
SLU
SCIENCE AND EDUCATION FOR SUSTAINABLE LIFE

Complementary porridge for undernourished children in Mozambique

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Motivation and challenges

- Between 720 and 811 million people are malnourished in the world (FAO, 2020)
- Malnutrition in children < 5 years of age
- Leave no one behind (2 SDG)
- Improper feeding practices
- Knowledge of raw material and traditional processing methods to develop porridge and new novel food products

Motivation and challenges

Germination

Soaking

Fermentation

Increase the nutritional profile
Bioactive compounds
Reduce anti-nutritional factors
Benefit grain digestibility
Adequate energy density
Favorable characteristics

Why pearl millet and cowpea ?

- Pearl millet (*Pennisetum glaucum*)

Climate-resilient

High protein /methionine

Produced/Affordable

Intercropping

Nutritious

- Cowpea (*Vigna unguiculata*)

Nutritious

Intercropping and rotational

Widely consumed

Drought-tolerant

Low cost protein / High lysine

Planned projects

1. Effect of soaking, germination and fermentation on physicochemical properties and structures of pearl millet and cowpea
2. Understanding the effect of cooking on physicochemical properties and phytic acid of cooked composite porridge
3. Effect of treatments on the starch digestibility of complementary porridge
4. Nutritional quality and sensory acceptability of the complementary porridge

Materials

- Pearl millet
- Cowpea

Treatments

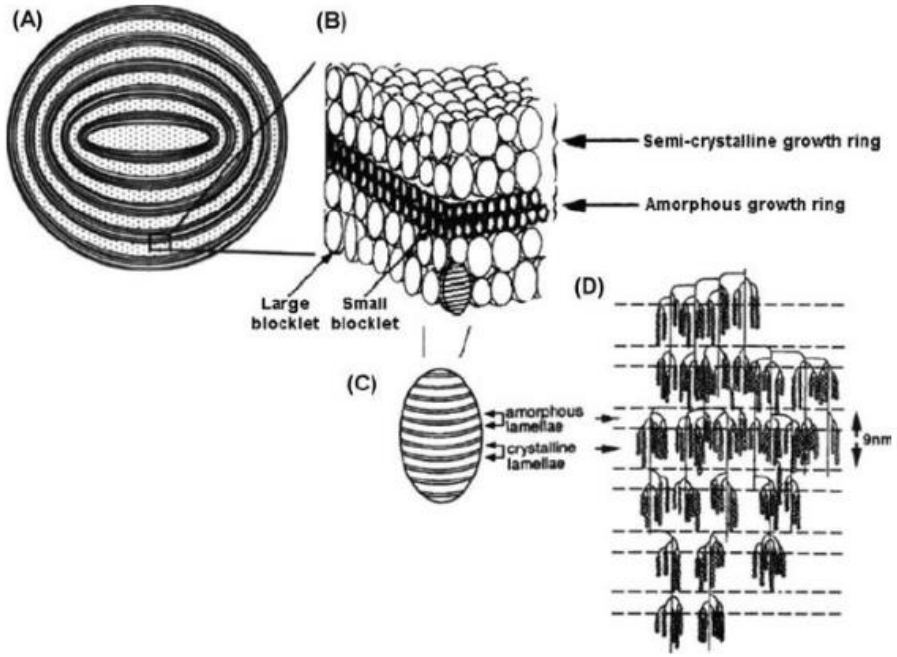
- Washed
- Soaked
- Germinated
- Fermented

Methods

- Total dietary fiber determined as neutral sugar residues, uronic acid residues, and Klason lignin : The Uppsala Method (Gas Chromatographic, colorimetric and gravimetric method)
- Total fructan quantified by a spectrophotometric method using the enzymatic assay kit K-FRUC
- Total starch content : Using enzymatic assay kit K-GLUC, Colorimetric method
- Amylose content : Colorimetric method based on iodine complex formation
- Crude Protein: Kjeldahl, N x 6,25
- Crude Fat: Hydrotec 8000 and Soxtec 8000 Extraction Unit
- Ash: Muffle furnace at 600°C
- Minerals: Spectro Blue ICP machine
- Rapid Visco Analyser: Pasting properties (50-95-50 °C)
- Scanning Electro Microscopy: Morphological properties of the starch
- Particle size distribution: Sieve fractionation using an AS 200 shaker
- Phenolic compounds - HPLC
- Slow and rapid digestible starch: Digestible and Resistant Starch Megazyme Assay Kit (K-DSTRS)

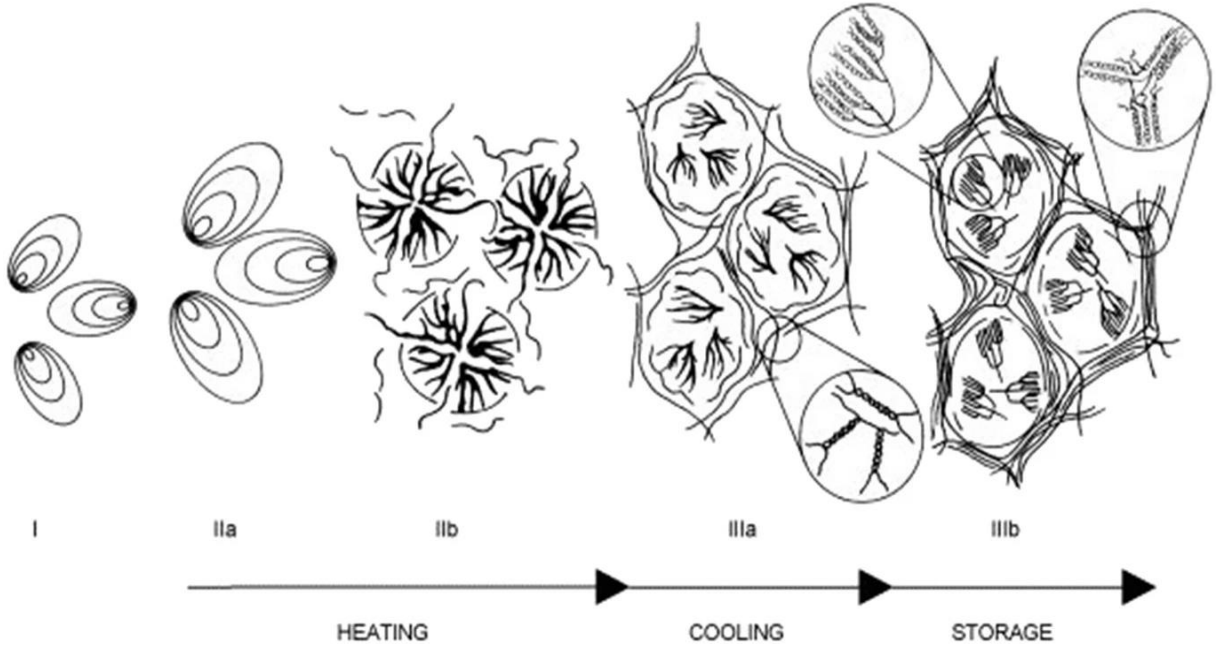
Background

Schematic representation of the starch granule



Delcour and Hoseney , 2010 (Adapted from Goesaert et al, 2005)

