THE EFFECTS OF USING FRUIT FIBRES AND RICE STARCH ON THE TECHNOLOGICAL AND TEXTURAL PARAMETERS OF A BEEF PRODUCT

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Abstract - There is a knowledge deficit in understanding the interaction of the functional ingredients on meat tenderness, particularly in the development of targeted meat products for elderly consumers. Developing beef injected products that require reduced mastication effort might contribute to improving beef intakes among the elderly population. In this study two fruit fibres and their mixture, in combination with rice starch were used in an injection process of beef *ST* in order to facilitate the optimization of a suitable combination of fibre and starch that might improve the technological and textural parameters of beef products. The inclusion of apple fibre in combination with rice starch represents a feasible alternative, providing a juicier/softer product suitable for elderly consumers.

Key Words – apple fibre, beef, citrus fibre, elderly

I. INTRODUCTION

Beef products are considered sources for fortification with ingredients that have a potential health and technological benefits [1]. It has been reported that dietary fibres – which includes fruit fibres, could be used as functional ingredients in meat products [2]. Furthermore, it is well known that starches are used in injected beef muscles for their ability to contribute to the water retention process during thermal treatment [3]. Hence, the inclusion of rice starches results in reduced cooking loss and softer meat products. Several authors [4, 5, 6] described the need to develop texture-optimised beef products for older consumers increase inclusion of meat in the diet. Three treatments along with one control were applied to beef *ST* muscles: apple fibre and rice starch (0.35% and 0.70%, respectively: AR), citric fibre and rice starch (0.35% and 0.70%, respectively: CR), mixture of apple/citric fibre and rice starch (0.17%, 0.17%, 0.70%, respectively: ACR); the control muscles were injected with water (C). The aim of this study was to identify a suitable combination of fruit fibres and rice starch for inclusion in beef products, in order to improve the technological parameters and tenderness.

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 cooking loss and texture and analyses.

II.2.Cooking loss

Cooking loss was determined using the relationship: cooking loss = $100(m_i*m_f)/m_i$, where m_i is the weight of the raw beef *ST* measured before the cooking and m_f the weight of the beef *ST* after the cooking.

II.3. Warner-Bratzler shear force (WBSF) and Texture Profile Analysis (TPA)

The analyses were carried out on cooked samples according to AMSA guidelines [7] and Wheeler *et al.* [8]. 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 described by Botinestean *et al.* [6]. Force time deformation curves were obtained at a cross speed of 500 mm/min.

II.4. 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 highly significant ($P<0.001$) reduced cooking loss values (Table 1). Previous studies [1, 3] reported a reduction in cooking loss in meat products with starch inclusion, which may be attributed to the retention of moisture by the starch. TPA results showed significant difference for gumminess values ($P<0.05$) (Table 1). Other researchers [1] reported a reduction in gumminess for injected meat products with rice starch that might due to the fact that the starch granules maintain the succulence of the products (caused by the retention of water) with the effect of obtaining less gummy and juicer meat products [1]. Even though no significant effect was measured for WBSF values and the other TPA parameters, their values decreased in a numerical fashion when compared with control samples.

Table 1. Effect of fruit fibres and rice starch inclusion treatments on cooking loss (%), WBSF values and texture profile parameters (hardness, chewiness, gumminess and cohesion force) of cooked beef *ST* samples

Injection treatments	Cooking loss (%)	WBSF (N)	Hardness (N)	Chewiness (N x mm)	Gumminess (N)	Cohesion force (-)
C	35.02 ± 0.59^{a}	26.09 ± 3.34	321.46 ± 80.40	713.26 ± 200.92	126.50 ± 32.97^{d}	0.8278 ± 0.03
AR	31.53 ± 0.35^{b}	21.71 ± 3.09	264.03 ± 75.91	541.47 ± 146.82	97.97 ± 23.67^{e}	0.8187 ± 0.03
CR	32.90 ± 0.66^{c}	25.54 ± 2.69	294.61 ± 78.79	592.25 ± 122.20	108.54 ± 20.38^{de}	0.8065 ± 0.03
ACR	31.75 ± 0.44^{b}	22.91 ± 3.22	259.15 ± 51.02	521.25 ± 120.64	94.51 ± 15.90^{e}	0.8140 ± 0.02
P value	<0.001	0.058	0.186	0.147	0.043	0.525
SEM	0.301	1.073	20.3	57.3	6.93	0.009

a, b, c – means within column that do not share a common letter are highly significant ($P<0.001$)
d, e – means within column that do not share a common letter are significantly different ($P<0.05$)
C, AR,CR, ACR: see section I (Introduction) for explanation of codes

IV. CONCLUSIONS

A mixture of apple fibre and rice starch could represent a feasible alternative to traditional ingredients used for beef injection and the final product might be appropriate for inclusion in the diet for the elderly consumers. Future work could focus on sensory evaluation to determine the acceptance of technologically optimised products among elderly consumers.

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