FGC
Functional Grains Centre

Functional Properties of Chickpea Flours:
Australian and Bangladeshi Varieties

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A report on a research project conducted by Prof Mohammad Gulzarul Aziz

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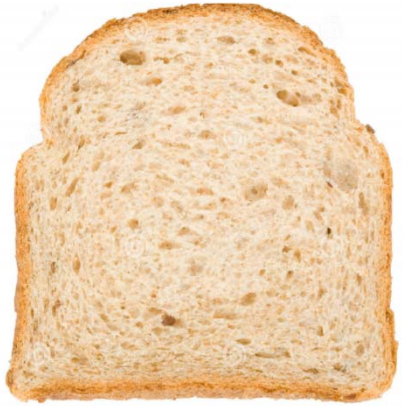
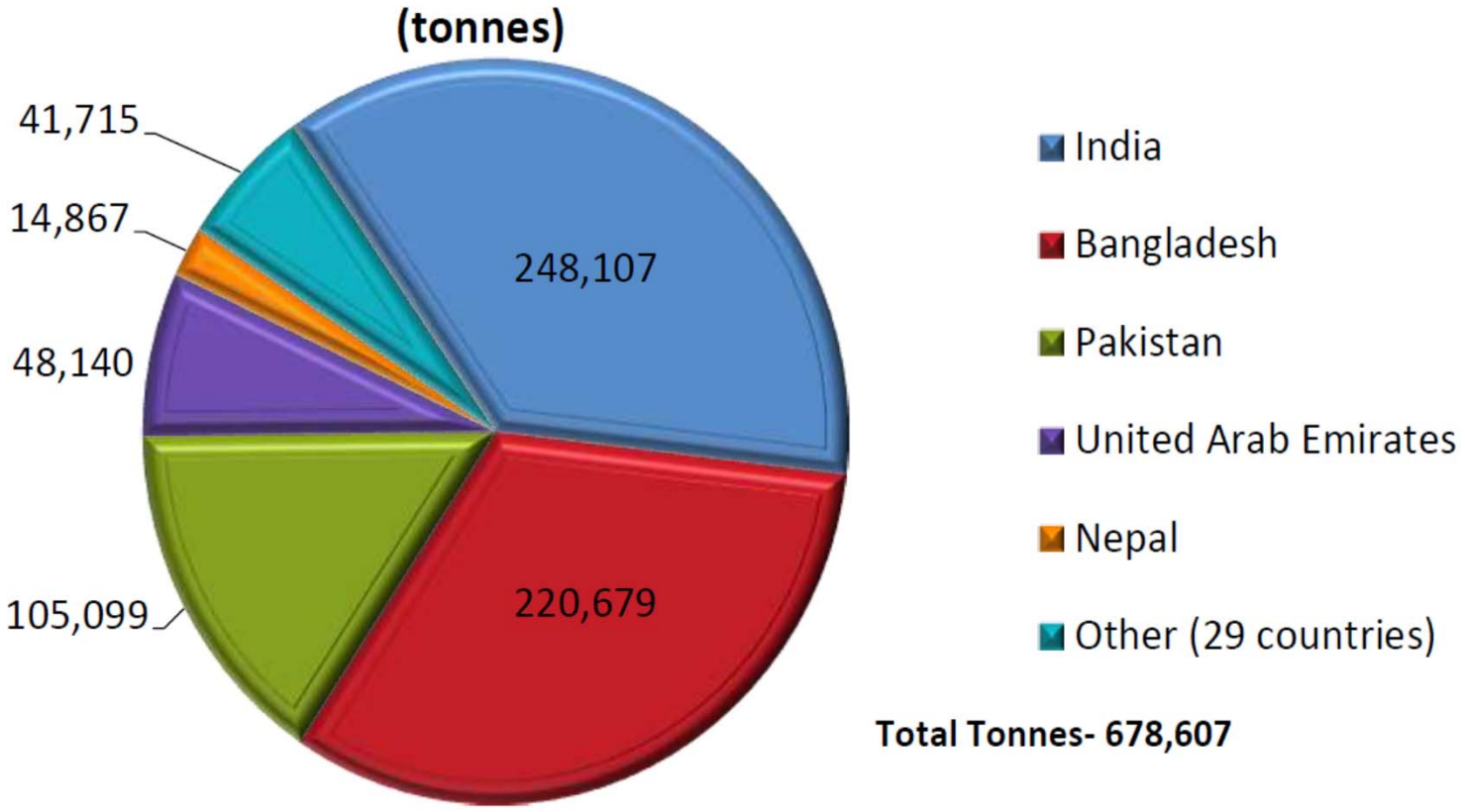
Why study chickpea flours?
Implications:

