



A Review on the Economic Uses of Species of Cucurbitaceae and Their Sustainability in Nigeria

Mercy Ajuru^{1,*}, Felicia Nmom²

¹Department of Plant Science and Biotechnology, Faculty of Science, Rivers State University of Science and Technology, Nkpolu-Oroworukwo, Nigeria

²Ndele Campus, Ignatius Ajuru University of Education, Port Harcourt, Nigeria

Email address:

ajurumercygospel@yahoo.com (M. Ajuru)

*Corresponding author

To cite this article:

Mercy Ajuru, Felicia Nmom. A Review on the Economic Uses of Species of Cucurbitaceae and Their Sustainability in Nigeria. *American Journal of Plant Biology*. Vol. 2, No. 1, 2017, pp. 17-24. doi: 10.11648/j.ajpb.20170201.14

Received: October 30, 2016; **Accepted:** November 25, 2016; **Published:** January 6, 2017

Abstract: The Cucurbitaceae family commonly known as the gourd family is an excellent example of a plant family with many economically useful species. They are native in most countries of the world, especially in the tropics, where they are cultivated in every country, state, and province. The Cucurbitaceae consists of many important food plants such as melon, pumpkin, squash, cucumber; useful plants for the production of items of utility such as bottle gourds, loofah, ornamental gourds, etc. Some species, example, bitter melon, cucumber, musk melon, etc are considered to have medicinal properties due to the presence of cucurbitacins, etc. Others such as *Luffa*, *Cucurbita*, etc are used as complementary dietary ingredient of feed for poultry and increasingly as a protein and vitamin supplement to aqua feeds. Members of this family such as *Momordica*, *Cucurbita*, *Cucumis* etc are also used as remedies for livestock. In addition, seed oil of melon is a source of biodiesel. This article briefly reviews the nutritional, medicinal, ethnoveterinary and ethnomedicinal value of these plants, as well as their uses as items of utility, complementary dietary ingredient for poultry and aquafeed and as a source of biodiesel. This is an attempt to compile and document information on the different uses of these plants and to recommend that increased in production of these plants will be profitable and will contribute to food security and livelihood sustainability in Nigeria.

Keywords: Food Plants, Medicinal Plants, Ornamental Gourds, *Cucurbita*, *Momordica*, Poultry Feed

1. Introduction

The family Cucurbitaceae is an interesting and an unusual family of dicotyledons. It is a medium sized family consisting of about 120 genera and more than 800 species distributed predominantly in the tropical and subtropical regions of the New and Old world [1]. But in Nigeria, it is represented by 21 genera and 41 species [2]. The plants of the family are collectively known as cucurbits [3].

The Cucurbits are characterized by a very extensive root system which ramifies in the surface soil. They have hollow angled stems which may be glabrous, hairy or prickly, and their vascular bundles are bicollateral [4, 5]. The stems may reach great lengths, either trailing along the ground or climbing supports with their tendrils.

The leaves are large, simple but often deeply lobed, alternate or spirally arranged on long petioles. In each leaf

axil, there is a flower bud, a vegetative bud and a tendril [6].

The plants are monoecious or dioecious with unisexual flowers occurring singly in the leaf axils. The hairy calyx-tube is divided into five lobes at the top, and the corolla has five petals which are fused. In female flowers, the inferior ovary consists of three united carpels with numerous ovules carried in three thick, fleshy, apparently parietal placentas. The fruits are large and fleshy, usually with a hard outer covering, a special type of berry called pepo. The seeds which are fairly flat are attached to the ovary wall in a parietal placentation,

Cucurbitaceae is of high economic value being a major source of food for man. Many species of *Cucurbita* (pumpkins, squashes, gourds, marrows, courgettes), *Cucumis* (melons, cucumbers), *Cucumeropsis manni* Naud. (egusi), *Colocynthis* (water melon) and *Sechium edule* (Jacq.) Sw. (*cho-cho*) are cultivated for edible purposes [7]. Others such

as *Lagenaria siceraria* (Molina) Standl. (calabash, bottle gourd) and *Luffa cylindrical* (L.) Rem. (loofah) are cultivated for making items of utility such as drinking vessels, cooking pots, utensils, bath sponge, in industrial filters and in sound insulation. Other important genera of the family are *Trichosanthes*, *Benincasa*, *Mormodica*, *Citrullus*, *Bryonopsis* and *Corallocarpus*. Members of the family contain cucurbitacins, which are bitter and highly medicinal.

2. Cucurbits as Food Plants

Benincasa hispida (Thunb.) Cogn., winter melon or wax gourd, was one of two cucurbit species identified as being an underexploited tropical. This plant exhibits relatively rapid growth and grows best in temperate climates with adequate but not excessive rainfall. Plants may be grown recumbent or trellised. The primary harvested plant part is the mature fruit, although seeds are sometimes extracted, fried, and eaten like pumpkin seeds. The white, chalky wax which covers the fruit deters microorganisms and helps impart an extraordinary longevity to the melon. Winter melon fruits can be stored for as long as a year without refrigeration. The flesh is often used to make soup stock.

Citrullus colocynthis (L.) Schrad., egusi, is native to tropical Africa and highly drought tolerant. A relative of watermelon, productivity is enhanced during dry, sunny periods and reduced during periods of excessive rainfall and high humidity. They can contribute substantially towards obtaining a balanced diet [8]. The seeds are edible and can be removed and roasted as an edible commodity, but the fruits are extremely bitter. Egusi seeds can be ground into a powder and used as a soup thickener or flavouring agent. Oil from the seeds can be extracted for cooking purposes [9].

