Session 3

Minerals & Human Health

'Soil Health is Human Health' - The Significance of Mineral Shortage

by Jerry Brunetti

The periodic chart of elements lists ninety-two (92) elements (excluding rare earth elements). Thirteen (13) elements are unimportant with regard to biological functioning of living things (seven are radioactive and six others are inert gases). The four elements of carbon, hydrogen, oxygen and nitrogen constitute the primary construction of biological life. In fact, over 95% of the structure of plants consist of these 4 elements. The remaining 75 elements are classified as minerals.

Thirty-one Minerals Essential to Animal Health

Aluminum*	Fluorine	Phosphorus
Arsenic*	Gallium	Potassium
Barium	Germanium	Selenium
Boron	Iodine	Silicon
Bromine	Iron	Sodium
Cadmium*	Lead*	Sulfur
Calcium	Lithium	Tin
Chlorine	Magnesium	Vanadium
Chromium	Manganese	Zinc
Cobalt	Molybdenum	
Copper	Nickel	

Essential, yet very toxic in high doses.

Thirty-one (31) minerals are classified as beneficial to animal life, including certain toxic elements such as aluminum, arsenic, barium, cadmium, lead and nickel, which although essential in minute doses are extremely poisonous in larger doses. (Thirty One Minerals) It is probable the remaining forty-four (44) minerals also contribute (yet to be determined), to metabolic pathways; albeit their contribution as measured by their actual presence in levels as low as parts per billion would suggest that they are profoundly influential substances on cellular processes.

Minerals have three (3) major roles in the bodies of animals. First, they provide structural materials for bones and connective tissue. Second, they allow electrical impulses to be transmitted across nerves. Third, they act as catalysts (such as being co-factors of enzyme synthesis) which are involved in the numerous physiological processes such as DNA replication, digestion, immune function, endocrine synthesis, neurological activity, energy storage and release, muscle contraction and countless others. In short, these catalysts, usually enzymes, are quite the phenomena, in that they can achieve the remarkable feat of allowing the body to burn sugars and fats at body temperature (a very low temperature) in a water medium, producing carbon dioxide and water as by-products.

The critical role minerals play in all of these physiological transactions clearly accounts for the devastating consequences that mineral deficiencies have on animal and human health. Magnesium alone is responsible for 100 enzymatic reactions in the human body. Zinc accounts for another 200. A deficiency of only these two minerals (which the vast majority of people, 80+%, have deficiencies!) can account for 300 physiological malfunctions!

Table 1.

Some Minerals in the Food Chain of the Sea

Mineral*	Seawater	Sea Plants	Sea Animals
barium	0.03	30.00	2.50
bromine	65.00	740.00	470.00
calcium	***400.00***	***145000.00***	***9250.00***
flourine	1.30	4.50	2.00
iodine	0.06	7.35	75.00
iron	0.01	700.00	400.00
lanthanum	0.00	10.00	0.01
lithium	0.18	5.00	1.00
magnesium	***1350.00***	***5200.00***	***5000.00***
molybdenum	0.01	0.45	1.25
nickel	0.01	3.00	12.70
phosphorus	0.07	3500.00	7000.00
potassium	***380.00***	***2000.00***	***12500.00***
rubidium	0.12	7.40	20.00
silicon	3.00	9250.00	70000.00
sodium	10500.00	33000.00	22000.00
strontium	8.10	570.00	260.00
sulfer	885.00	12000.00	7000.00
zinc	***0.01***	***150.00***	***753.00***

Terrestrial vs Marine Mineralization

The comparison of **Table 1** and **Table 2** illustrate the dichotomy of mineral movement in the two worlds of life on our planet: the sea and the land. It is very clear that in sea water, the cells of sea plants concentrate the sea's minerals, in some cases, more than a million times, demonstrating the "mineral hunger" of cells. Although sea animals have lower concentrations of minerals than sea plants, sea animal mineral concentrations are many times that found in seawater. Needless-to-say, sea plants and animals are excellent sources of mineral reserves for terrestrial plants, animals, and humans.

Table 2.

Essential Minerals in the Food Chain of the Land

Mineral*	Rock	Soil	Plants	Animals
arsenic	1-8	6	0.2	0.2
bromine	3-5	5	15	6
cadmium	0.2	0.06	0.06	0.5
calcium	*41500*	*4000-50000*	*18000*	*200-85000*
chlorine	130	100	2000	2800
chromium	100	5-3000	0.23	0.075
copper	55	2-100	14	2-4
flourine	625	200	5-40	150-500
iodine	0.5	5	0.42	0.43
lead	12.5	10	2.7	2
lithium	20	30	1	0.02
magnesium	*23000*	*5000*	*3200*	*1000*
molybdenum	1.5	2	0.9	0.2
nickel	75	40	3	0.08
potassium	*20000*	*14000*	*14000*	*7400*
sodium	23600	6300	1200	4000
sulfur	260	700	3400	5000
tin	2	2-200	0.3	0.15
zinc	*70*	*50*	*100*	*160*

When looking at **Table 2** however, we see that the dynamics of mineral concentration for terrestrial life is the opposite of how the minerals concentrate in the sea. Unlike sea plants, land animals and humans cannot draw their minerals directly from the sea. Animals and humans must either consume seafood or derive their mineral requirements from the earth's crust. This pathway, from rock to animals gut, is a lot more laborious than what happens in the sea. First, rock must appear via volcanic activity or mantle uplifting. Second, the breakdown of rock must occur via weathering, and geological and bacterial activity. Third, micro-organisms must assimilate minerals from the rock and incorporate them into their biological matrix, thereby chelating minerals for better assimilation by plants. Fourth, higher plants occupy this newly formed "soil" and mobilize minerals dispersed throughout the soil. The minerals are transported through the roots, into the foliage, and then can fertilize the topsoil upon the plant's death via the decomposition of its biomass. Clearly, the land food chain is much more fragile than that of the sea which provides an inexhaustible supply of minerals in the sea water. On land, the transformation of rock to soil requires an unbroken chain. A necessary link in this chain is the soil food web, consisting of billions of organisms, representing thousands of species, in a mere handful of topsoil. Micro-organisms must thrive and the minerals in decomposing plants and the manures of animals eating those plants, must be recycled into the soil.

Modern industrial agricultural practices have virtually destroyed the soil ecosystem. Macro and micro-nutrients are leached from the soil by applications of highly soluble acidulated fertilizers. These practices have also caused unprecedented amounts of topsoil, formed through eons of this four staged process, to be irrevocably eroded into the sea. They also rendered once "plant-available" nutrients to become "complexed" with other minerals, short circuiting their uptake by crops and requiring them to be increasingly dependent upon purchased, incomplete and unstable plant foods, which continue to exacerbate the crisis.

Table 3.

The Worst of the Crop:

Disappearing Trace Elements in Food, 1948-1992

(Per 100 Grams of Food)

	1948 (Highest)	1948 (Lowest)	1992 (Average)	% Difference Between 1948 Low &1992 Ave
Snap Beans				
iron	22.7 mg.	1.0 mg.	1.04 mg.	0
manganese	6.0 mg.	0.2 mg.	0.214 mg.	0
copper	6.9 mg.	0.3 mg.	0.069 mg.	-77%
Cabbage				
iron	9.4 mg.	2.0 mg.	0.59 mg.	-70%
manganese	6.0 mg.	0.2 mg.	0.159 mg.	-20%
copper	4.80 mg.	0.04 mg.	0.023 mg.	-42%
Lettuce				
iron	193.8 mg.	0.9 mg.	0.5 mg.	-44%
manganese	9.4 mg.	0.2 mg.	0.151 mg.	-25%
copper	5.3 mg.	0.3 mg.	0.028 mg.	-90%
Tomatoes				
iron	158.4 mg.	0.1 mg.	0.45 mg.	+350
manganese	51.6 mg.	2.0 mg.	0.105 mg.	-94%
copper	3.2 mg.	0	0.074 mg.	0
Spinach				
iron	22.7 mg.	1.9 mg.	2.71 mg.	+142%
manganese	6.0 mg.	0.9 mg.	0.097 mg.	-89%
copper	6.9 mg.	0.5 mg.	0.13 mg.	-74%

Table 4.

Changes in the Mineral Content of Grains, 1963-1992

(Per 100 Grams)

	1963	1992	% Change
Wheat, red winter, hard			
calcium	46 mg.	29 mg.	-36.96
phosphorus	354 mg.	288 mg.	-18.64
iron	3.40 mg.	3.19 mg.	-6.18
potassium	3.70 mg.	363 mg.	-1.89
magnesium	160 mg.	126 mg.	-21.25
Oats, rolled			
calcium	53 mg.	52 mg.	-1.89
phosphorus	405 mg.	474 mg.	+17.04
iron	4.5 mg.	4.2 mg.	-6.67
potassium	352 mg.	350 mg.	-0.57
magnesium	169 mg.	148 mg.	-12.43
Buckwheat			
calcium	114 mg.	18 mg.	-84.21
phosphorus	282 mg.	347 mg.	+23.05
iron	3.1 mg.	2.2 mg.	-29.03
potassium	448 mg.	460 mg.	+02.68
magnesium	229 mg.	231 mg.	+00.87
White rice			
calcium	24 mg.	9 mg.	-62.50
phosphorus	94 mg.	108 mg.	+14.89
iron	0.8 mg.	.08 mg.	0.00
potassium	92 mg.	86 mg.	-6.52
magnesium	28 mg.	35 mg.	+25.00

Table 5.

Changes in Nutrient Content of Beef and Chicken, 1963-1992 (Per 100 Grams)

	1963	1992	% Change
Beef, ground			
calcium	10 mg	8 mg	-20.00
iron	2.70 mg	1.73 mg	-35.93
magnesium	17 mg	16 mg	-5.88
phosphorus	156 mg	130 mg	-16.67
potassium	236 mg	228 mg	-3.39
vitamin A	***40 IU***	***0.00***	***-100.00***
thiamine	0.80 mg	0.03 mg	-52.50
riboflavin	0.16 mg	0.151 mg	-5.63
niacin	4.30 mg	4.48 mg	+4.19
Chicken			
calcium	12 mg	10 mg	-16.67
iron	203 mg	198 mg	-2.46
magnesium	1.30 mg	1.03 mg	-20.77
phosphorus	285 mg	238 mg	-16.49
potassium	23 mg	23 mg	0.00
vitamin A	***150 IU***	***45 IU***	***-70.00***
thiamine	0.10 mg	0.069 mg	-31.00
riboflavin	0.12 mg	0.134 mg	+11.67
niacin	7.70 mg	7.87 mg	+2.21

The following tables clearly illustrate the sobering statistics as to how all this ignorance on the part of farmers, and greed and arrogance on behalf of the so-called scientists of the Green Revolution have created the kinds of mischief that has destroyed our health and environment. **Table 3** compares high and low analysis of 1948 to 1992 averages. In just about every example the average for 1992 hardly comes close to the lows of 1948. Likewise, Figure 1 shows the sums of averages found in selected vegetable harvested in 1914, 1963, and 1997. The same trends of huge losses of minerals, as verified by USDA, are also found in fruits, grains, beans, beef and chicken. (See Tables 4,5,6,&7)

Table 6

Changes in the Mineral Content of Beans, 1963-1992 (Per 100 Grams)

	1963	1992	% change
Pintos			
calcium	135 mg	121 mg	-10.37
iron	6.4 mg	5.88 mg	-8.13
magnesium	1.70 mg	159 mg	-6.47
phosphorus	457 mg	418 mg	-8.53
potassium	9.84 mg	1328 mg	+34.96
Chickpeas (garbanzos)			
calcium	150 mg	105 mg	-30.00
iron	6.9 mg	6.24 mg	-9.57
magnesium	n/a*	115 mg	n/a
phosphorus	331 mg	366 mg	+10.57
potassium	797 mg	875 mg	+9.79

Table 7.

Changes in Nutrient Content in Leafy Vegetables, 1963-1992 (Per 100 Grams)

	1963	1992	% Change
Broccoli, raw			
calcium	103 mg	48 mg	-53.40
iron	1.10 mg	0.88 mg	-20.00
magnesium	24 mg	25 mg	+4.17
phosphorus	78 mg	66 mg	-15.38
potassium	382 mg	325 mg	-14.92
Romaine lettuce			
calcium	68 mg	36 mg	-47.06
iron	1.4 mg	1.1 mg	-21.43
magnesium	n/a*	6 mg	n/a
phosphorus	25 mg	45 mg	+80.00
potassium	264 mg	290 mg	+9.85
Iceberg lettuce			
calcium	20 mg	19 mg	-5.00
iron	0.5 mg	0.5 mg	0.00
magnesium	11 mg	9 mg	-18.18
phosphorus	22 mg	20 mg	-9.09
potassium	175 mg	158 mg	-9.71
Collard greens			
calcium	203 mg	29 mg	-85.71
iron	1.00 mg	0.19 mg	-81.00
magnesium	57 mg	9 mg	-84.21
phosphorus	63 mg	10 mg	-84.13
potassium	401 mg	169 mg	-57.86
Swiss chard			
calcium	88 mg	51 mg	-42.05
iron	3.2 mg	1.8 mg	-43.75
magnesium	65 mg	81 mg	+24.62
phosphorus	39 mg	46 mg	+17.95
potassium	550 mg	379 mg	-31.09

Since plants are critically dependent upon minerals to synthesize complexes that protect them from the ravages of diseases and insects, the results of "extractive agriculture" have been a proportionately inverse increase in the dependency upon fungicides and insecticides. In addition increased amounts of antibiotics and other drugs are also required to fight diseases in livestock and humans due to compromised immunity. So called "incurable degenerative diseases" are increasing at exponential rates to include cancer, osteoporosis, MS, CFS, depression, learning disorders such as ADD, ADAD, autism, and so on. Meanwhile the United States boasts some the highest levels of obesity in the world, including 61% of the population being overweight.

Session 6

The Basics of Animal Nutrition

The Secrets of Chemical-Free, Nutrient-Dense Meat & Milk

by Jerry Brunetti

Recent health discoveries associated with grass fed ruminants and their meat and dairy products present the most amazing opportunities while creating the most pressing challenges for present day stockman. The attempt to produce a totally grass fed **carcass** is considered an impossibility, if not and "unprogressive" or economically unsound practice. Having underweight, unthrifty, infertile or even dead stock hardly justifies any husbandry practice, holistic or conventional. The problem with today's nutritionists isn't their inability to balance a ration. The problem is they know so little about soil fertility and its relationship to producing forages that are capable of producing meat and milk at very profitable returns while preserving stock health, improving conception and enhancing longevity.

Table 1.

HOW TO FEED FOR 1,500 LBS. OF BUTTER FAT

(and 42,000 lbs. milk) IN 1952

CARNATION MILK FARMS

(135 cows @ 1,000+ lbs. of butter fat)

Pasture	30 - 40 lbs. ("lactogenic factors")
Beet Pulp	12 lbs.
Corn Silage	15 lbs. (use molasses for preservative)
Sliced Beets	25 lbs.
Alfalfa Hay	20 lbs. Summer/40 lbs. winter
Kelp	? (amount not stated)
Molasses	2 lbs.
Grain	20 lbs. (20% Protein, 5% Fat, 10% Fiber)

Wheat bran, ground oats, ground corn, linseed oil meal, soybean meal, rolled barley, coconut meal, corn germ meal, hominy feed, yeast, salt, minerals (8% of the grain).

NOTICE DIVERSITY OF THIS CONCENTRATE.

AVERAGE US PRODUCTION:

1910 - 154 lbs. B.F.

1952 - 200 lbs. B.F. 5,000 lbs. milk

Table 2.

"A Good Mineral Mixture for Cattle to Correct Bang's Disease and Breeding Troubles."

Mix:

- 100 lbs. Manganese Sulphate 65% Tecmangam. See analysis attached
- I/2 lb. Zinc Sulphate Monohydrate
- 1 lb. Copper Sulphate Monohydrate or Anhydrous
- 3 lbs. Magnesium Sulphate Anhydrous
- 11/2 lbs. Cobalt Sulphate Monohydrate
- 106 lbs.

Add to this:

- 10 lbs. Black strap or other feeding molasses
- 1/2 lb. Ground Russian Aniseseed

Mix thoroughly for a blend of uniform composition. Feed one ounce per head per day to all cattle, basis 1000 lbs. body weight. Include bulls, heifers, even calves, dry cows, milking cows and during period of gestation. May be mixed at the rate of one pound per 100 lbs. of grain or other concentrates, ensilage. One ounce per head per day for the average head is designed as a prophylactic and therapeutic (lose to prevent and correct Bang's disease and breeding troubles generally).

The above formula should result in a trace element feed supplement of the following approximate analysis:

Manganese sulphate MnSO4	60%
Magnesium sulphate MgSO4	20%
Ammonium Sulphate NH .S01	8%
Copper Sulphate CuSO4	1%
Cobalt Sulphate CoSO4	11/2%
Zinc Sulphate ZnSO4	1%
Molasses	7%
Aniseseed	0.50
	100%

including water of crystallization

Animals should also receive one and one.half grains potash iodide or equivalent of iodine from other sources per head per day.

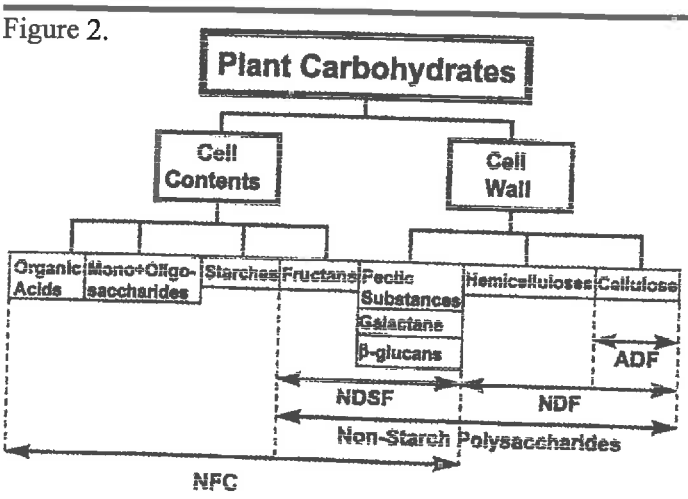
Table 1. shows a feed ration from **Carnation Dairy Farms** in 1952. Their top cow, Carnation Homestead Dairy Madcap, produced 41,943 lbs of milk and 1512 lbs of fat in a 365 day lactation. Not only would this be an amazing accom-

plishment today, but when one looks at the ration and sees only 15 lbs of corn silage and 20 lbs of a very diverse grain mix fed daily, it raises the bar even that much higher. Tremendous amounts of dry matter were obtained from pasture and/or alfalfa hay, beet pulp, mangel beets, kelp and molasses. What was clearly recognized 50 years ago was that exceptional production didn't have to come at the expense of stock health.

Another exemplary example of a world-class dairy utilizing holistic approaches to production without sacrificing herd health is **Randleigh Farms** of Lockport, New York. Nine volumes were written on this farm's experience with soil fertility, foliar fertilization, animal nutrition, feeding trials, genetics, stock and crop management techniques, and even human experiments incorporating milk as "medicine" in sanitariums for ill individuals. This "farm journal" was kept from 1935, 13 years after the farm was established in 1922, through 1959. **(Wm. R. Kenan, Jr.) (Table 2)**

Dr. William Albrect used to refer to the two main food groups as "grow foods" (nitrogen/protein) and "go foods" (carbon/carbohydrates and fats). Unfortunately, the industrial model of feeding livestock fails to look at the **quality** of protein, (is it amino acids or urea-rich, non-protein nitrogen?) or the **quality** of the energy (is it starch only, or does it also include cellulose, hemi-cellulose, organic acids, lipids, sugars pectins, beta-glucans?).

Figure 2.



