Thinking about <u>Clinical/Medical</u> Nutrition Issues and Applications of RDAs, RDI, DRIs, ULS, AIs, etc.:

Why We Need to Assure Adequacy of Zinc

(from the series "How Am I Supposed to Remember All This Stuff?!")

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- **Zinc is a necessary mineral cofactor needed for over 200 enzymes to work.**

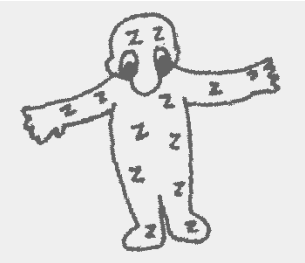
- **Not having enough screws stuff up a LOT.**

- **What kinds of things won't work well if zinc is inadequate? Read on …**

Memory Tricks for ZINC

Many people remember things best if they also see pictures, so here are some pictures identifying some specific places in the body for which zinc is absolutely essential. Other folks remember things best if they hear them … so if you are one of those people, be sure to read the descriptor for each function of zinc out loud.

The Zinc Story:



"Zinco" (Zorro's more irritating cousin) has just marked the places where people need zinc for their bodies to operate. Just picture the fellow on the left to remember that zinc is needed <u>all over</u> the body. It is a <u>co-factor for over 200 enzymes</u>! In other words … I dare you to name a body part that is <u>not</u> dependent on adequacy of zinc!

Here are some specific places where he marked things with a Z for Zinc:

Zinc is need to <u>make DNA</u> to make new cells

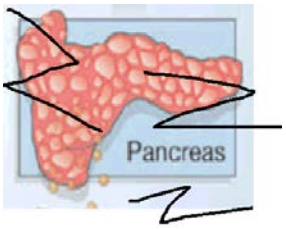
So Zinc is needed for <u>babies to develop</u>

And Zinc is needed to <u>grow kids</u>

Zinc is needed for <u>wound healing</u>

"Baby that Wound!"

T is for Tank … and zinc is needed to make <u>T-cells</u> part of our immune defenses



Zinc is needed to to make <u>Insulin</u>

Zinc is needed to be able to <u>taste</u>

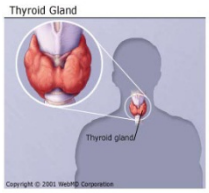
Zinc is part of a key <u>antioxidant</u> called "Zn-Cu Superoxide Dismutase"

Zinc is needed for "Alcohol Dehydrogenase" to <u>break down alcohol</u> and to play an important role in <u>vitamin A metabolism</u>

Zinc is important for skin and hair health:

This baby has a rare and very severe zinc deficiency called "acrodermatitis enteropathica" because he cannot absorb zinc normally from the intestine. (He needs to get zinc via a different route.)

Hypothyroidism is a common and well recognized cause of diffuse hair loss. Zinc and other trace elements such as copper and selenium are required for making thyroid hormones, and deficiency can result in hypothyroidism.



Thyroid hormones are needed to absorb zinc so hypothyroidism can result in acquired zinc deficiency. Hair loss attributed to hypothyroidism may not improve with thyroxine treatment unless zinc supplements are added.

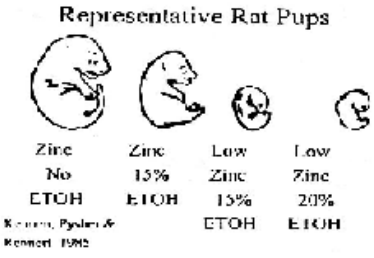
Take-Away message #1:

People trying to do <u>any</u> of the above activities require adequate zinc to do things right. Inadequacy can compromise all of them, impairing immune competence, making it hard to make DNA to make new cells to heal wounds or to make new red blood cells, etc. It also can make food have a bad taste or no taste at all, which gets in the way of improving their nutritional status. And it can contribute both to depression and to loss of appetite.

Zinc deficiency interacts <u>synergistically</u>

with other health problems.

<u>Fetal Alcohol Syndrome</u>: An example of <u>more serious injury</u> occurring from alcohol abuse <u>when one is also zinc deficient</u>.



