Phytochemical Examination and a few botanical attributes of some important vegetables common to South East Nigeria

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ABSTRACT

Scientific studies on Phytochemical examination and botanical attributes of some common vegetable crops of South East Nigeria was carried on between 2017 and 2018. The objective was to ascertain the unique attributes of these species particularly their relevance as herbal remedies. Alkaloids, Flavonoids, cardiac glycosides, Tannin, Phytate, Phenol, Anthocyanins and Steroid concentrations were all determined using procedures like Follins Dennis (1974); Young and Greaves (1940); Gravimetric method (Harbone, 1973); Spectrophotometic methods etcetera. At the end of the studies, it was found out that the dominant phytochemicals found in most of our vegetables include: cardiac glycosides, (194.82) Saponins, (151.80), Tannins (128.52) Flavonoids (112.84) while the least were Phytate, (8.13), Phenol (31.88) and Anthocyanins (31.89). vernonia amygdalina is one vegetable that has the highest phenol (3.421), Saponin (28.00), Cardiac glycoside (23.69) and Phytate (1.27) in this work. Vernonia amygdalina and Ocimum gratissimum had the highest steroid content in this work (5.009 and 5.097) respectively). Also Vernonia amygdalina and Ocimun gratissimun again recorded the highest content of Anthocyanin (3.370 and 3.762) respectively. As far as medicinal relevance is concerned therefore, our lead vegetables should be Vernonia amygdalina, Ocimun gratissimum, Gongronema latifolium and Piper guineense as far as this work is concerned. For Botanical attributes, those of vegetables are not very outstanding unlike Trees and Shrubs. This notwithstanding, most were annual forbs with yellowish flowers. Sustainability is the key in the overall development and utilization of our vegetables!

Key words: Phytochemical, Botanical, attributes, common, vegetables, South East, Nigeria.

1. INTRODUCTION

1.1 Background of Study. According to the Longman Dictionary of Contemporary English, third Edition (2000), vegetables are plants such as cabbage, carrot or potato that are eaten raw or cooked and is not usually sweet. The same dictionary gave some examples of vegetables to include: tomatoes, okra, pepper,

pumpkin, onions, cucumber, eggplant, peas and beans. Vegetables evolved along with man because they often provided the lubricating sauce, soup, thickner and stew with which the staple diets that has sustained civilizations over millennia have been consumed. Without vegetables like tomatoes, onions, okra, pepper, Amaranthus, lettuce, pumpkin etcetera, it would be almost impossible for staple diets like rice, cassava, wheat, oats, yam to be consumed in line with a balanced diet regimen.

1.2. Statement of the Problem. The unprecedented deforestation that is taking place currently in most of the world's terrestrial biomes has not spared even the vegetables most of which are fragile, annual forbs, shrubs and climbers. Land use conflicts, climate change, desertification and the all encompassing point and non-point sources of pollutants impacting the air, soil and water have all negatively affected both the quantity and quality of these indispensable biotic resources. This is very evident in the third world tropical countries with their myriad of socio-economic and leadership problems. In the tropics, most of these vegetables are grown under subsistence agriculture, and storage and preservation technology are few and far between. This prevailing fragile growth form and hostile environment makes these vegetables to be increasingly susceptible to particularly fungal and bacterial diseases that are prevalent in the tropics. The need therefore to quickly and effectively tackle these problems militating against the establishment of vegetables sustainably cannot be overemphasized.

1.3 Significance of the Problem. Without vegetables which are used as salads, soup and stews (sauce), staple foods like rice, wheat, yam, cassava could not be dietically complemented effectively for efficient digestion, assimilation and nutrient absorption. As principal sources of vitamins, minerals and fibres in addition to fruits, lack of dietary vegetables will lead to deficiency diseases like vision impairments, scurvy, and even constipation and hinderance of enzymatic functions. Vegetables also apart from their role as food are highly medicinal, source of income, industrial raw materials (dyes, shelter) purification of the atmosphere, plant and animal habitats, fuel, organic manure and a veritable source of animal fodder.

1.4 Aim of the Study. The aim of this study is to ascertain the potent medicinal components of vegetables and their basics botanical attributes.

1.5 Specific Objectives. The specific objectives of this study include:

1.To determine the phytochemical constituents and ranges, of these vegetables.