- Value addition to chickpea in developing new ingredients
- Breeding programs, developing new varieties



Australian Chickpea exports by country Nov 2014 – Oct 2015



Total Tonnes- 678,607

Source: Pulse Australia :www.pulseaus.com.au

Chickpea Samples


BINA-2


BINA-3


BINA-4


BINA-5


BINA-6


BINA-7


BINA-8

Bangladeshi Varieties


Amber


Slasher


HatTrick


Boundary

Australian Varieties

Dehuler

Mill

DSC
RVA
TA
Colorimeter
TPC
Emulsifying capacity

Chemical composition of chickpea flours

	Protein (wb%)	Protein (% db)	Moisture (%)	Ash (%)	Fat (%)	Dry matter (%)
Australian Varieties						
Amber	27.3	29.07	6.10	2.49	4.8	93.90
Boundary	24.5	26.18	6.40	2.45	4.9	93.60
HatTrick	24.3	25.88	6.10	2.41	5.1	93.90
Slasher	24.6	26.23	6.20	2.70	4.6	93.80
Bangladeshi Varieties						
BINA-2	19.35	21.29	9.12	3.1	ND	90.88
BINA-3	21.4	23.96	10.67	3.2	ND	89.33
BINA-4	22.1	24.55	9.97	3.08	ND	90.03
BINA-5	19.95	22.11	9.76	2.9	ND	90.24
BINA-6	21.59	24.08	10.34	2.95	ND	89.66
BINA-7	23.78	26.72	11.01	3.02	ND	88.99
BINA-8	23.8	26.62	10.60	3.01	ND	89.40

Dietary fibre of chickpea flours

	Insoluble DF (%)	Soluble DF (%)	Total DF (%)	IDF/SDF
Australian Varieties				
Amber	10.73	3.39	14.12	3.16
Boundary	13.25	4.76	18.01	2.78
HatTricK	9.93	5.88	15.81	1.69
Slasher	12.28	4.22	16.50	2.91
Bangladesh Varieties				
BINA 2	10.61	5.30	15.90	2.00
BINA-3	12.19	4.38	16.56	2.79
BINA-4	11.62	4.52	16.14	2.57
BINA-5	11.77	6.60	18.36	1.78
BINA-6	11.22	8.14	19.36	1.38
BINA-7	13.52	7.98	21.50	1.70
BINA-8	10.67	5.68	16.35	1.88

Colour of chickpea flours

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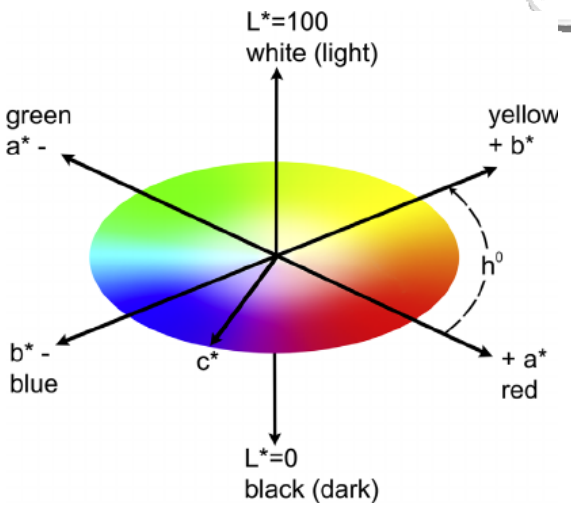
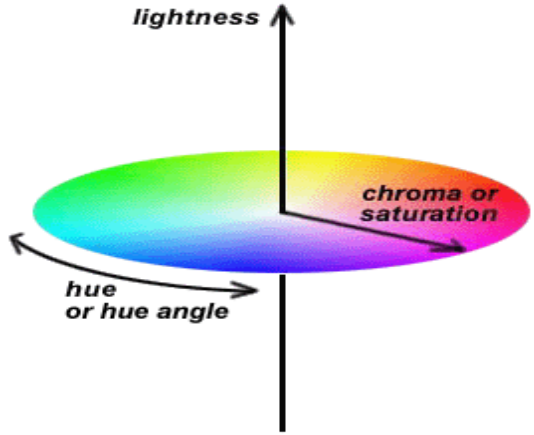
Variety	L-value	a-value	b-value	h-value	c-value
Australian					
Amber	89.10 ±.02	1.72 ±.01	20.99 ±.01	1.49 ±.00	21.06 ±.01
Boundary	89.14±.03	1.58±.06	20.15±.32	1.49±.00	20.22±.31
Hatrik	88.66±.07	1.76±.03	22.54±.12	1.49±.01	22.61±.11
Slasher	89.02±.17	1.91±.02	22.57±.20	1.49±.00	22.65±.20
Bangladeshi					
BINA-2	88.46±0.15	1.70±0.03	22.76±0.01	1.50±0.0	22.82±0.01
BINA-3	88.21±0.11	1.80±0.04	23.71±0.23	1.50±0.0	23.78±0.23
BINA-4	88.12±0.01	1.41±0.02	22.58±0.26	1.51±0.0	22.63±0.26
BINA-5	83.29±0.14	8.46±0.07	21.00±0.25	1.19±0.0	22.64±0.25
BINA-6	88.05±0.16	1.39±0.04	22.79±0.18	1.51±0.0	22.83±0.18
BINA-7	88.28±0.06	1.35±0.03	21.77±0.13	1.51±0.0	21.81±0.13
BINA-8	87.85±0.12	1.36±0.04	22.66±0.22	1.51±0.0	22.70±0.21





