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CAN NEW INGREDIENTS IMPROVE HYBRID MEAT QUALITY?

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I. INTRODUCTION

In the red meat industry, 80% of the value of the carcase comes from 20% of the animal, and efficient use of the carcase is crucial for making beef production and processing more sustainable [1]. CSIRO has developed a process to create various meat ingredient fractions utilising low-value parts of the carcase as a solution to these concerns. One of these fractions, is a nutrient dense meat protein concentrate (MPC) with a meat-like aroma and flavour. At the same time, meat mimetic and hybrid products have quality challenges and fail to replicate the taste and texture of meat [2]. The objective of this study was to assess the application of the MPC fraction in hybrid meat patties and compare the quality attributes to formulations containing other commercially available protein ingredients.

II. MATERIALS AND METHODS

Minced beef (82% chemical lean) was sourced from a local supplier and additional beef fat was added to each patty to standardise the fat content to 18%. Formulations are shown in Table 1. Collagen protein (CP), soy protein concentrate (SPC) and pea protein concentrate (PPC) were sourced from Bulk Nutrients (TAS, Australia).

Table 1 – Formulations for hybrid patty study

	Treatments*					
	Meat control (MC)	**Hybrid control (HC)**	**MPC**	**CP**	**SPC**	**PPC**
Minced beef (82% CL)	97.7	69.8	64.1	64.1	64.1	64.1
Beef fat	1.1	5.4	6.2	6.2	6.2	6.2
Hydrated TVP*		23.7	23.5	23.5	23.5	23.5
Meat protein concentrate (MPC)*			5			
Collagen protein (CP)				5		
Soy protein concentrate (SPC)					5	
Pea protein concentrate (PPC)						5

* All treatments contained 1.2% spice blend (0.7% NaCl, 0.1% garlic powder, 0.3% onion powder, 0.1% ground white pepper). TVP = texturized vegetable protein, MPC proximate composition: 81% protein, 10% fat, 5.2% moisture and 3.0% ash.

Cook loss from all the samples was determined by weighing the patty before and after cooking. Shrinkage was calculated using image analysis [3]. Moisture content was analysed as per Thornton et al. [4]. Colour measurements (light source A, observer angle 10 °, aperture size 5 cm) were made by a Hunterlab Miniscan EZ 45/0 LAV (Novasys Group, VIC, Australia). Kramer shear measurements (100 mm/min, 30 mm max.) were performed on a Lloyd LS 2.5 Universal testing machine fitted with a 1 kN load cell and a 5 blade Kramer shear cell (Lloyd Instruments, West Sussex, United Kingdom). Fat and water-binding were assessed by a Bruker Minispec LF NMR (0.47 T, 20 MHz). Fat content was determined on freeze-dried portions of raw and cooked patty as per Sørland et al. [5]. Water binding was determined by applying a Carr–Purcell–Meiboom–Gill sequence (16 scans, echo spacing of 0.08 ms, 3000 echoes) to determine the T2 relaxation times. The water distribution was determined using the CONTIN algorithm by Bruker. One-way ANOVA followed by Tukey's multiple comparisons test was performed using GraphPad Prism version 10.4.1 for Windows (GraphPad Software, Boston, Massachusetts USA, www.graphpad.com). P-values > 0.05 were non-significant.

III. RESULTS AND DISCUSSION

The treatments with the lowest cook loss results were MPC, SPC and PPC (Table 2). Shrinkage was lowest for the MPC formulation. All hybrid formulations had lower fat binding than the meat control (MC). Hardness with MPC was comparable to the controls (MC and HC) and SPC. Overall, all hybrid formulations exhibited a trend for increased lightness, redness and yellowness than the meat control, and inclusion of MPC did not change the cooked color compared to the hybrid control. Water-binding, assessed by LF-NMR, showed three distinct water populations at

T2b (8.7 - 10.8 ms), T21 (38.7 - 52.9 ms) and T22 (170.0 - 211.1 ms) (Figure 1). While only MPC and the controls (MC and HC) are shown in figure 1 for image clarity, MPC resulted in the lowest T21 ms in comparison to all other treatments ($p<0.05$), indicating that immobilized water was more tightly bound. The MPC formulation also had lower T22 relaxation than MC and HC indicating that the free water fraction was more tightly bound. These findings support the cook loss and shrinkage results.

Table 2 – Results of cook loss, shrinkage, fat binding, hardness and cooked color for hybrid meat patty experiment

Treatment	Cook Loss (%)	Shrinkage (%)	Fat binding (%)	Hardness (N)	L*	a*	b*
MC	31.4^{b}	43.9^{a}	69.1^{a}	346^{ab}	32.0^{c}	10.9^{c}	17.1^{b}
HC	34.4^{a}	40.3^{b}	59.2^{bc}	321^{ac}	37.1^{ac}	12.7^{ab}	19.7^{ab}
MPC	23.9^{c}	32.0^{d}	60.0^{b}	379^{a}	39.8^{ab}	11.2^{bc}	19.3^{ab}
CP	33.1^{a}	39.9^{b}	60.5^{b}	279^{c}	34.0^{bc}	13.7^{a}	21.9^{a}
SPC	25.2^{c}	36.8^{c}	54.8^{c}	372^{ac}	40.4^{a}	12.1^{bc}	20.8^{ab}
PPC	24.6^{c}	35.4^{c}	60.0^{b}	389^{bc}	40.5^{a}	12.6^{ab}	21.6^{a}
p-value	<0.05	<0.05	<0.05	<0.01	<0.01	<0.001	<0.05

Superscripts a-e within a column indicate a significant difference; Treatment column MC = meat control, HC = hybrid control, MPC = meat protein concentrate, CP = collagen protein, SPC = soy protein, PPC = pea protein

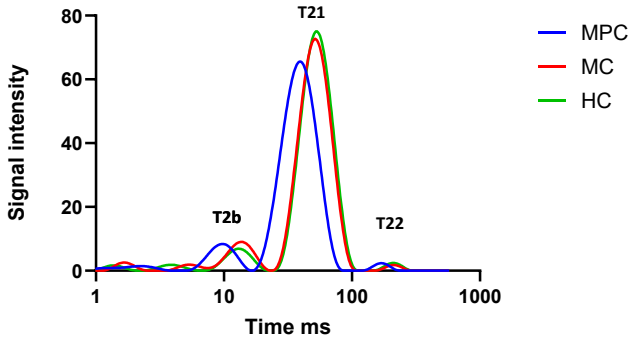


Figure 1. Relaxation time versus signal intensity of hybrid meat patties as analyzed by low-field nuclear magnetic resonance where MPC = meat patty with meat protein concentrate, MC = meat control and HC= hybrid control

IV. CONCLUSION

The application of a newly developed MPC in hybrid products presents an opportunity to reduce shrinkage and cook loss, while not affecting hardness. However, the MPC patties are lighter in color than the meat control. While informal sensory analysis indicated improved liking, further research is required to understand how these results translate to sensory attributes. The application of new ingredients, created from low-value meat or co-products, presents an opportunity to improve hybrid protein products, while maximizing the value and sustainability of red meat.

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