GRASS-FED BEEF

CHANGES IN CATTLE HUSBANDRY

THE PALEO DIET FOR PIGS?

BONE HEALTH AND OMEGA-3

LOREN CORDAIN, PH.D.
slaughter in 24 months and which exhibited “marbled meat”. Marbled meat results from excessive triacylglycerol accumulation in muscle interfascicular adipocytes. Such meat typically has greatly increased total and saturated fatty acid contents, reduced protein (by energy), a lower proportion of omega-3 fatty acids, higher omega-6 fatty acids and a higher omega-6/omega-3 fatty acid ratio.

Modern feedlot operations involving as many as 100,000 cattle emerged in the 1950's and have developed to the point where a characteristically obese (30% body fat) 545 kg pound steer can be brought to slaughter in 14 months. Although 99% of all the beef consumed in the U.S. is now produced from grain-fed, feedlot cattle, virtually no beef was produced in this manner as recently as 200 years ago. Accordingly, cattle meat (muscle tissue) with high total fat, low protein (by energy), high absolute saturated fatty acid content, low omega-3 fatty acid content, high omega-6 fatty acid content and an elevated omega-6/omega-3 fatty acid ratio represents a recent component of human diets that may adversely influence health and well being.

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GRAIN FED, FEED LOT CATTLE: NUTRITIONAL CONSEQUENCES FOR HUMANS

The practice of feeding grain and concentrated feed to cattle sequestered for long periods in feedlots is not necessarily benign, but rather yields meat with a number of potentially deleterious nutritional characteristics, particularly when compared to either wild animals or grass fed cattle. Table 1 summarizes a number of potential nutritional differences that have been identified between the meat of feed lot and grass fed beef cattle.
There is little argument that grass fed cattle accumulates more omega-3 fatty acids in their tissues than grain fed cattle.5,10-28 This nutrient amplification in tissues occurs because the concentration of 18:3n3 (alpha linolenic acid [ALA]) in pasture grass is 10 to 15 times higher than in grain or typical feedlot concentrates.25 In mammals the liver represents the primary tissue which chain elongates and desaturates 18:3n3 into long chain omega-3 fatty acids (20:5n3, 22:5n3 and 22:6n3) which then can be deposited in muscles and other tissues.41

Not only do feed lot cattle maintain lower omega-3 fatty acids in their tissues than grass fed cattle, but a characteristic increase in the total omega-6 fatty acids occurs10,11, 3,16,22,28 as a result of grain feeding.11 Because typical cereals fed to cattle such as maize (omega-3/omega-6 = 70.7) and sorghum (omega-6/omega-3 = 16.2) contain very little 18:3n3 and much higher 18:2n6,42 the cattle’s tissues reflect the fatty acid balance of the grains they consume.

The case for increasing omega-3 fatty acids in the U.S. diet has broad and wide sweeping potential to improve human health. Specifically, omega-3 fatty acids and their balance with omega-6 fatty acids play an important role in the prevention and treatment of coronary heart disease, hypertension, type 2 diabetes, arthritis and other inflammatory diseases, autoimmune diseases, and cancer.43, 44

### Table 1. Potential nutritional differences between feed lot and grass fed beef.

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Grass</th>
<th>Feed Lot</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Omega-3 fatty acids</td>
<td>Higher</td>
<td>Lower</td>
<td>(11, 15-30, 40, 47, 48)</td>
</tr>
<tr>
<td>Omega-6 fatty acids</td>
<td>Lower</td>
<td>Higher</td>
<td>(15, 16, 18, 21, 27, 48)</td>
</tr>
<tr>
<td>Omega-6/omega-3 ratio</td>
<td>Lower</td>
<td>Higher</td>
<td>(11,15-21,27-30, 40, 47, 48)</td>
</tr>
<tr>
<td>Long chain fatty acids (both omega-3 and omega-6)</td>
<td>Higher</td>
<td>Lower</td>
<td>(11,15, 16, 17, 21, 28, 29, 47)</td>
</tr>
<tr>
<td>Fat content</td>
<td>Lower</td>
<td>Higher</td>
<td>(11, 15, 16, 18-21, 27, 40)</td>
</tr>
<tr>
<td>Saturated fatty acids</td>
<td>Lower</td>
<td>Higher</td>
<td>(11, 15-18, 27)</td>
</tr>
<tr>
<td>P/S Ratio</td>
<td>Higher</td>
<td>Lower</td>
<td>(11,15-18, 21, 27)</td>
</tr>
<tr>
<td>Conjugated linoleic acid</td>
<td>Higher</td>
<td>Lower</td>
<td>(11,15,17, 30-36)</td>
</tr>
<tr>
<td>Vitamin E</td>
<td>Higher</td>
<td>Lower</td>
<td>(25, 37-40)</td>
</tr>
<tr>
<td>Vitamin C</td>
<td>Higher</td>
<td>Lower</td>
<td>(40)</td>
</tr>
<tr>
<td>Beta carotene</td>
<td>Higher</td>
<td>Lower</td>
<td>(37, 40-42)</td>
</tr>
<tr>
<td>Protein content</td>
<td>Higher</td>
<td>Lower</td>
<td>(43)</td>
</tr>
</tbody>
</table>

