ENHANCING THE TEXTURE ATTRIBUTES IN MEAT PRODUCTS USING FOOD GRADE ACIDS TO INCREASE THE APPEAL FOR OLDER CONSUMERS

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Abstract - Beef has a tougher texture compared with other food products and very often meat intake of older consumers is reduced. Therefore, there is a need to develop texture-modified meat products which might improve meat intake in the elderly. Here, two food grade acids of different concentrations and their combination were used in an injection solution in order to facilitate the optimization of texture-modified beef products targeted at elderly consumers. Citric and malic acids could represent a feasible alternative to traditional ingredients used for beef injection and the final product could be suitable for consumption by elderly consumers.

Key Words - acids, beef, elderly, tenderness

I. INTRODUCTION

Beef has a tougher texture compared to other foods and meat intake in elderly people is often reduced. According to Eom *et al.* [1] and Rothenberg *et al.* [2], age related masticatory decline is common and affects both their ability to eat and their food choices. Therefore, there is a need to develop softer beef products for older consumers, which might help to offset the decline in meat intake. It was previously reported that organic acids have a beneficial effect on meat tenderness [3, 4, 5]. The aim of this study was to identify a suitable food grade acid that might be used for inclusion in beef products targeted at elderly consumers. Five treatments along with one control were applied: citric acid at low (CAl) and high concentrations (CAh), 0.1M and 0.5M, respectively; malic acid at low (MAl) and high concentration (MAh), 0.1M and 0.5M, respectively; combination of Cal and MAl (CM); the muscles assigned to control were injected with water (C).

II. MATERIALS AND METHODS

II.1. Beef processing

Beef [*M. semitendinosus* (*ST*)] from Holstein-Friesian steers, were purchased on day 1 *post mortem* and aged for 7 days at 3°C. Muscles were pumped to 115% of their green weight, with Inject-O-MAT type PSM-21 (Dorit Maschinen, Switzerland). Muscles were tumbled for 2h continuous at 7 rpm (2-4°C). Tumbled muscles were vacuum packed in pouches and steam cooked (Fessmann cooker, T1800, Germany) to a core temperature of 72°C (≈4h). Cooked muscles were subsequently chilled (2-4°C, overnight) before being sub-sampled and vacuum packed for subsequent texture analyses.

II.2. Warner-Bratzler shear force (WBSF) and Texture Profile Analysis (TPA)

The analyses were carried out on cooked samples according to AMSA guidelines [6] and Wheeler *et al.* [7]. Samples were sheared perpendicular to the fibre direction using the Instron Universal testing machine, Model 4464 (Instron Ltd., UK), load cell of 500 N, cross head speed 250 mm/min and analysed in Bluehill®2 Software. For TPA, cooked samples were analysed according to the method used by Baugreet *et al.* [8]. Force time deformation curves were obtained at a cross speed of 500 mm/min.

II.3. Statistical analysis of data

Data were analysed using ANOVA in Genstat 14.1 (Rothamsted Experimental Station, Hertfordshire, U.K.) and Fisher's LSD test, with the level of significance set as $P<0.05$.

III. RESULTS AND DISCUSSION

All treatments resulted in significantly reduced WBSF values ($P<0.05$) and TPA hardness ($P<0.05$). For chewiness and gumminess all treatments, except MA1, resulted in highly significant reduction values (Table 1). The same softening effect caused by organic acids was reported by Chang *et al.* [3], they explained that the increase in meat tenderness was caused by the physical weakening of muscle structure, that resulted in the swelling of myofibrillar proteins (actin and mysosin). However, for cohesion force and springiness no effect was observed. On the other hand, Aktas *et al.* [5] reported that injecting the acid solutions led to a reduction of the pH values of the samples, followed by an increased tenderness, when compared with control.

Table 1. Effect of acidic treatments on WBSF and texture profile parameters (hardness, chewiness, gumminess, springiness and cohesion force) of cooked beef *ST* samples

Acidic treatments	WBSF (N)	Hardness (N)	Chewiness* (N x mm)	Gumminess* (N)	Springiness (mm)	Cohesion force (-)
C	23.35 ± 2.06^{a}	145.86 ± 14.08^{a}	387.43 ± 71.65^{a}	63.37 ± 7.71^{a}	5.986 ± 0.56	0.8767 ± 0.01
CAl	16.26 ± 4.00^{b}	123.48 ± 15.04^{b}	260.43 ± 36.99^{b}	44.82 ± 5.72^{b}	5.589 ± 0.44	0.8689 ± 0.02
CAh	15.24 ± 1.27^{b}	119.18 ± 21.87^{b}	277.19 ± 78.95^{b}	45.60 ± 10.44^{b}	5.990 ± 0.46	0.8744 ± 0.01
MAl	17.75 ± 3.24^{b}	123.86 ± 24.13^{b}	369.27 ± 60.66^{a}	57.24 ± 9.67^{a}	6.453 ± 0.33	0.8733 ± 0.02
MAh	16.19 ± 2.53^{b}	111.00 ± 2.38^{bc}	278.59 ± 61.22^{b}	44.57 ± 8.41^{b}	6.241 ± 0.59	0.8544 ± 0.02
CM	14.83 ± 3.13^{b}	99.75 ± 12.43^{c}	256.84 ± 40.90^{b}	39.95 ± 6.74^{b}	6.347 ± 0.34	0.8567 ± 0.02
P value	0.006	0.003	<.001	0.001	0.161	0.341
SEM	1.300	5.83	17.94	3.08	0.225	0.008

a, b,c – means within column that do not share a common letter are significantly different ($P<0.05$); * $P\leq0.001$

IV. CONCLUSIONS

Citric and malic acids proved to be efficient on improving beef texture therefore could represent possible option for inclusion in beef injection and the final products might be suitable for consumption by the elderly population. Future work could focus on sensory evaluation to determine the acceptance of technologically optimised products among elderly consumers.

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