Coccinia cordifolia Cogn., Ivy gourd, is a semi-perennial which grows best under conditions of adequate rainfall and high humidity. It produces best when a 1:10 ratio of male to females is used. Plants are commonly trellised. The leaves, shoots, and immature fruits are cooked and eaten, while the mature fruits are sometimes preserved.

Lagenaria siceraria (Molina) Standl., the bottle gourd, is said to have originated in Africa, although archaeological evidence indicate its origin in Peru, Thailand, and in Zambia. Young fruits are cooked as vegetable similar to Zucchini. Young shoots and leaves can be cooked, and seeds can be used in soups. Flesh of immature fruits can also be used in making icing for cakes, and the hard skin is sometimes sliced into thin, dry strips for cooking.

Luffa acutangula (L.) Roxb., the angled or towel loofah is commonly grown in hot, humid tropical areas in Asia. Plants are generally grown on a trellis. Immature fruits, which are dark green with tender ridges, are used in soups and curries or as a cooked vegetable. The flesh is spongy although the skin is coarse.

Luffa aegyptiaca Muell., the smooth loofah, along with *L. siceraria*, has the most diverse uses of any of the cultivated cucurbits. Immature fruits of the non-bitter genotypes are eaten fresh, cooked, or in soups, although they are inferior to

immature *L. acutangula* fruits.

Momordica charantia L., the bitter melon, is adapted to a wide variation of climates, although production is best in hot, humid areas such as tropical Asia. To remove some of the bitterness, the bitter immature fruits are usually soaked then boiled or fried. Volatile components released during cooking enhance the flavour. Compared to other cucurbits, the fruit is highly nutritious due to the iron and ascorbic acid content. Plants are usually trellised, and fruits are protected from flies by tying a paper cylinder around the stalk. Some forms have bright red seeds due to high lycopene content.

Praecitrullus fistulosus (Stocks.) Pang., the round melon, primarily grown in India, was long considered to be *Citrullus lanatus* but was recently given its own taxonomic category due in part to its difference in monoploid chromosome number. Growth conditions and requirements are similar to those of watermelon, but the entire immature fruit is used as a cooked vegetable. The seeds can also be removed and eaten.

Telfairia occidentalis Hook. f., the fluted pumpkin, a dioecious perennial, grown at elevations up to 2,000 m in West Africa, is drought tolerant and is usually trellised. Shoots from the female plants can be cooked and eaten. The fruits are large (up to 13kg) and inedible, but the seeds contain up to 30% protein and can be boiled and eaten, or ground into powder for soup. Seeds can also be fermented for several days and eaten as slurry.

Trichosanthes cucumerina Linn., the snake melon, is an annual which requires high levels of soil moisture and trellising and a long growing season. Immature fruits are boiled and eaten, while mature fruits are used in soups.

Cucurbita ficifolia Bouche., the malabar gourd grows in temperate highlands at elevations up to 2,000 m. The immature fruits can be prepared and eaten similar to summer squash. Mature fruits can be preserved, and the black seeds are edible. In Latin America, the flesh is impregnated with sugar to make a candy or it can be fermented to make beer [10].

Cyclanthera pedata Schrad., the wild cucumber, is relatively cold tolerant and adapted to elevations up to 2,000 m, but is also easy to cultivate in the tropics and subtropics. The seed cavity is spongy, and the seeds are attached to a single placenta. Seeds are usually removed and the fruits are eaten raw or cooked. They are often used stuffed with meat, fish or cheese, then baked and eaten similar to stuffed peppers. The shoots are also edible.

Sechium edule (Jacq.) Sw., chayote or cho-cho, is still one of the most widely cultivated of the cucurbits in Costa Rica. Unlike other cucurbits, the fruit contain only a single, large seed. The immature fruits can be eaten raw in salads and provide a good source of vitamin C. They can also be boiled, fried, steamed, or stuffed and baked. Young leaves and tendrils are also eaten. The large storage roots represent a rich source of starch.

The watermelon, *Citrullus lanatus* (Thunb.) Mansf. like other Cucurbits, are warm-season annuals having long, prostrate vine growth; the vines readily attain lengths of more

than 6 meters (20ft).

Seeds are roasted and ground into tamma meal, a nutritious food with a pleasant nutty taste. Leaves and young fruits are utilized as green vegetables [11]. The peels of the fruit are traditionally used for making jam. Watermelon is an excellent source of vitamin C and vitamin A. Watermelon seeds are rich in fat and protein, and are widely eaten as a snack, added to other dishes, or used as on oilseed.

The highly nutritious seeds of egusi watermelon, after delectations and powdering, are added to enrich and thicken soups [12]. The seeds may be fermented after soaking in water, boiled and further blackened with charcoal and wrapped up in leaves of *Newbouldia laevis* (P. Beauv.) Seeman ex Bureau, *Alchornea cordifolia* (Schum. and Thonn.) Stapf. or banana to form ogiri-isi, a food seasoner used in preparing certain kinds of soup or pottage [13]. The seeds may also be roasted along with peanuts (*Arachis hypogaea* L.) and pepper (*Capsicum spp.*), with or without dried shrimp and ground into a fine, oily paste, ose-oji, for use in eating Oji (Kolanuts) and/or fruits of eggplant (*Solanum melongena* L.). The ground seeds of egusi melon are used in making a type of bread.

