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Short Communication

Hypoglycemic Potential of Tender Coconut Water in Euglycemic Human Subjects

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ABSTRACT

Introduction: Hypoglycemic effect of tender as well as mature coconut water has been shown by various workers on Alloxan induced Diabetic rats and other animal models. But the role of tender coconut water on plasma Glucose in human was still not known. Therefore we wanted to look for the Hypoglycemic effect of Tender coconut water (TCW) in euglycemic human subjects.
Methods: 20 adult volunteers, of both sexes within the age group 18 to 45 years were included in the study. After a weeks' preparation, 75 gms of Glucose was dissolved in appropriate amount of water and the subjects were asked to drink the same. Venous blood samples were collected at 30 min, 60 min, 90 min and 120 min in Fluoride vials, and Glucose estimated by GOD-POD method in a semi-automatic analyser. After at least 7 days interval, under similar conditions the same procedure was repeated with 75gms of Glucose dissolved in 200ml freshly extracted TCW.
Results: The fasting plasma Glucose of the all twenty subjects for both pre and post TCW studies were between 70 to 110 mg/dl. The Glucose Tolerance test results of Glucose dissolved in plain water and Glucose dissolved in TCW were compared using Student's Paired T Test. TCW did not affect the peak plasma glucose ($p = 0.3919$) recorded at 30 min. However there was a significant difference in the pre and post TCW plasma Glucose at 60 min ($p = 0.0075$), 90 min ($p = 0.0335$) and 120 min ($p = 0.0203$).
Conclusion: Tender coconut water was found to have hypoglycemic action on euglycemic human subjects; their mechanism of action may be investigated further.

Key words: Tender coconut water, Hypoglycemia

INTRODUCTION

Cocos nucifera L., Coconut, is a tree which is widely cultivated for its multiple nutritional, medicinal and commercial values. The hypoglycemic effect and role of attenuating free radical damage of tender [1] as well as mature coconut water [1-3] has been shown by various workers on Alloxan induced Diabetic rats [1,4] and other animal models. [5-8] But the role of tender coconut water on plasma Glucose in human is still to be investigated.

Aims and Objective:

To look for the hypoglycemic effect of tender coconut water in euglycemic human subjects.

MATERIALS AND METHODS

This panel study was conducted in the Department of Biochemistry, All India Institute of Medical Sciences, Bhubaneswar (AIIMS, BBSR) between July 2014 and August 2014. Ethical clearance was obtained from the Institute Ethics Committee, AIIMS, BBSR. A *consent form* and a *Patient Information Sheet* was developed in English and in the local language, Odia, to take informed consent from the subjects taking part in this study, and to inform them adequately about the study respectively.

20 adult volunteers, of both sexes within the age group 18 to 45 years were included in the study. Most of the volunteers were students of MBBS 2012 batch of AIIMS, Bhubaneswar, Odisha. The volunteers were from the states of Kerala, Odisha and Uttar Pradesh. The selected subjects were healthy adults, not suffering from any chronic disease, who are not addicted to alcohol and are not addicted to tobacco products in any form, since tobacco is known to affect the Glucose metabolism in the body. Subjects with family history of Diabetes, pregnant subjects were excluded from this study. The detailed drug history of the subjects was taken prior to including them in the study. Antibiotics like Fluoroqinolones; anti-seizure drugs like phenytoin; anti-hypertensives like beta blockers, thiazide diuretics, diazoxide; Corticosteroids and Hormonal Contraceptives; Hypolipidemic drugs like statins are known to affect Glucose metabolism and subjects on these medications were not included in this study.

The subjects selected for this study were advised to be on a normal routine diet for at least 7 days prior to the test. They were advised not to skip any meal or perform strenuous exercise at any time during these 7 days prior to the test. The night before the test, the subjects were advised to take dinner at around 9 PM, so that the early morning fasting blood sample may be collected at around 9 AM, after 12 hours fasting. The sample collection was done at the AIIMS, BBSR OPD Biochemistry Laboratory collection centre, by a trained technician, as per standard protocol. Subsequently, 75 gms of Glucose was dissolved in appropriate amount of water and the subjects were asked to drink the same. The time was noted, and subsequently samples were collected at 30 min, 60 min, 90 min and 120 min in Fluoride vials. The vial was centrifuged, at 5000 RPM for 10 min and the plasma was used for estimation of Glucose by GOD-POD method, using Glucose estimation kit from Accurex, in a Robonik Semi-automatic analyser, within two hours after collection, in the AIIMS, BBSR OPD Biochemistry laboratory. Haemolysed samples were not used for estimation. The subject's data were recorded in the data collection form, developed for this study.

After at least 7 days interval, the next session was planned, as per the convenience of the subject for performing the second round of the Glucose Tolerance Test. After maintaining the precautions mentioned above again for a period of 7 days prior to the second selected date, the subjects were called for an early morning fasting blood sample at around 9 AM. Subsequently, 75gms of Glucose was dissolved in 200ml freshly extracted tender coconut water and the subjects were asked to drink the same. It was ensured that all coconuts used in this study were tender. The time was noted and subsequently, venous blood samples were collected at 30 min, 60 min, 90 min and 120 min in Fluoride vials and Glucose was estimated as mentioned above. The subject's data were recorded in the same individual data collection forms.

