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Research Article

Superiority of Citrullus Lanatus Seeds in Macros, Minerals and Nutrient Density Over Cucumis Sativus Seeds in Dry Extract Basis

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Abstract

This report is on the proximate, minerals composition of the seeds of W.M. and C.C. and other matters connected therewith. Table 1 contained proximate and mineral values on D.W. basis for reference only. Combined direct comparisons between the two samples (W.M./C.C.) are as follows:

The nutrient density (ND) showed the following ratings in W.M.: Cu an Mn (excellent source), CP, EE and Mg (very good source), Fe, Co, Zn and P (good source); in C.C., only CP and CHO were in good source rating. For statistical analysis, W.M./C.C. (proximate) had no significant difference but significant difference occurred in W.M./ C.C. (minerals) at rxy = 0.05. Both samples would exhibit similar mixed oxidation type of Ca/K < 4:1 and Na/Mg < 4.17:1.

Key words: phytonutrients composition; superiority; watermelon; cucumber; seeds

Abbreviations

EE: Ether Extract (Crude Fat)

CP: Crude Protein

CHO: Carbohydrate

CF: Crude Fibre

Kcal: Kilcalorie

kJ: Kilojoule

UEDP: Utilisable Enegy Due to Protein

MWB: Metabolisable Water Balance

Macros: (EE, CP, CHO)

WMS: Watermelon Is Superior

WM: Watermelon

MSI: Mineral Safety Index

CCS: Cucumber is Superior

CC: Cucumber

RAI: Recommended Adult Intake

DW: Dry Weight

DE: Dry Extract

ND: Nutrient Density

RDA: Recommended Daily Average

SD: Standard Deviation

CV%: Coefficient of Variation

CA: Coefficient of Alienation

IFE: Index of Forecasting Efficiency

AOAC: Association of Official Analytical Chemists

df: Degree of Freedom

DV: Dietary Value

DRI: Dietary Reference Intake

RBI: Reference Balance Ideal

AIR: Acceptable Ideal Range

TV: Table (Standard) Value

Introduction

Cucumber is a cultivated plant in the gourd family cucurbitaceae. It is a creeping vine that roots in the ground and grows up trelises or other supporting frames. Wrapping around supports with thin, spiraling tendrils. Cucumber fruit is roughly cylindrical, elongated with tapered ends, and may be as large as 60 centimeters (24 in) long and 10 centimeters (3.9 in) in diameter. Having an enclosed seed and developing from a flower, botanically speaking, cucumbers are classified as accessory fruits (**Wikipedia, the free encyclopedia**). They are often used as culinary vegetables. Three main varieties that are well known are slicing, pickling and burples. Slicing cucumbers are grwn to eat fresh mainly in the unripe green form. Cucumbers can be picked for flavour and longer shelf-life. Picklers, grow to about 7cm (3 in) t 10 cm (4in) long and 2.5 cm (1 in) wide.

Cucumber originated in India, where a great many varieties have been observed (**Doijode, 2001; Renner et al, 2007; Newstrackindia.com 2010**), from Cucumis hystrix (**Doijode, 2oo1; Encylopeadia Britannica on-line**). Records of cucumber cultivation appear in France in the 9th century, England in the 14th century and in North America by the mid-16th century. Cucumbers are mentioned in the Bible as one of the foods eaten by the Israelites in Egypt (Numbers 11:15). Isfahan burpless cucumber originated from Iran. Cucumbers are the fourth most cultivated vegetable in the world (NaturalNews, 2012). Cucumber plants naturally thrive in both temperate and tropical environments, and generally require temperatures between 60 – 90^{0}F/15 – 33^{0}C; hence, they are native to many regions of the world.

Cucumbers provide us with a variety of health- supportive phytonutrients. Included among these phytonutrients are flavonoids (apigenin, inteolin, quercetin and kaempferol), lignans (pinoresinol, lariciresinol, and sesoislariciresinol) and triterpenes (cucurbitacins A, B, C, D and E (Lee et al., 2010). Several different signaling pathways (for example, the JAK – STAT and MAK pathways) required for cancer cell development and survival can be blocked by activity of cucurbitacins (Thoennissen et al, 2009). Cucumber helps to scavenge free radicals, help improve antioxidant status, inhibit the activity of pro-inflammatory enzymes like cyclo-oxygenase 2 (COX -2) and prevent overproduction of nitric oxide in situations where it could pose health risks. All these antioxidant and anti-inflammatory benefits, support health along of the conventional antioxidant nutrients – including vitamin C, beta – carotene and manganese.

While some people have a personal preference for seedless cucumbers, it's worth remembering that cucumber seeds are rich source of cucumber nutrients that are sometimes absent in the pulp and skin. Watermelon (Citrulus lanatus var lanatus, family Cucurbitaceae) is a vine-like (scrambler and trailer) flowering plant. It is a large, sprawling and annual plant with coarse, hairy pinnately – lobed leaves and white to yellow flowers. Its edible fruit is a special kind of berry known as a pepo. The fruit that may be of different colours has many seeds. Watermelon probably originated in the Kalahari Desert in southern Africa (**de candolle, 1882; Wehner, 2024**). Watermelon seeds have been found in Twelfth Dynasity sites and in the tomb of Pharaoh Tutankhamum (Zohary and Hopf, 2000). It is also mentioned in the Bible as a food eaten by ancient Israelites while they were in Egypt **(Freedman and Myers, 2000)**. Pepo has thick rind (exocarp) and fleshy centre (mesocarp and endocarp) **(Worldbotanical, 2014)**. Cultivated varieties of watermelon may exceed 60cm (24in). Watermelon needs temperatures higher than about 25^{0}C (77^{0}F) to thrive and has a longer growing period than other melons and can often take 85 days or more from transplanting for the fruit to mature (Washington state university, 2014).

Watermelon is related to cucumbers, pumpkins and squash. The watermelon contains about 6% sugar and about 91% water by weight. It is a good source of vitamin C, high in vitamin A and potassium whilst being low in fat, cholesterol and sodium **(Nutritional data, 20 – 10 – 05)**. The seeds have a nutty flavour and can be dried and roasted or ground into flour **(South Africa National Biodiversity Institute, 2014)**. In China (present world top producer of watermelons), the seeds are esteemed and eaten like almonds are in the west, being consumed with other seeds at Chinese New Year celebrations **(Shiu-ying Hu, 2005)**. The seed oil has anthelmintic properties (ability to treat infections of animals with parasitic worms) **(South Africa National Biodiversity Institute, 2014)**. The amino acid citrulline was first extracted from watermelon and analysed (Wada, 1930). The citrulline in watermelon is converted to arginine in the body. This can relax and expand blood vessels, much like the erectile dysfunction drug viagra and may increase libido. It can also be used to help treat people with angina high blood pressure and other cardiovascular problems and is beneficial to the immune system (Science Daily, 2008). In vietnamese culture, watermelon seeds are consumed during the vietbanese New Year's holiday, Têt as a snack (Brady, 2004). Watermelon is a high source of lycopene, a carotenoid phytonutrient that's especially important for cardiovascular health and bone health as well.

Wikipedia has detailed the scientific classification of both cucumbers (Binomial name: *Cucumis Sativus* L.) and watermelon (Trinmial Name: *Citrullus lanatus* var. *lanatus* [Thunb.] Matsum and Nakai). Two common questions about cucumbers and watermelons involve consumption of their skin and their seeds. The skins and seeds of both fruits are both rich in nutrients. In fact, the nutrient richness of both plant parts is significantly higher than the flesh. For this reason, consumption of both skins and seeds is desirable from nutritional standpoint. However, some people have a personal preference for removal of the seeds from both fruits. This work sets out to analyze (on comparison basis) the seeds of cucumber and watermelon for their content of macros, minerals nutrient density (and other matters connected therewith) to fi and out if there are superiority in the quantities of watermelon parameters compared to those f cucumber parameters.

Materials and Methods

Samples and treatment

Both watermelon and cucumber fruits were collected from marketers at the Oba market, Ado-Ekiti, Ekiti State, Nigeria. The seeds can easily be removed from the fruit if it is cut lengthwise and the tip of a spoon is used to gently scoop out the seeds. The seeds were washed with running water and sun dried. The seeds were further oven dried, milled into flour and kept in the laboratory freezer, pending analysis. The fruit samples had earlier been authenticated.