(the rumen and its flora are the "soil" of the grazing animal). A build-up of rumen ammonia without a corresponding balance of soluble energy causes the ammonia to spill through the rumen wall, now becoming Blood Urea Nitrogen (BUN). This of course is a toxic substance and at high enough levels can kill stock. At elevated levels, over prolonged time, it causes high infertility rates, udder health issues (e.g. elevated somatic cell counts), abortions, unthrifty newborns, suppressed immunity with its consequences of disease, etc. Additionally, this toxic "protein" requires that the ruminant remove it from the blood stream utilizing an enzymatic cascade synthesized in the liver and kidneys. Unfortunately, the labor to remove waste is stolen energy that would otherwise be used to put on weight, or produce milk. Double Whammy!!

Figure 1.

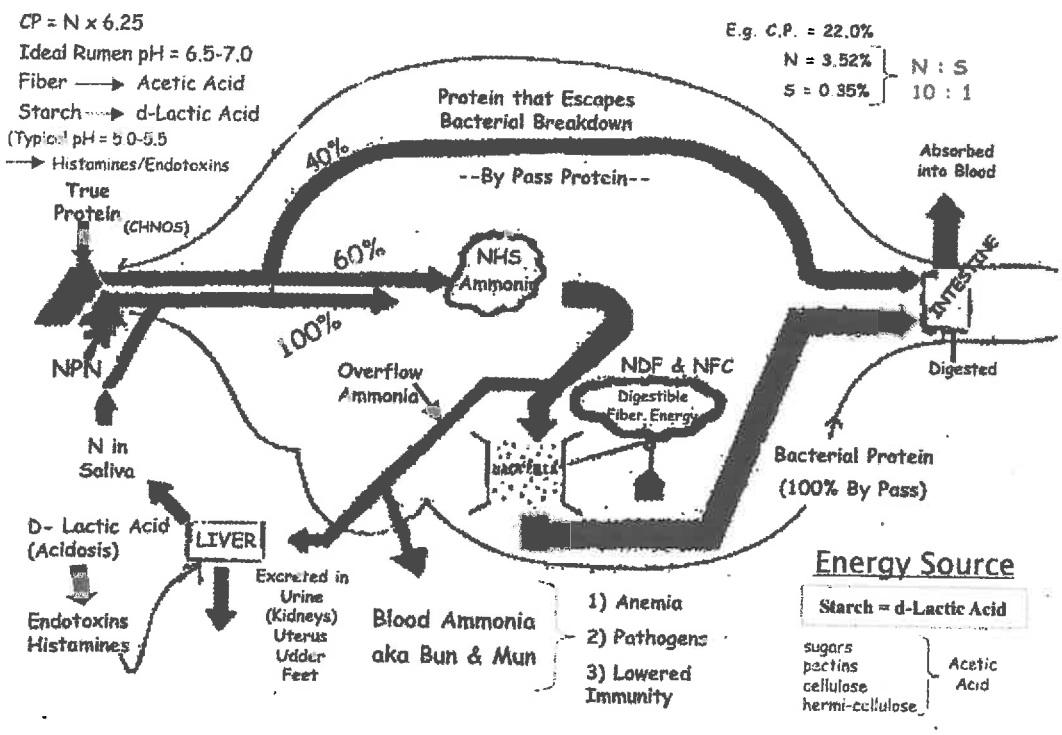
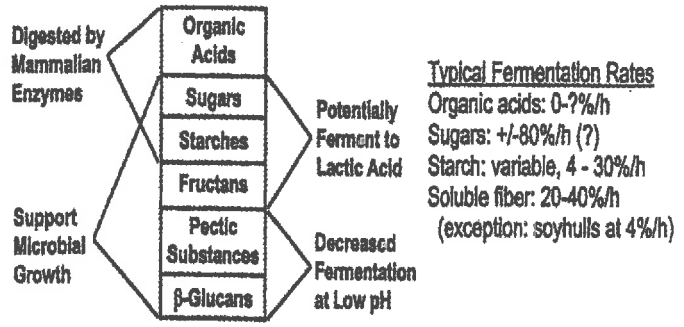


Figure 1 schematically illustrates the "eco-system" of a ruminant. It is critical to realize that 60% of the true protein in forage degrades to rumen ammonia. One hundred percent (100%) of the non-protein nitrogen, what I call "funny protein" degrades into rumen ammonia. Soluble protein as ammonia provides adequate "grow foods" for rumen microbes

Balancing the "grow food/go food" equation requires available, soluble energy sources, illustrated in **(Figure 2)** and classified into two primary groups. The first group, Neutral Detergent Fiber (NDF), consists of cellulose and hemi-cellulose and comprises the cell walls of plants. The second group, non-NDF carbohydrates are usually referred to as NFC and include organic acids, sugars (mono and oligosaccarides), starch and Neutral Detergent Soluble Fiber (NDSF). NDSFs include fructans, pectins, galactans and b-glucans. As you can see in the diagram, NFC consists of carbohydrates that are derived from both the cell wall and cell contents. The reason for the overlap is the following. Even though pectins, galactans and b-glucans are cell wall carbohydrates, they rapidly ferment

in the rumen like other sugars and starches. Their special advantage, however, is they don't contribute to lactic acid production. In fact their fermentation gets "shut off" when increases in lactic acid from the feeding of starch drops the pH of the rumen. **(Figure 3).**

Figure 3.



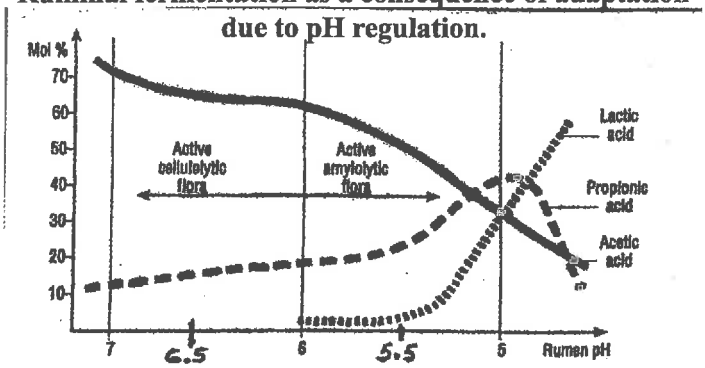
Nutritional characteristics of neutral detergent-soluble carbohydrates.

The Acid/Alkaline Tango

Since conventional "wisdom" has it that forages are high in protein and a poor source of energy, it has fostered a belief

Figure 4.

Ruminal fermentation as a consequence of adaptation due to pH regulation.



Kaufman, W., H. Hagemeister, and G. Durksen. Adaptation to changes in dietary composition level and frequency of feeding. In: Digestive Physiology and Metabolism in Ruminants, ed. Y. Ruckebusch and P. Thivend. Westport, Ct.: AVI Publishing, 1980, p. 587.

that starch and by-pass fats should be the source of energy to increase weight or produce milk. **Figure 4, Lactic Acid Curve,** illustrates the production of the three primary Volatile Fatty Acids (VFAs) in the rumen: acetic, propionic and butyric acid. Up to 80% of a ruminant's energy can come from these three primary VFAs. Fifty to sixty percent (50-60%) of these VFAs will consist of acetic acid at a rumen pH of between 6.5-7.0. As the pH drops in the rumen, acetic acid production decreases, being replaced by propionic and butyric acids. Another acid begins to appear at pH of 6.0, which is non VFA Lactic Acid. Lactic acid is toxic to fiber digesting microbes and alters the rumen ecosystem to become populated by microbes that thrive on a substrate of starch rather than pectins and other fibers. The point is, the fermentation of the valuable, high-energy raw materials found in good forage (i.e. pectins, b-glucans, galactans, etc) are rendered unavailable at lower pHs, causing the grain (starch) to meet the energy deficit. According to Richard Zinn, University of California, "Rumen bacteria do not grow when the pH level is below 6.0. When the level is between 6.5 and 6.0, bacterial growth rate declines 14% per hour with each 0.1 decrease on pH. Optimal growth is achieved when pH is above 6.5."

Figure 5.

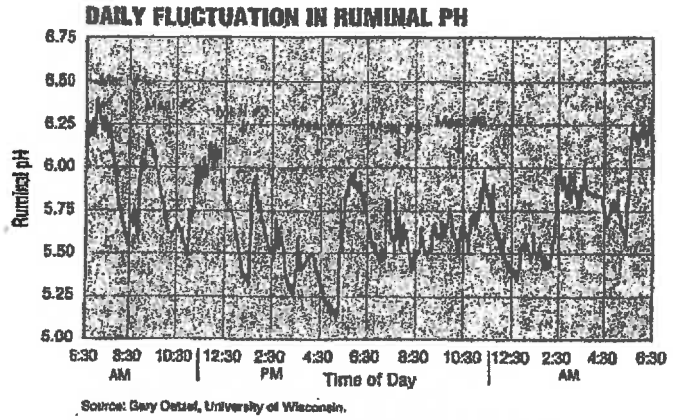


Figure 5 illustrates the ruminal fluid pH over a 24-hour period from a cow on a total mixed ration. In spite of doing a "good Job" of balancing the ration and not "slug feeding" grains, one can see that during 19 of the 24 hours, the rumen pH was below 6. This animal will not be an example of cow longevity because lactic acid build-up in the rumen will cause metabolic (systemic) acidosis and translate into liver abscesses, immune suppression, adrenal stress, feet/leg deterioration, breeding problems, chronic udder problems, and suppressed production.

It's the Soil, "Smart Ass".

So it should become increasingly obvious that first, ruminants are solely designed to consume forage for protein and energy. Second, since top performance herds were achieving record production on high forage diets 50 years ago, building quality protein and appropriate energy in forages can be done, but only by proper mineralization of first the soil and subsequently the forage.

Calcium

(Table 3) provides a target for mineral levels in forage in order to obtain the highest possible nutrient density. Calcium is the first consideration because it enters into the constitution of the proteins composing the cell-nucleus and plastids. If there is a calcium deficiency, these proteins will absorb magnesium instead. The resulting magnesium-protein compounds do not have the same well-defined capacity of inhibition that calcium-protein bodies possess. Additionally, calcium, as calcium pectate, provides the wonderful pectins that we are so much attempting to increase in our forages. Calcium pectate is one of the components of the middle

Table 3.

Optimum Parameters for Forage Nutrient Density	
Nitrogen	3.2 - 3.5%
ADF insol CP	< 0.90%
ADF	28 - 30%
NDF	38 - 43%

	Wet Chem Targets	Average % Plant Analysis
Ca	1.5 - 2.0%	<1.0 - 1.40%
P	0.35 - 0.50%	0.25%
Mg	0.35 - 0.50%	0.30 - 0.40%
K	2.0% (1:1 with Ca)	2.14%
S	0.32 - 0.35% (<10:1 N:S ration)	

Trace Mineral Goals	
Boron	40 ppm+
Copper	15 ppm+
Manganese	35 ppm+
Zinc	30 ppm+
Iron	< 200 ppm
Aluminium	< 100 ppm

lamella of the cell wall and also enters into the composition of protoplasm and certain proteins in the cell.

Now, when calcium in the soil is mobilized by the soil eco-system (which includes the plant roots), other minerals, assuming they are present, are also mobilized into the plant's tissues. That means important elements like phosphorous, magnesium and multiple trace minerals all increase in plant tissue, adding their mineral values as well as generating higher levels of amino acids and vitamins.

Boron

To further the advances of calcium, **boron** must also be present since it's necessary for the uptake of calcium. Boron has numerous plant functions, some of which are the transfer of sugars, cell division (especially on new terminal growth of roots, buds and leaf) and the increase in essential amino acids such as tryptophane, as illustrated in **(Table 4)**. Boron is also associated with parathyroid hormone production (PTH), which regulates calcium release into the blood and is necessary for calcium assimilation, deposition and retention.

Table 4.

Boron Concentration as a Factor Determining Trytophane Content in Lucerne

Boron in Parts Per 1,000 of the Nutrient Solution	Trytophane P.P.M. Dry Matter
0.00	1.27
0.22	1.36
0.44	2.17
1.08	2.55

Sulfur

Calcium and Boron aren't the only minerals required for improved protein quality. (So that true protein, amino acids/peptides, are synthesized and not "funny" protein, non-protein nitrogen, or NPN). **Sulfur** is an important partner in creating quality protein that doesn't contribute to high levels of Blood Urea Nitrogen (BUN) or Milk Urea Nitrogen (MUN). An additional benefit is that the digestibility of fiber, including lignin, is positively impacted by sulfur applications to soil that are taken up by plants.

Research published in the 1980's by the Journal of Animal Science and Journal of Dairy Science reported that crops took up sulfur as inorganic (sulfate) sulfur as well as organic (amino acids, peptides, fiber) sulfur. Animals performed better on plant sourced inorganic sulfur than supplemental inorganic sulfur (e.g. Sodium sulfate).

The feed industry for many years has recognized the importance of the N:S ratio which ideally should be 10(N):1(S) or less (Crude Protein ÷ 6.25=N x .10= minimum sulfur level). In that Methionine is one of the critical limiting essential amino acids and is comprised of sulfur, adds to the support that crops need to contain adequate sulfur. The addition of sulfur to the soil via sulfate fertilizers is the only cost effective method to achieve soil levels that are adequate (25-50 ppm) enough to enrich forages with ample sulfur. Typically, calcium sulfate, ammonium sulfate, and potassium sulfate, depending upon soil analysis, and at times elemental sulfur may be indicated, depending on soil pH and calcium levels. This is important because sulfur, being an anion and carrying a negative charge, readily leaches, like nitrate, out of the soil. Research conducted in 1995 and 1996 at Shenandoah Valley Agricultural Research and Extension center in Steeles Tavern, VA demonstrated that fertilizing tall fescue with nitrogen and sulfur as ammonium sulfate, increased average daily calf gains by 15% compared to fescue treated with nitrogen alone. This amounted to an additional $44 per calf at $.80/lb. It was also determined that weight gains were due to forage quality, not quantity. These animals were compared to animals supplemented with sodium sulfate and were found to use dietary nitrogen more effectively when sulfur was supplied through fertilization. Test done with orchard grass and sorghum yielded similar results, and were also supported by earlier metabolism trials with sheep at Virginia Tech.

Molybdenum

Another recommendation to reduce NPN, while increasing true protein, would be to spray a 0.1% Sodium Molybdate ($NA_2\ MoO_4$) solution prior to grazing or cutting hay. In order to make protein, nitrate (NO_3) must first be reduced to Nitrite (NO_2). This is accomplished by molybdenum, dependent enzyme called Nitrate Reductase. A mere 2 oz/acre (138 grams per hectare) will do the trick, assuming the soil is properly balanced for everything else. **(Table 5)** clearly illustrates this trace mineral advantage.

Table 5.

Nitrate Content of Normal & Molybdenum-Deficient Cantaloupe Leaves Grown on Sandy Soil

Description of Leaves	Nitrate Nitrogen in Dry Leaves, P.P.M.
Normal	900
Deficient	5,880
Normal	743
Deficient	3,965
Deficient*	1.040

* Sprayed with a 0.1% NA_2MoO_4 solution before harvesting leaves

Other Macronutrients

Ensuring that adequate phosphorous is present creates raw materials for plant energy (ATP) and increased bioavailability of calcium. Magnesium is involved as a catalyst in hundreds of biochemical reactions in the body, as well as increasing the assimilation of calcium in the livestock.

Potassium Caveat

Another critical influence on producing quality forages is the applications of excessive potassium on pastures and hay fields. As stated in "Forage Management in the North" by Dale Smith, increases in potassium fertilization on plots fertilized with KCl over a three year period, from 0-1000 lbs of K per acre, significantly increased forage concentrations of K (89% to 3.68%) but significantly decreased the concentrations of total NSC's, N, P, Ca, Mg, S, Na, Cu, Zn and B. In other words, excessive potassium fertilization creates a low energy, low nutrient density forage with more of its protein consisting of NPN instead of amino acids. It will also tend to be high in indigestible lignin and susceptible to leaf hopper, weevil and disease.

All the other trace elements, including zinc, iron, manganese, copper, cobalt, selenium, chromium, and iodine, need to be addressed as well. My talk on the Miracle of Trace Elements in Soil, Plants, Animals and Humans, follows this presentation. **Tables 6 & 7** illustrate that very inexpensive, nutrient dense, and highly available sources of macro and micro nutrients, as well as quality protein and energy, can be obtained from the undomesticated plants. Those who are ignorant of their value refer to them as "weeds". Those who are experienced with their value call them "herbs". The point is that plant diversity supplies not only excellent sources of standard nutritional inputs, but also supplies the too-numerous-to-count phytochemicals that have profound medicinal qualities as well.

It cannot be overemphasized that grass based ruminant meats and dairy products are the foods of the future, here today. The first international congress on the long chain alpha omega 3 fatty acids convened in 1985. The first major papers published on the miracles of conjugated linoleic acid (CLA) appeared in 1996. There is no doubt that the meat and dairy industry is about to hit a stonewall with their insistence of producing meat and milk with confinement operations that feed acidosis producing grains to livestock requiring antibiotics and hormones. The same practices encourage high levels of toxic organisms, such as, clostridium, salmonella and E. coli. Feedlot beef and dairy operations are unable to pro-

Table 6.

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	TABLE 6	ALFALFA	Dandelion	Lamb's Qtr	Chicory	Comfrey	Plantain	Nettle	Burdock	Cleavers	Curly	Yarrow	Purslane
2								Leaf			Dock	(in bloom)	
3	Protein	20.97%	25.00%	31.70%	19.5	23.7	19.6	25.7	29.0	11.7	32.7	15.2	18.6
4	Digestable Protein				14.7	18.5	14.7	20.4	23.5	7.3	26.9	10.7	13.8
5	Soluble Protein				4.7	2.7	2.9	4.3	3.9	1.2	1.6	1.3	5.2
6	Protein Solubility	50.07%	24.40%	18.10%	24.2	11.4	15.0	16.8	13.4	9.9	4.9	8.8	27.7
7	Nitrogen/Sulfur Ratio	11:1	10:1	12:1	8:1	14:1	6:1	4:1	5:1	7:1	15:1	14:1	12:1
8	Acid Detergent Fiber	32.10%	19.20%	15.00%	32.8	29.8	34.1	22.6	25.1	40.6	19.5	34.6	26.4
9	Neutral Detergent Fiber	43.61%	30.00%	21.90%	46.8	42.2	45.8	34.4	36.5	49.1	44.7	43	38.5
10	Relative Feed Value	136.20%	229.00%	329.00%	126	145	127	193	177	108	153	134	165
11	TDN (est.) Total Digestible Nutients	63.89%	80.90%	85.60%	63.5	66.8	64.4	74.5	71.8	57.1	77.8	61.7	72.9
12	ME (mcal/lb)		1.33	1.41	1.04	1.10	1.06	1.22	1.18	0.94	1.28	1.01	1.2
13	Est. Net Energy (therms/cwt)		69.9	74.3	54.0	57.0	54.7	64	61.6	48	67.1	52.2	62.6
14	NE/Lact (mcal/lb)	0.65	0.85	0.9	0.65	0.69	0.66	0.77	0.75	0.58	0.81	0.63	0.76
15	NE/Maint (mcal/lb)		0.895	0.959	0.648	0.697	0.661	0.806	0.768	0.551	0.853	0.62	0.784
16	NE/Gain (mcal/lb)		0.6	0.655	0.383	0.426	0.394	0.523	0.490	0.295	0.564	0.358	0.504
17	Calcium	1.58%	1.04%	1.10%	0.89	2.73	1.84	4.38	2.10	1.3	0.83	0.99	1.3
18	Phosphorous	0.37%	0.33%	0.39%	0.31	0.20	0.26	0.41	0.34	0.39	0.37	0.43	0.38
19	Potassium	2.05%	4.46%	7.66%	3.59	3.94	2.97	3.01	3.28	2.46	3.53	3.25	3.17
20	Magnesium	0.46%	0.26%	0.55%	0.26	0.39	0.17	0.39	0.43	0.25	0.64	0.29	0.8
21	Sodium	759ppm			0.04	0.04	0.011	0.005	0.028	0.014	0.020	0.034	
22	Sulfur - total	0.31%	0.41%	0.43%	0.37	0.27	0.53	0.94	0.90	0.26	0.35	0.17	0.24
23	ppm Iron	171	657	91	195	176	83	349	149	70	111	100	4419
24	ppm Copper	15	15	8	14	29	12	11	26	13	13	17	37
25	ppm Zinc	30	34	46	43	46	44	40	32	127	38	40	265
26	ppm Manganese	23	35	138	36	192	30	36	47	66	36	71	163
27	ppm Boron	50	30	44	28	42	29	67	32	15	31	26	29

Table 7.

