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Comparative Studies on Nutrient and Anti–nutrient Composition of Carrot (*Daucus carota* L.) and Cucumber (*Cucumis sativus* L.)

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Abstract: Carrot (*Daucus carota* L.) and cucumber (*Cucumis sativus* L.) are underutilized root vegetable and fruit belonging to the Apiaceae and Cucurbitaceae family, respectively. A comparative study was carried out on proximate composition, amino acid profile and anti–nutritional factors of *Daucus carota* and *Cucumis sativus*. The proximate composition values (%) for *Daucus carota* and *Cucumis sativus* were found to be as follows: Moisture (5.06 and 4.39), ash (7.75 and 15.26), crude fat (6.09 and 4.83), crude fibre (13.04 and 18.25), crude protein (9.39 and 14.39) and carbohydrate by difference (58.67 and 42.90). The calculated fatty acids and metabolizable energy values were 4.87 and 3.86%; 1382.35 and 1152.64 kJ 100/g, respectively. The amino acid profiles revealed that *Daucus carota* and *Cucumis sativus* contained nutritionally useful quantities of most of the essential amino acids. The total amino acid (TAA), total essential amino acid (TEAA) (with His), total sulphur amino acid (TSAA) and essential aromatic amino acid (EArAA) for the *Daucus carota* and *Cucumis sativus* samples were 82.36 and 64.14; 22.93 and 30.11; 1.26 and 1.71; 2.13 and 2.66, respectively. However, supplementation of essential amino acids is required in a dietary formula based on the flour samples of *Daucus carota* and *Cucumis sativus* when comparing the EAAs in this report with the recommended FAO/WHO provisional pattern. The first limiting EAA in both samples was Met and Cys (TSAA). The antinutrient contents of *Daucus carota* and *Cucumis sativus* were also found to be as follows: Oxalate (241.67 and 142.45 mg/100 g), saponin (0.22 and 0.91%), alkaloids (2.85 and 2.23%), tannins (329.03 and 254.45 mg/100 g), cyanide (4.01 and 3.03 mg/100 g) and phytate (616.41 and 349.62 mg/100 g). These antinutritional factors have been shown to be deleterious to health or evidently advantageous to human and animal health if consumed at appropriate amounts.

Keywords: *Daucus carota*, *Cucumis sativus*, Nutrient, Anti–Nutrient, Amino Acid Analyzer

Introduction

Vegetables are parts of plants that are consumed by humans or other animals as food. The original meaning is still commonly used and is applied to plants collectively to refer to all edible plant matter, including the flowers, fruits, stems, leaves, roots, and seeds. The alternate definition of the term *vegetable* is applied somewhat arbitrarily, often by culinary and cultural tradition. It may exclude foods derived from some plants that are fruits, nuts, and cereal grains, but includes fruits from others such as tomatoes, scourgettes and seeds such as pulses [1].

Originally, vegetables were collected from the wild by hunter-gatherers and entered cultivation in several parts of the world, probably during the period 10,000 BC to 7,000 BC, when a new agricultural way of life developed. At first, plants which grew locally would have been cultivated, but as time went on, trade brought exotic crops from elsewhere to add to domestic types. Nowadays, most vegetables are grown all over the world as climate permits, and crops may be cultivated in protected environments in less suitable locations. China is the largest producer of vegetables, and global trade in agricultural products allows consumers to purchase vegetables grown in faraway countries. The scale of production varies from subsistence farmers supplying the needs of their family for food, to agribusinesses with vast acreages of single-product crops. Depending on the type of vegetable concerned, harvesting the crop is followed by grading, storing, processing, and marketing [2].

