Effect of high pressure processing on the texture profile, digestibility and antioxidant properties of cooked "Kimberley large" kabuli chickpeas

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INTRODUCTION

High pressure treatment (HPT) is a non-thermal method used for the preservation of food and is known to produce food with a longer shelf life while retaining attributes such as colour, flavour and nutritional value (Oey et al., 2008). HPT has been widely utilised in the juice and cheese manufacturing industries, however its use in the fresh food industries is still limited. HPT could be utilised for a ready-to-eat product in the case of WA grown kabuli chickpea variety 'Kimberley large' (KL), which are widely used in fresh salads to maintain freshness, colour, and nutritional quality.

RESEARCH QUESTION: How does HPT affect the texture profile, nutritional, and phytochemical characteristics of cooked Kimberley large kabuli chickpeas?

METHODOLOGY

KL chickpeas were soaked in water for 12 hours followed by 30 min of cooking in boiling water. Chickpeas were removed from boiling water and cooled under running cold water to stop further cooking. Cooked chickpeas (300-400 g) were vacuum packed using an automatic vacuum packaging machine. Chickpeas were HP treated using a Hiperbaric 300 HP treatment equipment with the settings shown in Table 1. Untreated samples was were considered as control. Texture profile analysis, starch and protein digestibility and antioxidant capacity were analysed.

Table 1: HPT settings

Time	Pressure	
	1 minute	5 minutes
200 MPa	200 MPa, 1 min (2k1)	200 MPa, 5 min (2k5)
400 MPa	400 MPa, 1 min (4k1)	400 MPa, 5 min (4k5)
600 MPa	600 MPa, 1 min (6k1)	600 MPa, 5 min (6k5)

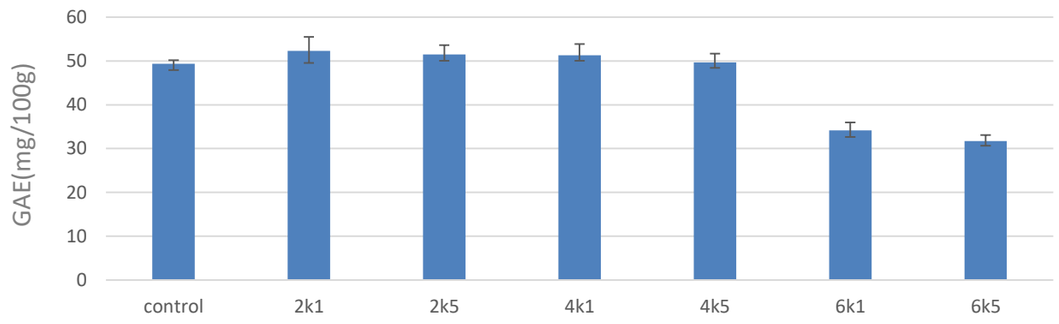

Figure 2: Total polyphenol content in high pressure treated Kimberley large kabuli chickpeas

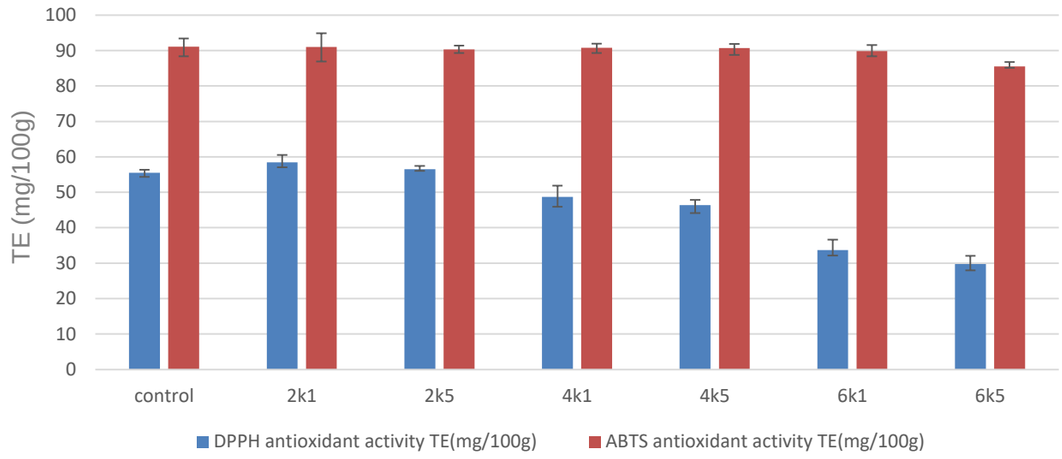

Figure 3: DPPH and ABTS antioxidant capacities in high pressure treated Kimberley large kabuli chickpeas

RESULTS AND DISCUSSION

- No significant ($p \leq 0.05$) differences between protein digestibility of HP treated samples and control were observed.

