



# Let's Juice! What the Glycemic Index Really Says About Carrot Juice and Blood Glucose

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## Abstract

Carrot juice is an integral part of The Hallelujah Diet<sup>sm</sup>. The effect of carrot juice on blood sugar was tested. Through this study we measured the glycemic index of carrot juice to be 86, on a scale where the glycemic index of bread is 100. The glycemic response of carrot juice was lowered to 66 by consuming oil along with the juice. Chromium was also found to be beneficial for 4 of 6 people who participated in a 1-week supplement test. Carrot juice is likely to cause fewer problems to individuals struggling to lower their blood sugar than animal fats, refined sugar, bread, and flour products.

## Introduction

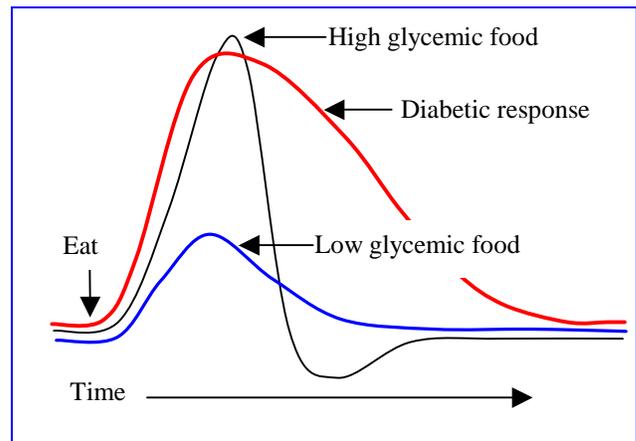
The Hallelujah Diet<sup>sm</sup> is a pure vegetarian diet emphasizing raw fruits and vegetables along with the use of freshly extracted vegetable juices and Barleygreen. An integral part of The Hallelujah Diet<sup>sm</sup> is carrot juice. The carrot juice might include small amounts of leafy greens and other vegetables, but the principle ingredient in the juice is carrot.

The carrot is a root vegetable that contains a substantial amount of sugar. A 100-gram serving of raw carrots contains a total of 6.6 grams of sugar (1). It is estimated that a cup (~230 ml) of carrot juice contains 14 grams of sugar (1).

**Blood sugar control.** Sugar is a very metabolically active component of food. The intake of sugar (whether natural, in foods, or in a refined, concentrated form) causes a rise in blood glucose, as depicted in Figure 1. This rise in blood glucose stimulates the secretion of insulin by the pancreas. Insulin causes the cells of the body to take up glucose and store it as glycogen to be released at a later time. Often, if the rise in blood glucose is rapid, the pancreas will secrete too much insulin. Too much of the glucose will be sent to storage, leaving a deficit in the blood stream—a reactive hypoglycemic effect. So, the high blood glucose peak is followed by a low glucose valley. It can be a real roller coaster ride for the body, causing metabolic disaster over a long period of time. This is one type of loss of blood glucose control. Type I diabetics (insulin-dependent) and people consuming high-sugar, high-fat diets are susceptible to this type of hypoglycemic effect.

Another way to lose control of blood sugar occurs as people age, increase in body fat, and become less conditioned. In this state the body becomes less

sensitive to the effects of insulin. So, more insulin is required to do the same amount of work that just a small amount of insulin was able to do previously. The body produces more and more insulin in its attempt to lower blood sugar concentrations to healthy levels. Over time this person develops what is called adult-onset, or type II, diabetes. In this diabetic state, when a person consumes carbohydrates their blood sugar rises quickly, but returns to normal very slowly (see Figure 1). Their body is resistant to the action of insulin and blood sugar levels always run high. Sugar will spill over into the urine as the body desperately tries to get rid of the sugar.



**Figure 1. Blood sugar response.** Depicted are a normal response to a high glycemic load and to a low glycemic load, and a Type II diabetic's response to a high glycemic load.

Elevated blood glucose is not near as detrimental in itself as is the accompanying elevated insulin levels. Elevated insulin levels cause many of the side effects of diabetes—high blood pressure, weight gain, retinal degeneration and blindness, peripheral neuropathies and amputation, kidney damage and failure, and heart disease. By controlling blood glucose in a normal range (and preferably in the low-normal range) these side effects are dampened, even eliminated. So, it is important to understand how carrot juice affects the control of blood glucose.