The entire study was completed in two sets, with ten subjects in each set.

The Glucose Tolerance test results of Glucose dissolved in plain water and Glucose dissolved in tender coconut water were compared using Student's Paired T Test.

OBSERVATIONS AND RESULTS

The fasting plasma Glucose of the all twenty subjects were between 70 to 110 mg/dl, and the levels were almost the same for both pre and post TCW studies.The Plasma Glucose levels (mg/dl) for the twenty subjects are shown after intake of Glucose dissolved in water (Pre-Tender Coconut Water or Pre-TCW), and then after Glucose dissolved in 200ml of Tender Coconut water (Post-Tender Coconut Water or Post-TCW), at 30min, 60min, 90min and 120min in tables I, II, III and IV respectively.

Table I: Showing the results of the plasma Glucose levels (mg/dl) for the twenty subjects at 30 Min after intake of Glucose dissolved in water (Pre-Tender Coconut Water or Pre-TCW), and then after Glucose dissolved in 200ml of Tender Coconut water (Post-Tender Coconut Water or Post-TCW), The t value is -0.876, and the two tailed p value is 0.3919.

Sl No	Pre-TCW mg/dl	Post-TCW mg/dl	d	d^2
1.	127.4	158.8	-31.4	985.96
2.	108.1	172.2	-64.7	4186.09
3.	168.0	174.2	-6.2	38.44
4.	105.2	109.9	-4.7	22.09
5.	130.7	124.0	6.7	44.89
6.	171.4	162.5	8.9	79.21
7.	150.7	148.9	1.8	3.24
8.	110.2	114.2	-4	16
9.	115.5	91.57	23.93	572.6449
10.	122.6	123.3	-0.7	0.49
11.	138.6	114.3	24.3	590.49
12.	130.4	142.4	-12	144
13.	140.4	153.1	-12.7	161.29
14.	124.5	121.3	3.2	10.24
15.	196.2	150.5	45.7	2088.49
16.	127.1	163.5	-36.4	1324.96
17.	132.8	176.4	-43.6	1900.96
18.	130.2	140.0	-9.8	96.04
19.	145.4	142.2	3.2	10.24
20.	134.4	124.0	10.4	108.16
		Sum of d =	-98.07	
		Sum of d^2 =		12383.92

None of the subjects developed symptomatic or documented hypoglycemia or any other observable physical discomfort during the study.

Table II: Showing the results of the plasma Glucose levels (mg/dl) for the twenty subjects at 60 min after intake of Glucose dissolved in water (Pre-Tender Coconut Water or Pre-TCW), and then after Glucose dissolved in 200ml of Tender Coconut water (Post-Tender Coconut Water or Post-TCW). The t value is 2.9889, and the two tailed p value is 0.0075.

Sl No	Pre-TCW mg/dl	Post-TCW mg/dl	d	d^2
1.	108.3	94.86	13.44	180.63
2.	101.1	89.73	11.37	129.27
3.	91.21	87.88	3.33	11.08
4.	86.06	69.01	17.05	290.70
5.	117.3	85.17	32.13	1032.33
6.	161.4	139.3	22.1	488.41
7.	145.7	108.0	37.7	1421.29
8.	78.42	85.75	-7.33	53.72
9.	68.02	54.99	13.03	169.78
10.	103.3	69.3	34	1156
11.	128.6	108.4	20.2	408.04
12.	99.72	94.5	5.22	27.24
13.	147.4	127.0	20.4	416.16
14.	126.1	95.04	31.06	964.72
15.	106.9	113.6	-6.7	44.89
16.	134.7	158.8	-24.1	580.81
17.	119.9	159.1	-39.2	1536.64
18.	132.6	80.4	52.2	2724.84
19.	127.6	74.3	53.3	2840.89
20.	116.5	97.7	18.8	353.44
Sum of d =			308	
Sum of d^2 =				14830.93

Table III: Showing the results of the plasma Glucose levels (mg/dl) for the twenty subjects at 90 min after intake of Glucose dissolved in water (Pre-Tender Coconut Water or Pre-TCW), and then after Glucose dissolved in 200ml of Tender Coconut water (Post-Tender Coconut Water or Post-TCW). The t value is 2.2917, and the two tailed p value is 0.0335.

