FRESH AND FROZEN LAMB MEAT – A COMPARISON OF MEAT COLOUR, FLUID LOSSES AND WARNER-BRATZLER SHEAR FORCE

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I. INTRODUCTION

It is, from a producer and consumer point of view, interesting to understand how freezing affects meat quality attributes compared to fresh meat. Therefore the aim of this study was to investigate differences between fresh and frozen lamb meat to reflect the domestic production of lamb meat in Iceland. Earlier research has shown a decrease in tenderness measured by Warner-Bratzler shear force (WBSF) values in frozen meat compared to fresh as well as a higher cooking loss for the frozen versus the fresh samples [1]. Even though freezing can affect meat quality parameters negatively, it does provide the advantage of increasing storage time and supply of meat for a longer period of time to stabilise the market price as well as increase the product flexibility [2].

II. MATERIALS AND METHODS

Meat was collected from ten twin pairs intact male lambs (i.e. 20 lambs), 150-160 days of age. One twin lamb from each pair was slaughtered at a small-scale abattoir (SSA) (75 lambs/day) and the other twin lamb at a large-scale abattoir (LSA) (2500 lambs/day). The systems differed in stunning method, electrical stimulation and chilling regime. The SSA uses captive bolt stunning, no electrical stimulation of carcasses and perform a slow chilling process, 10-15°C for the first six hours after slaughter and then chilled at 3-4°C. The LSA uses electrical stunning, electrical stimulation of carcasses (10A and 80V for 60 seconds) and a fast chilling process (2-4°C). Meat samples of *Musculus longissimus thoracis et lumborum* (LTL) were stored at 2°C for four days (SSA) or one day (LSA) before freezing for three months. All samples were weighed before and after cooking to get the combined fluid losses (thawing and cooking). All muscle samples were tested for colour L* (lightness), a* (redness), b* (yellowness), fluid loss and Warner-Bratzler shear force (WBSF). Data was analyzed using Proc Mixed in SAS (SAS 9.4, SAS Inst. Inc., Cary, NC, USA). Differences were denoted significant if $P<0.05$ and tendency of significance if $0.05 \leq P<0.10$.

III. RESULTS AND DISCUSSION

Results from the analysis of fluid losses, meat colour and shear force are presented in Table 1. Freezing had an effect on fluid losses ($P<0.0001$) where the percentage of fluid loss increased substantially in the frozen meat compared to the fresh. An explanation for the increased fluid losses could be protein denaturation which leads to reduced water holding capacity of the proteins [3]. Another or combined explanation could be increased losses of fluid due to cellular

damage caused by ice crystals during freezing [4]. A tendency (P=0.0654) for significance was found for lightness (L*), where the fresh meat was lighter than the frozen meat. Differences were also found in redness (a*) where fresh meat was redder, compared to frozen (P=0.0080), whereas the opposite was found for yellowness (b*), where frozen meat was more yellow than fresh meat (P=0.0006). The colour differences may be connected to the increased fluid losses [5] and/or potentially reduced activity of metmyoglobin-reducing enzymes in the frozen meat [6]. Tenderness in terms of WBSF showed a tendency for significance (P=0.0837) between fresh and frozen meat, where frozen meat had higher WBSF values (tougher) compared to fresh meat. The numerical values for both groups were however quite high, when compared to presented WBSF threshold of 49N for acceptably tender meat [7]. Further investigations on the effect of freezing and consumer acceptability are needed.

Table 1. Colour parameters, fluid losses and shear force values (WBSF) of lamb meat tested as fresh (n=18) and after frozen storage for three months (n=20).

Parameters	Fresh meat	Frozen meat	SEM[1]	P-value[2]
n	18	20		
Lightness (L*)	37.5	36.7	0.38	0.0654
Redness (a*)	19.5	18.8	0.37	0.0080
Yellowness (b*)	4.54	6.00	0.33	0.0006
Fluid losses (%)	15.0	26.9	0.70	<0.0001
WBSF (N)[3]	46.2	50.7	3.03	0.0837

[1] Standard error of the mean. [2] Differences considered significant at $P<0.05$ and tending towards significance at $0.05<P\leq0.10$. [3] Warner-Bratzler shear force measured in Newtons.

IV. CONCLUSION

Results showed that meat colour parameters overall differed in fresh compared to frozen samples. However, since the numerical differences were small, consumer acceptability needs to be further evaluated. Fluid losses increased extensively in frozen compared to fresh meat and WBSF tenderness values tended to be higher, i.e. tougher, in frozen meat compared to fresh.

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