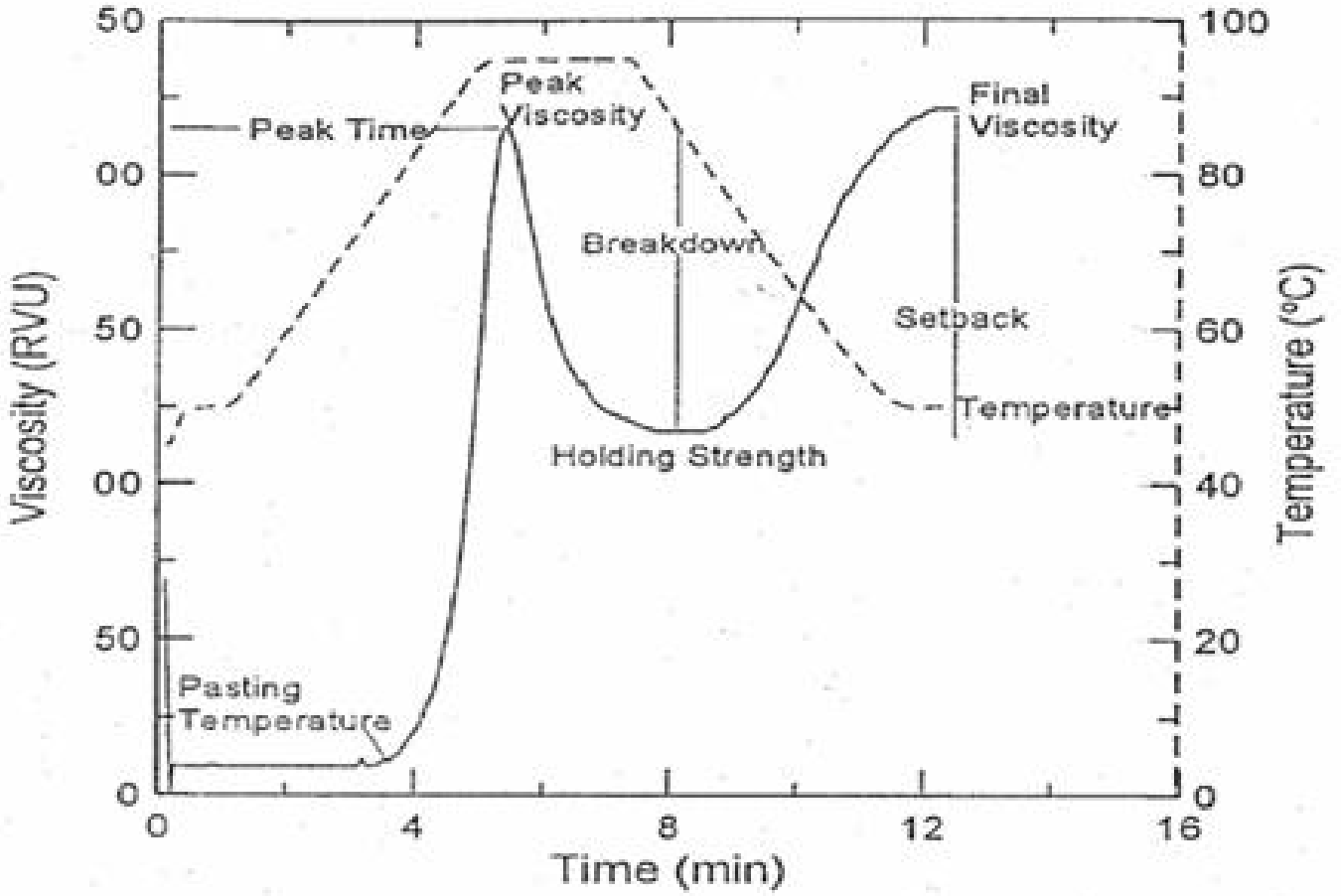
Flowability of chickpea flours

Variety	Bulk Density (kg/m^3)	Tapped Density (kg/m^3)	Carr Index	Hausner Ratio	Flowability	Cohesiveness
Australian						
Amber	379.33	540.61	29.83	1.43	Poor	High
Boundary	385.33	558.48	31.00	1.45	Poor	High
Hatrick	394.27	540.10	27.00	1.37	Passiable	Intermediate
Slasher	396.60	566.57	30.00	1.43	Poor	High