Alcohol in a well-nourished fetus makes the fetus have a smaller and injured brain and body … symptoms of Fetal Alcohol Syndrome (FAS.) **But introducing zinc deficiency into the mix results in wildly worse fetal damage than either zinc deficiency or alcohol abuse alone would cause. That kind of a situation is called a "synergistic relationship."**

For more on this, please see "Aunt Cathy's Guide to Nutrition: Fetal Alcohol Syndrome."

Alcohol requires a zinc-dependent enzyme called **alcohol dehydrogenase** to metabolize it. With inadequate zinc, the alcohol remains intact in the animal's system much longer and the fetus is exposed to much more than would have been the case if zinc were adequate. Similarly, it can have the effect of people becoming intoxicated staying and staying intoxicated longer than expected, which has general safety implications.

Using up zinc stores to detoxify all that alcohol also compromises all the other zinc functions shown above and it also contributes to alcohol-related organ damage. And zinc inadequacy for any reason can contribute significantly to loss of appetite, so people can get into a vicious cycle of a poor intake resulting in even poorer intake.

Take-away message # 2:

In addition to poor dietary supply, increased need for zinc can also contribute to a relative deficiency. . Infections, trauma, stress, and steroid medications are just some of the examples of situations where body tissues take up extra zinc from the blood, creating a relative deficiency.

If a person has <u>any</u> disease, injury or other health problem, optimizing recovery health clearly depends on adequacy of zinc. In some cases, assuring adequacy of zinc can make some other health problems hurt a person less

Just so you know that I am not making this stuff up, here's what it says about the need for zinc on the National Institute of Health website:

http://ods.od.nih.gov/factsheets/Zinc-HealthProfessional/#h3

From: **"Zinc:<u>Fact Sheet for Health Professionals</u>"**
6/13

http://ods.od.nih.gov/factsheets/Zinc-HealthProfessional/#h3

Introduction:

Zinc is an essential mineral that is naturally present in some foods, added to others, and available as a dietary supplement. Zinc is also found in many cold lozenges and some over-the-counter drugs sold as cold remedies.

Zinc is involved in **numerous aspects of cellular metabolism**. It is required for the catalytic activity of approximately **100 enzymes** [1,2] and it plays a role **in immune function** [3,4], **protein synthesis** [4], **wound healing** [5], **DNA synthesis** [2,4], and **cell division** [4]. Zinc also supports **normal growth and development during pregnancy, childhood, and adolescence** [6-8] and is required for proper **sense of taste and smell** [9].

A daily intake of zinc is required to maintain a steady state because the body has no specialized zinc storage system [10].

The paragraph above from NIH confirms what a big deal zinc adequacy is and how many places in the body it is crucial. **But also notice that last sentence in the box above … that a <u>daily intake is required to maintain a steady state</u> because the body has no specialized zinc storage system.**

Hmmm … what are the implications of this for our patients?

FOODS THAT ARE GENEROUS SOURCES OF WELL-ABSORBED ZINC:

MEATS:

1. "Organic" vs "Inorganic" issues

Meats of all kinds contain iron in an especially absorbable. This is also called "**organic zinc"** … which essentially means that it comes from a critter and not a rock or a pill or a plant. This is an important distinction because **intestinal absorption** of organic zinc is not affected by the presence or absence of certain other substances in foods the way plant zinc is.

Zinc in the organic form is about well absorbed and "inorganic iron" is much less well absorbed … only 2% absorbed, and often considerably less. That is why this approach alone is often not very effective. Inorganic zinc is the kind in plants and in supplements with words like "sulfate" attached to the word zinc.

Interestingly, the presence of plants that contain substances like phytates, oxalates and tannins impair orgnanic zinc absorption much more than their effect on absorption of organic iron. This is one area of intestinal absorption in which zinc and iron differ in their response. Studies on the bioavailability of zinc in man II Absorption of zinc from organic and inorganic sources Translational Research: Journal of Laboratory and Clinical Medicine 1979 :94 (335-343)

Like other nutrients, and in particular iron, supplemental or dietary zinc does no good at all if it is not absorbed into the bloodstream from the intestines. It just passes right out in the stools.

