HYBRID BOLOGNA: INNOVATIVE USE OF PLANT-BASED EMULSION GELS AS A HEALTHIER ALTERNATIVE TO PORK FAT

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I. INTRODUCTION

The quality of meat is determined by factors such as tenderness, juiciness, flavour, and appearance, all of which influence consumer acceptability. Fat plays a crucial role in the texture of meat products, such as hardness, gumminess, juiciness, and chewiness [1]. However, animal fat is linked to health issues such as hypertension, obesity, and cardiovascular diseases [2]. Replacing animal fat with vegetable oils can reduce these health risks but can also cause technological and sensory problems, as highly unsaturated oils fail to mimic the sensory performance of elastic animal fat tissue [3]. To create meat products with plant-based fats, the mechanical and thermal properties of fats must be considered [4]. Emulsion gels provide three-dimensional networked structures and entrap the oil phase and can provide better fatty texture. The main aim of this research was to use pulse proteins to stabilize canola oil-in-water emulsions as a substitute for animal fat in hybrid Bologna, while maintaining desired sensory and quality attributes. To achieve this, an emulsion gel was made by high-speed homogenisation using 10% faba bean protein concentrate (FPC), 50% water and 40% canola oil, which was then heated at 90ºC for 30 minutes before being added to the raw Bologna mixture.

II. MATERIALS AND METHODS

The Bolognas that were created for this study were prepared by completely substituting the pork back fat with different fat sources. To compare the results, a full-fat Bologna (FF) (with 20% pork back fat) and a low-fat Bologna (LF) with the same amount of fat as in the hybrid Bologna were also prepared. Other fat sources included canola oil (CO), emulsion ingredients (EI), unheated emulsion (UE) and heated emulsion (HE). The lean meat (55%) was mixed with dry ingredients (20% fat source, 22% water, 2% salt, 0.02% sodium nitrite, 0.3% sodium tripolyphosphate and 0.05% sodium erythorbate), and the batter was passed through an emulsion mill twice. All mixtures were then placed into waterproof casings and heated to an internal temperature of 72 ^{o}C and held there for 5 minutes. The viscosity of the meat batter and the colour, texture and purge loss, etc. of cooked samples were measured. The experiment was replicated three times. The results were analysed using SPSS software (v25, IBM, Armonk, NY, USA) as one-way analyses of variance (ANOVA) with a 95% confidence level where $P<0.05$ indicates a significant difference. The Tukey test was used for means separation.

III. RESULTS AND DISCUSSION

The study found that it was possible to replace pork back fat with either heated or unheated FPC emulsion gels in hybrid Bologna. All Bologna samples did not have any structural failure or emulsion separation. In terms of batter viscosity, CO, RE and HE exhibited similar values to the LF and FF Bologna, while EI addition to Bologna produced a significantly ($P<0.05$) lower viscosity than that of the FF treatment (Table 1). Purge loss of EI was significantly ($P<0.05$) greater than the FF, with other treatments intermediate in purge. Hardness of HE and FF tended ($P= 0.07$) to be higher than LF (Table 1). The colour parameters L^* and b^* varied among the treatments, with FF, CO, UE and HE having significantly ($P<0.05$) higher L^* values than LF, indicating a lighter colour (Table 1). Treatments with FPC (EI, UE, HE) were significantly ($P<0.05$) more yellow in colour (higher b^*) than others (Table 1).

Cooking loss and expressible moisture were generally similar across all Bologna samples (data not shown). All samples also had similar shear stress and shear strain at failure based on torsional rheology (data not shown).

Table 1 Bologna properties

Bologna treatment	Batter viscosity ($\times 10^3$cp)	Colour			Purge loss (%)	Hardness
		*L**	*a**	*b**		
Full-fat	170±22.4[a]	84.2±0.4[a]	9.54±1.0	9.94±0.4[b]	3.13±0.6[b]	132±23.2
Low-fat	111±26.9[ab]	80.3±1.9[b]	10.0±1.0	9.09±0.5[b]	4.67±0.6[ab]	96.4±10.8
Canola oil	151±22.0[ab]	86.9±1.2[a]	8.58±0.1	8.95±0.2[b]	4.81±0.5[ab]	119±12.7
Emulsion ingredients	107±18.1[b]	83.4±1.3[ab]	9.37±0.2	14.2±0.4[a]	4.90±1.0[a]	115±7.4
Un-heated emulsion	117±19.5[ab]	84.8±1.5[a]	8.79±0.3	13.7±0.4[a]	4.54±0.2[ab]	108±13.4
Heated emulsion	158±24.3[ab]	84.9±1.0[a]	8.86±0.3	12.6±1.6[a]	4.52±0.7[ab]	138±11.1
P-value	0.017	0.001	0.104	0	0.44	0.073
RSD[1] (%)	13-24	0.5-2	2-11	2-12	5-20	6-23

[ab] Means that do not share a letter are significantly different (Tukey test with 0.95% confidence).
[1] Relative Standard Deviation

IV. CONCLUSION

The spatial distributions and interactions between fats, animal, and plant proteins significantly influenced the structure and appearance of Bologna samples. FPC-stabilized emulsion gels with appropriate protein and oil concentration could be used as a substitute for pork back fat in Bologna without any adverse effects. Sensory analysis is needed to obtain a better understanding of consumer acceptance.

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