Bangladeshi						
BINA-2	354.5					
BINA-3	378.42					
BINA-4	375.2					
BINA-5	368.85					
BINA-6	360					
BINA-7	381.15					
BINA-8	383.92					

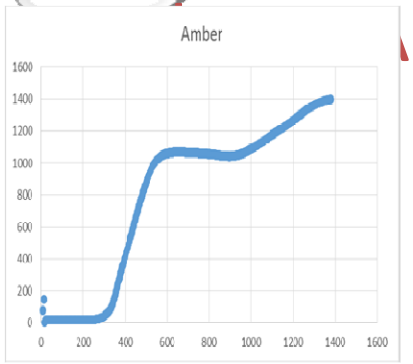
Less cohesive

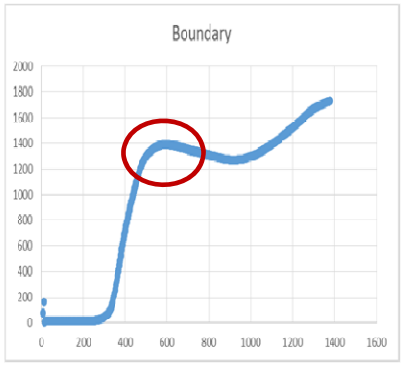
More cohesive

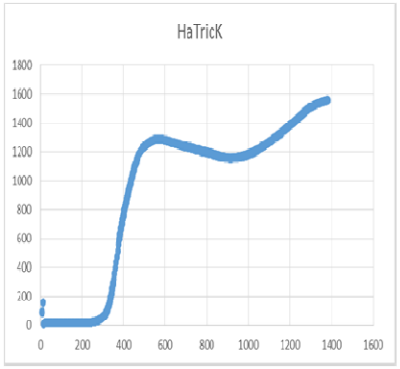
Pasting properties using Rapid Visco Analyser

