THE EFFECT OF *CUCUMIS SATIVUS* (CUCUMBER) ON BLOOD GLUCOSE CONCENTRATION AND BLOOD PRESSURE MEASUREMENTS OF APPARENTLY HEALTHY INDIVIDUALS IN PORT HARCOURT.

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**ABSTRACT**

The effect of *cucumis sativus* (cucumber) on plasma glucose concentration and blood pressure measurements of apparently healthy individuals were determined. A total of fifty apparently healthy individuals aged 18-29 years participated in the study and were divided into 5 groups. Group 1 was given 200g *cucumis sativus* juice only, group 2 received 200g *cucumis sativus* juice + 200g (w/w) rice meal, group 3 was given 400g *cucumis sativus* juice only, group 4 was given 400g *cucumis sativus* juice + 400g (w/w) rice meal, and Group 5 was given 400g rice meal (w/w) only. The systolic and diastolic blood pressures (baseline) and 2-hour post-prandial of the participants were determined immediately before blood samples baseline (fasting blood sample) and 2 hours post-prandial blood samples were collected for analysis of plasma blood glucose concentration. The result of the analysis showed no significant (p > 0.05) difference in plasma glucose concentrations between the participants when higher quantity of the juice was consumed.

**KEYWORDS:** Diabetes mellitus, hyperglycaemia, systolic blood pressure, diastolic blood pressure.

**INTRODUCTION**

All cucumbers belong to the botanical plant family called Cucurbitaceae. This broad family of plants includes melons and squashes. Cucumber is the edible fruit of the cucumber plant, *Cucumis sativus*. The plant has large leaves that form a canopy over the fruit. The fruit is roughly cylindrical, elongated, with tapered ends, and may be as large as 60 cm long and 10 cm wide. The most popular variety is the long smooth salad cucumber which has a smooth, dark-green skin. The cucumbers we are most familiar with in the grocery store belong to the specific genus, *Cucumis sativus*. Cucumbers are mainly eaten in the unripe green form. The ripe yellow form normally becomes too bitter and sour.

Cucumber (*Cucumis sativus*) originated in India but was soon cultivated in different parts of the world. Studies done in healthy rabbits in Mexico showed that cucumber is one of the edible plants with hypoglycemic activity and its anti-hyperglycemic effect significantly decreased the area under the glucose tolerance curve and the hyperglycemic peak.

Simmons (1976) reported that cucumber (whole fruit) has about 96 percent water content which is the highest of any vegetable.

Diabetes mellitus is a group of metabolic diseases characterized by hyperglycemia resulting from defects in insulin secretion, insulin action, or both. The chronic hyperglycemia of diabetes mellitus is associated with long-term damage, dysfunction, and failure of different organs, especially the eyes, kidneys, nerves, heart, and blood vessels.

The treatment and management of diabetes mellitus with synthetic drugs has brought great relief to diabetics but in many developing countries, the prohibitive cost of these medications has made it difficult for diabetics with poor income level to access the benefits of these therapies. Apart from cost, synthetic drugs used in the treatment of diabetes mellitus have side effects. For this reason, traditional medicinal practitioners have described a number of plants used as complementary herbal anti-
diabetic drugs, mostly with less dangerous side effects and low cost.\textsuperscript{[7]} The hypoglycemic effect of several of such plants belonging to the family curcurbitaceae has been confirmed and the mechanisms of hypoglycemic activity of this new bioactive drug constituents is also being studied.\textsuperscript{[8]}

Diabetes mellitus and hypertension has been found to co-exist in a number of patients. About 10 to 15\% and 1 to 2\% of Nigerians have hypertension and diabetes respectively.\textsuperscript{[9]} Data obtained from death certificates in the U.S.A. indicates that hypertension has been implicated in 44\% of deaths coded to diabetes, and diabetes is involved in 10\% of deaths to hypertension.\textsuperscript{[10]} Hyperglycaemia which could result to diagnosis of diabetes mellitus was defined based on the World Health Organization (WHO) criteria.\textsuperscript{[11]} Systolic blood pressure > 140mmHg and/or diastolic blood pressure > 90mmHg measured using standard procedures were used to make a diagnosis of hypertension.\textsuperscript{[12]}

