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Seaweed in lamb diet – Oxidative stability and consumer preferences (#237)

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Introduction

Seaweeds have been used as a valuable feed for ruminants in coastal regions of North Atlantic Europe due to feed shortage. Renewed interest in seaweed as feed ingredient is due to richness of minerals, complex carbohydrates, n-3 and n-6 fatty acids, vitamins, pigments and bioactive compounds evaluated as prebiotics[1]. Additionally, *in vitro* studies showed that seaweed decrease ruminal methane production[2]. There are limited data on the effect of seaweed on storage stability and sensory quality of lamb meat. We investigated the effect of seaweed in growing-finishing lamb diet on oxidative stability and consumer's odor perception.

Methods

Sixteen female Norwegian White lambs (mean ± SD; 37.3±1.67 kg) were allocated from pasture in two groups: control diet (C; concentrate and forage) and seaweed diet (S; concentrate, forage and 5% seaweed *Saccharina latissima* on dry matter basis) over 35 days. Loin and subcutaneous fat obtained 3 days *postmortem* were vacuumed and stored either as fresh (at -80℃) or at 4℃. Oxidative stability analyses were performed after 4 weeks of storage. Total antioxidant capacity 2,2-diphenyl-1-picrylhydrazyl (DPPH) and thiobarbituric acid reactive substances (TBARS) analysis were assessed on loin.
Headspace volatiles of 5 g intact fat were sampled at 30℃ on Micro-Chamber M-CTE250 (Markes, UK) using Tenax tubes. Analysis were done by Gas Chromatograph 6890 (Agilent Technologies, USA) equipped with DB - WAXetr fused silica capillary column (30 m×0.25 mm i.d., 0.5 µm film thickness; J&W Scientific, USA) and ion source Agilent 5975. Data were analyzed by MassHunter Qual using Correlator for volatile alignment. The volatiles were identified by NIST17.
Consumer panelists (n=150) were served two different lamb meat balls (1.6% NaCl, ℃ 13% of fat) prepared in a steam heater at 72 °C and packed in ziplock bags. Consumers were asked to describe odor after opening the bag.
General linear model (MINITAB 18) and principal component analysis (weighted A/SDev+B, Unscrambler X10.5) were used to identify differences between dietary groups.

Results

Supplementation of lamb diet with 5% seaweed reduced lipid oxidation (Table 1). The antioxidant capacity of meat was not affected by the diet and storage ($P > 0.05$), although seaweed increased antioxidative power. Due to large DPPH variations between animals from the same diet group, we speculated that bioactive compounds from pasture affect antioxidant status of the muscle more than the seaweed.
Multivariate analysis showed differences between the two diets and association with volatiles and odor characteristics (Fig.1). Consumers described odor of Control (C) group as good, mild and bullion. The fat volatile compounds that may have contributed to these attributes have sweet, fruity and umami notes, *i.e.* toluene, 2-butanone, methyl isovalerate, nonanoic acid, methyl ester and 1-octen-3-ol. Lamb/sheep odor and toluene, as indicators of pasture fed lamb[3], of C group indicate that growing-finishing diet could not diminish the effect of prior pasture diet. 1-octen-3-ol, oxidative product of C18:3 n-3, contributed to volatile profile of C group although no difference was found in fatty acids (data not shown) for two diets. Seaweed (S) group was described with meaty, acidic and tart odor, clustered with organic acids (acidic, cheesy, pungent), acetophenone and butyrolactone (sweet), 1-dodecanol (fatty), and benzonitrile (almond taste). Sea, salty and strong/spicy/herbal odor was more associated with S group due to frequency of used attributes to describe meat odor by consumers. Higher content of phenol in S group ($P < 0.05$) is expected to contribute to lamb spiciness, as reported in the consumer study.
Modified flavor was used to describe Kaaro lamb flavor that originates from fragrant bushes in North Cape region[4]. Similar, Icelandic lamb fed with *Angelica archangelica* are marketed with reference to its modified flavor[5].

Conclusion

Current study reveal that oxidative stability of lamb meat and flavoring volatiles were affected by endogenous (i.e. feed and genetics) prooxidants and antioxidants. Inclusion of 5% seaweed in lamb diet 35 days prior to slaughtering gave a unique meat odor and could be used in production of distinctive lamb meat on the market.

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3 Sivadier, G., Ratel, J., Engel, E. 2010. Persistence of pasture feeding volatile biomarkers in lamb fats, Food Chem., 118, 418-425.
4 Erasmus, S.W., Hoffman, L.C., Muller, M., van der Rijst, M. 2016. Variation in the sensory profile of South African Dorper lamb from extensive grazing systems. Small Rumin Res., 144, 62-74.

Notes

5 Thorkelsson, G., Jonsdottir, R., Hilmarsson, O. T., Olafsdottir, A., Martinsdottir, E. 2009. The influence of grazing time on Angelica archangelica on volatile compounds and sensory quality of meat from pasture lambs. ICoMST

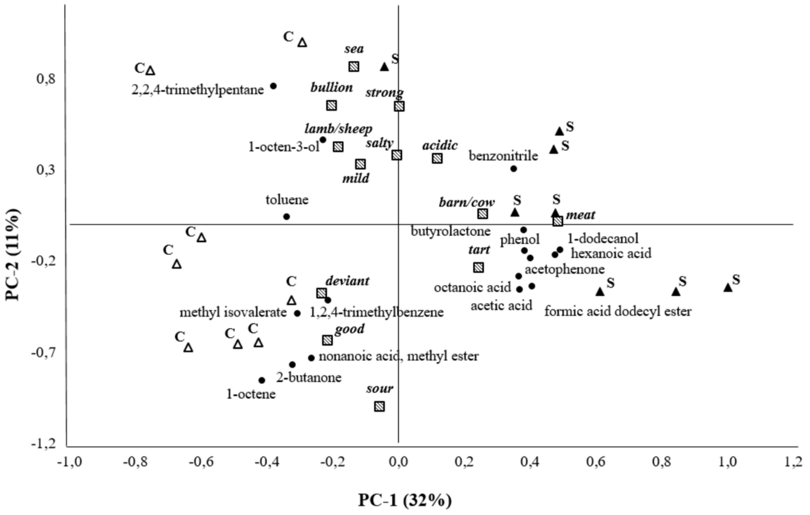

Figure 1 Figure 1. Principal component analysis of volatiles (•) in subcutaneous fat that showed significant difference (*P* < 0.05) between control (C) and seaweed (S) diet and odor attributes (▧) of lamb meat balls given by consumers.

Item	Treatment		*P*-value		
	C	S	Diet	Time	Diet × Time
TBARS (mg MDA/kg)					
Day 0	0.07±0.02	0.02±0.02			
4 weeks	0.11±0.02	0.10±0.02	<0.001	<0.001	0.003
DPPH (%)					
Day 0	60.71±5.33	63.71±5.33			
4 weeks	60.12±3.91	61.09±4.71	0.597	0.390	0.284

Table 1. The effect of seaweed in Norwegian White lamb diet on oxidative stability of loin

Notes