

Rationale for Treating Cancer with a Low-Protein High-Carbohydrate Plant-Based Diet

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Summary

Lowering dietary plant-based protein to 7% of calories slows or halts tumor growth through lowering of IGF-1 and mTOR signaling, limiting glutathione synthesis and increasing anti-tumor immunity.

Plant-based proteins are lower in sulfur amino acids (methionine and cysteine) and branched chain amino acids compared to animal derived proteins.

Rather than targeting individual amino acids, lowering overall protein within a plant-based diet may be a more effective and practical approach for dietary protein restriction for cancer therapy.

Achieving neutral nitrogen balance may be the optimal set point to derive the most therapeutic benefit without compromising anti-tumor immunity or causing malnutrition.

Monitoring plasma BUN may be the optimal means to fine tune dietary protein intake to neutral nitrogen balance.

Fruits offer a highly nutritious food choice that supports efficient reduction in dietary protein while providing calories, vitamins, minerals, fiber and phytonutrients.

Common objections to a high carbohydrate and low-protein diet are fully addressed and especially in relation to cancer.

Introduction

It is currently accepted within the scientific community that diet plays a highly significant role in both cancer prevention and treatment. However, oncologists routinely advise cancer patients to eat anything they want. This disconnect between science and medicine seems to be by design to benefit the pharmaceutical industry rather than the patient. Mainstream oncology is completely oriented towards drugs, radiation and surgery.

Nutrition is a deep dark void within conventional cancer care. Integrative oncology barely steps outside the box by suggesting exercise, meditation, acupuncture and a nutritious diet, but not a diet that has therapeutic benefit. It is about managing treatment side effects rather than changing the course of the disease.

Nutrition is the most powerful foundational element in treating cancer for both a conventional or an alternative approach. Cancer cells have different nutritional requirements compared to normal cells. which can be exploited. The most studied nutritional requirements of cancer cells that are significantly different from normal cells are glucose, glutamine, fatty acids, methionine, cysteine and branched chain amino acids. These nutritional requirements are necessary to sustain rapid growth and for the maintenance of redox balance (antioxidant defense).

Diet influences powerful tumor growth factors such as insulin and IGF-1, gut microbiome diversity, acid-base balance, inflammation and nutrient availability or excess. A plant-based diet is emerging as most ideal for cancer prevention and the Mayo Clinic recommends that all cancer patients should adopt a plant-based diet during treatment.

Is there an ideal form of a plant-based diet offering the greatest therapeutic utility? Studies show that limiting dietary protein significantly alters the rate of tumor growth. This discussion will explore the advantages of a low-protein diet as a powerful platform for cancer treatment. It is not suggested here that diet alone can be a complete cancer treatment but diet should be fundamental and foundational to all forms of cancer therapy and for sustained remission.

Fruits and vegetables are the most natural and health promoting foods on the planet. Yet, there are those in the field of alternative and integrative medicine who discourage fruit consumption for unwarranted reasons. However, non-starchy vegetable consumption seems to be universally acceptable.

The sugar feeds cancer myth has infected far too many minds within the community of practitioners and patients. The ketogenic diet has snowballed into a false, dangerous and scientifically unsupported approach. A ketogenic diet is also framed as an approach called "Metabolic Terrain". Starving cancer of glucose is an old worn out and ineffective exercise. This paper will discuss the pitfalls of a ketogenic diet and the merits of a high carbohydrate low-protein plant-based diet.

There is a dietary approach for cancer treatment that has very strong scientific support and early clinical evidence. This approach involves reducing the intake of specific amino acids and lowering overall protein intake. A high fruit diet is the most efficient and practical way to reach these objectives. First, a major objection to a high fruit diet needs to be addressed.