Schematic representation of changes that occur in a starch-water mixture



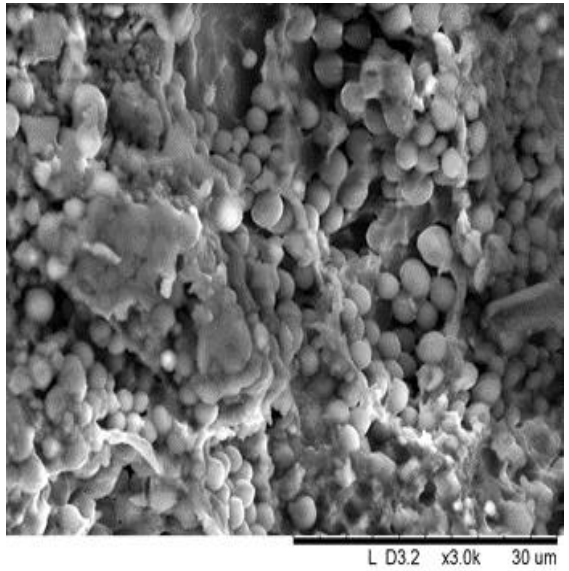
Kim et al., 2012, modified from Gallant et al., 1997; Vandeputte and Delcour, 2004).

Effect of pre-treatments on proximate composition of pearl millet and cowpea – First project

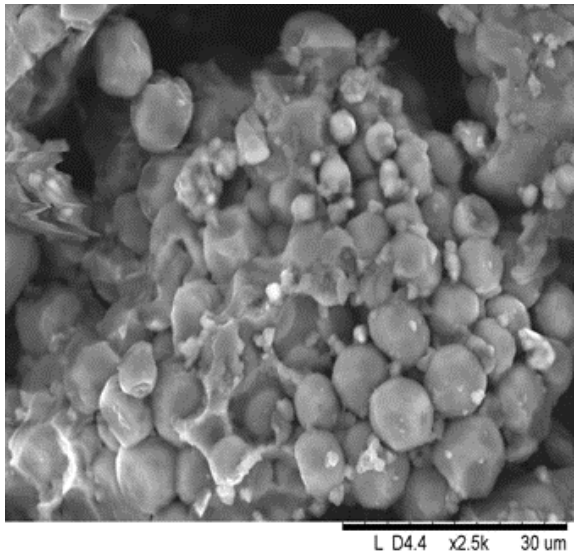
Treatments	Total dietary fibre [a]	Crude Protein (N*6.25)	Crude Fat	Ash	Total Starch	Amylose (% of starch)
Pearl millet						
Washed	7.0± 1.1^{bc}	12.8±0.1^{d}	6.0±0.4^{a}	1.3±0.1^{c}	71.0±0.5^{a}	32.1±1.4^{ab}
Soaked	6.0±0.3^{c}	12.7±0.02^{d}	6.1±0.2^{a}	1.3±0.0^{c}	69.9±0.2^{ab}	33.1±0.6^{ab}
Germinated	7.7±0.3^{bc}	12.1±0.2^{d}	5.9±0.2^{a}	1.0±0.1^{cd}	67.2±0.7^{b}	31.5±0.4^{b}
Fermented	6.8±0.4^{bc}	12.9±0.3^{d}	6.6±0.3^{a}	0.9±0.0^{d}	70.6±0.1^{a}	33.6±1.0^{ab}
Cowpea						
Washed	13.5±1.1^{a}	23.6±0.0^{c}	2.4±0.4^{b}	3.4±0.0^{a}	44.6±0.6^{e}	33.6±0.7^{ab}
Soaked	7.9±0.4^{bc}	24.7±0.2^{c}	2.3±0.2^{b}	3.5±0.0^{a}	48.1±0.1^{d}	36.2±0.0^{ab}
Germinated	8.3±0.0^{bc}	27.9±0.6^{a}	2.5±0.3^{b}	3.4±0.2^{a}	47.4±1.8^{de}	32.5±3.1^{ab}
Fermented	8.4±0.2^{b}	26.3±0.4^{b}	2.3±0.1^{b}	2.9±0.1^{b}	51.9±0.2^{c}	36.9±0.8^{a}

