Original

Impact of Cucumber Supplementation on some Hepato-Renal Parameters in the Elderly Individuals in Nnewi

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Abstract

Background: As people age, they often undergo different changes in biochemical markers, which may make them more vulnerable to problems related to liver and kidney disease. Incorporating foods high in antioxidant-rich compounds may have a favorable effect on the liver and kidney function. *Cucumis sativus* (cucumber) contains inorganic elements and phytochemicals believed to play important roles in human health, particularly in terms of the liver and kidney health and function.

Method: This pre-post study evaluated the effect of cucumber (*Cucumis sativus*) supplementation on some hepatorenal parameters in older adults in Nnewi. Thirty (30) apparently healthy older adults (15 males and 15 females) aged between 45 and 75 years were recruited for the study using simple random sampling. Five milliliters (5ml) of fasting venous sample was taken from each participant on day 0 and at 28 days following daily consumption of 400g cucumber. Serum urea, creatinine, alanine aminotransferase (ALT), aspartate aminotransferase (AST) and alkaline phosphatase (ALP) were analysed using spectrophotometric methods. Frequencies, percentages and paired t-test was used to compare the data obtained before and after cucumber supplementation with statistical significance assumed at $p<0.05$.

Results: The results showed that the mean serum urea (4.68±1.22 Vs 4.32±0.97; P=0.026) and creatinine (105.33±14.35 Vs 95.63±12.75; P=0.000) levels as well as ALT (6.82±3.76 Vs 5.64±3.42; P=0.002), AST (5.88±3.25 Vs 5.51±3.05; P=0.037) and ALP (35.06±6.14 Vs 29.72±9.76; P=0.000) activities were all significantly decreased after cucumber supplementation when compared to their baseline levels.

Conclusion: This study has shown that cucumber has hepatorenal-protective effects.

Keywords: *Cucumis sativus*, Cucumber, Kidney, Liver, Urea, Creatinine, Liver Enzymes.

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Introduction

Since the beginning of human history, people have utilized plants to prevent and treat illnesses. Today's modern medicine is derived from these natural sources and plants are the source of about 25% of medicines that are authorized.[1] Additionally, to being an essential component of local communities' histories and cultural activities, plants have long been used extensively in traditional medicine in developing nations.[2] Some of these plants and their products which are commonly consumed in Nigeria for their medicinal values include *Gongronema latifolium* (utazi),[3] *Tetracarpidium conophorum* (walnuts),[4] *Cucumis sativus* (Cucumbers),[5,6] *Moringa Oleifera* (Moringa),[7,8] *Telfairia occidentalis* (fluted pumpkin)[9,10] and *Glycine max* (soya bean).[11] Generally, fruits and vegetables are thought to be significant sources of several indigestible components and phytochemicals that, when consumed alone or in combination, work synergistically to enhance food's nutritional value and overall health.[12]

The vegetable cucumber (*Cucumis sativus* L.), a member of the Curcurbitaceae family, is cultivated extensively around the world and is frequently eaten fresh.[13] It is the fourth most important vegetable crop after tomato, cabbage, and onion.[14] It is an important source of vitamins and minerals in human diets[15] and has been shown to contain a number of phytochemicals such as reducing sugar, saponins, terpenoids, phytosterols and flavonoids[14,16], which possess medicinal values that can impact the kidney and liver functions positively. More so, cucumber contains inorganic elements including potassium, sodium, magnesium, calcium and iron.[16] These inorganic elements and phytochemicals found in cucumber fruit are believed to play important roles in human health, particularly in terms of the liver and kidney health and function.

These days, as lifestyles change due to industrialization, hunger, and other factors are on the rise[17], there is a growing interest in hepatorenal disorders which are commonly characterized by inflammation and oxidative stress.[18,19] As people age, they often undergo different changes in biochemical markers [20-22], which may make them more vulnerable to problems related to liver and kidney disease. Thus, incorporating foods high in antioxidant-rich compounds may have a favorable effect on the liver and kidney function. More so, it has long been known that medicinal plants are an abundant source of compounds that can be used to treat and prevent a wide range of illnesses.[17] Cucumber is one of such medicinal plant and hence this interventional study was designed to determine the effect of cucumber supplementation on some hepato-renal parameters (urea, creatinine, ALT, AST and ALP) in the older adults in Nnewi.