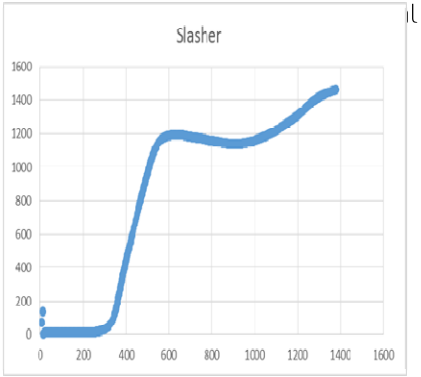


Pasting properties of chickpea flours

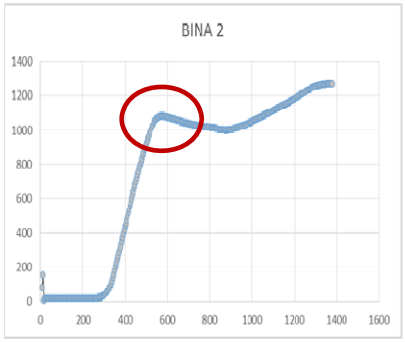


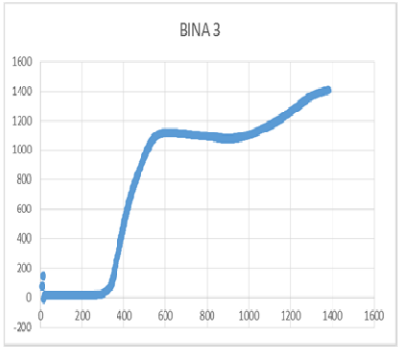


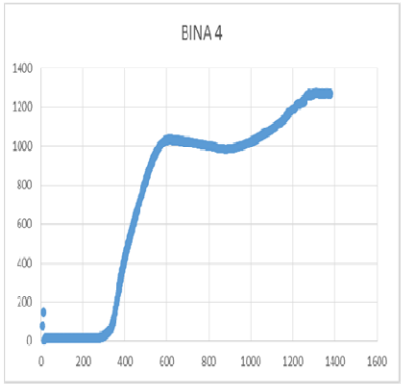


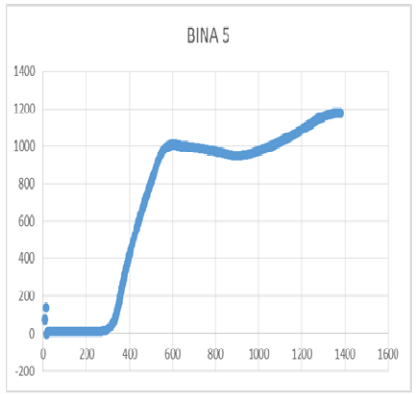


Australian

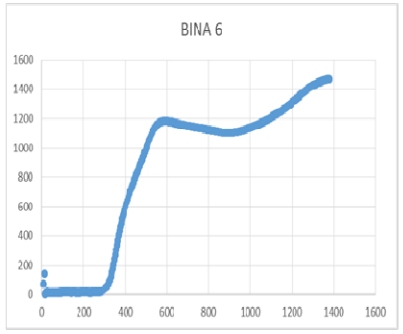


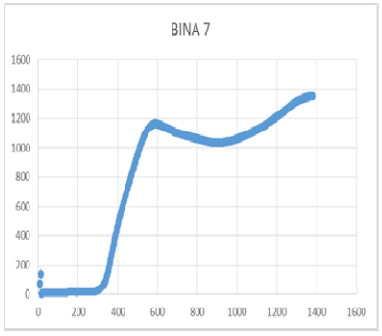


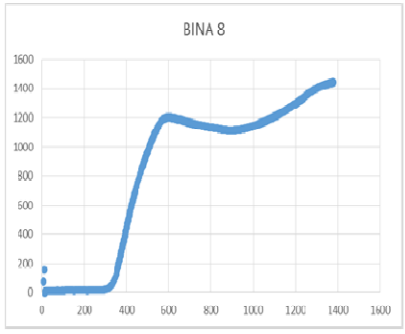




Bangladeshi







RVA pasting properties (cP) of chickpea flour

Variety	Peak 1	Trough 1	Breakdown	Final Viscosity	Setback	Peak Time	Pasting Temp
Australian							
Boundary	113.88±3.12	104.71±1.47	9.17±1.65	142.38±2.41	37.67±.94	9.90±0.04	74.00±.57
Amber	89.21±0.18	86.34±0.59	2.88±.77	114.50±2.72	28.17±2.12	10.63±.14	74.40±0
HatTrick	108.75±2.01	97.21±1.36	11.54±.65	130.58±1.41	33.38±.06	9.37±.05	72.35±0
Slasher	99.54±0.30	94.75±0.11	4.80±0.18	123.09±1.89	28.33±1.77	10.30±0.14	74.55±0.78
Bangladeshi							
BINA-2	89.67±0.35	82.17±1.53	7.50±1.17	105.50±0.59	23.34±0.94	9.57±0.05	73.98±0.04
BINA-3	91.59±2.35	88.50±1.77	3.09±0.59	115.17±2.71	26.67±0.94	10.17±0.33	74.95±0.28
BINA-4	85.13±1.70	81.67±0.35	3.46±1.36	105.38±0.29	23.71±0.06	10.00±0.38	74.98±0.32
BINA-5	85.54±2.18	80.96±2.77	4.59±0.59	101.13±4.07	20.17±1.29	9.93±0	74.55±0.28
BINA-6	98.55±0.18	91.88±0.06	6.67±0.12	124.17±2.60	32.29±2.53	9.80±0.10	73.78±0.32
BINA-7	97.79±1.00	86.71±0.88	11.09±0.12	114.09±2.00	27.38±1.12	9.74±0.09	74.18±0.32
BINA-8	98.79±1.82	92.13±1.00	6.67±0.83	120.67±0.59	28.55±1.59	9.87±0.19	74.78±0.60