Proximate analysis

Moisture content was determined gravimetrically by using ventilated oven set at 105^{0}C to dry the sample to constant weight **(AOAC 927.05)** Crude protein (CP) was determined by multiply the estimated nitrogen (Kjedahl method) by a factor of 6.25 **(AOAC method 955.04C)**. Either extract (EE) determination was carried out by the Soxhlet extraction

apparatus using chloroform/methanol (2:1 v/v) mixture **(AOAC method 920.39A)**. Total ash was determined by ignition of the sample in a muffle furnace set at 550^0C **(AOAC method 923.03)**. Dietary fibre (CF) was estimated by the method of AOAC (2006) (AOAC method 985.29) and carbohydrate was estimated by difference,

i.e., carbohydrate (g/100g) = 100 – (Moisture + CP + EE + CF + Ash) …… Equation (1)

Conversion of EE to true fatty acid (T- TFA) Ether extract x 0.80 = TFA (Greenfield and Southgate, 2003)

……Equation (2)

Total energy from protein, fat, carbohydrate, T – TFA and other lipids (OLs)

Total energy (kJ/100g) = (EE x 37) + (CP x 17) + (CHO x 17) ……Equation (3)

Total energy (kcal/100g) = (EE x 9) + (CP x 4) + (CHO x 4) ……Equation (4)

Utilisable energy due to CP (UEDP%) = % protein in total energy x 60% ……. Equation (5)

Energy requirement for infants per day = 740cal/Total energy x 100/1 = sample equivalent

……Equation (6)

Energy requirement for adult per day = 2500/total energy x 100/1 = sample equivalent

…… Equation (7)

Energy requirement for adult per day = 3000/total energy x 100/1 = sample equivalent

……Equation (8)

Water requirement for complete protein metabolism

Protein energy = P (kcal/ 100g)

Water for excretion = (Q) = 3 (P)[a]ml

Water deficit = (350/100 x P) = Tml

Water balance = (T – Q) ml …… Equation (9)

[a] = 1 calorie f protein requires 3ml of water for by – products excretion **(Albanese, 1959).**

Calorie split/Daily macros determination

CHO: Daily calories *0.40/4 = grams of CHO per day ……**Equation (10)**

CP: Daily calories *0.30/4 = grams of CP per day ……. **Equation (11)**

EE: Daily calories *0.30/9 = grams of EE per day ……. **Equation (12)**

(https://myhummusfit.com>news, 2024).

Mineral analysis

The minerals were analysed from the solution obtained by first dry ashing the sample at 550^0C. the filtered solution was used to determine: Ca, Mg, K, Na, Fe, Mn, Zn, Cu, Co, Pb P and Se by means of atomic absorption spectrophotometer (Buck Scientific Model – 200A/210, Norwal, connecticut 06855) and phosphorus was determined colorimetrically by Spectronic 20 (Gallenkamp, UK) using the phosphovanado molybdate **(AOAC method 948.09)**. All chemicals used were of analytical grade from the British Drug House (BDH), London, UK). The detection limits for the metals in aqueous solution were determined previously using the methods of **Varian Techtron (1975)**. The optimal analytical range was 0.1 – 0.5 absorbance units with coefficient of variation from 0.9% - 2.21%.

Mineral ratio

Ratios f Ca/Mg, Na/K, Ca/K, Na/Mg, Zn//Cu, Ca/P, Fe/Cu, Ca/Pb, K/Co, Fe/Pb, Fe/Co and [CK/(Ca + Mg)] were all calculated **(Hatcock, 1985; Watts, 2010; Analytical Research Labs, Inc., 2012).**

Mineral safety index (MSI)

The MSI **(Hatcock, 1985)** of Na, Ca, Mg, Zn, Fe, P, Cu and Se were calculated using the formula: Calculated MSI/ RAI x Research data result ……. Equation (13)

Note: MSI = Mineral Safety Index Table (Standard) value, RAI = Recommended Adult Intake.

Calculation of mineral percentage quantity

Formula: Each mineral/divided by total mineral x 100 …… Equation (14)

Calculation of concentration (macro and minerals) on dry extract (DE) basis (Adeyeye and Abioye, 2021)

Formula: $C_D = C_W/P_S$ x 100 ……Equation (15)

C_D = concentration corrected for dry extract.

C_W = fresh or dry weight concentration as the case may be.

P_S = solid concentration (i.e. 100 – moisture content)

Introduction to food rating system chart

In order to better help somebody to identify foods that feature a high concentration of nutrients for the calories they contain, a food Rating system is created. This system allows us to highlight the foods that are especially rich in particular nutrients. The chart below shows the classification criteria for which the food nutrient is either an excellent, very good, or good source. The chart will normally contain the nutrient name in order to find the nutrient amount represents, the nutrient density that is calculated for the food and nutrient, and the rating established in the rating system **(Mateljan, 2016)**.

Calculation of DRI/DV (%)

Formula: Nutrient valve/RDA (%) ……Equation (16)

(Note: DRI = Daily Reference Intake)

Nutrient density (ND) Calculation

(Encyclopedia of Food and Health, 2016)

Steps: (i) Nutrient value/RDA

(ii) Total food energy/Reference energy

(iii) Divide (i)/(ii)

Note: Reference energy used was 2900 kcal

ND Interpretation chart

World's Healthiest Foods Rating (Mateljan, 2016)	Rule
Excellent	DRI/DV > = 75% OR Density > = 7.6 AND DRI/DV > 10%
Very good	DRI/DV > = 50% OR Density > = 3.4 AND DRI/DV > = 5%
Good	DRI/DV > = 25% OR Density > = 1.5 AND DRI/DV > = 2.5%

Other statistical evaluations made from the generated data

- Statistics (mean, SD, CV%, correlation, C_A, IFE, etc) in the macro and mineral levels of the two fruit samples (Chase, 1976; Oloyo, 2001).

Pubchem database

Pubchem represents the database of chemical molecules and their activities against biological assays. The system is maintained by the National Centre for Biotechnology Information (NCBI), a component of the United States National Institutes of Health **(NIH)**; therefore, we can talk of PubChem compound ID **(PubChem and the American Chemical Society, 2005)**.

PubChem CID for the minerals under study

Mineral elements studies in this report were: Calcium/Ca(PubChem CID: 5460341); Magnesium/Mg (PubChem CID: 5462224); Ptasium/K(PubChem CID: 54662222); Sodium/Na (PubChem CID: 5360545); Iron/Fe (PubChem CID: 23925); Manganese/Mn (PubChem CID: 23930); Zinc/ZN (PubChem CID: 23994); Copper/ Cu (PubChem CID: 23978); Cobalt/Co (PubChem CID: 104730); Phosphorus/P (PubChem CID: 6326970); Lead/Pb (PubChem CID: 5352425) and Selenium/Se (PunChem CID: 6326970).

Results

The proximate and mineral compositions of both samples on dry weight (DW) basis were shown in table 1. On the macro's composition, EE and CP in the watermelon were correspondingly much higher than the cucumber values; watermelon/cucumber (g/100g); 47.56/5.44 and 30.84/11.16 respectively with corresponding high values of CV%: 112/66.29. However, these observations were reversed in the values of ash, CF and moisture with these corresponding values of cucumber/watermelon (g/100g); ash (8.17/3.22), CF (4.1/3.04) and moisture content (.02/5.33); also followed by corresponding CV% of 61.46, 21.34 and 8.60 respectively. Low values of CV% in CF and moisture exhibited the closeness of the two parameter values in the samples. CHO in the cucumber was much higher than in the watermelon, cucumber/watermelon (g/100g) = 65.09/10.01 and CV% = 104.

S/N	Parameter	Watermelon	Cucumber	Mean	Standard deviation (SD)	CV%
1.	Ether extract	47.56	5.44	26.5	29.78	112
2.	Crude protein	30.84	11.16	21.0	13.92	66.29
3.	Carbohydrate	10.01	65.09	37.55	38.95	104
4.	Ash	3.22	8.17	5.695	3.500	61.46
5.	Crude fibre	3.04	4.12	3.58	0.764	21.34
6.	Moisture	5.3	6.02	5.675	0.488	8.60
7.	Fe	6.527	0.215	3.371	4.463	132
8.	Cu	1.683	<0.0001	-	-	-
9.	Co	0.0036	<0.0001	-	-	-
10.	Mn	4.174	<0.0001	-	-	-
11.	Zn	4.143	0.2493	2.196	2.753	125
12.	Pb	0.0007	0.0009	0.0008	0.0001	12.50
13.	Ca	68.67	18.08	43.38	35/77	82.46
14.	Mg	327	15.96	171	220	129
15.	K	684	207	446	337	75.566
16.	Na	4.853	3.168	4.011	1.191	29.69
17.	P	785	107	446	479	107
18.	Se	0.0137	0.0005	0.007	0.009	129

[a]CV% = coefficient of variation; _b = not applicable

Table 1: Nutritional Composition [proximate (g/100g) and minerals (mg/100g)] of watermelon (Citrullus lanatus) and cucumber (Cucumis sativus) seed on dry weight (DW) basis.