Effect of pre-treatments on microstructure

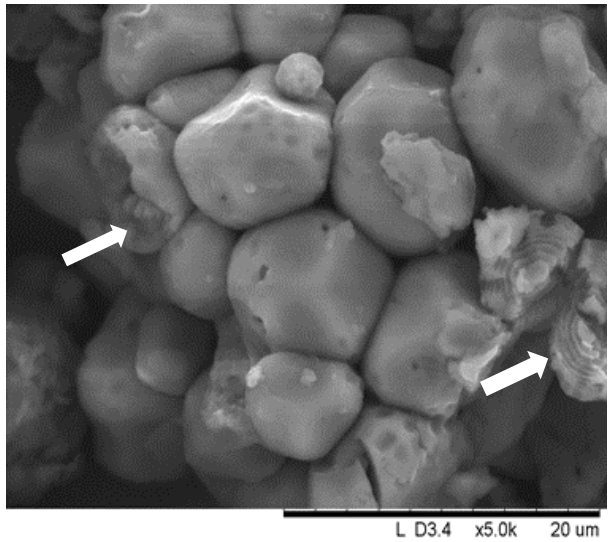
Washed pearl millet



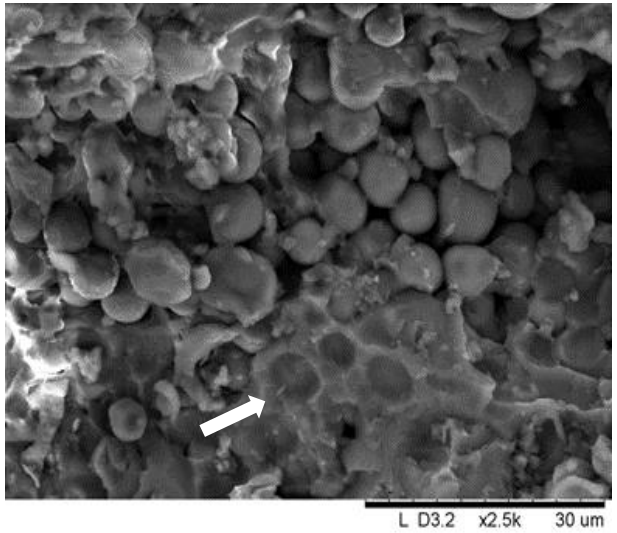
Soaked pearl millet



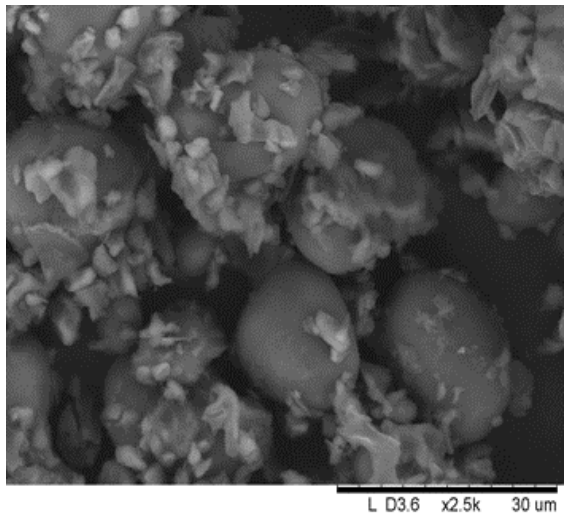
Germinated pearl millet



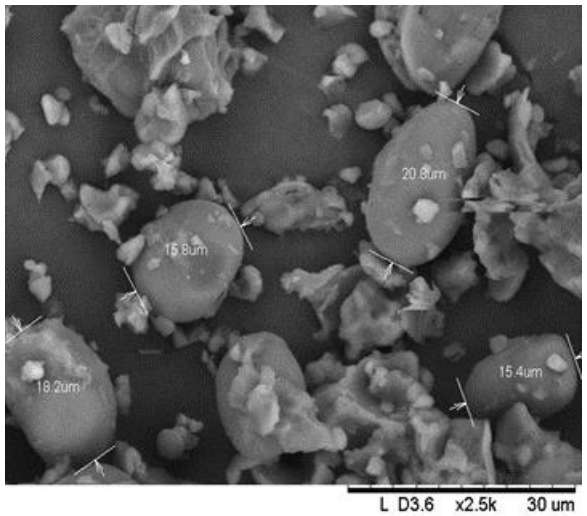