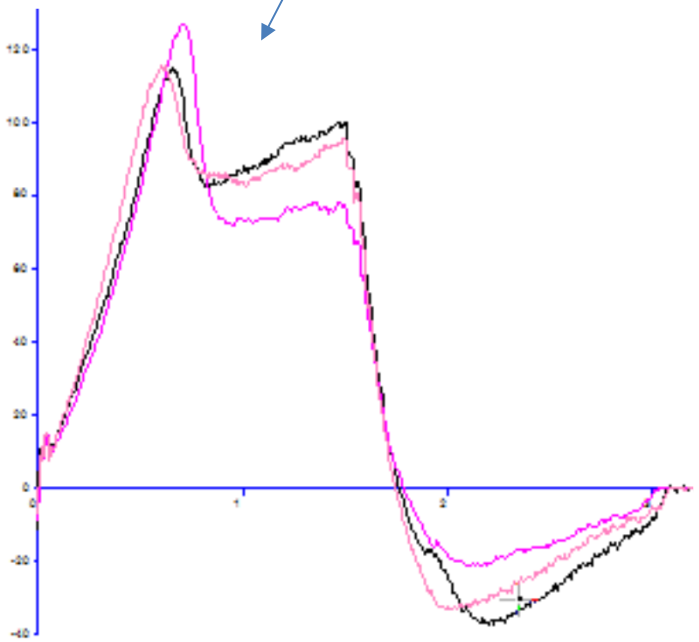
Manipulating pasting property of chickpea flours by particle size

Particle Size (µm)	Peak Viscosity (c	Final Viscocity (cP)	Setback viscosity (cP)	Pasting Temp C
Boundary				
Not seived	113.88	142.38	37.67	74.00
212	106.04	127.17	31.33	73.75
90	116.71	140.21	33.38	73.15
64	135.50	173.29	50.54	72.35
Amber				
Not seived	89.21	114.50	28.17	74.40
212	87.04	112.67	27.75	74.58
90	97.46	125.34	30.13	74.55
64	104.25	133.55	33.08	74.15
Slasher				
Not Seived	99.54	123.09	28.33	74.55
212	90.38	113.00	25.55	74.98
90	102.63	128.25	29.96	73.98
64	122.42	159.21	43.29	72.73
HatTrick				
Not seived	108.75	130.58	33.38	72.35
212	99.29	117.42	28.96	73.20
90	108.63	132.25	33.38	72.55
64	125.84	158.50	44.00	72.53

Particle size ↓ → peak and final viscosity ↑

Textural properties of chickpea gels as determined by Texture Analyser

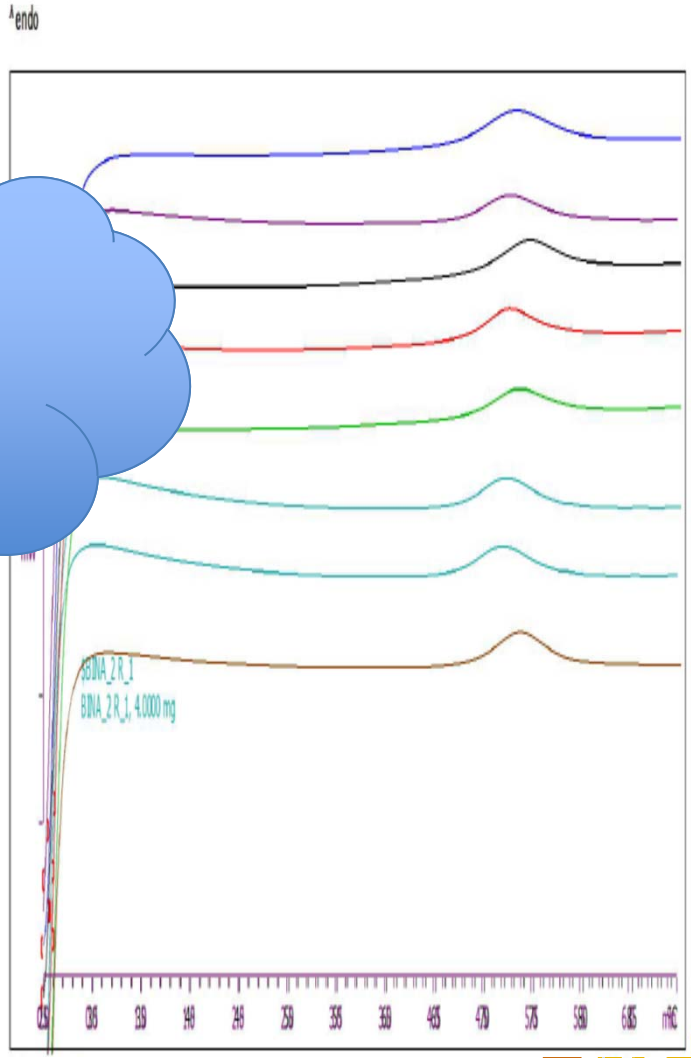
Varieties	Hardness (g/mm)	Work (g.mm)	Peak Force (g)
Australian			
Amber	20.74±1.0	373.41±18	115.64±1.0
HatTrick	23.20±1.0	358.68±10.0	126.61±1.2
Boundary	25.47±0.9	396.45±9.0	132.27±5.0
Slasher	24.20±0.9	338.68±0.98	116.61±3.0