Table 2: Texture profile analysis of high pressure treated KL kabuli chickpeas

Dependent variable	Time (min)	Pressure			Control
		200 MPa	400 MPa	600 MPa	
Firmness	1	$21.29 \pm 0.71^{a,A}$	$22.13 \pm 0.54^{a,A}$	$18.30 \pm 0.50^{b,A}$	
	5	$20.67 \pm 1.6^{a,A}$	$21.27 \pm 0.87^{a,A}$	$15.26 \pm 0.52^{b,B}$	25.28±0.69
Cohesiveness	1	$0.19 \pm 0.02^{a,A*}$	$0.21 \pm 0.1^{a,A}$	$0.17 \pm 0.01^{a,A*}$	
	5	$0.20 \pm 0.2^{a,A}$	$0.19 \pm 0.01^{a,A}$	$0.16 \pm 0.01^{a,A*}$	0.23±0.002
Springiness	1	$0.96 \pm 0.09^{a,A}$	$0.79 \pm 0.01^{a,A}$	$0.95 \pm 0.19^{a,A}$	
	5	$0.80 \pm 0.4^{a,A}$	$0.94 \pm 0.17^{a,A}$	$1.04 \pm 0.11^{a,A}$	0.80±0.00
Gumminess	1	$4.18 \pm 0.54^{ab,A}$	$4.87 \pm 0.07^{a,A}$	$3.32 \pm 0.13^{b,A}$	
	5	$2.44 \pm 0.45^{a,A}$	$4.26 \pm 0.43^{a,A}$	$2.53 \pm 0.26^{a,A}$	5.77±0.19
Chewiness	1	$3.66 \pm 0.03^{a,A*}$	$3.72 \pm 0.01^{a,A*}$	$2.86 \pm 0.31^{b,A*}$	
	5	$3.03 \pm 0.09^{ab,B*}$	$3.77 \pm 0.25^{a,A*}$	$2.32 \pm 0.36^{b,A*}$	4.68±0.5

*Mean ± s.d. n=20. Post hoc tests: Superscript a,b,c represents significant difference between samples processed at different pressures but the same time. Superscript A,B represents significant differences between samples processed at the same pressure but different times, superscript * represents a lower dependent variable value when compared to the control.

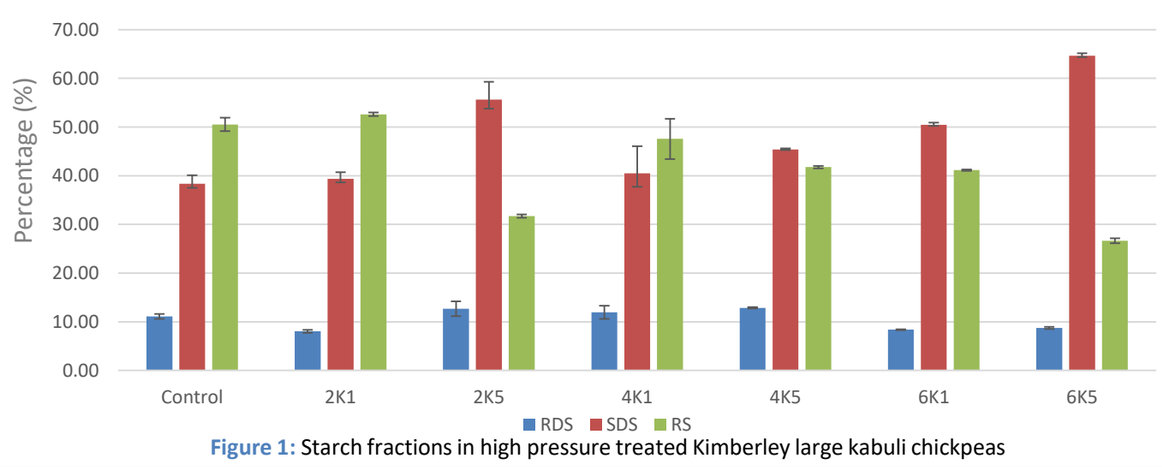

Figure 1: Starch fractions in high pressure treated Kimberley large kabuli chickpeas

- Significant changes in firmness, gumminess and chewiness of high pressure (HP) treated chickpeas when compared to the control (Table 2) were observed. This could be due to the rupturing of cells within chickpea seeds, thus increasing membrane permeability and faster enzymatic action, resulting in softening (Tangwongchai et al., 2000).
- The starch digestibility of chickpeas was modified following the HP treatment and an increase in slowly digestible starch content was observed (Figure 1). Katopo et al. (2002) and Colussi et al. (2018) have both reported that HP treatment results in decrease of relative crystallinity of starch, indicating partial gelatinisation of the granules during the process. This results in lower digestibility. Recrystallization of amylopectin during retrogradation has also been reported to reduce starch digestion (Fredriksson, Bjorck & Andersson et al., 2000).
- A significant decrease in total polyphenol content (Figure 2) and antioxidant capacities (Figure 3) of chickpeas treated at 600 MPa was observed. Doblado et al. (2007) reported a 10-15% decrease in the antioxidant capacity of HP treated germinated cowpeas, whereas Prestamo and Penas (2004) reported a decrease in the antioxidant capcity of HP treated soybean hydrolysates. Further research is required to understand the mechanism behind this phenomenon.
- HP teatment can potentially be used as an alternative to canning to modify the nutritional composition of cooked chickpeas for enhanced health benefits.

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