Among the minerals, C, Mn, Cu had < 0.000/mg/100g in each of them in the cucumber seeds. All these minerals: Fe, Cu, Co, Mn, Zn, Ca, Mg, K, Na, P and Se (all nutritional minerals) were each more concentrated in watermelon seeds than the cucumber seeds. However, the only toxic metal determined was more concentrated (marginally) in the cucumber than the watermelon: 0.0007mg/100g (watermelon) < 0.0009mg.100g in the cucumber with low CV% of 12.5.

Table 2 showed the macros, ash, CF, total solid and DM (DE) values. These dry extract values were calculated to put all the macros at 0.00% moisture content in both samples. This process made the samples to be at

the same level f physical characteristic. [DE values of the macros will be subsequently used in subsequent Tables whereas Table 1 could serve as references]. The pattern of concentration of the DE values followed the trend as observed in the DW but with slight increases of values at the DE level; e.g EE (DE/DW) in watermelon was 50.2/47.56g/100g. the total DE values in both samples were close at watermelon/cucumber as 94.67/93.98 and CV% of 0.517.

S/N	Parameter	Watermelon	Cucumber	Mean	Standard deviation (SD)	CV%
1.	Ether extract	50.2	5.79	28.0	31.40	112
2.	Crude protein	32.6	11.9	22.25	14.64	65.80
3.	Carbohydrate	10.6	69.3	39.95	41.51	104
4.	Ash	3.40	8.69	6.045	3.741	61.89
5.	Crude fibre	3.21	4.38	3.795	0.827	21.79
6.	Total solid	100	100	100	0.00	0.00
7.	Dry matter	94.67	93.98	94.33	0.488	0.517

Table 2: Proximate composition (g/100g) of watermelon and cucumber seeds compared [on dry extract (DE) or DM) basis].

In table 3, the DE values of the macros differences in the two samples were depicted. Whereas EE and CP had positive differences, CHO, ash and CF had negative differences. The highest difference was in CHO (-554%), followed by ash (-156%), third was EE (88.47%), fourth was CP (63.5%) and least or fifth position was CF (-36.45%).

S/N	Parameter	Watermelon minus (-) cucumber (g/100g)	Percentage difference	Percentage ranking
1.	Ether extract	44.41	88.47	Third
2.	Crude protein	20.70	63.50	Fourth
3.	Carbohydrate	-58.70	-554	First
4.	Ash	-5.29	-156	Second
5.	Crude fibre	-1.170	-36.45	Fifth
6.	Total solid	0.00	0.00	-

Table 3: Proximate composition differences (g/100g and percentage) between watermelon and cucumber seeds on dry extract (DE) basis.

In table 4, the EE analysis together with their accompanying energy values were shown. One very clear case was that where CV% were reported, they all had similar value f 112 because the EE was converted to TFA with a value of 0.80. The TFA was a reflection of the EE as seen; watermelon/cucumber = 40.16/4.632g/100g and the other lipids (OLs) were 10.04/1.158g/100g. Look at these consistent values (as a reflection of EE*0.80); TFA/EE (%) = 8-.0/80.0; OLs/EE (5) = 20.0/20.0 and OLs/TFA (%) = 25.0/25.0. The energy values (kJ and kcal) were calculated for both samples in their values of EE, TFA and OLs. The energy trend in the kJ/100g level was EE: 1857 > 1486 (TFA) > 371 (OLs) for watermelon and 214 > 171 > 42.85 in the cucumber.

S/N	Parameter	Watermelon	Cucumber	Mean	Standard deviation (SD)	CV%
1.	Ether extract (EE)	50.2	5.79	28.0	31.40	112
2.	EF x 0.80 (+TFA)	40.16	4.632	22.40	25.12	112
3.	Other lipids (OLs)	10.4	1.158	5.60	6.281	112
4.	TFA/EE (%)	80.0	80.0	80.0	0.00	-
5.	OLs/EE (%)	20.0	20.0	20.0	0.00	-
6.	OLs/TFA (%)	25.0	25.0	25.0	0.00	-
7.	Energy: (a) EE					
	kJ/100g	1857	214	1036	1162	112
	Kcal/100g	452	52.11	252	283	112
	(b) TFA					
	kJ/100g	1486	171	829	930	112
	kcal/100g	361	41.69	201	226	112
	(c) OLs					
	kJ/100g	371	42.85	207	232	112
	Kcal/100g	90.36	10.42	50.39	56.53	112

TFA = total fatty acid

Table 4: Crude fat analysis of watermelon and cucumber seeds on dry extract basis.

The energy contribution from the DE of the macros in the samples was depicted in Table 5. The macros were CP, EE CHO, total energy and the UEDP%. The percentage levels of the energy values due to kJ and kcal were close as seen in the Table 5. The performance of each macro was: CP; watermelon kcal/kJ (20.88%/21.38%), cucumber kcal/kJ (12.63%/12.69%); EE (72.33/71.66) and 13.83/13.43); CHO (6.788/6.953) and 73.55/73.88. The UEDP% had this trend, for watermelon (12.53/12.83) and for cucumber (7.578/7.614).

S/N	Parameter	Watermelon	Cucumber	Mean	Standard deviation (SD)	CV%
1.	Protein (g/100g)	32.6	11.9	22.25	14.64	65.80
	Kcal	130	47.6	88.8	58.27	65.62
	%kcal	20.88	12.63	16.76	5.834	34.81
	kJ	554	202	378	249	65.87
	%kJ	21.38	12.69	17.04	6.145	36.06
2.	Fat (g/100g)	50.2	5.79	28.0	31.40	112
	Kcal	452	52.11	252	283	112
	%kcal	72.33	13.83	43.08	41.37	96.03
	kJ	1857	214	1036	1162	112
	%kJ	71.66	13.43	42.55	41.17	96.76
3.	Carbohydrate (g/100g)	10.6	69.3	39.95	41.51	104
	Kcal	42.4	277	160	166	104
	%kcal	6.788	73.55	40.17	47.21	118
	kJ	180	1178	679	706	104
	%kJ	6.953	73.88	40.42	47.32	117
4.	Total energy					
	Kcal	625	377	501	175	34.93
	kJ	2592	1595	2094	705	33.67
5.	Total (kcal/kJ)	100/100	100/100	-	-	-
6.	UEDP%					
	Kcal	12.53	7.578	10.05	3.502	34.85
	kJ	12.83	7.614	10.22	3.688	36.09

Table 5: Energy contribution from dry extract of the fruit samples.

The approximate sample weight equivalents to the energy requirements of adults (2500 – 3000 kcal) and infants (740kcal) were depicted in Table 6. For adults in watermelon seeds consumption, weight equivalent range was 400g – 480g and 118g in infants; in cucumber, it was 663g – 796g and 196g respectively. Watermelon total energy was 625kcal and t was 377kcal in the cucumber.

S/N	Sample	Total energy	Adult energy requirement Per day			Infant requirement per day		
			2500kcal sample equivalent (g)	3000kcal sample equivalent (g)	Ratio of 3000:2500 kcal	740kcal sample equivalent (g)	2500:740kcal equivalent (g)	3000:740kcal equivalent
1.	Cucumber	377	663	796	1.20:1.00	196	1.38:1.00	4.06:1.00
2.	Watermelon	625	400	480	1.20:1.00	118	1.39:1.00	4.07:1.00
3.	Total	1002	1063	1276	1.20:1.00	314	1.39:1.00	4.06:1.00

Table 6: Approximate sample weight equivalents to the energy requirements of adults and infants from the proximate composition.

Table 7 contained the water requirement for complete metabolism of CP from the samples. It is interesting to note that all the parameters determined had virtually constant CV% seen as follows; parameter/CV%: protein (65.80), energy from protein (65.62), excretion of water (65.54), water deficit (65.67) and water balance (65.72). Items 2 – 5 in the Table 7 were reflections of the values ascribed to item number one.

