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Lipid Profiles and Health Promoting Uses of Carrot (Daucus carota L.) and Cucumber (Cucumis sativus L.)

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Abstract: Humans are in–separately linked to the existence of vegetables, as they are the source of several bio–products essential for the survival of the animal kingdom. The importance of vegetables from the point of view of the food industry is determined by their complex chemical content that is important to the human body and this includes organic substances (lipids, proteins, carbohydrates and organic acids). This study examines comparatively the levels of lipid compositions in the samples of dried carrot (*Daucus carota* L) and cucumber (*Cucumis sativus* L). The fatty acid, phospholipid and sterol compositions were determined from the samples using Gas Chromatography method. The most concentrated fatty acid (%) was linoleic acid (C18:2) (54.04 and 57.62) and the least was arachidic acid (C20:0) (0.01 and 0.01) for *Daucus carota* and *Cucumis sativus*, respectively. The result showed the quality parameters of fatty acids investigated in the *Daucus carota* and *Cucumis sativus* samples as: SFA (23.36 and 20.15 %); MUFA (15.27 and 15.5 %); PUFA (60.37 and 64.58 %); DUFA (54.04 and 57.62 %); TUFA (75.64 and 79.83 %); MUFA/SFA (0.63 and 0.76 %); PUFA/SFA (2.87 and 3.47 %); O/L (0.23 and 0.23 %). The total phospholipid contents present in the *Daucus carota* and *Cucumis sativus* were 546.11 and 594.51 mg/100 g while that of phytosterols were 366.16 and 376.69 mg/100 g, respectively. Phosphatidycholine has the highest content in both samples (265.80 and 283.64 mg/100 g). The concentrations of phytosterols were very low except in sitosterol (198.71 and 200.53 mg/100 g), stig–masterol (118.42 and 120.39) and campesterol (34.48 and 34.44 mg/100 g) for the *Daucus carota* and *Cucumis sativus* samples, respectively. This study revealed that *Daucus carota* and *Cucumis sativus* have high values of UFA that make them a special kind of vegetables for nutritional and health applications, and may be a good source of phytosterols.

Keywords: *Daucus carota*, *Cucumis sativus*, Fatty Acids, Phospholipids, Sterols

Introduction

The vegetables are plant–based foods with different uses and are significant sources of nutrients. The edible part of a plant – root, stem, bulb, fruit, flowers, seeds, leaves, or the whole plant – varies from one species to another. The intake of nutrients from vegetables depends on the consumed organ of the plant. Tubers are rich in starch but have few vitamins; roots and stems are high in fiber (cellulose and hemicellulose) but do not contain vitamin C; leafy vegetables are very rich in vitamin C, Mg, chlorophyll and carotenoids; flowers, which are rarely consumed as such (e.g cauliflower) are high in vitamin K and B-complex vitamins [1]. Lipids are in vegetables but in low amounts (except oilseeds). Among the saturated fatty acids; palmitic, myristic and steric acids can be found in peas, beans and spinach but low amounts of saturated fatty acids in almonds and peanuts. Of the monounsaturated fatty acids, omega–3 is found in soybeans and beans [2, 3]. Vegetables contain minerals, mainly K, Ca, Mg, P and Fe. They also contain traces of oligoelements (Cr, Cu, I, F, Zn, Mg, Mo and Se), which are absorbed from the soil together with water, therefore their proportions vary in the food samples. Ca is found in vegetables such as cabbage, cauliflower, broccoli, parsley, onions, peas and beans (with an absorption rate greater than 50 %). The vegetables provide less than 30 % of P needed by the body. Phosphorus has been identified in dried legumes in the form of phytic acid, which forms insoluble complexes with a predatory effect on Ca, Fe, Zn, and Mg [4–6]. The amount of vitamins in a vegetable depends on its type, ripening stage, the soil it grows in, and mode of conservation. Vitamin C from vegetables is more active than synthetic vitamin C, and when accompanied by vitamin A and other antioxidants, its uptake is enhanced. Vitamins and minerals have a significant presence in most green vegetables. Large amounts of ascorbic acid (Vitamin C) are found in leafy greens and some vegetables (tomatoes and peppers), tubers (asparagus and potato), and bulbs (onions). The concentration of vitamin C in vegetables depends on the development and maturation of crops. Vitamin C is present in higher quantities in the shell than in the core, so when the outer layer is removed vitamin C is lost [7]. Vegetables with a high proportion of ascorbic

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oxidase (cucumbers, zucchini and carrots) are almost devoid of vitamin C. Vitamin C in the form of dehydroascorbic acid is found in red pepper, parsley and horse radish [1].

