

# THE EFFECTS OF BRINE INJECTION LEVEL AND POST MORTEM AGING ON SENSORY AND PHYSICAL CHARACTERISTICS OF BEEF LOIN

Phillip E. Strydom<sup>1,2\*</sup>, Zarlus Kuhn<sup>3</sup>, Celia J. Hugo<sup>3</sup> and Arno Hugo<sup>3</sup>

<sup>1</sup>Animal Production Institute, Agricultural Research Council of South Africa, Irene, 0062, South Africa

<sup>2</sup>Department of Animal Sciences, Stellenbosch University, Stellenbosch, 7602, South Africa.

<sup>3</sup>Department of Microbial, Biochemical and Food Biotechnology, University of Free-State, Bloemfontein, South Africa.

\*Corresponding author email: pstrydom@arc.agric.za

**Abstract - The enhancement of beef, pork and chicken with brine solutions has become common practice in many countries. The combined effects of aging and brine injection level on beef quality is unknown. Our study investigated the effects of five brine injection level (0, 5, 10, 15 20%) combined with *post mortem* aging period (3 and 10 days) on sensory characteristics of broiled beef loin. Injected samples were scored higher for saltiness but aging reduced the effect. Brine injection had no effect on flavour but tenderness was improved up to 15% injection level. Apart from 0 and 5 % injection levels, aging had no effect on tenderness score. Juiciness was improved up to 10% injection level after 10 days aging and up to 5 % injection level for 3-day aged cuts. The results suggest that a maximum of 15% brine injection will give the best sensory results and save on *post mortem* aging time.**

**Key Words – tenderness, juiciness, saltiness.**

## I. INTRODUCTION

Brine injections have been used in the poultry industry since the 1950's [1]. Red meat processors saw this technology as an opportunity to improve beef and pork palatability that deteriorated as a result of the production of increasingly leaner animals that contain less fat [2,3,4], although atypical flavours may also develop [2, 3]. Hamling et al. [5] found that post mortem aging could be substituted by brine injection. High levels of injection may not necessarily improve eating quality while other negative effects such as purge may also occur [6]. The abuse of brine injection of poultry meat in the South Africa resulted in legislation stipulating a maximum of 10% to 15% brine for whole carcasses and portions, respectively after extensive research. However, brine injection of beef in South Africa was limited to 10% without any scientific verification [7]. Our study investigated the effects of *post mortem* aging and brine injection levels on sensory quality of loin cuts of young grain-fed beef.

## I. MATERIALS AND METHODS

Sixty beef loin primal cuts were subjected to five brine treatments: a non-injected control and four groups respectively injected to 5, 10, 15, and 20% level with a salt, sodium tripolyphosphate (STPP), potassium lactate containing brine; and two aging periods: 3 and 10 days *post mortem*. Loin steaks were oven-broiled and evaluated by a ten-member trained sensory panel on an 8-point hedonic scale for aroma, juiciness, tenderness/texture, beef flavour intensity, metallic/tin-like/bloody, chemical (salty), and sour off-flavours. Data were subjected to analysis of variance for a split-plot design with injection level as whole plots and days *post mortem* as sub-plots.

## II. RESULTS AND DISCUSSION

Despite adding salt to the control samples, injected steaks scored higher values for saltiness, although level of injection did not have an effect (Table 1). The effect of injection was less for cuts aged 10 days than for those aged 3 days. Knock et al. [4] reported higher scores for typical beef flavours, when beef loins were enhanced with KCl brine to 8.5% level, especially after 9 days aging. Although the different brine levels in our study had similar levels of salt, Knock et al. [4] showed higher scores for saltiness and rancidity when salt levels were increased. In contrast to our study, Grobbel et al [3] reported off-flavours, such as salty, metallic or chemical descriptors for brine injected beef loin. Injected steaks scored higher for tenderness in our study irrespective of aging period. Higher injection levels generally gave better results, although the effect plateaued at 15% injection level for 3 day aged steaks and at 10% injection level for steaks aged for 10 days. Injected steaks also scored higher for juiciness. The effect of injection level on juiciness plateaued at 10% for steaks aged for 3 and at 5% for steaks aged for 10 days. Knock et al. [4] found no effect of brine injection

(8.5%) on beef loin tenderness or juiciness, while Hoffman et al. [2] reported similar results as our study for four unaged muscle types injected to a 15% level. Hamling et al. [5] reported higher scores for tenderness, flavor and juiciness at 20% injection levels and this was unaffected by aging to 14 days. In our study, added effects of aging on tenderness and flavour were found at 5% injection level. Aging had no effect on juiciness perception, but 10 day aged samples injected to 10 and 15% levels scored lower than 3 day aged samples. Likewise, all 10 day aged injected samples, except 20%, scored lower for saltiness than 3 day aged samples.

