Rabbit Starvation

High protein and high fat diets

The following citation is taken from: http://westonaprice.org/traditional_diets/nasty_brutish_short.html The web site http://westonaprice.org is somewhat biased but a very interesting source for information about nutrition in traditional societies.

"Another myth about primitive diets, and one that is harder to dispel, is that they were low in fat, particularly saturated animal fat. Loren Cordain, PhD, probably the most well known proponent of a return to Paleolithic food habits, recommends a diet consisting of "lean meat, occasional organ meats and wild fruits and vegetables." While this prescription may be politically correct, it does not jibe with descriptions of Paleolithic eating habits, either in cold or hot climates.

Vilhjalmur Stefansson, who spent many years living with the Eskimos and Indians of Northern Canada, reports that wild male ruminants like elk and caribou carry a large slab of back fat, weighing as much as 40 to 50 pounds. The Indians and Eskimo hunted older male animals preferentially because they wanted this back slab fat, as well as the highly saturated fat found around the kidneys. Other groups used blubber from sea mammals like seal and walrus.

"The groups that depend on the blubber animals are the most fortunate in the hunting way of life," wrote Stefansson, "for they never suffer from fat-hunger. This trouble is worst, so far as North America is concerned, among those forest Indians who depend at times on rabbits, the leanest animal in the North, and who develop the extreme fat-hunger known as rabbit-starvation. Rabbit eaters, if they have no fat from another source-beaver, moose, fish-will develop diarrhea in about a week, with headache, lassitude, a vague discomfort. If there are enough rabbits, the people eat till their stomachs are distended; but no matter how much they eat they feel unsatisfied. Some think a man will die sooner if he eats continually of fat-free meat than if he eats nothing, but this is a belief on which sufficient evidence for a decision has not been gathered in the north. Deaths from rabbit-starvation, or from the eating of other skinny meat, are rare; for everyone understands the principle, and any possible preventive steps are naturally taken."

Normally , according to Stefansson, the diet consisted of dried or cured meat "eaten with fat," namely the highly saturated cavity and back slab fat that could be easily separated from the animal. Another Arctic explorer, Hugh Brody, reports that Eskimos ate raw liver mixed with small pieces of fat and that strips of dried or smoked meat were "spread with fat or lard." Pemmican, a highly concentrated travel food, was a mixture of lean dried buffalo meat and highly saturated buffalo fat. (Buffalo fat, by the way, is more saturated than beef fat.) Less than two pounds of pemmican per day could sustain a man doing hard physical labor. The ratio of fat to protein in pemmican was 80%-20%. As lean meat from game animals was often given to the dogs, there is no reason to suppose that everyday fare did not have the same proportions: 80% fat (mostly highly saturated fat) to 20% protein-in a population in which heart disease and cancer were nonexistent."

What limits the liver's capacity to convert amino acids to glucose?

Conversion of amino acids to glucose involves several metabolic processes; deamination or transamination, conversion of the released NH_4^+ to urea and finally synthesis of glucose from amino acid residues. The key to understanding the physiological limitation of glucose formation from amino acids lies in the large amount of energy required to fuel these processes. Energy in the sense used here means the hydrolysis of adenosinetriphosphate (ATP) to either AMP + PPi or ADP + Pi. Four ATP molecules are used to convert two NH_4^+ to urea and six more are required to convert the carbon skeletons of these amino acids to glucose. One ATP is also required to add a glucosyl group to a glycogen molecule so, you see, a lot of energy is used in this process. All cells and tissues are built up such that ATP levels are relatively stable. This is a basic prerequisite for life. Under gluconeogenesis the liver must rely upon aerobic metabolism to replace the ATP that is consumed. By definition this is an oxygen-dependent process. The "catch" is that the liver obtains most of its oxygen from the portal vein where the partial pressure of oxygen is rather low. This limits uptake of oxygen, limits ATP production and, therefore, the synthesis of glucose from amino acids.

We have data about the total amount of oxygen supplied to the human liver. Calculations based on this (and assuming the all of this oxygen goes to support conversion of amino acids to glucose) suggest that the maximum capacity of hepatic glucose synthesis from amino acids lies around 400 grams/day. This is the equivalent of approximately 1600 kcal, close to the metabolic rate of a bed-ridden person and hardly enough to support an active life.

