

What is a carbohydrate?

Success with the Zone Diet depends upon restricting the amount of carbohydrates consumed while maximizing the vitamins and minerals derived from them. Unfortunately, many people have trouble recognizing what a carbohydrate is because they think of carbohydrates as only pasta and sweets. In reality, fruits and vegetables are also carbohydrates. An easy way to remember this is that "carbohydrates grow in the ground, and don't move around." Pasta must be a carbohydrate, since it comes from wheat, which grows in the ground. Likewise, vegetables, such as broccoli grow in the ground, so they, too, must be carbohydrates. Finally, fruits, such as apples come from trees that grow in the ground, which makes them carbohydrates also. Although this may seem simplistic, the fact that fruits and vegetables are carbohydrates is a major revelation to many Americans.

INSULIN-STIMULATING CARBOHYDRATE CONTENT

Since the Zone Diet is about insulin control, you have to realize that not all carbohydrates affect insulin equally. Every complex carbohydrate must be broken down into simple sugars and will eventually enter the bloodstream as glucose, which in turn will have a stimulatory effect on insulin secretion. Fiber (both soluble and insoluble) cannot be broken down into simple sugars, and therefore it will have no impact on insulin. Taking this into account, I developed the concept of insulin-stimulating carbohydrate content for a food. Simply stated, this is the total amount of carbohydrate a food source contains minus its fiber content (which is usually included in determining the total amount of carbohydrates).

If a carbohydrate source (such as pasta) has very little fiber content, then virtually all of its listed carbohydrate content will be insulin-stimulating carbohydrate. On the other hand, if a carbohydrate source is rich in fiber (such as broccoli), then its insulin-stimulating carbohydrate content will be significantly reduced. This means that more volume of fiber-rich carbohydrate source must be consumed to have the same impact on insulin secretion as a much smaller volume of low-fiber content carbohydrate (see Table 1).

Table 1. Amounts of Insulin-Stimulating Carbohydrates in Various Food Volumes

Food	Volume	Total Carbs (g)	Fiber (g)	Insulin-stimulating carbs (g)
Pasta	1 cup	40	2	38
Apple	1 medium	20	4	16
Broccoli	1 cup	7	4	3

You can quickly see that you would have to eat a tremendous volume of broccoli (approximately 12 cups) to have the same impact on insulin as eating a relatively small amount of cooked pasta. This is why starches and grains are considered high-density carbohydrates, whereas fruits are medium-density carbohydrates, and vegetables are low-density carbohydrates. The Zone Diet relies heavily on low-density carbohydrates, so large volumes of food must be consumed in order to have an appreciable impact on insulin. This is also why high-density carbohydrates are used in moderation on the Zone Diet because very small volumes can stimulate excess insulin production.

ZONE BLOCKS OF CARBOHYDRATE

Zone Food Blocks are simply a way of putting various carbohydrates on an equal footing regarding their insulin-stimulating effect. I define a Zone Block of carbohydrate as a volume containing 9 grams of insulin-stimulating carbohydrate. So let's return to the above example, and determine the approximate amount of Zone Carbohydrate Food Blocks in each of the sources (see Table 2).

Table 2. Zone Food Block Calculations

Food	Volume	Insulin-stimulating carbs (g)	Approx. Zone carb. blocks
Pasta	1 cup	38	$38/9 = 4$
Apple	1 medium	16	$16/9 = 2$
Broccoli	1 cup	3	$3/9 = 1/3$

These numbers aren't too easy to remember, so I simplified them by normalizing the volume of the carbohydrate source required to make one Zone Carbohydrate Food Block. This is accomplished by dividing the volume of a carbohydrate source in Table 2 by the number of Zone Carbohydrate Food Blocks in that same source. Then you round that number to an approximate volume that you can easily remember, as shown in Table 3.

Table 3. Zone Carbohydrate Block Calculations Simplified

Food	Zone carb blocks in volume	Volume of Zone carb blocks
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Pasta	1 cup has 4 Zone food blocks	1/4 cup
Apple	1 medium has 2 Zone food blocks	1/2 apple
Broccoli	1 cup has 1/3 Zone food block	3 cups

Now you have a way to compare carbohydrates directly with their ability to stimulate insulin secretion. A more complete listing of these [Zone Food Blocks](#) containing carbohydrates is found in the Zone Resources section of this web site.