Carrot (*Daucus carota* L.) is valuable for its good digestible and high contents of provitamin A and other nutraceutical substances [8]. Different studies have shown its impact on the human health. Carrots have been ranked as the tenth in terms of nutritional value among thirty eight other fruit and vegetables, and seventh for their contribution to nutrition [9]. Carrot is considered to be the major dietary source of carotenes for humans providing more than 17 % of the total vitamin A requirements in its intake. Carrot is a root vegetable with carotenoids, flavonoids, polyacetylenes, vitamins, and minerals, all of which possess numerous nutritional and health benefits. Carrots are also good for eyes, carotenoids, polyphenols and vitamins present in carrot act as antioxidants, anti–carcinogenic, and immune–enhancers. Carrots can be as small as two inches or as long as three feet, ranging in diameter from one half of an inch to over two inches. Carrot roots have a crunchy texture and a sweet and minty aromatic taste and are associated with the colour orange [10].

Cucumber (*Cucumis sativus* L.) is one of the monoecious annual crops in the Cucurbitacae family that has been cultivated by man over 3,000 years [11]. Cucumbers are 95 % water this makes cucumber a great way to stay hydrated. Cucumbers contain several antioxidants, including vitamin C, beta-carotene and manganese, as well as flavanoids, triterpenes and lignans that have ant-inflammatory properties. The anti-inflammatory compounds in cucumbers help remove waste from the body and also reduce skin irritation. With respect to economic importance, it ranks fourth after tomatoes, cabbage and onions in Asia [12].

The study is aimed at investigating the fatty acid, phospholipid and sterol compositions of oils extracted from carrot (*Daucus carota*) and cucumber (*Cucumis sativus*) grown in north east Nigeria so as to provide information on the nutritive and health promoting uses of the samples. The data generated from the study will be useful for evaluating the oils for other potential uses in food, industrial and pharmaceutical applications.

Materials and Methods

Sample Collection

Samples of fresh carrot tuber (*Daucus carota* L.) and cucumber fruit (*Cucumis sativus* L.) were purchased from New Market Wukari, Wukari local government area, Taraba State in north east, Nigeria in the month of January, 2019. Identification of each sample was done in the Biology laboratory of Federal University Wukari, Taraba State.

Sample Preparation and Treatment

The *Daucus carota* and *Cucumis sativus* tubers were washed under running water for cleaning purposes and also to remove extraneous dirt particles. The tubers were manually sliced into small light round shapes in order to aid quick drying process. After all, they were sundried and oven dried to a constant weight in an oven at a temperature between 75^0C-105^0C. The dried samples of *Daucus carota* and *Cucumis sativus* were ground using the laboratory mortar and pestle, and then finally blended into powdery form using the blender. The powdered samples were then collected and stored in dry sealed plastic container and later sent to research laboratories for different analyses (Fig 1).