Thermal behaviour of chickpea flours: DSC

Variety	Ts (°C)	Tp (°C)	Tc (°C)	ΔE (J/g)	Tc-Ts
Australian					
Amber	64.59±0.13	69.43±0.34	75.28±0.24	3.58±0.17	10.69±0.24
Boundary	65.00±0.09	69.70±0.17	75.08±0.22		
HatTrick	63.85±0	68.85±0	74.71±0		
Slasher	64.19±0.05	69.05±0.13	74.98		
Bangladeshi					
BINA-2	67.01±0	71.78±0	77.27±0		
BINA-3	68.19±0.16	73.17±0.16	78.26±0.11	5.50±	10.08±0.05
BINA-4	67.48±0.18	72.51±0.10	78.43±0.17	5.13±0.40	10.96±0.35
BINA-5	67.92±0.11	73.02±0.12	79.22±0.04	5.18±0.17	11.30±ND
BINA-6	66.64±0.06	72.59±0.01	79.72±0.03	6.60±0.49	13.09±0.09
BINA-7	67.37±0	72.10±0	78.00±0	5.51±ND	10.63±ND
BINA-8	68.53±0	74.11±0	80.06±0	5.70±ND	11.53±ND

Delta H and Gelatinization Temperature: Ban> Au



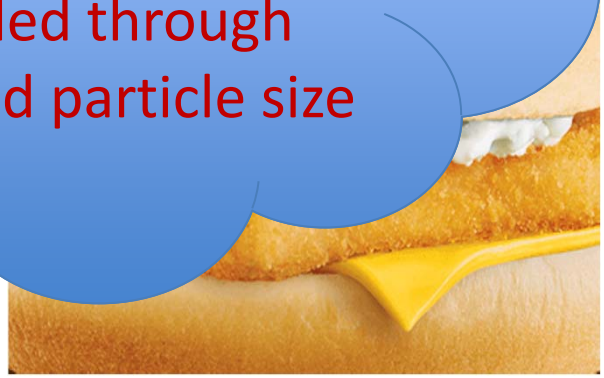
Oil and water absorption capacity of chickpea flours

Varieties	g oil/g flour	mL water/g flour
Bangladeshi		
BINA-2	0.99± 0.01	0.8
BINA-3	0.93±0.02	0.8
BINA-4	0.9±0.05	
BINA-5	0.97±0.08	
BINA-6	0.85±0.01	
BINA-7	0.84±0.0	
BINA-8	0.85±	
Australian		
Amber	0.85±0.0	
Boundary	0.80±0.	
HatTrick	0.81±0.0	
Slasher	0.84±0.05	

