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EFFECT OF CUCUMBER CONSUMPTION ON PLASMA ELECTROLYTES PROFILE LEVELS IN APPARENTLY HEALTHY STUDENTS OF COLLEGE OF HEALTH SCIENCES AND TECHNOLOGY, NNAMDI AZIKIWE UNIVERSITY, NNEWI CAMPUS, ANAMBRA STATE, NIGERIA

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ABSTRACT

This study was designed to investigate the effect of oral intake of cucumber on plasma electrolytes profile levels in young apparently healthy students. A total of 29 subjects (14 males and 15 females) were recruited. Each subject was advised to abstain from cucumber and similar vegetables consumption for two weeks. Thereafter, they received 400 g of whole cucumber for 21days prior to their daily breakfast. 5mls each of baseline (day zero) and post consumption (day 22) samples were collected after overnight fast into lithium heparin containers for estimation of biochemical parameters (Na^+, K^+, Cl^-, and $HCO3^-$) respectively. Plasma electrolytes were analyzed using Ion Selective Electrode Method. Results were subjected to statistical analysis using student t-test and pearson r correlation. The Body mass index (BMI) of subjects studied remained the same. There was no significant difference in the mean plasma electrolyte profile levels in post cucumber consumption when compared to the pre-cucumber consumption ($p<0.05$). However, the mean plasma Na^+ level differed significantly in female than male subjects after cucumber consumption (130.17 ± 11.68 Vs 139.55 ± 2.12; $p=0.011$). Significant correlations were noted in Na^+ Vs K^+, Na^+ Vs Cl^- as well as in weight vs BMI of subjects after cucumber consumption ($r=0.802$, -0.623, 0.957; $p=0.000$, respectively). This study revealed no harmful effect of cucumber consumption on the electrolyte profile.

KEYWORDS: Cucumber, *Cucumis sativus*, sodium, potassium, chloride, bicarbonate.

INTRODUCTION

Electrolytes are divided into anions that are ions with negative charge which move toward the positive electrode, or cations that are ions with positive charge that move toward a negative electrode. The major electrolytes are Na^+, K^+, Cl^- and $HCO3^-$ which are found primarily as free ions, compared to $Ca2^+$, $Mg2^+$, and other trace elements which are mainly protein bound (Mitchell *et al*., 2012). In a healthy person, 60 % of the body weight is body water (Martin, 2012). Body water is of two types namely ECF and the ICF, with a cell membrane in between. With the help of Na, K ATPase pump, equilibrium between the two compartments is maintained, where by Na being the main extracellular cation and K the main intra-cellular cation. The capillary membrane divides the ECF into intravascular and interstitial compartments. The membrane pore size, the relative concentration and oncotic pressure of proteins decides the equilibrium between the compartments (Lobo, 2004).

The use of plants as source of remedies for the treatment of diseases can be traced back to the prehistoric times (Lawrence and Bennett, 1995; Evans, 2009; Ankita *et al*., 2012) and medicinal herbs are being increasingly studied by pharmacological researchers (Sinclair, 1998). In Africa, traditional herbal medicine derived from plants forms an integral part of life in many indigenous communities as a readily available alternative to allopathic medicines (Wagate *et al*., 2010). Plants have been an indispensable source of both preventive and curative traditional herbal medicinal preparations for many people in Africa. Traditional herbal medicine is of great value, and more than 70% of the people in Africa refer to traditional herbal healers concerning health issues (Tijjani *et al*., 2009). Traditional herbal medicine has flourished in Africa and has continued to be the main source of health in the rural communities and is heavily relied on by the majority of the sub-Sahara African population. In Africa, traditional herbal medicine was used to cure diseases until colonialists introduced the use of the counter and prescription drugs.

The medicinal value of these plants lies in some chemical substances that produce a definite physiological action on the human body (Edeoga *et al*., 2005). These chemicals are termed as phyto-chemicals. Phyto-chemicals are bioactive non-nutrients plants compounds that have protective or disease preventive property. They confer plants with odor (terpenoids), pigmentation (tannins and quinines) and flavor (capsacin) (Mallikharjuna *et al*., 2007) and are a part of plants naturally defense system. These bioactive components are said to be responsible for the anti microbial effect of plant extract invitro. They are grouped as flavonoids, alkanoids, glycocides, saponins, tannins, terpenoids, carbohydrates, and sterols. Cucumber (*Cucumis sativus*) belongs to the family cucurbitacae. In general, there are 118 genera and 825 species worldwide (Rai *et al*., 2008) among which 30 cucumis species are found in Asia and African. Plants of this family have many medicinal and nutritional benefits (Gill and Bali, 2011). *Cucumis sativa* (cucumber) is a widely cultivated plant of gourd family which is eaten in the unripe, green form. Its fruit extract has shown free radical scavenging and analgesic activities in mice (Kumar *et al.*, 2010), carminative and antacid property (Sharma *et al*., 2012). Studies of Gill *et al*., (2009) have shown the antioxidant and anti-ulcer effect of *C. sativa* in rats. Abiodun and Adeleke, 2010 reported that the seeds of the plant served as a good source of protein, fat, minerals and calcium.