Cucumis sativus L., cucumber, are 96 percent water, with a little fiber and only a few calories. In addition, it provides a good source of vitamins A, K, and C, as well as a large amount of potassium.

Cucumis melo L., cantaloupe, honey dew or muskmelon is a 'fruit' rather than a vegetable; the sweet, delicately flavored, juicy flesh of the pepo is eaten raw, often as a dessert. The species is variable with a considerable range of fruit types, many of them highly esteemed for their delicious flavor.

Immature melons are used fresh in salads, cooked or pickled; they are also stuffed with meat, rice and spices, and fried in oil. Mature fruits are eaten fresh as a dessert fruit, canned or used for syrup or jam.

The white-seeded melon, *Cucumeropsis mannii* Naud. (Syn. *C. edulis* (Hooker f.) Cogn.) is a species of melon which is native to tropical Africa west of the Great Rift Valley. This monoecious plant is grown for food and as a source of oil. Its common names include egusi in Yoruba and agushi in Hausa. In English it is known as Mann's cucumeropsis and white-seed melon [14].

The seeds are edible and oily and used like the seeds of *Citrullus lanatus*. They are ground into a vegetable paste and used in soups, sauces and cakes. It is also used for cooking oil. In some parts of Eastern Nigeria, the leaves of *Cucumeropsis mannii* or those of pumpkin, *Cucurbita moschata* (Duch. ex Lam.) Duch. ex Poiret, are wrapped around fresh corn meal and winged termites, cooked and then eaten as a delicacy, mostly by women and children [15].

C. moschata (Duch ex Lam.) Duch. ex Poiret., the squash melon, which encompasses various cultivars of pumpkin and winter squash, is cultivated in warm areas around the world as food and animal fodder. Popular cultivars include butternut, winter crookneck, and cushaw, and numerous types developed in Japan and China. The names "winter

squash" and "pumpkin" are also applied to the cultivars of *C. maxima* (Duch ex Lam.) Dutch ex Poiret, *C. mixta* Pang., and *C. pepo* L. The flowers, young stems and young and ripe fruits are eaten as a vegetable. The latter are also commonly used to prepare sweets and as fodder. The seeds are eaten whole, roasted or toasted and are ground into different stews. They have high oil and protein contents and their consumption in urban areas is also fairly common.

Pumpkins provide a number of beneficial nutrients and minerals. They contain high levels of thiamin, niacin, vitamin B6, iron, magnesium and phosphorus. They have even higher levels of vitamin C, vitamin E, potassium, copper and manganese. The flesh is a good source of dietary fiber. They are also low in saturated fat, cholesterol, and sodium. Pumpkins contain a very large amount of vitamin A, with one hundred grams of pumpkin flesh providing 148% of the percent Daily value for the average diet. Though the seeds of pumpkin possess more fat, they make up for it with high levels of protein, magnesium and zinc.

The young shoots and leaves of the female plant species of *Telfairia occidentalis* are the main ingredients of a Nigerian soup, Edikan ikong. The large, dark-red seed is rich in fat and protein and can be eaten whole, ground into powder for a kind of soup, or made into a fermented porridge.

3. Cucurbits for Ethnomedicinal Purposes

[16] reported that whole plant of *Momordica charantia* (Bitter gourd/bitter melon) is used in the treatment of malaria in the south-western regions of Nigeria. The plant is reported to possess antifungal, anti-inflammatory, anti-parasitic, antiseptic properties, and act as a digestive stimulant, febrifuge, lactagogue, menstrual stimulator, purgative, vermifuge, and used in wound healing [17-19].

Generally, the fruits are used for the treatment of lots of ailments such as malaria, cholera, anaemia, jaundice, etc; they possess antiemetic, purgative, anthelmintic, and carminative properties [20]. In Turkish traditional medicine, mature fruits are used for rapid wound healing and for the treatment of peptic ulcers while the immature fruits are used for the treatment of diabetes [21].

Species of the Cucurbitaceae family contain a phytochemical of great interest due to its wide range of biological activities in plants and animals. This highly bitter and toxic substance is called cucurbitacins. As a result of this, there has been a lot of researches on the species of this family [22], and plant species containing cucurbitacins are good candidates in various pharmacopoeias [23].

Various parts of the plant species, *Cucurbita pepo* (Pumpkin) is used in ethnomedicine. The fruits have astringent effect on the bowels. It is also employed in the purification of blood and the treatment of leprosy in humans. The seeds are useful in the treatment of sore chests, fever, haemoptysis, and bronchitis. In addition, it is reported that they are applied in the case of benign prostatic hyperplasia

and possess anti ulcer cucurbitane type triterpenoid [24, 25].

A specific amino acid known as cucurbitin, represented as (-)-3-amino-3-carboxypyrrolidine, is present in varying levels in different varieties of pumpkin and squash and as a result, their seeds are used for the elimination of tapeworms and roundworms which are intestinal parasites and treatment of enlarged prostate glands in men.

The fruits of *Cucurbita ficifolia* (Leaf gourd) are currently employed in the treatment of diabetes type 2 [26, 27]. Other uses include wound healing, treatment of fever and hemorrhoids.