### GRASS VS. GRAIN FED BEEF: OMEGA-3 AND OMEGA-6 FATTY ACIDS

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### DIETARY SATURATED FAT

From per capita data it can be inferred that the average U.S. citizen consumes 82g of beef per day,45 with ground beef (42%), steaks (20%), and processed beef (13%) comprising the bulk of the beef consumed.46 Ground beef, choice and prime USDA quality steaks and processed beef (frankfurters, lunch meats etc) represent some of the highest total fat and saturated fat sources found in any cuts of beef. An 82 g serving of fatty (22% fat) ground beef can contain 8.8 g or more of saturated fat, whereas a comparable serving of lean (2.5% fat) grass fed beef may contain as little as 1.2 g of saturated fat. Hence a daily reduction of up to 7.6 g of saturated fat could be achieved in this scenario involving only displacement of high fat beef with lean grass fed beef.

Saturated fat intakes of < 10% total energy are recommended to reduce the risk of cardiovascular disease.47 Accordingly in a 2,200 kcal diet, saturated fat (9 kcal/g) should be limited to 24.4 g. Thus, the
savings accrued (7.6 g of saturated fat) in this scenario by replacing fatty ground beef with lean grass fed beef represents a substantial 31% reduction in total saturated fat.

**DIETARY PROTEIN**

Because of it's inherently low fat content (2.6% by weight), grass fed beef is also a high protein food averaging 76.5% protein by total energy. Contrast these values to USDA Choice (+) beef with only 48.7% protein by energy, or USDA Prime (o) beef with 40.8% protein by energy, or worse still, fatty ground beef with 20.3% protein by energy. A litany of recent human studies demonstrates that isocaloric replacement of dietary fat by lean protein has numerous health promoting effects.

**POTENTIAL HEALTH IMPROVEMENTS BY INCREASING GRASS FED BEEF CONSUMPTION**

A number of scenarios involving improvements in human health can be envisioned by including more and more lean grass fed beef into the diets of U.S. citizens. These scenarios are dependent upon the specific foods and food groups that would be potentially displaced by grass fed beef and by the amount of grass fed beef that would included in the diet. The health impact of such scenarios could range from minimal to highly significant.

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**THE PALEO DIET FOR PIGS?**

A recent study published in Nutrition and Metabolism has shown that pigs fed a Paleolithic diet are healthier than those raised on traditional cereal-based swine diets. Immediately after weaning, researchers randomly divided 24 piglets into either a Paleolithic group (meat, fruit, and vegetable-based diet) or a cereal group. After 15 months on the diets, glucose tolerance, insulin response, plasma-C reactive protein, and blood pressure were measured. Not surprisingly, the pigs on the Paleolithic diet had lower blood pressure, significantly higher insulin sensitivity, and an 82% lower concentration of C-reactive protein (a marker of inflammation associated with insulin resistance and CVD) on average. Apart from these clinical measurements, pigs on the Paleolithic diet weighed 22% less and had 43% lower subcutaneous fat thicknesses after 15 months. This study supports the notion that pigs, like humans, did not adapt through evolution to thrive on a cereal-based diet. Secondly, in the U.S. pigs are raised on cereal-based diets and in a similar manner to feedlot-produced beef. We can conclude the majority of our pork, like our beef, comes from obese, insulin-resistant animals with nutritional qualities inferior to their pasture raised, free-foraging counterparts.