S/N	Parameter	Watermelon	Cucumber	Mean	Standard deviation (SD)	CV%
1.	Protein (g/100g)	32.6	11.9	22.25	14.64	65.80
2.	Energy from protein (=P) kcal/100g	130	47.6	88.8	58.27	65.62
3.	Excretion of water) =3P) ml (=Q) ml	391	143	267	175	65.54
4.	Water deficit (350/100 x P = T) ml	1369	500	935	614	65.67
5.	Water balance (=T – Q) ml	978	357	668	439	65.72

Ratio of watermelon/cucumber water balance = 978:357 = 2.74;1.0

Table 7: Water requirement for complete protein metabolism from proximate composition of the fruit samples

What were the daily macros from the watermelon and cucumber seeds? The answer to this question is in table 8. These four main groups could be identified in the Table 8. They were:

S/N	Parameter	Watermelon	Cucumber	Mean	(SD)	CV%
1.	Protein (g/100g)	34.84	11.16	23.0	16.74	72.78
2.	Fat (g/100g)	47.56	5.44	26.5	29.78	112
3.	CHO (g/100g)	10.01	65.09	37.55	38.95	104
4.	Total macros	92.69	81.69	87.19	7.778	8.92
5.	Prot. Energy (Kcal/100g)	139	44.64	92.0	66.98	72.80
6.	Fat energy (kcal/100g)	428	48.96	239	268	112
7.	CHO (kcal/100g)	40.04	260	150	156	104
8.	Total energy (kcal)	607	360	484	175	36.16
9.	Calorie split:					
	(a) Prof. energy *0.3 = (X)	41.81	13.39	27.60	20.10	72.83
	(b) Fat energy *0.3 = (Y)	128	14.69	71.55	80.42	112
	(c) CHO energy *0.4 = (Z)	16.02	104	60.08	62.32	104
10.	Total: X + Y + Z	186	132	159	38.18	24.01
11.	Weight equivalent					
	(d) X/4(g)	10.45	3.348	6.899	5.022	72/79
	(e) Y/9 (g)	14.22	1.632	7.926	8.901	112
	(f) Z/4 (g)	4.01	26.00	15.01	15.55	104
12.	Total	28.68	30.98	29.83	1.626	5.451
RATIOS:	Macros total energy, watermelon: Cucumber = 1.69:1.00; Macros total nutrient, Watermelon: cucumber = 1.13:1.00; calorie split, Watermelon: cucumber = 1.41:1.00; Weight equivalent (g), Watermelon: Cucumber = 1.00:1.08; Calorie split ratio used was 30:30:40					

X, Y, Z: Each represents the corresponding daily macro from the corresponding parameter

Table 8: What are the daily macros from the watermelon and cucumber seeds

(i) macros quantities/total; (ii) macros energy (kcal)/total; (iii) calorie split/total; (iv) weight equivalent(g)/ total. These were the CV% in the categories; group (i): parameter/CV%, protein (72.78), fat (112), CHO (104), total (8.92); group (ii): protein energy (72.80), fat energy (112), CHO (104), total (36.16); group (iii): protein energy *0.3 (72.83), fat energy *0.3(112), CHO energy *0.4 (104), total (24.01); group (iv): protein energy *0.3/4g (72.79), fat energy *0.3/9(g) (112), CHO *0.4/4(g)(104), total (5.451). In summary, it could be seen that matters connected with protein had CV% f 72.8; fat (112%); CHO (104) but the total CV% varied between 5.451 – 36.16.

Table 9 contained the mineral profiles of the two fruit seeds. Thirteen mineral elements were reported out of which 12/13 (92.31%) parameters were better concentrated in the watermelon seeds than the cucumber seeds. All the 12 minerals were essential nutrients. Only Pb (a toxic mineral) was slightly higher in the cucumber seed: cucumber (0.00096mg/100g) > watermelon (0.00074mg/100g). Further observation showed that Cu, Co and Mn were having values of < 0.0001mg/100g in each case in the cucumber seeds. The total mineral contents in the watermelon were 1991mg/100g and 374mg/100g in cucumber yielding a ratio of 5.32:1.00.

S/N	Mineral	Watermelon	Cucumber	Mean	(SD)	CV%
1.	Fe	6.89	0.228	3.559	4.711	132
2.	Cu	1.78	<0.0001	-	-	-
3.	Co	0.0038	<0.0001	-	-	-
4.	Mn	4.41	<0.0001	-	-	-
5.	Zn	4.38	0.265	2.323	2.910	125
6.	Pb	0.0074	0.00096	0.0042	0.0046	110
7.	Ca	72.5	19.2	45.85	37.69	82.20
8.	Mg	345	17.0	181	232	128
9.	K	722	220	471	355	75.37
10.	Na	5.13	3.37	4.25	1.245	29.29
11.	P	829	114	472	506	107
12.	Se	0.0145	0.00053	0.0075	0.0099	132
13.	Total	1991	374	1183	1143	96.62

Ratio of total watermelon mineral: total cucumber mineral = 1991: 374 = 5.32:1.00

Table 9: Mineral composition of the fruit seeds on dry extract basis in mg/100g.

The mineral density (%) of the samples were depicted in Table 10. Parameters greater than 1.00% were four in each sample and their trends were (%) for: P (41.6) > K (36.3) > Mg (17.3) > Ca (3.64) in the watermelon seeds; in the cucumber, it was; K (58.8) > P(30.5) > Ca (5.13) > Mg (4.54) showing that similar minerals with values that were highly insignificant were: Co (?E-4), Pb (?E – 5) and Se (?E – 4) in the watermelon; they were: Cu (?E – 5), Co (?E – 5), Mn (?E – 5), Pb (?E – 4) and Se (?E – 4) in the cucumber seeds. The CV% (where applicable) ranged between 21.77 – 99.02.

S/N	Mineral	Density (%)		Mean	(SD)	CV%
		Watermelon	Cucumber			
1.	Fe	0.346	0.061	0.204	0.202	99.02
2.	Cu	0.089	2.94E-5	-	-	-
3.	Co	1.91E-4	2.94E-5	-	-	-
4.	Mn	0.221	2.94E-5	-	-	-
5.	Zn	0.220	0.071	0.146	0.105	71.92
6.	Pb	3.72E-5	2.57E-4	-	-	-
7.	Ca	3.64	5.13	4.385	1.054	24.04
8.	Mg	17.3	4.54	10.92	9.023	82.63
9.	K	36.3	58.8	47.55	15.91	33.46
10.	Na	0.258	0.901	0.580	0.455	78.45
11.	P	41.6	30.5	36.05	7.849	21.77
12.	Se	7.28E-4	1.42E-4	-	-	-
13.	Total	100	100	100	-	-

Table 10: Mineral density (%) of the seed's samples

The mineral differences of the samples were shown in Table 11. Negative difference (-29.73%) was observed for only Pb. Other differences were high and positive.

S/N	Mineral	Watermelon (minus) cucumber	percentage
1.	Fe	6.662	96.69
2.	Cu	-	-
3.	Co	-	-
4.	Mn	-	-
5.	Zn	4.115	93.31
6.	Pb	-0.00022	-29.73
7.	Ca	53.3	73.52
8.	Mg	328	95.07
9.	K	502	69.53
10.	Na	1.76	34.31
11.	P	715	86.25
12.	Se	0.014	96.34
13.	Total	6,617	81.22

Table 11: Mineral composition differences and their percentages

S/N	Mineral	Watermelon (minus) cucumber	percentage
1.	Fe	6.662	96.69
2.	Cu	-	-
3.	Co	-	-
4.	Mn	-	-
5.	Zn	4.115	93.31
6.	Pb	-0.00022	-29.73
7.	Ca	53.3	73.52
8.	Mg	328	95.07
9.	K	502	69.53
10.	Na	1.76	34.31
11.	P	715	86.25
12.	Se	0.014	96.34
13.	Total	6,617	81.22

Table 12: Inferential statistics of the data presented in Table 2 (proximate composition) and Table 8 (mineral composition.

The inferential statistics of the proximate and minerals composition of the two samples were shown in Table 12. The rxy was low in proximate (watermelon/cucumber) at -0.2372, also low values were observed in rxy^2, Rxy and IFE. Only the C_A (0.9714) was high. The proximate statistics had a non-significant difference in the two samples. On the other hand, the statistics in the mineral watermelon/cucumber had high rxy (0.8586), high rxy2 (0.7372), slightly high C_A (0.5126), slightly high Rxy (0.2007) and slightly low IFE (0.4874). The rxy in the minerals was significant at rxy = 0.05 where rxy calculated (0.8586) > $r_{xyTable}$ (0.752) at n – 2 (df).