2. To identify those characteristics that qualify vegetables to be called plants.

2. Literature Review

Uno et *al.* (2001) in their book, 'Principles of Botany' stated as follows: On average, vegetables and fruits make up about (10 to 20) % of our intake of calories; (7-20)% of our intake of proteins; most of our fiber,

and often, over 80% of many vitamins and minerals, an unimpressive 1% of our intake of fat, and no cholesterol. That is why fruits and vegetables are high on the list when it comes to a good diet-little fat, no cholesterol and lots of important nutrients. Idodo-Umeh (2011) in the book 'College Biology' defined vegetables as, 'Crops whose leaves and fruits are used as vegetables in foods. The crops are rich in vitamins and minerals. Examples are tomato, onion, fluted pumpkin, okro, green (Amaranthus species), lettuce and cabbage'. The Grolier science Encyclopedia (2002) Vol. 3 (Human body) contributed in this wise, 'fresh fruit and vegetables provide vitamins and minerals which are essential for good health and fibre (roughage) and keeps the digestive system working properly. Cunningham and Cunningham (2006) stated that, 'fruits and vegetables - including vegetable oils-make a surprisingly large contribution to human diets. They are especially welcome because they typically contain high levels of vitamins, minerals, dietary fibre, and complex carbohydrates. They contributed further thus, 'fruits, vegetables, whole grains, complex carbohydrates, and dietary fibre (plant cell walls), on the other hand, often have beneficial health effects. Certain dietary components-such as proteins; vitamins A, C, and E; substances produced in cruciferous vegetables (cabbage, broccoli, cauliflower, Brussels sprouts); and selenium, which we get from plants- seem to have anticancer effects. Diet also has an important effect on health. For instance, there is a strong correlation between cardiovascular disease and the amount of salt and saturated fat in one's diet. Lack of physical activity and poor diet are now the second leading causes of preventable death (after smoking) in the United States. Highly processed foods, fat and smoke-cured, high nitrate meats also seem to be associated with cancer'. According to Sarumi et *al.* (1996), 'The use of herbs by the natives as anti-malaria drugs, anti cancer, flavouring and sweetening agents, cardiovascular and nervous systems, proteolytic ferments, steroidal alkaloids, and other ailments have been discussed (Gbile 1985; Gbile, Soladoye and Adesina 1989), Gbile (1987) among others identified *Euphorbia hirta* used for diarrhea, *Cassia alata* as purgative, Talinum to prevent abortion, flowers of *Ageratum conyzoides* pounded with local soap for sickle cell anemia and the latex of *Ficus exasperata* for boils. In ethnomedicine leaves of *Vernonia amygdalina* taken as vegetable are recommended as antihypertensive. The leaves of *Persea americana*, *Ocimum gratissimum, ficus platyphilla, Parkia biglobosa, Vitellaria paradoxa, Morinda lucida, Allium sativum* to mention but a few, are of great medicinal value. For anti-diabetic Pourat (1977), identified *Valcinium myrtrillis* leaves, *Adansonia digitata* and *Gladiolus psittacinus* as anti-asthmatic.

3. Materials and Methods

Phytochemical Examination

Alkaloids Determination: Five grams (5g) of the sample was weighed into a 250ml beaker and 200ml of 20% acetic acid in ethanol was added and covered and allowed to stand for 4 hours at 250c. This was filtered with filter paper No. 42 and the filtrate was concentrated using a water bath (Memmert) to one quarter of the original volume. Concentrated ammonium hydroxide was added drop wise to the extract until the precipitate was complete. The whole solution was allowed to settle and the precipitate was collected and washed with dilute NH_4OH (1 % ammonia solution). Then, filter with pre-weighed filter paper. The residue on the filter paper is the alkaloid, which is dried in the oven (precision electrothermal model BNP 90S2 England) at 80°c. The alkaloid content was calculated and expressed as a percentage of the weight of the sample analyzed (Harbome, 1993; Obadoni and Ochuka, 2001).