Vegetables can be eaten either raw or cooked and play an important role in human nutrition, being mostly low in fat and carbohydrates, but high in vitamins, minerals and dietary fiber. Many nutritionists encourage people to consume plenty of fruit and vegetables, five or more portions a day often being recommended. They supply dietary fiber and are important sources of essential vitamins, minerals, and trace elements. Particularly important are the antioxidant vitamins A, C, and E. When vegetables are included in the diet, there is found to be a reduction in the incidence of cancer, stroke, cardiovascular disease, and other chronic ailments [1]. Research has shown that, compared with individuals who eat less than three servings of fruits and vegetables each day, those that eat more than five

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servings have an approximately twenty percent lower risk of developing coronary heart disease or stroke. The nutritional content of vegetables varies considerably; some contain useful amounts of protein though generally they contain little fat [2] and varying proportions of vitamins such as vitamin A, vitamin K, and vitamin B6; provitamins; dietary minerals; and carbohydrates. However, vegetables often also contain toxins and antinutrients which interfere with the absorption of nutrients. These include α-solanine, α-chaconine [3], enzyme inhibitors (of cholinesterase, protease, amylase, etc.), cyanide and cyanide precursors, oxalic acid, tannins and others.

Carrot *(Daucus carota* L.) is a root vegetable, usually orange in colour, though purple, black, red, white and yellow cultivars exist [4]. Carrots are a domesticated form of the wild carrot, *Daucus carota*, native to Europe and southwestern Asia. The plant probably originated in Persia and was originally cultivated for its leaves and seeds. The most commonly eaten part of the plant is the taproot, although the stems and leaves are eaten as well. The domestic carrot has been selectively bred for its greatly enlarged, more palatable, less woody–textured taproot.

Fig 1: Fresh carrot (*Daucus carota* L.) sample

Cucumber (*Cucumis sativus* L.) is a widely cultivated plant in the gourd family, Cucurbitaceae). It is a creeping vine that bears cucumiform fruits that are used as vegetables. The fruits are eaten raw with the seeds and peel. There are three main varieties of cucumber: *slicing*, *pickling* and *seedless*. Within these varieties, several cultivars have been created. In North America, the term ‘‘wild cucumber’’ refers to plants in the genera *Echinocystis* and *Marah*, but these are not closely related. The cucumber is originally from South Asia, but now grows on most continents. Many different types of cucumber are traded on the global market [5].

Fig 2: Fresh and slices of cucumber (*Cucumis sativus* L.) sample

A lot of investigations have been carried out on the chemical composition, effects of processing, lipid profiles and biochemical functions of carrot (*Daucus carota*) and cucumber (*Cucumis sativus*) which are available in the literature [6–9]. Therefore, the purpose of this work is to comparatively study the proximate, amino acids and antinutrients of *Daucus carota* and *Cucumis sativus* grown in Nasarawa State, Nigeria as contributors to the availability of nutritionally available amino acids as food.

Materials and Methods

Collection of samples

Fresh samples of carrot (*Daucus carota* L.) and cucumber (*Cucumis sativus* L.) were collected from a farm in Wukari local government area of Taraba State, Nigeria. These samples were identified in the Biology laboratory of Federal University Wukari, Nigeria.

Preparation and treatment of samples

The fresh samples of both carrot (*Daucus carota* L.) and cucumber (*Cucumis sativus* L.) were washed in clean water and sliced with a kitchen knife. The samples were then placed on two separate trays and sun-dried for five days. During this sun-drying, the samples were covered with fine meshes to trap particles of dirt or foreign bodies that may contaminate them. The dried samples of *Daucus carota* and *Cucumis sativus* were further oven-dried (between 75 to 105^{o}C) in the laboratory to a constant weight for three days in order to completely get rid of any moisture. These moisture-free samples were first pounded using pestle and mortar, then ground with a grinder, sieved through a sieve of size 0.5 µm and the powdered samples were stored in two separate well labelled air-tight plastic containers before finally taken for analyses (Fig. 3).