Furthermore, seeds extracts from cucmber have shown the presence of cardiac glycosides, terpenoids, carbohydrates and saponins. Cardiac glycosides have anti-inflammatory activity (Shah *et al*., 2011), and protect against lethal endotoxemia (Matsumori *et al*., 1997). Phytosterols have also been found in the extracts of *cucumis sativa* (cucumber). Phytosterols have a significant hypocholesterolemic effect (Castro *et al*., 2005; Ezeodili *et al*., 2017). Ogbodo *et al*. have also reported the hypoglycemic effect of cumber in apparently healthy students (Ogbodo *et al*., 2017). However, of all these studies, none to the best of our knowledge has evaluated the effect of cucumber consumption on the electrolytes profile levels in apparently healthy subjects. Hence, the need for this study.

MATERIALS AND METHODS

Study Area

Nnamdi Azikiwe University, Okofia-Otolo, Nnewi campus comprises the college of Health Sciences having the faculties of Basic Medical Sciences, Health Sciences and Technology and Medicine. It is located in the suburb of Nnewi - a popular town in Anambra State Nigeria.

The environment is poorly developed and lacking basic amenities such as housing, road, communication, electricity and potable water compared to campuses located in urban areas..

Study Design

This is a case-control study designed to investigate the effect of cucumber consumption on plasma electrolytes profile levels in apparently healthy students of College of Health Sciences and Technology, Nnamdi Azikiwe University, Nnewi Campus, Anambra State, Nigeria. A total of 29 subjects (14 males and 15 females) between 18 and 28 years old were recruited. The subjects were essentially medical students. Each subject was advised to abstain from cucumber and similar vegetables consumption for two weeks. Thereafter, they received 400g of whole cucumber for 21days prior to their daily breakfast. 5mls each of baseline (day zero) and post consumption (day 22) samples were collected after overnight fast into lithium heparin containers for estimation of biochemical parameters respectively. Plasma electrolytes (sodium, potassium, chloride and bicarbonate) were analyzed using Ion Selective Electrode (ISE).

Ethical Consideration

Ethical approval was obtained from the Faculty of Health Sciences and Technology ethical committee, Nnamdi Azikiwe University, Nnewi campus, Anambra State, Nigeria for sample collection.

Inclusion and Exclusion criteria

Apparently healthy male and female Subjects that consume cucumber and are between 18-28years of age and non-diabetic and not on drugs (hypoglycaemic and diuretic drugs) were recruited for the study. Subjects younger than 18years or older than 28years old that do not consume cucumber and other similar vegetables that are on drugs and medications (hypoglycaemic and diuretic drugs) were excluded from this study.

RESULTS

The mean age (years), height (metres), weight (Kg) and body mass index (Kg/m^2) were (23.3 $\pm$ 2.24 years, 1.63 $\pm$0.88 m, 62.62 $\pm$ 11.11 Kg, and 23.34 $\pm$3.19 Kg/m^2) respectively. The subjects were from young and apparently healthy population. When the anthropometric parameters were compared between the male and female subjects, there were a significant difference in the mean age and height of the male than female subjects. However, there was no significant difference in the mean weight of both sexes and in general, no significant difference in mean body mass index (BMI) of the subjects compared (P<0.05), (see table 1).

Table 1: Anthropometric parameters of subjects studied (Mean±SD; n=29).

Parameters	All Subjects (n=29)	Male (n=14)	Female (n=15)	t-value	p-value
Age (year)	23.3±2.4	24±2.4	2 2.5±2.4	2.122	0.043*
Height (meter)	1.63±0.88	1.69±0.86	1.59±0.62	3.526	0.002*
Weight (Kg)	62.62±11.11	65.79±8.85	59.67±12.42	1.534	0.137
BMI (Kg/m^2)	23.34±3.19	23.6±2.59	23.51±3.57	0.296	0.770

***Statistically significant at P<0.05**

The mean plasma electrolytes (Na+, K+, CL-, and HCO3-) levels did not differ significantly in the subjects before and after 3weeks of cucumber consumption (p>0.05), see table 2.

Table 2: Plasma electrolyte profile levels before and after 3weeks of cucumber consumption.

Variables	Pre-cucumber Consumption	Post-cucumber Consumption	t-value	p-value
plasma Na^+ (mmol/l)	137.95±2.51	135.02±9.40	1.558	0.130
plasma K^+ (mmol/l)	3.85±0.35	3.77±6.35	0.982	0.335
plasma Cl^- (mmol/l)	101.24±2.11	99.27±6.99	1.457	1.068
plasma HCO_3^- (mmol/l)	22.56±2.56	21.30±5.23	1.068	0.295

***Statistically significant at P<0.05**

The mean plasma electrolytes level showed no statistical significant difference between male and female subjects prior to cucumber consumption (p>0.05), see table 3.

Table 3: Plasma electrolyte profile levels of male and female participants before cucumber consumption.

