Cooking loss components of beef from three cattle breeds raised in a low input cattle production system

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Abstract

The effects of breed and ageing on beef cooking loss components were investigated. *Longissimus thoracis et lumborum* muscle steaks were prepared by an electric oven-broiling method using direct radiant heat at 260°C. Raw and cooked weights were recorded. Percentage cooking loss, thawing loss, drip loss and evaporation loss were determined. Beef cooking loss components were affected by ageing with meat aged for two days having higher losses than meat aged for 21 days. Cooking loss components were not affected by breed. There were no significant correlations among the cooking loss components.

Introduction

Cooking loss refers to the reduction in weight of beef during the cooking process (Drummond, & Sun, 2005). The major components of cooking losses are thawing, dripping and evaporation. Thawing loss refers to the loss of fluid in beef resulting from the formation of exudates following freezing and thawing. Dripping is the loss of fluid from beef cuts and water evaporation from the shrinkage of muscle proteins (actin and myosin) in the form of drip (Yu *et al*., 2005). Drip loss is of high importance due to its financial implications. Generally, beef with high drip loss has an unattractive appearance. It also decreases meat tenderness and juiciness. Evaporation refers to the loss of fluid from the beef surface through its conversion to gaseous form. It changes the shape of beef through shrinkage and causes firmness and poor juiciness in beef (Yu *et al*., 2005). The different components of cooking loss may vary depending on the ageing period. Furthermore, the cooking components may also be related.

An increase in cooking loss has a large financial impact in beef industry because it results in the loss of several essential minerals and vitamins which results in the deterioration of beef nutritional quality. Despite its importance as beef quality trait, previous studies on beef quality did not consider cooking loss components (Muchenje *et al*., 2008a; 2008b). Therefore, there is need to determine beef cooking loss components. The objective of the current study was to compare cooking loss components of beef from Nguni, Bonsmara and Angus steers raised on natural pasture in an extensive cattle production system over different ageing periods. The study also sought to determine relationships among different cooking loss components.

Materials and methods

The study was conducted at the University of Fort Hare farm. The meat for sample analyses were collected from fifteen steers of each of Nguni, Bonsmara, and Angus that were slaughtered at 18 months. The samples for treatment were aged for two and 21 days respectively before cooking loss determination. The steaks were prepared by an oven-broiling method using direct radiant heat. Following cooking, the steaks were cooled down at room temperature for 5 hours before cooking loss determination. Percentage thawing loss, drip loss, cooking loss and evaporation loss were calculated as follows:

Immediately after slaughter before freezing, the samples from LTL were weighed. The samples were thawed over a period of 24 hours at 0 - 4˚C and weighed again.

Thawing loss = [(weight before thaw - weight after thaw) ÷ weight before thaw] × 100.

Drip loss = (drip weight ÷ raw weight before drip) × 100.

Cooking loss = [(weight of raw steak after thawing – weight of cooked steak) ÷ weight of raw steak after thawing] × 100.

Evaporation loss = 100 – [(weight after cooking) ÷ weight raw] × 100

Breed and ageing effect on cooking loss components were analysed using the GLM procedures of SAS (2000). The significance differences between least square group means were compared using the PDIFF of SAS

(2000). Pearson's correlation coefficients among cooking loss components; thawing loss, drip loss and evaporation were determined using SAS (2000).

Results

Except for drip loss in meat from Bonsmara and Angus steers; as ageing increased, the thawing loss, drip loss, evaporation loss and cooking loss decreased ($P<0.05$) (Table 1). For beef aged for two days Bonsmara beef had the lowest ($P < 0.05$) evaporation and cooking losses. There were no ($P>0.05$) differences among the breeds in thawing and drip loss. All the beef cooking loss components were not ($P> 0.05$) correlated.

Table 1. Least square means and standard errors of means (in parenthesis) of cooking loss components for beef from Nguni, Bonsmara, and Angus steers aged for two days (CL2) and 21 days (CL21)

Cooking loss Components	Nguni		Bonsmara		Angus	
	CL2	CL21	CL 2	CL 21	CL 2	CL21
Thawing loss	3.26(0.289)^{bc}	2.59(0.289)^{ab}	3.35(0.299)^{bc}	2.23(0.299)^{a}	3.60(0.355)^{c}	2.80(0.355)^{abc}
Drip loss	0.97(0.138)^{ab}	0.84(0.138)^{ab}	1.05(0.143)^{ab}	1.14(0.143)^{b}	0.71(0.169)^{a}	0.84(0.169)^{ab}
Evaporation loss	24.1(0.439)^{d}	22.3(0.439)^{ab}	22.5(0.455)^{abc}	22.2(0.455)^{a}	24.3(0.538)^{d}	23.1(0.538)^{abcd}
Cooking loss	25.1(0.446)^{d}	23.2(0.446)^{a}	23.5(0.462)^{abc}	23.4(0.462)^{ab}	24.9(0.547)^{d}	23.9(0.547)^{abcd}

Discussion

The decrease in cooking loss as ageing increased was as expected since enzymatic reactions by endogenous enzymes, such as collagenase which are produced by bacteria within beef or by ionic solubilisation, progresses at faster rates as ageing increases. The collagenase enzymes disintegrate the myofibrillar proteins and connective tissue thereby improving water holding capacity by proteins (den Hertog-Meischke *et al*., 1998).

The explanation for low evaporation and cooking losses in Bonsmara beef aged for two days is not clear. The thawing loss levels in the current study were slightly lower than those reported in beef steaks by Jeremiah and Gibson (2003). The cooking loss levels in steaks in the current study were slightly higher than those reported by Jeremiah and Gibson (2003) which averaged 22.5 % but lower than those reported by Razminowicz *et al*. (2006) in pasture-fed steers which averaged 30 %. The differences in thawing and cooking losses in the current study and those reported by other authors may be attributed to several factors such as differences in ageing, cooking temperatures, duration of cooking, cooking methods, pH and Marbling (Yu *et al*., 2005).

Within the Nguni steers there were higher evaporation losses at two days ageing than at 21 days ageing. This may be ascribed possible to the high existence of calcium dependent protease inhibitor called calpastatin in some breeds, especially, *Bos indicus* breeds. Calpastatin inhibits the action of calpains in disintegrating the muscle proteins therefore not improving the water and nutrients retention (Ferguson *et al*., 2000).

The absence of significant correlations among cooking loss components was unexpected since cooking loss and evaporation loss are normally negatively correlated because as ageing increases at elevated temperatures, the myofibrillar water holding capacity improve resulting in a decrease in the ability of fluid to flow, while that of gases increases with an increase in temperature (den Hertog-Meischke *et al*., 1998; Yu *et al*., 2005). Thawing loss and drip loss are normally negatively correlated because of the crystallisation rate formed during freezing (Drummond & Sun, 2005). Rapid freezing in combination with rapid thawing provide the most firm texture and the lowest amount of exudates (Jeremiah & Gibson, 2003). Positive correlations between thawing loss and evaporation loss were expected because after the beef has been frozen, ice sublimation during thawing from the beef surface occurs, and if it is excessive during thawing, a dry and spongy beef product may occur (Yu *et al*., 2005).

Conclusions

The present study demonstrated that cooking losses from beef are affected by ageing but not by breed. There were no relationships among the cooking loss components. It is therefore recommended that each cooking loss component has to be determined separately when analysing for cooking loss as a meat eating and processing quality trait.

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