

Is Better Nutrition a Justification for Choosing Pasture Raised Animals?

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Abstract

A fairly large number of studies have examined nutritional differences between pasture raised (PR) and conventionally raised (CR) animals, including beef, dairy, poultry, swine and lamb. Comparing results from these studies is a challenge as numerous variables affecting the nutritional outcomes of interest differ across studies- season, length of time on pasture, the particular species or muscle measured, method of analysis and manner in which the data is reported (relative versus absolute comparisons) as well as the specific nutrients being compared. In spite of these challenges several conclusions can be made with some degree of confidence, the most critical being that PR animals will be much leaner than those CR. The proportion of different types of fat will generally be healthier, i.e., fat from PR animals will tend to have greater proportions of healthy fats (conjugated linolenic acid (CLA), omega-3 fatty acids), as well as higher levels of vitamin E. Milk from PR dairy cows will generally be higher in CLA and have different proportions of other fats; cheese will reflect the fatty acid composition of the milk. But, PR cows might have lower milk yields. Extrapolating from these findings to support claims of nutrition benefits, however, is not straightforward. Even if the fat from PR beef has a healthier profile of fatty acids, the amount of fat is far less, i.e., the consumer will not get a substantial amount of those fatty acids. Vitamin E levels are higher but still too low to make much difference in requirements. Do pasture raised animals have a better nutrition profile? Probably yes. Will that better nutrition profile benefit consumers? That depends.....

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I want to thank the Mott Group for inviting me to speak. I'm a little bit nervous because Michael keeps saying "We want to have controversy here, we want to have discussion", and I keep wondering if he's talking about my talk.



Is better nutrition a justification for choosing pasture raised animals? Yes and no.

We have of course just finished an interesting presidential election season in the United States where people are making a choice. People make choices about our food supply as well. And, not always correctly.

Some of us have just opted out of the whole discussion.



Gist of PRA nutrition "claims"

- Lower in fat & calories
- Higher in healthy fats & vitamins
 - omega-3 (n3) fatty acids
 - Conjugated linoleic acid (CLA)... "a potent defense against cancer"
 - Vitamin E... a potent antioxidant

www.eatwild.com

www.csuchico.edu/agr/grsfdbef/index.html

If you look on the World Wide Web at the grass fed beef and pasture raised animal sites, the nutrition claims will fall under two categories. It's lower in fat and calories, so it's leaner. It's higher in certain types of healthy fats, N-3, and conjugated linoleic acid, and Vitamin E. There were dozens and dozens of studies that support these claims. But it's not black and white. One thing that confounds all the studies is that there are a slew of variables that affect the nutrition, the

end product, and the nutrition profile of the meats or dairy.

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First, how is pasture defined? I reviewed 50 or 60 articles for this talk, and every one of them defines it differently. In some studies, animals were on pasture their entire lives. In others they were on pasture up until a month, or two months, before slaughter. Or they switch them to pasture, see what happens and then slaughter them. So the length of time on pasture is radically different.

In one study on a dairy farm, the nutritional quality of the milk was different based on whether you milked the cows in the evening and put them out in pasture for eight hours, or you milked them in the morning and put them out in the pasture for eight hours and brought them back in. That created different nutritional profiles in the milk.

Something that I found astounding with these studies was the mix of forage and pasture. Only a handful of the studies were at 100% pasture. Most combined pasture and feed. In some studies “pastured” animals ate 90% feed as the control animals. Were they comparing pasture or are they using pasture as an adjunct to conventional feed?

If animals are on pasture, what are they eating? The studies ranged. The study with acorns is really a swine study, not cattle, but cattle pasture variously included types of grass, clover, planted grains, or legumes. In Switzerland there have been a number of studies looking at the effect of altitude. As one moves up in altitude, there is a greater variety of plants, and a totally different nutrition profile, with higher altitude being better.

Different species and breeds react differently to pasture. For example, cattle react differently than swine. In Europe a lot of the studies look at pasture raised steers versus grain fed bulls. They may be the same species, but the reaction to the feed is quite different.

The muscles studied make a difference. In one of the studies on swine there was a different conclusion if you looked at different muscles. Within the same animal, the nutrition profile differed. The method of extraction affects data. One study compared three methods of fat/lipid extraction. There was a three time difference in the estimate of total fat and twice the difference in the ratio of N-6 to N-3 fatty acids.