Overcoming the Sugar Feeds Cancer Myth

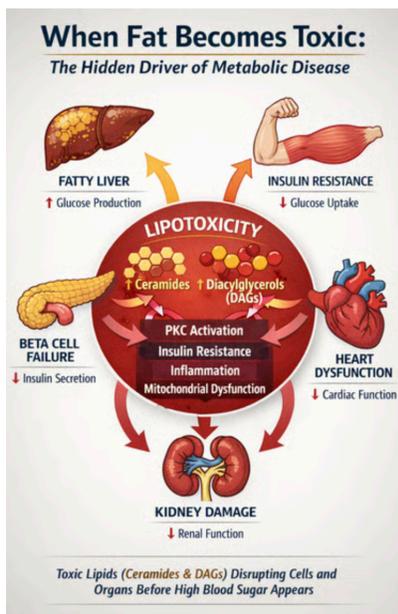
There is an irrational and misguided phobia surrounding fruit within the non-traditional cancer treatment space. Much of this fear is being generated by various experts who incorrectly believe that glucose metabolism is a valid and effective therapeutic target. Their rationale includes the fact that the PET scan utilizes a radioactive glucose tracer. Tumors exhibit a slightly higher uptake of glucose but a recent finding is that elevated glucose uptake by tumors is primarily flowing to immune cells.

Cancer cells are metabolic omnivores meaning that multiple fuels are available to cancer cells to support bioenergetic metabolism. Glucose is just one of many different fuels that cancer cells metabolize. Glutamine is always a readily available and abundant fuel for cancer cells regardless of dietary factors. The bottom line is that there are no practical and safe ways to starve cancer of bioenergetic fuels.

An alternative approach to leveraging diet to support cancer treatment is to target proteinogenic pathways rather than bioenergetic metabolism. This approach is well supported by studies on single and multiple amino acid deprivation experiments in cell culture and animal models.

The Cause of Insulin Resistance

Insulin resistance (type 2 diabetes) is not caused by an excess of carbohydrates but rather due to an excess of dietary fat. Fat can build up to toxic levels within muscle and liver cells which blocks insulin receptor signaling. This condition called lipotoxicity causes high blood glucose and high insulin. Lipotoxicity is the primary root cause of metabolic syndrome. Other factors such as overall food quality, fiber and the gut microbiome are involved in metabolic disease.



Sources of fat include animal products, all types of oils, nuts, seeds, avocado and coconut. The typical western diet can be 40-60% of calories as fat.

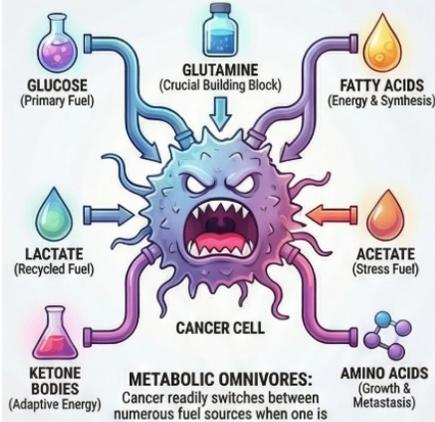
A ketogenic diet is not a cure for type 2 diabetes, it is a bandaid that does not treat the root cause of the condition. The cure to type 2 diabetes is a low-fat whole food plant-based diet. Initially, fat must be limited to less than 5% of calories.

Insulin is known to be a tumor growth stimulating factor so keeping insulin low and stable is more important than blood glucose level. When dietary fat is limited to less than 10% of calories, after a fruit meal, blood glucose typically rises to no more than 120 mg/dl.

THE PARADOX OF STARVING CANCER: WHY METABOLIC RESTRICTION FAILS AND WHAT MIGHT WORK INSTEAD

THE PROBLEM: THE FLAWED STRATEGY OF "STARVING CANCER"

Cancer Cells are Metabolic Omnivores



THE SOLUTION: EXPLOITING CANCER'S OXIDATIVE VULNERABILITY

A Better Target: Oxidative Stress



CANCER CELL UNDER OXIDATIVE STRESS

CONSTANT VULNERABILITY: Cancer cells are constantly on the verge of being overwhelmed by reactive oxygen species.

WHY METABOLIC RESTRICTION BACKFIRES

Restriction Can Harm the Patient More Than the Tumor

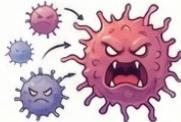


WEAKENS IMMUNE SYSTEM: Activated T-cells and NK cells require high levels of glucose/glutamine, same as tumors.