In the last few years there has been an exponential growth in the field of herbal medicine and these drugs are gaining popularity both in developing and developed countries like Nigeria because of their natural origin and less side effects.\textsuperscript{[13]} *Cucumis sativus* is an important medicinal plant with diverse pharmacological activity such as antibacterial and antifungal,\textsuperscript{[14]} cytotoxic,\textsuperscript{[15,16]} antacid and carminative activity,\textsuperscript{[17]} hepatoprotective activity,\textsuperscript{[18]} blood lipid lowering activity,\textsuperscript{[19]} and a host of others. Hence, *Cucumis sativus* plays a significant role in the prevention and treatment of disease.\textsuperscript{[20]} *Cucumis sativus* is a common stable fruit commonly consumed by most residents of Port Harcourt. However, there is paucity of literatures on studies based on the medicinal benefits of *Cucumis sativus* sold in Port Harcourt. Thus, this study was aimed at determining the effect of cucumber (whole fruit) on blood glucose concentration and blood pressure of apparently healthy individuals in Port Harcourt, Nigeria.

**MATERIALS AND METHODS**

**Study Area**

The research was conducted at the Department of Medical Laboratory Science using blood samples from apparently healthy subjects from the Rivers State University of Science and Technology, Port-Harcourt, Rivers State. *Cucumis sativus* (cucumber fruit) was purchased from the popular fruit garden market, along Kaduna Street, in Port Harcourt.

Figure 1: Cucumber creepers and fruit

**Study Population**

A total of 50 subjects were enrolled for this study, and all were apparently healthy individuals of both genders with age range of 18 to 29 years. The participants were all students of Rivers State University of Science and Technology, Port-Harcourt.

**Ethical considerations**

Ethical clearance was obtained from the Faculty Board of Science of the Rivers State University of Science and Technology, Port Harcourt, Nigeria and each of the participant gave their voluntary consent to participate in the study.

**Inclusion Criteria**

Apparently healthy individuals were used for this study. They were selected based on the fact that they were not diabetic, smokers or drink alcohol.

**Exclusion Criteria**

Individuals excluded from this research include, diabetic individuals, hypertensive individuals, chronic smokers, alcoholics and those who reported being on drugs during the period of the research.

**Study Design**

The participants (50 subjects) fasted all night (a minimum of 8 hours fast) after their last meal by 8.00pm the previous night and were divided into five groups. The fasting blood samples (baseline) of the participants (50 subjects) were collected and their systolic and diastolic blood pressures were measured. Group 1 participants (10 subjects) were given juice made from 200g of cucumber (two average size) only. Group 2 participants (12 subjects) were given juice made from 200g of cucumber and 400g of cooked rice meal (w/w) while group 5 participants (9 subjects) were given 400g of cucumber (four average size) only. Group 4 participants (8 subjects) were given juice made from 400g of cucumber and 400g of cooked rice meal (w/w) only. After administration of the meal and cucumber juice, their post-blood pressure (systolic and diastolic pressure) were determined two hours later with the simultaneous collection of their blood samples (2-hours post-prandial).

**Sample Collection and Plasma Preparation**

Fasting blood samples were collected from each participant before administration of the test meal from a prominent vein by venipuncture using 5ml syringe (LOT: 141021). 5ml of blood was withdrawn into the syringe and transferred to fluoride oxalate anticoagulant bottles (LOT: 140903) for plasma glucose estimation. Two hours later, blood samples were also collected from each of the participants using the same process, and they were also transferred to fluoride oxalate anticoagulant bottle (LOT: 130819).
The anti-coagulated blood samples were spun in a centrifuge at 3000 revolutions per minute (rpm) for 5 minutes. The plasma was separated from the red cells using a Pasteur pipette and transferred into a plain bottle and analyzed within two hours of separation.

**Determination of Glucose**
Trinder’s glucose oxidase-peroxidase method \(^{[21]}\) was employed in the determination of the plasma glucose concentration in the subjects. The method is based on the oxidation of glucose by glucose oxidase to produce gluconic acid and hydrogen peroxide. The \(\text{H}_2\text{O}_2\) is then oxidatively coupled with 4-aminophenazone (4-AAP) and phenol in the presence of peroxidase to yield a red quinoneimine dye that was measured at 505nm.

\[
\text{Glucose} + 2\text{H}_2\text{O} + \text{O}_2 \rightarrow \text{Glucose Oxidase} \\
\text{Gluconic acid} + \text{H}_2\text{O}_2 \\
2\text{H}_2\text{O} + 4\text{-AAP} + \text{Phenol} \rightarrow \text{Peroxidase} \\
\text{Quinoneimine dye}
\]

The absorbance of the coloured solution is directly proportional to the glucose concentration, when measured at 505nm.