Method

Study Design

This study adopted a pre-post research design. Pre-post research examines the incidence of an outcome both before and after the use of a specific intervention.[23,24] Pre-post studies can have one arm, where one group is assessed prior to the intervention and again after it, or numerous arms, where groups are compared. There is frequently an arm that is unaffected. In a multi-arm pre-post research, the control group is the arm with no intervention. Pre-post studies do not have control over other factors that are changing concurrently with the implementation of the intervention, even though these studies have the temporal strength to suggest that the outcome is impacted by the intervention. The outcome being measured determines the analytic techniques used in pre-post investigations.[24]

This pre-posttest study was designed to determine the impact of cucumber supplementation on some hepato-renal parameters (urea, creatinine, ALT, AST and ALP) in the older adults. The objectives and purpose of the study were explained to the volunteers before collecting signed informed consents. Then, each participant answered questions about their age, socioeconomic status, lifestyle choices (such as drinking, smoking, and eating habits), and any prior histories of chronic illnesses like diabetes mellitus, kidney disease, cardiovascular disease, etc. Thirty participants were selected using simple random sampling technique and they were supplemented with cucumber (*Cucumis sativus*). The baseline samples of the test group (older adults) served as the control for the pre-post study. Prior to the start of the supplementation study, the participants were advised to refrain from eating cucumber and other vegetables of a similar kind as well as other supplements for a period of two weeks. For this study, daily fresh cucumber purchases were made from vendors at Nkwo Market in Nnewi. The weights of the cucumbers were then determined using an electronic weighing scale (Peace Sky) model PH-2015A made in China, which can measure up to 180 kg of weight. Cucumbers that weighed 400 g ±10 g were meticulously selected. For a total of four (4) weeks (28 days), each participant received about 400 g of freshly whole cucumbers every day. The participants were required to eat the entire cucumber every day before their daily breakfast using the oral method of administration. The dietary (feeding) patterns of the participants were assessed before recruitment and consistency in their feeding patterns were ensured throughout the study period. The

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cucumbers were appropriately wrapped, delivered to each participant daily, and kept in good hygienic condition. To guarantee compliance, cucumbers were delivered to each participant each day prior to breakfast, observing the participants finish the entire cucumber. Baseline samples (day 0) and post-research samples (29th day) were collected from each participant for the determination of the biochemical parameters.

Inclusion Criteria

Apparently healthy older adult male and female individuals (45-75 years) who were nonsmokers; not actively exercising and not on any form of supplementation were recruited for this study.

Exclusion Criteria

Participants were examined for diabetes mellitus, kidney disease and cardiovascular diseases using fasting plasma glucose, glycated haemoglobin, urea, creatinine and fasting lipid profile and individuals with known conditions such as diabetes mellitus, kidney disease, cardiovascular diseases (heart disease), pregnant women, lactating mothers, alcohol abusers, smokers and those on any kind of supplementation were excluded from the present study.

Collection of samples and analysis

Five milliliters (5 mL) of venous fasting blood samples were collected aseptically after 10-12 hours of fast by venipuncture from each subject before (day 0) and after 4 weeks of cucumber supplementation via the antecubital vein using a plastic syringe with minimum stasis into plain containers and allowed to clot and retracted; it was then centrifuged at 4000 rpm for 5 minutes (Centrifuge 80-2, Techmel and Technel USA). The serum was separated and used for analysis of biochemical markers at Chemical Pathology Laboratory in NAUTH, Nnewi. Serum samples that were not analyzed immediately were stored frozen at minus twenty degree Celsius (-20°C).