TABLE 7	ALFALFA	Day Lily	Day Lily	Echinacea	Wild Grape	Wild Rasp	Willow	Hazlenut	Mulberry	Chinese	Linden	Elder
		Leaf	Blossom	Leaf	Leaf	Leaf	Leaf	Leaf	Leaf	Chstnt Lf	Leaf	Leaf
Protein	20.97%	20.6	23.4	15.7	22.1	15.2	19.8	14.1	26.2	21.8	16.5	24.2
Digestable Protein		15.7	18.3	11.1	17.1	10.6	14.9	9.6	20.9	16.7	11.9	19.0
Soluble Protein		5.4	14.8	1.8	1.2	0.4	1.5	0.7	3.6	14.7	.06	2.5
Protein Solubility	50.07%	26.4	63.0	11.4	5.6	2.8	7.5	4.9	13.7	67.7	3.4	10.4
Nitrogen/Sulfur Ratio	11:1	19:1	20:1	12:1	14:1	16:1	7:1	14:1	17:1	11:1	14:1	12:1
Acid Detergent Fiber	32.10%	28.2	17.0	20	19.5	22.6	24.9	20.2	21.5	41.2	19.8	18.0
Neutral Detergent Fiber	43.01%	35.7	23.5	29.3	34.6	43.1	37.6	42.3	34.2	70.9	35.3	27.4
Relative Feed Value	136.20%	175	299	233	198	154	172	161	197	75	194	255
TDN (est.)	63.89%	70.9	83.4	77.3	77.8	74.5	72	77.1	75.7	54.6	77.5	79.4
ME (mcal/lb)		1.16	1.37	1.27	1.28	1.22	1.18	1.27	1.24	0.9	1.27	1.30
Est. Net Energy (therms/cwt)		60.7	72.2	66.6	67.1	64	61.8	66.4	65.1	45.7	66.8	68.6
NE/Lact (mcal/lb)	0.65	0.74	0.87	0.81	0.81	0.77	0.75	0.8	0.79	0.55	.081	0.83
NE/Maint (mcal/lb)		0.756	0.929	0.845	0.853	0.806	0.771	0.842	0.823	0.513	0.848	0.875
NE Gain (mcal/lb)		0.479	0.629	0.557	0.564	0.523	0.493	0.555	0.538	0.259	0.560	0.583
Calcium	1.58%	0.81	0.39	2.57	1.91	0.85	1.45	1.44	3.09	1.37	2.79	1.72
Phosphorous	0.37%	0.25	0.43	0.25	0.32	0.16	0.23	0.12	0.26	0.2	0.20	0.25
Potassium	2.05%	2.24	2.17	2.22	0.95	1.6	1.71	0.75	1.85	0.84	0.88	1.87
Magnesium	0.46%	0.20	0.17	0.88	0.25	0.29	0.27	0.31	0.34	0.37	0.53	0.23
Sodium	759ppm	0.025	0.05	0.02	0.02	0.01	0.011	0.04	0.016	0.015	0.02	0.03
Sulfur - total	0.31%	0.17	0.19	0.21	0.25	0.15	0.44	0.16	0.24	0.31	0.19	0.31
ppm Iron	171	203	86	131	502	100	117	118	154	120	196	274
ppm Copper	15	10	22	21	16	18	13	19	12	15	19	14
ppm Zinc	30	25	66	32	32	35	105	27	36	61	26	21
ppm Manganese	23	54	40	132	89	210	101	373	63	160	65	48
ppm Boron	50	49	16	66	31	23	34	28	36	72	52	38

duce any of the newly discovered and extensively researched fatty acids that promote brain development, anti-inflammatory benefits, cancer prevention, weight loss, cholesterol reduction, strong immunity, and a host of other attributes. The reason is that the mere feeding of 15% of the ration (on a dry matter basis) nullifies the production of CLA. Herein lies the creation of an unprecedented opportunity for the ecological grass farmer to prosper while healing the land and his community.

Notes:

Session 9

Trace Minerals

Catalysts for Soil Microbes, Plants, Animals and Humans

by Jerry Brunetti

The macro-elements such as calcium, phosphorous, potassium, magnesium, (as well as carbon, oxygen, hydrogen, and nitrogen), etc. are mainly constituents of proteins, cell walls, or mechanical structures. They do play an important role in complex chemical reactions, but the bulk of these elements are present in the form of protoplasm or structural components.

The trace elements (micro-nutrients) do not have important structural components assigned to them. Their primary role is catalytic, which control chemical processes of all organisms, microbes, plants, animal and humans. Without them, important biological reactions may not take place, resulting in abnormal development, or even death.

Table 1 - The elemental composition of a typical plant (dry matter) - From ZELLER (335)

100 g. dry matter contain	1,000 million atoms of dry plant matter contain
45 g. carbon	515,000,000 hydrogen atoms
41 g. oxygen	276,000,000 carbon atoms
7 g. hydrogen	188,000,000 oxygen atoms
2 g. nitrogen	10,000,000 nitrogen atoms
5 g. ash elements	3,760,000 potassium atoms
	1,840,000 calcium atoms
	1,740,000 magnesium atoms
	1,060,000 phosphorus atoms
5 g. ash elements contain	730,000 chlorine atoms
2 g. potassium	580,000 sulphur atoms
1 g. calcium	320,000 sodium atoms
0.6 g. magnesium	340,000 silicon atoms
0.45 g. phosphorus	130,000 iron atoms

***Table 1** illustrates how incredibly minute amounts make up a plant. Only 5% of a total plant's weight consists of the ash elements, i.e. everything except nitrogen, carbon, hydrogen and oxygen. Out of 100 grams of plant weight, 1/100 of a gram contains all the trace elements. Another example is of one billion atoms of dry, plant material, only one atom would be cobalt!*

The definition of a catalyst is a substance, which in minute amounts promote chemical changes without being used itself in the reactions. Most biological reactions are catalytic and the most important catalysts are enzymes. Catalysts speed up reactions that would otherwise take place very slowly. Catalysts allow for the decrease of activation energy required by the cells. So, simply stated, trace minerals are key components to enzymes, which are catalysts that allow the plant/animal to efficiently generate the necessary energy involved in the following processes: respiration, waste removal, nutrient intake, growth, immunity, reproduction, metabolic maintenance, and thousands of other functions which are regulated by the 2000 or more different enzymes present in each cell!

MINERAL RELATIVITY

Soil-Plant Mineral Relationships

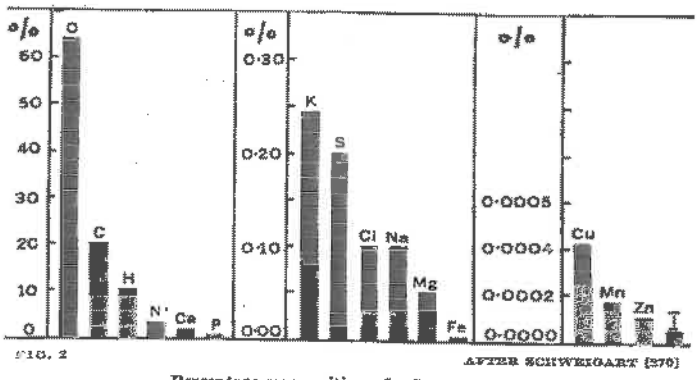


FIG. 2 AFTER SCHWEIGART [370]

Percentage composition of a human being

The concentration of elements in a 70 kg. [154 lb.] human being. Over 98 per cent of the weight is accounted for by oxygen, carbon, hydrogen, nitrogen, calcium, and phosphorus. Other elements, even if present in such low concentrations as iodine, can and do play a most important part in normal life and well-being.

Graph 1 illustrates a similar arrangement in humans, in that over 98% of a 70 Kg human consists of oxygen, carbon, hydrogen, nitrogen, calcium and phosphorous in that order. Needless to say, trace elements are quite powerful in their influence on biological systems to be able to affect so many metabolic pathways with such tiny amounts.

Interestingly, the range of essential elements is larger in soil micro-organisms than in higher plants and animals. This is because a very varied selection of biochemical systems can be found amongst lower organisms and invertebrates compared to higher plants and animals. The range of elements for higher plants and animals is much more constant and consequently there is a remarkable similarity between the metabolic phenomena in plants and animals that has been able to be more researcbed and quantified than with bacteria, algae, fungi, protozoa, and numerous invertebrates.

Table 2

The influence of the presence and absence of certain elements in the substrate upon the growth and nitrate reductase activity of the fungus

Neurospora crassa (Wild type 146). From Nicholas [210]

Element	Growth, % of Normal Mycellum	Nitrate Reductase Activity
+Ca	100	16
--Ca	26	38
+Mg*	100	40
--Mg	20	41
+Fc	100	29
--Fe	0.7	55
+Cu	100	27
--Cu	40	79
+Zn	100	25
--Zn	28	39
±Mn	100	30
--Mn	30	34
+Mo	100	53
--Mo	29	10

*1/100 the concentration of the control.

t Units of enzyme activity expressed as m~ moles NO_2 formed per 10 minutes per mg. protein.

+ = present. Fungus grown on the complete substrate.

An example of major and minor elemental influence upon vegetative growth, as well as enzyme synthesis is illustrated in **Table 2**. In this experiment, mycelial growth of the fungus Neurospora crassa was measured with all the seven elements present as well as after removing one element at a time. Nitrate reductase enzyme was also measured the same way. It is evident that the mere removal of one of the seven elements always impacted measurably both the mycelium growth and the production of nitrate reductase enzyme. However, iron had the largest impact on mycelial growth; molybdenum the largest impact on nitrate reductase enzyme production.

A very critical enzyme for both plants and animals is zinc dependent, carbonic anhydrase. This enzyme converts CO_2 gas into carbonic acid as a raw material for sugar production via photosynthesis. Carbon dioxide is present in very small amounts in the air- approximately 0.03%. Even though the leaf is efficient in absorbing this gas, the conversion to carbonic acid is necessary if the CO_2 gas is to be removed rapidly and utilized in photosynthesis. **Table 3** demonstrates that a zinc deficiency

Table3.

Variation in the carbonic anhydrase activity of normal and zinc deficient oat leaves, at different ages and zinc levels in the leaves. After WOOD & SIBLEY [332].

No of Days After Sowing	Carbonic Anhydrase Activity, Enzyme Units per g. Dry Matter		Zinc Content, in PPM Dry Matter	
	ZINC			ZINC
	CONTROL	DEFICIENT	CONTROL	DEFICIENT
21	104	104	76	76
49	111	110	276	7
91	120	80	119	27
121	81	41	41	11
140	50	34	19	7

Note that the young leaves have adequate supplies of zinc, even if grown on a zinc-deficient substrate. These are derived from reserves in the seeds. It is in the older leaves in which zinc deficiency is observed, as is a decrease in carbonic anhydrase activity.

Table 4.

List of Essential Elements for Higher Plants, Mammals and Man.

*C	Carbon	Major or Macro Elements	C	Carbon
*O	Oxygen		O	Oxygen
H	Hydrogen		H	Hydrogen
N	Nitrogen		N	Nitrogen
P	Phosphorus		P	Phosphorus
K	Potassium		K	Potassium
Ca	Calcium		Ca	Calcium
Mg	Magnesium		Mg	Magnesium
S	Sulphur		S	Sulphur
				Sodium
Fe	Iron	Minor or Micro Elements (Trace Elements)	Fe	Iron
B	Boron		Cl	Chlorine
Cl	Chlorine		Cu	Copper
Cu	Copper		Co	Cobalt
Mn	Manganese		I	Iodine
Mo	Molybdenum		Mn	Manganese
Zn	Zinc		Mo	Molybdenum
			Zn	Zinc
			Se	Selenium
			Cr	Chromium

*These are present in all organic matter.

results in decreased carbonic anhydrase activity. In animals, this enzyme works in reverse, removing high levels of CO_2 from the blood. Otherwise, a larger "lung" would be needed to remove the accumulation of CO_2 waste products.

Trace Mineral Celebrities & Their Functions

The list of essential elements for higher plants, mammals and man is illustrated in **Table 4**.

The division into major and minor elements is quite arbitrary and concentrations vary from species to species. But in this presentation, I will summarize the dozen or so minor elements and their relevance to plant and animal function.

First, here's a few agronomic ground rules on trace elements. For trace mineral applications to be economical and most effective, consider:

1) Sufficiency levels of major and secondary nutrients are addressed

2) Proper pH ranges must exist. Most trace elements are readily available at pHs between 5.0-7.0. Iron and manganese at 5.0-6.5. Molybdenum is most available to plants at a pH of 7.0-8.5.

Table 5.

Relationships between low levels of certain trace elements and enhanced susceptibility to infection in cultivated plants.

ELEMENT	HOST	INFECTING ORGANISM
Boron	Barley	Mildew, *Erysiphe graminis* D.C.
	Wheat	Rust, *Puccinia triticana* Rust, *Puccinia glumarum*
	Sunflower	Mildew, *Erysiphe cichoracearuni**
	Beet	Mildew, *Phoma betae*
	Cauliflower	Mildew, *Botrytis* sp.
	Flax	Mildew, Bacterial infection
Copper	Wheat	Rust, *Puccinia triticana*
Manganese	Oats	Bacterial Infection
Molybdenum	Lucerne Lettuce	Lowers resistance to infection in general
Zinc	Rubber	*Oidium hevae* *Phytophthora* sp.

*Sunflower infection by mildew is used as an indicator of boron deficiency in the U.S.A. [57].

3) Necessary plant requirement levels are applied. If one can't afford to meet the soil requirements, apply to the soil what can be afforded and supplement the remainder via foliar fertilization.

4) Avoid excessive fertilizing practices, which include over-liming and especially excess nitrogen, potash and phosphate.

Table 5 illustrates how trace mineral deficiency causes plants to be susceptible to various fungal and bacterial diseases. It raises the fundamental question: are plants universally vulnerable to diseases at random, or are they really suffering from a nutritionally deficient induced immune failure? Likewise, **Table 6** demonstrates that trace elements plus magnesium don't alter the nitrogen content of lucerne.

Table 6.

The influence of trace-element fertilization of the soil on the nitrogen, Tryptophane, and Methionine content of Lucerne and the average weight gains of rabbits fed on it.

From KOEHLER AND ALBRECUT [155]

Soil Treatment	N,%	Trypto-phane mg/g	Methio-nine	Avg Gain in Weight of Rabbits
None	3.12	1.86	4.57	740
Mg alone	3.20	—	—	744
T.E. alone	3.19	—	4.20	699
Mg & T.E.	3.05	2.52	5.44	849

The application of magnesium (Mg) or of trace elements (T.E.) either separately or together to the soil does not alter the nitrogen content of lucerne appreciably, but the application of the two together markedly enhances the food value, as can be seen from the gain in weight of the rabbits. The content of the essential amino acids tryptophane and methionine is also significantly increased by the fertilizer treatment. The trace elements used were manganese, copper, boron, zinc, and cobalt.

However, the quality of that protein has been altered significantly in that the levels of two essential amino acids are measurably higher. The consequence of feeding this additional protein quality (as amino acids vs. non protein nitrogen, or NPN) to rabbits is likewise dramatic, as reflected in the comparative weight gains of all groups.

ZINC FOR CROPS (CATION)

Zinc could be called the energy micro-nutrient because it's essential for phosphorous uptake, which is needed to produce the energy molecules Adenosine di/triphosphate (ADP & ATP). It regulates plant sugar use and the transformation of carbohydrates. Zinc is critical for the uptake of moisture, so consider it to be the drought protection trace mineral. Zinc is also critical for soil organisms, especially Azotobacter, a non-symbiotic nitrogen-fixing microbe.

ZINC FOR ANIMALS/HUMANS

Zinc is essential to cell growth and replication, sexual maturity, fertility and reproduction. It works with vitamin A for proper vision and is very important in the healing of wounds and burns. The immune system, the natural killer cells especially, require zinc. The thymus gland, the master gland of

the immune system, utilizes zinc to produce hormones. The brain and central nervous system require zinc for almost every enzymatic reaction. It is a component of over 200 different enzymes!

Zinc absorption can be inhibited by excessive intake of iron, copper, manganese and calcium and phytates (phytic acid) found in grains. The diet requires adequate levels of Vitamin A and B Complex for optimum absorption. Optimum daily intake for humans (adults) is 15-20 mg/day! Cattle intake range is 50-100 ppm. Good sources for humans include beef, shellfish, cheese, and dark leafy greens.

COPPER FOR CROPS (CATION)

As zinc could be classified as the energy trace mineral, copper could be considered the protein micro-nutrient. Copper increases the uptake of the ammonium (NH_4) form of nitrogen, a better raw material for making protein. It is essential for chlorophyll production, sugar synthesis and root metabolism. It increases stalk strength and elasticity as well as provides protection against fungal attack.

Table 7.

The influence of copper upon the ascorbic acid and carotene content of green barley. After LUCAS [175]

	ASCORBIC ACID, MG./100 G.		CAROTENE, MG./100 G.	
No treatment	29.2		4.00	
10 lb. $CuSO_4$ per acre		45.1		5.40
100 lb. $CuSO_4$ per acre	46.5		6.60	

Increasing copper applications result in appreciable increases of both ascorbic acid (vitamin C) and of carotene (pro-vitamin A) in barley.

Table 7 is interesting in that it clearly demonstrates that trace minerals like copper can increase vitamin levels in plant. In this case, both Vitamin C and Vitamin A have been significantly enhances in green barley grass. Anti-oxidant vitamins such as Vitamins C and A not only provide benefits to animals such as improving immunity. University of Wisconsin research suggests they also protect plants from insect and fungal attack. Ideal soil levels are 2-5 ppm (4-10 lbs/acre) and excessive levels of nitrogen, phosphorous and zinc and molybdenum are antagonists.

COPPER FOR ANIMALS/HUMANS

Copper is critical for the transportation of iron in the blood and in the formation of hemoglobin, the part of red blood cells that carry oxygen to every cell. Copper is an anti-oxidant, a co-factor in the powerful enzyme, super oxide disutase (SOD), a major free radical scavenger. Copper is critical in proper formation of the myelin sheath that surrounds and protects nerve cells. Copper is associated with elastin, a connective tissue that gives elasticity to blood vessels, lungs and skin. Two important enzymes, catalase and tyrosinase, consists of copper. Catalase scavenges excess hydrogen peroxide in the system, a free radical. Tyrosinase is an enzyme that makes up the whole Vitamin C complex. Copper absorption can be impaired by excessive zinc phytates (grains), iron and molybdenum. Ruminant levels range from 25-100 ppm of the ration. Optimum daily intake for human adults is 2-4 mg/day. Foods rich in copper are organ meats, shellfish, legumes, nuts and mushrooms.

MANGANESE FOR CROPS (CATION)

Manganese is required for the assimilation of nitrogen as well as carbon dioxide. It works with copper and potassium for stalk strength and is required for the uptake of iron. It is absolutely essential for the germination of seeds. Ideal levels are 25-40 ppm (50-80 lbs/acre). Soils low in sulfur or those that have a combined potassium/sodium base saturation in excess of 10% will discourage manganese uptake.

MANGANESE FOR ANIMALS/HUMANS

Found in the mitochondria of the cells, manganese is a key component of energy metabolism. It is a component of many enzymes, including SOD, the body's natural anti-inflammatory and free radical scavenger. Manganese is critical to the formation of cartilage as well as playing a role in the synthesis of neurotransmitters. Deficiencies on manganese may lead to infertility as well.

Table 8.