Calculation:

$$\% \text{ weight of alkaloid} = \frac{\text{weight of filter paper with residue - weight of filter paper}}{\text{Weight of sample analyzed}} \times 100$$

Flavonoids Determination. 10g of the plant sample was extracted repeatedly with 100ml of 80% aqueous methanol at room temperature. The whole solution was filtered through whatmann filter paper No. 42 (125mm). The filtrate .was later transferred into a crucible and evaporated into dryness over a waterbath and weighed to a constant weight (Boham and Kocipai, 1994)

Calculation:

$$\% \text{ Flavonoids} = \frac{(\text{weight of crucible + residue}) - (\text{weight of crucible}) \times 100}{\text{Weight of sample analyzed}}$$

Determination of Saponin. Exactly 5g of the sample was put into 20% acetic acid in ethanol and allowed to stand in a waterbath at 50^0c for 24hollrs. This was filtered and the extract was concentrated using a waterbath to one-quarter of the original volume. Concentrated NH_4OH was added drop-wise to the extract until the precipitate was complete. The whole solution was allowed to settle and the precipitate was collected by filtration and weighed. The saponin content was weighed and calculated in percentage (Obadoni and Ochuko, 2001).

Calculation:

$$\% \text{ saponin content} = \frac{(\text{weight of filter paper + residue}) - (\text{weight of filter paper})}{\text{Weight of sample analyzed}} \times 100$$

Cardiac Glycosides Determination. Wang and Filled method was used. To 1ml of extract was added 1ml of 2% solution of 3,5-DNS (Dinitro Salicylic acid) in methanol and 1ml of 5% aqueous NaOH. It was boiled for 2 minutes. (until brick-red precipitate was observed) and the boiled sample was filtered. The weight of the filter paper was weighed before filtration. The filter paper with the absorbed residue was dried in an oven at 50^0c till dryness and weight of the filter paper with residue was noted.

The cardiac glycoside was calculated in %.

Calculation:

$$\% \text{ cardiac glycoside} = \frac{(\text{weight of filter paper + residue}) - (\text{weight of filter paper})}{\text{Weight of sample analyzed}} \times 100$$

Tannin Determination by Follins dennis Titration. The follinsdennis titrating method as described by pearson (1974) was used. To 20g of the crushed sample in a conical flask was added 100ml of petroleum ether and covered for 24 hours. The sample was then filtered and allowed to stand for 15 minutes allowing petroleum ether to evaporate. It was then re-extracted by soaking in 100, of 10% acetic acid in ethanol for 4hrs. The sample was then filtered and the filter ate collected. 25ml NH_4OH were added to the filter ate to precipitate the alkaloids. The alkaloids were heated with electric hot plate to remove some of the NH_4OH still in solution. The remaining volume was measured to be 33ml. 5ml of this was taken and 20ml of ethanol was added to it. It was titrated wit h 01M NaOH using phenolphthalyneasndicator until pink end point is reached. Tannin content was then calculated in % ($C_1V_1 = C_2V_2$) molarity.

Calculation

Data

C_r= conc. Of Tannic Acid

C_2 = conc. Of Base

V_1 = Volume of Tannic acid

V_2 = Volume of Base

Therefore $C_1 = \frac{C_2V_2}{1}$

$$\% \text{ of tannic acid content} = \frac{C_1 \times 100}{\text{Weight of sample analyzed}}$$

Phytate Determination. Phytate contents were determined using the method of Young and Greaves (1940) as adopted by lucasMarkakes (1975). 0.2g of each of the differently processed corns was weighed into different 250ml conical flasks. Each sample was soaked in 100ml of 2% concentrated HCL for 3hr, the sample

was then filtered. 50ml of each filtrate was added in 250ml beaker and 100ml distilled water added to each sample. 10ml of 0.3% ammonium thiocynate solution was added as indicator and titrated with standard iron (111) chloride solution which contained 0.00195g iron per 1ml.

Phytic acid = $\frac{\text{Titre, value x 0.00195 x 1. 19}}{\text{Wt of sample}}$ x 100

Phenol Determination: The quantity of phenol is determined using the spectrophotometer method. The plant sample is boiled with 50ml $(CH_3CH_2)_20$ for 15min. 5ml of the boiled sample is then pipette into 50ml flask, and 10ml of distilled water is added. After the addition of distilled water, 2ml of NH_40H solution and 5ml of concentrated $CH_3(CH_2)_3CH_2OH$ is added to the mixture. The samples is made up to the mark and left for 30min to react for colour development and measured at 505nm wavelength using spectrophotometer.