Cucumis sativus (Cucumber) leaves contain isovitexin, saponin and various acylated flavone C-glycosides [28]. The fruit is demulcent; seeds have cooling effect, and is taken as a tonic, with diuretic and anthelmintic properties.

- The fruit of *Cucumis melo* (Musk melon) has diuretic and diaphoretic properties and is taken as a tonic, laxative and galactagogue and also used in the treatment of chronic eczema [29].

Report indicated that the aqueous extracts of the vegetative and reproductive organs of *Citrullus colocynthis* (Bitter apple) possess analgesic, anti-inflammatory, antipyretic, anthelmintic, carminative, and cathartic activities [30]. The bitter and acrid fruits have cooling effects and are used in the treatment of hypoglycemia, tumors, leucoderma, ulcers, asthma, bronchitis and constipation. This species contains cucurbitacins A, B, C, and D, ∞ -elaterin and various other constituents [31].

- *Luffa echinata* Roxb. (Bitter sponge gourd) has been recommended for the treatment of liver ailments. It is reported to contain echinatin, saponins, cucurbitacin B and E, β -sitosterol, echinatosol A and B, oleanolic acid [32].

Trichosanthes kirilowii Maxim. (Chinese cucumber) seeds are anti-inflammatory agent, a cough medicine and an expectorant. Several multiflorane triterpenoids including karounidiol and its 3-O-benzoate derivative have been isolated from the seed extract, and are expected to be potential anti-tumor promoters [33].

Whole plant of *Trichosanthes cucumerina* (Snake gourd) have medicinal properties. The root is used as a cure for bronchitis, headache and boils. A combination of the root and fruit are considered to be cathartic. Studies have shown the presence of anti-inflammatory activity in root tubers and antidiabetic activity in seeds [34].

Trichosanthes tricuspidata Lour. (Indrayan) plant is used as a laxative, anthelmintic and in the treatment of migraine. The root extract has shown antioxidant effect in Sildenafil induced migraine in albino mice [35].

Sechium edule (Chayote) is used in the treatment of kidney related diseases, circulatory system and inflammation. The antihypertensive effect of *S. edule* has been described [36]. The extract is capable of altering the bio-distribution of sodium pertechnetate in rats [37].

Lagenaria siceraria (Bottle gourd) is used in the treatment of pain, ulcers, fever, pectoral cough, asthma and other bronchial disorders, especially syrup prepared from the

tender fruits. The fruits have protective effects in myocardial infarction [38].

Benincasa hispida (Wax gourd) is recommended for peptic ulcer, hemorrhages from internal organs, asthma, cough, diabetes, epilepsy and other nervous disorders. Acid neutralizing and ulcer healing activities of this plant have also been described. Effect of *B. hispida* on high glucose-induced vascular inflammation of human umbilical vein endothelial cells has been studied [39]. Seeds possess free radical scavenging, anti-inflammatory and analgesic potential [40].

In Ghana, the fruit juice of *Cucumeropsis mannii* mixed with other ingredients is applied to the navel of newborn babies to accelerate the healing process until the cord-relies drop off. Macerated leaves are used in Gabon for purging constipated suckling babies. In Sierra Leone, cattle boys traditionally use the dried fruit-shell of an egusi-itoo type with small elongated fruits as a warning horn.

The fluted gourd of *Telfairia occidentalis* has high protein content and has been traditionally used by indigenous tribes as a blood tonic [41]. The plant can also be used to treat sudden attack of convulsion, malaria, and anaemia; it also plays a vital and protective role in cardiovascular diseases.

4. Cucurbits as Items of Utility and Cosmetics

Lagenaria siceraria fruit comes in a variety of shapes and sizes. In Nigeria, the fruits are used for various purposes. Medium-sized calabashes are used for the production of ladles, boxes, water jugs, planters, flutes, sitars, and other musical instruments. Various objects such as shells, bones, beads or metals are attached around carved gourds to form rattles. The dry rinds are employed as containers for palm wine, water, and floats by fishermen for fishnets and rafts, gun powder and seeds. [42] reported the use of gourds as receptacles for fish in the Argungu Fishing Festival in Sokoto State of Nigeria. Fulani women and young girls hawking madara (fresh milk), fermented milk (nono) and/or kunu, gruel from guinea corn in the Northern part of Nigeria use giant, beautifully tattooed calabash basins. They are also used for the production of masks or native artifacts.

The cucumber is highly valued in cosmetic industry because the fruit is excellent for rubbing over the skin for softness and whiteness; it is cooling, healing, and soothing to the skin irritated by the sun, also used in soap making. Cucumber scent is linked to female sexual arousal.

The mature fruits of *Luffa aegyptiaca* are the source of the spongy reticulated material known as the domestic loofah. These loofahs are used for sponges and filters, and for stuffing pillows, saddles, and slippers. They can also be used for insulation and are attractive sources for packing materials [9, 28]. There is an increasing interest in domestic production since the United States is the major market and imports millions of loofahs from Asia each year [43].

5. Cucurbits as Complementary Dietary Ingredient of Feed for Poultry and Aqua Feed

[44], in their investigation on the replacement of soybean meal with *Luffa cylindrica* in the diet of *Claria gariepinus* fingerlings in Nigeria, reported that wider utilization and availability of this conventional source for fish feed is limited by increasing demand for human consumption and by other animal feed industries [45]. This has encouraged the need to look for cheaper alternative protein sources, hence the need to focus on using less expensive and readily available plant protein sources to replace soybean meal without reducing the nutritional quality of fish feeds [46].