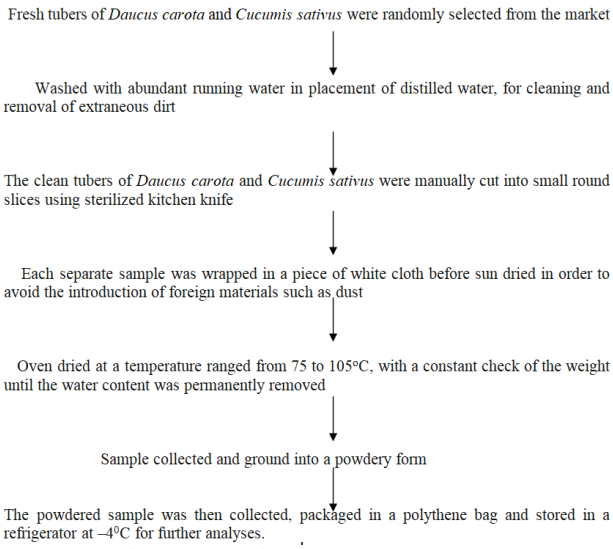

Fig 1: General flow diagram of sample preparation and treatment

Extraction of Oils

The method described by some researchers [13] is employed. Extraction flask of 250 mL capacity was dried in the oven at 105^0C, transferred to the desiccator to cool to the laboratory temperature and the weight of the flask was measured. 2.0 g of the sample was weighed into the labeled porous thimble. 200 mL of the petroleum ether was measured and then added to the dried 250 mL extraction flask. The covered porous thimble with the sample was placed in the condenser of the Soxhlet extractor arrangement that has been assembled. The sample was extracted for 5 h. The porous thimble was removed with care and the petroleum ether in the top container (tube) was collected for the recycling for reuse. The extraction flask was removed from the heating mantle arrangement when it was almost free of petroleum ether. The extraction flask with the oil was oven dried at 105^0C for the period of 1 h. The flask containing the dried oil was cooled in the desicator and the weight of the cooled flask with the dried oil was

measured.

Preparation and Fatty Acid Methyl Esters Analysis

The extracted fat content (50 mg) of the sample was saponified (esterified) for 5 min at 95^0C with 3.4 mL of the 0.5 M KOH in dry methanol. The mixture was neutralized by using 0.7 M HCl. 3 mL of the 14% boron triflouride in methanol was added. The mixture was heated for 5 min at the temperature of 90^0C to achieve the complete methylation process. The fatty acid methyl esters were extracted from the mixture with redistilled n-hexane in triplicate. The content was concentrated to 1 mL for GC analysis and 1 µL was injected into the injection port of GC. The injection port and the detector were maintained at 310°C and 350°C, respectively while the initial column temperature was 250°C rising at 5°C/min to a final temperature of 310°C. A polar (HP INNO Wax) capillary column (30 m × 0.53 mm × 0.25 µm) was used to separate the esters. The peaks were identified by comparison with standard fatty acid methyl esters obtained from Sigma Chemical Co. (St. Louis MO, USA). However, the quantitative evaluation was carried out on the base of GC peak areas of the different methyl esters. The heptadecanoic ester was used to calculate the response factor for FAs which was found to be 0.96 [13].

Phospholipids Analysis

The modified method of [13] was employed in the analysis of the extracted oil for phospholipids content determination. The extracted fat (0.01 g) was added to the test tubes. To ensure complete drying of the oil for phospholipids analysis, the solvent was completely removed by passing the stream of the nitrogen gas on the oil. 0.4 mL of chloroform was added to the content of the tube and it was followed by the addition of 0.10 mL of the chromo-genic solution. The content of the tube was heated at the temperature of 100^0C in a water bath for about 1 min 20 s. The content was allowed to cool to the laboratory temperature and 5 mL of the hexane was added and the tube with its content shaken gently several times. The solvent and the aqueous layers were allowed to be separated. The hexane layer was recovered and allowed to be concentrated to 1.0 mL for GC analysis using the pulse flame photometric detector [13].

Phytosterol Analysis

The phytosterol extraction and analysis were carried out by following the modified method AOAC 994.10 and AOAC 970.51 Official Methods [14]. 5.00 g of the powdered sample was weighed and transferred to stoppered flask and treated with petroleum ether until the powder was fully soaked. The flask shaken every hour for the first 6 h and then it was kept aside and shaken after 24 h. This process was repeated for three days and then the extracted was filtered. The extract was collected and evaporated to dryness by using nitrogen stream. 0.5 g of the extract of the sample was added to the screw-capped test tube. The sample was saponified at 95^0C for 30 min by using 3 ml of 10% KOH in ethanol to which 0.20 mL of benzene had been added to ensure miscibility. 3 mL of de-ionized water was added and 2 mL of hexane was used in extracting the non-saponifiable materials e.g sterols. Three extractions, each with 2 mL of hexane were carried out for 1 h, 30 min and 39 min respectively to achieve complete extraction of the sterols. The hexane was concentrated to 2 mL in Agilent vial for gas chromatography analysis [13].

Statistical Evaluation

The descriptive statistical analysis done was the determination of mean, standard deviation and coefficient of variation percent.