How is the data presented? Is it absolute amounts: it has so much fat, so much vitamin E; or is it relative: pasture raised has more compared to grain fed? What does that mean relative to the absolute? So this is a nightmare. In nutrition, it's a hassle to evaluate people's diets. How are we going to evaluate their diets and have an accurate estimate? I am not sure what kind of conclusions to draw, but I will try anyway.

Variables affecting nutrition

- How pasture feeding defined
 - Length of time on P
 - am vs pm
 - Mix of forage & feed
- Plant types
 - Acorns, clover, planted grains, legumes...
 - Altitude
- Species & breeds
 - Genders, age
- Muscles studied
- Method of extraction
- Way data presented –
 - ... absolute or
 - ... relative values

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Order of Discussion

- ** Beef
- Dairy
- Poultry (meat & eggs)
- Swine
- Lamb
- Conclusions

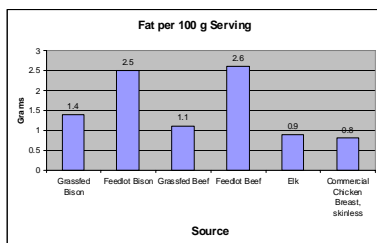
I am going to spend most of the time on beef, because that is where most of the studies are. The points I make on beef will apply to other animal systems. I will end with a couple of slides with some conclusions.

The strongest support, by that I mean the studies are consistent, and there are lots of studies, shows that grass fed animals are leaner. That is probably no surprise to anybody in this group. Grass fed beef is 25% - 50%, sometimes 70%, leaner, and as a result the calories are lower, maybe 15-50 calories less per serving. That is a serving defined as about 100 grams (a little less than a quarter pound), which is a lot less than many meat eaters will consume. I was on a panel with some people that raised grass fed bison and she said, "That's not a serving! 100 grams, that's the beginning of my serving."

Strongest support....

- Grass fed beef is leaner, with less...
 - Total Fat (25-50% lower)
 - Calories (15-50 less per serving)

This study was done by Dan Rule at the University of Wyoming. He compared fat in several meats, based on grams of fat per 100 gram serving. Grass fed beef had about a gram or 40% as much fat as feedlot beef. So grass fed beef was far leaner, and comparable to grass fed bison, wild elk and skinless chicken breast. Undoubtedly it's lower in fat. We are comfortable with that.



Rule et al. J. Animal Sci. 80(5):1202-11

What does that translate to from a health and a nutritional perspective? The average American consumes about three ounces of beef a day. If all that beef was grass fed they would save 5,000-18,000 calories per year, which corresponds to one-and-a-half to five pounds of fat per year. So it has some potential impact on weight. But most of the beef we eat comes from fast food burgers, which are not going to be grass fed. If people who eat a lot of beef switch to grass fed they will save some calories. There is also good support for this.

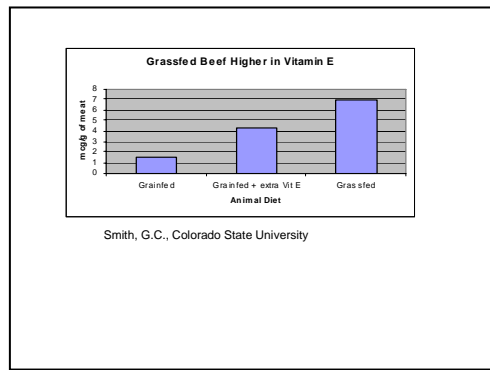
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A lot of data on types of lipid or vitamins is consistent. Compared to feed lot beef, grass fed beef has five times as much Vitamin E, three to five times as much conjugated linoleic acids (CLA), and a better mix of fatty acids. N-3 is a healthier type of fat and what we would like to see is a lower ratio of N-6 to N-3. So all that is positive as far as relative claims.

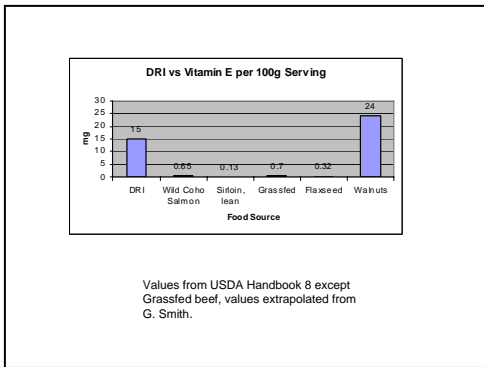
Relative claims
(good support)

- Grass fed beef has more Vitamin E (5x)
- GFB has higher proportion of CLA (1.5-3x)
- GFB has better mix of fatty acids (higher n-3; lower n-6/n-3 ratio)



