Original Article

Comparative Effect Of Tetrapack Juices And Fresh Fruit Juices On Blood Glucose Level Among Healthy Individuals

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Abstract:

Uses of tetra pack juices enhances the risk of diabetes and obesity. People were unaware of impact of fresh fruit juices on health. **Objective:** To compare the effect of tetra pack juices and fresh fruit juices on blood glucoselevels among healthy individuals **Methods:** 10 participants were selected using an internationalstandard Glycemic Index (GI) test protocol. After getting their fasting blood sample theywereinstructed to consume all the juice served in a period of 5 min. Further blood samples were taken at different intervals of time that is 0, 30, 60, 90, 120 and 150 minutes after consumption. Participants wereremained sedentaryduring each session. Blood was obtained by finger-prick and tested by the glucometer. **Results:** The glycemic index of Apple juice Nestle has the glycemic index of 95.87, Orangejuice Nestle has the GI value 93.78, Apple juice fresh has the GI value of 92.17 and Orangejuice fresh has the glycemic index value of 99.07, respectively **Conclusions:** Detailed study of glycemic index of tetrapack juices (Nestle Apple and Orangejuice) and fresh fruit juices (Apple and Orange juice) showed similar impact on the blood glucose level of healthy individual. In the study, both types of juices were found to be equally hyperglycemic (GI 70+) causing a fast rise in blood-sugar levels, hence should not be given to diabetic patients.

Key Words: Glycemic Index, Glycemic Load,Diabetes, Tetra Pack Juices, Fresh Fruit Juices.

Introduction:

The glycemic index (GI), was discovered by David Jenkins and Thomas Wolver of the University of Toronto in 1981, It is a systematic process for classifying carbohydrate-containing foods on the basis of how fast they elevate blood-glucose levels. Glycemic index is a rating system that how much carbohydrates containing food raise blood glucose levels. Standardized range of glycemic effect is from 0 to 100. Glycemic load range from 55 and lower is considered as a low glycemic index food. 56 to 69 is consider as middle and 70 to 100 is high glycemic load of the food. The Glycemic Response (GR) is a term use in measuring the effect of food on blood glucose levels [1]. Glycemic index (GI) and Glycemic load (GL) are two different terms used for Glycemic Response [2]. Raised postprandial blood glucose levels establish a global epidemic and a high risk factor for pre-diabetes and type II diabetes [3]. Diabetes is classified into three categories. Type1, Type 2 diabetes and Gestational diabetes mellitus [4, 5]. Carbohydrate with low-GI values is related with a lower risk whereas carbohydrate with high-GI values is associated with a higher risk of myocardial infarction[6].

The GI and GL are valuable variable in the nutritional classification of carbohydrate foods. Diets Identified by a low GI as well as low GL have been repeatedly and independently connected with reduce risk of diabetes and other chronic diseases[7]. Foods having carbohydrates with a less GI are more slowly digested and absorbed, but diets with a low GI are beneficial in controlling postprandial plasma glucose excursions [8].Lowering the GI of the diet also improve glycemic control and decrease the risk factors for coronary heart disease (CHD)[9]. A low GI diet is helpful for people with diabetes and has been appeared to improve pregnancy results when used from the

first trimester. A low GI diet is commonly prompted as treatment for women with gestational diabetes mellitus (GDM)[10]. Sugar-sweetened drinks and Tetra packed including entire variety of fruit drinks, soft drinks, vitamin water drinks, are composed of naturally extract caloric sweeteners that are sucrose, high fructose corn syrup, or fruit juice concentrates. Overall they are the biggest contributor in US to added sugar consumption diet. Over the past years different long term observational studies have found positive relation between tetra packed juices utilization and long-term weight gain and development of type2 diabetes and related metabolic diseases[11].

Tetra packed or sugar sweetened juices consumption has been appeared to induce fastest rise in blood glucose and insulin levels from high levels of sugars which in related with the high volumes consumed contribute to a high dietary GL [12, 13]. High GL foods assist in weight gain and may also increase the risk of CVD through postprandial hyper-insulinemia and insulin resistance promoting dyslipidemia and inflammation and through postprandial hyperglycemia by inducing oxidative stress, which adversely effect (BP) blood pressure, clot formation, and endothelium-dependent blood flow [14].