The descriptive statistics of the proximate and mineral values were depicted in Table 13. The mean and SD values in both proximate and minerals were lower in the watermelon than the cucumber correspondingly. However, the reverse was observed in the CV% as it was lower in watermelon than in the cucumber correspondingly.

The mineral safety index (MSI) of the samples was shown in Table 14. Each MSI value in the cucumber was less than 1.00. Minerals involved were Na, Ca, Mg, Zn, Fe, P, Cu and Se. these minerals had high MSI values in the watermelon yet, not at the deleterious levels; this is demonstrated as follows using the peers of MSI (calculated) /MSI (standard): Mg (12.94/15.0), Zn (9.636/33.0), Fe (3.080/6.70), P (6.906/10.0), Cu (19.58/33.0) and Se (2.900/14.0). Since each MSI (c) < MSI (s), no deleterious effect of the consumption of these minerals would be observed in their consumers from the sample seeds.

Some calculated mineral ratios of the samples were shown in Table 15. For Zn/Cu, Fe/Cu, K/Co and Fe/Co in cucumber seeds, they had no ratio, mean, SD and CV% because both Cu and Co had values of < 0.000/mg/100g each. Each ratio in the Table 15 has its own acceptable ideal range. In both samples, all these ratios were below the acceptable ideal range: Ca/Mg, Na/K, Ca/K, Na/Mg, Zn/Cu and Ca/P. Value in these following ratios were above the acceptable ideal range: Fe/Cu (only in watermelon) Ca/Pb (both samples), K/Co (watermelon only), Fe/Pb (both samples) and Fe/Co (only in watermelon) . At high levels in the sample, Cu, Co may be deleterious in the body at any level. The presence of the other nutrient mineral in the ratios would serve as a shield against the possible deleterious effects of the other members of the concerned mineral ratios.

The nutrient density (ND) of the watermelon seeds was shown in Table 16. The Table 16 depicted the nutrient amount, RDA, DRI,/DV (%), nutrient density and the rating. The ranking groups were excellent source, very good source and god source. Within one of these groups were CP, EE, Fe, Cu, Co, Mn, Zn, Mg and P. The ranking distribution trend was: excellent [2/15 = 13.33%]; very good [3/15=20.0%]; good [4/15 = 26.67%]; below ranking [6/15 = 40.0%]. This type of data would be less bias, unlike what obtained in Table 10.

In Table 17, the activities in Table 16 were repeated for cucumber seeds. In table 17, ND were not calculated for Cu, Co and Mn because each value was < 0.0001mg/100g. Only two parameters (CP and CHO) were within the good source group whereas the rest of the parameters were outside the ranking scheme. Hence, ranking summary: excellent [0/12 = 0.00%]; very good [0/12 = 0.00%]; good [2/12 = 16.67%]; below ranking group [10/12 = 83.33%]. All minerals in the cucumber seeds were low and outside any of source category group.

Discussion

Table 1 is mainly for reference's sake as it was reported on DW basis However since every other value was evaluated on DE basis (Table 2 and above) Table 1 was only relevant to check how the DE was obtained from the DW values. DE calculation was meant to bring both samples to similar moisture content (0.00%) to facilitate easy comparisons among the parameters of both samples.

Table 2 represented EE, CP, CHO, ash, CF on DE basis of the proximate from table 1. Litte differences existed from the values in Table 1 (DW) and table 2 (DE) proximate. However, some CV% were similar both in Tables 1 and 2 for the proximate, such were EE (112/112) and CHO (104/104). These parameters were higher in watermelon than in the cucumber seeds: EE, CP and total solid whereas CHO, ash and CF were lovers in watermelon than in cucumber. The high CV% among the parameters was evidence of widespread concentration variations among the two simples.

In table 3, the macros difference among the two samples were exhibited. The most outstanding difference was observed in the CHO where the difference was -554% and followed by ash (-156%); these two parameters were positive towards cucumbers. It is also noteworthy that CF was more in the cucumber than in the watermelon seeds. Fibre is one of the best benefits when it comes to losing weight and having consistent bowel movements. Carbohydrates is a major source of the human body energy and cucumber is a major in this peer. Although, ash in watermelon was less than in the cucumber, it would appear not to have been reflected in the mineral values of the cucumber seeds; could it be that much of cucumber ash was more acid insoluble compared with the watermelon seeds ash?

Dietary protein is composed of both essential amino acids and non-essential amino acids which are contained by both samples. CP in watermelon was 32.6g/100g and 11.9g/100g in the cucumber. Amino acids are the building blocks for new proteins that are made in the human body, including muscle proteins, enzymes and proteins that transport smaller molecules through the human body tissue. Watermelon seeds are comprised of 28% protein (less than this reports), or 8grams per OZ. Therefore, 1oz of watermelon seeds provides about 14% of the protein recommended dietary allowance for a 150 - pound woman **(Michaels, 2024)**. The EE range was 50.2 - 5.79g/100g (watermelon /cucumber). It is important to note that an oz of dried seeds contains 158 calories and 13g, of fat - making watermelon seeds a relatively high - calorie, high- fat protein sources. However, the fatty acids in watermelon seed oil are about 78% unsaturated. Unsaturated fatty acid are important components of all of human beings tissue call membranes and may help to lower the body cholesterol levels. The **American Heart Associations (2024)** recommends limiting human total fat in takes to 25-35% of total human daily caloric intake and saturated fat intake to less than 7% of total daily calories.

All the CV% in the EE analysis and the corresponding energy, values were 112 each. This influence for the consistent CV% of 112 was due to this simple conversion of EE*0.80. This type of consistent CV% has been observed in a report on vitamins composition in Clarias gariepinus fish body parts (liver, muscle, head): reporting on samples on fresh, smoked-dried and dry extracts **(Adeyeye and Abioye, 2021).** Two examples would be taken from the work (i) vitamin values (mg/100g) of wet liver Sample subtracted from dry extract values calculates Fran wet liver values

(mg/100g) of Clarias gariepinus in which these vitamins were involved at consistent CV%: vitamin B_3 (84.0), B_6 (84.0), C (84.0), A (84.0), B_1 (84.0), B_2 (84.0), D (84.0), E(84.0), B_9 (84.0), K(84.0), B_5(84.)), B_{12}(84.0) and totals (84.0). Similar report n vitamin values on wet muscle for the vitamins named above had consistent CV% of 83.6. In each present sample the true fatty acid levels were high at 80% in each sample whilst non-true fatty acid levels were 20% in each case. The energy levels obtained at the levels of EE, EE*0.80, OLs in kJ/kcal were all reflections of the listed parameters. The various energy values in the watermelon seeds were much higher than in the cucumber seeds.

In Table 5, all the macros energy values were displayed. Taking the kcalorie percentages, the followings were observed; watermelon/cucumber: CP (20.9%/12.6%), EE (72.3%/13.8%) and CHO (6.79%/73.6%). Looking at the ratio of energy of EE: CHO: P of 30: 40: 30, watermelon was only able to make ratio in EE that was more than double of its requirement in a diet; also, cucumber made almost double its requirement in CHO. This would make watermelon good as a supplement in fat deficient diets and cucumber good as a supplement in CHO deficient diets. The UEDP% has less than enough protein (energy wise) that is enough to prevent protein energy malnutrition (PEM) in an infant 39.0 maximum requirement, 26.0 maximum requirement in a child but more than enough for an adult requirement of 8.0 **(FAO/WHO/UNU, 1985)** only in the watermelon (12.53/12.83) but not in the cucumber (7.578/7.614).

The approximate sample weight equivalents to the energy requirements for adults and infants from the proximate values could be seen in table 6. The daily energy requirement for an infant is 740 kcal but ranges from 2500 – 3000kcal for adults depending on the adult's physiological state (Bingham, 1978). Therefore, weight requirement in the seeds for adults' satisfaction would be 663 – 796g (cucumber) and 400 – 480g (watermelon); also, weight would be 196g (cucumber) and 118g (watermelon) for the infant. There are some interesting ratios as depicted below:

1. Ratio requirement of 3000kcal: 2500kcal in cucumber, 1.20:1.00.
2. Ratio requirement of 3000kcal: 2500kcal in watermelon, 1.20:1.00.
3. Total ratio requirement of 3000kcal: 2500kcal in both samples, 1.20:1.00.
4. Ratio requirement of 2500kcal: 740kcal in cucumber, 1.38:1.00.
5. Ratio requirement of 2500kcal: 740kcal in watermelon, 1.39:1.00.
6. Total ratio requirement of 2500kcal: 740kcal in in both samples, 1.38:1.00.
7. Ratio requirement of 3000kcal: 740kcal in cucumber, 4.06:1.00.
8. Ratio requirement of 3000kcal: 740kcal in watermelon, 4.06:1.00.
9. Total ratio requirement of 3000kcal: 740kcal in both samples, 4.06:1.00.

