Ohmic Baking in Improving Gluten-Free Bread Characteristics: Role of Starch and Flour

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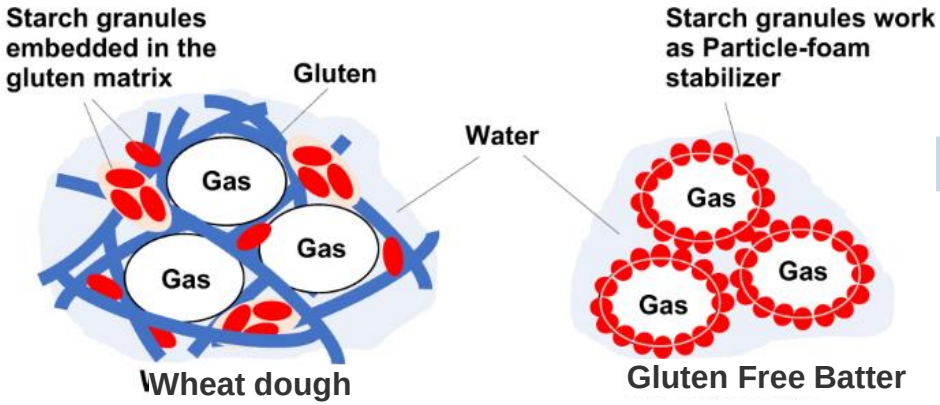
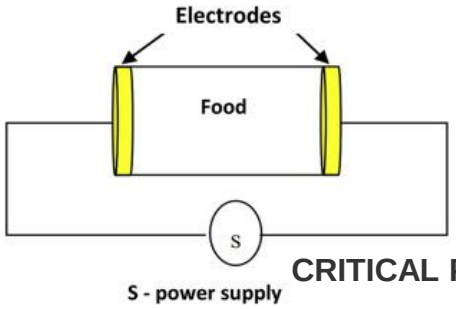
BACKGROUND



Less viscoelastic, CO_2 dissipate easily, low bread quality

Combined with ingredients or additives

G'>G", G">G', no effect



CRITICAL PARAMETERS

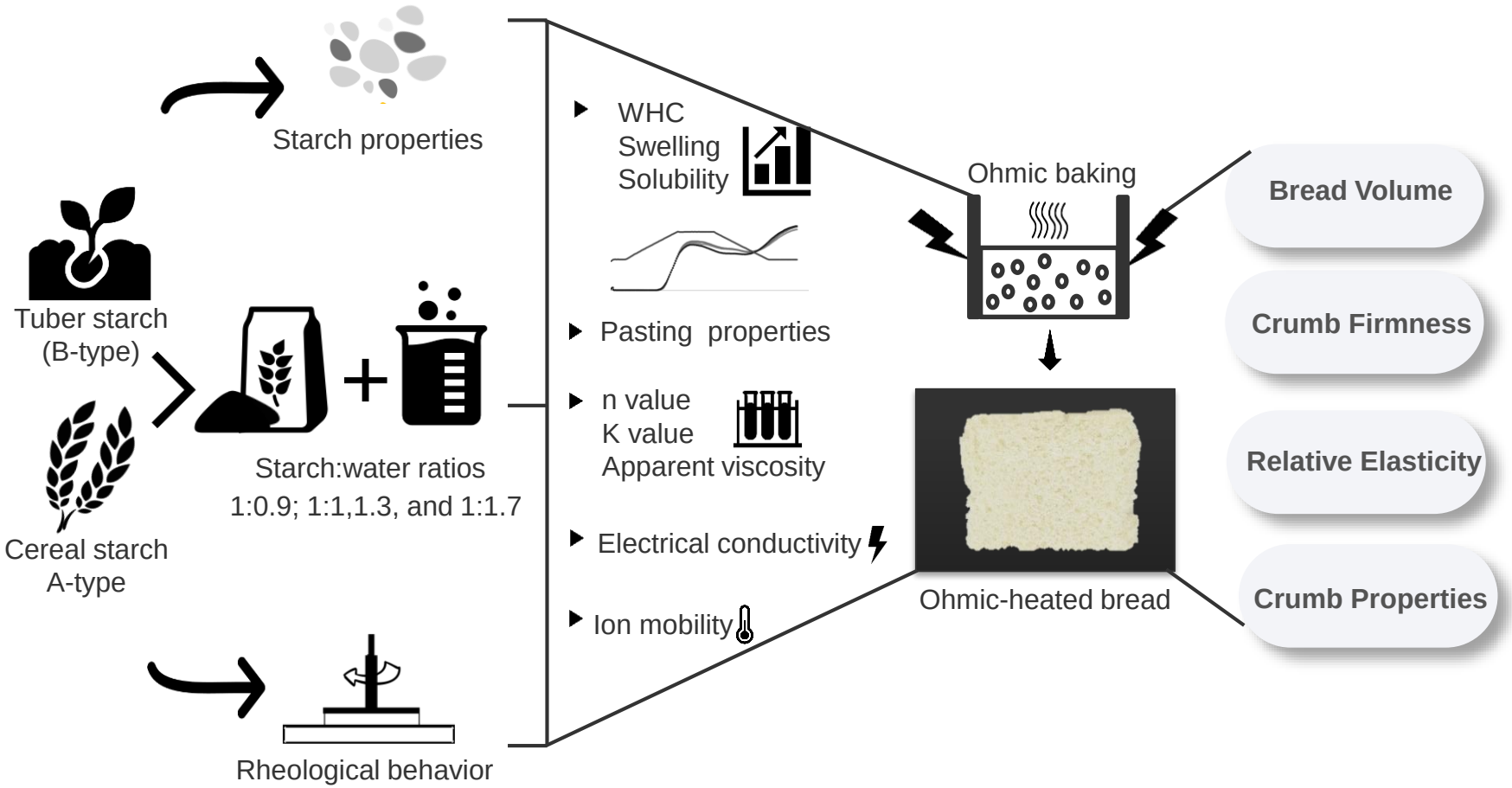
Rheology
Electrical conductivity
GF Bread Characteristics