**Measurement of Blood Pressure Using Digital Sphygmomanometer**
The measurement of systolic and diastolic pressures was based on oscillometric detection, using apiezeoelectric pressure sensor and electronic components, including a microprocessor. The left arm of the participant was put into the open cuff cylinder; the artery mark was positioned over the main artery on the inside of the arm. The cuff was wrapped around the arm of the participants and the systolic and diastolic pressure of the participants was digitally determined in mmHg. Two readings of the blood pressure were taken before the administration of the test meal and two hours after administration of the test meal. The mean of the values was taken as the blood pressure measurement.

**Statistical Data Analysis**
The data obtained from the study were analyzed using the GraphPad Instant Version 3.10, 12 bit for Windows. The analysis performed included the computation of the means and standard deviation. The student t-test analysis was used to verify significant differences between the means at \(p<0.05\).

**RESULTS AND DISCUSSION**

**Mean of the parameters for subjects given juice made from 200g of cucumber only**
The mean ± SD plasma glucose level of the subjects before treatment (baseline) with 200g cucumber juice was 5.75 ± 1.88 mmol/L while the mean ±SD of the systolic and diastolic pressures were 121.60 ± 15.75 mmHg and 73.90 ± 6.94 mmHg respectively. The mean ±SD of plasma glucose of the subjects after 2-hours post prandial administration of 200g of cucumber juice was 4.81 ± 1.42mmol/L, while the systolic and diastolic pressure measurement was 111.50 ± 12.29 mmHg and 69.30 ± 6.09 mmHg respectively (table 1). There were no significant differences between the mean plasma glucose levels (\(p>0.05\), \(t=1.28\)), systolic blood pressures (\(p>0.05\), \(t=1.59\)) and diastolic pressures (\(p>0.05\), \(t=1.58\)) respectively between these parameters in the subjects at baseline and two hours after the test meal.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Blood glucose (mmol/L)</th>
<th>Systolic pressure (mmHg)</th>
<th>Diastolic pressure (mmHg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-treatment (baseline) n=10</td>
<td>5.75 ± 1.88</td>
<td>121.6 ± 15.75</td>
<td>73.90 ± 6.94</td>
</tr>
<tr>
<td>Post-treatment (2HPP) n=10</td>
<td>4.81 ± 1.42</td>
<td>111.50 ± 12.29</td>
<td>69.30 ± 6.09</td>
</tr>
<tr>
<td>(p)-value</td>
<td>(p&gt;0.05, t=1.28)</td>
<td>(p&gt;0.05, t=1.59)</td>
<td>(p&gt;0.05, t=1.58)</td>
</tr>
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</table>

**Mean of the parameters for subjects given mixture of 200g cucumber juice and 200g of rice meal**
The mean ± SD of plasma glucose level in the subjects before treatment with juice prepared with 200g of cucumber and 200g of cooked white rice meal was 5.47 ± 1.68 mmol/L (baseline) while the systolic and diastolic blood pressures were 128.10 ± 14.53 mmHg and 74.50 ± 20.38 mmHg respectively. The 2-hours post prandial values were 4.80 ± 1.91 mmol/L for plasma glucose, 119.90 ± 16.17 mmHg for systolic pressure and 67.42 ± 14.21 mmHg for diastolic pressure respectively (table 2). There were also no statistical significant differences in the plasma glucose levels (\(p>0.05\), \(t=0.90\)), systolic pressure (\(p>0.05\), \(t=1.30\)) and diastolic pressure (\(p>0.05\), \(t=0.99\)) respectively between these parameters at baseline and two hours after the test meal.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Blood glucose (mmol/L)</th>
<th>Systolic pressure (mmHg)</th>
<th>Diastolic pressure (mmHg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-treatment control (fasting) n=12</td>
<td>5.47 ± 1.68</td>
<td>128.1 ± 14.53</td>
<td>74.50 ± 20.38</td>
</tr>
<tr>
<td>Post-treatment (2HPP) n=12</td>
<td>4.80 ± 1.91</td>
<td>119.9 ± 16.17</td>
<td>67.42 ± 14.21</td>
</tr>
<tr>
<td>(p)-value</td>
<td>(p&gt;0.05, t=0.90)</td>
<td>(p&gt;0.05, t=1.30)</td>
<td>(p&gt;0.05, t=0.99)</td>
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</table>