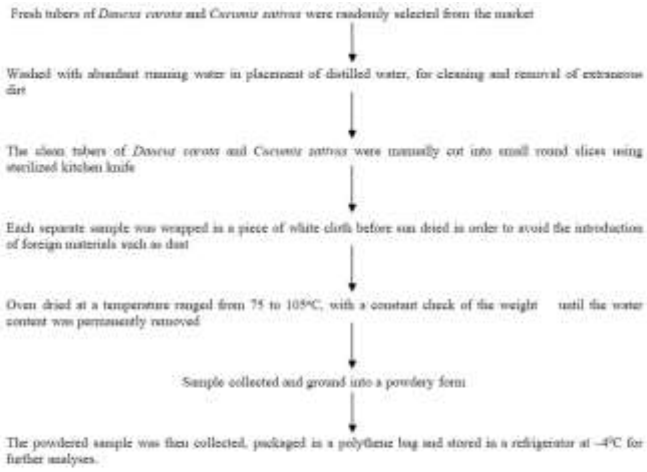

Fig 3: General Flow Diagram of Sample Preparation and Treatment [9]

Proximate Analysis

The ash, crude fat, moisture, crude protein (N x 6.25), crude fibre and carbohydrate (by difference) were determined in accordance with the standard methods of AOAC [10]. All proximate analyses of the sample flours were carried out in triplicate and reported in percentage. All chemicals were of Analar grade.

Amino Acid Analysis

The amino acid analysis was by Ion Exchange Chromatography (IEC) using the Technico Sequential Multisample (TSM) Amino Acid Analyzer (Technicon Instruments Corporation, New York). The period of analysis was 76 min for each sample. The gas flow rate was 0.50 mLmin^{-1} at 60°C with reproducibility consistent within ± 3%. The net height of each peak produced by the chart recorder of the TSM (each representing an amino acid) was measured and calculated. Amino acid values reported were the averages of two determinations. Nor–leucine was the internal standard. Tryptophan was determined after alkali (NaOH) hydrolysis by the colorimetric method.

Determination of Isoelectric Point (pI), Quality of Dietary Protein and Predicted Protein Efficiency Ratio (P–PER)

The predicted isoelectric point was evaluated according to Olaofe and Akintayo [11]:

$$plm = \sum_{i=1}^{n=1} pliXi \quad --------(1)$$

Where:

pIm = the isoelectric point of the mixture of amino acids;

pIi = the isoelectric point of the ith amino acids in the mixture;

Xi = the mass or mole fraction of the amino acids in the mixture.

The quality of dietary protein was measured by finding the ratio of available amino acids in the sample protein compared with the needs expressed as a ratio. Amino acid score (AAS) was then estimated by applying the formula [12]:

$$AAS = \frac{mg\ of\ amino\ acid\ in\ 1g\ of\ test\ protein}{mg\ of\ amino\ acid\ in\ reference\ protein} \times \frac{100}{1} \quad ----- (2)$$

The predicted protein efficiency ratio (P–PER) of the seed sample was calculated from their amino acid composition based on the equation developed by Alsmeyer *et al.* [13] as stated thus;

P–PER = –0.468 + 0.454 (Leu) – 0.105(Tyr) - - - - - - - - - - - - - - - - - - - (3)

Anti–nutritient Content Determination

The contents of tannin, alkaloid, saponin, phytate, oxalate and cyanide were determined on each of the sample flours by methods described by some workers [14].

Statistical Analysis of the Samples

The fatty acid values were obtained by multiplying crude fat value of each sample with a factor of 0.8 (i.e. crude fat x 0.8 = corresponding to fatty acids value. The energy values were calculated by adding up the carbohydrate x 17 kJ, crude protein x 17 kJ and crude fat x 37 kJ for each of the samples. Errors of three determinations were computed as standard deviation (SD) for the proximate composition.