In general, factors affecting zinc absorption are quite similar to the effects on absorption of various forms of organic and inorganic iron. This makes remembering it a lot easier because most people are aware of "iron deficiency anemia." If you know what is a great source of iron, you will find that it is likely also a great source of zinc … and things that enhance or decrease iron absorption will do the same to zinc. We

will examine a few of these later.

Most of us were taught that iron deficiency is the number one nutrient deficiency in the US. Actually, it is pretty much the only one we easily and regularly check in doctor's offices or WIC programs, etc. Hemoglobin and hematocrit are standard on a common lab panel, but a serum zinc level is not. **So, let's think about this …**

Fact 1: Iron deficiency is the most common (identified) nutrient deficiency in the US.

Fact 2: Food and supplement sources that improve or impair absorption of iron have almost the same effect on zinc.

Fact 3: GI factors (e.g. poorly controlled celiac disease, crohn's disease, bariatric surgery, PPI use, loss of stomach acid, etc.) that can impair absorption of iron have the same effect on zinc absorption. For example, a patient having iron deficiency is sometimes the clue that makes a physician screen a patient for celiac disease. Zinc deficiency would do the same … except for the fact that we rarely check it.

Fact 4. Another factor to consider in interpreting zinc from iron labs: Blood loss can be a contributor to relative iron deficiency in young women (especially those not on not on birth control medication) due to menstrual losses, and in people who have had serious injuries or surgery. So low iron from blood loss will not be a reliable indicator of likely zinc status. But for other causes of iron deficiency besides the blood loss issue, zinc status will mirror iron status.

Here's a question … does this mean that we need to get zinc levels on everybody?

No, it means that since we are already often getting labs to evaluate iron status, we should look at iron status labs as a potential clue or marker for compromised zinc status.

In other words … iron deficiency should raise our index of suspicion that zinc status might also be inadequate.

Fact 5: Supplemental inorganic iron (as sulfate) at a ratio of 1:1 to inorganic zinc (also as sulfate) slightly decreased zinc absorption. However, **ratios of 2:1 to 4:1 decreased zinc absorption significantly.** Organic forms had no effect on each other. This seems to illustrate that the inorganic zinc and iron are **competing for seats on the same transport vehicle, and they get on board in proportion to the relative amounts of**

each present.

Since in nature, the zinc and iron content of foods are fairly consistent, this would not be a problem. But in an artificially **iron-fortified world that lacks comparable zinc supplementation, iron supplementation because of perceived iron deficiency has the potential to:**

1) **Have us continue to fail to recognize the potential existence of zinc deficiency as well, and**

2) **Actually make zinc inadequacy worse by adding generous inorganic iron that will successfully further compete with zinc for absorption.**

Oh, fine!

2. "Meat Protein Factor"

In addition to being a generous source of absorbable iron, meat also has a special property of causing increased absorption of iron from the inorganic iron sources in the meal. In other words, the zinc and iron in chili beans will be much more easily absorbed if there is meat in the chili. This is called the "Meat Protein Factor" effect. It is not well understood how it works, but it clearly does increase absorption of inorganic zinc and iron in other foods and supplements, so it helps to further improve recovery from low iron stores.

3. Meat and other Critters: Variable AMOUNT of Zinc

The total AMOUNT of zinc animal-based foods … by far … is "eastern oysters." **They have five to ten times the amount of well-absorbed zinc as the amount found in any other creature.** Maybe we should explore recommending that folks enjoy a pre-surgery banquet of cooked oysters and liver pate prior to coming in for planned surgical procedures.

(Cautionary note: In this circumstance be sure the oysters are well cooked and not raw. Raw oysters have the potential to cause food-borne vibrio vulnificus infections, especially among people with any kind of liver problem, including alcoholic liver disease.) Chronic Liver Disease and Consumption of Raw Oysters: A Potentially Lethal Combination—A Review of Vibrio vulnificus Septicemia. The American Journal of Gastroenterology (2005) 100, 1195–1199.

The amount of zinc in different kinds of meat varies. Red meat is the next highest in absorbable zinc. Poultry and fish have much less zinc than red meat, but what

they have is still a much greater amount than what is found in plant foods, and it also much better absorbed than inorganic zinc.