The water required for excretion of urea and sulphate formed as well as water deficit as a result of protein metabolism could be seen in Table 7. Values of water required for complete metabolism of 100 calories f food substances are as follows; preformed water: 0.0g (for protein, fat and starch); water gained by oxidation: 10.3 (protein), 11.9 (fat) and 13.9 (starch); water lost in excreting end products: 30 (protein) and 0.00 (for both fat and starch); water deficit: 350 (protein), 48 (fat) and 46 (starch). One (1) Calorie of protein requires 3ml of water for excretion of urea and sulphate formed from it (Albanese, 1959). In table 7, the required water balance for excretion of urea and sulphate by-products formed (T-Q ml) ranged from 978 (watermelon) – 357 (cucumber) because protein value in watermelon > protein value in the cucumber. Effects of water deficit cannot be mitigated by carbohydrate and fat since they still have their own water deficit (although very insignificant). However, water deficit in the samples would be mitigated by water intake on the consumption of the sample seeds.

The steps in obtaining the daily macros from the samples were detailed and shown in table 8. From the various energies calculated, the calorie split was calculated as follows:

(i) CP energy *0.3 = (x)
(ii) EE energy * 0.3 = (y)
(iii) CHO energy *0.4 = (z)
(iv) Total: X + Y + Z

Therefore, weight equivalents:

(i) X/4 (g) in watermelon/cucumber = 10.45/3.348.
(ii) Y/9 (g) in watermelon/cucumber = 14.22/1.632.
(iii) Z/4 (g) in watermelon/cucumber = 4.01/26.00.
(iv) Total (g) in watermelon/cucumber = 28.68/30.98.

X, Y and Z represented the corresponding daily macro from the corresponding parameter (CP, EE and CHO respectively). The following ratios were generated from table 8.

I. Macros total energy, watermelon: cucumber = 1.69: 1.00.
II. Macros total nutrient, watermelon: cucumber = 1.13: 1.00.
III. Calorie split, watermelon: cucumber = 1.41: 1.00.
IV. Weight equivalent (g), watermelon: cucumber = 1.00: 1.08
V. Calorie split ratio used was 30: 30: 40.

The minerals profiles in the samples have been depicted in Table 9. Minerals of high values in the watermelon were: Fe, Cu, Mn, Zn, Ca, Mg, K, and P; high mineral values in the cucumber were Ca, Mg, K and P. Each mineral value in the watermelon was better concentrated than in the cucumber except in Pb where the value in cucumber (0.00096mg/100g) > watermelon (0.00074mg/100g). Both Cu and Mn had a value each of < 0.0001mg/100g. Values of three digits in the watermelon were (mg/100g): P (829), K (722) and Mg (345); only P (114) was in this position in the cucumber. The total minerals in watermelon was 1991mg/100g and in cucumber (374mg/100g) with resulting ratio of 1991: 374 = 5.32: 1.00. Zinc is a mineral required for healthy body functioning, including the sense of smell, nutrient metabolism, building proteins and genetic material, repairing damages skin and maintaining the body immune system **(Michaels, 2024)**. Lack of enough Zn in the daily diet, may lead to symptoms such as hair loss, diarrhea, eye and skin disorders, impaired appetite and depressed immunity. Adult women should consume about 8mg of Zn per day – 11 to 12mg per day during pregnancy and lactation. A 100g serving of watermelon seeds contains 10mg of Zn, while each ounce contains 3mg of Zn **(Michaels, 2024)**. Present results were (mg/100g): watermelon (4.38) and cucumber (0.265). A one ounce serving of watermelon seeds contains 2mg of Fe (USDA: National Agricultural Library). Women between the ages of 19 – 15 should consume 18mg of Fe per day. The body Fe requirement increases to 27mg per day. The body Fe requirement increases to 27mg per day during pregnancy. The body requires Fe to maintain red blood cells, which carry oxygen to the body tissue. Because Fe deficiency can result in anaemia – leaving you feeling weak and fatigued – it is important to consume enough Fe on a daily basis via sources that may include watermelon seeds. Fe content in the samples was (mg/100g): 6.89

(watermelon) and 0.228 (cucumber). Other sources of Fe include oysters, beet, turkey, chicken, tuna and pork (USDA: NAL).

Copper is an essential trace mineral and found abundantly in the brain, liver, heart, lungs, kidneys, pancreas, muscles and bones. It plays a major role in oxygen transport, mental and cognitive function, immunity, energy production, neurotransmitter production and bone tissue maintenance **(Cognitive Function, 2016)**. The established RDI for Cu is 1-3mg/day. Cu levels in the samples were (mg/100g): 1.78 (watermelon) and <0.0001 (cucumber). Manganese is present as a coenzyme in any biological processes, including macronutrient metabolism, bone formation and free radical defence systems. It is a critical component in dozens of proteins and enzymes **(Erikson and Ascher, 2019)**. In the human brain, the Mn is bound to manganese metalloproteins, most notably glutamine synthase in astrcytes **(Taked, 2003)**. Adequate intake of Mn for adult men and women is 2.3 and 1.8 mg/day, respectively, being the Tolerable upper intake level for adults of 11mg/day (Institute of Medicine (US), 2001). Mn levels in the samples were (mg/100g): 4.41 (watermelon) and <0.0001 (cucumber).

Zinc was confirmed as an essential trace mineral for the growth of living organisms in 1961 for humans (Zinc 2016). Zn is involved in wound healing, protein synthesis, DNA synthesis, cell division, cellular metabolism and is required for more than 200 enzyme reactions within the body (HHS, 2016). The established RDI f Zn is 15mg or 0.2mg/kg. Zn level in the sample was 4.38mg/100g (watermelon and 0.265mg/100g (cucumber). Selenium is an essential component of various enzymes and proteins, called selenoproteins that help to make DNA and protect against cell damage and infections; these proteins are also involved in reproduction and the metabolism of thyroid hormones **(Selenium, Harvard…)**. The RDA of Se at 55mg/day **(WHO/FAO/IAEA, 1996)** for both adult males and females is as depicted by food and Nutrition Board at the Institute of edicine. Tolerable upper limit is 0.4mg/day **(WHO/FAO/IAEA, 1996)**. Present value was (mg/100g): 0.0145 (watermelon) and 0.00053 (cucumber).

Calcium is the most abundant mineral in the body. It is used structurally to build bone bones, teeth and a messenger in cell signalling. The bone serves as a Ca reserve in case of dietary deficiency. The US RDA of Ca is 1000 – 1200mg/day for adults **(Shaffer, 2023)**. Ca levels in the samples were considered low at (mg/100g): 72.5 (watermelon) and 19.2 (cucumber). Phosphorus forms a part of the bones in the form of the mineral hydroxyapatite. It is used in cell membrane and is part of the energy molecules, adenosine triphosphate (ATP). DNA and RNA also contain phosphate. Phosphorus RDA is 700mg for adults **(Shaffer, 2003)**. Phosphorus levels in the samples were (mg/100g): 829 (watermelon) and 114 (cucumber).

Magnesium main body functions include energy production, synthesis of biomolecules and as a structural component f cell membranes and chromosomes. It is also used in ion transport, cell signalling and cell migration. The RDA for Mg is 400 – 420mg for men and 310 – 320mg for women **(Shaffer, 2003)**. Samples Mg contents were (mg/100g): 345 (watermelon) and 17.0 (cucumber).

Sodium helps to maintain proper blood volume and blood pressure. Most adults require between 1.5 and 3.8 grams of sodium chloride per day. Potassium is an electrolyte (like sodium). K is a cofactor for a number of enzymes. Low K levels can be dangerous, resulting in fatigue, muscle cramps and abdominal pain. Adults need about 4.7g of K per day. K, Na and Cl^- maintain charge gradients across cell walls **(Shaffer, 2003)**. Na levels were low in both samples: 5.13 – 3.37mg/100g but K was better concentrated: 722 – 220mg/100g.

The mineral levels profiled in Table 9 were converted to their density percent as depicted in Table 10. Highest percentage was P (41.6%) in watermelon but K (58.8%) in cucumber. On the other hand, K was the second highest (36.3%) in watermelon but P (30.5%) was the second highest in the cucumber. The mineral composition differences and their percentage were shown in table 11. The percentage differences were mostly high and positive towards watermelon, but the difference was negative but positive towards cucumber in Pb.