Table 1 The effects of brine injection level combined with *post mortem* aging on sensory characteristics of beef loin

Maturation time (days)	Injection level n	Aroma 12	Juiciness 12	Tenderness 12	Flavour 12	Metallic# 12	Salty# 12	Sour# 12
3	0%	5.2 <sup>a</sup>	4.6 <sup>a</sup>	4.0 <sup>a</sup>	5.2 <sup>ab</sup>	1.7	2.5 <sup>a</sup>	0.8
3	5%	5.3 <sup>ab</sup>	5.0 <sup>bc</sup>	4.8 <sup>b</sup>	5.0 <sup>a</sup>	1.8	4.3 <sup>de</sup>	0.6
3	10%	5.4 <sup>ab</sup>	5.5 <sup>de</sup>	5.3 <sup>cd</sup>	5.1 <sup>ab</sup>	1.8	4.4 <sup>e</sup>	0.6
3	15%	5.4 <sup>ab</sup>	5.5 <sup>de</sup>	5.8 <sup>e</sup>	5.2 <sup>ab</sup>	1.6	4.0 <sup>de</sup>	0.6
3	20%	5.3 <sup>ab</sup>	5.7 <sup>e</sup>	6.0 <sup>e</sup>	5.2 <sup>ab</sup>	1.8	3.8 <sup>cd</sup>	0.7
10	0%	5.5 <sup>ab</sup>	4.5 <sup>a</sup>	4.4 <sup>a</sup>	5.3 <sup>ab</sup>	1.5	2.6 <sup>a</sup>	0.8
10	5%	5.6 <sup>b</sup>	4.9 <sup>b</sup>	5.3 <sup>c</sup>	5.4 <sup>b</sup>	1.6	3.3 <sup>b</sup>	0.8
10	10%	5.5 <sup>ab</sup>	5.2 <sup>bcd</sup>	5.7 <sup>de</sup>	5.3 <sup>ab</sup>	1.7	3.6 <sup>bc</sup>	0.6
10	15%	5.5 <sup>ab</sup>	5.1 <sup>bc</sup>	5.7 <sup>cde</sup>	5.4 <sup>b</sup>	1.6	3.3 <sup>b</sup>	0.7
10	20%	5.4 <sup>ab</sup>	5.4 <sup>cde</sup>	5.9 <sup>e</sup>	5.3 <sup>ab</sup>	1.7	3.4 <sup>bc</sup>	0.6
SEM		0.027	0.030	0.033	0.016	0.021	0.037	0.020
Significance		$P = 0.009$	$P < 0.001$	$P < 0.001$	$P = 0.003$	$P = 0.081$	$P < 0.001$	$P = 0.324$

<sup>a,b,c,d,e</sup> Means in the same column with different superscripts differ significantly; SEM – Standard error of mean

#Sensory scores scale was 1 – 8, but a score of 0 was given if no traces were found for these attributes.

## I. CONCLUSION

Ten percent seems to be the optimum injection level for improved juiciness and tenderness of loin primals, while flavour is not affected by brine injection. Perception of saltiness due to brine injection is reduced when samples are aged. In general, brine injection can save on *post mortem* aging time with regards to improvement of tenderness.

## ACKNOWLEDGEMENTS

PE Strydom thanks Dr Ina van Heerden and her sensory team for sample testing.

## REFERENCES

- Buchanan, B. F. (1955). Process for Treating Poultry. United States Patent Office. Patent 2 709 658, application 17 April 1951. <https://docs.google.com/viewer?url=patentimages.storage.googleapis.com/pdfs/US2709658.pdf>.
- Hoffman, L. C., Vermaak, A., & Muller, N. (2012). Physical and chemical properties of selected beef muscles infused with a phosphate and lactate blend. *South African Journal of Animal Science* 42: 317–340.
- Grobbel, J. P., Dikeman, M. E., Hunt, M. C., & Milliken, G. A. (2008). Effects of different packaging atmospheres and injection-enhancement on beef tenderness, sensory attributes, desmin degradation, and display color. *Journal of Animal Science* 86: 2697–2710.
- Knock, R. C., Seyfert, M., Hunt, M. C., Dikeman, M. E., Mancini, R. A., Unruh, J. A., & Monderen, R. A. (2006). Effects of potassium lactate, sodium chloride, and sodium acetate on surface shininess/gloss and sensory properties of injection-enhanced beef strip-loin steaks. *Meat Science* 74: 319–326.
- Hamling, A. E., Jenschke, B. E., & Calkins, C. R. (2008). Effects of aging on beef chuck and loin muscles enhanced with ammonium hydroxide and salt. *Journal of Animal Science* 86: 1200–1204.
- Miller, R. 1998. Functionality of non-meat ingredients used in enhanced pork. *Pork Quality Facts*. National Pork Board, Des Moines, IA, pp. 1–12. [http://articles.extension.org/pages/27340/functionality-of-non-meat-ingredients-used-in-enhanced-pork#Total\\_level\\_of\\_added\\_ingredients\\_and\\_injection\\_level](http://articles.extension.org/pages/27340/functionality-of-non-meat-ingredients-used-in-enhanced-pork#Total_level_of_added_ingredients_and_injection_level).
- Government notice No. 55 of 30 January 2015. Regulations regarding the classification and marketing of meat. Department of Agriculture, Forestry and Fisheries, Republic of South Africa. [http://www.gov.za/sites/www.gov.za/files/38431\\_reg10358\\_gon55.pdf](http://www.gov.za/sites/www.gov.za/files/38431_reg10358_gon55.pdf).