**Glycemic index.** Complex carbohydrates are converted into sugars in the body, through digestion. The rate of starch digestion depends on the amount of carbohydrate, the type of monosaccharides present (glucose, galactose, fructose), the nature of the starch (straight or branched chain, resistant), form of the food,

starch particle size, and degree of food processing. All of these factors affect how much and how quickly a food will cause a rise in blood sugar. These factors are all taken into account intrinsically with the glycemic index. The glycemic index of some common foods is given in Table 1.

The glycemic index is a normalized measurement of blood glucose response to food. The official definition of the glycemic index is “the incremental area under the blood response curve of a 50g carbohydrate portion of a test food expressed as a percent of the response to the same amount of carbohydrate from a standard food taken by the same subject.” (2) The standard is either pure glucose or white bread. Because the glycemic index is normalized, the variation between individuals’ responses to carbohydrate is removed, and the results are more easily applied to other individuals.

**Table 1. Glycemic Index of some common foods (3).**

Food	GI	Food	GI
Baked potato	121	Yam	73
Bread	100	Oatmeal	70
Dry beans	40	Beans, canned	60-75
Banana	77	Dates	146
Apple	54	Apple juice	58
Pasta	53-65	Nuts	16-32
Sucrose	92	Fructose	32

The question we will address in this study is this: what is the effect of carrot juice on blood glucose levels? What is the Glycemic index of carrot juice? This question is a concern for people, especially people who already know they are sensitive to large sugar intakes. This question is particularly important for diabetics who wish to regain their health. Is it best for them to stay away from carrot juice and its health benefits, or can they consume it safely? This question is a concern for others, too, who desire their blood sugar to stay in the low normal range, which is correlated with high resistance to infection.

Along with this question of carrot juice and blood sugar, we will explore ways to decrease the rate of blood sugar rise when drinking carrot juice. It is well known that fat will decrease the rate of gastric emptying. Large effects are seen when 0.5 – 1.0 g fat / g carbohydrate are added to a test meal (4). Consuming Udo’s Oil along with the carrot juice will likely slow down the rate of blood glucose increase. We tested whether or not including Udo’s oil along with the carrot juice would alter the area under the glucose response curve (glycemic index).

A second method of reducing the glycemic index of carrot juice will also be examined—using chromium to

boost the effectiveness of insulin to respond quickly to a carbohydrate load. Chromium, as part of the Glucose Tolerance Factor, is a trace mineral that is a necessary co-factor for insulin’s action. Chromium makes the body more sensitive to the action of insulin, possibly by several mechanisms. Individuals who have impaired glucose tolerance can often improve their glucose tolerance by supplementation with chromium (5-9). A review of controlled interventions with subjects who had impaired glucose tolerance found that in 12 of 15 studies chromium had a beneficial effect on insulin sensitivity or blood lipid profile (10). Many diabetics have low levels of chromium possibly due to a higher requirement for chromium in the diabetic state (7).

## Methods

### Subjects

6 volunteers (2 females, 4 males) were recruited from Hallelujah Acres to participate in this study. An oral presentation of the study was given, along with a written informed consent document, and written informed consent was received from each volunteer before participating in the study.

Physical characteristics (age, sex, height, weight, % body fat) were gathered for each subject. A short food-screener was administered to determine usual food intake patterns of the volunteers.

### Test Protocol

**Juice Preparation and analysis.** Carrot juice was made using a commercial juicer (Model X-1, Goodnature Products, Inc., Buffalo, NY) on Monday and Wednesday mornings in the kitchen at Hallelujah Acres, in Shelby, NC. Large commercial-grade California juicing carrots were used. Sufficient juice was made so that all volunteers consumed the same juice. Tests were conducted on Tuesday, Wednesday, and Friday mornings of 3 consecutive weeks. There were possibly slight differences in sugar and mineral content of different batches of carrot juice. 4 samples of carrot juice were analyzed for total sugar by an independent laboratory (Southern Testing & Research Laboratory). Two samples of carrot juice were tested by STRL for total carbohydrate as well. Estimates of the total carbohydrate of all samples used were based on these analyses. Total carbohydrate of a sample is determined by what is left after everything else is accounted for. So, the moisture, fiber, fat, protein, and mineral (ash) content of the samples had to be determined to find total carbohydrate content. Protein was determined by the Kjeldahl method, fat by methanol extraction, fiber by a crude fiber test, and moisture in a forced draft oven. Total sugars were determined by an HPLC separation method.