The Concepts of Glycemic Index and Glycemic Load

One of the major nutrition breakthroughs was the development of the concept of the glycemic index. It was always thought that there were only simple and complex carbohydrates. The simple ones would enter the bloodstream rapidly, whereas the complex carbohydrates would be slowly broken down, thus providing sustained release over time. From this seemingly reasonable concept, came the nutritional "wisdom" that eventually led to the development of the USDA Food Pyramid.

Unfortunately, research began to rear its ugly head when investigators began to ask whether or not such simplistic thinking was justified. Lo and behold, it wasn't. Some simple carbohydrates, such as fructose, entered the bloodstream as glucose very slowly. On the other hand, some complex carbohydrates, such as potatoes, entered the bloodstream at a faster rate than table sugar. The explanation of this apparent paradox led to the development of the concept of the glycemic index.

The glycemic index is a measure of the entry rates of various carbohydrate sources into the bloodstream. The faster their rate of entry, the greater the effect on insulin secretion. There are three factors that affect the glycemic index of a particular carbohydrate. The first is the amount of fiber (and especially soluble fiber) a carbohydrate contains; the second is the amount of fat found in the carbohydrate source (the more fat consumed with the carbohydrate, the slower the rate of entry into the bloodstream); the third is the composition of the complex carbohydrate itself. The greater the amount of glucose it contains, the higher the glycemic index; whereas the more fructose a carbohydrate contains, the lower the glycemic index. This is because fructose cannot enter into the bloodstream without first being converted into glucose, a relatively slow process that takes place in the liver.

With time the glycemic index soon became the new fashionable guideline to determine which carbohydrates to eat. However, the glycemic index had significant experimental problems in dealing with low-density carbohydrates, such as vegetables.

The difficulties arose because determination of the glycemic index requires that a sufficient intake of carbohydrate (usually 50 grams) be consumed. But it is simply too difficult to consume this amount of carbohydrate from most vegetables at a sitting. For instance this would require consuming about 16 cups of steamed broccoli. As a result, nearly all the glycemic index work has been done with grains, starches, and some fruits, and virtually nothing is known about the glycemic index of low-density vegetables that are the backbone of the Zone Diet.

These difficulties have given rise to a more sophisticated understanding known as the *glycemic load*, which is far more important than the glycemic index in determining the insulin output of a meal. The glycemic load is the actual amount of insulin-stimulating carbohydrates consumed multiplied by its glycemic index. This reflects the reality that a small volume of high-glycemic carbohydrates has the same impact on insulin as a large volume of low-glycemic carbohydrates. Therefore, eating too many low-glycemic carbohydrates can have a major effect on increased insulin production. For example, black beans have a low-glycemic index because of their high fiber content. However, they are also very dense in carbohydrate content. As a result, eating too many black beans at a meal can have a very great stimulatory effect on insulin.

Ultimately, a healthy diet is obtained through insulin moderation, which can best be achieved by primarily consuming low-density carbohydrates that also have a low-glycemic index. That means eating a lot of vegetables. To illustrate this concept, Table 4 examines three distinct carbohydrate sources in the volumes which they are typically consumed. The glycemic load is the product of the number of grams of insulin-stimulating carbohydrate times the glycemic index for that carbohydrate. The lower the glycemic load number, the lower the insulin stimulation of that carbohydrate.

Table 4. Comparison of Different Glycemic Loads

Source	Typical volume (grams)	Glycemic index	Glycemic load
Pasta	1 cup	59	2242
Apple	1	54	864
Broccoli	1 cup	50*	150

*Estimated from the glycemic index of various boiled beans

Even though the glycemic index of each of these carbohydrates is about the same, 1 cup of pasta generates 20 times the insulin response as 1 cup of broccoli. And a single apple generates about 6 times the insulin response as the 1 cup of

broccoli. It is clear that a glycemic load based on the serving size of carbohydrate is a much more valuable tool than using the glycemic index. Table 5 lists the various glycemic loads of a wide variety of carbohydrates. For vegetables that have never been tested for their glycemic index, I have used an estimate of 50 (although it could be considerably lower in reality) as I did in Table 4.