Determination of Anthocynanin in the water of life using the gravimetric method of Harborne , 1973

Principle. Acid hydrolysed sample when filtered reacts with ethyl acetate to enable extraction of anthocyanin. Upon addition of amyl alcohol, anthocyanin was extracted and after drying, the percent composition was determined in relation to weight of original sample gravimetrically.

Procedure. 5.0g of the powdered sample (water of life) was boiled in 100ml of 2MHCl for 30minutes. The hydrolysate was filtered using whatmann filter paper. The filterate was transferred into separation funnel and equal volume of ethylacetate added, mixed and allowed to separate into two layers. The ethylacetate layer was recovered while the aqeous layer was discarded. The extract was dried over a steam bath. The dry extract was then treated with 50ml of concAmylalcohol to extract the anthocyanin. After filtration, the alcohol extract was dried. The weight of anthocyanin was determined and expressed as percentage of original sample.

Calculation (g(%) = $\frac{\text{weight of Anthocyanin}}{\text{Wt of original sample}}$ x 100

Determination of steroid content. 1.0g of the powdered sample was weighed and mixed in 100ml of distilled water in a conical flask. The mixture was filtered and the filtrate eluted with 0.1N ammonium hydroxide solution. 2ml of the eluent was put in a test tube and mixed with 2ml of chloroform. 3ml of ice cold acetic anhydride was added to the mixture in the flask. 2 drops of (200mg/dl) standard sterol. Solution was prepared and treated as described for test as blank. The absorbance of standard and test was measured, zeroing the spectrophotometer with blank at 420mm.

Calculation (mg/100ml) $\frac{\text{Absorbance of test}}{\text{Absorbance of Std}}$ x Conc. Of std.

4. RESULTS

Table 1. Phytochemical Examination of some important vegetables common to South East Nigeria

S/N	Scientific Name	Local Name	Common Name	Alkaloid	Phenol	Saponin	Tannin	Cardiac Glycosides	Steroid	Phytate	Anthocyanin	Flavonoid
1	Vernonia amygdalina	Onugbu	Bitterleaf	2.073	3.421	28.00	10.79	23.69	5.009	1.127	3.370	10.76
2	Solanum melongena	Anara	Egg plant	3.610	2.318	15.13	9.72	14.76	4.021	0.902	3.300	4.273
3	Gongronema Latifolium	Utazi		8.761	3.069	16.31	9.32	17.11	2.857	0.591	2.670	8.496
4	Talinum Triangulare	Gbolodi	Waterleaf	6.103	2.020	8.72	14.93	15.53	3.228	0.528	3.298	8.393
5	Ocimum gratissimum	Nchuanwu	Scent leaf	6.335	1.633	12.21	9.42	17.29	5.097	0.944	3.762	12.92
6	Piper guineense	Uziza	Hot leaf	8.503	2.730	10.30	11.12	15.98	4.039	0.472	2.350	12.75
7	Telfeiria occidentalis	Ugu		6.716	2.837	9.84	11.48	16.60	3.122	0.524	2.185	12.25
8	Murraya Koenigii		Curry leaf	3.309	2.730	4.128	14.95	2.97	3.139	0.7053	2.474	8.030
9	Pterocarpus soyaxica	Oha		2.766	2.777	12.95	7.94	19.39	3.333	0.816	2.894	8.960
10	Pterocarpus santalinoides	Nturukpa		5.209	3.421	14.00	8.05	21.98	2.963	0.808	1.838	10.73
11	Amaranthus viridis	Inine	Green Amaranthus	6.065	2.902	14.11	11.23	20.61	3.704	0.7046	2.825	8.912
12	Corchorus olitorius	Keren Keren		4.317	2.020	6.100	9.57	8.91	3.686	0.607	1.927	6.367
		TOTAL		63.767	31.878	151.798	128.52	194.82	44.198	8.729	32.893	112.841