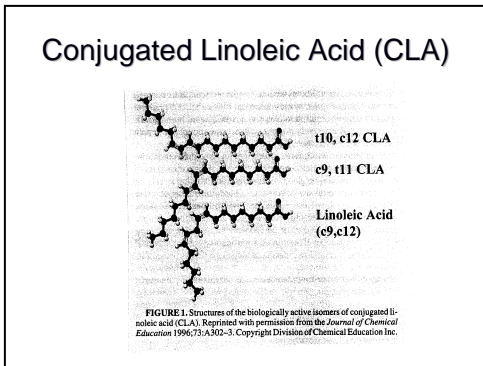
What do these positive relative differences mean in terms of absolute amounts? That gives us a little different picture. This research was done by Gary Smith in the Animal Science Department at Colorado State University. Grass fed beef compared to grain fed, has five times as much Vitamin E. Even when they supplemented the grain fed cattle with vitamin E, they could not get it up as high as the grass fed. So no question grass fed is higher in Vitamin E. The issue arises when we compare these Vitamin E levels to what we require.

The dietary reference intake (DRI) is the amount of various nutrients that we require or are recommended to consume on a daily basis. Vitamin E, at 15mg/day happens to be one that is tough to get (i.e., meet DRI) from the diet. Even though grass fed beef has five times as much Vitamin E, it's only five percent of our requirements. In order to label a food as a good source of a nutrient, it must provide at least ten percent of the DRI per serving. So unless we can figure out how to double the vitamin E in grass fed beef.... it's not a bad source, but it's certainly not a good source of vitamin E. The vitamin E keeps the quality of meat, and gives it a longer shelf life. I put walnuts up just to contrast it with a food that is particularly high in vitamin E, although most people aren't going to eat 100 grams of walnuts at a sitting.



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I am sure you don't want to go back to high school chemistry, but I wanted to make a couple of points before I talk about CLA. These are fatty acids. Linoleic acid is an essential fat; we have to have it in our diet because we can't produce it. When I talk about N-6 and N-3, it has to do with where the double bonds are. You can see there are two double bonds here. This is a polyunsaturated fat. The first double bond is at the sixth carbon, it's an N-6. In a N-3 fatty acid, the first double bond is going to be at the third carbon. The location of the double bond changes the

structure, changes the biological activity of the fatty acids. A conjugated linoleic acid is really nine different isomers, nine forms. The bacteria in the rumen of cattle produce these nine different isomers, which have purportedly a variety of health benefits.

Most of this information comes from a supplement to the American Journal of Clinical Nutrition, one of the top nutrition journals, in 2004. The whole supplement was on CLA and a variety of the health benefits associated with CLA. It is anti-carcinogenic, helps the immune system, helps blood lipids or blood cholesterol profile, maybe helps you to gain muscle and not gain fat. The catch is that there is no consistency in the data. Effects are found in some animal studies and not others; in mice and not rats; in rats and not hamsters; some of the findings are in swine, but not people; and some in people and not animals. So there is no consistency. Part of the reason that there is no consistency is that in the diet, CLA has these nine isomers, this combination of fatty acids. Most of the studies used a supplement, a single isomer. When you supplement a single isomer, you don't get the same effect as when you have the mix. There is no synergy.

"Reported" benefits of CLA

- Anti-carcinogenic
- Enhances - immune function
 - * lean body mass gain
 - * growth in young rodents
 - diabetes or glucose control (?)
- Reduces inflammation
 - atherosclerotic blood lipid profile
 - * body fat gain
 - (Not necessarily enhance loss)
 - * seen in young, growing animals not adults
- CAVEAT: many of these benefits seen in some animal studies but not proven in humans

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- Websites report incorrectly that a 3.5 oz serving of GFB has ...
 - 1.2g (25% of 5 g "needed" for biological effect) vs
 - 0.48 g (10%) in feedlot beef
- Articles report CLA as % of 100g fat NOT 100g of meat
- Absolute amount CLA MUCH lower since less fat in GFB
- REALITY ~ 6 mg in GFB vs 8 mg in feedlot
 - (Rule et al., 2002)