Results and Discussion

The proximate composition of *Daucus carota* and *Cucumis sativus* is displayed in Table 1. The moisture content of *Daucus carota* (5.06%) and *Cucumis sativus* (4.39%) were all within the recommended dietary allowance (RDA) (3 – 10%) [15]. These contents are higher when compared with some legumes; bambara groundnut (1.7 ± 0.51%) and kersting's groundnut (1.7 ± 0.12%) [16]. High moisture content in food is important to act as a solvent to aid in all biochemical reactions and physiological activities during digestion. However, foods with high moisture contents are prone to easy microbial spoilage and subsequent short shelf life [17–19]. Moderate moisture content of < 12% is preferred for shelf stability of food on long storage [20]. Ash content is a measure of mineral content of food. The results indicate that there were more minerals in *Cucumis sativus* (15.26%) than in *Daucus carota* (7.75%); the values of ash content are high compared to those reported for some leafy vegetables such as *Solanium nodiflorum* (ogumo) (2.67%) [21] and *Basella albs* L. (Indian spinach). Both samples have ash values higher than the lowest RDA value of 6%. Crude fat content of *Daucus carota* and *Cucumis sativus* were 6.09 and 4.83%, respectively. This does not qualify the samples as oil-rich vegetables, since their crude fat content are low compared with soybean (22.8 – 23.5%) [22, 23] and pumpkin [24, 25] grown in Nigeria. The crude fat content obtained in this report are fairly high when compared with values reported in some leafy vegetables such as bush – buck (3.51%) and scent leaf (4.02%) [26]. Crude protein values for *Daucus carota* and *Cucumis sativus* were 9.39 and 14.39%, respectively. The value obtained for *Cucumis sativus* is more than what was reported for some leafy vegetables such as *Momordica balsamina* (11.29%) and *Lesianthera africiana* leaves (13.10%) [26]. Plant foods that provide more than 12% of their calorific value from protein have been shown to be good sources of protein [27]. This shows that *Cucumis sativus* is more of a good source of protein than *Daucus carota* L. Crude fibre is a significant component in the body. It increases stool bulk and decreases the time that waste materials spend in the gastrointestinal tracks [28]. Crude fibre in the diet consists mostly of the plant polysaccharides that cannot be digested by human dietary enzymes such as cellulose, hemicelluloses and some materials that make up the cell wall [29]. The crude fibre content values obtained in *Daucus carota* (13.04%) and *Cucumis sativus* (18.25%) exceed that of *T. triangulare* (2.40%), *T. occidentalis* (1.7%) and *C. argentea* (1.8%) [30]. Therefore, the consumption of *Daucus carota* and *Cucumis sativus* may be advantageous since high fibres content of foods help in digestion, prevention of colon cancer and in the treatment of diseases such as obesity, diabetes and gastrointestinal disorders [31].

Table 1: The proximate composition (g/100 g sample)[a] of *Daucus carota* and *Cucumis sativus*

Parameter	*Daucus carota*	*Cucumis sativus*
Moisture	5.06 ± 0.05	4.39 ± 0.20
Ash	7.75 ± 0.26	15.26 ± 0.19
Crude fat	6.09 ± 0.14	4.83 ± 0.10
Crude fibre	13.04 ± 0.24	18.25± 0.35
Crude protein	9.39 ± 0.22	14.39 ± 10.00
Carbohydrate	58.67 ± 0.06	42.90 ± 0.23
*Energy (kJ 100/g)	1382.35	1152.64
+Fatty acid	4.87	3.86

[a]Values are means of triplicate determinations ± standard deviations; Carbohydrate = 100 – (Moisture + ash + crude fat + crude fibre + crude protein); *Calculated metabolisable energy (kJ 100 /g) = (Protein × 17 + fat × 37 + carbohydrate × 17); *Calculated fatty acid = (0.8 × crude fat)