Variables	Males (n=14)	Females (n=15)	t-value	p-value
Plasma Na^+ (mmol/l)	137.81±3.1	138.08±1.95	0.280	0.781
Plasma K^+ (mmol/l)	3.93±0.41	3.77±0.28	1.167	0.255
Plasma Cl^- (mmol/l)	100.89±2.46	101.57±1.74	0.853	0.402
Plasma $HCO3^-$ (mmol/l)	22.65±3.18	22.47±1.93	0.179	0.859

***Statistically significant at P<0.05.**

There was no significant difference (P=0.111, 0.120, and 0.905) in the mean plasma levels of k, cl and biocarbonate in male subjects compared to female subjects. However, mean plasma Na level was significantly high (p=0.011) in the female subjects (130.17±11.68 Vs139.55±2.12) when compared to male subjects in the study (table 4).

Table 4: Plasma electrolyte profile levels of participants after 3weeks of cucumber consumption.

Variables	Males (n=14)	Females (n=15)	t-value	p-value
Plasma Na^+ (mmol/l)	130.17±11.68	139.55±2.12	2.959	0.011*
Plasma K^+ (mmol/l)	3.66±0.42	3.87±0.25	1.648	0.111
Plasma Cl^- (mmol/l)	96.43±9.32	101.92±1.21	1.621	0.120
Plasma $HCO3^-$ (mmol/l)	21.18±4.17	21.41±6.20	0.120	0.905

***Statistically significant at P<0.05**

There was a significant negative correlation in plasma Na Versus K (r=;-0.432 p= 0.019), while all other parameters compared showed a positive correlation prior to cucumber consumption (table 5).

Table 5: The levels of Association between Parameters Studied before cucumber consumption.

Parameters	Subjects(n)	Correlation Coefficient Pearson r	p-value
Ht Vs Wt	29	0.642	0.000*
Wt Vs BMI	29	0.802	0.000*
Na Vs K	29	-0.432	0.019*
Na Vs Cl	29	0.383	0.040*

*** Statistically significant at P<0.05; Ht=height; Wt=weight.**

There were significant positive correlation between weight versus body mass index (r=0.802; p=0.000) and concentration of sodium versus chloride(r=0.957; p=0.000), whereas, the concentration of sodium versus potassium was negatively correlated in the apparently healthy subjects post-cucumber consumption (r=-0.623; p=0.000), (table 6).

Table 6: The levels of Association between Parameters Studied Post cucumber consumption.

Parameters	Subjects(n)	Correlation Coefficient Pearson r	p-value
Ht Vs Wt	29	0.642	0.000*
Wt Vs BMI	29	0.802	0.000*
Na Vs K	29	-0.623	0.000*
Na Vs Cl	29	0.957	0.000*

*** Statistically significant at P<0.05; Ht=height; Wt=weight.**

DISCUSSION

Cucumis sativa seed have been reported to served as a good source of protein, fat, minerals and calcium and possess several phytochemical constituents of medical importance such as cardiac glycosides, terpenoids, carbohydrates, saponins, Phytosterols, among others (Castro *et al*., 2005; Shah *et al*., 2011). Also, Ogbodo *et al*. have also reported the hypoglycemic effect of cumber consumption with no deleterious effect on the kidney in apparently healthy students (Ogbodo *et al*., 2017).

In the present study, the mean plasma electrolytes (Na^+, K^+, CL^-, and $HCO3^-$) levels did not differ significantly in the subjects before and after 3weeks of cucumber consumption (p>0.05). This maybe due to the short term duration of cucumber consumption by the subjects.

Interestingly, the mean plasma Na^+ level was more significantly increased (130.17±11.68 Vs139.55±2.12; p=0.011) in the females than the males after cucumber consumption whereas other electrolytes levels (K^+, CL^-, and $HCO3^-$) did not differ significantly (P>0.05). However, the mechanism behind this significant increase in the mean plasma concentration of sodium in the females than the male subjects post cucumber consumption is yet unknown.

Furthermore, there were significant positive correlation between weight versus body mass index (r=0.802; p=0.000) and concentration of sodium versus chloride(r=0.957; p=0.000), whereas, the concentration of sodium versus potassium was negatively correlated in the apparently healthy subjects post-cucumber consumption (r=-0.623; p=0.000).Sodium remains the major extra-cellular fluid (ECF) cation while potassium is the major intra-cellular fluid (ICF) cation and they have an inverse relationship which helps to keep the blood pressure in check (Martin, 2012).

CONCLUSION

In conclusion, the mean plasma electrolyte profile levels in post cucumber consumption when compared to the pre-cucumber consumption did not differ significantly. However, the mean plasma Na^+ level differed significantly in female than male subjects after cucumber consumption. However, significant correlations were noted in the concentration of Na^+ Vs K^+, and Na^+ Vs Cl^- as well as in weight vs BMI of subjects post cucumber consumption (p=0.000). This study therefore, revealed no harmful effect of cucumber consumption on the electrolyte profile.

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