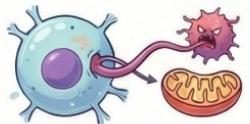
ACCELERATES CACHEXIA: Affects 50-80% of advanced cancer patients. Nutrient restriction can make this muscle-wasting syndrome catastrophically worse.

It May Select for More Aggressive Cancers



Aggressive Cancers Weeds out weaker cancer cells, leaving behind the most adaptable and aggressive ones. Some studies show ketogenic diets can increase metastasis.

Cancer's Ultimate Survival Tactic: Mitochondrial Theft



Under stress, cancer cells can steal fully functional mitochondria from healthy neighboring cells, including immune. 2023 study found 64.4% of bladder cancer cells acquired mitochondria from T-cells.

Clinical Trials Show Disappointing Results



Ketogenic Diets: Limited and equivocal results in human trials.

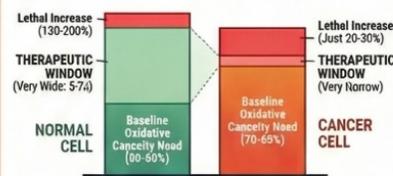


Glutaminase Inhibitors: Major Phase III trial failed to show improvement in kidney cancer.



Glucose Inhibitors (e.g., 2-DG): Lack of clinical efficacy at tolerable doses for over 50 years.

Cancer Has a Narrow Safety Margin for Oxidative Stress



Treatments can fatally damage cancer cells while being easily tolerated by healthy tissue.

KEY WEAKNESSES EXPLOITED

Cancer Cannot Adapt to Overwhelming Oxidative



Unlike switching fuel sources, which can take hours, oxidative damage is explosive, occurring in seconds. Cancer cells cannot activate backup antioxidant systems fast enough to survive.

A Key Weakness: The GPX4 Enzyme



GPX4
SINGLE POINT OF FAILURE
The only enzyme that repairs specific membrane damage. Has no backup systems.



Kills Therapy-Resistant Cancer Stem Cells

Most stubborn cancer stem cells are paradoxically more vulnerable to oxidative stress-induced cell death (ferroptosis) due to high iron dependency.

SHIFTING FOCUS:
From futile starvation attempts to a targeted strike on an inescapable vulnerability.

This diagram, courtesy of Dr. Daniel Thomas, MS, DO, clearly illustrates the futile and paradoxical challenge of starving cancer of bioenergetic fuels.

Fruit Does Not Equal Refined Sugar

Whole unprocessed fruit is not equivalent to refined sugar (sucrose) and does not abnormally elevate blood glucose or spike insulin provided that insulin resistance is not present. Prevention of insulin resistance (type 2 diabetes) involves limiting fat intake, avoiding processed foods and following a basic exercise program. It is excess dietary fat that builds up over time within liver and muscle cells which results in lipotoxicity.

Whole fruit releases sugar gradually because the sugars are bound up in fiber. Fruit juices are not recommended except for fresh squeezed citrus juices. Diabetics easily handle whole fruit in their diet and actually improve with greater fruit intake. See www.masteringdiabetes.org.

Unprocessed whole carbohydrates are also not the cause of dysregulated blood glucose. Whole grains, beans and starchy vegetables are very helpful in managing blood glucose and provide necessary fiber for gut health. Certainly, refined or ultra processed carbohydrates should be avoided.

The Idea of Starving Cancer

Very popular in some circles is the concept of starving cancer. This idea arises from the observation that tumors show a higher glucose uptake than normal cells and is related to the Warburg effect. But cancer cells are highly metabolically flexible and can tap into a wide array of fuels to sustain energy (ATP) production. These alternative fuels include glutamine, fatty acids, ketones, lactate and amino acids. Cancer cells are adept at stealing these nutrients from other cells within the tumor microenvironment. So the idea of selectively starving cancer is extremely challenging given these realities.

Protocols have been proposed for starving cancer that incorporate off-label drugs, supplements and a ketogenic diet. Trials involving this approach have not generated any promising outcomes except for certain brain cancers which are highly glucose dependent.