The carbohydrate by difference values for *Daucus carota* L. (58.67%) and *Cucumis sativus* L. (42.90%) as revealed in Table 4.1 are high compared to the carbohydrate level of 8.0% in *T. occidentalis* [32]. The calculated fatty acids and metabolizable energy values for *Daucus carota* L. and *Cucumis sativus* L. were 4.87 to 3.86 kJ / 100 g and 1382.35 to 1152.64 kJ/100 g, respectively. High fatty acid value in oil indicates that the oil may not be suitable for use in cooking (edibility), but however, be useful for industrial purposes [33]. The high metabolizable energy values obtained showed that the samples have energy concentration more favourable than cereals [34–36]. However, the values are lower than those reported for some legumes such as bambara groundnut (1691.3 kJ/100 g) and kersting's groundnut (1692.9 kJ/100 g) [16], and red kidney bean (1678.4 kJ/100 g) [37].

The result of amino acid composition of *Daucus carota* and *Cucumis sativus* is shown in Table 2. Glutamic acid was the most highly concentrated non – essential amino acid in both samples (7.57 and 10.29 g/100 g crude protein, cp). However, the values obtained in this report is lower than Glu content of some Nigerian plant foods; *Luffa cylindrical* kernel (13.0 g/100 g cp) [38], *Anarcadium occidentalis* protein (13.6 g/100 g cp) [19], soybean (16.25 g/100 g cp) [39] and *Cyperus esculentus* (19.7 g/100 g cp) [40]. But the values are comparable to the reported Glu content of some Nigerian legumes; lima bean (7.45 g/100 g cp), pigeon pea (8.40 g/100 g cp) and African yam bean (7.45 g/100 g cp) reported by [41]; *H. barteri* leaves (9.52 g/100 g cp) and *H. cannabinus* (11.11 g/100 g cp) reported by [42]. It is observed that Glu and Asp for *Daucus carota* L. (together make up 13.18 g/100 g cp) and those for *Cucumis sativus* (together make up 17.79 g/100 g cp) are the most abundant amino acids in the two samples. Some workers [16, 33, 39, 41, 43, 44] had similar observation. Arginine constituted the highest single essential amino acid (EAA) in both the *Daucus carota* and *Cucumis sativus* samples (3.61 and 5.33 g/100 g cp). Arginine is an AA acid for children growth [33]. The least amino acid was tryptophan (0.37 and 0.73 g/100 g cp) in *Daucus carota* and *Cucumis sativus*, respectively. The calculated isoelectric points (pI) were 2.98 for *Daucus carota* L. and 3.76 for *Cucumis sativus*. This is useful in predicting the pI for protein in order to enhance the quick precipitation of protein isolate from biological samples [11]. The predicted protein efficiency ratio (P – PER) is one of the quality parameters used for protein evaluation [12]. The P – PER in this report for *Cucumis sativus* (1.76) is higher than the reported P – PER values of *Lathyrus sativus* L. (1.03) [23], but lower than those reported by [37] (2.5) for red kidney bean. Moreover, the P – PER value obtained for *Daucus carota* (0.95) in this study is lower than that of *Phaseolus coccineus* (1.91) [45]. Chemical, biochemical and pathological observations in experiments conducted in human and laboratory animals showed that high leucine in the diet impairs the metabolism of tryptophan and niacin, and it is responsible for niacin deficiency in sorghum eaters [46]. High leucine is also a factor contributing to the pellagragenic properties of maize [47]. This study suggests that the leucine/isoleucine balance is more important than dietary excess of leucine alone. The Leu/Ile ratios in both samples for this study (1.19 and 2.32) are low. The *Cucumis sativus* sample has the highest concentrations of all the amino acids except for Ile, Pro, Tyr, Ala and Thr which differ from *Daucus carota* by 23.92%, 5.80%, 16.51%, 17.04% and 18.67%, respectively.

