The Nutritional Case for Genuine Beef

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There is a war underway for *space*. Space on supermarket shelves, on restaurant menus, and in the diets of consumers. We need more ammunition. We are currently using World War I munitions to fight a century-later battle. Marketers of meat-alternatives are free to claim virtually anything they wish with no fear that FDA will intervene. In 2016, US Congress-persons proposed a "Dairy Pride Act" with the mission of prohibiting the use of the claim "milk" on products (e.g., almond milk) that are not derived from animals and urged FDA to enforce new labeling standards for plant-based foods and beverages. FDA has done nothing, despite survey results: (a) by IPSOS (2018) which found that 73% of consumers erroneously believed that almond-based drinks have as much or more protein per serving as cow's milk, and (b) by IPSOS (2019) which found that 61% of consumers want FDA to prohibit non-dairy beverage companies from using the term "milk" on their product labels. USDA has likewise done nothing to prevent use of the word "meat" on plant-based meat-alternatives.

The American Heart Association (2019) has issued a warning: "People choosing 'alt-meats' (i.e., plant-based or cell-cultured meat-alternatives) should be careful to compensate for the loss of nutrients; that goes double for people moving away from animal products entirely. If they're not having meat, egg, or dairy products in their diet they might have a hard time getting enough grams of protein (men need 56, women need 46, grams daily) and not all proteins are created equal."

Many American shoppers look solely at "grams of protein" rather than the "Quality" or "Daily Value" of protein to determine the protein content of foods. Most protein from plants is "incomplete" (i.e., doesn't adequately provide all of the essential amino acids the body needs but can't make). Importantly, protein from plant sources isn't as readily absorbed as protein from animal-based foods. "Daily Values" take both factors into account. While plant-based foods do contain some protein, you typically must eat larger amounts of plant-based food to get the sufficient amount of amino acids your body needs. Be aware of tradeoffs if you choose plant-based meat-alternatives (PBMAs) solely for purported health reasons. Early in the game, the PBMA companies claimed their products were "equal in nutritional value" to genuine meat. When challenged, some PBMA companies used fortification to more than double their "grams of protein per serving" claim. Some PBMA-makers have lately added mung beans to their recipe--trying to bolster their content of essential amino acids, but this attempt has fallen short of the "Quality" achieved by animal proteins. A deficiency of even only one essential amino acid will limit the use of all amino acids for protein synthesis in the human body.

The most abundant protein (at 30% of total protein) in the human body is collagen, which is the most needed protein for assurance of healthy skin, hair, nails, joints, tendons, ligaments, bone, and the digestive tract. The three key amino acids in collagen are glycine, proline, and hydroxyproline. Animal-based foods are human dietary sources of proline and hydroxyproline, as plants and plant-based diets do not contain collagen.

Beef is an abundant source of functional amino acids (e.g. taurine and hydroxyproline), β-alanine-containing dipeptides (e.g., carnosine and anserine), and creatine (a metabolite of

amino acids). Taurine, creatine, carnosine, and hydroxyproline were originally discovered in research with cattle, and the discovery of anserine (a methylated product of carnosine) was also linked with cattle. These five nitrogenous nutrients are highly abundant in beef, and have important physiological roles in anti-oxidative and anti-inflammatory reactions, as well as neurological, muscular, retinal, and cardiovascular function. Therefore, taurine, hydroxyproline, carnosine, anserine, and creatine are expected to improve human health and reduce risks for chronic diseases (e.g., obesity, cancer, neurological disorders, hypertension, and stroke) that are all characterized by oxidative stress in tissues.

However, the public is generally not aware of these physiologically significant nutrients and, disappointingly, is misled by negative epidemiological studies that are populated in the media. In recent studies, highly publicized researchers have continued to raise concerns that consumption of beef increases risks for obesity as well as associated cardiovascular and metabolic dysfunction in humans. Consequently, the public is increasingly reluctant to eat meat; accordingly, the national consumption of beef has decreased over the past 40 years. Scientific studies of beef are urgently needed to refute these misconceptions. This would ensure that the physical growth and development of American children, as well as the health and well-being of all Americans, will not be compromised.