Pure organic (100 %) fruit juices can be nutrient-dense foods containing Ca, Mg, K, folate, vitamins C and A, and soluble fiber as well as a variety of bioactive compounds containing carotenoids and flavonoids. Although, utilization of fruit as part of a healthy and balanced diet is often encouraged by nutritionists, yet balanced consumption of fruit as juices is recommended due to the lack of fibers. Also, the capability of high energy intake Juices having moderately high GI ratings shows relatively instant and high post-prandial glucose response as compared with foods with a low GI, and foods lower in these types of simple carbs may be relevant for the prevention and management of some chronic diseases including Type 2 Diabetes [15].

Consumption of high-GI foods for a long time has been prefer to increase insulin demand, increase insulin resistance, damage pancreatic β-cell function, and ultimately lead to type 2 diabetes[16]. Carbonated beverages (called soft drinks) and tetra packed juices, which have a high glycemic load comparative to other foods and 100 % fruit juices, have been hypothesized as pancreatic cancer risk factors[17].

Fruit juice is also criticized for not having a fiber content However, Schulze *et al*, discover that fruit fiber was not essentially identified to the lower risk of diabetes based on the data of past prospective studies [18]. Furthermore, it has been exhibited that in spite of the fact that natural fruit juice is inadequate in fiber, other important preventive nutritional components, such as antioxidants and phytochemicals are present in fruit juice[19].

This study was designed to determine the difference between the health benefits of fresh fruit juices and tetra pack juices and to carefully analyze their effect on blood glucose levels. This study will guide people to choose a healthy option and risk of diabetes and other metabolic disorders associated with consumption of juices could be reduced.

Methods:

To carry out the research an experimental study was designed and experiments were performed in Nutrition lab 101, University Institute of Dietetics and Nutritional Sciences, Faculty of Allied Health Sciences, The University of Lahore. Total of 10 healthy individuals with no previous medical diagnosis (aged between 18 to 45 years) were selected for the study period of 4 months. Diabetic, Obese or individuals with any other medical diagnosis, or people below or above the age limit were excluded.

Study protocol:

Participants were examined physically and anthropometrically. A day before the test participants were approach to limit their participation in extreme physical activity. The entire products sample prepared contained 50gm carbohydrates in 500ml solution. After a 12 hr. night fasting blood sample were taken and then prepared sample were provided to the participants that they had to consume in 5 minutes. Further blood samples were taken at 0, 30, 60, 90, 120, 150 minutes. New lancet was used at every finger prick. Alcohol swab were

used for cleaning finger. New packed sugar sticks were used at every blood sample. Accu-check glucometer were used to find out the sugar levels. Results of samples were noted on time. Participants remained sedentary during each session of experiment.

Determination of glycemic index:

The Glycemic Index (G.I) was indicate as a ratio comparing the blood sugar increase caused by a test food to that of a reference food for 2 hours following ingestion [20]

$$G.I = \frac{Area\ under\ the\ curve\ for\ test\ food}{Area\ under\ the\ curve\ for\ reference\ food} \times 100$$

GI is estimated in the human participants in vivo. For every individual subject, the GI value of the test food is calculated as, GI value of test food = [IAUC * of the test food/individual subject's average IAUC of the reference food] × 100

The overall GI was calculated as, the mean (±SEM) GI value for 10 or more participants

The Trapezoidal Rule

Trapezoidal sums were applied. In this, area under a curve is commonly approximated using rectangles (e.g. left, right, and midpoint Riemann sums), but it can also be approximated by trapezoids. Trapezoidal sums actually give a better approximation; in general, than rectangular sums that use the same number of subdivisions [21]. Following procedure was followed;

Step 1: time was taken as variable on X-axis and glucose level on Y-axis.

Step 2: joint points of variable (Time) with Glucose level were plotted.

Step 3: line from the point was drawn and a perpendicular line on X-axis was drawn making trapezoids.

Step 4: area of trapezoids was calculated using the formula

$$A = \frac{y_1 + y_2}{2} \times t$$

Where t is the time unit taking as $t = 1,2,3, \ldots, n$.

Step 5: sum of area of all the trapezoids was calculated and area under the curve was measured.