Fermented pearl millet



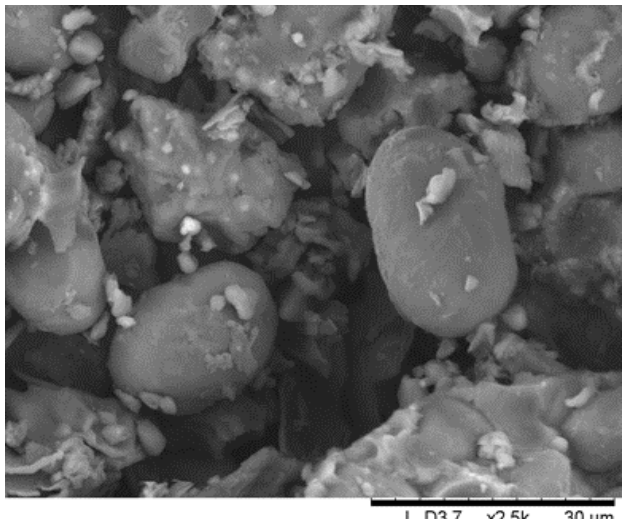
Washed cowpea



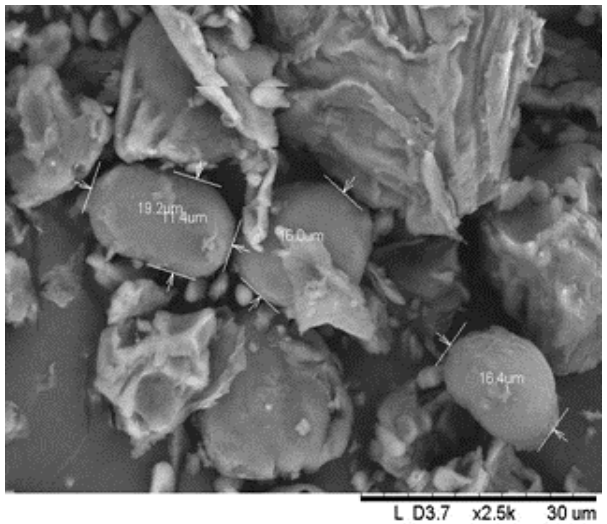
Soaked cowpea



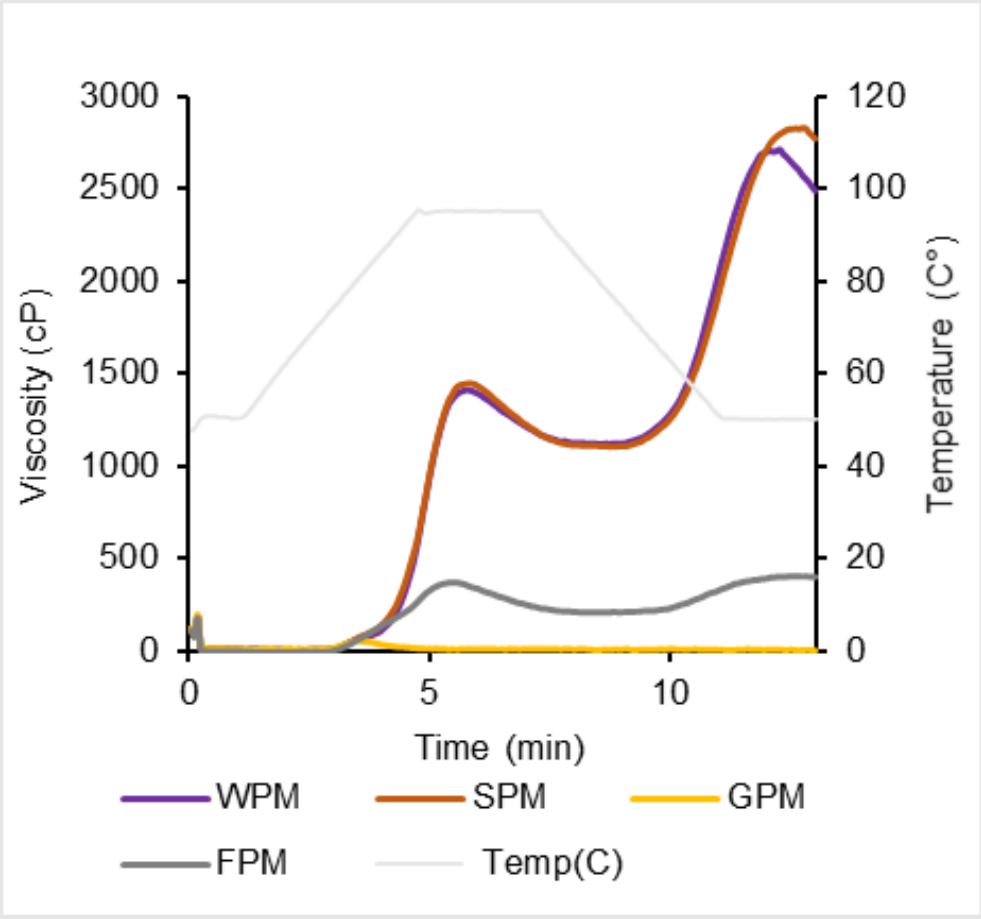
Germinated cowpea

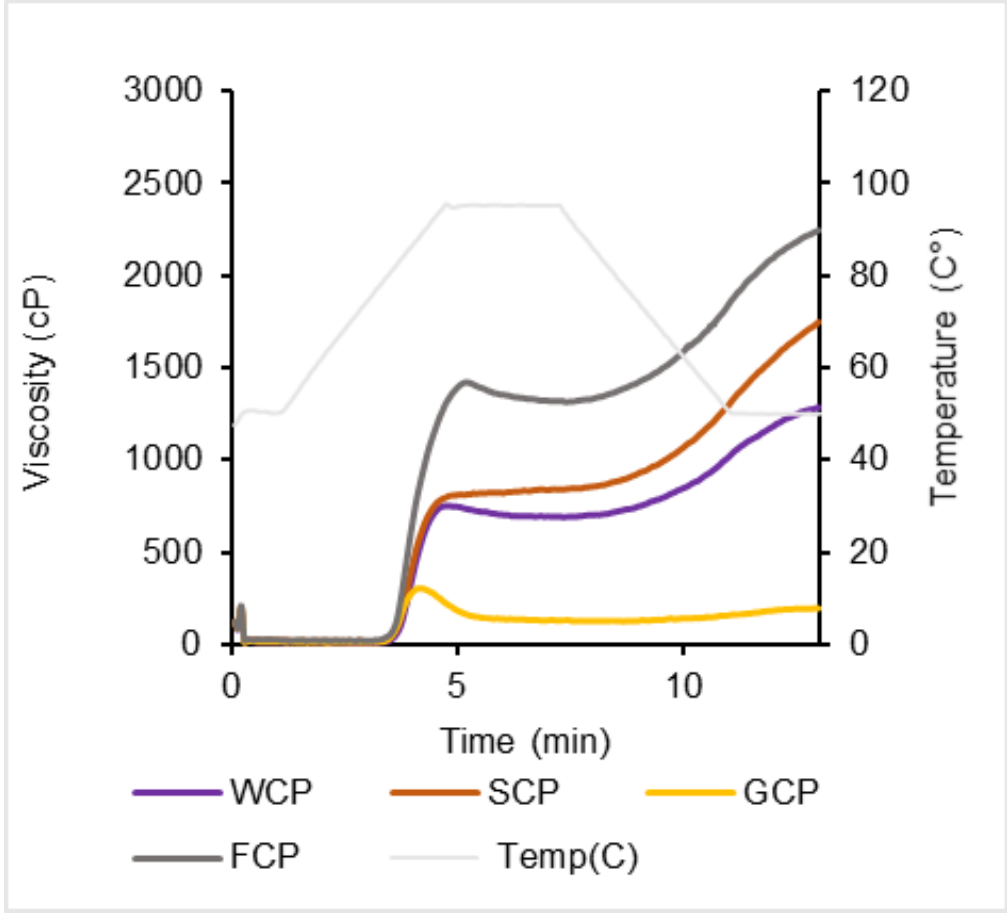


Fermented cowpea

