KOMBUCHA TEA EXTRACT AND ULTRASOUND ON QUALITY ATTRIBUTES OF MARINATED BEEF

Hilal Sena Yıldırım[1], Pınar Kadıoğlu Şentürk[1], İlayda İşleyen[1] and Kezban Candoğan[1*]

[1] Ankara University, Faculty of Engineering, Department of Food Engineering, Ankara, Turkey

*Corresponding author email: candogan@eng.ankara.edu.tr

I. INTRODUCTION

Meats are marinated to offer safe food, extended shelf life and enhanced functional and sensorial characteristics. Acid marinades consisting of organic acids and/or their salts are the most commonly used marinade types for meats. In conventional immersion marination, in most cases, uniform diffusion of a brine solution into the meat tissue cannot be attained [1]. Ultrasonication seems to be a good approach to accelerate brine diffusion and to enhance uniformity [2]. In recent years, there is keen interest both from consumers and the food industry to use natural additives for health reasons and other factors. Replacing chemical additives with natural health promoting ones is a sound alternative to improve the health image of meat products [3]. Kombucha tea is a fermented beverage produced with fermentation by a symbiosis of acidophilic yeast and acetic acid bacteria. This beverage offers health benefits due to its antimicrobial, antioxidant, anti-inflammatory, anticarcinogenic, and anti-diabetic activity [4]. The objective of this study was to evaluate the overall quality of marinated beef treated with sonicated brine solutions containing Kombucha tea extract.

II. MATERIALS AND METHODS

Beef from *M. semimembranosus* muscle obtained from a local market was separated from visible fat and connective tissues and cut into 50±1 g pieces. Kombucha tea culture was purchased from a local market in Ankara, and fermented with black tea and sugar in our laboratory. After fermentation, Kombucha tea was diluted with distilled water at a ratio of 2:3 (Kombucha tea:distilled water, v/v) and incorporated with 2% NaCl for further use as marinate. The control marinades contained 1.5% citric acid and 2% salt. The marination treatment was applied at a ratio of 1:2 meat/marinade (w/v). Beef samples were marinated by immersion using these brines with or without sonication for one hour at 4°C where the beef cuts and the brines were placed into pouches. Ultrasound treatments (UST) were performed in an ultrasound bath at 40 kHz frequency at 4°C. There were 4 groups of marinated beef: 1) C: Control marinade (1.5% citric acid and 2% NaCl), 2) K: Kombucha marinade, 3) UC: Control marinade with UST, 4) UK: Kombucha marinade with UST. These marinated beef samples were drained and wrapped with stretch film in foamed polystyrene trays for further analyses including pH; CIE* lightness (*L**), redness (*a**) and yellowness (*b**) values; total aerobic mesophilic bacteria (TAMB) counts; texture profile analysis; water holding capacity (WHC); cooking yield and microstructure (Scanning Electron Microscope, SEM). Data from two replications were evaluated by analysis of variance with Tukey's multiple comparison test ($P<0.05$) using SPSS (SPSS 20.0, IBM, Chicago, IL, USA).

III. RESULTS AND DISCUSSION

The pH values of beef marinated with Kombucha tea (K) with or without UST had higher ($P<0.05$) pH than control marinades (C) and controls with UST (UC) (Table 1). Cooking did not significantly change pH values of marinated beef except for the UC samples which showed a significant increase in pH upon cooking ($P<0.05$). It was found that UST resulted in higher *L** values in marinated beef when Kombucha tea extract ($P<0.05$) were used. The beef samples marinated with Kombucha tea extract showed significantly higher *a** values ($P<0.05$) which means these samples are redder. UST resulted in lower hardness values (softer products) in beef marinated with Kombucha tea extract ($P<0.05$) (Table 2). Control samples had the lowest chewiness and cohesiveness values among all the samples. There was no statistical difference ($P>0.05$) in the springiness values between all samples. While

cooking yield did not differ among samples (P>0.05), marination with Kombucha tea extract increased water holding capacity (P<0.05). TAMB counts of C, K, UC and UK samples were 4.93 cfu/g, 5.10 cfu/g, 4.39 cfu/g and 5.31 cfu/g, respectively, which did not differ between the sample groups (P>0.05) (Table 2). In SEM images, rupture of myofibrils in all samples were observed due to marination. Moreover, sonication led to larger interfibrillar cavities between muscle fibers.

Table 1 The pH and instrumental colour values of raw and cooked marinated beef

Sample Groups	Raw marinated beef				Cooked marinated beef			
	pH	*L**	*a**	*b**	pH	*L**	*a**	*b**
C	4.99^{b}	52.4^{ab}	14.1^{c}	11.9^{b}	5.14^{b}	32.4	9.48^{ab}	12.9
K	5.67^{a}	50.8^{b}	21.6^{a}	13.9^{a}	5.78^{a}	29.6	9.11^{bc}	11.1
UC	4.67^{c}	51.0^{b}	11.0^{d}	10.4^{c}	5.14^{b}	31.4	8.18^{c}	12.2
UK	5.63^{a}	55.1^{a}	16.0^{b}	12.4^{b}	5.73^{a}	31.8	10.3^{a}	13.5
SEM	0.11	0.51	0.43	0.18	0.08	0.52	0.16	0.38
P value	<0.01	<0.01	<0.01	<0.01	<0.01	0.25	<0.01	0.14

*SEM; standard error of the means. $^{a-d}$: The difference between the means with different superscript letters in the same column is statistically significant (P<0.05). C: Control marinade (1.5% citric acid and 2% NaCl), K: Kombucha marinade, UC: Control marinade with UST, UK: Kombucha marinade with UST.

Table 2 Texture properties, cooking yield (CY), water holding capacity (WHC) and TAMB counts of marinated beef

Sample Groups	Hardness (N)	Springiness	Cohesiveness	Chewiness (J)	CY (%)	WHC (%)	TAMB count (logKOB/g)
C	80.9^{c}	0.86	0.76^{b}	52.4^{b}	43.9	79.9^{ab}	4.93
K	129^{a}	0.84	0.83^{a}	93.7^{a}	45.8	87.2^{a}	5.10
UC	105^{b}	0.89	0.82^{a}	76.1^{ab}	44.7	76.1^{b}	4.39
UK	109^{ab}	0.84	0.82^{a}	78.7^{a}	44.6	86.4^{a}	5.31
SEM	5.00	0.01	0.01	4.62	0.33	1.55	0.16
P value	<0.01	0.20	<0.01	<0.01	0.27	<0.01	0.19

*SEM; standard error of the means. $^{a-c}$: The difference between the means with different superscript letters in the same column is statistically significant (P<0.05). C: Control marinade (1.5% citric acid and 2% NaCl), K: Kombucha marinade, UC: Control marinade with UST, UK: Kombucha marinade with UST.

IV. CONCLUSION

The results of this study demonstrate that marinated beef treated with brine solutions enriched with Kombucha tea extract in combination with ultrasound could enhance their colour stability and functional properties while adding value because of therapeutic effects. These alternative treatments offer new opportunities for the developing of safe functional meat products.

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