Results and Discussion

The result of fatty acid composition is shown in Table 1. The most concentrated saturated fatty acid in both samples was palmitic acid (C16:0) with values of 15.57 % (*Daucus carota*) and 15.54% (*Cucumis sativus*) followed by stearic acid (18:0) with values of 7.42% (*Daucus carota*) and 4.29% (*Cucumis sativus*). The values recorded for both palmitic and stearic acid in this study are in close agreement with the results of palmitic and stearic acids of seed samples from literature [13, 15]. Lignoceric, behenic, arachidic, margaric and myristic acids are all saturated fatty acids which were present in small quantities with none of them recording up to 1.0% in both samples. The % difference of myritic and stearic acid contents between the *Daucus carota* and *Cucumis sativus* in this study were 27.78 and 42.18, respectively in favour of *Daucus carota*. Erucic and arachidonic acids which are unsaturated fatty acids were also found in small quantities with neither of them recording up to 1.0 % in both samples. The most predominant monounsaturated fatty acid was oleic acid (C18:1) with values of 12.59 and 13.03 for *Daucus carota* and *Cucumis sativus* samples, respectively. These values are comparable to the oleic acid (12.40 and 14.80) reported in *Artocarpus altilis and Buchholzia coriacea*, respectively but lower than the values reported for African locust bean (32.24%) [16], mesquite bean (30.95%) [16], *Artocarpus altilis and Buchholzia coriacea* (56.78 and 35.72%) [13], pulp and seed of *Persea Americana* (39.84 and 35.76%) [17]. Oleic has been shown to decrease HDL–cholesterol concentrations which affect positively cardiovascular disease risk [5]. It is the biosynthetic precursor of a family of fatty acid with the (n-9) terminal structure and with chain length of 20-24 or more carbon atom [13]. Linoleic acid was present in highest concentration (54.04 %) followed by palmitic acid 15.57 % and stearic acid 7.42 % for

Daucus carota; linoleic (57.62%), palmitic (15.54%) and stearic (4.29%) for *Cucumis sativus*. The linoleic acid (C18:2) values in both samples (54.04 and 57.62) are higher compared with values obtained for linoleic in *Luffa cylindrical* and *Brachystegia eurycoma* as reported by some researchers [18, 19]. The value of (C18:2) in the carrot (54.04) is lower than that of the cucumber (57.62) by 3.58, while the value of the alpha–linolenic acid (C18:3) in *Daucus carota* (6.26%) is lower than that of the *Cucumis sativus* (6.89%) by 0.6 (Table 1). It has been reported that an insufficient intake of omega–6 fatty acid such as linoleic causes growth retardation in children, heart attack risk and skin ailments [20]. Alpha–linolenic acid plays a significant role in the skin. In dry skin, it strengthens the lipid barrier of epidemic, protects against trans-epidermal loss of water and normalizes the skin metabolism. Linoleic acid is natural component of sebum [21]. The LA and ALA are essential fatty acids which have critical roles in the membrane structure and as precursors of eicosanoids, which are potent and highly reactive compounds since they compete for the same enzymes and have different biological roles, the balance between the LA and the ALA fatty acids in the diet can be of considerable importance [22]. Deficiency of linoleic acid leads to dry hair, hair loss [23] and poor wound healing [24]. It also leads to poor growth, fatty liver, skin lesions and reproductive failure [25]. It has been reported that linoleic acid plays a role in lowering the risk of cardiosvascular disease [26]. It has been found that the intake of alpha–linolenic acid in the diet protects against fatal ischemic heart disease [27]. It has also been reported that linoleic acid moderately reduces serum cholesterol and low density lipoprotein levels (LDL) [22]. The highest CV (%) was found in myristic acid (C14:0) (Table 1)

Table 1: Fatty acid composition (%) of carrot (*Daucus carota* L) and Cucumber (*Cucumis sativus* L)