Results:

Study included 3 participants aged between 22 to 25 years and 7 participants were aged between 26 to 32 years and the mean age of these participants was 27.50+-3.21. Among 10 participants 6 were males and 4 were females and out of 10 only 2 participants were smokers while 8 were non-smokers. When inquired about sleeping habits 4 participants were taking 8-9-hour sleep and 6 were sleeping 9-10 hour, but all of the 10 participants were having normal BMI. When inquired about eating habits, 6 participants preferred whole wheat chapatti and 4 participants preferred white floor chapatti, while only 4 preferred whole wheat bread and when it came to rice all preferred white rice over brown rice. Among fruits, 7 preferred whole fruit while only 3 preferred fruit juices. Moreover, it was also observed that all the participants preferred white sugar over brown sugar and none of them was using artificial sweetener.

Sr. No	Attributes	Frequency
1	No. of participants	10
2	Gender	6 males 4 females
3	Age limit	18-40 years
4	BMI	All normal
5	Smoking habits	2 smokers 8 non smokers
6	Eating preferences • Chapatti	6 preferred whole wheat chapatti 4 preferred white floor chapatti
	• Bread	4 preferred whole wheat bread 6 preferred white bread
	• Rice	All preferred white rice over brown rice
7	Sugar preference	All preferred white sugar
8	Fruit and juice preference	7 preferred whole fruit 3 preferred fruit juice

Table 1: Frequency distribution of subjects according to attributes

According to the results the Apple juice Nestle glycemic response mean values in blood were 87.40 at 0 minute and 114.30, 115.00, 96.60, 85.50, 83.70 were at 30, 60, 90, 120 and 150 minutes respectively, as shown in Figure 1.

Whereas, for Apple juice fresh GR values in blood were 91.90 at 0 minute and 121.00, 103.90, 88.10, 80.60, 77.30 were at 30, 60, 90, 120 and 150 minutes respectively, as shown in Figure 1.

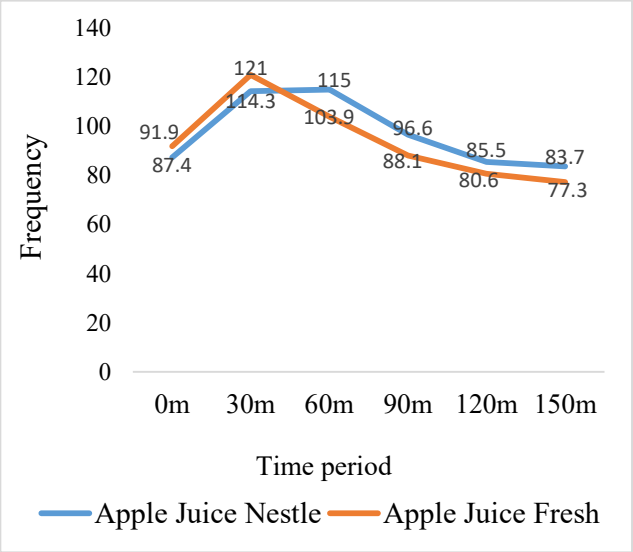

Figure 1: Distribution of participants according to Apple juice Nestle and Apple juice fresh glycemic response mean values.

According to the results the Orange juice Nestle GR mean values in blood were 87.20 at 0 minute and 116.30,106.40,93.70,89.10,86.40 were at 30, 60, 90, 120 and 150 minutes respectively, as shown in Figure 2. Whereas, for Orange juice fresh GR mean values in blood were 91.20 at 0 minute and 132.10, 112.30, 94.30, 88.10, 83.20 were at 30, 60, 90, 120 and 150 minutes respectively, as shown in Figure 2.

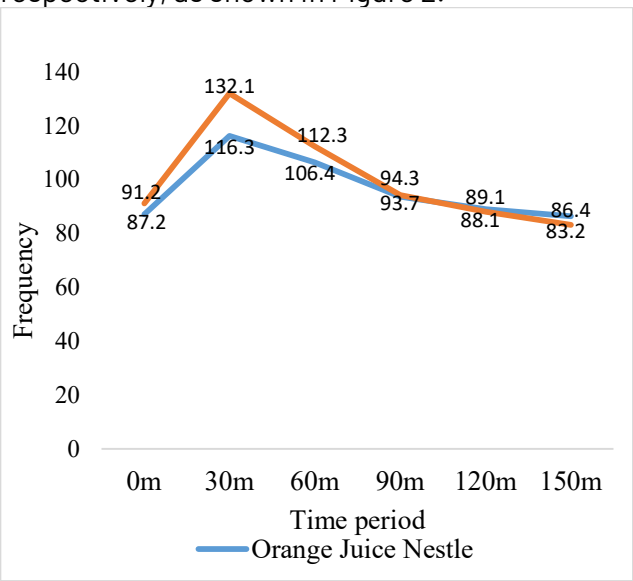

Figure 2: Distribution of participants according to Orange juice Nestle and Orange juice fresh glycemic response mean values.