The nutritive value of a protein depends primarily on the capacity to satisfy the needs for nitrogen and essential amino acids [48]. Table 3 depicts the essential, non–essential, acidic, neutral and sulphur containing amino acids. The total essential amino acids (TEAA) with His of *Daucus carota* L. (22.93 g/100 g cp) and *Cucumis sativus* L. (30.11 g/100 g cp) represent 27.84 and 46.94% respectively. This is less than that of some Nigeria legume protein concentrates; lima bean (44.88 g/100 g cp), pigeon pea (48.11 g/100 g cp), and African yam bean (48.28 g/100 g cp) reported by [41] and tiger nut (41.21 g/100 g cp) by [40]. Nevertheless, the TEAA contents (%) of *Cucumis sativus* L. in this report are well above the 39% considered to be adequate for ideal protein food for infants, 26% for children and 11% for adults [49]. The concentrations of total sulphur amino acids (TSAA) were 1.26 and 1.71 g/100 g cp are lower than the 5.8 g/100 g cp recommended for infants [49]. The values of essential aromatic acids (EArAA) (2.13 – 2.66 g/100g cp) are also lower than the ideal range suggested for infant protein (6.8 – 11.8 g/100 g cp) [49]. The total acidic amino acids (TAAA) (13.18 and 17.79 g/100 g) are found to be greater than the total basic amino acids (TBAA) (7.44 and 11.58 g/100 g) in both samples indicating that their protein is probably acidic in nature (Aremu *et al.*, 2012). The percentage ratios of TEAA with His to TAA in the samples were 27.84 and 46.94% for *Daucus carota* and *Cucumis sativus*, respectively. These values are low compared to that of egg (50%) [12], scarlet runner bean (48.31%) [45], *Anarcadium occidentale* (47.19%) [33].

Table 2: Amino acid compostion (g/100 g crude protein) of *Daucus carota* and *Cucumis sativus*

Amino acid	*Daucus carota*	*Cucumis sativus*
Leucine (Leu)*	3.59	5.31
Lysine (Lys)*	2.17	4.14
Isoleucine	3.01	2.29
Phenylalanine (Phe)*	2.13	2.66
Tryptophan (Try)*	0.37	0.73
Valine (Val)*	2.86	4.30
Methionine (Met)*	0.53	0.80
Proline (Pro)	3.45	3.25
Arginine (Agr)*	3.61	5.33
Tyrosine (Tyr)	2.06	1.72
Histidine (His)*	1.66	2.11
Cystine (Cys)	0.73	0.91
Alanine (Ala)	3.11	2.58
Glutamic acid (Glu)	7.57	10.29
Glycine (Gly)	2.23	3.24
Threonine (Thr)*	3.00	2.44
Serine (Ser)	3.62	4.54
Aspartic acid (Asp)	5.61	7.50
(pI)	2.98	3.76
(P-PER)	0.95	1.76
Leu/Ile	1.19	2.32

P-PER = Predicted protein efficiency ratio; pI= isoelectric point
***Essential amino acids

Table 3: Classification of amino acid composition (g/100 g crude protein) of *Daucus carota* and *Cucumis sativus*

Parameter	*Daucus carota*	*Cucumis sativus*
Total amino acid (TAA)	82.36	64.14
Total non-essential amino acid (TNEAA)	59.43	34.03
% TNEAA	72.16	53.03
Total essential amino acid (TEAA)		
With histidine	22.93	30.11
Without histidine	21.27	28.00
% TEAA		
With histidine	27.84	46.94

Without histidine	25.83	43.66
Essential aliphatic amino acid (EAAA)	12.46	14.34
Essential aromatic amino acid (EArAA)	2.13	2.66
Total neutral amino acid (TNAA)	63.40	36.08
% TNAA	76.98	56.25
Total acidic amino acid (TAAA)	13.18	17.79
% TAAA	16.00	27.74
Total basic amino acid (TBAA)	7.44	11.58
% TBAA	9.03	18.05
Total sulphur amino acid (TSAA)	1.26	1.71
% Cysteine in TSAA	57.94	53.22

The essential amino acid contents in this report are lower than the [12] recommended pattern. Thus by implication, dietary formula based on the flour samples of *Daucus carota* L. and *Cucumis sativus* L. will require all the essential amino acids supplementation for both samples. It has been reported that EAAs most often acting in a limiting capacity are Met (and Cys), Lys and Try [49]. The first limiting EAA in *Daucus carota* and *Cucumis sativus* was Met + Cys (TSAA) with values of 0.36 and 0.49, respectively.