The inference statistics for both macros and minerals in the samples were depicted in Table 12.

rxy = correlation coefficient; rxy^2 = variance; Rxy = regression coefficient; C_A = coefficient of alienation; IFE = index of forecasting efficiency; df = degree f freedom; rxy = 0.05 (level of significance) = 0.754

The C_A and IFE in macros and minerals need further explanation. The C_A and IFE work together in this type of statistics. C_A + IFE = 1.00 when fractional calculations are made or C_A + IFE = 100 when percentage calculations are made. C_A represent error of prediction of relationship when two similar entities are involved; it also represents level of alienation between two compared similar entities. On the other hand, IFE represents the reduction in the error of prediction of relationship between two compared similar entities. When C_A > IFE, error of prediction is high, or non-prediction at all; when C_A < IFE, then the error of prediction is low, easy and accurate prediction of relationship. In the macros, $C_{A(0.9714)}$ >> IFE (0.0286) and in the minerals, $C_{A(0.5126)}$ > IFE (0.4874); that is, error of prediction in macros was 97.14% (and error of prediction in macros was 97.14% (and error of reduction was 2.86%); in minerals, error of prediction was 51.26% (can error of reduction was 48.74%). Since C_A > IFE in both statistics, it meant that macros of watermelon could not carry out the biochemical activities of cucumber macros and vice-versa; similar conclusion holds for the minerals. The Table 13 had adequately been discussed in results since it is just the description portion of the statistics for both macros and the minerals for the samples.

The MSI calculated < MSI reference in all the minerals in both samples, hence, such minerals would not be deleterious to the consumers even if consumed alone in a diet. K, Mn, C MSI were not determined because they have no reference MSI (Table 14).

S/N	parameter	Proximate/mineral	Proximate/mineral
		Watermelon	Cucumber
1.	Mean	*20.002/284**	*20.012/53.44**
2.	Standard deviation	*20.72/358**	*27.703/83.74**
3.	CV%	*104/126**	*138/157**

* = watermelon value as appropriate; ** = cucumber value as appropriate

Table 13: Descriptive statistics of the data presented in Table 2 (proximate composition) and Table 8 (Mineral composition).

S/N	Mineral	RAI (mg)	MSI (TV)	MSI/ RAI	Watermelon	Cucumber	Means	SD	CV%
1.	Na	500	4.80	9.60E-3	0.049	0.032	0.041	0.012	29.27
2.	Ca	1200	10.0	8.33E-3	0.604	0.160	0.382	0.314	82.20
3.	Mg	400	15.0	3.75E-2	12.94	0.638	6.789	8.699	128
4.	Zn	15	33.0	2.20	9.636	0.583	5.110	6.401	125
5.	Fe	15	6.70	4.47E-1	3.080	0.102	1.591	2.106	132
6.	P	1200	10.0	8.33E-3	6.906	0.950	3.928	4.212	107
7.	Cu	3	33.0	11.0	19.58	0.001	9.791	13.84	141
8.	Se	0.07	14.0	200	2.900	0.106	1.503	1.976	131

RAI = recommended adult intake; TV = Table (standard) MSI; No standard MSI for K, Mn, C

Table 14: Mineral safety index (MSI) of Na, Ca, Mg, Zn, Fe, P, CU and Se of the fruit seeds.

The nutrient elements have been defined and are considered essential for many biological functions in the human body. The toxic elements or "heavy metals" are well-known for their interference upon normal biochemical function. They are commonly found in the environment and therefore are present in some degree, in al biological systems. However, these metals clearly pose a concern for toxicity when accumulation occurs in excess. Low levels of Pb toxic metal were observed in the samples (mg/100g): Pb in watermelon (0.00074) and in cucumber (0.00096). A calculated comparison of two elements to each other is called a ratio. If the synergistic relationship (or ratio) between certain minerals in the body is disturbed, studies show that normal biological functions and metabolic activity can be adversely affected. Toxic ratios research, has shown that toxic minerals can also produce an antagonistic effect on various essential minerals eventually heading to disturbances in their metabolic utilization. In ratios, reference ranges are considered as guidelines for comparison with reported test values.

The mineral ratios of the samples were shown in Table 15. Ca/Mg is called blood-sugar ratio. The ratio was within the acceptable ideal range; therefore, there would be no antagonism between Ca and Mg on consumption. Na/K is called life-death ratio because it is so critical. Te ratio was low to acceptable range. The nutritional minerals such as Ca, P, Cu, Fe, Mn, Mg, etc will impact the Na/K ratios as well. The Ca/K was also low to the acceptable range. The ratio is called thyroid ratio because Ca and K play a vital role in regulating thyroid activity. This ratio could also be associated with adrenal activity. Ca/K ratio can be affected by Fe, Zn, Cu, Se, Li, Co, Mn and others **(ARL, 2012)**.

S/N	Mineral ratio	Reference balance ideal	Acceptable ideal range	Water melon	Cucumber	Means	SD	CV%
1.	Ca/Mg	7.00	3 – 11	0.210	1.129	0.670	0.650	97.01
2.	Na/K	2.40	1.4 – 34	0.007	0.015	0.011	0.006	54.55
3.	Ca/K	4.20	2.2 – 6.2	0.100	0.087	0.094	0.009	9.574
4.	Na/Mg	4.00	2 – 6	0.015	0.198	0.107	0.129	121
5.	Zn/Cu	8.00	4 – 12	2.461	- [bb]	-	-	-
6.	Ca/P	2.60	1.5 – 3.6	0.087	0.168	0.128	0.057	44.53
7.	Fe/Cu	0.90	0.2 – 1.6	3.871	- [bb]	-	-	-
8.	Ca/Pb	42	84 – 168	97,973	20,000	58987	55135	93.47
9.	K/Co	750	2000	212,353	- [bb]	-	-	-
10.	Fe/Pb	6.00	4.40 – 8.80	9,311	238	4775	6416	134
11.	[K/(Ca + Mg)]	2.20	_ [aa]	3.459	12.15	7.805	6.145	78.73
12.	Fe/Co	225	440	190,000	- [bb]	-	-	-

[aa] = not available; [bb] = cu < 0.00011mg/100g, Co< 0.00011mg/100g

Table 15: The mineral ratio values of the seeds of watermelon and cucumber fruits.

The Na/Mg, Zn/Cu, Ca/P, were all low to the acceptable range. Na/Mg ratio is referred to as the adrenal ratio because Na levels are directly associated with adrenal gland function. A low sample Na/Mg ratio would indicate a likely reduced adrenal expression. Using the Zn/Cu ratio is a much more effective method of evaluating Zn and Cu readings than considering either Cu or Zn levels alone. Low Zn/Cu ratio would lead to lowered progestrone and testosterone dominance relative to ostrogen. Zn and Cu are also related to the antioxidant activity of superoxide dismutase (SOD); their balance would reflect the activity of Zn and Cu activated SOD **(Watts, 2010)**. The autonomic nervous system (ANS) is represented by the Ca/P relationship. The sample was poor in Ca as related to P as shown in this ratio. The Fe/Cu ratio value was very much above the acceptable ideal range. The relationship between Fe and Cu is important for many reasons. For example, a disruption in their equilibrium can lead to serious consequences in normal cellular activity. An elevated Fe/Cu ratio in the diet leads to increased free radical production, particularly lipid peroxidation that can lead to mitochondrial damage (Watts, 2010). The corresponding reduction in Cu could increase the damage from superoxide radicals due to suppression of Cu activated SOD. An elevation

or reduction in the Fe/Cu ratio is associated with a decrease in the utilization of Fe.

The toxic ratios show the relationships of the protective nutrient minerals relative to the heavy metals. Everyone is exposed and has heavy metals ever present in their body, the higher the toxic ratios, the better. However, there may be no clinical significance of the ratios being double, triple or even ten times higher than the minimal acceptable level (Watts, 2010). The Acceptable level of Ca/Pb ratio is 84:1. Since calcium reduces Pb absorption and retention with the body, Ca is considered protective of excess Pb retention. The ratio of Ca to Pb should be at east 84 times higher than Pb in Order to be protective or to prevent the adverse effect of Pb within the body **(Watts, 2010).** The toxic ratios in the samples were Ca/Pb and Fe/Pb. The paired acceptable ideal of the toxic mineral and the sample mineral ratios were: Ca/P (84 – 168/97, 973 and 20,000); Fe/Pb (4.40 – 8.80/9,311 and 238). A Ca/Pb rati below 84:1 would lead to potential for Pb interference with metabolic processes. Heavy metals interfere with normal metabolic processes due to their ability to displace nutritional minerals or poison enzyme function by their attachment to proteins. Ca is protective of excess Pb to the level of 97,973/20,000 times; Fe is protective of excess Pb to the level of 9,311/238 times.