**Mean of the parameters for subjects given juice made from 400g of cucumber only**
The mean ±SD of plasma glucose level in the subjects (baseline) before treatment with 400g cucumber juice was 5.26 ± 0.86 mmol/L while the systolic and diastolic blood pressures were 126.36 ± 20.57 mmHg and 70.27 ± 18.80 mmHg respectively. The 2-hours post prandial values after administration of 400g of cucumber juice
were 4.4 ± 0.59 mmol/L for plasma glucose, 113.82 ± 18.31 mmHg for systolic blood pressure and 67.27 ± 15.07 mmHg for diastolic pressure respectively (table 3). There was a significant difference between the plasma glucose levels (p<0.05, t=2.76) of the subjects who consumed 400g of cucumber juice and those who did not (baseline); whereas no significant difference in systolic pressure (p>0.05, t=1.51) and diastolic pressure (p>0.05, t=0.41) respectively were observed between these parameters in the baseline subjects and the 2-hours post prandial subjects although obvious decrease in the blood pressure measurements were observed.

<table>
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<tr>
<th>Table (3): Mean ± SD of parameters for subjects given 400g of cucumber only</th>
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<tbody>
<tr>
<td><strong>Treatment</strong></td>
</tr>
<tr>
<td>Pre-treatment control (fasting) n=11</td>
</tr>
<tr>
<td>Post-treatment (2HPP) n=11</td>
</tr>
<tr>
<td><strong>P-value</strong></td>
</tr>
</tbody>
</table>

**Mean of the parameters for subjects given mixture of 400g of cucumber juice and 400g of rice meal.**

The mean ± SD of plasma glucose level of the subjects (baseline) before treatment with 400g of cucumber juice and 400g of cooked white rice meal was 5.36 ± 1.03 mmol/L while the systolic and diastolic pressures were 127 ± 7.91 mmHg and 77.25 ± 7.78 mmHg respectively. The 2-hours post prandial values after treatment with the test meal were 4.35 ± 0.72 mmol/L for plasma glucose, 114 ± 9.78 mmHg for systolic blood pressure and 65.75 ± 5.23 mmHg for diastolic blood pressure respectively (table 4). There was a significant difference (p<0.05, t=2.27) in the means of plasma glucose levels between the subjects who consumed the test meal and those who did not (baseline), whereas no statistical significant difference in systolic blood pressure (p>0.05, t=0.08) and diastolic blood pressure (p>0.05, t=1.47) respectively was observed between these parameters at baseline and 2-hours after the test meal even though there also an observed decrease in the blood pressure measurements between the two groups.

<table>
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<tr>
<th>Table (4): Mean ± SD of parameters for subjects given 400g of cucumber juice and 400g of cooked white rice meal</th>
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<tbody>
<tr>
<td><strong>Treatment</strong></td>
</tr>
<tr>
<td>Pre-treatment control (fasting) n=8</td>
</tr>
<tr>
<td>Post-treatment (2HPP) n=8</td>
</tr>
<tr>
<td><strong>P-value</strong></td>
</tr>
</tbody>
</table>

Mean of the parameters for subjects given mixture of 400g of rice meal only

The mean ± SD of plasma glucose level of the subjects who were not given the 400g rice meal (baseline) was 5.03 ± 0.73 mmol/L while the systolic and diastolic blood pressures were 132.6 ± 11.65 mmHg and 78.67 ± 6.34 mmHg respectively. The 2-hours post prandial values for subjects given 400g of rice meal only were 4.8 ± 0.93 mmol/L for blood glucose, 128.3 ± 10.27 mmHg for systolic blood pressure and 71.88 ± 13.57 mmHg for diastolic blood pressure respectively (table 5). There was an increase between the plasma glucose level of the subjects at baseline and those who received the 400g rice meal only after two hours of measurement which was statistically significant (p<0.05, t=12.02) and an obvious decrease in the blood pressures which were not statistical significant (p>0.05, t=0.82) when compared with the baseline.