From table 1 above, the Phytochemical that was in highest concentration in these vegetables include: Cardiac glycosides, (194.82), Saponin, (151.80), Tannin (128.52) and Flavonoids (112.84) in that order while the least available were phytate, (8.73) phenol (31.88), anthocyanins, (32.89) Steroid (44.20) and alkaloids (63.77) in this order. *Gongronema lalifolium* and *Piper guineense* (8.503) had the highest alkaloid content, while *Vernonia amygdalina* (2.073) and *Pterocarpus* soyaxica (2.766) had the least; *Vernonia amygdalina* and *Pterocarpus santalinoides* jointly (3.421) had the highest phenol content, while *Ocimum gratissimum* (1.633), *Corchorus olitorius* and *Talinum triangulare* had the least; *Vernonia amygdalina* had the highest saponin content (28.00), while Murraya koenigii had the least (4.128); *Murraya koenigii*, (14.95) *and Talinum triangulare* (14.93) had the highest *Tannin* content, while *Pterocarpus soyaxica* (7.94) had the least. *Vernonia amygdalina* had the highest cardiac glycoside content (23.69), while *Murraya koenigii* had the least (2.97). *Ocimum gratissimum* had the highest steroid content (5.097), while *Gongronema latifolium* had the least (2.857). *Vernonia amygdalina* had the highest phytate content (1.127), while piper guineense had the least (0.472). *Ocimum gratissimum* had the highest Anthocyanin content (3.762), while *Pterocarpus santalinoides* had the least content (1.838). *Ocimum gratissimum* had the highest Flavonoid content (12.92), while *Corchorus olitorius* had the least (6.367).

Table 2 Botanical attributes of some important vegetables common to South East Nigeria

S/n	Botanical Name	Colour	Local name	Family	Growth form	Habit	Common name others
1	Telfeiria occidentalis	Creamy white	Ugu	Cucurbitaceae	Climber	Annual	
2	Amaranthus viridis	Yellowish Green	Inine	Amaranthaceae	Forb	Annual	Amaranth
3	Solanum melongena		Anara	Solanacea	Forb	Annual	Egg plant
4	Ocimum gratissimum	Yellowish green	Nchuanwu	Lamiaceae	Shrub	Perennial	Sweet basil
5	Vernonia amygdalina	White	Onugbu	Asteraceae	Shrub	Perennial	Bitter leaf
6	Murraya koenigii	White		Rutaceae	Forb	Annual	Curry leaf
7	Corchorus olitorius	Yellow	Keren- keren	Tiliaceae	Forb	Annual	Ewedu
8	Talinum triangulare	Pink	Gbolodi	Portulacaceae	Forb	Annual	Water leaf
9	Gongronema latifolium	Cream coloured	Utazi	Asclepiadaceae	Climber		
10	Piper guineense	Greenish	Uziza	Piperaceae	Climber	Annual	Hot leaf
11	Solanum lycopersicum	Yellow		Solanacea	Forb	Annual	Tomatoes
12	Abelmoscus esculentum	Purple	Okwuru	Malvaceae	Forb	Annual	Okra
13	Cucumis pepo	Yellow	Anyu (Ugboguru)	Cururbitaceae	Trailer	Annual	Pumpkin
14	Capsicum annum		Ose	Solanaceae	Forb	Annual	Chillies
15	Pterocarpus soyaxica	Yellow	Oha	Fabaceae	Tree	Perennial	
16	Asclepsias lineolata	Green	Okazi	Asclepiadaceae	Climber	Annual	
17	Pterocarpus santalinoides		Nturukpa	Fabaceae	Tree	Perennial	
18	Pennisetum purpureum	Yellow	Achara	Poaceae	Grass	Perennial	
19	Gnetum africanum		Afang	Gnetaceae	Climber	perennial	

From table 2 above, out of about 16 vegetable species, the most, commonly occurring families were *Solanaceae, Cucurbitaceae* and *Asclepiadacea*; forbs were the dominant growth form (nine out of sixteen), most were annual plants, others were climbers and trailers. Only three perennial species were encountered- the most remarkable being *Pterocarpus* the two members of the Genus which were the only tree specie encountered and as such had the highest Economic relevance.

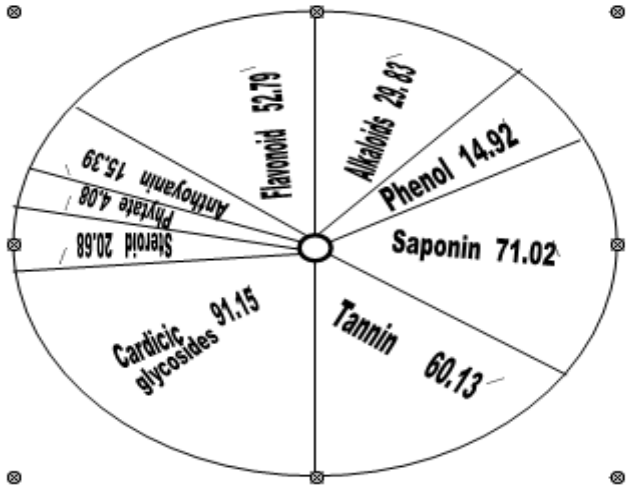

Fig. 1. Pie-Chart depicting levels (concs) of phytochemicals in some important vegetables common to South East Nigeria.

