EFFECT OF AGE AND FAT CLASSIFICATION ON THE BINDING AND SALT CONTENT IN DEBONED DRY-CURED LEG OF LAMB/MUTTON (FENALAAR)

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Abstract – Fenalaar, dry-cured leg of lamb/mutton, is a traditional Norwegian product. Fenalaar can be produced with bone in or deboned. If the leg is deboned before salting, it may result in splitting of the muscles in the sliced meat. A method for improving the binding of the cutting surface is desirable, in order to avoid this problem. The aim of this study was to evaluate the effect of raw material (lamb/mutton) and fat classification of the raw material on the binding in deboned dry-cured leg of lamb/mutton (fenalaar). A total of 12 legs of lamb and 12 legs of mutton were divided into two groups after deboning, each with a different fat classification (low/high). In addition to chemical analysis of the finished product, a subjective evaluation for assessing the binding was performed. The results indicate that by using raw material from younger animals (lamb) and with lower fat classification, the binding was improved.

Key Words – traditional product, raw material, water activity.

I. INTRODUCTION

As a preservation method, lamb and sheep meat has been salted and dried in Norway since the Viking age (800-1050) [1]. Through the middle age and up to modern times, entire legs were salted and dried at the farms in traditional storehouses, which resulted in the traditional product fenalaar. Most of the fenalaar today are produced at small meat processing plants. Deboning before salting has become more and more common during the last decade, simplifying the slicing-process of the final product. However, if the meat is not properly "glued" back together during processing, this will increase both the chance of mold growth and slicing issues of the finished product, with cracks and splitting between muscles. Therefore, finding a method to improve the binding of the final product is desirable. The choice of raw material, especially fat content (which is related to the fat classification), may play a significant role on the binding capacity. Thus, the aim of this study was to evaluate the effect of raw material, age and fat classification, on the binding in deboned dry-cured leg of lamb/mutton (fenalaar). In addition, the effect of raw material and fat classification on the salt content was also studied.

II. MATERIALS AND METHODS

Twelve lamb legs and twelve mutton legs were assigned to four design groups, (Table 1).

Table 1. Design of experiment for studying effect of binding in fenalaar.

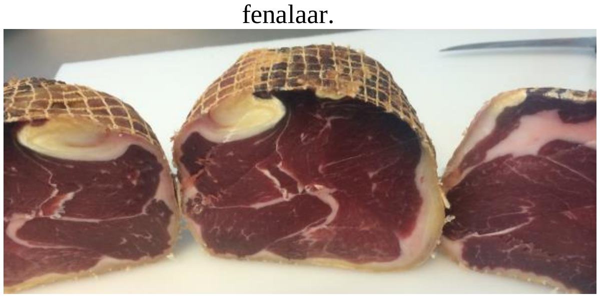
Raw material Lamb (0)/mutton (1)	Fat classification Low (0)/high (1)	Number
0	0	6
0	1	6
1	0	6
1	1	6

Twelve lamb legs and twelve mutton legs were collected and frozen at a Norwegian abattoir. The legs were thawed at approximately 4°C for 2 days, prior to deboning and trimming for visible fat and connective tissue. The legs were then divided into two groups according to their fat classification (Table 1). After deboning, the meat from each leg was folded back together and tightly netted in a meshing net. The deboned and netted legs were salted (3 % fine coarse salt and 3 % nitrite salt) in a vacuum drum with 31 rounds with the following program: 2 min rotation (10 % vacuum, 2 rpm); 45 min without rotation (40 % vacuum); 0.5 min with vacuum release (down to 10 % vacuum). At the end of the program, there was a 24 h waiting time (10 % vacuum). For all rounds, the temperature was 4°C and the inclination of the vacuum drum was 35°. The deboned and netted lamb (1.95 ± 0.33 kg) and mutton (3.44 ± 0.61 kg) legs were stored, under pressure, at 4 °C for 14 days to allow the salt to equalize before drying. After salt equalization, the legs were immersed in potassium sorbate solution (approximately 3.13 % w/v) for 1 h prior to the drying process. The lamb and mutton legs were dried at 12-14°C and 73-76 % RH until weight loss reached approx. 38 % from initial weight. At approximately 15 % weight loss, the legs were smoked for 1 day at 12-13°C and 60-70 % RH. The smoke was applied in intervals. Immediately after the smoking process, the legs were kept under pressure at 6.5 bars for 48 h at approximately 12 °C, before continuing the drying process. The total drying period was approximately 6 weeks, and the lamb and mutton legs were not covered during this period.

Samples for chemical analyses, water activity, sodium chloride and water content, were collected from four fenalaar from each group. Water activity was measured by a water activity meter (Aqualab, USA). The water and sodium chloride content were measured by an accredited lab (Eurofins, Norway). The sodium chloride content was calculated using silver nitrate titration of chloride ions [2]. The data was statistically processed by one-way ANOVA and Tukey's multiple comparison test at P-value < 0.05 (R Foundation for statistical Computing, version 3.2.3).

All the fenalaar were cross cut (Figure 1) and subjectively evaluated for visible cracks, hollow areas and muscle adhesiveness, and categorized into three groups: 1) flawless, no visible cracks or hollow areas; 2) small and few cracks, which were not likely to affect slicing; 3) large or many cracks, which would not be intact during slicing.

Figure 1. Cutting pattern for evaluating binding in fenalaar.



III. RESULTS AND DISCUSSION

Table 2 shows the mean and standard deviation for chemical analyses of fenalaar, for each experimental group. The weight loss was calculated from the initial weight of the meat samples.

Table 2. Results from chemical analysis of fenalaar.

Raw material Lamb (0)/mutton (1)	Fat classification Low (0)/high (1)	Salt content g/100g	Water content g/100g	Water activity
0	0	6.19 ± 0.51^{a}	$53.03 \pm 1.34^{a,b}$	0.90 ± 0.01^{b}
0	1	$5.07 \pm 0.31^{b,c}$	47.73 ± 2.93^{c}	$0.91 \pm 0.00^{a,b}$
1	0	$5.40 \pm 0.69^{a,b}$	55.23 ± 1.60^{a}	0.92 ± 0.00^{a}
1	1	4.24 ± 0.41^{c}	$48.83 \pm 2.41^{b,c}$	0.92 ± 0.01^{a}

Different letters within the same column indicate that the means are significantly different (P<0.05).

Fenalaar of lamb have lower salt content than fenalaar of mutton. Likewise, fenalaar with lower fat classification (and therefore lower fat content) have higher salt content than those with higher fat classification. This is to be expected, given that salt diffusion and water extraction occur slower in raw material with higher fat content. Generally, older animals have higher fat content than younger animals. The water content is lower for fenalaar with lower salt content. However, the variation in water content is quite high which might be due to variations in the water content for the raw material. The effect of age and fat classification on binding of fenalaar was evaluated and categorized. All six fenalaar from lamb with low fat classification were category 1 (flawless), and only one of six fenalaar from lamb with high fat was not acceptable. Leg of mutton with low fat classification resulted in more acceptable fenalaar, than leg of mutton with high fat classification, where five out of six fenalaar were category 3 (not acceptable).

There are very few international publications regarding the production of fenalaar, and none as far as the authors know regarding binding in fenalaar. However, these results indicate that the best results for binding would be achieved using raw material of lamb, and with lower fat classification (fat content).

IV. CONCLUSION

Lower age (lamb) and lower fat classification for the raw material resulted in fewer cracks and cavities in the finished fenalaar, indicating that the binding was improved for these groups.

As expected, the fenalaar of lamb (smaller diameter), and the products with lower fat classification, had a higher salt content.

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