Luffa cylindrica syn. *L. aegyptica* is a tropical running vine with rounded leaves and yellow flowers [47]. They have nutritional quality comparable to other oilseed proteins, including soybean and other conventional legumes. The results of the study showed that it is possible to replace soybean meal in the diet of *C. gariepinus* fingerlings with cooked *L. cylindrica* seed meal, with optimum growth response at a 15% replacement level.

A research study was carried out by [48], on the effects of replacing fishmeal with squash seed meal (*Cucurbita maxima*) on performance of juvenile Nile tilapia (*Oreochromis niloticus*). They reported that the formulation of fish feed using a cheap, locally available and highly nutritious terrestrial resource such as *C. maxima* seeds is needed [49]. They reported that the crude protein levels of *C. maxima* seeds and kernels are comparable to high protein-containing seeds and legumes such as soybeans and cowpea; while lipid content of *C. maxima* kernels is comparable to sunflower, soybeans and cotton seeds [50]. The results showed that fish fed 5% Squash seed meal exhibited numerically highest growth performance and feed utilization efficiency. They recommended diet inclusions of 5 to 20% Squash seed meal as these were found to be efficiently utilized by *O. niloticus* fingerlings as well.

[51] carried out an investigation on the effect of squash seed meal (SSM) (*Cucurbita moschata*) on broiler performance, sensory meat quality, and blood lipid profile. Squash pulp is consumed but the seeds are not used as human food or animal feed, and consequently, thousands of tons of seeds, containing 940 g/kg dry matter and significant amounts of proteins, amino acids, unsaturated lipids, phytosterols, squalene, dietary fiber, and minerals, are wasted. Squash seeds produce 225 to 248 kg crude protein/hectare and 240 to 255 kg ether extract/hectare, which could potentially be used for poultry feeding [52].

Squash seed meal is rich in proteins, but its inclusion in diets for monogastric animals has shown poor results [89]. However, literature search has not retrieved sufficient information on the use of full-fat squash seeds in poultry diets, particularly in broiler diets.

They discovered that the inclusion of 0, 33, 66 and 100 g/kg of Squash Seed Meal in broiler diets, partially replacing

soybean meal and vegetable oil, improved live performance and edible portions yield.

The better performance obtained with the inclusion of 33 and 66 g SSM /kg feed as compared to control diet may be due to the flavor enhancement promoted by unsaturated fats. [53], showed that when unsaturated fat levels were increased in broiler diets, feed intake and final body weight was higher than that obtained with the control treatment. [54, 55], demonstrated a linear increase in broiler daily gain with increasing dietary fat inclusion levels. The results of the present study showed that SSM acts as a natural growth promoter in broilers when added up to 66 g/kg of feed.

6. Cucurbits of Ethnoveterinary Importance

Ethnoveterinary medicine, which is traditional animal healthcare practices, provides low cost alternatives in situation where western type drugs and veterinary services are not available or are too expensive [56]. Plant remedies are still the most important and sometimes the only source of therapeutics for nearly more than 90% livestock population [57]. Ethnoveterinary medicine offers medicines which are cheap and locally available than pharmacotherapy. Farmers can prepare and use homemade remedies without any expenditure.

[58], reported that the tuber of *Cucumis ficifolius* A. Rich., Fig leaf cucumber, is used for the treatment of black leg, colic and emaciation in animals such as cow, bovine, etc, and the leaves of *Cucurbita pepo* is used for the treatment of trypanosomosis in animals; leaves and seeds of *Lagenaria siceraria* is used to treat rabies and trypanosomosis; *Momordica foetida* Schum. & Thonn., Snake food or wild cucumber, is for fracture, rabies, trypanosomosis, myiasis, lice and some ectoparasite infestation. It also has sedative effects on animals. *M. foetida* and *C. ficifolius* were reported to have broad spectrum activity and known as “master of medicinal plants” and this is in support of earlier reports by [59]. A single plant part was occasionally observed to be used for treatment of multiple ailments; the same applied to combination of plant parts. One or more or whole parts of the plants were added to many home made remedies. The herbalists believe that these plants have low antagonist and very high synergistic effect when they are utilized with others.

[55], reported that the root decoction of *Citrullus colocynthis* is given to the animals to cure constipation. The plant is also mixed with honey, mustard oil and applied internally for easy opening of the uterus during delivery.

7. Cucurbits for the Production of Biodiesel

Biodiesel is defined as the mono alkyl esters of long chain fatty acids obtained from renewable feedstock, such as

vegetable oil or animal fats, for use in compression ignition engines. It is more attractive because it is environmentally friendly, derived from renewable resources, biodegradable and non-toxic in nature [60]. Biodiesel acceptance as a substitute for fossil-derived diesel has grown the world over. *Citrullus colocynthis*, egusi melon seed oil was studied for the first time as a potential feedstock for biodiesel production. The major sources of the world's energy needs are petroleum, coal and natural gases which are fossil-derived and non renewable. Scarcity of traditional petroleum fuels, its over dependence by nations, increasing emissions of combustion-generated pollutants and their increasing costs have made renewable energy sources more attractive. Seeds of cucurbits are sources of oils and protein with about 50% oil and up to 35% protein. Specifically for these reasons they are cultivated and consumed world over.