Table 4: The amino acid scores of *Daucus carota* and *Cucumis sativus*

EAA	**PAAESP** (g/100 g crude protein)	***Daucus carota*** **EAAC**	**AAS**	***Cucumis sativus*** **EAAC**	**AAS**
Ile	4.0	3.01	0.75	2.29	0.59
Leu	7.0	3.59	0.51	5.31	0.76
Lys	5.5	2.17	0.40	4.14	0.75
Met + Cys (TSAA)	3.5	1.26	0.36	1.71	0.49
Phe + Tyr	6.0	4.19	0.70	4.34	0.72
Thr	4.0	3.00	0.75	2.44	0.61
Try	1.0	0.37	0.37	0.73	0.73
Val	5.0	2.86	0.57	4.30	0.86
Total	**36.0**	**20.45**	**4.41**	**25.26**	**5.49**

EAA = Essential Amino Acid; **PAAESP** = Provisional Amino Acid (Egg) Pattern; **EAAC** = Essential Amino Acid Composition (see Table 4.2); **AAS** = Amino Acid Score

Table 5 presents the composition of antinutrient content of *Daucus carota* and *Cucumis sativus*. The saponin content was 0.22%% in *Daucus carota* and 0.19% in *Cucumis sativus*. The values for both samples compare with 0.05% and 0.23% reported for mung beans and chickpeas, respectively [50]. Saponin has been shown to possess both deleterious properties and to exhibit structure-dependent biological activities [51]. Saponins in high concentrations, impart a bitter taste and stringent in dietary plants. The bitter taste of saponin is the major factor that limits its use. Saponins cause hypocholesterolaemia by binding cholesterol, making it unavailable for absorption. They also cause haemolysis of red blood cells and are toxic to rats [52]. Saponins from *Bulbostermma paniculatum* and *Pentapamax leschenaultii* have also been demonstrated to have anti–spermal effects on human spermatozoa [53, 54]. They significantly inhibited acrosine activity of human sperms and the spermicidal effect was attributed to strong damage of the spermal plasma membrane [52].

The levels of tannin in the *Daucus carota* and *Cucumis sativus* samples were 329.03 mg/100 g and 254.45 mg/100 g, respectively. The tannin content in *Cucumis sativus* is low when compared to the value for *Daucus carota* (329.03 mg / 100 g) in this work (Table 5). The nutritional effects of tannins are mainly related to their interaction with protein due to the formation of complexes [53]. Tannin–protein complexes are insoluble and protein digestibility is decreased. Tannin acid may decrease protein quality by decreasing digestibility and palatability. Other nutritional effects which have been attributed to tannin include damage to the intestinal tract, interference with the absorption of iron and a possible carcinogenic effect [56]. The alkaloid content in this study was 2.85% in *Daucus carota*. and 2.23% in *Cucumis sativus*. These values are higher than those obtained by [57] for black turtle bean (1.6, 1.8%). Alkaloids are considered to be antinutrients because of their action on the nervous system, disrupting or inappropriately augmenting electrochemical transmission. For instance, consumption of high tropane alkaloids will cause rapid heartbeat, paralysis and in fatal case, lead to death. Uptake of high dose of tryptamine alkaloids will lead to staggering gate and death. Indeed, the physiological effects that alkaloids have on humans are very evident. Cholinesterase is greatly inhibited by glycoalkaloids, which also cause symptoms of neurological disorder. Other toxic action includes disruption of the cell membrane in the gastrointestinal tract [58].