The relationship between the fertility of cows and the manganse content of their hair. From MEYER AND ENGELBERTZ [188]

Manganese Content of Hair, ppm	Insemination Index	Number of Inseminations	Number of Cows in Gestation	Gestation Percentag
Less than 10	1.71	103	53	51.6
10 - 20	1.56	282	144	62.2
More than 20	2.00	108	50	46.3

*The number of inseminations for one live birth. 351 cows were studied, with an average hair content of 15.8 ppm manganese and a range of 3.9 - 49.9 ppm Mn.

The administration of oral manganese resulted in a rapid rise in the manganese content of the hair. When it was stopped, the manganese level of the hair dropped to its original level in eight weeks.

A manganese content of more than 20 ppm or less than 10 ppm in the hair indicates a decrease in fertility.

Table 8 shows the relationship of bovine fertility and manganese content of the hair. Manganese levels between 10-20 ppm showed the highest levels of conception. High levels of iron, copper, zinc, magnesium, calcium and refined carbohydrates may impair the availability of manganese. Food for humans, rich in manganese include nuts and whole grains (especially the germ) as well as black tea. Ruminant levels range from 75-200 ppm of the ration.

BORON FOR CROPS (ANION)

Boron is a critical regulator of cell division, especially the tips of roots, buds and leaves. It is required for the translocation of sugar and releases cations from the soil, especially calcium, magnesium and potassium. Boron governs salt absorption, water use and nitrogen uptake. Ideal soil lev-

els are 1-2 ppm (2-4 lbs/acre). Boron should not be applied to calcium deficient soils, and at a maximum amount of 2 lbs of boron/acre.

BORON FOR ANIMALS/HUMANS

Boron in animals works by increasing calcium absorption by influencing the parathyroid hormone (PTH), which regulates the calcium to phosphorous ratio. Additionally it helps convert vitamin D into its active form facilitating absorption of calcium from the intestines. This trace mineral also maintains magnesium levels in the body and helps to maintain levels of two hormones, testosterone and estrogen. Optimum daily intake for humans is 3 mg. Foods rich in boron are fruits, legumes and nuts. Ruminant levels range from 25-50 ppm in the ration. Boron availability in legumes allows them to synthesize better quality protein, higher in amino acids like tryptophane.

Table 9.

Potential crop improvements in Waitiki County, New Zealand, by the use of molybdenum fertilisers. From LOBB [170]

CROP AND SOIL	CONTROL, NO MOLYBDENUM	YIELDS WITH MOLYBDENUM	INCREASE %
Lucerne on sandstone soil	3,060	13,920	355
Lucerne on clay soil	13,664	19,488	43
Rape on sandstone soil	7,616	53,536	603
Rape on clay soil	8,288	14,784	78
Pasture on clay soil:			
a	3,300	6,233	89
b	2,038	9,357	359
c	3,561	17,450	390
d	995	1,505	51
e	4,968	7,028	44
f	2,080	2,868	38
g	13,700	20,500	50
h	12,200	18,800	54

Crop yields are given in lb/acre green matter. Dosage of molybdenum used not given.
All the soils and crops treated gave a marked response to molybdenum.
Both clay and sandstone soils gave crop increases of over 300 per cent.

IRON FOR CROPS (CATION)

The second most abundant mineral in soils is iron and ranges from 20,000-200,000 lbs/acre. Iron has been long recognized as essential and associated with the function of chlorophyll, but isn't actually a part of the chlorophyll molecule. It fixes magnesium to the chloroplast. Iron should always be higher than manganese in soils. The best way to mobilize iron into plants is to have adequate sulfur. Foliar feeding of iron can provide supplemental amounts to prevent iron-associated chlorosis. Cold soils and small root systems can hinder the uptake of iron. So, keep an eye on compacted and water logged soils.

IRON IN ANIMALS/HUMANS (CATION)

Approximately 66% of the body's iron is contained in the hemoglobin. The rest is stored in the liver, spleen and bone marrow as ferritin to make additional hemoglobin when needed. Hemoglobin carries oxygen from the lungs to all the cells and transports CO_2 from the cells back to the lungs. Iron is also used by the liver for detoxification and is used by the immune system to fight pathogens. It is a constituent of many enzymes and proteins, including the synthesis of DNA.

Optimum daily intake of iron for human adults is 20 mg and is best derived from animal sources (heme iron) which is 10 time more available than non heme iron. These include beef liver and tuna. High phosphates, phytates and tannins inhibit iron absorption. Ideal range for iron in ruminant rations is 100-200 ppm.

MOLYBDENUM IN PLANTS (ANION)

This trace mineral is essential, especially for rhizobia bacteria on legumes, which produce the enzyme nitrogenase, which converts atmospheric nitrogen (N_2) to nitrate nitrogen (NO_3). Additionally, all plants use molybdenum, via the enzyme nitrate reductase to convert nitrate (NO_3) to nitrite (NO_2) in order to make true protein in the plant. **Table 9** illustrates that merely providing molybdenum alone to deficient soils increased yields of Lucerne, rape and pasture from 34-603%! High molybdenum levels are antagonistic to copper, however, and this must be watched. Ideal soil levels are 1ppm (2lbs/acre).

MOLYBDENUN FOR ANIMALS/HUMANS

The primary benefit of this trace element appears to be its role in the detoxification of several substances, namely alcohol and sulfites. It prevents the formation of carcinogenic nitrosamines. Optimum daily intake for human adults is 150-200 micrograms daily. Food sources richest in molybdenum are lamb, barley, lentils, squash, green beans and carrots. The level in a ruminant ration should be below 5 ppm.

ANIMALS ONLY: PLANTS KNOCK BEFORE ENTERING

IODINE (ANION)*

The thyroid and ovaries are the richest sources of iodine. **Table 10** illustrates the importance of iodine to hatchability of eggs and the accumulative nature of eggs to increase iodine levels in the yolk. Iodine is associated with the synthesis of thyroxine and diiodotyrosine, which control energy metabolism, body temperature, growth and immune function. Foods highest in iodine are seafoods in general, and eggs from free range hens. The family of brassicas, soy, cannola and peanuts are high in goitrogenic compounds, which suppress iodine uptake unless they are first cooked (or fermented). Optimum daily intake is 200 mcg. Iodine influences the metabolism of Vitamin A. A thyroid gland deficient in Vitamin A affects thyroid hormone output. Iodine, in the ration of ruminant, ranges from 0.5-2.0 ppm.

Table 10.

Iodine deficiency as a factor in determining the length of incubation and hatchability of hen eggs. From ROGLER, PARKER, ANDREWS, and CARRICK [246]

	CONTROL	IODINE DEFICIENT
Total number of fertile eggs	106	110
Total number of dead embryos	16	65
Chickens hatched on:		
21st day	90	0
22nd day		4
23rd day		9
24th day		14
25th day		11
26th day		6
TOTAL	90	44

COBALT (CATION)**

Cobalt is actually a component of the vital, essential vitamin B-12, which is readily synthesized by rumen organisms. Vitamin B-12 is the cure for pernicious anemia and is quite essential to bone marrow synthesis, the nervous system, amino-acid synthesis and is also part of the enzyme involved with the production of anti-oxidants. Fertility, cellular longevity, absorption of nutrients and the metabolism of fats and carbohydrates are influenced by cobalt. (Ketosis may be partially the result of B-12 deficiency; the incidence of Johne's increases with a cobalt/B-12 deficiency).

Human adults require 1 microgram of cobalt per day (as a component of B-12). Ruminants require a range from 0.10-1.0 ppm in their ration.

* Iodine benefits plants by stimulating specific non-symbiotic nitrogen fixing bacteria in the soil.

** Plants benefit from cobalt in that nitrogen-fixing bacteria utilize cobalt for their growth and maintenance.

SELENIUM (ANION)*

This trace mineral is the mineral of protection. It's a key component in the enzyme glutathione peroxidase, which is a powerful free radical scavenger, immune builder, and detoxifier. It also is involved in the conversion of the thyroid hormone T4 into the metabolically active form, T3, and is able to bind heavy metals. Optimum daily intake for human adults is 250-300 mcg/day. Human food sources are seafood, Brazil nuts, brewer's yeast, butter, garlic, kelp, and molasses. In ruminants, the ration should contain 1.0-3.0 ppm. Fertilizing pasture appears to be economical and effective. Apply only 10 grams of selenium/acre/year. (60 grams/acre/year produces toxic forage). Use selenate rather than selenite.

CHROMIUM (ANION)

This trace element is vital to the function of insulin, which is required by cells for glucose uptake. Chromium also has an active role in the metabolism of fats and carbohydrates and appears to be associated with the structural integrity of DNA and RNA. Chromium appears to have a strong positive influence on blood cholesterol levels and a deficiency is strongly implicated in arteriosclerosis. Due to high intakes of refined carbohydrates, 90% of the US population is deficient, which causes impaired glucose intolerance leading to diabetes.Optimum daily intake for human adults is 300 mcg. Brewer's yeast, unrefined sugar, molasses and germs of cereals are good sources of chromium. Ruminants should have approximately 0.5-3.0 ppm of chromium in the diet. Chromium appears to improve the immune response, decreases the incidence of ketosis, and improves growth rates and milk yields.

Randleigh Farms mineral ration (Table 11) is an excellent example of a balanced and complete ration, full of the minerals just discussed.

* Apparently selenium absorbed by plants provides resistance to insect attack

Notes:

Session 12

My Battle with Cancer

Fighting Cancer without Chemo

Jerry Brunetti

About three years ago, eco-consultant Jerry Brunetti received word that without aggressive chemotherapy treatment he would be dead in as little as 6 months from lymphoma. He opted not to travel that route, and instead has embarked on his own journey seeking advice, treatments, alternative protocols, and hands-on care from a wide variety of sources. The result has been depth of understanding that is almost beyond compare, steady improvement in his own overall health, and a marked reduction in the size of the affected lymph nodes. Oh, and he's still alive. We asked Jerry Brunetti to expand upon his remarkable speech on the subject of cancer, natural treatments, and his own health that he presented at the 2001 ACRES U.S.A. Conference. His story will serve as inspiration and education for readers worldwide who are touched by cancer, either themselves or in a friend or loved one.

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A VOICE FOR ECO-AGRICULTURE

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ACRES U.S.A. Our subject is human health. So many biologically correct farmers do everything right for their soil, but ignore their own personal health.

BRUNETTI It's a problem that's too disconcerting for most people. It is interesting to me that many farmers who understand how a whole farm system includes understanding the laws of nature on that farm - whether it is their soils, forages or animals - lose track of all they know of those laws as soon as they get a death sentence from their doctor. Suddenly all bets are off, and they completely cave in to the medical establishment's way of thinking.

ACRES U.S.A. Why do we have this terrible reluctance to take our personal health into our own hands?

BRUNETTI I think the successful marketing of fear by government agencies and the pharmaceutical industry has convinced us that disease is far too complex and mysterious an issue for the average person to reconcile. When you are emotionally motivated, you do not necessarily always make the best decisions. Many farmers whom I have worked with in the last 20 years made the transition cows and the crops did not go away, and over the years the frustration increased to the point where somebody finally said, "Maybe I ought to look at some other ways of doing this." You take a portion of your farm, make some changes and, lo and behold, you see that you are getting the kinds of positive responses that the forgiveness of nature can give you. When you are dealing with a health issue and the clock is ticking and some high priest physician is telling you that you've got six months or a year, the panic button is very close at hand. You just hope for the best and hope that this guy bas your best interest at heart. Then, of course, you have the amalgamation of medicine with the insurance industry, so who is going to pay these outrageous fees that are supposed to save your life?

ACRES U.S.A. You have personally had some experience in dealing with this problem, haven't you?

BRUNETTI I was diagnosed with lymphoma about three years ago, and this diagnosis came about quito inadvertently. I bad been in a car accident that caused a backache. After three or four months of not being able to get rid of the pain, I had an MRI done. The MRI showed that I had a couple of bulged disks that were causing the discomfort, but it also showed that I had some enlarged lymph nodes in my abdomen. I had a subsequent CAT scan, which verified that I had a bigh probability of non-Hodgkin's lymphoma, the type of which could be confirmed through a biopsy. I held off getting a biopsy because I am not a fan of surgery, but I eventually did get it - at the urging of a physician I work with - to confirm the type of non-Hodgkin's lymphoma that I had. By the time I received verification, I had already decided that I was going to take things into my own hands.

ACRES U.S.A. What did you do first?

BRUNETTI The first thing I did was research. I went to the Lymphoma and Leukemia Society to find out just what kinds of survivability rates exist within the conventional model. What I saw there was not very encouraging. They were talking about 37 percent survivability rates within five years. Of course, the five-year benchmark is what they attribute to their success story. If you survive five years after conventional cancer treatment, you are a success story, even if you die six months later. I did not know how many people survived 10 years, but I am sure it was less than that. I decided that if I was going to have a chance at this thing, I certainly wasn't going to work with odds of around one in three.

ACRES U.S.A. But you did go to the doctors to get the odds?

BRUNETTI I went to nine physicians, and two of them were conventional oncologists. I did spend a lot of time talking to a lot of people.

ACRES U.S.A. Tell us, blow by blow, how did that go?

BRUNETTI Some of the people I first went to were the conventional oncologists. Basically they said I had to do what they knew how to do, which was chemotherapy, and I had to do it immediately. These doctors told me that if I didn't respond to their advice, I had a life expectancy of anywhere from six months to two years. I was taken aback by that, and I think that is where people usually cave in. When you hear that death sentence, it is like a punch in the gut, because you don't have any experience with it, whereas this

man you are talking to allegedly has loads of experience. It is pretty hard not to take his words at face value. I pressed the issue and said that I wanted to see what they were going to administer. They told me they were going to administer two drugs, called MOP and CHOP, acronyms that I found amusing in and of themselves. I was interested in what these drugs were, since I had never heard of them. I did find out that the "P" in both of the acronyms represents prednisone - there is so much inflammation caused by the other drugs in the cocktail that they have to give good doses of prednisone to keep the inflammation down.

Important Foods to Eat

1. Raw (grass-fed) dairy products which are rich in CLA, alkalizing minerals (Ca, Mg, K) critical Vitamin D, beneficial probiotics, numerous enzymes, vitamins A, E, K, and B Vita-mins.

2. Free-range eggs, which are rich in fat-soluble vitamins A, D, E, K, cysteine and other amino acids, lecithin (phospholip-ids).

3. Cod liver oil, which is a rich source of vitamins A, D, E and K and some EPA/DHA.

4. Coconut oil, which is rich in medium-chain, saturated fatty acids as found in human breast milk. Very anti-fungal, anti-viral, anti-bacterial. Readily absorbed, easily processed by the liver.

5. Fermented soy products such as miso and tempeh (avoid processed soy products, soy-based supplements).

6. Fermented vegetables (raw) such as sauerkraut, kim-chi which contain powerful anticarcinogenic compounds, lactic acid, lactic bacteria, enzymes.

7. Fermented milk products: kefir, yogurt, clabbered milk, buttermilk.

8. Raw butter/cream from grass-fed ruminants: rich in CLA, fat-soluble vitamins A, D, E and K, Wulzen factor (anti-inflam-matory).

9. Sprouted-grain products: rendered free of phytates, enzyme inhibitors; rich in enzymes and additional vitamins.

10. Pigment-rich fruits containing resevetrol, astazanthins, lutein, lycopene, proanthocyanidins, bioflavonoids, flavenols, ascorbic acid, etc.: elderberries, raspberries, prune-type plums, cherries, etc.

11. Sea vegetables and ocean fish rich in EPA/DHA, such as sardines (watch mercury in large fish), wild (not farmed!) salmon, sea vegetables rich in algevates, which are metal decontaminants, iodine, numerous trace minerals, mucopolysac-charides.

12. Vegetables: brassica (especially kale, brussels sprouts), also broccoli, asparagus, garlic and onions, winter squashes, carrots, beets, sweet potatoes, and miscellaneous greens such as raddichio, arugula, mustard greens, endive, dandelion, radish, celery, etc.

13. Meats (pork, poultry, beef, lamb) should be range fed and drug free. If your pH levels are low, eat small amounts until they rise.

14. Tropical fruits (for enzymes!) - pineapple, mango, papaya, jack fruit, lychee, guava, coconut, etc.

15. Pure water: up to half your body weight in ounces. Consider alkaline and energized waters.

ACRES U.S.A. And you thought these were unsafe drugs?

BRUNETTI I asked the doctors for material safety data sheets (MSDS), a kind of OSHA requirement in the workplace. If someone is working with or shipping a hazardous material, these information sheets tell you whether there are any hazards to exposure, inhalation, skin irritation, eye irritation, GI-tract toxicity, etc. They are kind of like the LD50 analogs for poisons. I wanted to look at the MSDS sheets as well as the Physician's Desk Reference (PDR) explanations of these drugs. When I read the materials, I found out that these drugs were quite cytotoxic - bone marrow was susceptible, kidney tissue, liver tissue - and they could cause anaphylactic shock. Right then and there I was turned off. I asked the physician what alternatives were being looked at, and, of course, there weren't any. I had, at that visit, brought along a dossier of peer-reviewed research using alternative compounds made from plant extracts, nutraceuticals and so forth.

ACRES U.S.A. You brought papers from the professional literature?

BRUNETTI Yes. The only reason I brought it along was because I knew these physicians would not be inclined to look at anything that was not in the professional literature. Nevertheless, they had no interest in looking at peer-reviewed research on alternative treatments. In fact, they advised me that I ought to be a bit concerned about using things like herbs because they are dangerous.

ACRES U.S.A. Herbs are dangerous, and they are feeding you things like prednisone?

BRUNETTI Right. I told them that I found their comment quite interesting, humorous and even paradoxical, since they just gave me a MSDS sheet and a PDR reference that showed that the drugs they so enthusiastically wanted to administer to me were dangerous. There was also the fact that, if I did take this medication, I would have to sign an indemnification re-lease holding the hospital as well as the administers of these drugs harmless if something happened to me. At any rate, the first oncologist gave me that information. The second oncologist was even more grave and stern and indicated that I was taking a very, very big risk in not getting on the protocol as soon as possible.

ACRES U.S.A. You decided to take that risk and give yourself a chance by dealing with your own immune system. Is that what you are saying?

BRUNETTI Yes. Since all cancer patients have a compromised immune system, and, in my case, non-Hodgkin's lymphoma is a cancer that actually attacks the immune system, I realized that if I was going to have any logical solution to getting well, it was going to be based on my immune system coming back to life. I started pursuing avenues of research to find out which substances, foods and lifestyle changes would augment bringing my immune system back to normal.

ACRES U.S.A. What is shutting down the immune systems of so many people these days?

BRUNETTI That is a big question. I think there are a number of reasons - for instance, look how sick the Earth itself is from pollution, destruction of habitats, toxic dumping, all of the negative

ways we humans have left our mark. We are organisms of the Earth; if the Earth is sick, then we will be sick. The state of the human body, obviously, is a prime reason for immune system failure. First of all, one needs to know the levels and activity of natural killer cells in the body, the cells which defend the body against invasion by disease. The activity of these cells is measured through a determinant called lytic units, which is a measure of the natural killer cells' ability to recognize and then attack cancer cells. Optimum lytic units would measure above 225 in an individual. Lytic units for the average American measure somewhere between 25 and 50, right around 200 points below the optimum level. My own measurement for lytic units was detected at 75, which puts me in the "fair" range, not best and not good. I have to continually work on my immune system even though I am above the U.S. average, especially because the cancer I have targets my immune system.

ACRES U.S.A. So our immune systems have lost the ability to fight these diseases?

BRUNETTI There is a medical doctor by the name of Jesse Stoff who has written a couple of books - one on chronic fatigue syndrome and another on prostate cancer - and he has an acronym that I think sums up the immune system problem pretty comprehensively. It is called the PITTS. Those initials stand for the following: P for poor nutrition; I represents infection; the first T represents toxins of any kind; the second T represents trauma, which he defines as exposure to radiation; and the S stands for stress, which is a very generic, all-encompassing word that everybody can find their own personal definitions for. When I looked at that acronym, I started realizing where those particular components contributed to my health having a major compromise. Poor nutrition - although I did at least get good home-prepared food, a Mediterranean type of diet in an Italian-American family, I probably ate as many sweets and drank as many soft drinks as the next kid growing up in the '50s and '60s. I was exposed to a lot of American junk food, as kids are.

