!



INCREASING SOLIDS CONTENT OF THE PORRIDGE SHOULD INCREASE NUTRITIVE VALUE. BUT THEN, VISCOSITY RAPIDLY INCREASES BEFORE THIS HAPPENS.



CONCLUSIONS

- The flow properties (dynamic viscosity) of Sorghum and some of the common South African complementary porridge samples is a limiting factor for protein and energy intake in infants and young children of ages 6-24 months.

SIGNIFICANCE OF FINDINGS

- Need to explore technologies to improve the oral flow properties of sorghum and other common complementary porridges, in order to optimize protein and energy intake.

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