Citrullus colocynthis L. is among the 300 species of melons that are cultivated for its seeds, which are rich in oil (53%) and protein (28%). Various studies have reported predominantly high linoleic fatty acid content in egusi melon seed oils. Due to the unsaturated fatty acid composition of its oil, it was reported to resemble that of safflower, corn, cottonseed, sunflower, soybean and sesame oil which are already been used for as feedstock for biodiesel production.

8. Conclusion

From the papers used in this review, it is clear that members of Cucurbitaceae have multipurpose functions in the lives of humans and animals. They can be employed in the nutritional, medicinal, ethnoveterinary needs of any nation, as well as in the production of items of utility and biodiesel and as complementary dietary ingredient for poultry and aquafeed. It is recommended that there should be increased in the production of these plants which will be profitable and will contribute to food security and livelihood sustainability in Nigeria in particular and other parts of the world in general.

References

- [1] V. E. Rubatzky and Yamaguchi-Mas. "World Vegetables, Principles, Production and nutritive value", 2nd Edition, Chapman and Hall, U. S. A, 1997, pp. 577–639.
- [2] J. Hutchinson and J. M. Dalziel. "Flora of West Tropical Africa" Crown Agents, London, 1954.
- [3] A. Kocyan, L. B. Zhang., H. Schaefer and S. S. Renner. "A multi-locus chloroplast phylogeny for the Cucurbitaceae and its implications for character evolution and classification". *Mol. Phylogenet. Evol.*, 44: 553-557, 2007.
- [4] M. G. Ajuru and B. E. Okoli. "Comparative Vegetative Anatomy of some Species of the family Cucurbitaceae Juss. In Nigeria", *Research Journal of Botany*, 8 (1), 15-23, 2013a.
- [5] M. G. Ajuru and B. E. Okoli. "The Morphological Characterization of the Melon species in the family Cucurbitaceae Juss. and their Utilization in Nigeria", *International Journal of Modern Botany*, 3 (2), 15-19, 2013b.
- [6] M. G. Ajuru and B. E. Okoli. "Comparative Anatomical Studies of some Genera of Cucurbitaceae Juss", *LS-International Journal of Life Sciences*, 2 (2), 91-96, 2013c
- [7] M. Ajuru and G. Ajuru "Indigenous and Exotic Cucurbits in Nigeria", *Current Advances in Plant Sciences Research*, 1 (1), 12-17, 2014.
- [8] M. B. Fokou, M. B. Achu and T. M. Chaungues. "Preliminary nutritional evaluation of five species of egusi seeds in Cameroon" *African Journal of Nutrition and Agricultural Development*, 4:8, 2004.
- [9] G. I. O. Badifu and A. O. Ogunsua. "Chemical composition of Kernels from some species of Cucurbitaceae grown in Nigeria", *Plant Foods Human Nutrition*, 41: 35-44, 1991.
- [10] T. W. Whitaker. "Cucurbits of potential economic importance", p. 318-324. In: D. M. Bates, R. W. Robinson, and C. Jeffrey (eds) *Biology and Utilization of the Cucurbitaceae*. Cornell Univ. Press, Ithaco, 1990.
- [11] B. E. Van Wyk and N. Gericke "People's Plants", Briza, Pretoria, 2000, pp. 90-114.
- [12] B. E. Okoli. "Wild and cultivated Cucurbits in Nigeria", *Economic Botany*, 38 (3): 350–357, 1984.
- [13] G. C. Obute, B. C. Ndukwu, O. F. Chukwu. "Targeted mutagenesis in *Vigna unguiculata* L. Walp. and *Cucumeropsis mannii*. Naud. in Nigeria", *African Journal of Biotechnology*, Lagos, Nigeria; *Academic Journal* 6 (21): 2467–2472, 2007.
- [14] Cucumber, with peel, raw. "Nutrition Facts. "Nutrition Data: Know What You Eat", 2008. <http://www.nutritiondata.com/facts-C0001-01c20dL.html>.
- [15] I. P. Dike, O. O. Obembe and F. E. Adebisi. "Ethnobotanical survey for potential anti-malarial plants in south-western Nigeria", *Journal of Ethnopharmacology*, 2012.
- [16] M. D. Choudhury, M. Bawari and L. M. Singha. "Some antipyretic ethnomedicinal plants of Manipuri community of Barak valley, Assam, India", *Ethnobotanical Leaflets* 14: 21-28, 2010.
- [17] P. Das, S. P. Sinhababu and T. Dam "Screening of antihelminthic effects of Indian plant extracts: a preliminary report", *Journal of Alternative and Complementary Medicine*, 12: 299-301, 2006.
- [18] M. R. Khan and A. D. Omoloso "Momordica charantia and Allium sativum: broad spectrum antibacterial activity", *Korean journal of Pharmacognosy*, 29: 155-158, 1998.
- [19] I. A. Ross. "Medicinal Plants of the World", Humana Press, New Jersey, USA, 1999, pp. 213-219.
- [20] I. Gurbuz, C. Akyuz; E. Yesilada and B. Sener. "Anti-ulcerogenic effect of *Momordica charantia* L. fruits on various ulcer models in rats", *Journal of Ethnopharmacology* 71: 77-82, 2000.
- [21] K. Dhiman A. Gupta., D. K. Sharma., N. S. Gill and A. Goyal. "A Review on the Medicinally Important Plants of the Family Cucurbitaceae", *Asian Journal of Clinical Nutrition*, 4: 16-26, 2012.