ACRES U.S.A. Do you mean Wendy's and McDonald's types of food?

BRUNETTI Not so much that because those things showed up later - it was more the sweets. Refined sugar is one of the things that feeds tumors. As far as an infection, I had immunological compromising procedures done to me when I was very young. I think I had a reaction from a vaccination when I was quite young that caused an intestinal complication called intussusception of the intestine, and I had surgery to correct that. When they did the surgery, they did me the so-called favor of removing my appendix. About nine months later I ended up having an inflamed lymph ganglion in my groin, so they surgically removed that. Then nine months or a year after that, I had blown tonsils, and they removed those. By the time I was four, I had already had a lot of invasive surgery that attacked my lymph system.

ACRES U.S.A. You may have been harboring a low-level infection ever since.

BRUNETTI Maybe. Every winter I would have to get penicillin shots to deal with strep-throat infections. Then, in 1980 I had a scar tissue accumulation that led to more surgery. They think the scar tissue was an accumulation from all of those childhood operations. There was a lot of medical history here. Then, in 1998, I got hit with Lyme disease, and again in 1999, and that brings us to the time of my diagnosis.

ACRES U.S.A. What did you do for Lyme?

BRUNETTI In the beginning it was my acupuncturist who diagnosed it. I had these symptoms of high fever and very severe headaches, and she thought I had Lyme disease and advised me to see my regular physician and get the conventional treatment, which is an antibiotic. The doctors insisted it wasn't Lyme disease - they misdiagnosed it. The disease progressed to the point where I had a very strong inflammation and ended up in the hospital because nobody knew what I had - they thought I had septicemia or cellulitis. After a few days in the hospital, getting nuked with these really powerful antibiotics - none of which were doing me any good - an infectious disease specialist came in and looked at me. The specialist told me that I had a classic textbook case of Lyme disease, and that none of the medication I was receiving was doing me any good. He prescribed an antibiotic that did work, and I responded to that. But in the meantime, my digestive system was so devastated by the drugs that I had to go out in my own garden and make an herbal porridge to restore a comfort zone.

ACRES U.S.A. That is from the toxicity of the drugs they gave you?

BRUNETTI There was so much irritation and trauma. I had an extremely high titer of Lyme. The level of Lyme that showed up in the urine antigen test was a number over 300, and a positive is 45. The physician who got the report called me up and asked me how I was feeling after I had recovered from the symptoms. He told me that he was concerned because he had never seen a Lyme titer as high as mine, and he had seen thousands of them. I was interested in hearing that, because obviously my immune system recovered from Lyme. I was also interested because lymphoma seems to have

Important Foods to Avoid

1. Sugar: Feeds cancer cells and causes insulin production, which stimulates cancer growth. Demineralizes and acidifies the body fluids. This also includes refined carbohydrates.

2. Vegetable oils: easily oxidized, causing peroxidized lipids (carcinogenic); especially avoid hydrogenated oils (trans-fatty acids). Exception: Raw, first-expeller-pressed olive oil, which is rich in chlorophyll and squalene.

3. Processed dairy foods and conventionally raised meats - they lack CLA, but are likely to contain hormones, antibiotics, E. coli, salmonella, camphylobacter, etc.

4. Too many carbohydrates, even from whole grains (high in phytates, which inhibit mineral absorption and enzyme activity). Soak and/or sprout grains before eating.

5. Refined soy foods.

6. Fluorine, chlorine: enzyme inhibitors, carcinogens that suppress iodine uptake by thyroid.

7. Pesticide-laden produce: especially potatoes, apples, coffee, bananas, celery, onions, etc.

8. All processed (canned/frozen) foods as much as possible, including organic processed foods. These foods are "dead."

9. Foods containing artificial colors - very carcinogenic.

10. Microwave and barbecued foods.

a smoking-gun association with viral infections. There was a physician in Africa by the name of Denis Parsons Burkitt who did research and biopsies on many lymph nodes of lymphoma patients, and in close to 100 percent of the cases he found viral-herpes-family viruses in those lymph nodes. There does seem to be an association with the herpes family and the Epstein-Barr family, although I have never had any active herpes symptoms such as shingles, fever sores, or anything like that, but when I had the blood test done I did show presence for Herpes VII.

ACRES U.S.A. If you are not availing yourself of the armamentarium that the medical profession has, what are you doing?

BRUNETTI I am doing several things. I take supplements. It is important to know when using supplements that there are two necessary types, which can be called "immune fuels" and "immune modulators." The immune fuels nourish the immune system and include things such as selenium, Co-enzyme Q10, glutathione, etc.

Supplement Arsenal

1. AIE-10: Antigen-infused colostrum whey extract (from cows hyperimmunized with human vaccine). Enhances natural killer cell activity, T-4 and T-8 cell function.

2. Thymic fraction A: Provides thymic hormone sublingually, which increases T-4 cell function, which in turn orchestrates activity of the immune cascade.

3. Low-dose Naltrexone: Prescription medication taken at bedtime to improve endorphin release, which increases NK cell levels and possible apoptosis.

4. LARIX (LARCH) arabinogalactan: macrophage activator.

5. Astragalus extract: macrophage activator.

6. Shitake extract: macrophage activator.

7. Chelated selenium: 1,200 mcg/day. Take this high dosage only if iodine supplementation is provided; precursor to glu-tathione peroxidase.

8. Iodine: Necessary for thyroid function and white cell phagocytosis (paint tincture of iodine on skin daily).

9. Vitamin D (cholecalciferol): 20,000 IUs/day. Check saliva/urine pH to monitor intake. Make sure vitamin D is primarily obtained from foods and U.V. light. Vitamin D ionizes calcium, which is needed to regulate inner and outer cellular pH. Alkaline pHs are oxygenated; acidic pHs are anaerobic (favorable to cancer growth).

10. Enzymes: Both food-derived and pancreatic enzymes with meals: Food-derived enzymes (high in protease) between meals. This is very important!

11. Fish oils rich in EPA/DHA fatty acids. Anti-inflammatory prostaglandins.

12. Vitamin A: 100,000 IU/day. From fish oil, palmitate and natural carotenoids.

13. Co-enzyme Q-10: 400 mg/day. Very important antioxidant, immune enhancer.

14. Other antioxidants: Lutein, bilberry, grapeseed, vitamin E (800 IU), vitamin C (4-6 grams), astazanthin, green tea, carnitine.

The immune modulators provide nourishment to molecules engaged in cellular communication within the immune system. I hooked up with a physician in New York City by the name of Dr. Bernard Bihari, who specializes in HIV and cancer patients. He is working on a medication, a pharmaceutical drug that I am taking, called low-dose naltrex-one <www.lowdosenaltrex one.org>. It was a medication developed for heroin addicts because, when given at high doses (around 50 milligrams per day) it inhibited the endorphin cascade, thus blocking the intoxicating effects of heroin. It did not go over well because it caused sleeplessness and anxiety. But there was a researcher at Hershey Medical Center, Dr. Ian Zagon, who actually was doing research on laboratory animals and finding out whether or not this medication, taken at low doses, would have a paradoxical effect. In other words, would it raise endorphin levels?

ACRES U.S.A. What effect would that have on the body?

BRUNETTI The importance of impacting the endorphin cascade is that when the endorphin levels rise, the natural killer cell levels also rise. The other thing that happens is that endorphins migrate to what is known as opiate-receptor sites. Some tissues in the body, such as the prostate, pancreas, testes and lymphatic tissue, are very rich in these opiate-receptor sites. These endorphins are released by the brain as you sleep, and they migrate to the opiate-receptor sites. If you have a cancer that grows out of tissue rich in these sites, then the cancer tissue itself is also rich in opiate-receptor sites, and these endorphins lock in to the sites and shut off cell division. So you have two things going on: you are raising endorphins, and you are creating a phenomenon known in the cancer industry as apoptosis, the shutting down of cancer-cell division. That is what you want to do with cancer: you basically want to shut the cells off.

ACRES U.S.A. Isn't it true that if you keep the alkalinity up to a certain level, then the cancer cannot progress?

BRUNETTI There seems to be very strong support for the idea that cellular and intracellular pHs have an optimum range, based on the fact that pH inside of the cell is ideally around 6.75, while that of the fluids surrounding the cell is around 7.4 - slightly acidic inside and slightly alkaline outside. This acid/alkaline differential creates a positive and negative charge - a battery.

ACRES U.S.A. In other words, we are talking about the cell now, and the cell is basically electrical?

BRUNETTI That is correct. When you have that optimum differential, you create about 70 millivolts of electricity, which dictates the opening and closing of the permeable membrane of the cell, so that waste can get out and the proper nutrients can get in. Since we are talking about an intracellular pH of 7.4, which is alkaline, we need to be focused on alkalinity. The question you have to look at is what are the ideal ways to alkalize the body? One of the best ways is to make sure that calcium becomes ionized. How do you ionize calcium? You need a good calcium-rich diet, and that is why I am a big proponent of leafy greens that are high in calcium, like kale, but also raw, grass-fed, organic types of dairy products. Not only do they carry the calcium and other minerals, like magnesium, but they are also a rich source of the ionizing agent known as vitamin D.

ACRES U.S.A. Don't all of the minerals figure very heavily in this equation? For instance, you need molybdenum to take the waste out. We are so short of minerals in our soil systems and diets that it is a wonder anybody even functions today.

BRUNETTI That's it. There are huge mineral deficiencies, and all of these minerals, of course, are co-factors. They also represent the essence of the enzyme systems. All enzymes, without exception, are built on the presence of micronutrients.

ACRES U.S.A. Trace-mineral keys.

BRUNETTI You need the micronutrients, and then you need the alkalizing. Interestingly enough, although calcium receives the most attention, it is not really more important than zinc or copper - it is, however, used by the body in greater quantities, as it is by soil and plants. Calcium is the governing mineral; it is the mineral that basically brings the other minerals to the cell.

ACRES U.S.A. This ties back in to what Dr. Albrecht said.

BRUNETTI Precisely the same dynamic. You need to mobilize calcium up into the plant, and when that happens, you have a plant rich in other macro- and micronutrients as well - if they are there in the soil.

ACRES U.S.A. You have to mobilize the food that you take in, and that means digestion.

BRUNETTI Absolutely number one.

ACRES U.S.A. How do you handle digestion?

BRUNETTI I am very big on digesting enzymes both from foods themselves through juicing and from supplemental en-zymes. I take enzymes with my meals, but I also juice. When I juice, I take a mixture of approximately one quart. The recipe is a mixture of carrot, celery, beet, ginger and turmeric and also consists of four to six ounces of cereal grass juice, which I produce by growing barley, wheat, rye and oats. I grow them outside on a bed, and I harvest about a colander-full first thing in the morning, then I run it through a wheat grass juicer to produce about four to six ounces of green juice.

ACRES U.S.A. How do you get it down?

BRUNETTI With great difficulty. I do it as quickly as possible because it is definitely not a gourmet drink. Oftentimes I chase it with some grape juice. Into that juice cocktail I will throw high levels of enzyme powders. I use a lot of enzyme powders in the work I do with livestock, high levels of pro-teolytic enzymes.

ACRES U.S.A. You use veterinary supply?

BRUNETTI Yes, I buy it by the drum because I use it in my business. I really pound the juice with the enzymes. I also throw in whey protein powder because I am trying to build glutathione levels. It is really important if you are going to be dealing with any kind of disease, particularly cancer, to take in high levels of the raw materials that build glutathione. Glutathione is an amino acid, if you will, that consists of three other amino acids: glycine, glutamic acid and cysteine. I try to build glutathione in my body rather than take glutathione because it is questionable how much you can absorb if you just take it by itself as a supplement.

ACRES U.S.A. What is happening when people do not digest well and exhibit a great deal of flatulence and so on?

BRUNETTI What is happening is that if you are not eliminating, you are reabsorbing things that best are eliminated. I went through four months of an aggressive detox system whereby, in addition to the dietary things I was doing every day, I went to a day spa and did an hour's worth of far-infrared sauna treatment followed by a couple of hours of lymphatic drainage treatment using an instrument that breaks up the congestion in the lymph system. Ultimately, the lymph drains into the bowel, so I finished up that treatment with a colonic. I did this once a week for four months. That really helped a lot in getting my elimination organs tuned up. If you do not do that, you begin to recycle indoles and other toxic compounds that are in the large bowel, which causes and awful lot of stress on the liver. It also suppresses the immune system and consumes quite a bit of energy.

ACRES U.S.A. Do you make use of any herbal extracts in order to move the truckload of stuff along?

BRUNETTI Quite a few. I make herbal teas for antibacterial, liver cleansing, and lymph and blood cleansing purposes. To make sure that the bowel is swept clean pretty regularly, I also take a mixture of slippery elm bark and psyllium seed husk. The reason I take both is that slippery elm bark is an insoluble fiber, while psyllium seed husk is a soluble fiber, so it is a very good mixture.

ACRES U.S.A. Do you get that as a capsule?

BRUNETTI Those are products that I use in my animal remedies, so I get them in bulk, and I mix them 50/50 in the blender, then drink it. It is very effective. It is effortless. I use that for the mechanical cleansing of the GI tract.

ACRES U.S.A. We discuss these things quite openly, but you realize that practitioners who start entertaining these ideas begin to run into the law and the gold standard of world medicine.

BRUNETTI They have done an excellent job of repressing these non-toxic and quite inexpensive remedies. It is interesting that in January 1999 Business Week had a report that the fourth leading cause of hospitalization is from FDA-approved drugs, affecting over 2.5 million people - and these drugs are being used as directed.

ACRES U.S.A. They actually lose something like 150,000 people, don't they?

BRUNETTI That was reported in the Journal of the American Medical Association in an article on side effects from properly administered FDA-approved drugs. It is no surprise. An average of 65 to 75 percent of FDA employees end up working for drug companies after they leave the government. There is only one thing that we can expect from this. I think people have to realize why we

Glutathione Builders

Necessary for glutathione peroxidase, a free-radical scavenger and immune activator of neutrophils; and glutathione s-transferase, a powerful detoxifier used by the liver.

1. Amino acids: Glycine, glutamic acid, cysteine (whey protein concentrate, eggs, raw dairy, etc.).
2. Alpha lipoic acid: Universal anti-oxidant and liver protectant. 300-600 mg/day.
3. NAC (u-acetylcysteine): powerful anti-oxidant, glutathione precursor.
4. Selenium (as selenomethionine): 1200 mg/day.
5. Melatonin: 21 mg/day at bedtime.
6. Turmeric.
7. Beets.
8. Cruciferous vegetables, especially brussels sprouts.

T-Cell Tonic

- Organic yellow ginger (1-2 oz.; approx. 2" section of root)
- Organic turmeric root (1/2-1 oz.; approx. 2" section of root)
- Organic red beets (1 small, or 1/2 large beet)
- Organic carrots (3-4 large carrots)
- Organic celery (3-4 stalks)
- Perfect Food green mix (1 Tbs.)*
- Barleygreen (1 Tbs.)*
- Proteolytic enzymes (1 Tbs.)
- Whey protein concentrate (2 scoops)
- Organic grape juice (top off if necessary)

* During growing season, substitute 6 oz. fresh-squeezed cereal grass (wheat, rye, oats, barley).

Mix ingredients in juicer. Makes 1 quart.

Jerry's 'Poten-Tea'

- Pacific yew (3 Tbs.)
- Jason Winters tea (3 Tbs.)
- Pau D'Arco (1 Tbs.)
- Green tea (1 Tbs.)
- Chapparell (1 tsp.)
- Clove (1/2 tsp.)
- Ginger (1/2 tsp.)
- Cinnamon (1/2 tsp.)
- Yogi-Detox (1 bag)

Place loose herbs in 11/2 quarts of water, bring to a boil, then shut off heat and let brew overnight. Strain in the morning.

Makes 1 quart. Drink 1-2 quarts daily.

have such a health holocaust; it is simply because of the fact that the pharmaceutical cartels have become inseparable from medicine. That is one of the reasons that I took a stand.

ACRES U.S.A. The pharmaceuticals can kill you.

BRUNETTI I am not saying that people should not consider some conventional therapies. I certainly know that people have had good results. There are people who have come up to me and said, "I was treated conventionally, and I am OK right now." I don't have any argument with that. I will say to folks that if you are going to go down that road, you really should pay a lot of attention to what health really is. Health is not just the absence of a tumor. Health is about the state of the body - that tumor showed up because there was a systemic anomaly somewhere.

ACRES U.S.A. You have to look at the total lifestyle.

BRUNETTI Cancer is caused by all of those things that were itemized in the PITTS. It is up to the individual to go back and unravel where this disease might have come from, or where it might come from next time, and address it. This unraveling takes a lot of work. You have got to get rid of toxins, you have got to reduce stress loads, and you have got to eat nutrient-dense foods. If you do have infections, you have got to augment the immune system.

ACRES U.S.A. What other things are you doing?

BRUNETTI The other thing that I am doing for my immune system is taking a product called Proboost, which is thymic protein fraction A. It is basically a hormone that the thymus gland produces when you are young. It is an over-the-counter drug that comes in a powder form, and you put it under the tongue. It activates the T-4 cells, which are the cells that communicate especially to the T-8 cells - the cytotoxic cells. I also take another immune modulator called AIE-10, derived from colostrum milk harvested from cows that have been hyper-immunized with human vaccines in the udder. AIE-10 in-creases natural killer-cell activity, which is the immune system's first line of defence. It also supports the functioning of T-4 and T-8 cells.

ACRES U.S.A. In summation, would it be correct to say that if you have one of these problems, you had better know a lot more about it in three months than most physicians?

BRUNETTI I think if people really have the heart and will to figure out their health, the resources are tremendous. There are so many websites. I get calls from people who have heard I have lymphoma and have been diagnosed themselves with some form of cancer. They are calling for input and suggestions, and I tell them that there are tremendous resources out there. There are so many opportunities, whether it be clinics, alternative practitioners, or even if you want to try to do it on your own. I am not doing it entirely on my own, I am using two physicians as coaches, but I don't see them all the time. I won't work with anybody who is going to be antagonistic toward my viewpoint. I tell people that the responsibility is ultimately on the individual to deal with this. The bad news is also the good news: there are a lot of opportunities and a lot of options. In other words, you have got to filter it. You have got to talk to people and eventually make some decisions based on what you are comfortable with, because ultimately it comes down to that. It is your body, your health, and you are the one who has to decide what is best.

Jerry Brunetti is managing director of Agri-Dynamics, a 23-year-old firm that specializes in the formulation and production of products for farm livestock and pets. He consults on such wide-ranging topics as golf course turf management, racing camel diets, dairy feed and husbandry issues, lagoon odor control, and eliminating "hot spots" on dogs and contends there are curiously similar dynamics at work in all of these seemingly unrelated areas. He works with such materials as seaweeds, herbs, enzymes, probiotics, vitamins, chelated min-erals, "rare-earth" minerals and more. He can be reached at:

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Session 15

Biological Terrain

The Landscape of Life

by Jerry Brunetti

Biological Terrain refers to the landscape and therefore the "soil" to determine if the substrate allows for the proper exchange of energy to occur; for wastes to be effectively removed; for respiration to occur; for nutrients to be able to reach the cells; for waste to be effectively and rapidly removed; for cellular regeneration to occur; for the proper, efficient exchange of energy to transpire; for an immune system to be able to protect its host. Whether we are talking about soils or animals, the function and vitality of all cells are determined by fundamentals of chemistry. This is because the appropriate chemistry levels, be it in the soil, plant or animal, generate electricity by a "battery" that operates on electrolytes, hydrogen, oxygen, nitrogen, carbon, functional calcium, magnesium, potassium, sodium and trace elements. Biological terrain is an assessment of these elements quantitatively (i.e. concentration) and qualitatively (i.e. ratios to each of the other elements).

pH

The first parameter to measure is the pH, which is the analytical measurement representing the activity and potential energetics found within the hydrogen ion. pH is associated with water, the life sustaining fluid that no living species on this planet can survive without. Water, H_20, is capable of dissociating into ions of hydrogen, H+, and hydroxide, OH-. So, pH then is expressed in terms of the concentration of hydrogen ions on a scale of 0-14, 7 being neutral. Less than 7, we have an acidic condition; above 7, an alkaline condition. Simply, an acid is a molecule or ion that can function as a proton donor. A base is a molecule or ion that can function as a proton acceptor. More specifically, an acid is an ion or molecule that can furnish a hydrogen ion (H+) to a solution. Thus, HCl or hydrochloric acid, when it ionizes in water into (H+) ions and chloride (CL-) ions is such an acid because it donates Hydrogen to the solution. Other important acids in biological systems consist of carbonic acid, nitric acid, acetic acid, uric acid, phosphoric acid, and so on.