Phytate (a salt form of phytic acid) content was 616.41 mg/100 g in *Daucus carota* and 349.62 mg/100 g in *Cucumis sativus*. These values obtained for both samples are higher than the value obtained for sesame seed (25.96 mg/100 g) [59] but that for *Cucumis sativus* L. (349.62 mg/100 g) is lower than values reported for soybean (4050 mg/100 g), pigeon pea (1170 mg/100 g) and cowpea (2040 mg/100 g)

[60] and black turtle bean (11250 mg/100 g) [57]. Phytic acid is an important storage form of phosphorus in plant, it is insoluble and cannot be absorbed in human intestine and it has 12 replaceable hydrogen atoms with which it could form insoluble salts with metals such as calcium, iron, zinc and magnesium. The formation of these insoluble salts renders the metals unavailable for absorption into the body. Phytate can also affect digestibility by chelating with calcium or by binding with substrate or proteolytic enzyme. Phytate is also associated with cooking time in legumes [57, 60].

Table 5: The anti-nutrient composition of *Daucus carota* and *Cucumis sativus*

Parameter	*Daucus carota*	*Cucumis sativus*
Oxalate (mg/100 g)	241.67 ± 0.11	142.45 ± 0.55
Saponin (%)	0.22 ± 0.01	0.19 ± 0.01
Alkaloids (%)	2.85 ± 0.16	2.23 ± 0.00
Tannins (mg/100 g)	329.03 ± 0.97	254.45 ± 0.05
Cyanide (mg/100 g)	4.01 ± 0.12	3.03 ± 0.13
Phytate (mg/100 g)	616.41 ± 0.38	349.62 ± 0.46

Oxalate is an anti–nutrient which under normal conditions is confined to separate compartments. However, when it is processed and/or digested, it comes into contact with the nutrients in the gastrointestinal tract [61]. When released, oxalic acid binds with nutrients, rendering them inaccessible to the body. If food with excessive amounts of oxalic acid is consumed regularly, nutritional deficiencies are likely to occur, as well as severe irritation to the lining of the gut [62]. Oxalate values presented in this report were 241.67 mg/100 g in *Daucus carota* and 142.45 mg/100 g in *Cucumis sativus*. Both samples of *Daucus carota* and *Cucumis sativus* have oxalate values lower than 254 mg/100 g for soybean and 286 mg/100 g for pigeon pea [63], 225740 mg/100 g found in red kidney bean and 166890 mg/100 g found in black turtle bean [57]. Oxalate is produced and accumulated in many crop plants and pasture weeds. Cyanogens are glycosides of a sugar, sugars and cyanide containing aglycone. Cyanogens can be hydrolyzed by enzymes to release a volatile cyanide gas. Excess cyanide inhibits the cytochrome oxidase, the final step in electron transport, and thus blocks ATP synthesis and so tissues suffer energy deprivation and death follows rapidly. Prior to death, symptoms include faster and deeper respiration, a faster irregular and weaker pulse, salivation and frothing at the mouth, muscular spasms, dilation of the pupils, and bright red mucous membranes [64]. High level of HCN has been implicated for cerebral damage and lethargy in man and animal. The cyanide values found in this work were between 4.01 – 3.03 mg/100 g for *Daucus carota* and *Cucumis sativus*, respectively.

Conclusion

The proximate, amino acid and anti–nutrient compositions of *Daucus carota* and *Cucumis sativus* are presented in this study. The study showed that *Daucus carota* and *Cucumis sativus* have moderate fat and protein contents, and useful amino acids expected for infants. There are also potential health beneficial constituents to be derived from the incorporation of these vegetables into diets and this indicates the need for their exploitation in seeking optimum health benefits of the fruits for the populace. The study indicates that *Daucus carota* and *Cucumis sativus* may be better sources of some of the essential nutrients than some of the members of the family to which they belong. However, some of the antinutrient contents may pose nutritional problems in their consumption.

Conflict of Interest

The authors declare that there is no conflict of interest reported in this study.

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