**GI Testing protocol.** Tests were conducted on Tuesday, Wednesday, and Friday mornings of 3 consecutive weeks. Blood glucose concentrations (whole blood values) were measured using a finger prick device and a blood glucose monitoring system (OneTouch Ultra, LifeScan, Inc., Milpitas, CA). This device allowed rapid testing (5 seconds to get the result) with a small sample of blood, minimizing pain from multiple samples. Readings were calibrated to whole blood glucose values.

After an overnight fast, before eating anything in the morning (drinking water OK), subjects had their blood glucose checked (fasting) and then consumed the test food (served in a randomized order). Subjects were then allowed to carry out their normal duties (light office work) while their blood glucose level was checked over the next 2 hours (0, 15, 30, 60, 90 and 120 minutes).

In order to determine the glycemic index of carrot juice a standard carbohydrate source was tested. The usual standard is a 50g carbohydrate portion of white bread (note that dietary fiber is not included in this carbohydrate count). In this study we used a 50g carbohydrate portion of whole wheat bread. The glycemic index of whole wheat bread is identical to the glycemic index of white bread. (Note that this demonstrates that there are many more factors than just fiber intrinsically accounted for in the glycemic index.) Since the glycemic indexes of white bread and whole wheat bread are identical, and our subjects and investigators preferred whole wheat bread, we used the whole wheat bread as our standard.

This testing was repeated once for each sample. Two samples were tested: (1) 14.5 oz of pure carrot juice, and (2) 14.5 oz of carrot juice with 30g of Udo's oil. Along with these 2 samples we tested the standard food 3 times.

**Chromium.** About 1 month after these tests were completed, a follow-up sub-study was carried out. Subjects in the previous study, along with 2 new participants participated in the chromium study. Two tests using 14.5 oz of carrot juice were done on consecutive days to establish a baseline blood glucose response of the participants. For 7 days, subjects then took 200 µg of chromium daily, supplied as chromium picolinate (Soloray). Subjects were then retested twice on consecutive days to determine if there was any change in their blood glucose response to 14.5 oz of carrot juice.

## Analysis

The blood glucose responses to carrot juice were analyzed by calculating the area under the curve (AUC) (11). AUC is a measure of the amount of blood glucose greater than the fasting level integrated over time. Only the area greater than the fasting value was included in the AUC calculation. Responses were normalized to each

individual's response to the test food, whole wheat bread. This yielded that individual's glycemic index for carrot juice. The 6 individual glycemic indices were averaged to obtain an overall glycemic index rating for carrot juice.

Since the carbohydrate load of 14.5 oz of carrot juice was not 50 g, a formula was used to evaluate the glycemic index for a 50g carbohydrate portion of carrot juice. The formula, from Wolever & Bolognesi (4) is:

$$GR = 1.5 \cdot GI (1 - e^{-0.018 \cdot D}) + 13 \quad (1)$$

GR is the glucose relative response (compared to wheat bread), GI is the glycemic index of the food, and D is the amount of carbohydrate in the serving of food. By rearrangement of the equation, knowing GR and D, the GI of carrot juice was determined.

## Results

The physical characteristics of the volunteers are given in Table 2. There was a wide range in ages and body sizes within this group.

**Table 2. Characteristics of Volunteers.**

Subject	% body fat	Age	Sex	BMI, kg/m <sup>2</sup>
1	32.5	36	F	21.1
2	39.2	68	F	38.8
3	25.6	38	M	27.6
4	12.4	53	M	20.9
5	18.9	68	M	23.6
6	15.6	31	M	22.1
Mean	24.0	49		25.7

Total carbohydrate and total sugar content of carrot juice was analyzed by STRL, an independent laboratory. Results are shown in Table 3. All of the numbers are averages of 2 samples, except for total sugar, which is the average of 4 samples—3 from California carrots and one sample of carrots only marked as grown in the USA. The total sugar of just the 3 samples of California carrots is slightly higher, at 5.3 g/100g, compared to the average of 4.9 g/100g of all 4 samples. The sugar profiles are the average of 2 samples of California carrots. The concentrations of sucrose, maltose, and lactose were less than 0.1 g/100g.