Similarly, a base is an ion or molecule that combines with hydrogen (H+) ions and removes them from solution. Bicarbonate, or HCO_3, combines with (H+), removing it from solution and forming H_2CO_3 or carbonic acid. Other examples of bases in biological systems are sodium bicarbonate, sodium phosphate, hemoglobin, and intracellular proteins.

The balance created by the concentration of these acid/base compounds allows for proper and biologically compatible pH levels to be sustained. These levels are precise and must be maintained in order for vital chemical reactions and healthy cellular function to occur. Otherwise cellular function diminishes or death of the organism will occur.

Table 1 provides vital pH parameters in the human body.

Table 1.

Tissue or Fluid BTA - 2000	pH
Saliva	6.0 - 7.0
Gastric secretion	1.0 - 3.5
Pancreatic secretion	8.0 - 8.3
Bile	7.8
Small Intestinal secretion	7.5 - 8.0
Urine	4.5 - 8.0
Arterial blood	7.4 - 7.45
Capillary blood	7.35 - 7.4
Venous blood	7.3 - 7.35

BUFFER SYSTEMS

Homeostatic organisms have developed elaborate and complex systems that carefully monitor and safeguard any aberrant acid/alkaline deviations by a system called an acid-base buffer system. There are 4 primary buffering systems in a mammal.

1. **The bicarbonate/carbon dioxide system**
2. **The extracellular system (comprised of phosphate)**
3. **The intercellular system (hemoglobin and intercellular proteins)**
4. **The bone**

Acids, produced by the body, are a normal function of metabolism. Stress increases acidosis. Too much exercise (exertion) increases the rate and concentration of acids. The largest contributor, however, to the inventory of acid excess comes from the oxidation of proteins, carbohydrates and fats.

The following is an example of the pathway that demonstrates the oxidation of carbohydrates and lipids: Carbohydrates + cellular oxygen + insulin produces excessive CO_2, which is potentially toxic. Small amounts of CO_2 are vented through the lungs. The remainder will combine with water to form a volatile acid known as carbonic acid, H_2CO_3. Note

that this conversion is dependant upon a zinc-based enzyme called carbonic anhydrase.

$$CO_2 + H_2O \xrightarrow{\text{carbonic (zinc) anhydrous enzyme}} H_2CO_3$$

carbonic acid

Carbonic acid must now be converted for more efficient acid removal.

$$H_2CO_3 \longrightarrow H+ + HCO_3-$$

carbonic acid bicarbonate

The kidneys are now able to remove the acidic (H+) ions, while reabsorbing the bicarbonate ions. At this point, it is imperative that the bicarbonate ion can team up with a carbonic salt or alkaline metal, namely calcium, magnesium, potassium or sodium. Otherwise, the bicarbonate ion will be reabsorbed into the blood, leading to an increase of critical blood pH. Elevated blood pH slows down the blood's ability to remove CO_2 from the cells, equaling cellular acidosis.

$$HCO_3- + Na \longrightarrow NaCO_3$$

bicarbonate sodium sodium bicarbonate

Low O_2 or Low Insulin

In the event that carbohydrates or lipids are oxidized in the presence of low insulin and/or low oxygen, large quantities of non-volatile acids are produced, namely lactic acid and betahydroxybutyric acid. The removal of these non-volatile acids is similar to the removal of the non-volatile acids that are products of the oxidation of protein.

OXIDATION OF PROTEIN

The oxidation of amino acids forms the non-volatile compounds of sulfuric acid, hydrochloric acid, nitric acid, and phosphoric acid. Again, the rescue from acidosis depends upon the carbonic salts, or alkaline metals, calcium, magnesium, potassium and sodium. When carbonic salts react with strong acids, the alkaline minerals bound to the carbonate leave the salt and recombine with the acid to make another less detrimental salt, water and a molecule of carbon dioxide.

Example:

$CaCO_3$	+ H_2SO_4	$CaSO_4$	+ H_2O	+ CO_2
Calcium carbonate	sulfuric acid	calcium sulfate	water	carbon dioxide

Table 2 illustrates the metabolic production of volatile and non-volatile acids from the diet. The average American diet consumes 150 mEq/day total of both groups of acids. With a deficiency of alkaline minerals in the diet, compounded by excessive sugar intake and further complicated by an inability to adequately saturate the cells with oxygen (sedentary lifestyle), a crisis looms. The inability to neutralize and remove excess acids requires the body to store acids in intercellular space. What does this mean? (See Figure 1)

Table 2.

Food Source	Acid Produced	Quantity (mEq/day)
Carbohydrates & Fats	Volatile Acids "Non-Volatile (low O_2, insulin) = Lactic Betahydroxybutyric"	20 mEq/day
Amino Acids:	Non-Volatile:	
a. Sulfur-containing	H_2SO4	
b. Cationic	HCL	
c. Anionic	HCO_3	100 mEq/day
Phosphate	H_2PO_4	30 mEq/day
Total Acids Consumed:		150 mEq/day

Table 3.

Acid-Forming Foods

All meat (beef, port, lamb, chicken) and fish	Alcoholic Drinks
Rice (white, brown or basmati)	Coffee and other caffeinated drinks
Cornmeal, oats, rye, spelt, wheat, bran	Sweetened yogurt
Popcorn	Refined table salt
Pastas	Soy sauce
Bread and most other grain products like cereals (hot or cold), crackers, pastries	Mustard (dried powder and processed)
The following beans (unless sprouted, in which case they become alkaline-producing): pinto, navy, mung, lentils, black, garbanzo, red, white, adzuki and broad	Most forms of sweeteners (artificial sweeteners, cane sugar, beet sugar, barley syrup, processed honey, maple syrup, molasses, fructose, lactose)
Cheese (parmesan is the worst, along with the sharper cheeses)	Ketchup (unless natural and homemade)
Sunflower and pumpkin seeds	Mayonnaise (unless natural and homemade)
Wheat germ	Nutmeg
The following nuts: walnuts, pecans, cashews, dried coconut (fresh coconut is alkaline-producing), pistachios, macadamias, filberts, brazil nuts and peanuts	White vinegar (apple cider and sweet brown rice vinegar are less acid-producing and preferred)
Colas (I've warned numerous times in the past how the phosphorus in cola turns to phosphoric acid and destroys bone).	Tobacco
Practically all drugs.	

Table 4.

Alkalizing Foods

Practically all vegetables	Plain yogurt
Practically all fruits with the exception of blueberries, plums, prunes and cranberries. Even citrus fruits such as lemons, which we think of as being acidic, are alkaline-producing in the body. They are rich in organic salts, like citrates, which are converted into bicarbonates.	Sweeteners like raw, unpasteurized honey, dried sugar cane juice (suscanat), brown rice syrup
Beans such as string, soy, lima, green and snap	Fruit juices
Peas	All vegetable juices
Potatoes	Most herbal teas
Arrowroot flour	Garlic
Grains such as flax, millet, quinoa and amaranth	Cayenne Pepper
Nuts like almonds, pignoli, fresh coconut and chestnuts	Gelatin
Sprouted seeds of alfalfa, radish and chia	Most all herbs
Unsprouted sesame	Miso
Fresh, unsalted butter	Most vegetable and unprocessed sea salt
Milk	Most all spices
Cream	Vanilla extract
Goat's milk	Brewer's yeast
Eggs	Most unprocessed, cold-pressed oils are neutral or alkaline-forming (even margarine seems to be neutral, but I don't recommend that anyone eat this 'liquid plastic')
Whey	Fermented foods

The inside of the cell is slightly acidic; the outside of the cell is slightly alkaline. This creates a differential of (+) and (-) charges that sets up an electrical potential of 70 millivolts across the cell membrane. This allows the cell to adequately transport oxygen, nutrients and waste products across the membrane as needed. Should the pH drop in the interstitial space between cells, in order to sustain the electrical potential across the membrane, the same differential must be maintained. That means that the pH of the cell itself must also drop. When the pH of the cell is even slightly altered, the overall enzyme function of numerous systems will be detrimentally affected, with symptoms showing up in the various organs, digestion, immunity and lymphatics.

Table 3 & 4 provides a list of alkaline and acid forming foods. As you can see, many acid forming foods are also healthy foods. The point here is BALANCE. Generally speaking, one should consume 75-80% of their diet from foods that are alkalizing and 20-25% from foods that are acid-forming.

OXIDATION/REDUCTION rH_2

The oxidation/reduction potential (ORP) reaction has two purposes:

1. To create high levels of cellular energy in the form of ATP (adenosinetriphosphate)

2. To oxidize invading pollutants and micro-organisms

OXIDATION is the LOSS or removal of electrons and/or the loss or removal of hydrogen atoms. **REDUCTION** is the GAIN or addition of electrons and/or gain or addition of hydrogen atoms.

When a reaction has a (+) E, it is **oxidized**. The reaction has moved to the right and is unable to carry out any additional reactions without the aid of a potent electron donor. When a reaction has a (-) E, it is reduced. The reaction has moved to the left and is quite capable of carrying out any additional reactions on its own accord. It is considered to be loaded with potential energy.

The scale for rH_2 is from 0-42. The equilibrium point is 28. Therefore, an rH_2 value greater than 28 is oxidized and an rH_2 value less than 28 is reduced. Biological systems of the body respond best in a slightly reduced environment.

REDOX/pH MAXIMS:

Table 5.

Ideal Redox (rH_2) Values on BTA

Blood	22
Saliva	22
Urine	24

Table 5 illustrates ideal REDOX (rH_2) Levels.

1. When the blood has become more alkaline, its oxygen carrying capacity increases, BUT its ability to deliver O_2 to the tissues has decreased.

2. If the blood cannot remove enough CO_2 from tissue, then HYPOXIA sets in and creates increased acid accumulation in the cell, causing the cell to run anaerobically.

3. When the cell runs anaerobically, then it does not produce enough ATP.

4. With a deficiency of ATP, meaning a shortage of cellular fuel, tremendous amounts of electrons are wasted in the urine.

5. If the TISSUE IS ACID, it is giving off an abundance of electrons, therefore the URINE becomes MORE REDUCED.

These REDOX maxims are of course associated with pH, because REDOX is dependant upon the oxidation of hydrogen, the formula being H_2 2H+ + 2E-. Individuals that experience chronic fatigue, frequent sighing, muscle pain or cramps after short walks, or have difficulty holding their breath for more than twenty seconds are experiencing acidosis.

Toxins (xenobiotics) such as chemical pollutants, radiation, drugs, pesticides, and food additives create FREE RADICALS that consume free and available electrons in the body, leaving the cells, blood, lymph and saliva in a state of depleted OXIDATION. This is countered by ANTIOXIDANTS:

A. Glutathione C. S.O.D
B. Reductase D. Catalayse

(Note: the above require trace elements, amino acids and EFA's)

RESISTIVITY

In simple terms, resistivity is the inverse of conductivity. Therefore, as conductivity increases, resistivity decreases. It is a simple and relative measurement of the concentration of electrically conductive ions in solution. It is referred to and stated in the electrical scale in terms of ohms/cm. Since we are concerned about biological systems, a balance or homeostasis must be maintained for health to exist. Resistivity, then, is monitoring the concentration of essential mineral salts, which are designed to exist in relatively small and balanced concentrations in blood and saliva (and plant sap!). Conversely, the mineral salts are designed to flow freely through the excretable urine. If too many mineral salts are lost through excretion, there are problems such as a lack of buffering mechanisms. If insufficient amounts are removed, the body becomes toxic. Resistivity then, concerns issues of blood purification, kidney excretion, enzyme concentration, alkaline reserve potential, etc.

SUMMARY

Table 6.

Optimal Values of BTA

	pH	rH_2	r
Blood (cell)	7.35	22	190 - 210
Saliva (Lymph)	6.5	22	180 - 220
Urine (Connective Tissue)	6.8	24	30 - 45

Table 6 provides the optimum values of pH, rH_2 and resistivity for blood, saliva and urine, based upon analysis by a BTA-2000 instrument (not pH paper).

Direction of pH in Disease:

- Blood must not move acid.
- Urine must not move alkaline (metabolic wastes, ie. acids are in urine).
- Saliva must not move acid (reflects alkalizing buffers, Ca, Mg, K, Na)

Saliva Reflects:

- Lymphatic function
- Digestive functions of stomach, liver, pancreas
- Nervous system
- Optimal A.M. pH value (with pH paper) = 6.0 - 6.8

Urine Reflects:

- Stability of blook pH
- Totality of cell metabolism
- Optimal A.M. pH value (with pH paper) = 6.0 - 6.4

Tables 7, 8, 9, 10, 11 and 12 reflect the results of challenging the mineral buffering system of body fluids. The degree of the adaptability of the individual's buffer system will reveal the state of the mineral reserves.

Table 7.

Normal Results

Easily Produces Alkaline Buffers

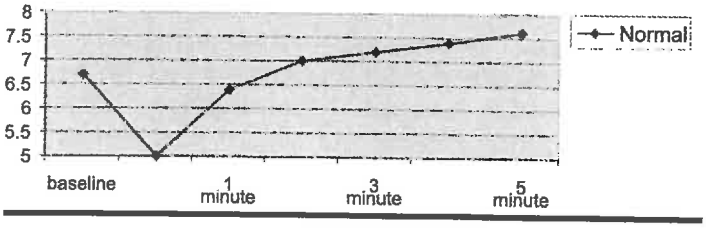


Table 7 illustrates NORMAL REACTION.

Table 8.

Alkaline Baseline

Indicates slowed metabolic reaction of lymph, liver, pancreas or stomach.

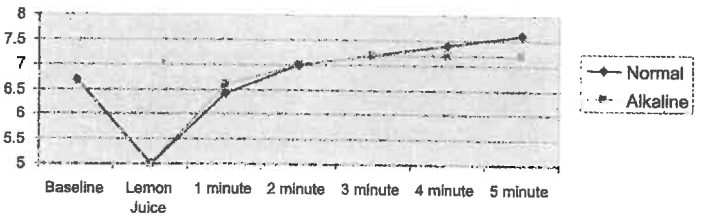


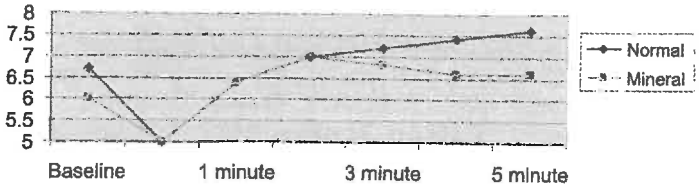
Table 8, ALKALINE BASELINE. This individual needs to consume more vegetables, mono and saturated fats, and less protein and carbohydrates, . INDICATES SLOWED METABOLIC REACTION OF LYMPH, LIVER, PANCREAS AND STOMACH.

Table 9, MINERAL DEFICIENCY. This individual needs to consume more vegetables (especially green drinks and

Table 9.

Mineral Deficiency

Cannot maintain alkaline buffer



juicing) and quality proteins, and needs more exercise and relaxation. CANNOT MAINTAIN ALKALINE BUFFER.

Table 10.

Hyper-Sympathetic with Mineral Deficiency

Minimum Alkaline Buffers ... Ammonia Present

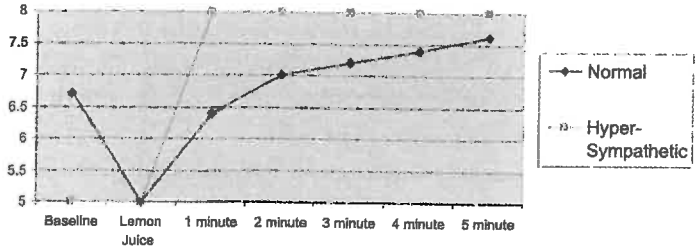


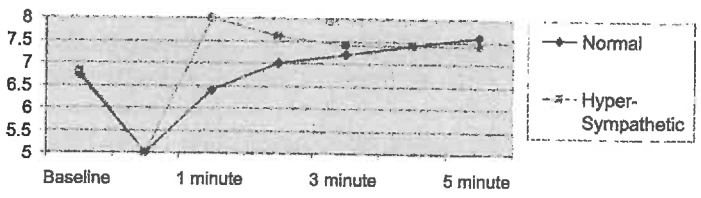
Table 10, HYPER-SYMPATHETIC WITH MINERAL DEFICIENCY. This individual needs to alkalize with macro-nutrients (Ca, K, Mg), and green drinks. Mild exercise and relaxation is a must. Herbal adaptogens, like licorice root, siberian ginseng and adrenal supplements are needed. MINIMAL ALKALINE BUFFERS - AMMONIA PRESENT.

Table 11, HYPER-SYMPATHETIC WITH MINERALS INTACT. This individual has adequate mineral reserves, but

Table 11.

Hyper-Sympathetic with Minerals Intact

Rapid alkaline reaction, sustained alkaline buffers



is experiencing stress, probably emotional/spiritual. Emphasis here is on mild exercise, acupuncture, relaxation, massage and increased water intake.

Table 12.

Probably Serious Organ Pathology

Cell rigidity with an acid domain, further tests needed.

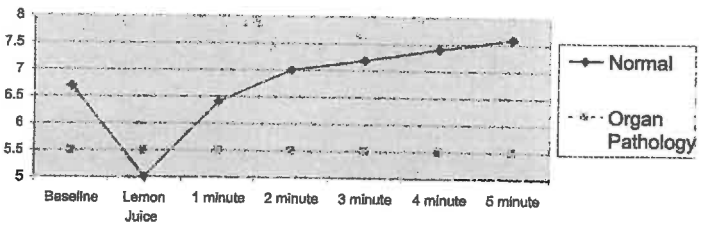


Table 12, PROBABLE SERIOUS ORGAN PATHOLOGY. This shows cell rigidity with an acid domain. Need to seriously alkalize with green drinks, KCO_3, and then macro-minerals. Lymph drainage via massage, colonics, sauna, acupuncture, and herbal adaptogens are needed.

Notes:

Session 17

Food Facts and Fallacy

by Jerry Brunetti

If one were to dutifully subscribe to the tenants outlined in the USDA food pyramid, one's diet would consist primarily of carbohydrates, a generous intake of fruits and vegetables, little or no saturated fat (to be substituted with vegetable fat), and little red meat (to be substituted with poultry and fish). On it's face, it appears to be balanced and wholesome. Yet this diet does little to correct continuing trend in the U.S. toward increasing obesity, epidemic levels of cardio-vascular disease, diabetes, cancer, arthritis and a plethora of other autoimmune disorders as well.

Medical pundits would have us believe that thanks to high tech, surgeries and miraculous pharmaceutical drugs, that people in the U.S. are living longer lives; that we are the healthiest nation on the face of the earth; and that the primary reason we are encountering high rates of cancer, heart disease is that people are living longer. (This is no doubt to suggest that a century or so ago, people lived to the ripe old age of 50, and then died of some "plague-like" organisms because there weren't any antibiotics). Contrary to this assumption, are cemeteries that prove that people, a century ago, lived to be as old as they do today. The reason that their life expectancy average was so much lower was because of the higher mortality with childhood illnesses and mothers who died in childbirth. Not many people realize that there were more centenarians per capita in the late 1800's than there are today.

Let's address a number of presumptions about how healthy we are (U.S.A.) and the causes of diseases like cardio-vascular disease, cancer, diabetes, stroke, arthritis, CFS, etc.