Laboratory Methods

Estimation of Serum Creatinine Level:

Serum creatinine level was assayed using Jaffe-Slot Alkaline Picric Acid Method as described by.[25]

Estimation of Serum Urea: Estimation of serum urea level was done using Berthlot Method as described by.[26]

Estimation of serum liver enzymes activities:

Aspartate aminotransferase (AST) and Alanine aminotransferase (ALT) activities were estimated according to the method of [27] while Alkaline phosphatase activity was assayed for using the method described by.[28]

Statistical Analysis

The IBM SPSS statistics version 26.0,[29] was used to analyse the data collected for this study. Frequency, percentage and Paired t-test was used to compare the data acquired before (pre) and after (post) cucumber supplementation. Frequency and percentage were employed to obtain descriptive statistics of the participants while paired t-test was the parametric statistical tool of choice because the data obtained was normally distributed and also, the study involved the same subjects that their markers were assessed at different points (before and after supplementation). Results were expressed as mean± SD. At $p<0.05$, statistical significance was assumed.

Results

A total of thirty (30) participants took part in the study; of which 50% of the participants were males, and 50% were females. Twelve of the study participants (40%) were between the ages of 45 and 55 years, 14 (46.67%), between the ages of 56 and 66 years, and 4 (13.33%), between the ages of 67 and 75 years. Sixteen (53.33%) had a BMI of 18.5-24.9 kg/m^2, 9 (30%) had a BMI of 25-29.9 kg/m^2, while 5 (16.67%), participants had a BMI above 30kg/m^2, and 0 (0%) had a BMI < 18.5 kg/m^2. Out of the thirty study participants, there were 26 Christians (87%) and 4 traditional worshipers (13%). While 27 of the participants (90%) were married, 2 (7%) were single and 1 (3%) was divorced. Also, 4 (12.9%) of the participants had primary school education; 16 (56.67%) had secondary school education while 10 (32.3%) of the participants had tertiary education. Further, 2 (6.67%) of the study participants were farmers, 9(30%) were civil servants while 19 (63.33%) were traders (See table 1).

Table 1: Socio-demographic and background characteristics of study participants

Variables	Freq	Percentage
Sex		
Male	15	50.0%
Female	15	50.0%
Total	30	100%
BMI		
<18.5 kg/m^2	0	0%
18.5 – 24.9 kg/m^2	16	53.33%
25- 29.9 kg/m^2	9	30.0%
30 kg/m^2 and above	5	16.67%
Total	30	100%
Age range		
45-55 years	12	40%
56-66 years	14	46.67%
67-75 years	4	13.33%
Total	30	100.0%

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Variables	Freq	Percentage
Religion		
Christianity	26	86.67%
Islam	0	0.0%
Traditional worshipers	4	13.33%
Total	30	100%
Occupation		
Farmers	2	6.67%
Civil servants	9	30.0%
Traders	19	63.33%
Total	30	100%
Education level		
Primary school	4	12.9%
Secondary school	16	56.67%
Tertiary	10	32.33%
Total	30	100%
Marital status		
Married	27	90%
Single	2	6.67%
Divorcee	1	3.33%
Total	30	100%

There was significantly decreased mean serum urea (4.68±1.22 Vs 4.32±0.97; P=0.026) and creatinine (105.33±14.35 Vs 95.63±12.75; P=0.000) levels after cucumber supplementation when compared to their baseline levels in the older adults. Also, the results showed that the mean serum ALT (P=0.002), AST (P=0.037) and ALP (P=0.020) activities were all significantly decreased after cucumber supplementation when compared to their baseline levels in the older adults (See table 2).