OBJECTIVES

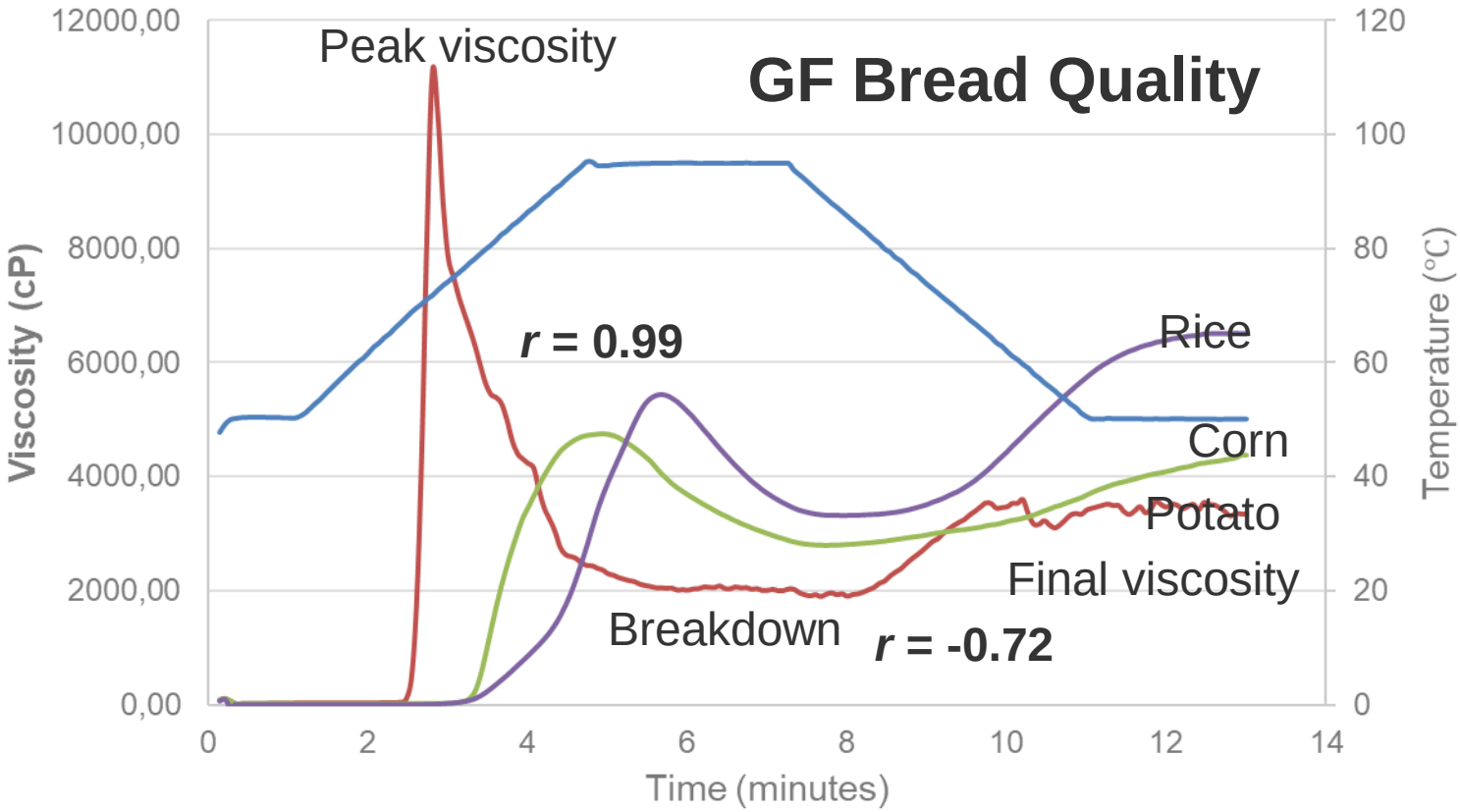
1. Investigate the role of GF starch (and flour) from different sources (tuber and cereal)