Rather than attempting to starve cancer of bioenergetic fuels, cancer can be starved of specific amino acids that are essential for the cancer cell to grow, divide and balance oxidative stress. Methionine is the most studied amino acid in relation to cancer. In fact, methionine dependence is universal for all forms of cancer. Dietary methionine restriction has been demonstrated in small clinical studies to enhance the efficacy of chemotherapy.

Other amino acids have been identified as essential to cancer cell growth and survival. Examples are cysteine, serine, glycine, leucine, isoleucine, valine, asparagine and also a group of non-essential amino acids.

The diagram below, courtesy of Dr. Daniel Thomas, MS, DO, illustrates the benefits of a plant-based diet for supporting cancer treatment.

Rethinking the Food Pyramid: A Cancer Patient's Guide to Protein & Fat

The modern "inverted" food pyramid correctly advises limiting ultra-processed foods, but its heavy emphasis on animal protein and fats can be problematic for cancer patients. Research reveals that animal-based foods can create a biological environment that fuels tumor growth, while plant-based foods offer protective effects.

Animal Sources: Problematic for Cancer

Fuels Cancer Growth

Supporting Detail: High animal protein diets are linked to a fourfold increase in cancer deaths.

Provides Cancer's "Fuel"

Animal protein is high in methionine, an amino acid cancer cells need to grow.

Weakens Your Defenses

Animal fats can impair cancer-fighting immune cells and create an acidic body environment.

Plant-Based Sources: A Safer Choice

Creates a Protective Environment

Supporting Detail: Vegan diets are associated with a 15% lower overall cancer rate.

Starves Cancer Cells

Plant protein is low in methionine, limiting a key resource for tumor growth.

Strengthens Gut Health

Fiber from plants feeds gut bacteria that produce cancer-fighting compounds like butyrate.

Impact on Body Environment & Risk Factors

Impact of Animal-Based Diet	Impact of Plant-Based Diet
<p>+</p> <p>Increases (Fuels Cell Growth)</p>	<p>-</p> <p>Lower Levels (Protective)</p>
<p>Acidic (Favors Tumors)</p>	<p>Alkaline (Less Favorable)</p>
<p>Harmful, Toxic Compounds</p>	<p>Protective, Anti-Cancer Compounds</p>

Food for Thought

Are there any real health benefits from consuming animal products? Science points strongly in favor of plant foods as offering a wide array of health benefits compared to animal foods. In fact, it is rare to find any factors related to consuming whole plant foods that might create any negative health concerns. Contrast this with all of the data suggesting that consuming animal foods directly causes chronic degenerative diseases. Animal foods contain zero fiber which may be the primary reason for negative health consequences. Other issues with animal foods include high amounts of saturated fat, cholesterol, protein, purines, choline, phosphorous and are acid forming. The human body is evolved and adapted to predominately consuming carbohydrates and fiber, not animal flesh, eggs or cow's milk. Areas of the world called "Blue Zones" consume a predominately plant-based diet and exhibit very low rates of chronic degenerative diseases and extraordinary longevity.



A High Fruit Diet as a Potent Anticancer Therapy

A fruitarian diet may seem objectionable on some levels as a healthy diet, let alone a diet that supports recovery from cancer. A clear understanding of what a fruitarian diet offers therapeutically is discussed in detail.

Probably the primary objection is that a fruitarian diet is highly deficient in protein and one will starve to death. The reality is that cancer cells will starve to death while normal cells will easily survive reduced dietary protein intake. Fruits are not devoid of protein (amino acids) and actually provide sufficient protein to achieve positive nitrogen balance. The only challenge is consuming enough fruit to obtain enough calories. For the overweight individual, a fruitarian diet is ideal for weight loss. Evidence suggests that a protein intake of 0.3 grams/kg per day is sufficient for avoiding protein deficiency provided that caloric intake requirements are met.

A secondary objection relates to the misunderstanding that eating fruit is equivalent to eating sugar. This is totally false and will be explained in the next sections.

