EFFECTIVENESS OF LENTIL (*LENS CULINARIS* MEDIKUS) COMPONENTS FOR REPLACING PHOSPHATES IN MECHANICALLY SEPARATED CHICKEN BOLOGNA

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I. INTRODUCTION

Alkaline phosphates are widely used in the meat industry as a multifunctional ingredient. They contribute to reduced losses during cooking and storage, improved texture, flavor and color and inhibit lipid oxidation in meat and poultry products [1]. These phosphates are chemically synthesized compounds. Currently, ingredients of natural origin to replace synthetic phosphates are gaining attention due to the increasing consumer demand for processed foods with reduced synthetic additives. Plant based ingredients derived from different legumes and cereals are beneficial to improve the quality and yield of emulsion type meat products. Infrared heated lentil flour is rich in starch and protein and shows some antioxidant properties [2]. Various phenolic compounds are also concentrated in the seed coat. Therefore, the objective of this study was to evaluate the applicability of lentil components as replacers for phosphates in mechanically separated chicken bologna.

II. MATERIAL AND METHODS

Bologna was prepared from mechanically separated chicken by incorporating infrared heated (IR) lentil flour (NutraReady®, 43% starch and 25% protein), ground lentil seed coat (250µm particle size) or water extract of lentil seed coat. There were seven treatments as described in Table 1 below. All other ingredients (1.8% salt, 0.16% spices) were kept constant in the formulations except water (33.75 – 26.94%) and there was no nitrite added to any formulation. The cooking characteristics and texture properties of the products were analyzed. Lipid oxidation was determined as 2-thiobarbituric acid reactive substance (TRARS) values at 14 days intervals for 42 days in vacuum packaged bologna samples stored at 4^{o}C. Sensory properties of the bologna were evaluated by a 12-member semi-trained panel using 8-point category scales. The experiment was arranged in randomized complete block design with three complete replications. Analysis of variance (ANOVA) using mixed model (Proc Mixed) procedure of SAS (SAS Institute, 2004) was performed for data analysis and the Tukey method was used to compare differences among means. Significance was determined at $P<0.05$.

III. RESULTS AND DISCUSSION

The water retention and textural properties of lentil incorporated bologna made from mechanically separated chicken were compared (Table 1). Phosphates are used in meat products to improve the water retention properties and this was revealed by the lowest values of purge loss, cook loss and expressible moisture for the control sample (T2) formulated with IR lentil flour and 0.3% sodium tripolyphosphate (STPP). The samples incorporated with lentil flour and seed coat or water extracts showed similar water retention properties to T2.

Table 1. Effect of lentil flour, seed coat and water extract of seed coat on water retention and texture properties of chicken bologna

Treatment[1]	Water retention properties			Texture properties			
	Cooking loss (%)	Purge loss (%)	Expressible moisture (%)	Hardness (N)	Cohesiveness	Springiness (%)	Chewiness (N mm)
T1	0.79^{a}	9.45^{a}	20.35^{a}	55.43^{b}	0.55^{a}	82.84^{a}	322.49^{d}
T2	1.09^{a}	4.87^{c}	16.56^{c}	88.20^{a}	0.51^{b}	81.92^{a}	503.60^{a}
T3	1.79^{a}	5.86 ^{b}	16.74^{bc}	91.63^{a}	0.51^{b}	82.50^{a}	513.12^{a}
T4	1.43^{a}	5.58^{bc}	18.00^{abc}	81.40^{a}	0.49^{bc}	80.65^{ab}	422.68^{bc}
T5	1.32^{a}	5.44^{bc}	19.98^{ab}	80.40^{a}	0.45^{d}	77.41^{b}	380.59^{cd}
T6	1.70^{a}	5.70^{bc}	17.05^{bc}	86.43^{a}	0.52^{b}	81.64^{a}	480.07^{ab}
T7	1.63^{a}	5.71^{bc}	17.62^{abc}	88.63^{a}	0.52^{b}	81.73^{a}	493.21^{a}
SEM[2]	0.208	0.186	2.774	3.002	0.008	0.890	18.421