2. Investigate the rheological behavior of GF batter and the final bread quality after baking with ohmic heating

MATERIALS AND METHODS



PASTING PROPERTIES



Amylosa, swelling power, solubility index, granule sizes tuber starch > cereal starch

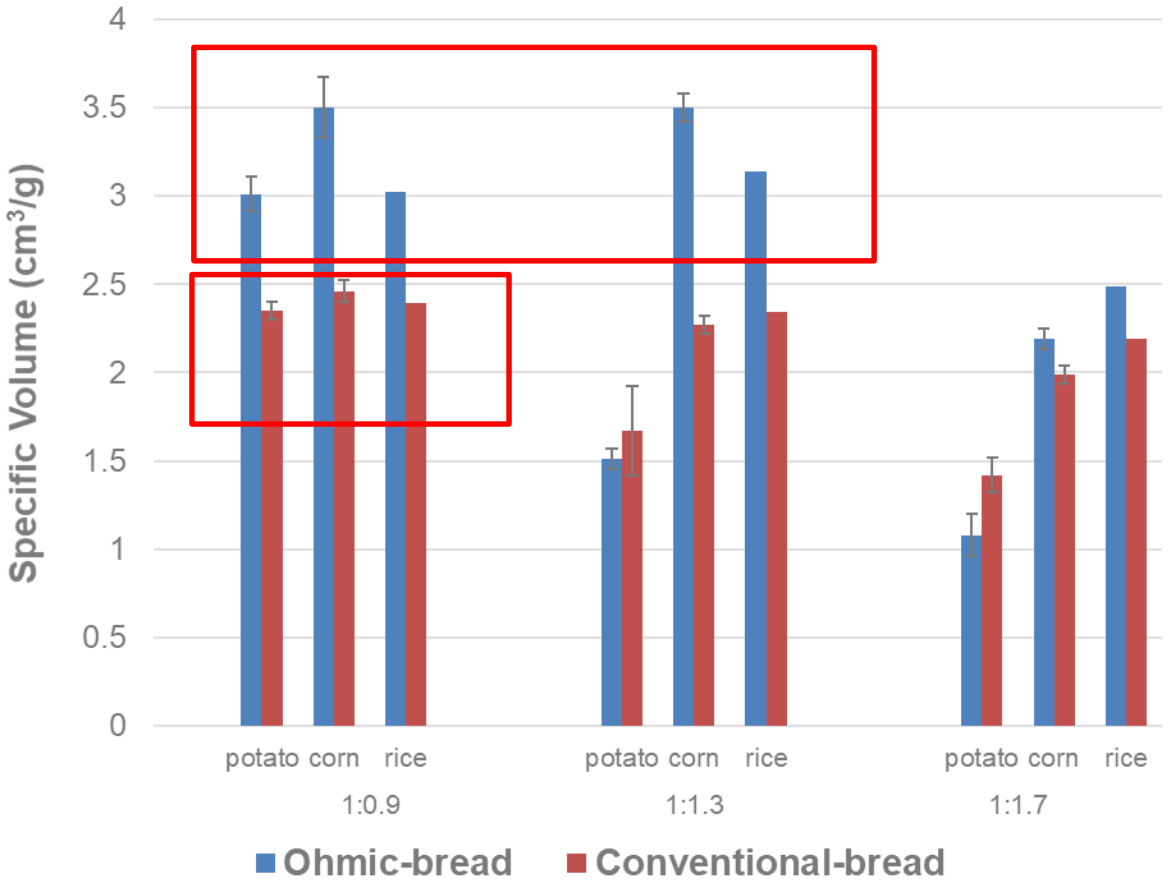
RHEOLOGY BEHAVIOR

Sample	Ratio	Electrical conductivity (S/m)	n	K (Pa. S^n)	Apparent viscosity (Pa·s)
Corn	1:0.9	0.64 ± 0.04a	0.48 ± 0.06a	266.98 ± 13.84c	29.11 ± 4.33b
	1:1.3	0.53 ± 0.04a	0.46 ± 0.01a	62.36 ± 0.44b	4.15 ± 0.15a
	1:1.7	0.56 ± 0.08a	0.52 ± 0.02a	21.20 ± 1.00a	1.98 ± 0.09a
Potato	1:0.9	0.47 ± 0.03a	0.55 ± 0.06a	358.95 ± 13.19c	47.12 ± 10.09b
	1:1.3	0.53 ± 0.01b	0.55 ± 0.02a	70.85 ± 3.86b	8.14 ± 0.27a
	1:1.7	0.46 ± 0.02a	0.55 ± 0.03a	28.06 ± 0.97a	2.80 ± 0.10a
Rice	1:0.9	0.57 ± 0.00c	0.36 ± 0.02a	749.23 ± 50.08c	63.04 ± 13.99ba
	1:1.3	0.53 ± 0.02b	0.45 ± 0.02b	130.14 ± 6.68b	15.86 ± 0.71ab
	1:1.7	0.42 ± 0.01a	0.53 ± 0.04c	46.51 ± 0.88a	5.64 ± 0.07ab

- Dillution effect of water on electrical conductivity, EC requirement 0.1-10 S/m
- Pseudoplastis, n value < 1
- Higher water decreased the viscosity and consistency

Frequency sweep: Loss modulus (G")>Storage modulus (G'), tan δ < 1
viscoelastic liquid with a dominant viscous behavior