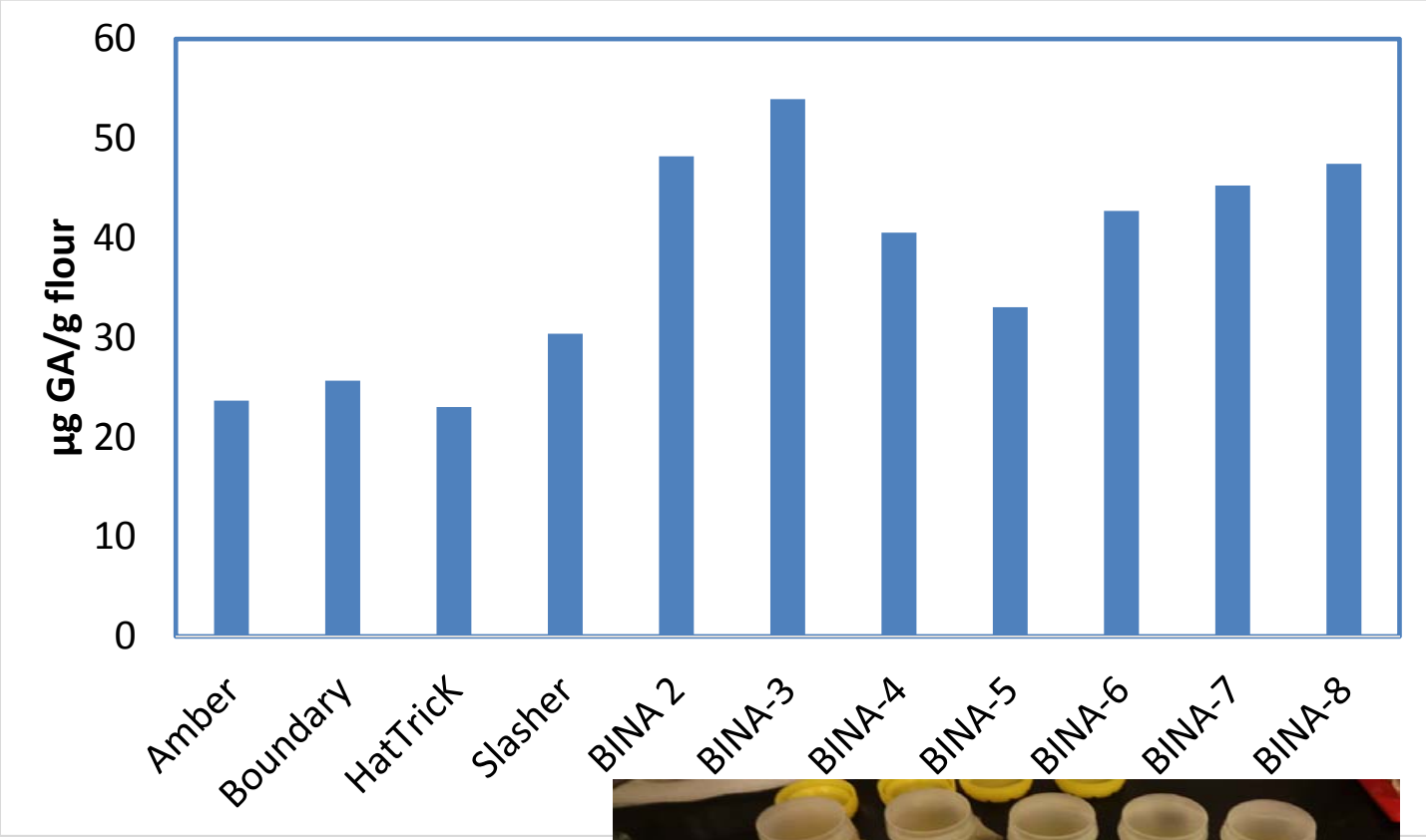
Oil absorption of different varieties vs particle size

Particle size	Slasher	Amber	Boundary	HatTrick
	Oil absorbed, g/g flour			
		85±0.05	0.80±0.03	0.81±0.05
		07	0.70±0.02	0.72±0.03
		2	0.80±0.02	0.72±0.04
		9	0.73±0.0	0.81±0.03

Oil and water absorptions can be controlled through variety and particle size



Total Phenolic Content (TPC) of chickpea flour extracts



Conclusion

- **Chemical composition of Australian and Bangladeshi chickpeas are different**

-protein and fibre

- **Pasting properties of cooked chickpea flours are affected by variety**

-Some Australian varieties produce higher consistencies

-Particle size impacted pasting and gelling properties significantly

- **Thermal properties:**

Gelatinization energy and temperature of Bangladeshi varieties were higher and can affect processing time and nutritional quality (GI)

- **Bioactive compounds (e.g. Total Phenolic Content):**

Bangladeshi varieties were richer