Additionally, white meat chicken/turkey has less iron than dark meat. Think of the zinc and iron content of meat as "color-coded" … darkest is highest and the lightest is lowest. But all have the beneficial "Meat Protein Factor" effect described above, and because it is organic iron, the form of zinc is well absorbed.

Of cuts of meat, liver is an extremely generous source of absorbable zinc. This also includes foods made from liver like paté or liverwurst. These are not universally popular choices, however. (Helpful hint: if you are trying to eat liver for the zinc and iron it can provide, but you don't LIKE liver, it can be ground up and mixed in with hamburger to make chili or meatballs or meatloaf. You can add a lot of onions and spices to mask its presence.)

Foods That INCREASE Absorption of (Inorganic) Zinc and Iron:

Acid Foods

Any acid substance, including vinegar, citric acid and vitamin C (ascorbic acid) can enhance iron absorption from sources of inorganic zinc and iron (the form found in pills or plants, like ferrous or zinc sulfate.) Because of this, people identified as having iron deficiency are often advised to take their iron supplement or iron fortified cereal with orange juice, or some other acidic beverage. However, the size of the increase in absorption is not as great as many people think, so that intervention alone is not likely to be that helpful.

For example, inorganic iron and zinc are generally only about 2% (or less) absorbed, with some forms being much less absorbable than that because of substances in some foods that interfere with absorption. For that reason, the "take with orange juice" effect is a much less important factor affecting iron or zinc absorption than the highly absorbable and generous zinc and iron found in meat (especially oysters, red meat and liver.)

Hydrochloric acid production is also a factor, so people with low acid production

(achlorhydria) from aging or from using proton-pump inhibitor drigs (PPIs) will also absorb inorganic zinc and iron less well. Acidity and alkalinity do not affect absorption of organic iron, so there is no special iron- or zinc-absorption benefit associated with eating liver with orange juice or dousing it with ketchup (a vinegar- containing food), although the latter may make it more palatable to some people … and ketchup is also a great source of the red plant pigment lycopene … a potent antioxidant! ☺

Foods That DECREASE Absorption of (Inorganic) Zinc and Iron:

As described above, the presence of acid and/or meat contributes to improved absorption of inorganic iron. Other food substances can significantly impair absorption of inorganic iron but they have minimal effect on absorption of organic iron. **For example, the organic zinc and iron are about 20% absorbed, which is at least ten times as well absorbed as any inorganic iron. In addition, the per cent of absorption of inorganic iron is much more likely to be negatively affected by other substances in a meal.**

Dairy Foods

Dairy foods are notoriously poor sources of iron and zinc and they also decrease absorption of the iron and zinc in plants and pills. That means that taking iron or zinc supplements with milk, or putting milk on iron- or zinc-fortified cereal, or cheese on a sandwich can result in less of the iron present in the pill, cereal or bread being absorbed. This is one of the issues behind the phenomenon of iron deficiency anemia in infants and toddlers who have cow or goat milk in place of mother's milk or iron fortified formulas. **So, yes, milk "has" some iron and zinc, but it is not well absorbed and it actually impairs absorption of zinc and iron from inorganic sources.**

A Bit of History:

When I started working in nutrition this kind of iron deficiency anemia condition was common, and it was called **"cow's milk anemia."** It is much less common today because the WIC Program (Women, Infants and Children Supplemental Food Program) came along in the late 1970s and it has done a lot to prevent infants being fed cow's milk or goat's milk too early. Before WIC, babies in low-income families were often fed those low-iron milks much earlier than was recommended because of the relative cost of **iron-**

fortified infant formula.

[I am including this historical vignette here in my zinc paper because that the same situation would have been true about the babies' zinc status that we observed with their poor iron status … we just didn't know anything about that way back then, and hemoglobin was the only lab test at our disposal. Result: We just assumed zinc was fine and did nothing about it.]

An even bigger thing WIC has done that has had a tremendous effect on reducing the incidence of cow's milk anemia (and likely unrecognized inadequate zinc status as well) is that they **promote and support breastfeeding**. The zinc and iron in human milk is extremely well-absorbed. Absorption has been described as between 20-50% absorption, which is WAY better than the absorption of iron in formula or cereal even if orange juice is fed at the same time.