We also run into some problems about whether the data is reported relatively or absolutely. This data is from three months ago when I looked at a website. Every one of the grass fed beef web sites said "a three and a half ounce serving of grass fed beef has 1.2 grams of CLA, 25% of the needed biological fat". I don't know where the needed five grams comes from. This compares to feedlot beef with 0.48 grams of CLA. Those numbers are absolutely false. I know exactly where they got their numbers. All the studies reported CLA as a percent of 100 grams of

fat - 1.2 grams of CLA per 100 grams of fat. The web sites are reporting it as 100 grams of CLA per 100 grams of meat. Grass fed beef is lean. Maybe one gram out of 100 grams is fat. When you adjust for the actual amount of fat, the amount of CLA in meat is not going to have a health impact. It is not a selling point for beef; there is just not enough in there. To complicate things further, if there were a significant amount of CLA in beef, it would vary depending on the diet, the seasons (it's highest in summer), how the meat was processed, how it was aged, cooking methods, and whether the animal was supplemented. All these factors affect CLA. So I think we should back off on the CLA as far as making it a selling point for grass fed or pasture raised animals. I don't think there is enough to matter.

- CLA content affected by diet, season (highest in summer), processing, aging, temperature, cooking methods, supplements
- If CLA beneficial, GFB has too little to matter

N-6 vs N-3 fatty acids

- n6/n3 ratio tied to heart disease, infant brain development, pregnancy outcomes, aging
- DRI ratio 10:1 (US pattern)
- Hunter gather 1:1 to 2:1
- German Recs. < 5:1
- # researchers Rec. 2:1

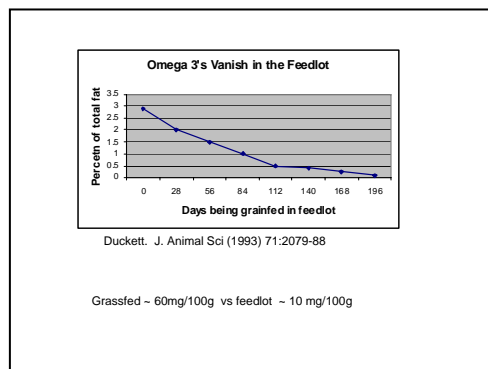
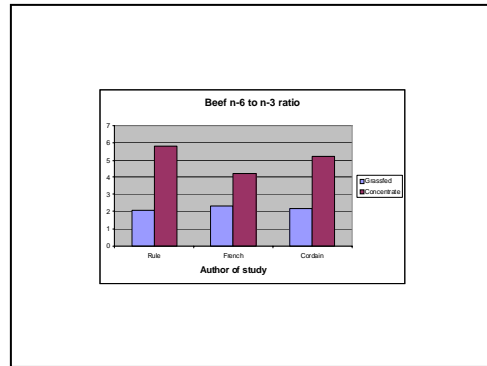
The ratio of N-6 to N-3 fatty acids is a hot research area in nutrition right now. The ratio of N-6 to N-3 in the diet is associated with heart disease risk and infant brain development. We are completing a clinical intervention at Colorado State University, where we supplemented pregnant women with N-3 fatty acids. The initial suggestion, although the study is not complete yet, is that the babies have a higher IQ. There is less of a tendency for a pregnancy to go low birthrate or premature with adequate N-3. So this ratio has lots of health impacts.

The DRI for this ratio is 10:1, which happens to be the U.S. dietary pattern. I think the USDA has copped out on this. I think there is considerable evidence that this is way too high. We evolved with a 1:1 to a 2:1 ratio, an N-6 to N-3 that is pretty balanced. German researchers recommend less than 5:1, and a lot of the researchers in the field recommend less than 2:1.

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So where's the link to grass fed beef? In this case it looks pretty good, at least on the relative scale. Three different studies show the N-6 to N-3 ratio around two, a very good ratio. Of course, even the grain fed beef is six so it is quite a bit less than the average American. We also know that if animals go from pasture to grain, it doesn't take very long for the N-3's or the omega-3's to disappear. They lose about 30% in one month, two-thirds by two months and by three to three and a half months the N-3 is gone.



They lose about 30% in one month, two-thirds by two months and by three to three and a half months the N-3 is gone. If you have animals on pasture and then switch them to grain to fatten them up, you have lost any N-3 advantage.

Those are relative comparisons. Here's another problem. The U.S. dietary intake shows that we get about 17g per day of N-6, mostly from vegetable oils and from salad dressings, margarine, or baked goods that use vegetable oils. We get about 1.6g a day of N-3, mostly from fish, nut seeds and grains, foods which aren't extremely popular in the American diet. So we saw that the N-6 to N-3 ratio is much better with grass fed animals, about 2:1, which is great. But the N-3 is only about 1.6g or three percent of the total dietary fat. So changing to grass fed animal products will not substantially change the N-6 to N-3 ratio, unless people also drastically reduce their consumption of vegetable oils. In fact, a lot of nutritionists are saying forget the N-3; go to the next fatty acids down line which are DHA and EPA, because there is just no way to get around this very high ratio of N-6 to N-3.