In cattle, creatine and β-alanine are synthesized through the inter-organ metabolism of amino acids that involves the small intestine, liver, kidneys, and pancreas, whereas taurine is synthesized primarily in the liver and, to a limited extent, in the brain. While it is commonly thought that skeletal muscle cells *synthesize* creatine, β-alanine, and taurine, they do not; skeletal muscle takes up these substrates from the blood for use (e.g., energy metabolism, buffering, and formation of β-alanine-containing dipeptides) and storage. In addition, the hydroxylation of proline residues in the collagen protein of animal connective tissues (e.g., the extracellular matrix of skeletal muscle, tendons, and bones) generates large quantities of hydroxyproline.

So, consumption of 30 grams (approximately 1 ounce) of beef can fully meet daily physiological needs of a healthy 70 kg adult human for taurine and carnosine, and can provide large amounts of creatine, anserine, and 4-hydroxyproline to improve human nutrition and health, including metabolic, retinal, muscular, neurological, and cardiovascular health. In contrast, plant-source foods do not provide taurine, carnosine, creatine, or anserine, and contain only a negligible amount of hydroxyproline. And, based on the ratio and amount of amino acids in beef, and beef's digestibility, beef has higher protein quality than plant-based food as "quality" relates, in human nutrition, to the promotion of healthy growth and development in humans.

Another substitute for animal-based protein that has been widely publicized is cell-cultured meat-alternatives (CCMA). CCMAs are derived from cultured cells that are created by proliferation of skeletal muscle stem-cells. Unless they are bathed in bovine blood during their growth cycle, the end-product (CCMA) will not contain creatine, taurine, or β -alanine because these compounds are not synthesized in skeletal muscle. Note that, due to biosafety concerns, the whole blood of any animal species cannot be used to culture muscle stem-cells that are intended for human consumption.

At present, PBMAs like Beyond Beef™, Morning Star Farms Beef®, Impossible Beef™ are not nutritionally equivalent to genuine beef. There is no information on the labels of PBMAs

about the composition of amino acids and related nitrogen-containing nutrients in the plant-based product compared to that in beef. Nutritionally, 1 gram of plant protein is not equal to 1 gram of protein in beef. *At present, consumers cannot make informed decisions because both labels contain the word "BEEF".* The same will be true of CCMAs like Memphis Meats™, Mosa Meats™, Aleph Farms™ if they ever enter commerce. The public must be provided sufficient knowledge of nutritionally and physiologically significant amino acids and dipeptides to either make informed decisions among different products labeled "BEEF"; to select among genuine BEEF, "beef-light", or "beef-like"; and to select among genuine BEEF, "fake beef", or "cultured muscle cells".

In addition to protein, the quality and quantity of fat in animal products has a major impact on human health and wellbeing. In the 1950s, "supposed nutrition experts" declared that: (a) Eating beef will likely kill you, and (b) The fat in beef is predominantly "saturated". By 2010, we knew that neither claim was true. The 1950's story was that higher TOTAL cholesterol in a person's blood supply caused blockage of blood vessels and, subsequently, cardiovascular events (i.e., heart attacks, strokes) and that:

- Eating saturated fatty acids *increases* TOTAL cholesterol.
- Eating monounsaturated fatty acids *has no effect* on TOTAL cholesterol.
- Eating polyunsaturated fatty acids *decreases* TOTAL cholesterol.
- Eating trans-polyunsaturated fatty acids *decreases* TOTAL cholesterol.

By 1970, we knew that TOTAL cholesterol isn't a useful medical determinant because there are two kinds of cholesterol: "good" cholesterol (called HDL cholesterol) because it carries cholesterol in the blood *to the liver* where it is metabolized to bile salts for excretion via the feces, and "bad" cholesterol (called LDL cholesterol) because it is carried via the blood *away from the liver* to other tissues and can form plaques in the arteries. Importantly, we had learned that not all "saturated" fatty acids *are created equa*l, nor are all "unsaturated" fatty acids. By 2019, the scientific evidence demonstrated that:

- Eating saturated fatty acids *elevates* "bad" (LDL) cholesterol but also *elevates* "good" (HDL) cholesterol.
- Eating polyunsaturated fatty acids *generally decreases* TOTAL cholesterol.
- Eating trans-polyunsaturated fatty acids *raises* LDL cholesterol and *lowers HDL* cholesterol.
- Eating the monounsaturated fatty acid, oleic acid, *lowers* LDL cholesterol and *raises* HDL cholesterol.