Breastfeeding is wildly more common now, but in those days WIC was essentially a pioneer in promoting the benefits of breastfeeding … even when we did not yet know what a lot of them were!

[**Side note: the iron and zinc content of human milk drops sharply after 6 months**, so after that period it is advisable to supplement by introducing meat, or giving a crushed children's chewable multivitamin with minerals that contains both iron and zinc. Most liquid baby vitamin drops have no minerals at all except possibly iron and fluoride. They also provide no folic acid and often no vitamin B12 … I realize that I am making a point sort of unrelated to the overall topic, but I just can't help myself!]

Another contributor to "cow's milk anemia" in toddlers (and, of course, likely unrecognized inadequate zinc status as well,) is drinking quite a lot of cow's milk or goat's milk, which serves to displace other foods that are good sources of iron and zinc. This is in addition to the role of cow's milk in actually impairing iron and zinc absorption from those foods.

Not surprisingly, this effect is most likely seen in children who also do not eat much meat (which would be unaffected by milk consumption) and those who also do not take a multivitamin with minerals, which would at least have provided a higher amount of inorganic iron plus vitamin C in the same tablet.

But keep in mind that it is not at all uncommon still for iron to be the only mineral in many products ordered by health care professionals…these are often still called something like "a multivitamin with iron," and that is often the way prescriptions are worded as well, with predictable results. It is sometimes the only "pickable" option in electronic medical records.

A good educational step we might take is to be sure people are at least ordering something like "a complete-type multivitamin with minerals" … recognizing that none of them is actually "complete." But the "complete-type" will at least have some inorganic zinc PRESENT with the inorganic iron, as discussed earlier, which can affect zinc absorption … and other nutrients.

A BIG IDEA:
IRON IS NOT THE ONLY MICRONUTRIENT THAT MATTERS AND IT IS NOT THE ONLY ONE MOST LIKELY TO BE INADEQUATE IN PATIENTS.

Tea

Tea contains "tannins," plant substances that bind iron and zinc very well in the intestines and significantly reduces its absorbability. **This effect is so marked that tea is the one food shown to be interfere with iron absorption enough to be helpful for people who have a serious genetic condition called hemochromatosis**, a problem that causes them to absorbing way too much iron. And, as seen before, the consumption of tea has the most marked effect in decreasing absorption of inorganic iron and zinc compared with meat (organic) iron.

Here is an example of a clinical trial showing the effect of regular tea drinking on absorption of iron even among people with hemochromatosis which causes dangerously high iron accumulation. (Gut. 1998;43(5):699-704.):

"A significant reduction in iron absorption was observed when the test meal was accompanied by drinks of tea instead of water. In the tea drinking group, the increase in storage iron was reduced by about one third compared with that of the control group."

Note that Hemochromatosis is a very dangerous condition, and it is now known to be much more common than previously thought. However, it is often unrecognized until it has caused serious injury.

For information on nutrition factors that can be helpful in this condition that causes excessive iron absorption, please see my paper "Aunt Cathy's Guide to Nutrition: Nutrition Support of Hemochromatosis Therapy."

Bottom line, tea has many other excellent healthful properties, but for people with iron deficiency and/or zinc deficiency it is important to remember that helping them to improve iron and zinc status is <u>not</u> one of them.

Leafy Greens

Traditional nutrition advice still commonly given is to correct iron deficiency anemia by eating spinach. Spinach is a terrific food to include in your diet for many reasons, but unlike other iron-rich foods it is NOT a terrific zinc source.

Additionally, many leafy foods like spinach contain "**oxalates**" that bind up iron and zinc in the intestinal tract and make it too big a molecule to be absorbed well. This is true even though the iron and vitamin C content of the spinach is generous. Some green plants like broccoli do <u>not</u> have oxalates and so their iron and zinc is better absorbed.

As noted before, leafy green plants are extremely nutritious foods and a very important part of a healthy diet. They provide **lutein** (a potent antioxidant that is a green phytochemical pigment with a special role in preventing or slowing the development of macular degeneration … the #2 cause of blindness in America. They are also low in calories and fat and sugar and salt … what's not to like?