- Current intakes
- n6 (~ 17 g/d)
- n3 (~1.6 g/d)
- While n6/n3 ratio much better, $\leq 3\%$ of fat is n-3.
- Still not a substantial source of n-3 in light of large n6 intakes

So you see some of the problems relative to beef. It's undoubtedly more nutritious, but when you look at it from an absolute point of view, some of the advantages are not quite so apparent.

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Dairy

- In general, pasture led to more
 - CLA (up to 5 x higher) (Dhiman, '99)
 - n3 (up to 60% higher) (Loor, '03)
 - Lower n6:n3
- Adding grain to pasture fed animals lowers CLA & n3 & increases n6 (Wijesundara, '03)
 - But grain increases milk yield

Now we are talking about dairy products, especially milk. In general you see the same pattern. With cows on pasture, the milk will be five times higher in CLA. In this study the cows started at 100% pasture. As soon as they went to two-thirds pasture, one-third grain, there was a dramatic drop in CLA. Pasture raised is 60% higher in N-3 and has a lower N-6 to N-3 ratio. This is similar to the same pattern that we saw with beef. In various studies, as soon as grain was added CLA and N-3

dropped and N-6 increased.

Fresh grass is higher in CLA and higher in polyunsaturated fats (N-3) than silage. There are seasonal variations. In the summer, the grass has higher CLA. In Michigan, the temperate grasses have more N-3s than tropical grasses. The people in the south will not get the same effect from pasture raised animals as people further north. Higher altitudes also help. In Europe a lot of the studies show that the higher altitude, the higher CLA and the better the N-6 to N-3 ratio.

Dairy 2

- Fresh grass has > CLA, PUFA than silage
- Seasonal variation in CLA & milk yield
- Temperate grasses > ALA (n3) than tropical
- Higher altitude had higher CLA (3 x)
- Cheese fatty acid profile parallels milk's (Innocente, '02)
- Transition to pasture led to lower milk yield & marginal nutrition in Sweden
 - ? Nutritional adequacy of pasture (type or amount of forage)

Not surprising, the cheese fatty acid profile parallels milk. So if you have milk that's high in CLA, low in N-6 to N-3, high in N-3, then the cheese will reflect that.

Poultry

- Intensive (52 d feed) vs extensive (feed + 117 d pasture) (Lalif, 1996)
- Extensive ...
 - ¼ to ½ growth rate
 - > 117 d, still < ½ wt
 - Transylvanian naked neck < affected than broilers
 - Slightly higher protein (g/100g) but < ½ the fat
 - No data on n6, n3 but intensive slightly higher saturated fat

I have just one study to summarize the poultry situation. This study compared broilers that were 52 days on feed versus a combination of feed and 117 days on pasture. It was not clear what proportion of the diet was feed and what proportion was pasture. But it must have leaned more towards pasture because the growth rate was so much lower, even at 117 days of extensive feed ("pasture"), the average weight of the birds was two and a quarter pounds; at 52 days on the intensive feed, the weight was five and a half

pounds. So even at twice the length of time, you still did not get the growth. The pasture raised birds were a little higher in protein, and had about half the fats.

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What about eggs? This study was not pasture raised, but I want to point it out because the researchers supplemented six different laying hen strains with ALA or N-3 fatty acids. There were no strain differences. They have a much lower N-6 to N-3, two versus eight. With free range plus a mixed diet versus mixed diet only, the N-6 to N-3 was quite a bit lower in the free range plus mixed than the mixed feed. You can manipulate the fatty acid profile of eggs. Here is one of the problems. They sampled eggs in the store based on labeled feeding regimen, then looked at the fatty acid profiles. They were quite different. The researchers said that something going on with the feeding regimen was making a difference. What exactly do the labels mean when they say “free of animal fat”, “organic free range brown eggs”, “uncaged unmedicated brown eggs”, “cage free vegetarian brown eggs”, or “naturally nested uncaged eggs”? So we have a difference but we are not sure why.