From fig 1. We can see that the most abundant phytochemicals present in our common vegetables occur in the following order: Cardiac glycosides (91.15/), Saponin (71.02/), Tannins (60.13/), Flavonoid (52.79/), Alkaloids (29.83/), Steroids (20.68/), Anthocyanins (15.39/), Phenols (14.92/) and Phytate (4.08/).

5. DISCUSSION

Alkaloids which are found in many organisms are a major plant indicator of vital pharmacological relevance. Plants that contain high levels of alkaloids have proved very relevant in both orthodox and unorthodox medical therapeutics. From this work, *Gongronema lalifolium* (Utazi) (8.761) and *Piper guineense* (Uziza) (8.503) had the highest, content. Little wonder they are indispensable in the diet of nursing convalescing mothers. Phenols are useful oxidants, a weak acid though they are useful in body metabolism. *Vernonia amygdalina* (3.421) and *Pterocarpus santalinoides* (3.421) had the highest content of phenols from this work. *Vernonia amygadalina* particularly has been very useful as a herbal remedy for many diseases particularly diabetes. These bitter tasting vegetables, *Gongronema*, Piper and *Vernonia* are very repugnant to bacterial and other pathogens that thrive on sweet substrates. Using them as chewing stick; mouth wash, keeps the mouth, teeth and tongue, clean, fresh and healthy. Saponins which are found in many plants as their name implies ought to be very useful in fat and carbohydrate metabolism and from this work *Vernonia amygdalina* also has the highest concentration of 28.00. Whereas saponins bind fats, tannins bind proteins and certain unpalatable substances, inherent in tannis and alkaloids make them unacceptable to foreign invaders that attack the body. Vegetables with the highest content of tannin in this work include *Murraya*

koenigii (14.95) and *Talinum triangulare* (14.93). Glycosides play a versatile role in human metabolism found in many plants as inactive chemicals, they can be brought to enzymatic activity as a result of their glycosidic bonding to sugar moeties. Cardiac glycosides particularly have proved very useful in the treatment of heart disease and in animal control studies.

Vernonia amygdalina in this work also recorded the highest cardicic glycoside content of 23.69. Steroid containing substances are utilized therapeutically to treat injuries and as performance enhancers in sports and other activities. *Ocimum gratissimum* (5.097) and Vernonia amygdalina (5.009) had the highest content of steroids. Phytates which are readily available in plants contains phosphorus- a plant growth limiting nutrient. They bind minerals in digestion and regulates their absorption and utilization. They are therefore important in enzymatic, co-enzymatic function and in phytoremediation. *Vernonia amygdalina* again recorded the highest phytate content from this work (1.127). Plant pigments like chlorophyll, *xanthophyls* and *carotenoids* help the plant harness solar energy for photosynthesis. *Anthocyanin*, another light stimulated plant pigment imbues colouration to plants and plant-parts. From this work, *Ocimum, Vernonia, Solanum* and *Talinum* recorded the highest *anthocyamin* content. Little wonder Solanum species are typically multi-coloured particularly the fruits. Flavonoids play an indispensable, multifaceted role in plants and other organisms. Preponderant in plants, they are useful in disease control and as food supplement. Encountered vegetables with the highest content in this work include: *Ocimum gratissimum* (12.92), *Piper guineense* (12.75) and *Telfeiria occidentalis* (12.25). From table 2, the dominant vegetable family is *Solanaceae* with three (3) examples, followed by *Cucurbitaceae*, (2), *Fabaceae* (2) and *Asclepiadaceae* (2). From our phyrochemical result of table 1, the lead vegetables belong to the following families. *Asteraceae, lamiaceae, Asclepiadaceae* and *Piperaceae* in that order. One wonders why many of our edible vegetables bear yellow flowers?

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