- [22] M. Miro. "Cucurbitacins and their pharmacological effects", *Phytother. Res.*, 9: 159-168, 1995.
- [23] M. K. Abdel-Rahman. "Effect of pumpkin seed (*Cucurbita pepo* L.) diets on Benign Prostatic Hyperplasia (BPH): Chemical and morphometric evaluation in rats", *World Journal of Chemistry* 1: 33-40, 2006.
- [24] N. S. Gill, S. Kaur., R. Arora and M. Bali. "Screening of antioxidant and antiulcer potential of *Citrullus colocynthis* methanolic seed extract", *Res. J. Phytochem.*, 2: 98-106, 2011.
- [25] R. Roman-Ramos, F. J. Lara-Lemus., F. J. Alarcon-Aguilar and J. L. Flores-Saenz. "Hypoglycemic activity of some antidiabetic plants", *Arch. Med. Res.*, 23: 105-109, 1992.
- [26] J. L. Acosta-Patino, E. Jimenez-Balderas., M. A. Juarez-Oropeza and J. C. Diaz-Zagoya. "Hypoglycemic action of *Cucurbita ficifolia* on type 2 diabetic patients with moderately high blood glucose levels" *Journal of Ethnopharmacology* 77: 99-101, 2001.
- [27] M. N. Abou-Zaid, D. A. Lombardo; G. C. Kite., R. J. Grayer and N. C. Veitch. "Acylated flavone C-glycoside from *Cucumis sativus*", *Phytochemistry* 58: 167-172, 2001.
- [28] I. Vouldoukis, D. Lacan., C. Kamate., P. Coste and A. Calenda "Antioxidant and anti-inflammatory properties of a *Cucumis melo* L. extract rich in superoxide dismutase activity", *Journal of Ethnopharmacology* 94: 67-75, 2004.
- [29] B. Marzouk, Z. Marzouk., E. Haloui., N. Fenina., A. Bouraoui and M. Aouni. "Screening of analgesic and anti-inflammatory activities of *Citrullus colocynthis* from Southern Tunisia", *Journal of Ethnopharmacology* 128: 15-19, 2010.
- [30] S. E. I. adam, M. A. Al-Yahya and A. H. Al-Farhan. "Response of Najdi sheep to oral administration of *Citrullus colocynthis* fruits, Nerium oleander leaves or their mixture", *Small Ruminant Res.*, 40: 239-244, 2001.
- [31] B. Ahmed, T. Alam and S. S. Khan. "Hepatoprotective activity of *Luffa echinata* fruits", *Journal of Ethnopharmacology* 76: 187-189, 2001.
- [32] T. Akihisa, H. Tokuda., E. Ichiishi., T. Mukainaka and M. Toriumi. "Anti-tumor promoting effects of multiflorane-type triterpenoids and cytotoxic activity of Karouinidiol against human cancer cell lines", *Cancer Lett.*, 173: 9-14, 2001.
- [33] R. M. Kolte, V. V. Bisan., C. R. Jangde and A. A. Bhalerao. "Antiinflammatory activity of root tubers of *Trichosanthes cucumerina* (Linn.) in mouse's hind paw edema induced by carrageenin", *Indian Journal of Indigenous Medicine* 18: 117-121, 1996.
- [34] P. Nithiya and K. Mohan. "Antioxidative effect of *Trichosanthes tricuspidata* root extract on sildenafil induced migraine in albino mice", *Pharma. Res.* 1: 402-405, 2009.
- [35] E. A. Gordon, L. J. Guppy and M. Nelson. "The antihypertensive effects of the Jamaican Cho-Cho (*Sechium edule*)", *West Indian Medical Journal* 49: 27-31, 2000.
- [36] G. Dire, E. Lima., M. Gomes and M. Bernardo-Filho. "The effect of a chayote (*Sechum edule*) extracts (decoct and macerated) on the labeling of blood elements with technetium- 9m and on the biodistribution of the radiopharmaceutical sodium pertechnetate in mice. An in vitro and in vivo analysis", *Pakistan Journal of Nutrition* 2: 221-227, 2003.
- [37] B. N. Shah, A. K. Seth and R. V. Desai. "Phytopharmacological profile of *Lagenaria siceraria*", *A review of Asian Journal of Plant Science* 9: 152-157, 2010.
- [38] M. K. Moon, D. G. Kang., Y. J. Lee., J. S. Kim and H. S. Lee. "Effect of *Benicasa hispida* Cogniaux on high glucose-induced vascular inflammation of human umbilical vein endothelial cells", *Vascular Pharmacology* 50: 116-122, 2009.
- [39] N. S. Gill, K. Dhiman., J. Bajwa., P. Sharma and S. Sood. "Evaluation of the free radical scavenging, anti-inflammatory and analgesic potential of *Benincasa hispida* seed extract", *International Journal of Pharmacology* 6: 652-657, 2010.
- [40] M. O. Akorode. "Ethnobotany of *Telfairia occidentalis* (Cucurbitaceae) among Igbos of Nigeria", *Economic Botany*, 29-39, 1990.
- [41] J. M. Davis. "Development of a production system for *Luffa* sponge gourds", *HortScience*, Vol. 26: 326-451, 1991.
- [42] W. A. Jimoh, A. Z. Aderolu., A. A. Ayeloja and M. O. Shodamola. "Replacement value of Soybean meal with *Luffa cylindrica* in diet of *Clarias gariepinus* fingerlings", *International Journal of Applied Agricultural and Apicultural Research*, 9 (1&2): 98-105, 2013.
- [43] P. Siddhuraju and K. Becker. "Preliminary nutritional evaluation of mucuna seed meal (*Mucuna pruriens* var. *utilis*) in common carp (*Cyprinus carpio* L.): An assessment by growth performance and feed utilization", *Aquaculture* 196: 105-123, 2001.
- [44] M. M. Barros, E. Lim and P. H. Klesius "Effect of soybean replacement by cottonseed meal and iron supplementation on growth, immune response and resistance of channel catfish (*Ictalurus punctatus*) to *Edwardsiella ictaluri* challenge", *Aquaculture* 207: 263-279, 2002.
- [45] V. I. E. Ajiwe, G. I. Ndukwe and I. E. Anyadiegwu. "Vegetable diesel fuels from *Luffa cylindrica* oil, its methylester and ester-diesel blends", *Chem. Class J.* 2: 1-4, 2005.
- [46] C. T. Jonni Fay, M. Marie Noelle., J. Fernandez and A. Ragaza. "Effects of replacing fishmeal with squash seed meal (*Cucurbita maxima*) on performance of juvenile Nile tilapia (*Oreochromis niloticus*)", *ACL Bioflux*, 7 (2): 68-75, 2014.
- [47] A. G. J. Takon and M. Metian "Global overview on the use of fish meal and fish oil in industrially compounded aquafeeds: trends and future prospects", *Aquaculture*, 285: 146-158, 2008.
- [48] M. A. Alfawaz. "Chemical composition and oil characteristics of pumpkin (*Cucurbita maxima*) seed kernels", *Res. Bult.*, No. (129), Food Science and Agriculture Research Center, King Saud University, Saudi Arabia, 2004, pp. 5-18.
- [49] Y. M. Aguilar, O. M. Yero., M. I. V. Navarro., C. A. B. Hurtado., J. A. C. Lopez and L. B. G. Mejia. "Effect of squash seed meal (*Cucurbita moschata*) on broiler performance, sensory meat quality, and blood lipid profile", *Rev. Bras. Cienc. Avic.*, 13 (4): 219-226, 2011.
- [50] Y. Martinez, M. Valdiviá; A. L. LaO and E. Leyva. "Potencialidades de la semilla de calabaza como alimento para monogástricos", *Revista ACPA*; 4 (3): 20-22, 2008.