In an 8 ounce glass of carrot juice (~230 g), there would be about 76 calories, 11.3 g sugar, lots of vitamins and minerals, and very little fat or protein. By comparison, an 8-ounce serving of soda pop would have between 25 and 31 g of sugar, along with caffeine and phosphoric acid.

**Table 3. Food analysis of carrot juice.**

	Carrot juice, this study	Carrot juice, USDA (1)
Units are g/100g of juice		
Calories	33 Cal	40 Cal
Moisture	91	89
Protein	<0.2	0.95
Fat	0.3	0.15
Ash	0.76	0.75
Fiber, crude	0.3	0.8
Total Carbohydrates	8.0	9.3
Total Sugar*	4.9	6.0
Fructose	0.7	1.0
Glucose	4.25	1.0
Sucrose	<0.1	3.6

\*Average of 4 samples.

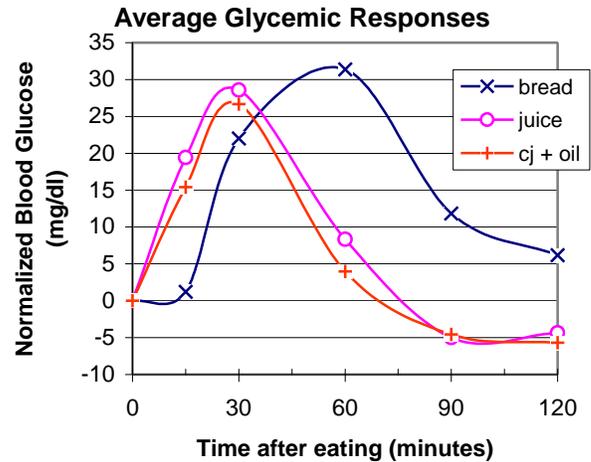
Figure 2 shows what the average glycemic response was for the test foods. The beginning blood glucose is set to zero, in order to normalize all of the data to the same starting point. Fasting glucose values varied from 70 to 115 mg/dl in this study group. The mean fasting glucose value was 88 mg/dl. So, the average peak in blood glucose after consuming 14.5 oz of carrot juice is only 116 mg/dl, still in the range of normal blood glucose values.

In fact, there were very few abnormal readings throughout this study. Out of 66 blood glucose trials, there were only 8 tests with peaks higher than 140 mg/dl, and 3 of these were when bread was consumed. Also, there were only 4 trials with a nadir lower than 70 mg/dl, with none lower than 65 mg/dl. So, even with a large serving of carrot juice, 14.5 oz, blood glucose values did not soar or plunge in this study group.

The glycemic index for carrot juice determined here is 86, and the glycemic index for carrot juice + Udo's oil is 66, with standard deviations of 33 and 26, respectively. There was a lot of variation within and between individuals. Responses by an individual on different days to the same test food varied as much as two-fold.

In order to determine what factors affected individual's response to the same carbohydrate load, a supplementation test using chromium was performed. 6 individuals completed the chromium supplementation study, following the protocol above in the Methods section.

As shown in Table 4, chromium was beneficial to 4 of the 6 subjects. Overall, a paired t-test showed that

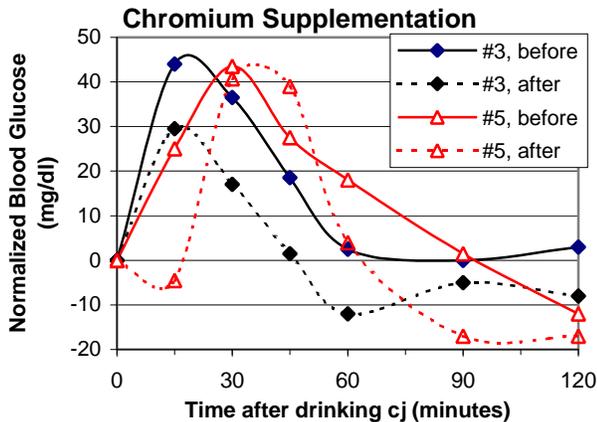


**Figure 2. Average Glycemic Responses.** Blood sugar values are normalized to fasting level for clarity of presentation. Values for carrot juice and carrot juice + oil are not corrected for lower carbohydrate load (30 g, see text). Bread (X) is a 50g carbohydrate portion. Juice (O) is a 14.5 oz serving of carrot juice. cj + oil (+) is 14.5 oz of carrot juice with 30 g of Udo's Oil.