Table 5. Glycemic Loads of Various Tested Carbohydrates

Source	Typical volume	Grams	Glycemic index	Glycemic load
Fruits				
Apple	1	18	54	864
Apple juice	8 oz.	29	57	1653
Apricot	1	4	81	324
Banana (med.)	1	32	79	2528
Cantaloupe	1 cup	15	65	975
Cherries	10	10	31	310
Grapefruit	1	10	36	360
Grapefruit juice	8 oz.	22	69	1518
Grapes	1 cup	15	66	990
Kiwi	1	8	74	592
Mango (medium)	1	33	80	2640
Orange (medium)	1	10	63	630
Orange juice	8 oz.	26	66	1716
Papaya (medium)	1	28	83	2324
Peach	1	7	40	280
Pear	1	21	54	1134
Plum	1	7	56	392
Raisins	1 cup	112	91	10192
Watermelon	1 cup	11	103	1133
Legumes				
Black beans (boiled)	1 cup	41	43	1763
Black bean soup	1 cup	38	91	3458
Chickpeas (boiled)	1 cup	46	47	2162
Fava beans (boiled)	1 cup	34	113	3978
Kidney beans (boiled)	1 cup	40	39	1560
Kidney beans (canned)	1 cup	38	74	2812
Lentils (boiled)	1 cup	32	43	1376
Navy beans (boiled)	1 cup	38	54	2052
Pinto beans (canned)	1 cup	36	64	2304
Soy beans (boiled)	1 cup	20	26	520
Breads and pasta				
Bagel, small	1	38	103	3914
Bread, dark rye	1 slice	18	109	1962
Bread, sourdough	1 slice	20	74	1480
Bread, white	1 slice	12	100	1200
Bread, whole-wheat	1 slice	13	99	1287
Croissant (medium)	1	27	96	2592
Hamburger bun	1	22	86	1892
Kaiser roll	1	34	104	3536
Linguine pasta (thin)	1 cup	56	79	4424
Macaroni	1 cup	52	64	3328
Pita bread	1	35	81	2835
Pizza	1 slice	28	86	2408
Spaghetti	1 cup	52	59	3086
Starches, grains and cereals				
Barley (boiled)	1 cup	44	36	1584
Bulgur (cooked)	1 cup	31	69	2139
Cherrios	1 cup	23	106	2438
Couscous (cooked)	1 cup	42	93	3906
Corn, sweet (canned)	1 cup	30	79	2370
Corn Chex	1 cup	26	119	3094
Corn Flakes	1 cup	24	120	2880
Grapenuts	1 cup	108	96	10368

Oatmeal (slow-cooking)	1 cup	24	70	1680
Potato, red (boiled)	1	15	126	1890
Potato, white (boiled)	1	24	90	2160
Potato, white (mashed)	1 cup	40	100	4000
Rice cakes	3	23	117	2691
Rice Chex	1 cup	22	127	2794
Rice Krispies	1 cup	21	117	2457
Rice, white	1 cup	42	103	4326
Rice, brown	1 cup	37	79	2923
Dairy products				
Milk (low-fat)	1 cup	11	43	473
Soy milk	1 cup	14	44	616
Frozen tofu	1 cup	42	164	6888
Yogurt (plain)	1 cup	17	20	340
Vegetables (cooked)				
Artichoke hearts	1 cup	7	50*	350
Bok choy	1 cup	2	50*	100
Broccoli	1 cup	2	50*	100
Cabbage	1 cup	2	50*	50
Collard greens	1 cup	3	50*	150
Eggplant	1 cup	5	50*	250
Kale	1 cup	3	50*	150
Mushrooms	1 cup	3	50*	150
Onions	1 cup	14	50*	700
String beans	1 cup	5	50*	250
Swiss chard	1 cup	4	50*	200
Spinach	1 cup	2	50*	150
Zucchini	1 cup	4	50*	200

*Estimated glycemic index of 50

Others

Coca-Cola (regular)	1	39	90	3510
Fructose	1 packet	3	33	100
Gatorade	8 oz.	14	111	1554
Granola bar	1	23	87	2001
Honey	1 tablespoon	16	83	1328
Power Bar	1	45	83	3735
Snickers bar	1	36	59	2124
Table sugar	1 teaspoon	4	93	372

A good rule is that you should not consume a glycemic load of more than 3,000 units in any one meal. As you can see from the data, if you are eating low-density carbohydrates it is very difficult to have a meal with a high glycemic load. On the other hand, eating typical volumes of grain and other starch-based carbohydrates gives a meal a very high glycemic load and results in a far greater insulin response.