Another objection to a fruitarian diet is nutritional deficiencies. The only potentially real deficiencies are vitamin D and vitamin B12. Supplementation can correct these potential deficiencies.

Challenging Cancer Cell's Dependence on Amino Acids

Cancer is an anabolic process that requires a readily available supply of building blocks for protein synthesis. The amino acid methionine has been extensively studied as one of these building blocks that cancer cells highly depend on for growth. Another key amino acid is cysteine which cancer cells are dependent on to maintain redox (ROS, oxidative stress) balance. Cysteine itself is an antioxidant and is necessary for the synthesis of glutathione. Branched chain amino acids are also involved in sustaining tumor growth.

Targeting Bioenergetic Pathways

Bioenergetic pathways are primarily involved in glucose metabolism. In cancer cells, metabolism is rewired to compensate for dysfunctional mitochondria. The major bioenergetic pathway begins with glucose uptake, conversion to pyruvate, entry of pyruvate into the TCA cycle and then the electron transport chain. Cancer cells commonly exhibit defects in the electron transport chain which is responsible for generating most of the ATP. Targeting any bioenergetic pathway is not representative of a selective approach that would not affect normal cells.

Targeting Proteinogenic Pathways

Cancer cells exhibit altered metabolism as a result of dysfunctional mitochondria. Cancer cells compensate by up regulating glycolysis which means a small increase in glucose uptake. Cancer cells also metabolize glutamine and fatty acids for energy so targeting glucose metabolism offers little to no therapeutic benefit. Cancer cells are omnivores for obtaining energy generating substrates. Attempting to decrease the ability of cancer cells to generate energy (ATP) is a futile exercise.

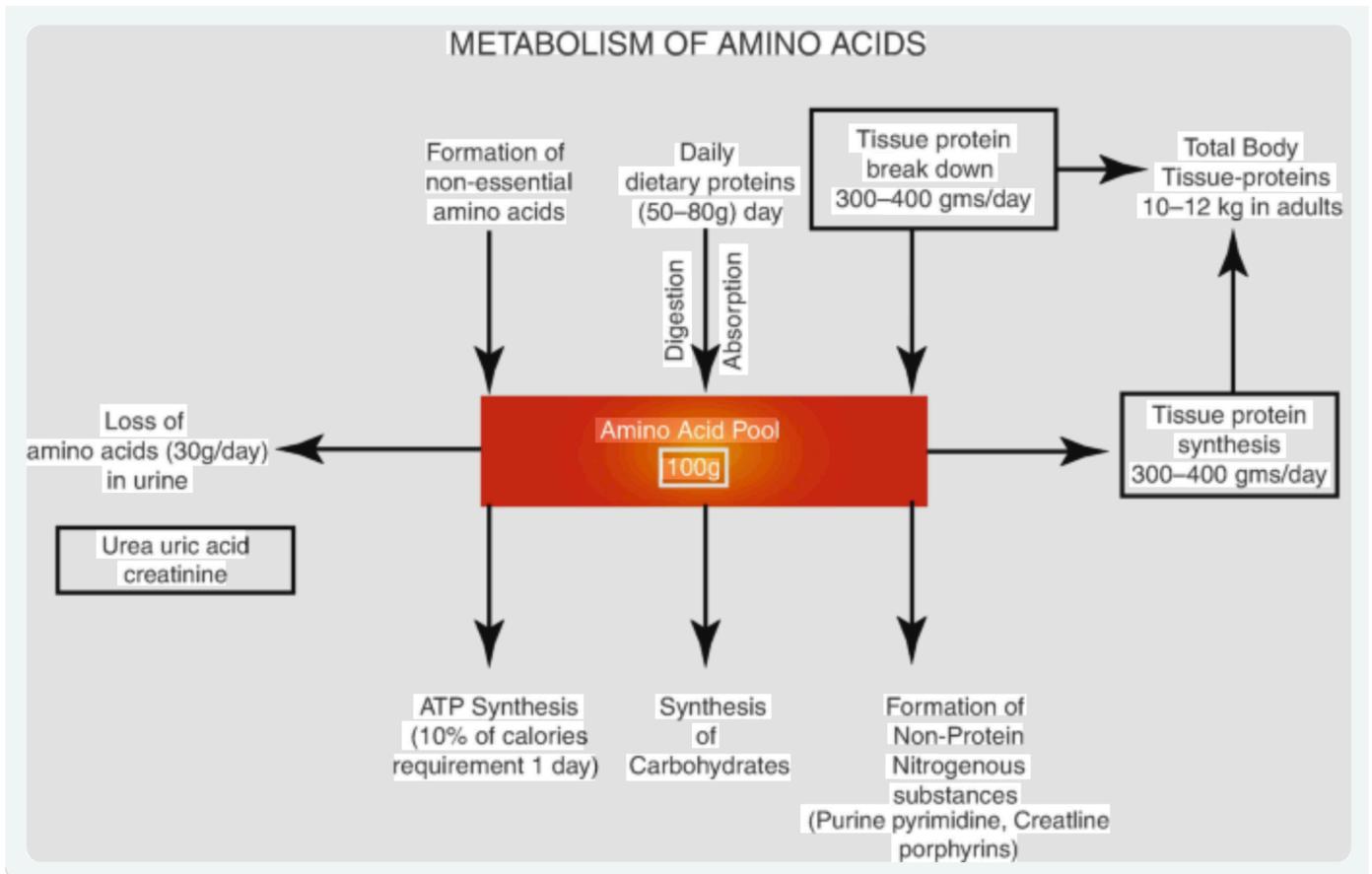
Given this fact, is it possible to starve cancer? It depends if the objective is to starve cancer's bioenergetic metabolic pathways or cancer's proteinogenic pathways. Targeting amino acids that are essential for cancer cell growth and survival is a far better approach than targeting bioenergetic pathways.