It starts with Minerals

Every previous lecture I have presented provides just a slice of the voluminous amount of research that proves that without minerals, little else matters. The synthesis of enzymes, anti-oxidants, proper pH, respiration, in other words, all cellular functions, the main emphasis on nutrient density, is the "dust" of life: macro and micro minerals.

Table 1 reminds us how far we have come in taking care of ourselves, compared to how we feed pets and lab animals. Compared to a dog's diet, humans average about 11% the intake of (8) essential trace elements that a dog is fed in a commercially prepared diet.

Table 1.

Essential Trace Elements in Human, Rat, Rabbit and Dog Diets, ppm

Elements	Human	Rat	Rabbit	Dog	Human/Dog, %
Iron	30.6	197	252.6	200	15.3
Zinc	30.6	30.3	32.5	178.3	17.2
Manganese	4.62	54.4	44.4	59.95	7.7
Copper	3.15	15.1	13	17.05	36
Cobalt	0.1	0.37	0.38	0.48	2.1
Fluorine	0.59	65	-	50?	0.91
Iodine	0.12	1.17	0.59	2.25	5.3
Chromium	0.12	0.17	-	4.24	2.8

Note: Data on animal diets from Purina Laboratory Chows

Table 2.

History of Randleight Farm

Dr. Ira Allison's Formula for Undulant Fever in Humans
3 grains Manganese Sulfate
2 grains Magnesium Sulphate
1/20 grain Copper Sulphate
1/30 grain Zinc Sulphate
1/30 grain Cobalt Sulphate

In capsules, enteric coated. Two a day after the main meals. Also, take at a separate time, 1/30 grain potassium iodide or the equivalent in other iodine compounds, hydroiodic acid, etc. (Reasons: Copper and iodine are not compatible when taken together.)
Avoid diet of white bread, white potatoes or other starchy foods when pills are taken, as copper inhibits the metabolism of carbohydrates.

Table 2 points out a remarkable finding as published by Randleigh research papers. In 1940 Dr. Ira Allison, MD was successful in treating 356 patients that had undulant fever (Bang's Disease), with nothing more than a preparation of trace mineral salts. Three years later, there wasn't one relapse. So-called "highly contagious" illnesses such as tuberculosis and hoof and mouth disease were proven to be about as contagious as a stomachache if challenged animals were adequately nourished. This was demonstrated by Sir Albert Howard in Kenya and Dr. William Ablrecht in the USA.

Consider the state of American health as illustrated in **Table 3**, modern medical "care" is now one of the largest killers of U.S. citizens: 100,000 people die yearly of hospital acquired infections; 120-140,000 people die yearly of side effects of properly prescribed prescription drugs. In the last 100 years, the risk of getting cancer has gone from 3% to now approaching 50%, a 1600% increase. A deadly combination of excessive amounts of toxic fats and drug-like carbohydrates, along with an acute deficiency of minerals, fat-soluble vitamins and healthy fats has created unprecedented chronic degenerative illnesses in all age groups.

Table 3.

USA Health Facts

- 36% of all hospital patient admittance are due to iatrogenic causes
- Between 1981-1987, **3 million people died as a direct result of medical treatment.** In the same period, only 39,000 people died of AIDS.
- Every year **100,000 people die from infections** acquired while in the hospital, and as a direct result of antibiotic use.
- From 1982-1988 there was a **300% increase in drug addiction** as a direct result of the use of medical prescriptions. In the same period, drugs from Colombia accounted for only 30% increase.

Each year, the average American adult consumes:

- 170 pounds of refined sugar
- 55 pounds of fats and oils
- 300 cans of soda pop
- 200 sticks of chewing gum
- 5 pounds of potato chips
- 7 pounds of pretzels, corn chips, and popcorn
- 18 pounds of candy
- 20 gallons of ice cream
- 50 pounds of cakes and cookies
- 63 dozen donuts

In 1900 the risk of cancer was 1 person in 30
In 1980 the risk of cancer was 1 person in 5
In 1990 the risk of cancer was 1 person in 4
In 1995 the risk of cancer was 1 person in 3
In 2000 the risk of cancer was 1 person in 2

- 36% of adults continue to smoke (that's 1 in 3)
- 7% of adults are active alcoholics (that's 1 in 14)

Prescription drugs are now the third largest killer of the American population: 140,000.

- The average American will live to age 76...the average M.D. to age 68.
- The U.S. spends 14 million dollars per minute on "healthcare", more per capita than any other nation on earth.
- **Over 50% of all healthcare costs** is spent keeping people alive in the last 5 days of their lives.

Courtesy of Deepok Copora, MD., Muchael Murray, N.D., and the Metagenics Corp.

The Sugar Blues

One of the more pertinent statistics is the consumption of refined sugar. In 1820 the average American consumed an average of 10 lbs per year; today the average per capita consumption approximates 170 lbs, representing over 25% of average caloric intake. (Another 25% is derived from refined white flour, oxidized, rancid vegetable fats and hydrogenated vegetable oils).

Refined sugar and carbohydrates create mischief in numerous ways. When these "abnormal" carbohydrates are consumed, especially in the absence of healthy fats and proteins, they quickly enter the bloodstream in high concentrations, causing the blood sugar normalization process to kick in: secretions from the pancreas (insulin), thyroid and adrenal glands begin to work overtime, eventually causing glandular exhaustion. This becomes exacerbated by the fact that refined sugar/carbohydrates are devoid of most of the vitamins and minerals present in foods naturally high in sugars. An undesirable process known as glycation is also the result of high blood sugar. This is when sugar bonds to amino acids, creating unhealthy proteins which then become part of organ proteins, creating defective tissue such as the myelin sheath of nerves, the lens of the eye, connective tissue of skin, ligaments, tendons, etc.

Sugar consumption is also known to cause tooth decay which is an outward sign of osteoporosis because it upsets the Ca:P ratio in the blood causing demineralization of the skeleton and teeth.

Sugar has been associated with an increase in triglycerides, rise in cholesterol, increase of stickiness of blood platelets, lesions in the arteries (also from chromium, vanadium deficiencies associated with denatured sugar), byperactivity, aggravation of candida albicans yeast infections, and so, so much more!

Western diets are actually addicted to sugar and it may be the most addictive substance humans partake in - more than nicotine, cocaine and alcohol! It's no secret that the food industry laces everything with this white crystalline substance; our palates have evolved to recognize that naturally occurring sugars found in ripened fruits, vegetables and grains, grown on mineralized soils, are a good indication that these foods are nutrient-dense, rich in vitamins, minerals, amino acids, fatty acids and numerous pbytocbemicals that make foods medicines.

The Myth of Fat and Cholesterol

The entire controversy about saturated fat, cholesterol and heart disease conveniently leaves out some of the most significant nutritional research conducted. Weston A. Price, a Cleveland, Ohio dentist, traveled to every corner of the globe during the 1930's and 40's to study the traditional diets of indigenous people and how those diets affected teeth and facial bone formations, the incidence of dental cavities and the level of degenerative diseases. What he discovered is nothing less than astounding.

Table 4.

Nutrients in Traditional Diets Compared to 20th Century Western Diets (Numbers Represent Percentage Greater in Traditional Diets)

	Calcium	Phosphorous	Magnesium	Iron	Fat-Soluble Vitamins
Eskimo	540%	500%	790%	150%	1,000+%
Swiss	370	220	250	310	1,000+
Gaelics	210	230	130	100	1,000+
Australian Aborigine	460	620	170	5,060	1,000+
New Zealand Maori	620	690	2,340	5,830	1,000+
Melanesians	570	640	2,640	2,240	1,000+
Polynesians	580	720	2,650	1,860	1,000+
Peruvian Indians	660	550	1,360	510	1,000+
African (cattle raising)	750	820	1,910	1,660	1,000+
Africans (agricultural)	350	410	540	1,660	1,000+

(Source: Price, 1936)

Table 4 illustrates the comparison between the diets of various traditional people and 20th century Western diets in 1938. On the average, traditional diets were at least (4) times greater in minerals and water-soluble vitamins; and (10) times greater in fat soluble vitamins (e.g. A, D. E). Comparing traditional diets of 1938 to Western diets of 2003 would be even more mind-boggling.

Cholesterol, Our Friend

Most people going for checkups these days are under the medical establishment's spell that cholesterol is a dangerous thing to have; that the lower your cholesterol, the better; that high cholesterol comes from foods like saturated animal fats, eggs, dairy, meat and so on. Therefore, eat a low-fat diet and you'll be heart attack free! What we never hear about is that damaged blood vessels are the result of: free radical damage (from foods rich in free radicals like oxidized vegetable oils); from a deficiency of anti-oxidants (which are found in fat soluble vitamins like A & E, as well as trace elements like selenium, zinc, chromium, etc.); from viruses which attack the lining of these vessels and which happen to be contained by compounds such as lauric acid, found in saturated fats like butter and coconut.

A primary culprit that has been associated with heart disease is homocysteine, which causes plaque build-up in the arteries and clot formation. By simply consuming vitamins B-6, B-12, folic acid and choline, dangerous homocysteine levels can be neutralized.

Poor thyroid function from iodine deficiency, fat-soluble vitamins, and other trace minerals (e.g. selenium) can cause a build-up of cholesterol to occur as a protective mechanism to protect the blood vessel lining.

Cholesterol is necessary for Vitamin D synthesis, needed for proper mineral absorption, insulin production, and healthy nervous systems. Cholesterol is needed for bile salts. Cholesterol is needed to produce corticosteroids, (anti-stress hormones) as well as the sex hormones, estrogen, progesterone, testosterone, and androgen. Cholesterol provides the cell membrane with elasticity and strength. Cholesterol acts as an anti-oxidant. Cholesterol is critical for the development of brain and nervous tissue in young children. Cholesterol is required for seratonin to be available in the brain.

Cholesterol becomes a problem when it, like fats, becomes oxidized. Thus, LDL, also known as "bad cholesterol" is not actually bad at all, but is a problem in the arteries of those who have consumed foods that are destructive to such, and have failed to consume protective foods to prevent such from occurring. Curiously, analysis of the fat in parterial plaque suggests that only 25% of the fat is saturated, the remainder is unsaturated and primarily polyunsaturated. Finally, the simplest refutation of the theory of cholesterol causing heart attacks is that the per capita incidence of heart attacks in 1900 was a fraction of what it is today; yet dietary cholesterol has remained constant during that time. Additionally, the Japanese, who although consume less dietary fat, consume foods higher in cholesterol (such as shellfish) than Americans do, and they have a very low rate of heart disease.

The Fat Parade

Table 5.

Percentage of Essential Fatty Acids in Human Body Fat (1991-1992)

Society	% Omega–6	% Omega-3	Ratio
New Zealand Maori	2.6	0.93	2.8:1
Japanese	14.8	3.2	4.6:1
American	10.2	0.58	17.6:1

(Source: Erasmus, 1993)

Table 5 provides evidence that the ratio of alpha-omega 6 to alpha-omega 3 oils in Western diets is very imbalanced. Alpha-omega 6 oils produce Series 1 and Series 2

Table 6.

Heart Attacks Per 100,000 People

Country	Rate	Fat In the Diet
Japan	34	Low fat, high fish consumption
France	58.6	High fat, high butter consumption
Italy	94.7	High fat, high olive oil consumption
United States	170	High fat, low fish, butter, and olive oil consumption

(Source: U.S. Department of Commerce, 1996)

Table 7.

Percentage of Omega-3 Fatty Acids in Fish and Meats

(Per 100 Grams of Meat)

Food	Total Fat (Grams)	Omega-3 Fatty Acids (%)
Salmon (wild)	6.34	4.65
Salmon (cooked0	8.13	4.6
Sardines (canned)	11.45	4.35
Trout	3.46	3.44
Halibut	2.29	2.84
Deer	2.42	2.89
Elk	1.45	2.76
Catfish	2.82	2.52
Lamb	21.59	1.81
Bison (wild)	1.84	1.63
Beef (retail cuts)	19.2	1.19
Salmon (canned)	6.05	0.95
Chicken	15.06	0.93
Salmon (farmed)	10.85	0.87
Shrimp	1.73	0.81
Beefalo	4.8	0.8
Bass	2.33	0.64
Pork (retail cuts)	14.95	0.6
Beef (ground)	26.55	0.6
Clams	0.97	0.41
Snapper	1.34	0.3
Tuna (canned)	0.82	0.2
Shrimp (fast food)	15.1	0.17
Cod	0.67	0.15

prostaglandins. The former being anti-inflammatory, the later, inflammatory. Alpha-omega 3 oils produce Series 3 prostaglandins. All three are required in a balance to control and moderate the inflammatory response. Otherwise, we see an increase in inflammatory, blood-thickening Series 2 prostaglandins, and a deficiency of Series 3 prostaglandins, which encourages heart attacks, strokes and inflammatory diseases.

Table 6 provides the incidence of heart attacks in four countries. What is most relevant isn't whether there was a high fat vs. low-fat advantage, but rather what kind of fat was consumed in the healthier nations, regardless of the amount of cholesterol consumed.

Table 7 lists the % of alpha-omega 3 fatty acids in fish and meat. Note how wild fish and game have substantially higher levels than their domesticated counterparts.

Table 8.

Some Beneficial Constituents in Butter

Benefit	Description
Wulzen (anti-stiffness) factor	Protects against degenerative arthritis, hardening of the arteries, and cataracts
Short- and medium-chains fatty acids	About 15 percent of butterfat. Absorbed directly by the small intestine without emulsification by the bile. Antimicrobial, anti-tumor, immune stimulating, antifungal
Conjugated linoleic acid	Anticancer
Glycosphingolipids	Protect against gastrointestinal infections
Trace minerals	Chromium, iodine, manganese, selenium, and zinc

(Source: Fallon, 1995)

Table 8 highlights the wonderful resources contained in (especially raw) butter.

Another oil that keeps making an appearance relative to the demographics of healthy populations is Virgin Olive Oil.

Table 9.

Some Beneficial Substances in Virgin Olive Oils

Substance	Effect
Beta-carotene	Antioxidant
Vitamin E	Antioxidant
Chlorophyll (contains magnesium)	Nourishes the heart
Squalene	Protects the heart
Phytosterols	Reduce cholesterol
Oleic Acid (monosaturated)	75%
Saturated	13%
Omega 6	10%

Table 9 provides the nutritional co-factors that team up with oleic acid to create a wonder food.

Tropical oils are one of the most amazing and unusual foods that one can eat for optimum health. Coconut oil is 92% saturated, two thirds being medium chain fatty acids. Very rich in lauric acid, coconut oil has strong anti-fungal, anti-bacterial, and anti-viral properties. It is very stable and is quite resistant to oxidation and rancidity.

Flax Seed Oil is the exception to the grain rule in that unlike most grain oils, which are predominantly omega 6, flax is 57% omega 3, 16% omega 6 and 18% oleic acid. It provides a good remedy for the omega 6 to omega 3 imbalances in the diet; however, adequate magnesium zinc, vitamin B-6 and vitamin C are essential to convert alpha-omega 3 into EPA/DHA essential fatty acids that the body requires.

The Incredible Egg

Eggs are one of the most nutrient-dense foods available, provided that they come from hens that are free range, consuming 25-30% of their diet from forages and insects. The omega 6: omega 3 ratio in such an egg is about the ideal 1:1. Factory farm eggs, where hens are fed in close confinement on a 100% drug-laced grain diet may contain up to (20) times more omega 6 than omega 3 oils.

Table 10.

EGGS FROM GRASS: FOOD "OVA-TION"

- Primary Source of Essential Fatty Acids
- 1:1 Ratio of Alpha Omega 3's and 6's
- Rich in EPA/DHA (Landlubber Salmon)
- Arachidonic Acid
- Cholesterol!
- Cysteine - Pre-cursor to Glutathione
- Fat-Soluble Vitamins
- Vitamin A (as Retinol vs. Carotene)
- Vitamin E
- Lecithin
- Choline: Necessary for Liver Detox

Table 10 shows the wonderful nutritional resources eggs provide.

Table 11 illustrates some of the nutritional distinctions between an "omega egg" and a "concentration camp" egg.

Table 11.

NUTRITIVE VALUE OF OMEGA EGGS COMPARED TO STANDARD EGGS

	Omega Egg	Standard Egg
	60 g – large egg	60 g – large egg
Calories	75	75
Protein	6 grams	6 grams
Carbohydrate	.6 grams	.6 grams
Total Fat	6.0 grams	6.0 grams
Saturated Fat	1.5 grams	2.2 grams
Polyunsaturated Fat	1.35 grams	.90 grams
n-6 Fatty Acids	750 mg	800 mg
n-3 Fatty Acids	350 mg	60 mg
C18:3	250 mg	40 mg
C22:6 DHA	100 mg	20 mg
n-6:n-3 Ratio	2.6	13
Monounsaturated Fats	2.8 grams	2.4 grams
Cholesterol	180 mg	210 mg
Vitamin A	660 i.u.	470 i.u.

Eggs also provide the benefit of packaging its high quality protein with it's high quality fats - the ideal way to consume both food groups, i.e. together, to maximize absorption of the amino acids, fatty acids, vitamins and minerals.

A Caveat on Cereals

Whole grain carbohydrates are certainly far better in their nutritional profile than refined cereals. However, cereals contain phytates (or phytic acid), which are mineral absorption inhibitors. Grains also contain enzyme inhibitors. The ideal way to consume grain is to soak, sprout or ferment them, which neutralizes the components that interfere with digestion, absorption and metabolism. Avoid consuming carbohydrates with proteins, and again avoid refined carbohydrates and sugars as if your life depended upon it.

A Word on Protein

Animal source protein is by far, the most complete protein in that it typically contains the (8) essential amino acids, necessary to provide raw materials for the remaining 14 non-essential amino acids. It's always advisable to consume proteins with fats for optimum digestive efficiency and absorption. Because of amino acid deficiencies, unique to cereals and legumes, it is wise to consume them together as complementary ingredients, to help make better dietary protein intake.

Notes:

Session 20

Disease Management

Digestion as a Factor in Disease

by Jerry Brunetti

The proper feeding, respiration, toxin removal and ability of all cells to reproduce is first dependent upon the organism's ability to convert crude raw materials into sustenance. The word for this alchemical phenomenon is digestion.

The protection of plants is expressed in the integrity of the rhizosphere, or root ball of plants. Apparently, a vigorous population in the rhizosphere translates into a balanced soil food web, which translates into a protective substrate to fortify phyllosphere microbes that occupy the leaf surface.

Compost Tea Trials

At Earthworks, we developed a compost tea kit and brewer, initially for use on golf courses, especially greens and teas, and also for the wine grape vineyards established primarily in the Northeastern US. Research trials were conducted at Rutgers University (New Jersey) as well as field trials at various locations representing various crops (turf, grapes, vegetables and flowers). The 2002 Rutgers' trials, although encouraging in wine grapes, were inconclusive because year 2002 was one of the driest on record, so there was little disease pressure for the incidence of downy and powdery mildew. Furthermore, there was an unusually late killing frost that destroyed 90% of the fruit, so we were not able to get adequate data on fruit related diseases such as Botrytis and Black Rot. Our in-vitro studies however, suggested that both our tea and our compost made from the tea were very disease suppressive.

Figure 1 (see Page 115) shows the analysis of the compost used to ultimately brew the compost tea. This compost was comprised of three (3) separate kinds of compost blended together, including dairy and turkey manure, forest litter, and highly aerated horse manure-based mushroom compost. The soil food web lab analysis indicates a healthy population of bacteria, as well as encouraging numbers of fungi. Protozoa populations were also quite strong.

Table 1 discloses the amount of species diversity in this blend of the three composts, as well as the population of the selected groups. What is evident is that this compost is rich in species diversity and fairly balanced in terms of the percentages of each functional group. There is room for improvement on the aerobic:anaerobic ratio; and the level of pseudomonads is slightly elevated. Being that the moisture is higher than optimum, this may be a factor affecting the levels of anaerobes.

Table 1.