Dark leafy greens also provide **vitamin K**, a nutrient now known to be critical for prevention of osteoporosis and the calcification of arteries but found to be inadequate in the diets of many people. A generous amount of many other nutrients are also provided in these foods. **So <u>do</u> eat these foods for <u>many</u> reasons …. <u>just don't rely on the oxalate-containing ones to solve the problem if a person is iron or zinc deficient</u>.**

For information on nutrition factors that are provided by dark leafy greens, please see my paper "Aunt Cathy's Guide to Nutrition: Vitamin K," "Aunt Cathy's Guide to Nutrition: My Top Five Easy Ways to Improve Your Family's Health" and "Aunt Cathy's Guide to Nutrition: Some Ideas for Trying to Eat More of Those Terrific Antioxidant Phytochemicals . . . and Liking It."

Bran

The bran is the fibrous coating on grains. Bran contains "**phytates**" which impair

iron absorption as tannins and oxalates do. For that reason, taking a bowl of iron-fortified bran cereal in milk along with a cup of tea is not the best way to get inorganic iron and zinc where you want it to go. Some grains naturally contain less phytate than others, but it is still an issue. Some other grains are used more commonly in other parts of the world, like "teff" … a very common food in parts of Africa, and they are especially high in phytates. People's absorption of inorganic iron and zinc is greatly affected.

Eggs

Interestingly, although in the 1950s egg yolk used to be fed to infants as an iron source, the form of iron in eggs has been found to be poorly absorbed. Eggs are an excellent source of protein (the protein in one egg is like the amount in 1 ounce of meat) and other beneficial nutrients as well such as choline and biotin in particular. The egg white has most of the protein (6 of the 7 grams) and essentially none of the iron at all. Nearly all of the iron is in the yolk. **So eggs are still a terrific food, but not a good iron source.**

Iron-Fortified Foods

Iron or zinc "fortification" involves adding inorganic iron or zinc to foods that would not usually have much of either one. This includes milk-based infant formulas or similar "nutrition beverages" for adults or children. **"Fortified"** also can mean that the iron or zinc (or another nutrient) was added to achieve a level higher than would naturally be in the food.

"Total"-type cereals are an example: it is fortified to provide **18 mg of inorganic iron per cup compared with 4.5 mg of inorganic iron in a cup of a similar but unfortified whole wheat cereal like regular wheat flakes.**

"Enrichment" means that a nutrient was removed by processing but then it was added back to the level it contained before processing. In America, iron but not zinc is added back to refined grains. The available iron and zinc naturally in the grains is in the "germ" part of the grain that is lost when grains are refined.

Unfortunately, we do not add back any other minerals …only iron … and only three B vitamins are added back (B1, B2 and B3.) That is all … no zinc, no magnesium,

no chromium, no vitamin E, etc.

This is one of the reasons why "**whole grain" products (containing the germ and bran) are nutritionally superior to enriched grains.** However, the term "enriched" is confusing … it makes it sound like a food is extra nutritious, not much less nutritious.

An interesting aside:

In 1998, processed grains products, whole or enriched, began to have the B vitamin "folic acid" added to improve the folic acid status of Americans.

This was food "**fortification**"… a nutrient was added that was not there very much naturally. The form of the vitamin (crystalline folic acid) was also one that was much easier for many people to absorb than plant forms.

This nutrient addition resulted in a 50% drop in the rate of certain birth defects like spina bifida, and also a drop of 10-15% in stroke rates across America.

Assuring adequacy of micronutrients can be a very powerful Public Health AND Clinical Nutrition tool!

The iron content of commercial cereals can be quite variable, depending on the enrichment or fortification of the product. For example, "Quick" iron-fortified cream-of-wheat has over 15 mg of (inorganic) iron per cup, but unfortified cream-of-wheat or oatmeal only has about 2 mg.

Foods that have had iron added will indicate that they are fortified or enriched with iron if you check the label. The words "ferrous" or "ferric" in the ingredient list is an indication of inorganic iron being added. Most are not fortified with zinc, but if they are it would typically be as zinc sulfate.