Low Sulfur Amino Acid Diet

Methionine and Cysteine are the primary sulfur amino acids that have been studied extensively for their relationship to cancer progression and survival. Methionine is essential for protein and polyamine synthesis. Methionine free diets have been shown to slow tumor progression in animal studies. Methioninase, a methionine degrading enzyme, is under investigation for augmenting chemotherapy.

Cysteine depletion is lethal to cancer cells due to the limitation of glutathione synthesis. Also, cysteine itself serves as an antioxidant. Glutathione is synthesized from cysteine, glycine and glutamate. Methionine and cysteine are intimately related and occur at nearly the same levels in most foods. A percentage of methionine is converted to cysteine.

Cysteine can be depleted further by vitamin B6 (P5P) with iron as a catalyst. An experimental enzyme, cysteinase, has demonstrated remarkable effects against pancreatic cancer.



The Amino Acid Pool

The body efficiently recycles proteins maintaining an amino acid pool. Very little goes to waste when considering amino acid reserves. Amino acids that are not recycled for protein synthesis are broken down for energy.

The amino acid pool consists of about 100 grams of amino acids circulating in the blood stream. 300-400 grams of tissue protein are broken down daily. 300-400 grams of tissue proteins are synthesized daily. Dietary protein is necessary to maintain the amino acid pool. Excess dietary protein is excreted as urea.

Branched Chain Amino Acids (BCAAs)

The branched chain amino acids, leucine, isoleucine and valine are involved in cancer progression. mTORC1 senses the availability of leucine and regulates tumor progression. Drugs have been developed that interact with mTOR. Rapamycin is one such drug and others have been evaluated clinical as cancer therapeutics.

Branched chain amino acids are mainly found in high amounts in animal protein foods and in some plant foods such as tofu, lentils, nuts and seeds. Fruits contain very little BCAAs.

Advantages of Plant vs. Animal Protein

There are major differences between animal derived protein and plant derived protein that affects chronic disease risk and mitigation. Amino acid profiles differ across all dietary proteins. Animal proteins contain higher levels of sulfur amino acids (methionine and cysteine) and branched chain amino acids (leucine, isoleucine and valine). These are the major differences between plant and animal proteins.