Fatty Acid (%)	*Daucus carota*	*Cucumis sativus*	Mean	SD	CV %	D-C	Difference (%)
Myristic Acid (C14:0)	0.18	0.13	0.16	0.11	68.75	0.05	27.78
Palmitic Acid (C16:0)	15.57	15.54	16.06	0.10	0.62	1.03	6.22
Margaric Acid (C17:0)	0.02	0.02	0.02	0.00	0.00	0.00	0.00
Stearic Acid (C18:0)	7.42	4.29	5.86	2.21	37.71	3.13	42.18
Arachidic Acid (C20:0)	0.01	0.01	0.01	0.00	0.00	0.00	0.00
Behenic acid (C22:0)	0.08	0.08	0.08	0.00	0.00	0.00	0.00
Lignoceric Acid (C24:0)	0.08	0.08	0.16	0.00	0.00	0.00	0.00
Palmitoleic Acid (C16:1)	2.59	2.13	2.36	0.33	13.98	0.46	17.76
Oleic Acid (C18:1)	12.59	13.03	12.81	0.31	2.42	-0.44	-3.49
Eruic Acid (C22:1)	0.09	0.09	0.09	0.00	0.00	0.00	0.00
Linoleic Acid (C18:2)	54.04	57.62	55.83	2.53	4.53	-3.58	-6.62
Linolenic Acid (C18:3)	6.26	6.89	6.58	0.45	6.84	-0.63	-10.06
Arachidonic Acid (C20:4)	0.07	0.07	0.07	0.00	0.00	0.00	0.00
TOTAL	**100**	**100**					

SD=Standard Deviation; CV=Coefficient of variation; D=*Daucus carota*; C=*Cucumis sativus*

The quality parameters on fatty acids for the two samples are presented in Table 2. The SFA levels were 23.36 and 20.15 % with a percentage difference of 2.07. The total SFA contents in this report are comparable with the TSFA values of 24.80 and 20.50 % reported for raw and boiled tigernut samples [15], but lower that the value of 54.51 % reported for dehulled African yam bean [28], 34.68 % reported for bambara groundnut [3], 40.20 and 43.00% reported for African locust bean and mesquite bean, respectively [16]. However, the reported values of 12.3 % for groundnut [29], 15.2 % for soybean [30] and 9.0-12.9% for processed pinto bean [2] are lower than the values reported in this work. The values for total UFA were 75.64 and 79.83% for *Daucus carota* and *Cucumis sativus* samples, respectively. They are comparable with the values reported for processed tigernut samples with 75.20 % (raw) and 79.50 % (boiled) [15], *Parkia biglobosa* with a reported value of 33.69 % [31] and mesquite bean with a reported value of 56.90 % [16]. The MUFA concentrations were 15.27% (*Daucus carota*) and 15.25% (*Cucumis sativus*) with a difference of 0.13%. TUFA (75.64 and 79.83%) in this study is of great concern because report has shown that fat and oil with high unsaturation are particularly susceptible to oxidation and intakes of food containing oxidized lipid increase the concentration of secondary peroxidation products of liver [32]. The high amount of TUFA makes oils of *Daucus carota* and *Cucumis sativus* highly special for nutritional and industrial applications.

Table 2: Quality parameters of carrot (*Daucus carota* L.) and cucumber (*Cucumis sativus* L.)

Parameter	*Daucus carota*	*Cucumis sativus*	Mean	SD	CV %	D-C	Difference (%)
Total SFA	23.36	20.15	22.23	0.46	2.07	4.211	7.28
Total MUFA	15.27	15.25	15.26	0.01	0.07	0.02	0.13
Total PUFA	60.37	64.58	62.48	2.93	4.67	–4.21	–6.97
DUFA	54.04	57.62	55.83	2.53	4.53	-3.58	-6.62
Total UFA	75.64	79.83	77.73	2.96	3.80	-4.19	-5.54
MUFA/(SFA)	0.63	0.76	0.69	0.09	13.04	-0.13	-20.63
PUFA / (SFA)	2.87	3.47	3.17	0.42	3.25	- 0.60	-20.90
Total EFA	60.30	64.51	62.40	2.98	4.78	-4.21	6.98
O / L	0.23	0.23	0.23	0.00	0.00	0.00	0.00

SD=Standard Deviation;CV=Coefficient of Variation; D=*Daucus carota*; C=*Cucumis sativus*

The ratios of MUFA/SFA and PUFA/SFA are (0.63 and 0.76) and (2.87 and 3.47). These ratios are important in the determination of detrimental effects of dietary fats. The higher the PUFA/SFA ratio, the more nutritionally useful is the oil [28]. It has been reported that the severity of the disease condition such as atherosclerosis is closely associated with the proportion of total energy supplied by PUFA and SFA [33]. The O/L levels were 0.23 in *Daucus carota* and 0.23 in *Cucumis sativus*. These O/L values are lower than that of *Anarcadium occidentale* (12.28) [34], tigernut (2.11) [15] and peanut (1.48)[35]. The ratio of oleic/linoleic (O/L) has been associated with high stability and potentiality of the oil for deep frying fat [35] hence *Daucus carota* and *Cucumis sativus* oils may not be stable compared with peanut oil and may not also be useful as frying oil due to very low values of O/L ratios.

