# Fatty acid profile of typical Norwegian lambs sustained entirely on fresh mountain pastures

D.E. Mushi[a], G. Steinheim[b], R, Johannessen[c], L.O.Eik[b]

# INTRODUCTION

- Studies have shown that consumers' perception on meat healthiness is related to its fat content and fatty acid composition (Fisher et al., 2000).

- Higher intakes of animal fats, especially those rich in long-chain saturated fatty acids (SFA), are associated with increased plasma cholesterol, and the risk of atherosclerosis and cardiovascular diseases (Ascherio, 2003; Mensink et al., 2003).

# INTRODUCTION

- Fatty acid composition of lamb meat  is influenced by  both internal factors, e.g. breed, and external factors such as feeding system.

- Mountain pasture, also called herbage lipids, usually contain increased amounts of unsaturated fatty acids (average 70–90%), particularly linoleic (18:2, $n-6$) and linolenic (18:3, $n-3$) acids (Dewhurst et al.,2003; *Schroeder et al.,2004).*

- Therefore, the aim of  the present study was to determine the influence of high altitude mountain pastures on the fatty acid profile of meat from Norwegian lambs

# MATERIALS AND METHODS

- The lambs studied were in six different flocks and grazed mountain pastures in the low-alpine zone (≈ 1000 – 1350 m.a.s.l.) and mid-alpine zone (≈ 1350 – 1600 m.a.s.l.) of southern Norway.

- Grasses, especially *Avenella flexuosa and Carex* spp, and several herbs and *Salix spp.* provide forage.

- From each flock (fig 1), 10 animals were randomly selected for fatty acid profiling.

- Mean age of lambs at slaughter was 136 d with mean carcass weight of 21 kg.
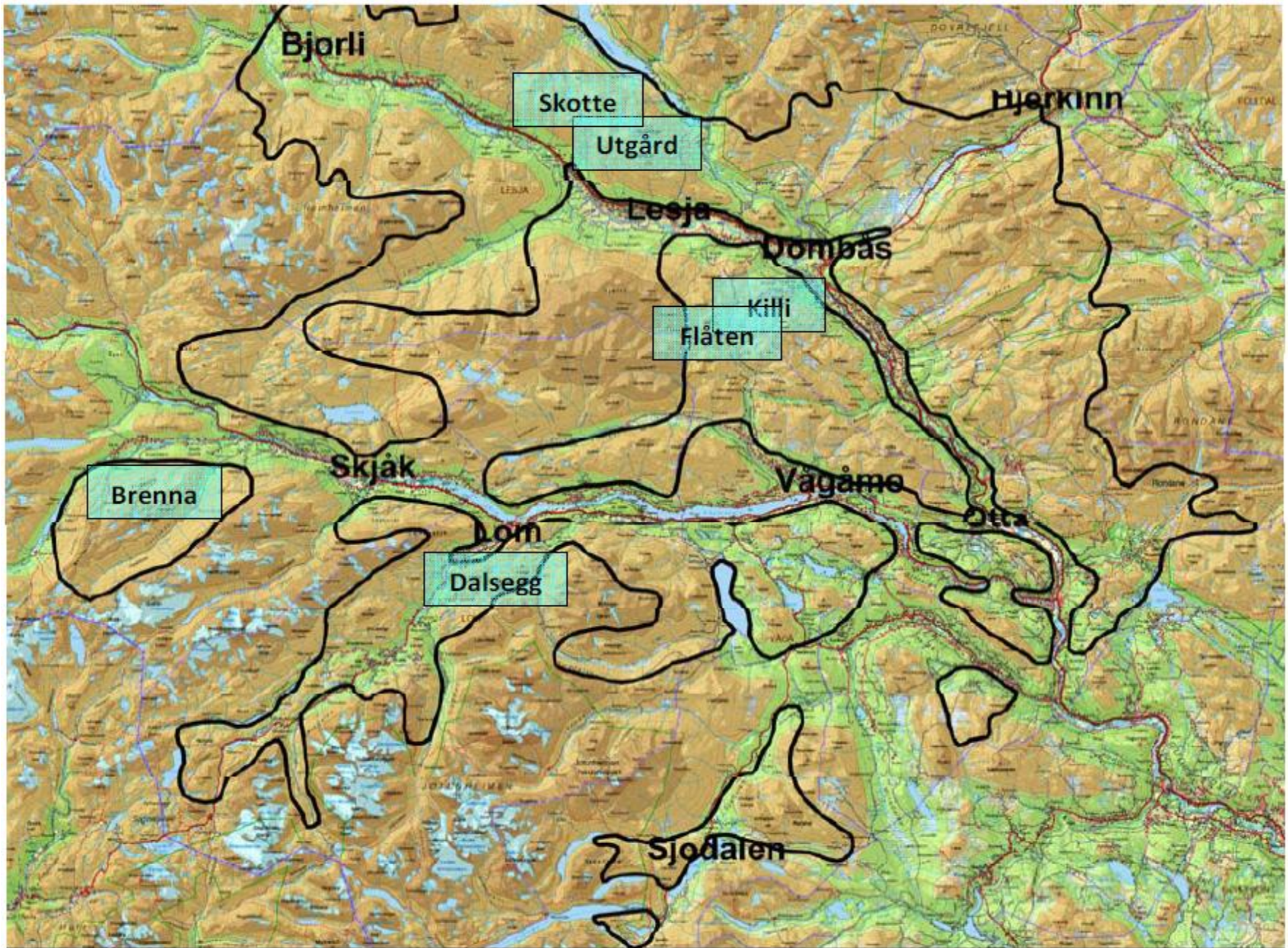
Fig.1: Location of six farms from which slaughter lambs were sourced