Compost Species Diversity

Parameters	Normal Ranges	Enumeration	Species Richness Diversity (SRD)[1]	SRD Moderate Levels
Heterotrophic Plate Count (Aerobic)	10^8 - 10^{10}	3.8×10^9 CFU/dgw	2.0	1.6
Anaerobic Bacteria	10:1 A:AN	1.6×10^9 CFU/gdw	0.9	0.8
Yeasts and Molds	10^3 - 10^5	1.2×10^5 CFU/gdw	2.8	0.8
Actinomycetes	10^6 - 10^8	1.5×10^6 CFU/gdw	1.5	0.9
Pseudomonads	10^3 - 10^5	1.7×10^7 CFU/gdw	1.1	0.5
Nitrogen-Fixing Bacteria	10^3 – 10^5	5.6×10^4 CFU/gdw	0.6	0.3
% Moisture (dw)	40 – 50%	71%	—	—
Total Species Richness Diversity	—	—	9.9	3 – 6.5 + 6.5 = high

Table 2.

Compost Maturity Report (Dairy/Turkey - Luebke)

Compost Maturity*	Result	Ideal	Method
Germination Rate	Full Strength Extract – 68% 1/3 Strength Extract – 92%	>85%	Journal of Environmental Quality, 23:1177-1183 (1994)
Maturity Index (Phytotoxicity)	Full Strength Extract – 37% 1/3 Strength Extract – 82%	>50%	Journal of Environmental Quality, 23:1177-1183 (1994)
Conductivity	Full Strength Extract – 6.69 dS 1/3 Strength Extract – 2.86 dS	< 6 Hort. < 10 Agric.	MoSA 10-3.3, Saturated Paste
pH	8.2	6.5 – 8.5	MoSA 12-2.6

Tables 2, 3 and 4 are measures of the individual composts, comprising the finished blend used to make the tea. The measurements taken include those parameters related to Compost Maturity; including: Germination Rate, Phytotoxicity, and conductivity. These evaluations were obtained by making a water extract of the compost (not quite a brewed tea) and measuring the full strength and diluted leachate's effects. What we discovered is that the highly aerated dairy and turkey manure compost showed the best quality in terms of its effect on germination, phytotoxicity and conductivity. Not surprisingly, the compost with the least

Table 3.

Compost Maturity Report (Aerated, Inoculated Mushroom)

Compost Maturity*	Result	Ideal	Method
Germination Rate*	Full Strength Extract – 5% 1/3 Strength Extract – 72%	> 85%	Journal of Environmental Quality, 23:1177-1183 (1994)
Maturity Index* (Phytotoxicity)	Full Strength Extract – 0.20% 1/3 Strength Extract – 40%	> 50%	Journal of Environmental Quality, 23:1177-1183 (1994)
Conductivity	Full Strength Extract – 17.9 dS 1/3 Strength Extract – 5.97 dS	< 6 Hort. < 10 Agric.	MoSA 10-3.3, Saturated Paste
pH	7.8	6.5 – 8.5	MoSA 12-2.6

*Problem Parameters

Table 4.

Compost Maturity Report (Aerated Forest Litter)

Compost Maturity*	Result	Ideal	Method
Germination Rate*	Full Strength Extract – 24% 1/3 Strength Extract – 84%	> 85%	Journal of Environmental Quality, 23:1177-1183 (1994)
Maturity Index (Phytotoxicity)	Full Strength Extract – 4% 1/3 Strength Extract – 58%	> 50%	Journal of Environmental Quality, 23:1177-1183 (1994)
Conductivity	Full Strength Extract – 17.6 dS 1/3 Strength Extract – 6.05 dS	< 6 Hort. < 10 Agric.	MoSA 10-3.3, Saturated Paste
pH	7.3	6.5 – 8.5	MoSA 12-2.6

Our interest in considering this compost (only as a product that would have to be reconditioned) was because of its availability; its cost and the additional diversity it could provide.

Tables 5A and 5B again gives a variety of parameters that are more representative of the chemistry of compost, rather than its biology. These chemical indicators are associated with compost maturity and potential toxicity to the roots and organisms in the rhizosphere. These tests indicate that ideally, this compost needs to be aged further in order to decrease excessive salts and to balance the nitrogen and sulfur. Again, the biggest challenges apparently, are originating from the mushroom soil compost.

Table 6 illustrates the degree of stability based upon the respiration rates. All aerobic organisms inhale O_2 and exhale CO_2, and so this rate of respiration measurement is an indication of additional digestion needed in order for the compost to stabilize.

From Compost to Tea

After concluding that we had a compost that met a majority of the prerequisites to make a tea, we then brewed a batch of compost tea in our own Earthworks compost tea brewing machine, consisting of 10 lbs of equal parts of the (3) composts. These (3) individual composts were mixed together in a compost pile and then thoroughly aerated again as if it were one compost.

Figure 2 (see Page 115) provides an analysis of a tea made with this same compost, brewing it for 22 hours at 70°F and adding 3 lbs of foods to the solution (35 gallons), prior to brewing. These foods consisted of simple sugars, starches, cellulose, humic acids, seaweed extracts, herbs, vitamins and minerals. The ratio of bacteria to fungi would not normally be considered to be ideal because the level of bacteria is so high, over 50 times higher than the expected range.

Table 5A.

Compost Analysis Report

Sample ID	Nitrogen Tests (ppm) Ammonia NH_3	Nitrites NO_2	Nitrates NO_3	Sodium (ppm)	Sulfur Tests Sulfate S (ppm) (level)	Sulfides H_2S	Seed Germ & Vigor Tests 7 day Germ (%)	14 day Vigor (%)	Humus
Blend 1	93	1	824	74√	99 √	0	95 √		100
Blend 2	190	0	844	870	888	0	60		58
Blend 3	137	0	835	713	216 √	0	50		72
Blend 1,2,3	346 √	2	825	868	752	0	75		84 √
Desired Level	<50	0	700-800	90-200	100-500	0	>80	>70	50-80

maturity was the aerated mushroom soil compost. This compost was turned 50 times, and inoculated with biostimulants each time. Spent mushroom soil removed from the mushroom houses typically requires a lot of aging to allow for a reduction in salts, ammonia, sulfides, all of which can be phytotoxic and detrimental to microbes in the rhizosphere.

However, both the total and the active fungal biomass are more than twice the maximum of what is usually expected. It is unusual to get the active fungal biomass this high for two reasons: 1) The compost quality is not rich in adequate fungal populations; 2) During the brewing process, not enough fungal foods are supplied to grow these organisms. The im-

Table 5B.

Compost Analysis Report

Sample ID	Water Soluble Tests			Moisture (%)	C:N Ratio
	pH	Conductivity (Ergs)	Redox Potential		
Blend 1	7.8	3450	25.8	62.2	25.3
Blend 2	7.6	6000	25.4	50.0	15.5
Blend 3	7.5	4100	25.1	22.5	9.9
Blend 1,2,3	7.8	4160	25.5	39.1	17.2 √
Desired Level	7.0-8.1	2-3000	26.5-29	40-50	15-20

Table 6.

Compost Stability

Client Sample ID	Lab ID	Respiration Rate
Blend 1	10412	38 mg O_2/Kg compost ds-h
Blend 2	10413	34 mg O_2/Kg compost ds-h
Blend 3	10414	6 mg O_2/Kg compost ds-h

Interpretation of Respiration rate:

1. Respiration rate of ≤ 100 mg O_2/Kg Compost dry solids – hour acceptable for field applications.
2. Respiration rate of ≤ 20 mg O_2/Kg Compost dry solids – hour acceptable for horticultural applications.

Table 7.

Pathogen Inhibition Assay
Compost Tea

Pathogen Challenged	Inhibition to Pathogen Growth
Botrytis cinerea	Partial Inhibition – 100% Trials (12/12)
Colletotrichum graminicola	Partial Inhibition – 75% Trials (9/12) No Inhibition – 25% Trials (3/12)
Helminthosporium solani	Strong Inhibition – 100% Trials (12/12)
Phaeoacremonium inflatipes	Strong Inhibition 75% Trials 9/12 No Inhibition – 25% Trials (3/12)
Phaeomoniella chamydospora	Strong Inhibition 67% Trials 8/12 Partial Inhibition – 33% Trials (4/12)
Phytophthora cinnamomi	Partial Inhibition – 100% Trials (12/12)
Phytophthora infestans	Partial Inhibition – 100% Trials (12/12)
Pythium ultimum	Partial Inhibition – 92% Trials (11/12) No Inhibition – 8% Trials (1/12)
Rhizoctonia solani	Partial Inhibition - 92% Trials (11/12) No Inhibition - 8% Trials (1/12)
Sclerotinia sclerotiorum	Strong Inhibition - 100% Trials (12/12)
Sclerotium rolfsii	Strong Inhibition - 100% Trials (12/12)

portance of having active fungal growth is associated with the fact that many, disease-suppressive exudates ("anti-biotics") are produced by beneficial, fungal organisms.

Table 7 provides the results of pathogen inhibition assays, used to determine the degree of disease suppression the tea had on selected organisms in-vitro. The pathogen was challenged in 12 trials with the control being 12 trials of sterile water. The diseases selected were primarily those affecting wine grapes, turf and to a small degree, vegetables. Trials scored as "strong" inhibition are those in which there was little or no expansion of the initial pathogen sample. Trials scored as "partial" inhibition are those in which there was significant growth of the pathogen in the presence of the product, but the pathogen colony was unable to reach the product samples. The tea was not used full strength, but rather diluted to 25% strength. The diseases selected were Botrytis, *Colletotrichum graminicola* (anthracnose), *Helminthosporium solani* (leaf spot), *Phaeoacremonium inflatipes* (grape vine decline), *Phaeomoniella chamydospora* (slow decline, grapes), *Phytophthora cinnamomi* (blight: grapes and misc.), *Phytophthora infestans* (late blight), *Pythium ultimum, Rhizoctonia solani* (root rot), *Sclerotium rolfsii* (white rot), and *Sclerotinia sclerotiorum* (white mold). In seven of the eleven pathogen trials there were partial inhibition ranging from 75-100% of the twelve repetitions. In four of the eleven pathogen trials there were strong inhibition ranging from 67-100% of the 12 repetitions.

From Laboratory to Landscape

What we discovered in the field, including grape trials conducted at Rutgers University, was that when the tea was made properly (temperature, amount of time brewed, proper amount of foods, etc.), we saw an impact on disease suppression. Year 2002, in the Northeast USA, was exceptionally bot and dry; so many disease pressures were climatically curtailed. Furthermore, tests to find out the impact on fruit related diseases on grapes (Botrytis and Black Rot) at the Rutgers Experimental Station, proved disappointing because a very late frost (late May) destroyed 90% of the grape blossoms. Greens keepers who injected compost tea into their fertigation systems saw positive effects on root diseases such as pythium. Those who applied the product on trees and greens, as a spray, were surveyed as to their results. Generally speaking, those who applied the tea every 5 days, especially when disease pressure was highest (humidity, temperature, traffic stress, rains, etc.), appeared to get disease suppression on anthracnose, fairy ring, leaf spot, summer patch, dollar spot and pythium. Those who waited until diseases showed up and then attempted to use the tea as a "fungicide" were not successful. It appears that incorporating compost tea as part of a total soils and horticultural systems approach, shows much promise, especially with high value crops. New trials for 2003 are forthcoming for wine grapes, turf, flowers and vegetables.

KIM-CHI TEA

The process of fermentation goes back to at least 6000 years ago when the Chinese were fermenting cabbage. Simply stated, the science of fermentation (in this discussion, Lacto-fermentation) entails the conversion of sugars (not only lactose) into lactic acid under anaerobic conditions.

The production of high levels of lactic acid creates an environment whereby spoilage organisms are deterred from growing. High populations of lactic acid producing organisms such as *L. acidophilus, L. bulgaricus, L. casei, L. lactis, L. rhamnosus, L. plantarum*, as well as species from *Lactococcus, Pediococcus and Enterococcus*, are often associated with this process along with lactic acid producing yeasts. Both bacteria and yeasts are found on the leaf surfaces of plants, thereby providing a "wild", indigenous inoculant.

In essence, there are two groups of fermenters: mesophyllic and thermophyllic. The mesophyllic operate at ambient temperatures and are the catalysts that are associated with fermentation of silage for livestock and sauerkraut and kim-chi fermentation of vegetables for humans. The mesophyllic strains are homofermentive, that is they ferment sugars predominantly to lactic acid, and they grow rapidly under a wide range of temperature and moisture conditions.

Since the orient seems to have "invented" the fermentation of vegetables, it isn't surprising that they also have incorporated fermentation practices into ecological farming. In countries such as Korea and Japan, ferments of grasses, herbs, fruits, fish waste, and milk are produced for the purpose of acting as bio-stimulants, seed treatments and plant protectants. Additionally the use of indigenous, micro-organisms, harvested from forest litter are used to make an anaerobic ferment with cooked rice and rice bran, which then is used to activate compost. These same ferments of vegetation, fruits and milk are utilized in livestock operations to improve animal health. One of the objectives of small oriental farmers in "wildcrafting" indigenous organisms from various local and regional soils to make various fermented products, is to increase the natural diversity of microbial populations through the farm's ecosystem, including the digestive system and manure of the livestock on the farm.

INDUSTRIAL YOGURT

Fermentation of dairy products for human consumption (yogurt, keifer, clabbered milk, sour milk/cream) is nearly as ancient as the fermentation of vegetables. A highly perishable food like milk can only be preserved via fermentation when there is no refrigeration. To predictably ferment dairy products however, requires the incorporation of Thermophyllic organisns, that are only efficient in controlled temperatures, usually around 95°F-105°F. To make the maximum conversion of lactose (milk sugar) into lactic acid also requires that adequate pH ranges are maintained, otherwise when the pH drops, fermentation is halted.

Table 8.

Pathogen Inhibition Assay
Lactosan 4

Pathogen Challenged	Inhibition to Pathogen Growth
Alternaria alternata	88% reduction in pathogen growth, relative to control
Botrytis cinerea	52% reduction in pathogen growth, relative to control

Several years ago, Agri-Dynamics ran some field experiments using a fermented cheese whey as a coating for commercial fertilizer. Using two liters per tonne, we were able to see reductions in nitrogen applications by 25+%; there was a higher percent of germination, as well as earlier germination and yields were equivalent or higher on the treated plots than on the controls. Crops tested were wheat, soybeans, potatoes and corn (maize). This product was called "Bio Net."

In 2001, experiments were conducted on using reconstituted whey powder and permeate by inoculating in a two-stage fermentation, using proprietary cultures. This product was called "Lacto-San" of which there were four (4) variations. We found series 3 and 4 to be most promising in limited greenhouse trials. In vitro studies confirmed our conclusions. **Table 8** illustrates the efficacy of Lacto-San #4 when challenged by Alternaria alternata and Botrytis cinerea. Lacto-San was added, unsterilized, to a growth medium at a rate of 8%. The pathogen was grown on amended and unamended media. Relative to the control, Lacto-San #4 reduced the growth of Alternaria alternata, and Botrytis cinerea 88% and 52% respectively. Table 9 illustrates that using equal parts of Lactos-San #3 and #4 at 8% dilution reduced pathogen growth by 85% and 71% respectively. Additonally Table 9 also shows that an 8% dilution of Lacto-San 3 & 4 reduced Phytophtora infestans by 100% compared to the controls. The promise of fermented base biologicals is very exciting in that they can easily be made using affordable, readily available, raw materials, even waste products. The process of fermentation produces numerous metabolites that act as biostimulants for other healthy organisms; a myriad of enzymes; B-vitamins; amino acids; and a host of pathogen fighting compounds including lactic acid, lactoperoxidase, acidolin, hydrogen peroxide, and nicin. Interestingly, these compounds seem to be equally antagonistic against pathogens of plants, animals and humans.

Figure 1.

THE EARTH WORKS *COMPOST TEA KIT*

Soil Foodweb Incorporated

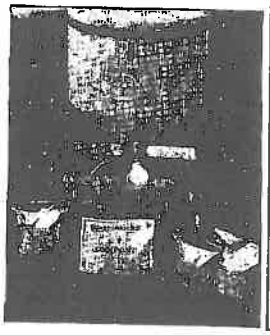
Sample received: 04/11/01 date mailed: 05/04/01
Compost type: Forest litter/mushroom compost/manure

Compost Foodweb Analysis
Client: EarthWorks

Organism Biomass Data

Sample #	Treatment	Dry Weight of 1 gram Fresh Material	Active Bacterial Biomass (ug/g)	Total Bacterial Biomass (ug/g)	Active Fungal Biomass (ug/g)	Total Fungal Biomass (ug/g)	Hyphal Diameter (um)	Protozoa Numbers/g			Total Nematode Numbers (#/g)
								Flagellates	Amoebae	Ciliates	
87985	EarthWorks compost	0.50	34.8	383	12.3	453	2.5	27,692	11,394	144	NR
		OK	Excellent	Excellent	Excellent	Excellent	OK	Excellent	Good	A Touch High	
Desired Range			15-30	150-300+	2-10+	150-200+	2-3+	10,000+	10,000+	20-50	

The EarthWorks CT Brew Kit



EarthWorks CT Compost

- An incredibly diverse blend of three separate composts.
- A forestry litter rich in fungal activity.
- A spent mushroom compost with strong bacterial counts.
- A composted blend of horse, cow and chicken manures that provide a wide spectrum of microbial support.
- All composted in wind-rows and enhanced for over a year.

EarthWorks CT Activator

- A powerful package of food stuffs designed to stimulate both bacterial and fungal activity in the brewed tea.
- Tests have shown that this mix has significantly raised the microbial counts of the teas.
- Over twenty different ingredients including complex carbohydrates, protein rich meal products, and minerals, designed to feed microbes.

EarthWorks CT Cleaner

- Cleaning the brewing tank is very important to keep residues from building up and potentially creating an anaerobic condition during the brew cycle.
- The CT Cleaner is a dry material that, if used after each brew, will perform this function.

Figure 2.

Soil Foodweb Inc.
1128 NE 2nd St. Suite 120
Corvallis, OR 97330
Phone: 541-752-5066
FAX 541-752-5142
E-Mail: info@soilfoodweb.com

Compost Tea Analysis

Client:

Earthworks Natural Organic Products
PO Box 278K
Martins Creek, PA 18063

Sample Received: 01/23/02 Date Mailed: 1-24-2002
Tea recipe: Primarily fungal
Invoice #:
Grower:

Organism Biomass Data

Sample #	Treatment	Tea Volume (mL)	Active Bacterial Biomass (µg/mL)	Total Bacterial Biomass (µg/mL)	Active Fungal Biomass (µg/mL)	Total Fungal Biomass (µg/mL)	Hyphal Diameter (µm)	Protozoa Numbers /mL			Total Nematode Numbers (#/mL)
								Flagellates	Amoebae	Ciliates	
92034	Earthworks	1.00	579	15744	22.7	42.8	2.5	NR	NR	NR	NR
			Excellent	EXCELLEN	Excellent	EXCELLENT!	OK				
Desired Range		1	10 - 150	150 - 300	2 - 10	2 - 20	(A)	1,000	1,000	20-50	2 - 10

Bold means low

This is great teal
What recipe was used?
The bacterial biomass is very, very high, so the sugars in the activator should probably be reduced in order to reduce the bacterial-fungal competition.

(A) Hyphal diameter of 2.0 indicates mostly actinomycete hyphae, 2.5 indicates community is mainly ascomycete, typical soil fungi for grasslands, diameters of 3.0 or higher indicate community is dominated by highly beneficial fungi, a Basidiomycete community.

Temperature of brewing, type of water (chlorine will kill organisms), type of compost and type of brewer used must be considered in determining the set of organisms in the tea. See the Compost Tea Brewing Manual for complete information. Tea assessment should be accompanied by leaf organism assessment to see if there were effects of spraying or diluting in the sprayer. Pesticide use, fertilizer use, tillage, irrigation, etc., affect soil and foliar effectiveness. One report is sent to the mailing address on the submission form.

22 hour brew w/ 1/3 ea. Leubke compost (dairy/ chicken/ hay/ straw), deciduous tree trimming compost, & aerated mushroom compost; well water; reached 70F. For use on turf, grapes, vegetables & ornamentals.