The oral application of dietary glycerol phospholipids GPLs with a specific FA composition has the potential to cause defined alterations of the FA composition of membrane phospholipids (PLs) within a certain cell type. As a consequence, cellular functions including signaling and transport as well as the activity of membrane bound enzymes, could be modulated by dietary PLs and hence contribute to the health benefits [36]. The result showed that *Cucumis sativus* was of higher phospholipids content than that of *Daucus carota* sample (Table 3). The phosphatidylethanolamine (154.45 and 175.25 mg/100 g) and phosphatidylcholine (265.80 and 283.64 mg/100 g) showed greater concentrations in the *Cucumis sativus* sample with a difference of 13.47 and 6.71%, respectively. Phosphatidythanolamine is usually the most abundant phospholipid in animals and plants often amounting to almost 50 % of the total and as such they are the building block of membrane bilayer [37]. But contrary to this assertion, the values for phosphatidycholine for the two samples were the highest in this report. This may be as a result of the shelf life of the samples, because researchers had found that phosphatidycholine (PC) concentration is high at infancy but slowly depletes throughout the age of life and may drop as low as 10 % of the cellular membrane in the elderly plants and animals [38], As a result of this, researchers have recommended daily supplementation of PC as a way of improving brain functioning memory capacity [38].

Table 3: Phoholipids composition of carrot (*Daucus carota* L) and cucumber (*Cucumis sativus* L.)

Phospholipid (mg / 100 g)	*Caucus carota*	*Cucumis sativus*	Mean	SD	CV %	D-C	Difference (%)
Phosphatidylethanolamine	154.45	175.25	164.85	14.70	8.91	-20.80	-13.47
Phosphatidylcholine	265.80	283.64	274.72	12.61	4.59	-17.84	-6.71
Phosphatidylserine	9.99	13.77	11.88	7.14	60.10	-3.78	-37.83
Lysophosphatidycholine	2.67	3.41	3.04	0.52	17.10	-0.74	-27.71
Sphingomyelin	5.26	6.23	5.73	0.69	12.00	-0.97	-18.44
Phosphatidylinositol	96.51	100.04	98.28	6.23	6.34	-3.53	-3.66
Phosphatidic Acid	11.42	12.17	11.79	0.53	4.49	-0.75	-6.57
Total	**546.10**	**594.51**					

SD=Standard Deviation;CV=Coefficient of Variation; D=*Daucus carota*; C=*Cucumis sativus*

Phosphatidylserine (PS), lysophosphatidycholine (LC), sphingomyelin and phosphatidic acid are in lower concentrations in both samples, that is, they are in minor quantities with concentrations lower than 15 mg/100 g. The values recorded for phosphatidylserine and phosphatidic acid for both *Daucus carota* and *Cucumis sativus* may be of help a little in the reduction of the rate of dementia and cognitive dysfunction in the elderly people, in young people, it reduces mental stress and increase mental

accuracy and stress resistance [39]. PS supplementation promotes desirable hormonal balance for athletes and might reduce the physiological deteriorations that accompanies over training and/or overstretching [40]. Therefore, consumption of *Daucus carota* and *Cucumis sativus* may participate well in these functions. Phosphatidic acid mediates cellular functions through different modes of action such as membrane teething, modulation of enzymatic activities and structural effects on cell membranes. The process in which phosphatidic acid plays a role includes signaling pathways in cell growth, proliferation reproduction and responses hormones in biotic and abiotic stress. However, consumption of these two vegetables may have a role to play in the above listed functions. The coefficient of variation (%) varied from 4.59 in PA to 17.10 in LC (Table 3).