- [51] S. Bernal, L. Guadalupe; R. Martínez; G. Ávila; B. Carrasco and L. Shimada. "Aminoácidos limitantes de la pasta de semilla de calabaza para ratas", *Técnica Pecuaria en México* 32 (3): 91-92, 1997.
- [52] R. W. Rosebrough, J. P. McMurtry and R. Vasilatos-Younken. "Dietary fat and protein interactions in the broiler", *Poultry Science* 78 (7): 992-998, 1999.
- [53] E. Lulekal, E. Kelbessa, T. Bekele, and H. Yineger. "An ethnobotanical study of medicinal plants in Mana Angelu District, Southeastern Ethiopia", *Journal of Ethnobiology and Ethnomedicine*, 4: 1-10, 2008.
- [54] J. D. Latshaw. "Daily Energy Intake of broiler Chickens is Altered by Proximate Nutrient Content and Form of the Diet", *Poultry Science*; 87 (10): 89-95, 2008.
- [55] P. Galav, A. Jain and S. S. Katewa "Traditional veterinary medicines used by livestock owners of Rajasthan, India", *Indian Journal of Traditional Knowledge*, 12 (1): 47-55, 2013.
- [56] H. Tadeg, E. Mohammed, K. Asres, and T. Gebre-Mariam. "Antimicrobial activities of some selected traditional Ethiopian medicinal plants used in the treatment of skin disorders", *Journal of Ethnopharmacology*, 100: 166-175, 2005.
- [57] G. Yirga, M. Teferi., G. Brhane and S. Amare. "Plants used in ethnoveterinary practices in Medebay-Zana District, Northern Ethiopia", *Journal of Medicinal Plants Resources* 6: 433-438, 2012.
- [58] F. Tamiru, W. E. Terfa., G. Kebede., R. K. Dabessa., R. K. Roy and M. Sorsa. "Ethnoknowledge of plants used in veterinary practices in Dabo Hana District, West Ethiopia", *Journal of Medicinal Plant Research*, 7 (40): 2960-2971, 2013.
- [59] T. Sori, M. Bekana., G. Adugna and E. Kelbessa. "Medicinal Plants in the Ethnoveterinary Practices of Borana Pastoralists, Southern Ethiopia", *Intern. J. Appl. Res. Vet. Med.* 2: 220-225, 2004.
- [60] S. Giwa, L. C. Abdullah and N. M. Adam. "Investigating Egusi (*Citrullus colocynthis* L.) seed oil as Potential Biodiesel Feedstock.", *Energies*, 3 (4): 607-618, 2010.