Eggs

- Added ALA (n3) to feed of 6 different laying hen strains for 3 mo (Sunwoo, 1995)
 - Only minor strain differences
 - n6/n3 ~ 1.6 vs 7.6 ALA vs control eggs
- Free range (grass + mixed diet) vs mixed only (Lopes-Bote, 1998)
 - n6/n3 5 vs 19; 2-3 x DHA, EPA
- Sampled eggs from store with different “labeled” feeding regimens (Cherian, 2002)

Swine

- Iberian pigs – pasture (acorns, forage) vs indoor (feed) 60d pre-slaughter (Muriel, 2002)
 - Increase n6, n3, DHA, EPA
 - n6/n3 4-14 vs 18-29
 - Different muscles showed different effects
- Outdoor (feed + grazing) (Nilzen, '01)
 - RN genotype largest influence
 - Outdoor - more PUF & Vit E, no diff n6/n3

Swine are not going to react quite the same as beef. Changes will be the same direction but maybe not to the same extent. Iberian pigs, pastured 100% with acorns and forage, were compared with indoor feed sixty days pre-slaughter. Researchers saw an increase in unsaturated fats including N-6, a drop in the N-6 to N-3 compared to the indoor feed. There was a lower N-6 to N-3 ratio, but not as low as with beef, which can get down to around two. The range is because different muscles give different results

and is quite broad.

Another study looked at Hampshire crossbreds for 90 days on feed and grazing. They planted oats, peas and barley for the grazing. But they were still getting feed as well. There was some difference, but not a dramatic difference. The genotype seemed to have a bigger effect than the diet itself.

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With 100% grazing versus dry lot, lambs were raised to 30 kilograms, and then slaughtered. There was about 40% less fat in the grazing animals; and the N-6 to N-3 was 4 versus 13. This was not as good as beef, but certainly a significant improvement. A second study of grass fed lambs found much lower N-6 to N-3, much lower fat, three percent versus seven percent. In a third study, one to two versus four N-6 to N-3 ratio. These animals were slaughtered at 20 kg, so they were a much younger animal. I haven't seen enough studies to judge whether as the animal gets older, that means automatically these values are going to get worse, or whether it just happens to be an artifact of these two studies.

Lamb

- Grazing vs dry lot to 30 kg (Rowe, 99)
 - 7% vs 11% fat but more saturated fat
 - n6/n3 4 vs 13
- Grass fed lambs (Enser, 1998)
 - n6/n3 1.0 to 1.7 depending on muscle (similar to GF beef)
 - - 3% fat but < 20 kg at slaughter
- Carotenoid pigments in plasma biomarker of grass feeding (Prache, 2003)
 - stall fed 2-3% carotenoids of grass fed

Pasture Raised Animals

- Obvious benefits to environmental & treatment of animals
- Lower total fat & calories
 - Calorie savings biggest nutrition benefit
- Better (lower) n6/n3 ratio
- Higher CLA (dairy/beef) vitamin E, DHA, EPA
 - But relatively little compared to daily needs

I included a study on blood carotenoids because I have had questions in the past "How do we know it's really pasture raised? Is there some way that we can test to see if it's pasture raised?" I would say based on this that there probably is. This might be an area for research. The carotenoid pigments in blood plasma are very sensitive. They took grass fed or pasture raised lambs, measured their carotenoid pigments, then switched them to grain fed. Within four to thirteen days, they had only as much as three percent of

the carotenoid pigments left. So there is a very dramatic quick drop in plasma carotenoids when you switch from pasture to grain. So if you have low plasma carotenoids, then you haven't been on pasture recently.

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I am not anti-pasture raised animals. I believe they have many environmental and economic benefits for the farmer and the humane treatment of animals. There are lots of reasons to buy pasture raised animals. They are much leaner, which is a plus. Most Americans can benefit from that. We do get a better, or lower, N-6 to N-3 ratio. We do get higher CLA, Vitamin E, DHA, and these other N-3 fatty acids. Frankly, I don't think these are high enough to make a dramatic impact on health, although if you are substituting these products for foods that are high in saturated fats, high in fat, it has to be beneficial. I am not sure how beneficial it is in the large scheme of things. Given the large number of variables that affect the nutrition profile and the fat content, it will be hard to standardize this. But it's pretty consistent that summer grazing will be beneficial. Minimize grains in the diet and if you have the option of growing at higher altitudes or higher latitudes, you will probably get a better nutrition affect.

- Large number variables affect nutrition profile and fat content (quality & quantity)
- Most favorable nutrition outcomes with ...
- ... summer grazing
- ... minimal grains in diet
- ... higher altitudes and latitudes
- Trade-off between growth rate (or milk yield)

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