Table 2: Serum Levels of Parameters Studied in the older adults before and after cucumber supplementation (Mean ± SD; n=30)

Parameters	Before cucumber supplementation (n=30)	After cucumber supplementation (n=30)	t-value	*P*-value
Urea	4.68±1.22	4.32±0.97	2.336	0.026*
Creatinine	105.33±14.35	95.63±12.75	5.204	0.000*
ALT	6.82±3.76	5.64±3.42	3.444	0.002*
AST	5.88±3.25	5.51±3.05	2.181	0.037*
ALP	35.06±6.14	29.72±9.76	2.466	0.020*

**P*-value is statistically significant at <0.05

The mean serum creatinine (106.80±14.78 Vs 94.87±15.27; P=0.001) level and ALP activity (35.87±6.28 Vs 27.80±7.18; P=0.000) was significantly decreased after cucumber supplementation when compared to their baseline levels in the older adult males. However, the mean serum urea level (P=0.833), as well as ALT (P=0.166) and AST (P=0.138) activities were not significantly different after cucumber supplementation when compared to their baseline levels in the older adult males (See table 3).

Table 3: Serum Levels of Urea, Creatinine and ALT, AST and ALP Activities in the older adult males before and after cucumber supplementation (Mean ± SD; n=15)

Parameters	Before cucumber supplementation (n=15)	After cucumber supplementation (n=15)	t-value	*P*-value
Urea	4.42±1.06	4.36±1.00	0.214	0.833
Creatinine	106.80±14.78	94.87±15.27	4.231	0.001*
ALT	6.20±3.16	5.47±2.97	1.461	0.166
AST	5.33±3.84	4.93±3.63	1.572	0.138
ALP	35.87±6.28	27.80±7.18	5.172	0.000*

**P*-value is statistically significant at <0.05

There was significantly decreased mean serum urea (P=0.000) and creatinine (P=0.008) levels after cucumber supplementation when compared to their baseline levels in the older adult females. Also, the results showed that the mean serum ALT (P=0.007) and ALP (P=0.000) activities were significantly decreased after cucumber supplementation when compared to their baseline levels in the older adult females. However, the mean serum AST activity did not differ significantly (P=0.110) after cucumber supplementation when

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compared to their baseline levels in the older adult females (See table 4).

Table 4: Serum Levels of Urea, Creatinine and ALT, AST and ALP Activities in the older adult females before and after cucumber supplementation (Mean ± SD; n=15)

Parameters	Before cucumber supplementation (n=15)	After cucumber supplementation (n=15)	t-value	*P*-value
Urea	4.94±1.34	4.30±0.98	4.759	0.000*
Creatinine	103.87±14.26	96.40±10.11	3.121	0.008*
ALT	7.27±4.11	5.73±4.04	3.151	0.007*
AST	6.40±2.61	5.93±2.40	1.705	0.110
ALP	35.87±6.28	27.80±7.18	5.172	0.000*

**P*-value is statistically significant at <0.05

Discussion

In Nigeria, cucumbers are a widely consumed vegetable that are said to have therapeutic properties that might improve human health, particularly in relation to liver and kidney function. This interventional study aimed to ascertain the effects of cucumber supplementation on hepato-renal parameters (ALT, AST, ALP, creatinine, and urea) in the elderly population of Nnewi.

The results of this study showed that after 400g of cucumber supplementation for 4 weeks, the mean serum urea and creatinine levels in the older persons were significantly decreased than baseline. This finding indicates better renal function, which may be attributable to the antioxidant chemicals in cucumbers, which reduce inflammation and oxidative stress in the body and protect the kidneys from damage. Cucumbers have been shown to have antioxidant properties in earlier research.[14,16,30] By eliminating metabolic wastes like urea and creatinine from bodily fluids, kidneys optimize the composition of bodily fluids and preserve physiological homeostasis. Blood urea and creatinine levels are frequently employed as indicators of renal function and are sensitive indicators of renal impairment.[31] This result is consistent with the findings of multiple prior studies of a similar nature in experimental animals.[13,32-34] However, it is not consistent with the findings of a previous study which reported no significant difference in the mean serum urea and creatinine levels in apparently healthy students three weeks after consuming cucumbers.[6]