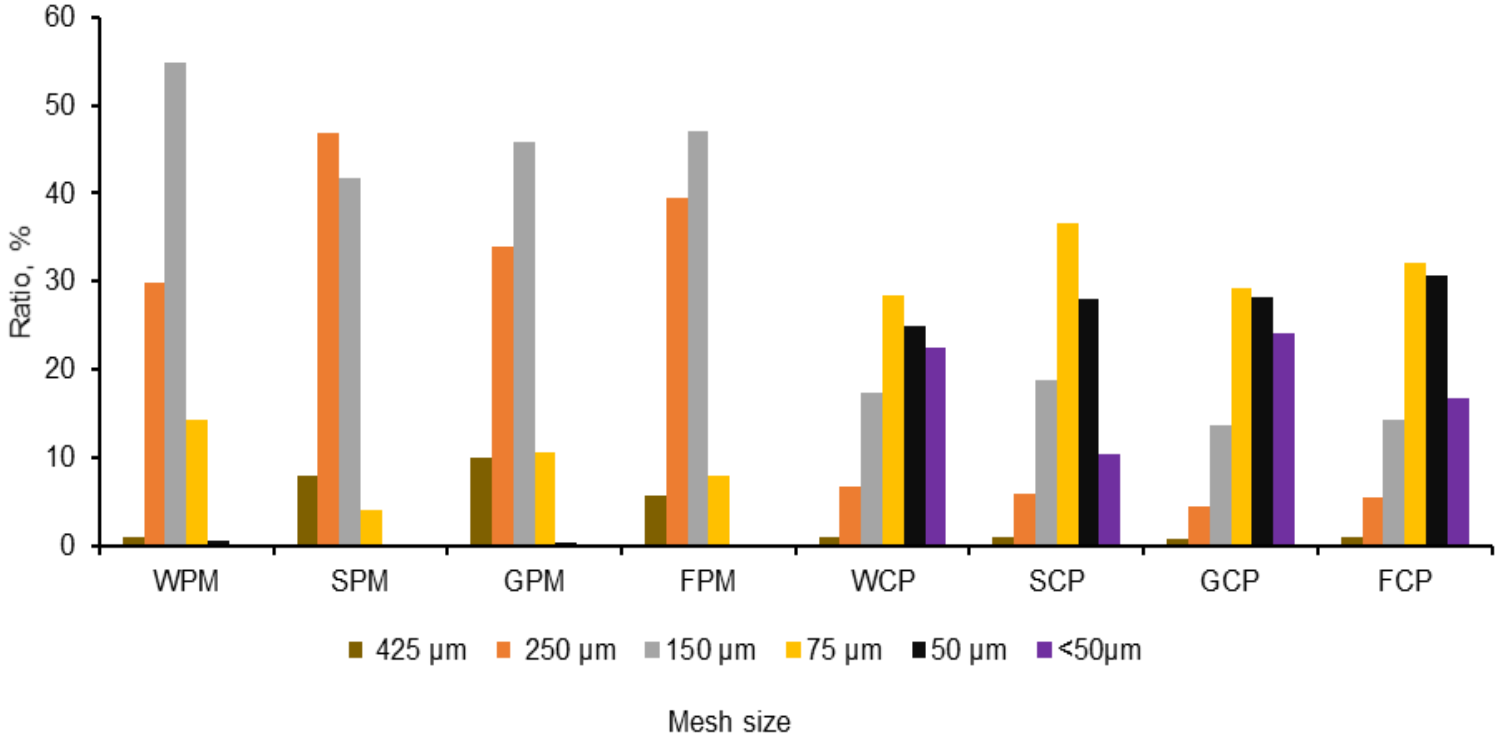


Effect of pre-treatments on the pasting properties

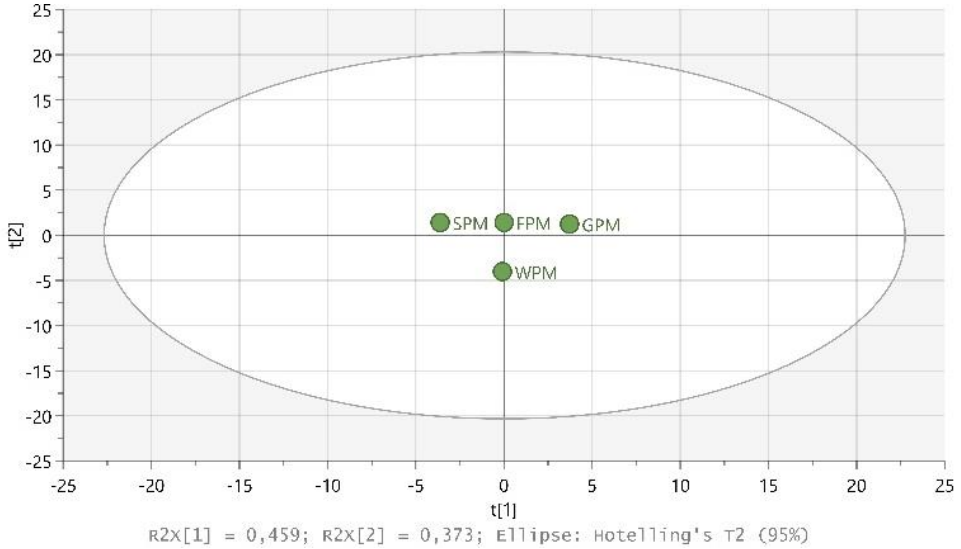


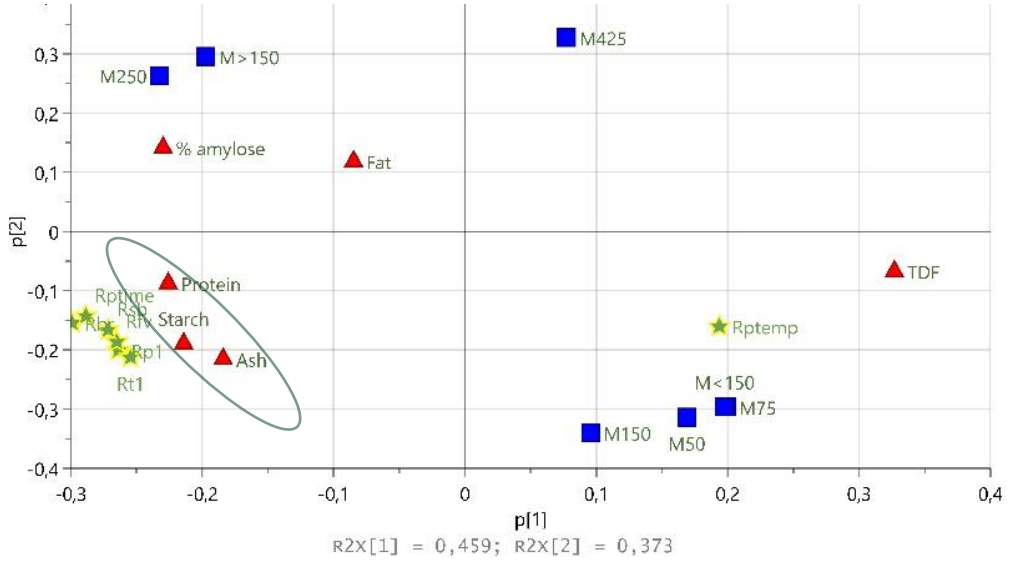


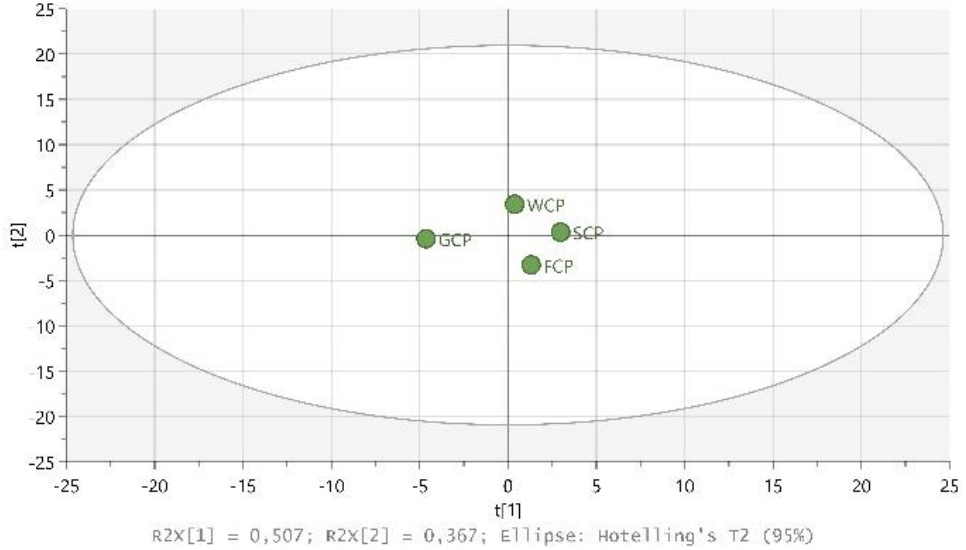
Effect of pre-treatment on the particle size distribution