And you can also understand why many of the carbohydrates found in traditional grain-based vegetarian diets are likely to dramatically increase insulin levels. For example, white rice generates a tremendous amount of insulin response compared to the same volume of oatmeal or barley because rice has a greater glycemic load. Likewise, most breakfast cereals will have the same impact on insulin as a Snickers bar, since their glycemic loads are approximately the same. Meanwhile cooked vegetables represent a very low glycemic load, which is why they are a critical component of the Zone Diet.

But remember that the more processed a food, the higher the glycemic load. This is why boiled beans have a much lower glycemic load than the same volume of canned beans. And when you make any bean (like black beans) into a soup, the glycemic load skyrockets because the prolonged cooking breaks down the cell walls of the bean making it easier for the body to digest it into simple sugars for absorption.

Thus using the glycemic load concept, it is also becomes clear why consuming most of your carbohydrates from vegetables is the key to maintaining insulin levels within an appropriate zone.

VITAMIN AND MINERAL Contents

Another major goal in the Zone Diet is to consume as many vitamins and minerals as possible from carbohydrate sources with the least insulin-stimulating ability. This is easily achieved by using low glycemic load carbohydrates, especially vegetables, which are great storehouses for both vitamins and minerals, whereas fruits are especially rich in anti-oxidant vitamins. Starches, by contrast, are relatively poor sources of both vitamins and minerals, especially when you consider

the amount of insulin they can stimulate.

In order to compare various types of carbohydrates, Table 6 lists serving sizes of typical carbohydrates that contain 1 Zone Block along with their vitamin and mineral contents.

Table 6. Vitamin and Mineral Content of 1 Zone Block Servings of Typical Carbohydrates

A. Vegetables (cooked and drained)

Carb	Amount	Vit. A	Vit. C	Folic Acid	Magnesium	Calcium	Fiber
Asparagus	1 cup	940	19.5	262	18	36	3
Broccoli	3 cups	6,492	348	234	114	210	13.2
Cauliflower	4 cups	88	216	216	48	80	12.8
Green beans	1 cup	832	12	41	31	57	4
Kale	2 cups	16,000	34	36	46	556	5.2
Okra	1 cup	920	26	72	90	100	4
Onions (cooked)	1/2 cup	0	5.5	17	11.5	23	1.5
Red pepper	2 cups	10,224	464	48	28	26	3.2
Spinach	3.5 cups	51,600	62	917	546	854	15
Swiss chard	2.5 cups	10,986	63	30	300	203	7.4
Zucchini	2 cups	864	16	60	80	46	5

B. Fruits

Carb	Amount	Vit. A	Vit. C	Folic Acid	Magnesium	Calcium	Fiber
Blueberries	1/2 cup	72	9.4	4.5	3.5	4.4	1.8
Cantaloupe	3/4 cup	3,771	49	19.5	12.8	13.2	1.0
Grapes	1/2 cup	46	3.3	1.8	2.3	6.4	0.5
Kiwi	1	133	57	1.0	23	19	2.5
Nectarine	1/2	500	3.7	2.5	5.4	3.8	1.1
Orange	1/2	12	40	23	7	28	1.8
Peach	1	53	6.5	3.3	6.8	4.9	2
Pear	1/2	17	3.3	6	4.9	9.1	2
Plum	1	217	6.3	1.4	4.6	2.6	0.9
Raspberries	1 cup	159	31	33	22	27	8.3
Strawberries	1 cup	45	94	29	17	23	3.8

C. Starches (cooked and drained)

Carb	Amount	Vit. A	Vit. C	Folic Acid	Magnesium	Calcium	Fiber
Rice, brown	1/5 cup	0	0	1.6	21	3.9	0.7
Rice, white	1/5 cup	0	0	1.2	6.3	3.8	0
Spaghetti, whole wheat	1/4 cup	0	0	2.5	6.3	2.0	0.6
Potato, baked	1/4	0	5	3.5	9.8	1.9	0.6
Bread, white	1 slice	0	0	3	6	27	0.6
Bagel, small	1/4	0	0	3.9	5	13	0.4

It's easy to see why most of your vitamins and minerals will come from vegetables coupled with additional fruits. You can also see why starches, grains, and pasta are very poor nutritional choices for virtually any diet considering the amounts of carbohydrates they bring to the table. This is why they are used as condiments on the Zone Diet.