Glycemic Index for the products:

According to the results Apple juice Nestle has the glycemic index of 95.87, Orange juice Nestle has the GI value of 93.78, Apple juice fresh has the GI value of 92.17 and Orange juice fresh has the glycemic index value of 99.07, as shown in the Table 1.

Test Food	G.I
Apple Juice Nestle	**95.87**
Orange juice Nestle	**93.78**
Apple juice fresh	**92.17**
Orange juice fresh	**99.07**

Table 1: Glycemic Index for the products

Variables	N	Mean ± SD	t	P-value
Apple juice Nestle	10	582.50±23.30594	1.708	0.122
Apple juice fresh	10	562.80±36.28835		
Orange juice Nestle	10	579.10±39.90670	-2.396	0.040*
Orange juice fresh	10	601.20±43.18384		

Table 2: Mean Difference of Tetra pack and Fresh Juices,
Paired Sample t-test, P-value <0.05*

The mean value of Apple Juice nestle was 582.50±23.30594 and Fresh Juice was 562.80±36.28835. There was insignificant difference was observed between Effect of Tetra pack and Fresh Apple Juices in GI. The mean value of Orange juice Nestle was 579.10±39.90670 and Orange juice fresh was 601.20±43.18384. There was significant difference was observed between Effect of Tetra pack and Fresh Orange Juices in GI.

Discussion:

Present study was carried out on 10 healthy participants, aged between 18 to 40 years. Analysis of glycemic values revealed that tetra pack juices i.e. Apple juice Nestle has GI of 95.87 and Orange juice Nestle has GI of 93.78. On the other hand, almost similar values of fresh Apple juice and Orange juice were observed i.e. 92.17 and 99.07 respectively. The result signified that both types of juices (tetra pack and fresh fruit juices) have GI values above 70, hence were categorized as high GI food/

hyperglycemic food. Therefore, the study concluded that consumption of both types of juices (tetra pack juices and fresh fruit juices) has almost similar impact on blood glucose level among healthy individuals. Moreover, no significant difference in glycemic index of Apple juice and Orange juice was observed (i.e. both juices were equally glycemic). Recently, a similar study on ten healthy individuals was conducted by KouassiAK *et al.*, in 2017 where they adopted the same strategy to observe the GI and GL of fresh fruit juices of Baobab, Tomi and Néré. Unlike the results of our study which showed both the fresh fruit juices equally hyperglycemic, the results of their study highlighted Néré juice as hyperglycemic (GI 89.54 ±1.63) whereas Baobab and Tomi juices were found to have intermediate glycemic index[22].

Like current research, many other researchers also studied the association of natural food sources and artificial drinks with reference to glucose level. In 2013, Eshak ES *et al.*, conducted a study on 27,585 Japanese men and women (aged 40-9 years) having no past history of diabetes and effect of vegetable, fruit juices and soft drink intake was observed[23]. Results contradictory to our research was observed. Current study suggest that fresh juices are hyperglycemic, whereas their study concluded that pure juices intake is not linked to risk of diabetes in Japanese population, specifically women but soft drinks could lead to diabetes. Basu S *et al.*, also studied the association between intake of soft drinks and obesity and diabetes within 7 countries. His findings backed up the results of previously discussed study that soft drinks have a significant association with obesity and diabetes in developing and developed countries [24]. His work contradicts from our work as he concluded that soft drinks but not juices raise the glucose levels in blood.

Conclusions:

Detailed study of GI of tetra pack juices (Nestle Apple and Orange juice) and fresh fruit juices (Apple and Orange juice) showed similar impact on the blood glucose level of healthy individual. In conclusion, both types of juices were found to be equally hyperglycemic (GI 70+) causing a rapid rise in blood-glucose levels, hence should not be given to diabetic patients.

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