Now we can explain "rabbit starvation" and the weight-reducing effects of low-carbohydrate high protein diets. Proteins and the amino acids derived from these can only be "burned" as glucose. Conversion to glucose is mandatory if the energy in these is to be utilized. Consumption of more protein than can be converted to glucose simply results in loss of these as amino acids in urine.

Protein Supplements.

Normal activity in adults requires about 0.80 grams of protein per kilo body weight. Thus a 70 kg person requires about 55-60 grams of protein per day. Intense training or in teenage growth periods this can increase to 1-1.2 grams per day. We have NO storage form of the amino acids needed for replacement of our proteins; we must eat new protein daily (almost) to support normal function. These requirements can easily be met with a normal diets, both with and without animal products.

The next figure shows the "biological value" of differing foods containing relative high levels of protein. All values are compared to chicken egg which is set to 1.0.

Biological Value of Some Protein-Rich Foods

	Ile	Leu	Val	Thr	Met + Cys	Trp	Lys	Phe + Tyr	His	Biological Value
Egg, chicken	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	0,94
Milk, human	1,1	1,4	1,0	1,0	1,1	1,6	1,0	1,0	0,9	0,95
Milk, Cow	1,1	1,3	1,0	0,9	0,7	1,3	1,3	0,9	1,1	0,90
Muscle, beef	0,8	0,9	0,7	0,9	0,9	0,9	1,4	0,7	1,6	0,76
Soybeans	1,0	0,9	0,8	0,8	0,6	1,3	1,1	1,0	1,4	0,75
Rice	0,8	0,9	0,9	0,8	0,9	1,2	0,5	1,2	0,8	0,75
Wheat	0,6	0,8	0,6	0,7	0,8	1,1	0,4	0,8	1,0	0,67
Potatoes	0,6	1,1	0,8	1,3	0,6	1,9	1,4	0,8	1,1	0,67
Oats	0,8	0,8	0,8	0,7	0,6	1,2	0,6	1,0	1,1	0,66
Corn	1,0	1,7	0,8	0,7	1,1	0,5	0,4	1,0	1,0	0,60

From: McGilvery, Biochemistry, 1970

We can see that human milk has slightly higher concentrations of most amino acids, the major exception being histidine. Amino acids found in low levels (< 70% of chicken egg) are shown in yellow. Note especially these low values in vegetable products. You can see that there is a large variation between different corn products and, by combining several of these one can obtain a good balanced amino acid contribution in the diet. Click on the following links for good discussions of this: http://www.bbc.co.uk/health/healthy_living/fitness/energy_protein.shtml or http://sportsmedicine.about.com/cs/nutrition/a/aa060101a.htm .

I quote the first reference; "It's easy to meet your protein needs from food. All a protein supplement will do is contribute to your protein intake and burn a large hole in your wallet. There's also no advantage to taking expensive amino acid supplements". More precisely, using large protein supplements does not lead to more muscle mass and the amino acids from these supplements cannot be stored in the body! They go to "very expensive urine".
In spite of this there is an enormous "protein supplement" market. A recent search

on the Internett gave over 2 million hits for this subject (mostly sales offers!).

Low Carbohydrate Diets.

If the carbohydrate content of the diet is low, amino acids can and do supply the glucose necessary to hold a stable blood sugar level and brain activity. In starvation, the body uses its own proteins. With a high protein diet these come from food. In both situations, the total amount of glucose produced is limited by the liver's restricted capacity for gluconeogenesis and ureogenesis (only about 400 grams or 1600 kcal per day).

What about energy necessary for a normal active life when one consumes a high-protein diet? This has to come from fat, either from the body (weight-loss) or the diet (pemmican and other high-protein high-fat diets). Vilhjalmur Stefansson, Fridtjof Nansen og Helge Ingstad have all written about the intense "hunger for fat" that they and their associates experienced while living and working in Artic areas. Their diets were largely meat-based and fat was an extremely important energy source for them.