Some Potentially Useful (and Important) Nutrition Teaching Tools:

The removal of so many of the nutrients in grain when they are "**enriched**," and the suggestion from this term that the grain product is made to be more nutritious than before has caused considerable confusion. It has also contributed to common nutrition problems

in America with major consequences. These include a poor intake of magnesium and chromium, which contributes to diabetes and several other serious conditions.

For that reason, I teach my clients to **think of "EN-riched" as "UN-riched"** because so many nutrients are removed and not added back. Instead, we should **include more "Baby Plants"** in our diets, [seeds, nuts, legumes (e.g. beans, peas, peanuts and lentils) and the germ part of whole grains. Baby plants are loaded with good nutrition.

For more on this please see my other papers "Aunt Cathy's Guide to Nutrition: My Top Five Easy Ways to Improve Your Family's Health," "Aunt Cathy's Guide to Nutrition: Magnesium," "Aunt Cathy's Guide to Nutrition: Chromium," and "Aunt Cathy's Guide to Nutrition: OTHER Nutrition Issues in Diabetes."

The amount of iron and zinc contained naturally in some other foods

(See separate chart for zinc and iron content of many foods)

Legumes (like lima beans, chili beans, lentils, peas and peanuts) have about 5-6 mg of iron and 2 mg zinc per cup, but vegetables like carrots have only about 1 mg. (But I still want you to eat your carrots for reasons other than iron content. ☺)

Prune juice contains quite a lot of iron (over 9 mg per cup compared with about 1 mg per cup of other fruit juices) and it naturally contains some other substances that help one avoid the constipation issues. Absorbability of the iron has not been well studied, however.

Three Important Points:

1. **As you can see on the chart, the foods highest in absorbable iron tend to also be highest in absorbable zinc, and vice versa.**

2. **Iron deficiency is the most often recognized nutrient deficiency in the USA, but that is generally because it is the only one we actually look for by easily checking hemoglobin levels.**

3. **So unless the person is anemic because of actual blood loss, a person who is found to be iron deficient and living in our "iron fortified/ enriched" world could easily have unrecognized poor**

<u>zinc status as well.</u> Happily, zinc inadequacy is similarly best corrected by foods that also are best at correcting iron deficiency.

Zinc status is important in **iron deficiency anemia** as well because inadequate zinc can also impair the production of red blood cells, even if there is plenty of iron available to make hemoglobin.

But zinc is important for much more than that. As described earlier, zinc is involved in over 200 processes in the body but it is harder to evaluate with labs than iron is, so it is regularly not identified unless a nutrition history asking about meat consumption and supplement use, etc. is obtained. That does not happen often either.

Impaired zinc status will interfere with the production of DNA … the genetic center of every cell … so adequacy of zinc is critical for **growth and wound healing**. It is also a key factor in the **functioning of the immune system** because production of T-cells is very zinc-dependent.

Breaking down **alcohol** also requires zinc because it is needed by the enzyme alcohol dehydrogenase. So combinations of alcohol exposure AND inadequate zinc status can make the all the damaging effects of alcohol abuse even more severe.

A mnemonic to help to sort out and remember important nutrition issues to consider: "FATSUE" *

F	**F**orm the nutrient is in (organic, inorganic, food, pellet, liquid, etc.)
A	**A**mount of the nutrient taken in, and **A**bsorbability in the intestine of that nutrient in that form (including size, pH, competition, stomach and intestinal health)
T	**T**ransport of the nutrient in the body (example: iron relies on copper to move it from liver stores to the bone marrow, so inadequate copper LOOKS LIKE iron deficiency even if iron stores are generous.
S	**S**torage of the nutrient --- (some are stored, some are not; which nutrients are which? In what form is it stored and where?)
U	**U**tilization of the nutrient (can it be used normally? Example: can a person successfully convert the pigment beta-carotene into the hormone retinol, and

	25 hydroxyvitamin D into the hormone dihydroxyvitamin D? If not, the <u>amount</u> you take in as food or supplements may not matter much.)
E	**E**xcretion of the nutrient (Is it excreted? Is it lost some other way? How and where? How do we get rid of iron and zinc?)

* I made this up and that's what it spelled. Apologies to anybody named Sue. ☹