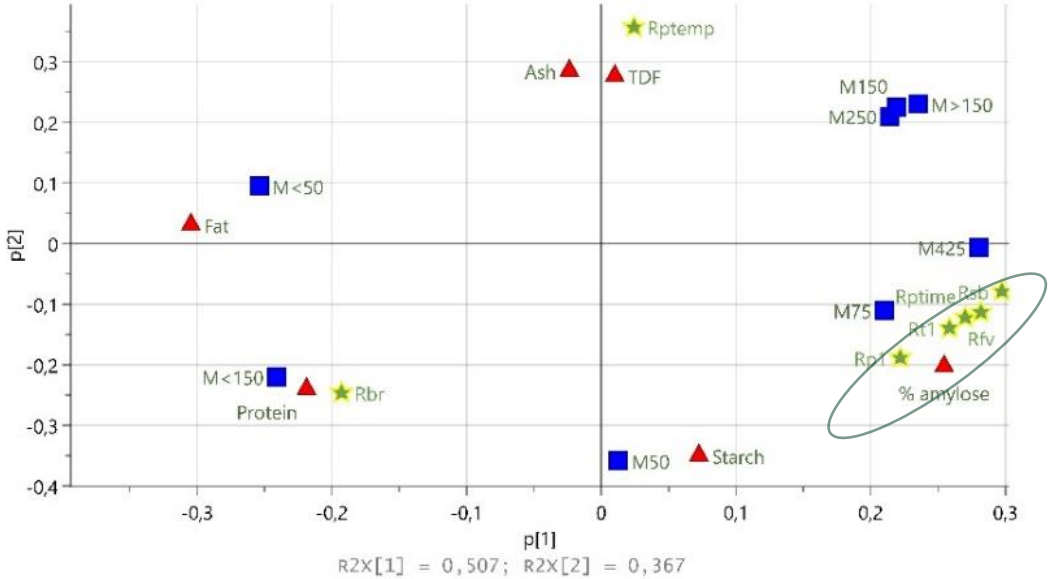


Multivariate Analysis

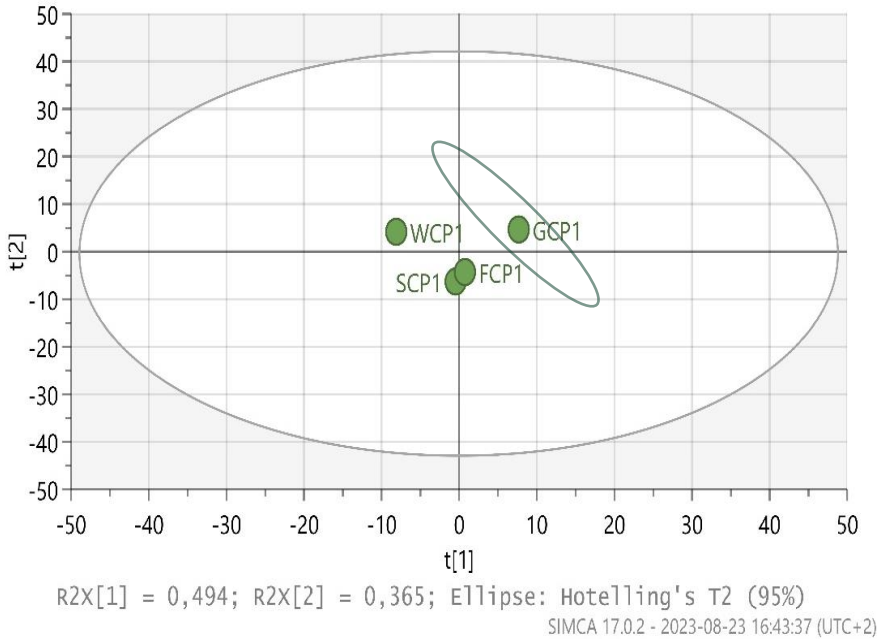


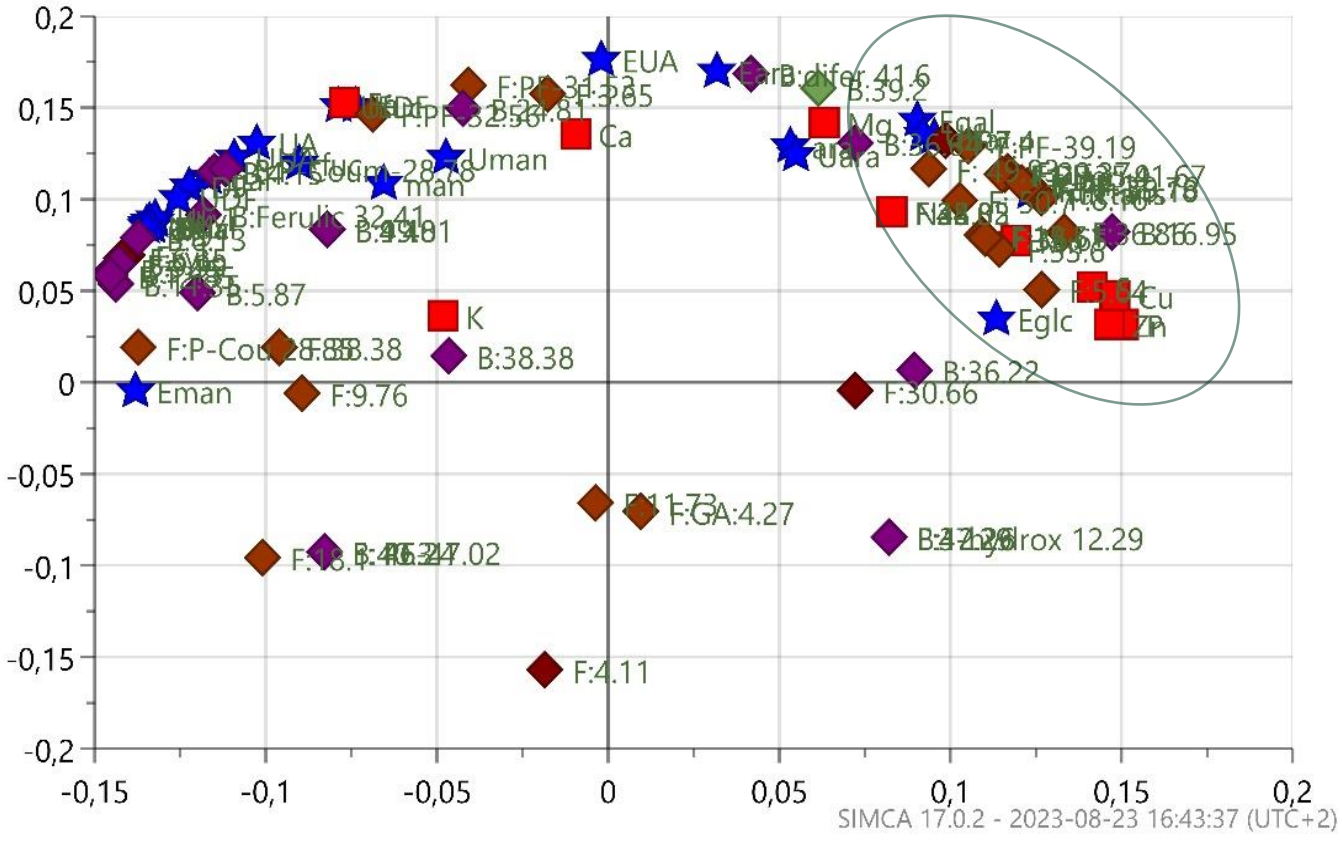




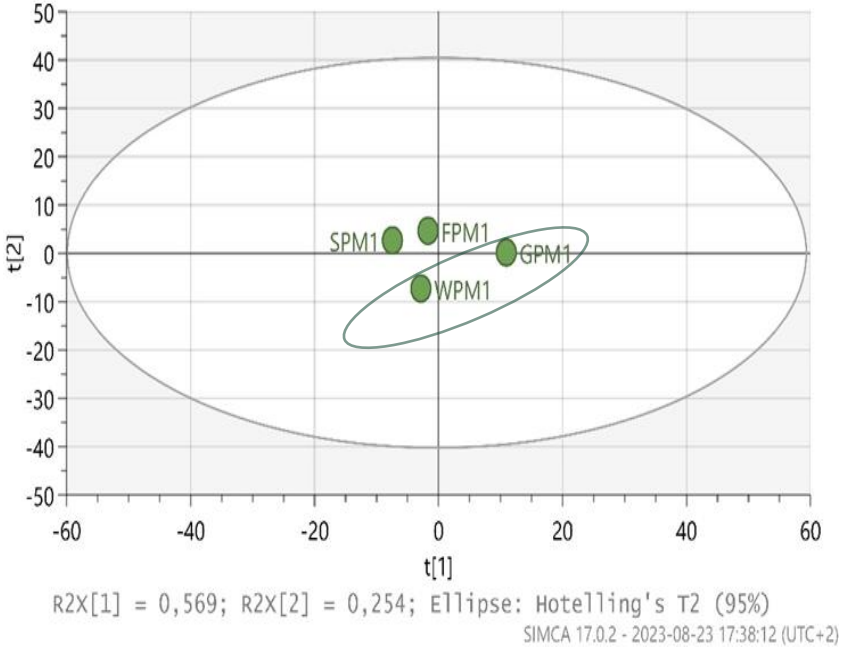


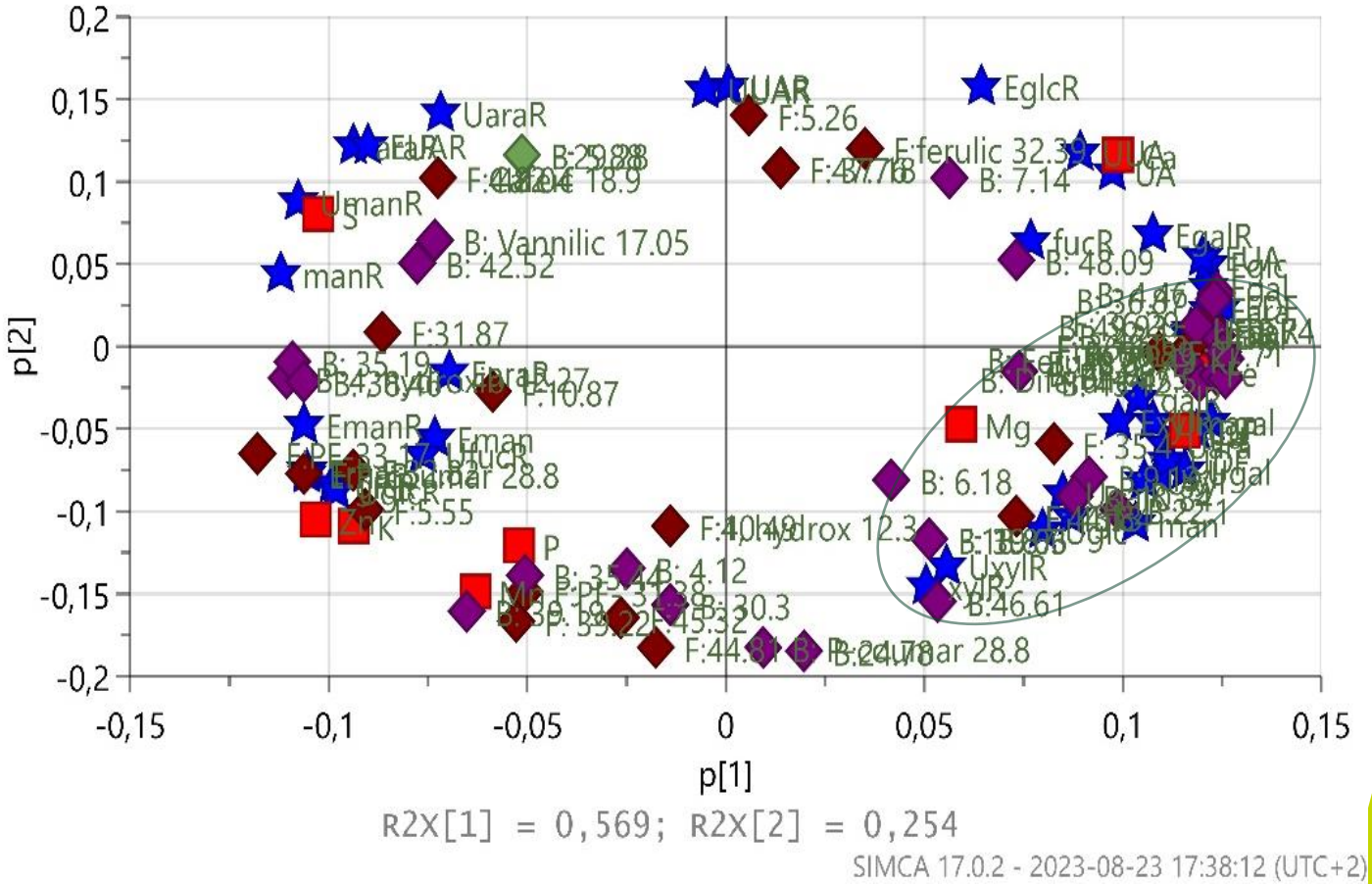
Multivariate Analysis





Multivariate Analysis





Some conslusion marks

- The study showed that the pre-treatments such as soaking, germination and fermentation, had a positive effect on the grains changing the physicochemical as well as microstructure properties