So, the rest of the story is: A beef porterhouse steak contains:

- About 10% total fat
- 51% monounsaturated fatty acids (mostly oleic acid)
- 4% other polyunsaturated fatty acids
- 45% saturated fatty acids (about one-third stearic acid)

That means that 65% to 70% of the fatty acids in a Porterhouse steak will *improve* "good cholesterol" values (compared to consuming carbohydrates); the remaining 30% to 35% will

raise LDL cholesterol but will also *raise* HDL cholesterol. For a healthy man, the steak will increase LDL cholesterol 4 mg per 100 milliliters of blood; at best, this represents a 3% increase in LDL cholesterol, which has no effect on risk for cardiovascular disease. This steak also will raise HDL cholesterol 4 mg per 100 milliliters of blood, but this represents a 10% increase in HDL cholesterol, which can have profound effects on risk of cardiovascular disease.

The Advisory Committee for the 2020 version of the "Dietary Guidelines For Americans" has announced that "It plans to build on the 2015 DGFA Advisory Committee review of "saturated fat" rather than using the more recent data contradicting emphasis on that dietary component. A large international group of scientists recently submitted a public comment to the DGFA Advisory Committee regarding the latest consensus science on saturated fats that has been published in the British Medical Journal (2019). This comment made a number of important points regarding saturated fats, none of which are currently being addressed by DGFA-AC. Among the British Medical Journal's points are: (a) "Saturated fatty acids" is not a single group with identical biological effects, but mainly different fatty acids with very diverse effects; (b) The effects of saturated fatty acids on cardiovascular disease not only depend on the specific fatty acid, but also on the food matrix they exist in; (c) And, therefore, the approach to look at saturated fat as one group is likely to lead to erroneous conclusions.

Much is already known about the fatty acid composition of genuine beef. What is needed, to add to our body of knowledge, is the source of fats and the fatty acid composition of both PBMAs and CCMAs. It is known that the landscape is undergoing change: (a) One manufacturer of PBMAs has recently added globs of coconut oil to its recipe in an effort to improve the appearance, increase the melting point of the fat, and to attain the taste benefits of marbling; and (b) One manufacturer of CCMAs has recently commingled stem-cells of skeletal muscle (beset with nutritional and biosafety concerns as noted previously) with stem-cells of lipids for the same reason. Nevertheless, there is predication to draw a present "line in the sand".

The Wall Street Journal, in "The Modern Meaning of Meat" wrote "The meat industry is overwrought and too old-school about its regard about 'meat' being derived from an animal. We shouldn't be passing laws that ban the use of word 'meat' for plant-based meat-alternatives, or 'milk' for plant-based milk-alternatives. Farmers, ranchers, and their processing industries are 'entrenched interests' that fight changing the definitions out of personal best interests." We are going to own the argument that, "No, we believe that these entrepreneurs are marketing products that provide nutritionally inferior and lower-quality products than consumers expect from animal-based products, and we must be able to prove it."

Chronic diseases are characterized by oxidative stress in tissues, particularly the heart, liver, and adipose tissue. Beef contains large amounts of anti-oxidative nutrients (taurine, hydroxyproline, carnosine, anserine, and creatine); HDL cholesterol, which is elevated by the fatty acids in beef, now also is known to reduce vascular inflammation and oxidation. Therefore, beef plays an important role in mitigating oxidative stress and decreasing risks for chronic diseases. However, the public is not generally aware of nitrogenous substances and fatty acids in beef that have enormous physiological roles. Despite results of clinical studies, use of GRADED research-study meta-analyses, and collective scientific re-examination of 60 years of attempts, we have failed to identify a food group or ingredient that can be added to, or removed from, the American diet to prevent the occurrence of cardiovascular disease or

cancer. As a result, too many “experts” have been allowed to claim quality protein and to vilify cholesterol, saturated fat, or meat (especially beef) as the culprit. That will not end soon; so, we must prepare to counter claims by meat-alternative marketers regarding “my protein and my fat is more healthful than yours”.

The time for action is now! It is time for the beef industry and the academic community to make certain that accurate and science based nutrition information comparing beef with plant and cell based products is first available and second utilized in an effective manner to communicate the science based facts..

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