# MATERIALS AND METHODS

- Slaughtering and grading were performed at a commercial slaughterhouse (Nortura, Gol).

- Grading of carcasses based on the EUROP grading system for lambs was done on a 15-point scale

- The carcasses were then placed separately on hooks in chilled storage at an air temperature of 0 oC for 48 h.

- Thereafter m. longissimus dorsi, was excised at the lumbar vertebrae for fatty acid analysis using GC

**Table 1: Variation in the age, and carcass weight, conformation, percent fat and fatness scores of slaughter animals by farm of origin**

| Parameter | 511Dovre | 512Lesja | 513Skjak | 514Lom | 515Vaga | Sign. |
|---|---|---|---|---|---|---|
| Age | $138.9^a$ | $141.0^a$ | $131.1^{bc}$ | $129.3^c$ | $141.9^a$ | *** |
| Carcass WT | 21.0 | 21.6 | 20.6 | 21.8 | 19.4 | ns |
| Conform. | $7.4^c$ | $10.0^a$ | $9.0^b$ | $9.2^a$ | $9.2^{ab}$ | *** |
| Fat.Score | 6.8 | 5.5 | 6.2 | 5.9 | 6.1 | ns |
| Fat percent | 19.9 | 17.6 | 17.0 | 17.7 | 22.7 | ns |

## Table 2: Variation of groups of fatty acids and iodine number of slaughter animal by farm of origin

| Parameter | 511Dovre | 512Lesja | 513Skjak | 514Lom | 515Vaga | Sign. |
|---|---|---|---|---|---|---|
| SFA | 51.5$^b$ | 51.3$^b$ | 50.6$^b$ | 53.9$^a$ | 52.4$^{ab}$ | * |
| MUFA | 41.4$^a$ | 41.4$^a$ | 42.0$^a$ | 38.8$^b$ | 39.8$^{ab}$ | * |
| PUFA | 6.9 | 7.5 | 7.5 | 7.3 | 7.4 | ns |
| n-3 PUFA | 2.6$^b$ | 3.0$^b$ | 2.9$^b$ | 3.7$^a$ | 3.1$^b$ | * |
| n-6 PUFA | 4.1 | 4.2 | 4.4 | 3.5 | 4.2 | ns |
| n-9 MUFA | 33.6$^{ab}$ | 33.9$^a$ | 34.9$^a$ | 31.1$^c$ | 32.3$^{bc}$ | ** |
| n-6:n-3 | 2.1$^a$ | 1.4$^b$ | 1.6$^{ab}$ | 1.0$^b$ | 1.3$^b$ | * |
| Iodine no. | 52.3 | 53.5 | 54.0 | 52.0 | 52.3 | ns |