The current investigation revealed four weeks (28 days) after consuming cucumbers, there was a significant decrease in the mean blood activity of ALT, AST, and ALP as compared to baseline. This points to the hepatoprotective effects of cucumber which may also be related to its rich antioxidant chemicals. This is in keeping with the reports of similar studies.[13,30,32,35] However, this is invariance with the results of previous study which recorded no significant difference in serum ALT and AST activity three weeks post cucumber consumption in healthy students.[5] This disparity may be due to the difference in study duration. Serum enzyme analysis has shown to be highly helpful in the detection of liver disorders. Markers for hepatocellular injury include serum aspartate aminotransferase (AST), alanine aminotransferase (ALT) and alkaline phosphatase (ALP). Due to an increase in the permeability of the cell membrane or cellular disintegration, these enzymes are important in determining and tracking liver cell inflammation and necrosis, which causes the release of these enzymes into the bloodstream.[36] Liver cells have a larger concentration of AST than ALT, although ALT is only found in the cytoplasm, where it is more concentrated than AST. For liver injury, an increase in ALT serum levels is consequently more specific.[37] The bone, liver, spleen, gut, placenta, and kidneys have the highest quantities of ALP. There are several isoenzymes found in ALP; the most well-studied forms are those found in the liver, placenta, and bone.[38] Because increased synthesis of ALP occurs in the affected ducts, increasing the activity of this enzyme in the plasma, elevated level of ALP is a sensitive indication of biliary cholestasis.[37]

Implications of the findings of this study

Cucumber consumption has been demonstrated to have positive hepatorenal effects in this study; as a result, it may be helpful as an adjuvant in the therapeutic management of conditions linked to elevated levels of hepatic and renal indicators. To better understand the mechanisms underlying its effects on liver and kidney health, more research is necessary, with a larger sample size and follow-up. This research should also evaluate the minerals that cucumber contains and determine how cucumber affects antioxidants and oxidative stress markers.

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Strengths and Limitations of the Study

The strength of this study is its design which adopted a random sampling method which helps to minimize the issue of selection bias. The study participants were assessed for their patterns of feeding before recruitment and consistency was ensured throughout the study period which minimizes the risk of confounding variables arising from participants' dietary intake. Also, we used older adults who were neither actively exercising nor on any other forms of supplementation that may influence the findings of this study. Furthermore, all the participants received supplementation within the same study period and also completed the study which may have influenced the results in terms of efficacy.

The present study investigated the effect of cucumber supplementation on some hepato-renal parameters in the elderly individuals and the results may not be definitely generalised to the middle-aged groups and adolescents due to differences in metabolic status. Also, our study has some other notable limitations: the small number of participants, short duration of study, use of single dosage administering, and two points sample collection (before and after supplementation). It seems that increasing the intervention length, using different dosages of supplements and collection of samples at multiple stages within the study period may give better results. The non-investigation of the micronutrients and macronutrients taken along with meals by participants can be pointed out.

Conclusion

This study showed that after four weeks of supplementing with cucumbers, older persons' serum urea and creatinine levels, as well as their ALT, AST, and ALP activities, significantly decreased. Four weeks after receiving cucumber supplements, the older adult males also showed a decrease in serum creatinine level and ALP activity, while the older adult females showed a decrease in mean serum urea and creatinine as well as ALT and ALP activities. Consequently, this study has shown the positive impact of cucumber on the liver and kidney function.

Declarations

Ethical Consideration: Ethical clearance for the study was obtained from Nnamdi Azikiwe University Teaching Hospital (NAUTH) Ethics Committee (NAUTH/CS/66/VOL. 16/VER. 3/07/2023/07). Prior to the start of the study, the participants' written informed consent was sought and obtained.

Authors' Contribution: Ogbodo EC was involved in all aspects of the work, Onah CE designed and supervised the work, Ogbodo MC, Okeke CS, Ifesinachi MO and Akpa KC were involved in the acquisition, analysis and interpretation of data for the study, Okezie AO, Iwuji JC and Achiaku A, was involved in Literature review and manuscript preparation. All authors read through and approved the final manuscript

Conflict of interest: None

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