Sl No	Pre-TCW mg/dl	Post-TCW mg/dl	d	d^2
1.	91.65	82.79	8.86	78.49
2.	132.2	130.7	1.5	2.25
3.	98.45	68.31	30.14	908.41
4.	87.52	80.72	6.8	46.24
5.	104.1	83.46	20.64	426.00
6.	109.6	107.1	2.5	6.25
7.	89.06	100.2	-11.14	124.09
8.	90.05	76.68	13.37	178.75
9.	82.54	65.16	17.38	302.06
10.	81.00	100.4	-19.4	376.36
11.	92.00	74.2	17.8	316.84
12.	91.37	92.5	-1.13	1.27
13.	127.7	127.3	0.4	0.16
14.	100.7	88.7	12	144
15.	117.2	121.5	-4.3	18.49
16.	120.9	132.4	-11.5	132.25
17	94.46	104.8	-10.34	106.91
18.	126.6	75.0	51.6	2662.56
19.	126.9	78.87	48.03	2306.88
20.	123.8	105.4	18.4	338.56
Sum of d =			191.61	
Sum of d^2 =				8476.8831

Table IV: Showing the results of the plasma Glucose levels (mg/dl) for the twenty subjects at 120 min after intake of Glucose dissolved in water (Pre-Tender Coconut Water or Pre-TCW), and then after Glucose dissolved in 200ml of Tender Coconut water (Post-Tender Coconut Water or Post-TCW). The t value is 2.53, and the two tailed p value is 0.0203.

Sl No	Pre-TCW mg/dl	Post-TCW mg/dl	d	d^2
1.	93.92	78.13	15.79	249.32
2.	104.0	56.66	47.34	2241.07
3.	92.18	77.99	14.19	201.35
4.	100.6	74.21	26.39	696.43
5.	127.3	92.36	34.94	1220.80
6.	98.86	93.51	5.35	28.62
7.	101.0	87.98	13.02	169.52
8.	89.52	72.50	17.02	289.68
9.	81.92	68.24	13.68	187.14
10.	102.2	101.2	1	1
11.	89.96	72.27	17.69	312.93
12.	105.6	90.12	15.48	239.63
13.	121.9	114.6	7.3	53.29
14.	65.45	81.67	-16.22	263.08
15.	89.81	102.1	-12.29	151.04
16.	103.8	139.7	-35.9	1288.81
17.	114.0	90.72	23.28	541.95
18.	79.08	80.33	-1.25	1.56
19.	97.49	84.54	12.95	167.70
20.	125.4	120.0	5.4	29.16
Sum of d =			205.16	
Sum of d^2 =				8334.1396

DISCUSSION

Thirty minutes after consuming 75 gms of Glucose, the plasma Glucose levels were found to be higher than the other four readings. There is not much difference in this value between the pre and post Tender coconut water, as seen in Table I (two tailed p value is 0.3919). Thus TCW did not affect the peak plasma glucose.

However there was a significant difference in the pre and post tender coconut water plasma Glucose values at 60 min, 90 min and 120 min. This might be due to- (a) Tender coconut water slowing the late intestinal absorption of Glucose due to the presence of soluble fibres in it (b) Some active ingredient in the tender coconut water promoting entry of Glucose into cells and an early clearance of the Glucose from blood, either by directly or indirectly acting as Insulin secretagogue or by acting directly at the tissue level.

CONCLUSION

Since tender coconut water was found to have hypoglycemic action on euglycemic human subjects, their mechanism of action maybe investigated further.

Tender coconut water may be a non-invasive, easily available, widely acceptable way of achieving glycemic control, without an apprehension of developing hypoglycemia.

Tender coconut water already has antioxidant effects as found in some animal studies. [5,6] So supplementing the diet with tender coconut water may mitigate the free radical generation and damage thereof, in subjects with Diabetes Mellitus.

Summary:

The hypoglycemic effect of tender coconut water (TCW) has been shown by various workers on Alloxan induced Diabetic rats and other animal models. But the role of TCW on plasma Glucose in human was still to be investigated. So we wanted to look for the effect of TCW in euglycemic human subjects.

The study proposal was cleared by Institute Ethical Committee. 20 euglycemic adult volunteers, of both sexes within the age group of 18 to 45 years were included in this study. The procedure was explained to the subject and a consent form was signed.

After a morning fasting venous blood sample was collected, 75 gms of Glucose was dissolved in appropriate amount of water and the subjects were asked to drink the same. The time was noted, and subsequently samples were collected at 30 min, 60 min, 90 min and 120 min in Fluoride vials. After at least 7 days interval, the same was repeated now with 75 gms of Glucose, dissolved in 200ml freshly extracted TCW. All samples were analysed by GOD-POD based Glucose estimation kit from Accurex, in a Robonik Semi-automatic analyser, within two hours after collection.

The Glucose Tolerance test results of Glucose dissolved in plain water and Glucose dissolved in TCW were compared using Student's Paired T Test.

TCW did not affect the peak plasma glucose (p = 0.3919) recorded at 30 min. However there was a significant difference in the pre and post TCW plasma Glucose values at 60 min (p = 0.0075), 90 min (p = 0.0335) and 120 min (p = 0.0203). This might be due to: (a) TCW slowing the late intestinal absorption of Glucose due to the presence of soluble fibres in it (b) Some active ingredient in the TCW promoting entry of Glucose into cells and an early clearance of the Glucose from blood, either by acting as Insulin secretagogue or by acting directly at the tissue level, which needs to be further investigated.

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