Increasing Beneficial Fatty Acids in Lamb:

From Lamb Diet to your Plate

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Department of Plant and Animal Sciences

Omega-3 Fatty Acids in the Human Diet

The fats and oils in our diet are comprised of different types of fatty acids, two of which are essential, meaning we cannot synthesize them ourselves and must consume them in the diet. These are the omega-6 fatty acid, linoleic (LA) and the omega-3 fatty acid, alpha linolenic (ALA). Both LA and ALA are produced by plants. While LA is readily available in commonly consumed oils, ALA is present in small amounts unless consumers choose specific oils such as flaxseed. From ALA our bodies can synthesize two longer omega-3 fatty acids: EPA (eicosapentaenoic acid) and DHA (docosahexaenoic acid), however this conversion is sub-optimal. North Americans consume only 15% of the recommended amount of EPA & DHA. EPA & DHA are not produced by plants and currently recommended sources are marine oils. Many health benefits are attributed to EPA and DHA. Both EPA and DHA are involved in the regulation of lipid and carbohydrate metabolism and extensive research is being conducted to understand the role these fatty acids have in preventing obesity and type II diabetes, as well as cardiovascular disease and chronic inflammation.

Conjugated Fatty Acids in the Human Diet

Conjugated linoleic acid (CLA), is the name given to specific conformational variants of LA, some of which have been linked to decreased fat deposition, protection against types of cancers, improved immune response and normalization of insulin levels. ***CLA is a product of microbial fermentation in the rumen and ruminant food products are currently the best dietary source of these fatty acids***.

Meat Fatty Acids in the Human Diet

Meat products are generally criticized for having a high saturated fatty acid content. However meat products are a source of EPA and DHA, which plant oils do not supply. Furthermore ruminant meat is an excellent source of CLA.

Objective: To produce nutrient-enhanced lamb that will command premium prices, increase consumer demand and the competitiveness of the industry.

Red clover has been shown to increase the CLA and omega-3 fatty acid content in ruminant meat, while fish oil supplements have been shown to increase the content of EPA and DHA. Thus, by modifying forage-based lamb production systems already in use, it should be possible to produce lamb rich in CLA and the beneficial omega fatty acids, EPA and DHA.

Experimental Procedures

A 2-year trial was recently conducted at the Nappan Experimental Farm in Nova Scotia, using 64, 2-3 month old lambs. The animals were grazed on one of two pasture types, for three months (Aug-Oct): 1) > 30% red clover/tall fescue or 2) a pure stand of tall fescue. After pasturing the lambs received hay and grain with one of four oil supplements, three weeks prior to market: 1) no supplemental oil; 2) soybean oil; 3) CLA + soybean oil; 4) fish oil. Pasture productivity, growth, glucose/insulin levels, plasma lipid metabolites and fatty acid profiles in blood and carcasses of lambs, as well as detailed molecular and reproductive analyses of tissues were monitored throughout the trial.

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Preliminary Results: Growth & FA Composition

Lambs grazed on red clover/tall fescue gained significantly more weight per day than those on the tall fescue alone (Table 1). The red clover (variety AC Christie) pastures were approximately 50% red clover in the first year and 35% in the second year.

Table 1. Lamb growth on pasture

	Start weight (kg)	End weight Pasture (kg)	ADG (kg)
Red clover	20.5	32.8	0.16
Tall fescue	20.5	29.2	0.12
Average	**20.5**	**31.5**	**0.145**

Pasture type did not affect gain on the finishing diet (Table 2). The red clover/tall fescue group maintained a heavier weight until the end of the trial, and therefore had a larger carcass. Muscle scores, not shown, were higher for the red clover lambs as well, increasing carcass value.

Table 2: Finishing performance of the lambs

	Finished Wt. (kg)	Finishing ADG (kg)	Carcass Wt. (lbs)	Fat depth
Red clover	43.7	0.20	44.4	11.6
Tall fescue	40.0	0.20	40.0	9.6
Average	**41.9**	**0.20**	**42.2**	**10.6**

Early results of the fatty acid analysis (Figure 1) indicate that lambs grown on red clover/tall fescue during the pre-finishing period have a higher level of long chain omega-3 fatty acids than those grazed on tall fescue. Supplementation with fish oil resulted in a dramatic increase in these healthy fatty acids for both pasture treatments; soybean oil actually decreases these levels slightly (not shown).

Reproductive Performance

Ram lambs grazing red clover had a heavier testicular + epididymal weight (496.00 g) than lambs on tall fescue alone (446.99 g). Ram lambs grazing red clover had enhanced sperm production/ reserves compared with lambs grazing tall fescue alone (Figure 2). Half of the ewe lambs grazing red clover became pregnant and half of the ewe lambs grazing tall fescue became pregnant.

Preliminary results suggest some fatty acid supplementation appears to have an effect on sperm production. Semen evaluation and hormonal analysis are currently being conducted.

Fatty acid supplementation and red clover appear to have little effect on lamb pregnancy. Half the lambs that were fed no oil supplement or an oil supplement became pregnant. The red clover cultivar (AC Christie) used in this study when grazed for 3 months had no apparent negative effects on reproduction.

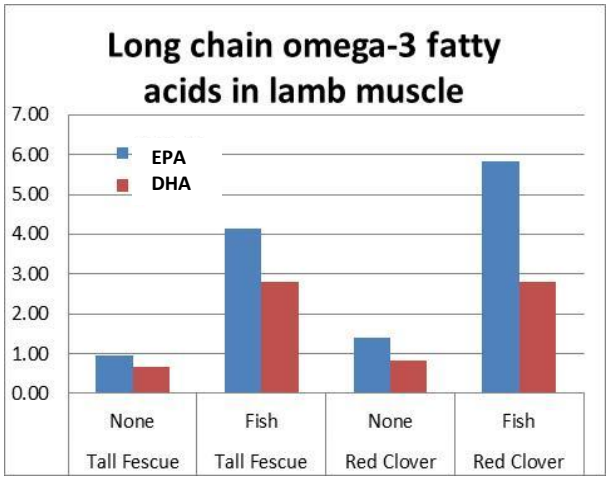

Figure 1: Long chain omega-3 fatty acids in lamb muscle

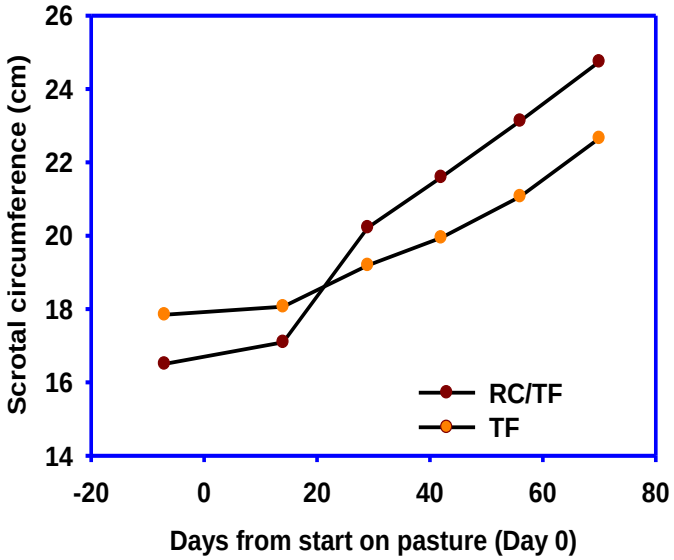

Figure 2: Scrotal circumference of lambs during pasturing

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Prince Edward Island ADAPT Council
AACI Agri-Adapt Council Inc.
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