Both K/Co and Fe/Co are within the group of nutrient ratios, their relationships tallied with the observations in the toxic mineral ratios. The K/Co comparison was 2000/212,353 (in watermelon) showing high level f K to very low level of Co, also similar scenario played for Fe/Co having a comparison of 440/190,000 (in watermelon). The milliequivalent ratio of the samples were higher than the reference balance; this was to high value of K versus low values of Ca and Mg in both samples. The consumption of more than 30mg of lycopene daily (major source is watermelon endocarp) could potentially cause neausea, diarrhea, indigestion and bloating, according to the **American Cancer Society**. People with serious hyperkalemia, or too much potassium in their blood, should probably not consume more than about one cup of watermelon a day, which has less than 140mg f potassium. According to the **National Institutes of Health (NIH)**, hyperkalemia can result in irregular heartbeats and other cardiovascular problems, as well as reduced muscle control **(Szalay, 2014)**. People with hyperkalemia should exercise restraint in consuming watermelon seeds.

The ratios in Table 15 watermelon seeds. Oxidation types (ARL, 2012).

Fast oxidation: Ca/K ratio < 4:1 and Na/Mg ratio > 4.17:1

Slow oxidation: Ca/K ratio > 4:1 and Na/Mg ratio < 4.17:1

Mixed Oxidation: Ca/K ratio > 4:1 and Na/Mg ratio > 4.17:1

Or : Ca/K ratio < 4:1 and Na/Mg ratio > 4.17:1

Of these oxidation types, the mixed oxidation would be the lot of the samples as the following was observed in Table 15:

Ca/K ratio <4:1 and Na/Mg ratio < 4.17:1 which were actually 0.100.0.087 and 0.015/0.198 respectively. Mixed oxidation is a transition or unstable state which is defined as either a calcium-to-potassium ratio greater than 4:1 and a sodium-to-magnesium ratio greater than or equal to 4.17:1, or a calcium-to-potassium ratio less than or equal to 4:1 and a sodium-to-magnesium ratio less than 4.17:1 **(Wilson, 1986)**.

S/N	Nutrient	Amount	RDA	DRI	DRI/DV (%)	Nutrient density	Rating
1.	Protein	30.84g	50g	0.617	61.68	2.86	Very good
2.	Fat	47.56g	78g	0.610	60.97	2.83	Very good
3.	CHO	10.01g	275g	0.036	3.64	0.169	Below ranking
4.	Fibre	3.04g	28g	0.019	1.86	0.086	Below ranking
5.	Fe	6.527mg	18mg	0.363	36.26	1.680	Good
6.	Cu	1.683mg	1.00mg	1.683	168	7.81	Excellent
7.	Co	0.0036mg	0.008mg	0.450	450	2.09	Good
8.	Mn	4.174mg	2.30mg	1.815	181	8.42	Excellent
9.	Zn	4.143mg	11.0mg	0.377	37.66	1.75	Good
10.	Ca	68.67mg	1000mg	0.069	6.87	0.319	Below ranking
11.	Mg	327mg	420mg	0.779	77.86	3.61	Very good
12.	K	684mg	3400mg	0.201	20.12	0.934	Below ranking
13.	Na	4.853mg	2300mg	0.002	0.21	0.010	Below ranking
14.	P	785mg	1250mg	0.628	62.8	2.91	Good
15.	Se	0.0137mg	0.05mg	0.274	27.4	1.27	Below ranking

Evaluated parameters = 15; Ranking distribution: Excellent (2/15 = 13/33%); Very good (3/15 = 20.0%); Good (4/15 = 26.67%); Below ranking (6/15 = 40.0%)

Table 16: Nutrient density profile of watermelon.

The nutrient density rating of watermelon seeds was depicted in Table 16. The ratings were into these groups: excellent, very good and good. In watermelon seeds, two macros were in the very good group, two minerals were in the excellent group, one mineral was in the very good group and four minerals were in the good group. Despite the high level of K, it was below any of the ranking group. From this observation, the information from the nutrient density might be a better predictor of determining the high source of nutrients rather than its mere percentage composition value. In the literature watermelon Fruit, Cu, K, Mg had this respective nutrient density: 2.6, 1.5; all were in the good group rating as shown in **World's Healthiest Foods Rating (WAFR) (Mateljan,2016)**. Nutrient density value table was table 17 in the cucumber seeds. Only two parameters were within the rank in the cucumber seeds: protein (good). World's Foods Rating in cucumber had these groupings: excellent (Mo), good (Cu, Mn, p and Mg). The compared tables 16 and 17 showed that watermelon seeds surpassed the high nutrient sources of many of the determined nutrients than it occurred in the cucumber seeds.

S/N	Nutrient	Amount	RDA	DRI	DRI/DV (%)	Nutrient density	Rating
1.	Protein	11.16g	50g	0.223	22.32	1.72	Good
2.	Fat	5.44g	78g	0.070	6.97	0.536	Below ranking
3.	CHO	65.09g	275g	0.237	23.67	1.821	Good
4.	Fibre	4.12g	28g	0.147	14.71	1.132	Below ranking
5.	Fe	0.215mg	18mg	0.012	1.19	0.092	Below ranking
6.	Cu	<0.000/mg	-	-	-	-	-
7.	Co	<0.000/mg	-	-	-	-	-
8.	Mn	<0.000/mg	-	-	-	-	-
9.	Zn	0.249mg	11mg	0.023	2.27	0.175	Below ranking
10.	Ca	18.08mg	1000mg	0.018	1.81	0.139	Below ranking
11.	Mg	15.96mg	420mg	0.038	3.80	0.292	Below ranking
12.	K	207mg	3400mg	0.061	6.09	0.468	Below ranking
13.	Na	3.168mg	2300mg	0.001	0.14	0.011	Below ranking
14.	P	107mg	1250mg	0.086	8.56	0.659	Below ranking
15.	Se	0.0005mg	0.05mg	0.010	1.00	0.077	Below ranking

Evaluated parameters = 12; Ranking distribution: Excellent (0/12 = 0.00%); Very good (0/12 = 0.00%); Good (2/12

Table 17: Nutrient density profile of Cucumber

Conclusion

Both cucumber (Cucumis sativus) and watermelon (Citrullus lanatus var. lanatus) are widely cultivated plants in the gourd family cucurbitaceae that bear cylindrical fruits that are used as culinary vegetables. Their seeds were analysed for Macros and minerals, discussed and compared. In the proximate, EE, CP and solid were higher in C. l. var lanatus than in C. sativus; but CHO, ash and CF were higher in C. sativus. Widespread concentration differences existed in the macros between the two samples. C. L. var. lanatus seed is relatively high - calorie, high - fat protein source. C. L. var lanatus may be good supplement in EE, C. sativus may be a good supplement in CHO. Whereas C. L. var. l. seeds could prevent PEM in adults, C. sativus could not. These minerals had higher values in C. L. var lanatus than in C. sativus: Fe, Cu, Mn, Zn, Ca, Mg, K and P; Pb was in the reverse. Total minerals in C. l. var lanatus was 1991mg/100g but was 374mg/100g in C. sativus with ratio values of 5.32:1.00. The mineral percentage differences were mostly high and positive towards C. l. var lanatus, but the difference was negative (and low) but positive towards C. sativus in Pb C. l. var lanatus may not be recommended for hyperkalemia disease patients due to high potassium in the seeds. In the World's Healthiest Foods Rating (WHFR), C. l. var lanatus were in these groups: Cu and Mn (excellent), CP, EE and Mg (very good), Fe, Co, Zn and P (good) whereas only CP and CHO were in the good rating in C. sativus. In the statistical analysis carried out, the macros values were not significantly different but the minerals were significantly different at rxy = 0.05. Forty-two (42) parameters were comprehensively compared, out of these, 37 (88.1%) in watermelon were found to be higher than the C. sativus whilst it was 10(23.8%) in cucumber found to be higher than C. l. var lanatus. In all, it could be concluded that Citrullus. lanatus. var lanatus seeds were far more superior nutritionally than the seeds of cucumis sativus.

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