- Germinated samples showed that enzymes break down the starch, reducing the amount of total starch and amylose content. Which is an important factor to increase the energy density of the porridge

- Germination and fermentation processes released free and bound phenolic compounds. Phenolic compounds are important for human beings because they act in defence response as anti-inflammatory, antioxidants and preventing chronic diseases.

A good comprehension of these modifications in the grains introduced by pre-treatments is very important to prepare complementary porridge with high nutritional value for undernourished children in Mozambique and around the world and for developing new novel food products

Understanding the effect of cooking on physicochemical properties and phytic acid of cooked composite porridge – Second ongoing project

		Pearl millet				Cowpea			
	CODE	Treatment	%	Treatment	%	Treatments	%	Treatment	%
1	SS	Soaked	60	-	-	Soaked	40	-	-
2	SGS	Soaked	55	Germinated	5	Soaked	40	-	-
3	SSG	Soaked	60			Soaked	35	Germinated	5
4	SF	Soaked	60	-	-	Fermented	40	-	-
5	SGF	Soaked	55	Germinated	5	Fermented	40	-	-
6	SFG	Soaked	60			Fermented	35	Germinated	5
7	FS	Fermented	60	-	-	Soaked	40	-	-
8	FGS	Fermented	55	Germinated	5	Soaked	40	-	-
9	FSG	Fermented	60			Soaked	35	Germinated	5
10	FF	Fermented	60	-	-	Fermented	40	-	-
11	FGF	Fermented	55	Germinated	5	Fermented	40	-	-
12	FFG	Fermented	60			Fermented	35	Germinated	5

Effect of treatments on the starch digestibility of complementary porridge –

Third ongoing project

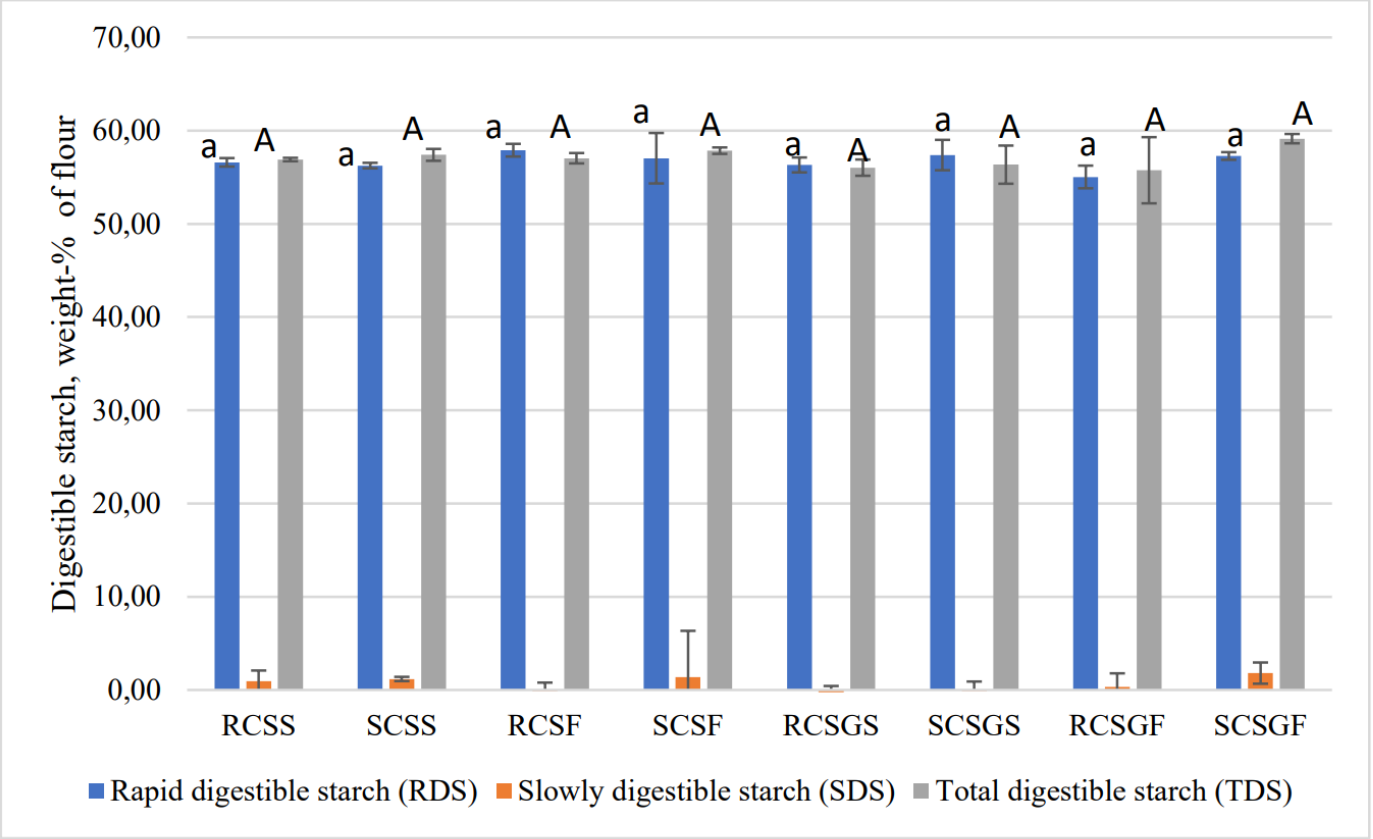


Figure 5 Results of starch digestion of "cooked" formulated blends. Values are mean of two replicates. Sample codes are explained in Table 1 under materials and methods. Bars with same letters are not significantly different.

Figure extrated from
(Signe Christerson, Master thesis (SLU); co-supervision by Sunera Nurmomade)

Thank you for your attention

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