BREAD SPECIFIC VOLUME

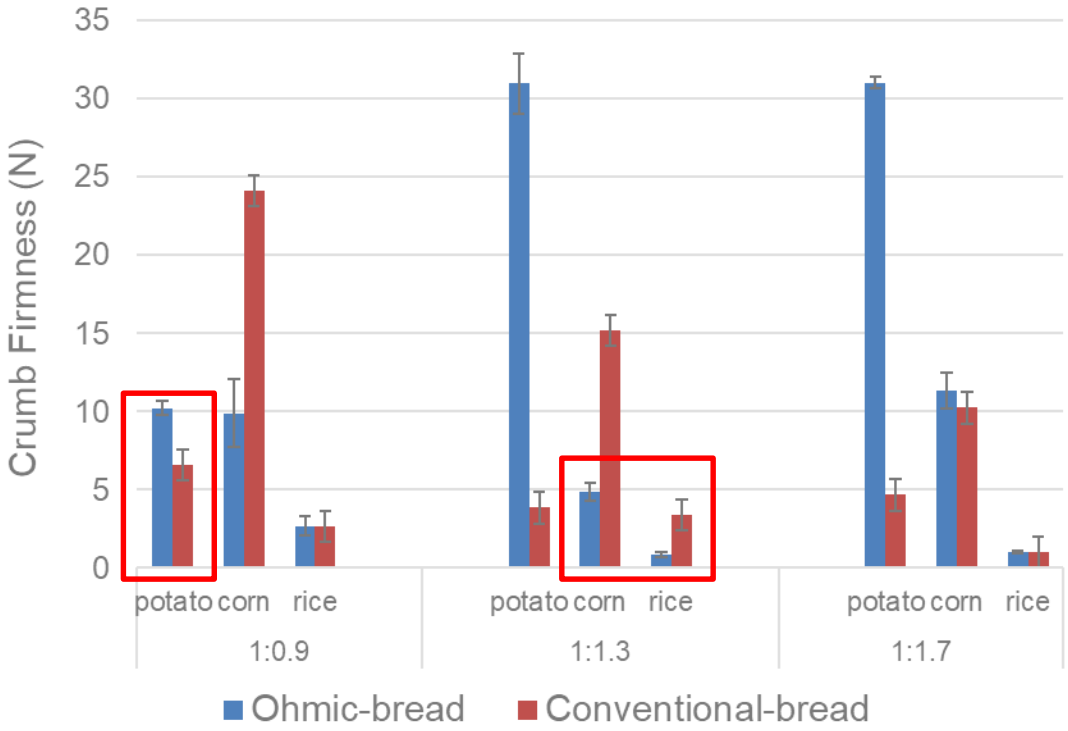


OH formed stable or firm bread crumb before CO_2 dissipation

Correlation with baking loss $r = 0.67$

Ohmic-bread has no crust

CRUMB FIRMNESS

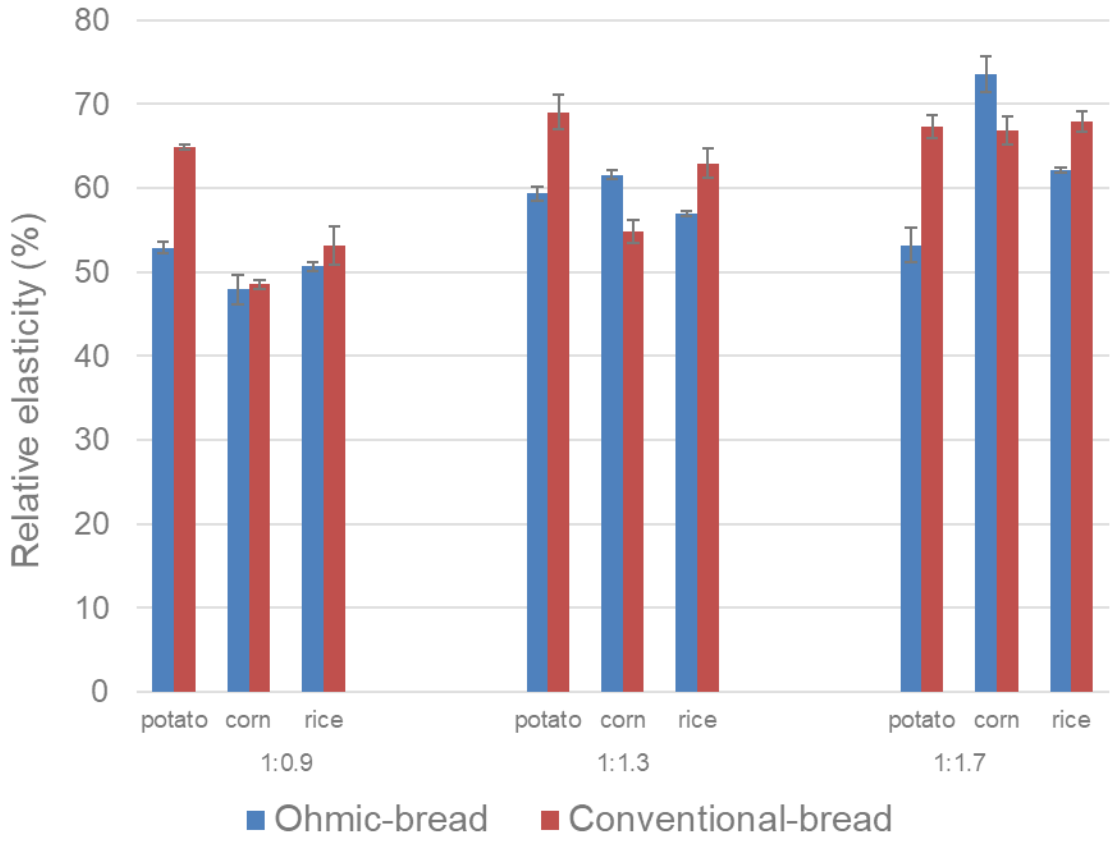


Crumb firmness of tuber starch > cereal starch at higher water content

Negative correlation with breakdown and peak viscosity, $r = 0.81$

Pasting properties influenced crumb firmness