## Table 3: Variation of individual fatty acids in slaughter animals by farm of origin

| Parameter | 511Dovre | 512Lesja | 513Skjak | 514Lom | 515Vaga | Sign. |
|---|---|---|---|---|---|---|
| C16:0 | 23.0 | 22.1 | 22.7 | 22.5 | 22.2 | ns |
| C16:1 n7 | 1.7[a] | 1.7[a] | 1.8[a] | 1.5[bc] | 1.5[c] | * |
| C17:0 | 1.3[c] | 1.5[ab] | 1.4[bc] | 1.4[b] | 1.7[a] | ** |
| C18:0 | 19.4[bc] | 20.4[ab] | 18.2[c] | 22.0[a] | 21.5[a] | * |
| C18:1 n9 | 33.3[ab] | 33.7[a] | 34.6[a] | 31.0[c] | 32.0[bc] | * |
| C18:2 n6 | 3.5 | 3.6 | 3.9 | 3.0 | 3.6 | ns |
| C18:3n3 | 0.9[c] | 1.4[a] | 1.2[b] | 1.6[a] | 1.5[a] | *** |
| C20:4n6 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | ns |
| C20:5n3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | ns |
| C22:5n3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | ns |

**Table 4: Variation in the age, and carcass weight, conformation, fatness scores and percent fat of slaughter animals by sex**

| Parameter | Female | male | SE | Sign. |
|---|---|---|---|---|
| Age | 138.3 | 134.6 | 1.4 | ns |
| Carcass WT | 20.3 | 21.5 | 0.4 | * |
| Conformation | 8.8 | 9.1 | 0.2 | ns |
| Fatness Score | 6.4 | 5.7 | 0.2 | * |
| Fat percent | 20.2 | 17.8 | 1.1 | ns |

## Table 5: Variation in groups of fatty acids and iodine number by sex of slaughter animals

| Parameter | Female | male | SE | Sign. |
| --- | --- | --- | --- | --- |
| SFA | 52.5 | 51.4 | 0.5 | ns |
| MUFA | 40.8 | 40.6 | 0.5 | ns |
| PUFA | 6.8 | 7.8 | 0.3 | * |
| n-3 PUFA | 3.1 | 3.1 | 0.1 | ns |
| n-6 PUFA | 3.6 | 4.6 | 0.3 | * |
| n-9 MUFA | 33.1 | 33.2 | 0.5 | ns |
| n-6:n-3 | 1.4 | 1.6 | 1.7 | ns |
| Iodine no. | 52.0 | 53.8 | 0.6 | ns |

## Table 3: Variation of individual fatty acids in slaughter animals by sex

| Acid | Female | male | SE | Sign. |
|------|--------|------|-----|-------|
| C16:0 | 23.1 | 21.9 | 0.3 | ** |
| C17:0 | 1.4 | 1.5 | 0.0 | ns |
| C17:1 | 0.7 | 0.8 | 0.0 | ** |
| C18:0 | 20.0 | 20.6 | 0.3 | ns |
| C18:1 n9 | 33.0 | 32.9 | 0.5 | ns |
| C18:2 n6 | 3.1 | 3.9 | 0.2 | * |
| C18:3n3 | 1.3 | 1.3 | 0.1 | ns |
| C20:4n6 | 0.3 | 0.3 | 0.0 | ns |
| C20:5n3 | 0.3 | 0.3 | 0.0 | ns |
| C22:5n3 | 0.3 | 0.3 | 0.0 | ns |
| C24:1 | 0.3 | 0.3 | 0.0 | ns |

# CONCLUSION

- Meat from lambs grazed on Norwegian mountain pastures has salubrious fatty acid profile based on the following:
  - higher level of unsaturation  as indicated by high Iodine number
  - Favourable n-6:n-3 ratio (below 4),
  - Higher proportion of MUFA ( > 38%)
  - SFA being mainly due to stearic acid, which has no cholesteromic activity
- This information can be used to promote consumption of lambs finished on mountain pastures.