Neutral Nitrogen Balance

Neutral nitrogen balance, or nitrogen equilibrium, is a state where the amount of nitrogen ingested into the body (primarily through dietary protein) is equal to the amount of nitrogen excreted (via urine, feces, and sweat). This indicates that the body is in a steady state, where protein synthesis (anabolism) is roughly equal to protein breakdown (catabolism), and no net gain or loss of body protein is occurring.

Excess dietary amino acids not utilized for protein synthesis must be deaminated. This means removal of the nitrogen group (NH₂) from the amino acid molecule. The nitrogen group is converted to ammonia. Ammonia is a highly toxic byproduct of deamination which is converted to urea and excreted through the kidneys as urine.

Managing stage 4-5 chronic kidney disease without dialysis involves limiting dietary protein to as low as 0.3 g/kg.

The official recommended dietary protein intake is 0.8g/kg per day. Built into this recommendation is a 100% safety buffer meaning that the real requirement intake is 0.4g/kg per day.

Other Advantages of a Low-Protein Diet in Cancer Therapy

Lowered IGF-1 and Less mTOR Stimulation

A strictly fruitarian diet supplies an adequate level of protein necessary for all normal physiological requirements except for tumor growth.

A low protein diet greatly reduces IGF-1 and mTORC1 which are tumor growth promoting signals.

Acid-Base Balance

Foods can be classified as either acid or alkaline forming which depends on the food's mineral balance. One measure is the food's calcium to phosphorous ratio. Fruits are the most alkaline forming foods while animal proteins are the most acid forming.

The tumor microenvironment is acidic due to cancer cell's abnormal metabolism which produces lactate.

Alkalization of the extracellular fluid supports the neutralization of the acidic tumor microenvironment which offers multiple benefits. Alkalization can be supported by bicarbonate supplementation. Urine pH should be 8.0 or higher.

Gut Microbiome

A fruitarian diet supports a well balanced and diverse gut microbiome from the high fiber content and the elimination of protein fermentation within the colon. Probiotics and fermented vegetable preparations can provide further support for optimal gut health.

Reduced Inflammation

Inflammation is known to be a powerful driver of cancer progression. A plant-based diet reduces chronic inflammation by eliminating pro-inflammatory triggers like saturated fat and processed foods while providing high levels of fiber, antioxidants, and phytochemicals. Inflammation markers such as C-reactive protein are significantly lower in those following a plant-based diet.

Lymphatic Flow and Drainage

The lymphatic system is involved in immunity and waste disposal. Lymphatic fluid can become stagnant. Lymph is moved by physical activity

Enzymes contained in certain fruits such as pineapple and papaya can be very helpful in improving lymphatic flow.

Protein Content of Plant Food Groups

Plant foods vary considerably in protein content. Highly processed plant foods such as soy protein isolate and protein powders can exceed 20% protein content. To achieve neutral nitrogen balance or to reduce protein intake below 7% of calories, careful meal planning is necessary to meet these goals. All whole plant-foods contain far more than adequate protein to meet nutritional needs.

Fruits 1-5%

Vegetables 4-6%

Grains 7-18%

Legumes 22-45%

Nuts 4-17%

Seeds 15-30%

From these numbers, it can be seen that nuts, seeds, grains and legumes must be highly limited to achieve a 7% protein intake level. Fruits must comprise at least 50% of the diet followed by vegetables. The challenge in implementing a low-protein and low-fat diet is obtaining sufficient calories. Non-starchy vegetables must be minimized and starchy vegetables like potatoes should be emphasized.

By contrast, lean animal protein can be as much as 90% protein and the amino acid profile is highly unfavorable for cancer therapy. Therefore, all animal products must be eliminated from the diet for optimal therapeutic effects.

Conclusion

Presented is the rationale for implementing a low-protein plant-based diet as a nutritional platform for treating cancer. Outlined are the specific mechanisms by which a low-protein plant-based diet affects tumor progression and cancer cell survival.

Dietary intervention within conventional oncology is centered around sufficient protein intake which is counterproductive. Limiting protein intake, especially animal protein has been proven to offer the greatest therapeutic potential for treating cancer.

Future studies will build upon already compelling science that informs us that cancer patients can take full control of their treatment plan and adopt a highly effective dietary intervention.

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