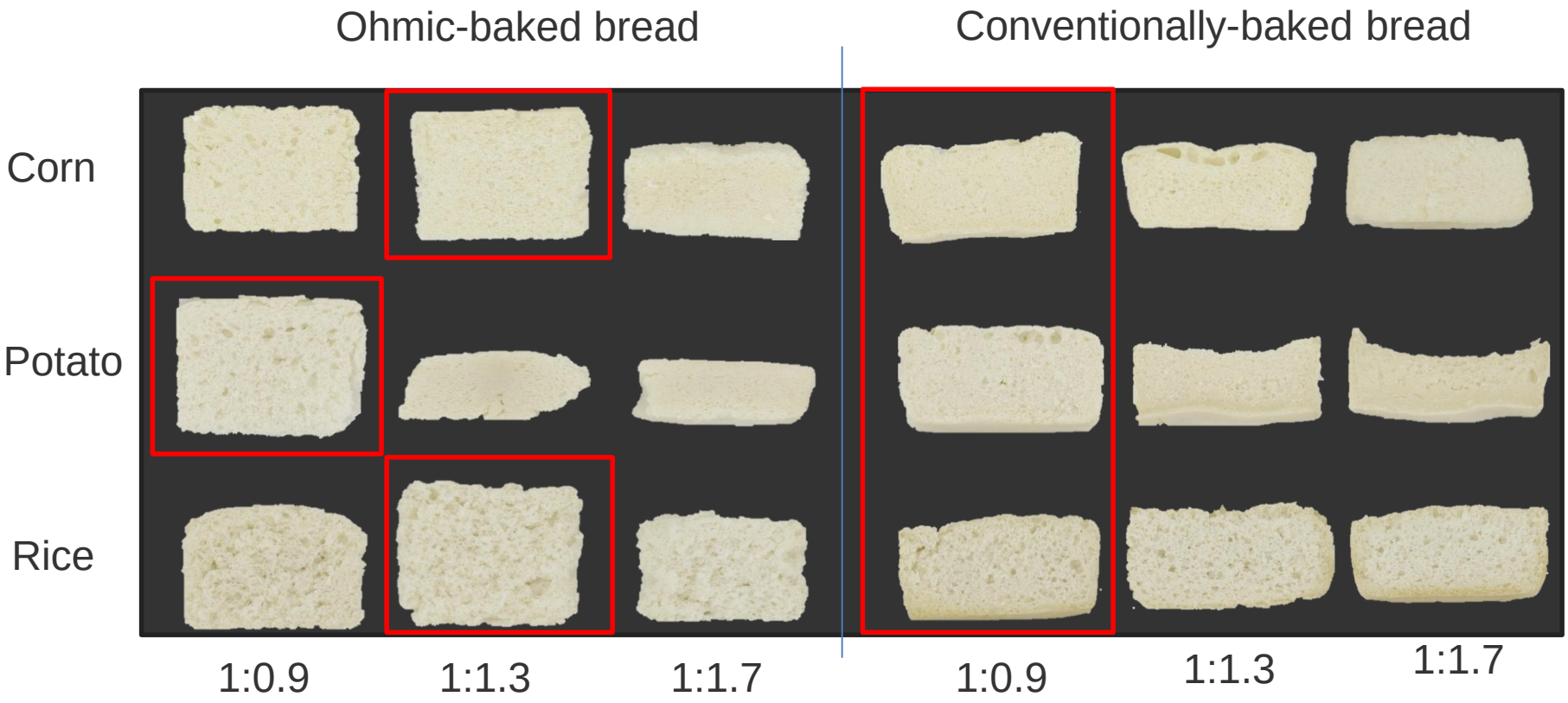
RELATIVE ELASTICITY



Ohmic-heated bread and conventionally bread showed similar trends

Higher relative elasticity not always reflected better bread properties

BREAD SLICES CROSS-SECTIONS



CONCLUSIONS

1. A non-linear relationship between viscosity and ohmic-baked bread characteristics was found
2. The different behavior of A and B-type starches at similar water content was strongly influenced by its structural characteristics
3. B-type starch required lower water content with a high viscosity
4. A-type starch required medium water content with a low to medium viscosity range

PUBLICATION

Waziiroh E, Bender D, Saric A, Jaeger H, Schoenlechner R (2021) Ohmic baking of gluten-free bread : role of starch and flour on batter properties. App. Sci, *11*(6567). https://doi.org/https://doi.org/10.3390/app11146567

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