<table>
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<th>Table (5): Mean ± SD of parameters for subjects given 400g of rice meal</th>
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</thead>
<tbody>
<tr>
<td><strong>Treatment</strong></td>
</tr>
<tr>
<td>Pre-treatment control (fasting) n=9</td>
</tr>
<tr>
<td>Post-treatment (2HPP) n=9</td>
</tr>
<tr>
<td><strong>P-value</strong></td>
</tr>
</tbody>
</table>

A lot of oral hypoglycaemic drugs are available along with insulin which are used in the treatment of diabetes mellitus; yet the cure for diabetes is still elusive. Literature are beginning to report the antidiabetic potential of many traditional medicinal plants especially in the experimental animals. Although many traditional medicinal plants have shown great antidiabetic potentials, the activities of some still remain to be scientifically established. Ethanolic extracts of *Cucumis sativa* (cucumber) have been reported to have hypoglycaemic effects on alloxan induced diabetic rats through a mechanism similar to euglycaemic agents.

Results from related works done by Mahomed and Ojewole, [25] and Andrade-Cetto and Wiedenfeld, [26] also reported that cucumbers possess regulatory functions on blood glucose concentration. In this study, we have shown that cucumber can significantly (p<0.05) reduced blood glucose concentration. Subjects who were given either juice made with 400g of cucumber alone or in combination with 400g of rice meal experienced significant reduction in their blood glucose levels from baseline a difference in systolic blood pressure (p>0.05, t=0.08) and diastolic blood pressure (p>0.05, t=1.47) respectively was observed between these parameters at baseline and 2-hours after the test meal even though there also an observed decrease in the blood pressure measurements between the two groups.

[23] Cetto and Wiedenfeld
[24] Ojewole
[25] Andrade-Cetto and Wiedenfeld
[26] Mahomed and Ojewole
previous studies by Lee et al. (2003)\textsuperscript{[27]} where it was shown that cucumber contain compounds known to be responsible for the hypoglycemic activity of the plant. The phytosterol which is a constituent of cucumber has been shown to improve the control of blood sugar among diabetics.\textsuperscript{[27]} The possible mechanism by which cucumber juice exert may exert hypoglycaemic effect may be by potentiating the insulin effect of plasma by causing a stimulation of insulin from the β- islet cells of the pancreas \textsuperscript{[25]}. Other pathways such as the stimulation of peripheral glucose utilization, or enhancing glycolytic and glycogenic processes with concomitant decrease in glycogenolysis and gluconeogenesis may also be involved \textsuperscript{[26]}. The presence phytonutrients found in cucumber such as flavonoids and tannins which have been reported to cause regeneration of damaged pancreatic islets, stimulate calcium and glucose uptake may also contribute to the antihyperglycaemic effect of cucumber.\textsuperscript{[28]}

It has also been reported by other researchers that \textit{cucumis sativus} are found as suitable food for medicinal purpose against some diseases such as diabetes mellitus, hyperlipidaemia, hypertension, gall bladder stones and constipation in Asian traditional remedies \textsuperscript{[29,30]}. Several studies have revealed that high dietary consumption of potassium and magnesium is associated with reduced blood pressure \textsuperscript{[30]}. In this study, we observed a decrease in both the systolic and diastolic blood pressure in participants in groups 1 to 4 although the variation in the means between the participants before the cucumber juice was taken and those observed after 2-hour post prandial were not significant (p> 0.05). The thinking is that increasing the quantity of cucumber in the juice could result in significant decrease in the blood pressure of hypertensive subjects. Furthermore, individual variations and other factors such as the genetic composition of the individuals may have also contributed to the delay in significant reasonable reduction in the blood pressure of the subjects.\textsuperscript{[29,31]}

CONCLUSION

The results revealed that cucumber has hypoglycaemic and anti-diabetic effects since an intake of an increased dose or at concentrations of 400g caused a significant change in blood glucose concentration. It also showed that an intake of cucumber could have significant effect on blood pressure if taken in higher quantity for a considerable period of time

ACKNOWLEDGEMENTS

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