the difference for this small test group was almost significant (p=0.064). In a slightly larger group the measured change in glucose response would be statistically different. Note that changes greater than 50 percent reduction were possible after just a week of supplementation. Also, a higher blood glucose response did not predict that chromium would be beneficial (see subject #2 data). Finally, this is not a definitive report proving that chromium is beneficial. To show this conclusively, it is helpful also to monitor glycosylated hemoglobin (Hgb A<sub>1c</sub>), C peptide excretion, and fasting insulin levels also. However, this does give an indication that chromium is beneficial for lowering blood glucose response to a carbohydrate load.

**Table 4. Response to chromium supplementation.** Data shown is the calculated area under the blood glucose response curve. Data are the average of 4 tests before and 2 tests after chromium supplementation.

Subject	AUC, Before	AUC, After	% Change
1	1,109	1,114	0.5%
2	1,416	1,457	2.9%
3	1,531	710	-54%
4	1,021	548	-46%
5	1,765	1,209	-32%
6	859	678	-21%



**Figure 3. Effect of chromium supplementation on 2 volunteers.** The normalized blood glucose response to 14.5 oz of carrot juice is shown, both before and after daily supplementation with 200  $\mu\text{g}$  of chromium as chromium picolinate for 7 days. Data are the average of 2 samples each before and after supplementation.

Figure 3 shows the blood glucose profile of 2 volunteers before and after chromium supplementation. The figure adds some information not seen in Table 4 in the AUC data. First, the blood glucose concentration at 15 minutes after consuming carrot juice is much lower for these two subjects. The lower peak glucose concentration contributed to the smaller AUC for subject #3, while a slower rise and quicker fall in elevated blood glucose contributed to the smaller AUC for subject #5, without reducing the peak glucose concentration at all. So, the response to chromium in different individuals will vary even in the way that the AUC is reduced.

It is of note that subjects could not predict what their blood glucose level would be based on how they felt. Even at the peak or after a sharp drop in the blood glucose concentration there was generally no change in the way the individual felt. None of the blood glucose measurements were below 65 mg/dl, and only 4 tests fell below 70 mg/dl. At lower concentrations of glucose there would be symptoms of low blood glucose, but none of the subjects here felt any symptoms associated with hypoglycemia.

Because of the small size of our study group there were no conclusive correlations between anthropomorphic measurements and response to bread, carrot juice, or fasting glucose concentrations. Correlations between body composition and fasting glucose levels and insulin resistance do exist (12), but they could not be confirmed here in our study.

## Discussion

**Carrot juice composition.** Though there is some composition information on carrot juice in the USDA database, a look at the information reveals that much of data is inferred from the composition of carrots without any direct measurement (see number of measurements of each nutrient on the Nutrient Data Laboratory website (1)). Therefore, it was felt that a direct measurement of the nutrients most pertinent to this study would be important, since they might vary from the estimates in the database. The main difference was the lower measurement of protein in our study, and the slightly lower carbohydrate content of the carrots we tested, compared to the values given in the USDA database. These differences could easily be accounted for by variations in the carrots, our smaller sample, and perhaps differences in varieties and growing conditions of the carrots.

The sugar profile that was measured by STRL is remarkably different from the profile reported for carrots in the USDA database. The main sugar in the carrots analyzed here was glucose, while sucrose was found to be the main storage sugar in other reports (1, 13). It is unclear the reason for this disparity. STRL used a HPLC method and detected no peaks for sucrose, despite having a clean chromatograph. It is possible that there was an invertase enzyme present in the juice, which would convert sucrose into its two sugar components, glucose and fructose. However, the amount of detected fructose was low, indicating that any invertase activity, if present, could not have changed the profile very much.

There was one other difference in methodology that should be noted. Total sugar reported here only includes the five sugars fructose, glucose, sucrose, maltose, and lactose, as required by food labeling guidelines. The total sugar data in the USDA database also includes other sugars, usually present in small amounts, about 15 percent of the total sugar. This may account for the slightly higher numbers reported by the USDA compared to our numbers reported here.