The contents of phytosterols in oils extracted from *Daucus carota* and *Cucumis sativus* are displayed in Table 4. Phytosterols are natural components of plant origin forming cell membrane and occur in small quantity in many fruits, nuts, seeds, vegetables, cereals, vegetable oils, legumes and other plants. They are abundantly present in the fat, soluble fractions of all the plants and food containing plant based raw materials including principally oils, cereals, pulse and dried fruits [41]. Phytosterols may exist as free sterols (FS's), esterified with fatty acids (SE's), phenolic acids (SPHE's) or as glycosides (SG's) and acylated glycosides [41, 42]. Sitosterol has the highest concentration in both samples (198.71 and 200.53 mg/100 mg) followed by stig–masterol with values of 118.42 and 120.39 mg/100 g for *Daucus carota* and *Cucumis sativus*, respectively. The results are in agreement with what were recorded for many plant–based oils where sitosterol constitutes the major phytosterol follow–up by stig–masterol [13, 17, 43]. Systematic reviews studying the efficiency of phytosterols have shown that phytosterols enriched foods can significantly lower LDL cholesterol [44]. Daily intake of phytosterols helps to prevent heart disease by lowering HDL cholesterols levels by as much as 14 % [4]. A number of studies using phytosterols have been carried out and showed significant lowering of blood cholesterol levels. The total phytosterols in the two samples were 366.16 and 379.69 mg/100 g with % difference of 3.69 in favour of *Cucumis sativus.* The results showed that *Daucus carota* and *Cucumis sativus* can be regarded as better sources of phytosterols when compared to any known plant–based foods in the literature [13, 15, 45, 46, 47].

Table 4: Phytosterol composition of carrot (*Daucus carota* L) and cucumber (*Cucumis sativus* L)

Phytosterol (mg / 100g)	*Daucus carota*	*Cucumis sativus*	Mean	SD	CV %	D-C	Difference (%)
Cholesterol	3.70	8.89	6.29	3.89	61.84	-5.19	-140.27
Cholestanol	4.65	4.63	4.64	0.01	0.22	0.02	0.43
Ergosterol	2.02	2.13	2.08	0.08	3.85	-0.11	-5.45
Campesterol	34.48	34.44	34.46	0.03	0.09	0.04	0.12
Stig-masterol	1 18.42	120.39	119.41	1.39	7.30	-1.97	-10.92
Savenasterol	4.18	8.68	6.43	3.15	48.98	-4.50	-107.66
Sitosterol	198.71	200.53	199.62	1.29	0.65	-1.82	-0.92
Total	**366.16**	**379.69**					

SD=Standard Deviation;CV=Coefficient of Variation; D=*Daucus carota*; C=*Cucumis sativus*

As plant components, phytosterols (PS) may offer protection against cancer by several different means [48, 49]. These include inhibiting cell division, stimulating tumor cell death and modifying some of the hormones that ae essential to tumor growth [50]. Phytosterols have been useful in treating other conditions, including rheumatoid arthritis, but their widest application is in protecting the heart. However, report also suggests that excessive intake of dietary phytosterols and stanols in plasma and tissues may contribute to the increased blood pressure [51]. Plant sterol has also been described as anti-inflammatory and anti cancer compounds [48]. The CV (%) values ranged from 0.09 in campesterol to 61.84 in cholesterol (Table 4).

Conclusion

The research has focused on the analysis of fatty acid, phospholipid and sterol's compositions of oils extracted from carrot (*Daucus carota* L.) and cucumber (*Cucumis sativus L.*). Thirteen different individual fatty acids were identified with linoleic (54.04 and 57.62%), palmitic (54.04 and 57.62%) and oleic (12.59 and 13.03%) acids predominating in the studied samples. The results showed that the total UFA was higher than the total SFA in *Daucus carota* and *Cucumis sativus*, therefore making the vegetable fats good for human health. The quality parameters such as MUFA/SFA, PUFA/SFA and O/L were all observed to be good. The high contents of linoleic and alpha–linolenic acids (essential fatty acids) make *Daucus carota* and *Cucumis sativus* oils a very nutritious and health enhancing oils. The values recorded for PS (9.99 and 13.77 mg/100 g) in both samples were quite good and can meet up with the US Food and Drug Administration (USFDA)

standards. The contents of phytosterols are so high and very significant that the samples of *Daucus carota* and *Cucumis sativus* may be regarded as better sources of phytosterols when compared with any known plant–based foods.

Conflict of Interest

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

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