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**OMEGA-3 FATTY ACIDS & BONE HEALTH**

The results of a 10-year Swedish study on bone health were published this month in the American Journal of Clinical Nutrition. Seventy-three healthy, 16-year-old males participated in the Northern Osteoporosis and Obesity Study (NO2 Study) aimed at determining the
role fatty acids play in bone accumulation and peak bone mass. Bone mineral density (BMD) of the hip, spine, and total body was measured in each individual at the beginning of the study, and again six and eight years later. Researchers found a positive association between blood concentrations of omega-3 fatty acids and bone mineral accumulation and peak density in the young men. The correlation between decosahexaenoic(DHA) and total body and spine BMD was especially strong. This research suggests that DHA, and other long chain omega-3 fatty acids, play a crucial role in bone development and mineralization. Osteoporosis and bone fractures afflict and disable many elderly people in the Western world. Accumulation of bone mass during adolescence and young adulthood is vital to preventing the disease; therefore identifying factors that enhance peak BMD is an important step in prevention. Incorporating grass-fed meats into your diet, which are naturally richer in omega-3 fatty acids, is a great way to support the health of growing bones.


THE ALA ANTI-INFLAMMATORY

Also published in the American Journal of Clinical Nutrition this month, a study showing protective anti-inflammatory effects of alpha-linolenic acid (ALA), the long chain omega-3 precursor. Twenty-three men and women with elevated cholesterol were randomly assigned to one of three diet groups: the ‘average American’, the high linoleic acid (omega 6 vegetable oils), or the high alpha-linolenic (omega-3) diet. As previously discussed in this issue, the ALA concentration in grass-fed beef is 39 mg/100 g muscle tissue, on average, compared to only 12 mg ALA in the same serving size of grain-fed beef.


READER FEEDBACK

Hi,

How does the pre-columbian Mayan Diet of game, beans, corn, and squash fit into your paleo thesis? Amino acids in corn and beans provide the body with a complete protein.

Thanks,
Rudy

Dear Rudy,

I guess it depends upon how much of each food is consumed. I suspect that in the fully developed Mayan culture beans, corn and squash were the staples with a very small amount of calories contributed by game. This consumption pattern is quite different from hunter gatherers who ate the majority of their energy from animal foods. Diets high in corn (grain) and beans would be expected to produce a number of health problems, despite having complementary amino acid patterns. Unless maize is treated with lime, high consumption of this staple food causes pellagra, whether or not beans are consumed. High consumption of both maize and beans with little meat causes an iron deficiency anemia that results in a condition in the skeletons of American Indians known as cribra orbitalia (a de-ossification of the bones surrounding the orbit). In addition to iron deficiencies a high maize and bean diet will also cause zinc, calcium and magnesium deficiencies because a substance within these foods called phytate prevents the absorption of virtually all divalent ions.

Cordially,

Loren Cordain, Ph.D., Professor Emeritus
PRIMAL IN THE KITCHEN

BAKED TILAPIA WITH MANGO SALSA

2 large, ripe mangos
¼ jalapeno pepper
¼ c red onion
¼ bunch cilantro
2 lime wedges
2 Tilapia fillets

Place 2 Tilapia fillets in baking dish with light olive oil and diced garlic. Bake at 350 degrees for 15 minutes, depending on thickness of fish.

Flesh and dice mangos. Chop cilantro, jalapeno, and red onion. Mix together and add lime juice. Makes about 3 cups. This salsa is great on its own or as a compliment to any white fish.

ROASTED BABY SQUASH AND CARROTS

2 Tb extra virgin olive oil
1 or 2 garlic cloves, crushed
8 oz baby zucchini, cut into ¼ inch rounds
8 oz baby carrots, sliced in half
1 t. dried thyme
1 t. finely chopped fresh dill

Preheat oven to broil. Combine olive oil with garlic in a glass or ceramic baking dish. Add vegetables and mix in dill and thyme. Broil for ten minutes.

Stir vegetables, then continue broiling for one minute. Vegetables are done when easily pierced with a fork. Cool for five minutes before serving.
REFERENCES:


45. U.S.D.A. Per capita beef supply and use.