**Some assumptions made in the analysis in this report.** First, it was not feasible for subjects to consume a 50 g carbohydrate load of carrot juice, approximately 24 ounces. The serving given in the study, 14.5 ounces was already almost twice the usual serving. This fact alone points out how difficult it is to get a truly large carbohydrate load from drinking carrot juice, compared to eating a typical serving of complex carbohydrates.

However, in serving a smaller amount of carbohydrates, we had to approximate the glycemic response to a full 50 g carbohydrate load. To do this we used an equation derived from servings of complex carbohydrates. It is not known whether this equation is

truly valid for foods made mostly of sugars rather than complex carbohydrates.

We also had to approximate the total amount of carbohydrate in each serving of carrot juice. It was not feasible to get a laboratory analysis of each juice before using it, since the laboratory analysis took a week to complete. We assumed that the carbohydrate content, and total sugar content of the juice did not vary dramatically from batch to batch. An attempt was made to correlate Brix measurements of total sugars with total sugar assays from STRL laboratory, but no correlation could be obtained using the 4 samples submitted. Furthermore, the only published correlation between Brix and total sugar (13) also reported a much higher content of total sugar for California carrots (12g/ 100g), making their correlation irrelevant to our study.

**Glycemic Index of Carrot Juice.** The glycemic index of carrot juice was found to be 86, on a scale where bread has a glycemic index of 100. The other published reports for the glycemic index value of carrot juice list it as 85 (14), and 64 (3), which are in agreement with our number. If anything, our estimate appears to be on the high side. This places carrot juice in the medium range of foods in terms of the sugar response generated by the carbohydrates in the food.

**Glycemic Response.** The response of individuals to carrot juice is characteristically different from the response to a complex carbohydrate. By 15 minutes the blood glucose had risen significantly after drinking carrot juice, while there was no rise in blood glucose 15 minutes after eating bread. Note that if blood glucose rise is part of the signal to the brain to tell us that we are getting full, then this would indicate that it is much easier to overeat on complex carbohydrates than on simple sugars as are found in fruits and carrot juice. However, stomach distention and peptide hormone production in the small intestine are also part of the complex signal to stop eating (15), so this theory is incomplete. Note that when the carrot juice is used with the oil, the shape of the curve does not change. Only the height is different. But this difference in height is significant when the area under the curve is calculated, as done when determining the glycemic index. The difference is 20 points on the GI scale, which can make a difference in long-term use.

**Variation in glycemic response between individuals.** Our study group was not large enough to make any correlations between glycemic response, fasting glucose levels, and anthropomorphic measures. However, the onset of diabetes is strongly correlated with obesity, indicating that these measures of body composition can be used to evaluate somebody's risk of becoming diabetic.

**Variation in glycemic response within individuals.** Throughout this study it was noted that day-to-day variations in an individual's glycemic response to a

food could vary two-fold. This result means that there are factors that vary daily in individuals that have a dramatic effect on how the body responds to the same glycemic load. Two known factors are the overall glycemic index of a person's last meal (16) and the amount and quality of sleep the night before a glycemic test (17, 18). These factors were not recorded in this study. It is possible that other factors also are important. Possibly the chromium content of the food eaten the day before a glycemic test would also be important along with glycemic index of the diet, especially for people with low body stores of chromium.

**Chromium.** The chromium supplementation study showed that additional chromium is beneficial even among healthy individuals eating a diet low in refined sugar. This test was very short; many studies of chromium supplementation have been done for 8 weeks or longer. Even so, dramatic results were seen in 4 of the 6 individuals in the study. An average of 4 tests of carrot juice before supplementation and 2 tests after supplementation were used to help minimize the daily variation in glycemic response.

Chromium taken by diabetics and others has increased insulin sensitivity, reduced fasting insulin, decreased fasting glucose levels, decreased cholesterol and triglyceride levels, and stimulated weight loss (10). However, not all diabetics or normal people respond to chromium supplementation. Supplemental chromium is only helpful for people who have low body stores of chromium. This was true in our study as well, since 2 of the 6 volunteers had no change in glycemic response after supplementing with chromium.

