THE EFFECTS OF DAVIDSON`S PLUM FRUIT POWDER AS PLANT-BASED PRESERVATIVE IN RAW PROCESSED MEAT

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I. INTRODUCTION

Meat is highly perishable with the shelf-life of raw meat during storage generally being limited by the growth of spoilage microorganisms and lipid oxidation which, if no preventive measure is taken, might result in vast economic loss [1]. As a general manufacturing practice, the meat industry widely uses synthetic chemicals such as Sodium metabisulphite to delay the safety and quality degradation of the meat products. However, there is a growing concern by the consumer over the safety of the usage of synthetic chemicals in the processing of meat and meat products [5]. Extensive works on natural preservative such as plant-based food preservatives are now being intensively conducted [2]. Davidson plum fruit (*Davidsoniaceae pruriens*), an Australian native plant, has been found to possess bioactive compounds with preservative attributes [3]. Nevertheless, to the best of our knowledge, there is no peer reviewed study available in which Davidson plum fruit powder (DPP) was used to preserve raw meat. Therefore, the objective of this study was to evaluate the DPP effects on the microbial growth, lipid oxidation and physico-chemical parameters in raw beef patties.

II. MATERIALS AND METHODS

To evaluate the preservative effects of the DPP in raw beef patties a factorial design of 6 x 6 x 3 corresponding to six treatments, six sampling points during storage time and three replicates, was executed. The treatments were: the negative control (NC) (no added preservative), Sodium metabisulphite (SMB) (450ppm), and DPP (0.2, 0.4, 0.6. 0.8 % of the basal recipe). Samples were collected for microbiological and chemical analysis at day 0, 4, 8, 12, 16 and 20 during the storage period. The microbiological analysis was performed using the Australian Standard AS 5013.5: 2016 for microbiological enumeration [4] and lipid oxidation analysis was carried out using the TBARS assay as described by Mukumbo, Descalzo [5]. The pH of beef patties was measured by a direct insertion of the probe in beef patties. Color parameters were measured using a portable spectrophotometer (Catalogue number 6834, BYK-Garden, GMBH, Germany). The General Linear Models procedure using the IMB SPSS statistical package was used to perform statistical analysis of data generated.

III. RESULTS AND DISCUSSIONS

The results of the microbial growth, lipid oxidation, and physico-chemical parameters are presented in Table1. Microbial growth expressed in terms of Total viable counts (TVC) was significantly affected by the treatment and the storage time. The inclusion of the DPP at level of 0.4%, 0.6% and 0.8% in beef patties delayed ($P<0.05$) the growth of microorganisms in comparison to the NC beef patties. The antimicrobial attribute of the DPP could be due to the presence of bioactive compound such as anthocyanin and vitamin C [6]. SMB displayed the strongest antimicrobial effects. This could be due to the presence of sulphur dioxide which acts as bacteriostatic or bacterial causing effective disruption of the bacterial cell wall [7]. However, SMB has been found to cause asthma and other allergenic reactions when consumed [8]. In terms of lipid oxidation, beef patties treated with DPP had significantly lower lipid oxidation rate throughout the storage period in comparison to the NC samples. The antioxidant activities observed in DPP-treated beef patties could be attributed to the presence of phenolic compounds such as anthocyanins and vitamin C which have antioxidant attributes [3].

The results of the color measurement including the lightness (L*), redness (a*), yellowness (b*) are presented in Table 1. The L* was not affected ($P>0.05$) by the treatment. The inclusion of the DPP in beef patties reduced ($P<0.05$) the redness (a*). This could be due the natural color of the Davidson`s plum fruit which is dark blue on the outside and deep red inside. Nevertheless, the a* values of all samples decreased ($P<0.05$) progressively with the storage. This could be attributed to the gradual degradation of oxymyoglobin, lipid oxidation and microbial growth [9]. The interaction between the treatment and storage period had an impact ($P<0.05$) on pH values of beef patties. DPP-treated beef

patties had lower pH values compare to both NC and SMB treated beef patties. The low pH observed in the DPP-treated could be due to the presence of organic acid such as vitamin C [6].

Table 1 Results of the application of DPP in beef patties on microbial growth and physico-chemical

Attributes	Treatment						Storage time						SEM	P-Value		
	NC	SMB	0.2%DPP	0.4%DPP	0.6%DPP	0.8%DPP	0	4	8	12	16	20		T	SP	T * SP
TBARS (mg MDA/Kg meat)	0.53^{a}	0.36^{c}	0.46^{ab}	0.4^{b}	0.39^{b}	0.37^{b}	0.12^{d}	0.17^{d}	0.47^{c}	0.5^{bc}	0.59^{ab}	0.66^{a}	0.38	*	*	NS
TVC (cfu/ g meat)	8.5^{a}	4.1^{f}	7.5^{ab}	7.1^{c}	6.1^{d}	5.6^{e}	4.5^{E}	4.7^{E}	5.5^{D}	6.5^{C}	7.9^{B}	9.8^{A}	0.79	*	*	NS
L*	46.2^{ab}	48.7^{a}	45.7^{b}	45.6^{b}	43.8^{b}	44^{b}	45.9	46.1	44.9	46	44.9	46.2	0.65	*	NS	NS
a*	12.2^{b}	15.7^{a}	10.9^{c}	9.7^{cd}	9.6^{cd}	9.3^{d}	15.4^{A}	12.5^{B}	11.7^{BC}	10.4^{CD}	9.2^{DE}	8.2^{EF}	0.46	*	*	*
b*	14.2^{b}	17^{a}	13.6^{bc}	13^{cd}	12.4^{d}	12.4^{d}	16^{A}	14.5^{B}	13.8^{BC}	13.4^{C}	12.4^{D}	12.4^{D}	0.3	*	*	NS
pH	5.79^{b}	5.84^{a}	5.69^{c}	5.59^{d}	5.48^{e}	5.36^{f}	5.58^{C}	5.62^{B}	5.7^{A}	5.61^{B}	5.61^{B}	5.64^{B}	0.08	*	*	NS

a-f - Means in the same row with the same letter do not differ ($P<0.05$) between treatments. $^{A-E}$ - Means in the same row with the same letter do not differ ($P<0.05$) over storage time. * Statistically significant, NS= not significant NC = negative control, SMB = 450ppm sodium metabisulphite, DPP (0.2, 0.4, 0.6 and 0.8) %, SEM (Standard error of mean), T (treatments), SP (storage period), T*SP (interaction treatment and storage period).

IV. CONCLUSION

This research demonstrated that the use of DPP in raw beef patties stored under refrigeration condition has a preservative effect in delaying microbial growth and inhibiting lipid oxidation. Thus Davidson`s plum fruit could be use used as plant-based preservative in raw processed meat.

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