[1] (T1) no binder phosphate control-0.3% sodium tripolyphosphate (STPP), (T2) lentil phosphate control-6% IR lentil flour+0.3% STPP, (T3) 6% IR lentil flour, (T4) 6% IR lentil flour+seed coat (equivalent to 300 ppm of total phenolics), (T5) 6% IR lentil flour+seed coat (500 ppm phenolics), (T6) 6% IR lentil flour+water extract of seed coat (300 ppm phenolics), (T7) 6% IR lentil flour+water extract of seed coat (500 ppm phenolics). [2] Standard error of mean. [abc]Means with the different letters in the same column are significantly different ($P<0.05$)

Thus, the addition of lentil flour and seed coat components to the bologna had similar effects as STPP on water holding properties. The results from the texture profile analysis revealed that the hardness of all formulations with lentil flour were firmer than the phosphate only control; however, the addition of seed coat reduced the cohesiveness and chewiness of the products.

The TBARS values of the bologna increased during the 42 days of storage in all treatments however, the TBARS values of the chicken bologna with seed coat or water extract of seed coat was significantly lower than that of control samples showing that lentil seed coat components were more effective in controlling lipid oxidation in chicken bologna than STPP or IR lentil flour alone (Figure 1). There was no significant difference in the TBARS values among the bologna samples with 300ppm or 500ppm of seed coat or water extract of seed coat.

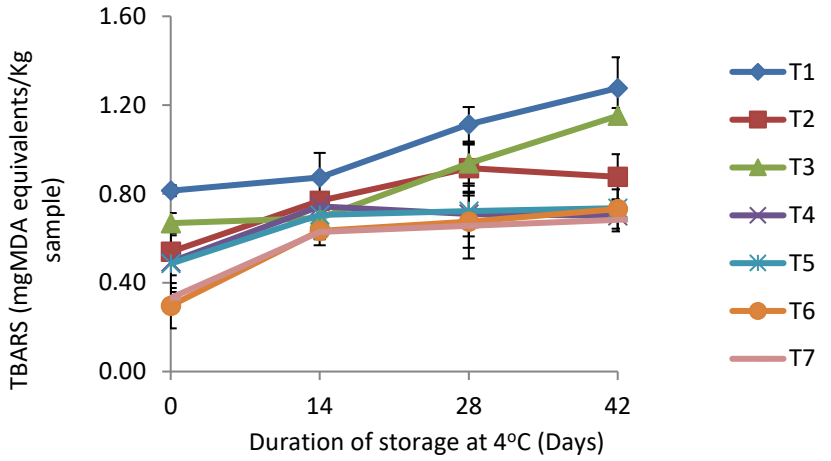

Figure 1. TBARS values of vacuum packaged chicken bologna with added IR lentil flour, seed coat and water extract of seed coat stored at 4°C

Panelists preferred the color, flavor and texture properties of the bologna samples formulated without seed coat. The addition of seed coat has reduced the scores for color desirability, surface moisture, springiness, hardness, cohesiveness, density and chewiness and increased the foreign flavor intensity and after taste probably because of the fiber and the flavor compounds contributed by the seed coat.

IV. CONCLUSION

The addition of IR lentil flour together with seed coat or water extract of seed coat was able to control the lipid oxidation in chicken bologna as effectively as STPP. The water retention and texture properties of the bologna with IR lentil flour and water extract of seed coat were comparable to those with lentil flour and 0.3% of STPP and better than that with only 0.3% STPP and no binder. The addition of seed coat in chicken bologna had negative effects on sensory properties, particularly color and flavor. Therefore, the combination of IR lentil flour and water extract of seed coat would be a suitable candidate to contribute the functional properties of phosphates and would be beneficial in controlling lipid oxidation without compromising the texture and sensory properties particularly in products where nitrite is not included.

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