## Application

**Carrot juice—too much sugar?** Carrot juice is not a low-glycemic food. The intention is not to suggest that it is a low-glycemic food, but rather to understand the role of carrot juice in the context of other foods. First of all, the serving size of carrot juice generally recommended is about 8 oz, which only contains about 12g of sugar, 18 g of carbohydrate (see Table 5). This is a not a large sugar load. However, if an individual is intolerant of fruit, then carrot juice would have to be considered carefully as well.

In Table 5 a comparison is given between carrot juice, a few common fruits, and three common carbohydrate foods. The glycemic response expected from a serving of these foods, compared to a 50 g carbohydrate serving of bread, is given in the last column, labeled as the serving size GI. This calculation is based on equation (1), given above.

As you can see, even though the GI of carrot juice is 86, the typical serving size would yield only about half as much of a glycemic response as 2 large slices of

**Table 5. Context for carrot juice.** Serving size GI is the predicted glycemic response for this amount of each food, compared to a 50g carbohydrate serving of bread.

Food Item	Weight (g)	Carb (g)	Sugar (g)	Svg size GI
Carrot Juice, 1 C	230	18	11	46
Medium Apple	138	21	17	35
Medium Orange	131	15	12	32
Medium Banana	118	28	22	55
Medium Sweet Potato	114	28	11	52
Medium Baked Potato	122	31	2	84
Whole Wheat Bread-Homemade, 2 slices	92	47	4	92

bread (46 vs 92). From this analysis it appears that a diabetic individual, or others who have poor blood sugar control, would be able to drink carrot juice and eat fruit in moderation. Emphasizing grains and complex carbohydrates over fruits and carrot juice is not sound advice for the sugar-sensitive individual.

**Juice with oil.** The glycemic response of carrot juice can be reduced by drinking it with a spoonful of oil. About 1 tablespoon of oil with an 8-ounce serving would get the results seen in this report. The oil has an added benefit of increasing the absorption of the fat-soluble carotenoids, such as beta-carotene, alpha-carotene, and lutein. Any oil or fat will produce this effect. This is a great way to get in beneficial oils and carrot juice at the same time.

**Diabetics and carrot juice.** Hallelujah Acres has recommended that diabetics start with smaller servings of carrot juice. Diluting 4 oz of carrot juice with 4 oz of distilled water has been the recommendation. Since less carrot juice is consumed, the glycemic response will be less, and the sugar-sensitive individual will tolerate the juice better. Many people with diabetes do not have problems with drinking an 8-ounce serving of carrot juice right from the beginning. So, a person needs to monitor their blood sugar and be very careful when making effective dietary changes, such as adopting The Hallelujah Diet<sup>sm</sup>.

As time passes and a person with diabetes becomes a person who *used* to have diabetes they should be able to consume more carrot juice at one time without harmful effects.

**Chromium.** Chromium intake is sub-optimal in most individuals. High sugar diets promote the excretion of chromium in the urine (19). A two-week trial with daily chromium supplementation would be adequate to see if a person receives any benefit. Up to 1000 µg/day of chromium has been used with no negative side-effects. There is some evidence that more than 200 µg/day of

chromium is necessary to see a positive effect in diabetics (7, 20). Fasting blood glucose concentration may be reduced along with fasting insulin, which is harder to measure. Also, a morning challenge with carrot juice such as done in this study would easily reveal any benefit from the chromium supplement (plot results as shown in Figure 3). Diabetic symptoms, such as frequency of urination, may also be alleviated, along with weight loss and lean tissue gain.

Chromium is found in nuts, seeds, whole grains, and in brewer's yeast. Increasing nut and seed intake will provide more chromium and more of the beneficial plant oils associated with successful raw food diets (14). It will also reduce the amount of sugar in the diet, thus lowering the requirement for chromium in the body.

## Conclusion

Carrot juice has a glycemic index of 86, while carrot juice and oil has a glycemic index of 66. While this is a moderately high value, all grain flour products have higher glycemic index values. Since an 8-oz serving of carrot juice only contains 18 g of carbohydrates, most people can consume it without causing any sugar imbalances. Loss of blood sugar control is more likely due to over consumption of animal fat, refined sugar, and grain products rather than moderate consumption of carrot juice and fruit.

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