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TAXIMETRICS: A TOOL IN MORPHOLOGICAL CHARACTERIZATION OF LAGENARIA SICERARIA (MOL.) STANDL.

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Abstract
Taximetrics as a tool in the morphological characterization of twenty-four landraces of *Lagenaria siceraria* (Mol.) Standl found in Nigeria were accessed across fifteen states of the federation. Investigation involving morphological characters was studied to elucidate the diversity in fruit shapes of the species. The observation made, showed vital variations which are useful in biosystematics. The qualitative result obtained shows similarity in morphological characters apart from the dissimilarity observed in fruit and seed shape and size. The taximetrics analysis result grouped them into two major groups with a common ancestor, hence indicating the close relationship amongst the species, this depicts that a morphological character is a useful tool in the taxonomic delimitation of *L. siceraria* complex and as such the species should remain as a single species based on this line of taxonomic evidence.

Keywords: Taximetrics, morphological characterization, *Lagenaria siceraria*

Introduction

Plant morphology is the study of the development, form, and structure of plants. It is the basis of the similarity of plant and origin(Raven et al., 2005). Maggs (1999) reviewed that taxonomy is the study and descriptions of the variation of organisms and the investigations of the causes and consequences of this variation have relied traditionally on morphological information. Morphological characters that can be counted, measured, compared and described are used to assess similarities and differences in plant taxa. These characters are further utilized in the identification, description, and classification. (Evert & Esau, 2006). Morphological characters used in identification are diagnostic or key characters that can be qualitative and quantitative. The knowledge of molecules in a plant is not enough to foretell the characteristics of the cells; neither does the knowledge of cells predict all properties of the plant's structure hence, each area of investigation of plant morphology overlaps with another field of the biological sciences(Bäurle &Laux, 2003*;* Harold et al., 1987; Leopold, 1964*).* Morphological characters have been used in classification in the past decades, which were majorly based on gross morphological features of the leaves, flowers, and fruits. The presence of stipule is an important source of identification in Salix and viola. Leaf veins have been used in the identification of the species Tilia and Ulmus. Spiraea has been separated from Sorbaria based on pinnate leaves. Floral characters are used in the delimitation of taxa. In different species of *Euphorbia* distinctive cyathium inflorescence with clusters of male flowers each represented by a single stamen has been used in its delimitation. Fruit characteristics have been used in the delimitation of the species of the genera Compositae and the genus Valerianella (Çilden, 2022; Yılmaz-Çıtak & Dural 2020, Coode, 1967). Seed characters have been widely used as valuable identification characters in the genus Veronica (Mazur, 2021).

Singh et al. (1991) have reported that morphological variations as markers are useful in both breeding programmes and genetic studies, this was demonstrated in his work on genetic diversity in cultivated common beans. Przybylo et.al. (2000) have further reported that morphological characters have been producing useful data for genetic studies but this method has been decreased because it has been used to assess limited phenotypic features that are affected by environmental and climatic influences. Taximetrics deciphers relationships between plant species or those within

groups of species are determined quantitatively and depicted graphically in resolving the quagmire in the diversity of *Lagenaria siceraria* complex.

Materials and Methods

The study involved extensive field trips to different states and herbaria in Nigeria. Plants were collected using the simple random sampling method based on standard ecological procedure (Edwin-Nwosu & Omara-Achong, 2010) from Kaduna, Kano, Plateau, Oyo, Akwa-Ibom, Bayelsa, Abia and Rivers state. The various plant samples collected represented about twenty-four landraces of *Lagenaria siceraria* (Mol.) Standl. found in Nigeria. The different landraces were planted out in triplicate using randomized block design in the ecological centre of the University of Port Harcourt, Abuja campus.

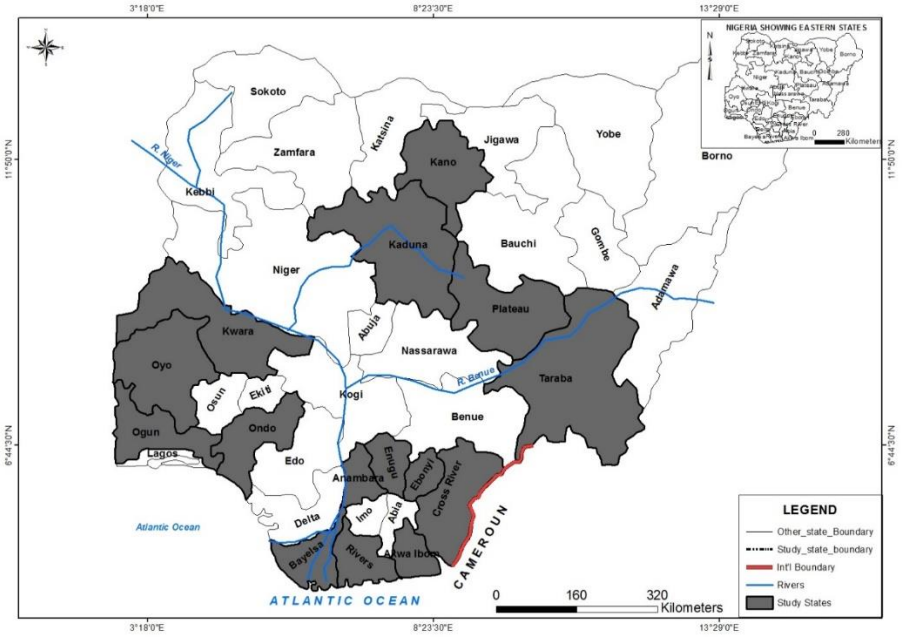

Fig. 1: Map of the study area

The various landraces of *Lagenaria siceraria* (Mol.) Standl. were collected for morphological characterization. Observation of vegetative and floral characteristics was made on mature plants according to Singh (2004). Morphological data were generated by measuring and direct counting which formed the basis for qualitative and quantitative data that were analyzed using Microsoft Excel package 2007 and PAST software.

Results

Taximetric evidence has proved to be of great value in revising and improving the classification of landraces of *Lagenaria siceraria* (Mol.) Standl. found in Nigeria and the understanding of its evolution (Sighn, 2004; Davis & Heywood, 1973). Vegetative and floral characteristics of landraces of *L. siceraria* is an annual prostrate herb, highly pubescent in the leave, stem and in young fruit, having a length of about 6 to seven metres long. The leaves are large, they possess an angled stem with bifid tendrils, spirally coiled, and aid in climbing. It is situated at the upper part of the base of the petiole. The plant regenerates from seeds and has a bitter taste. It exhibits a diagnostic odour in animals. The leaves are green, palmate, simple, alternate, exstipulate, petiolate, slightly lobed, cordate to rounded. The leave blades possess acuminate to acute apex, dentate margin, and reticulate venation and are highly pubescent on both surfaces. The summary of the qualitative character is in Table 1 and the quantitative character is recorded in Table 2. The plant is monoecious, actinomorphic with a unisexual flower, which is radially symmetrical, pentamerous, tubular, whitish, pedicellate, solitary and borne in the axil of the leave. The male flower buds 6 to 7 days before the occurrence of the first female flower. The female flower produces no nectar while the male flower secretes nectar at the base of the flower. Further, more male flower is produced than female flowers. The

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morphological characteristics of both male and female sepals and petals are similar. The sepal is epigenous and pentamerous, it is united into a tubular or funnel-shaped tube that is green in colour, oblong to lanceolate in shape, and the apices are acute.

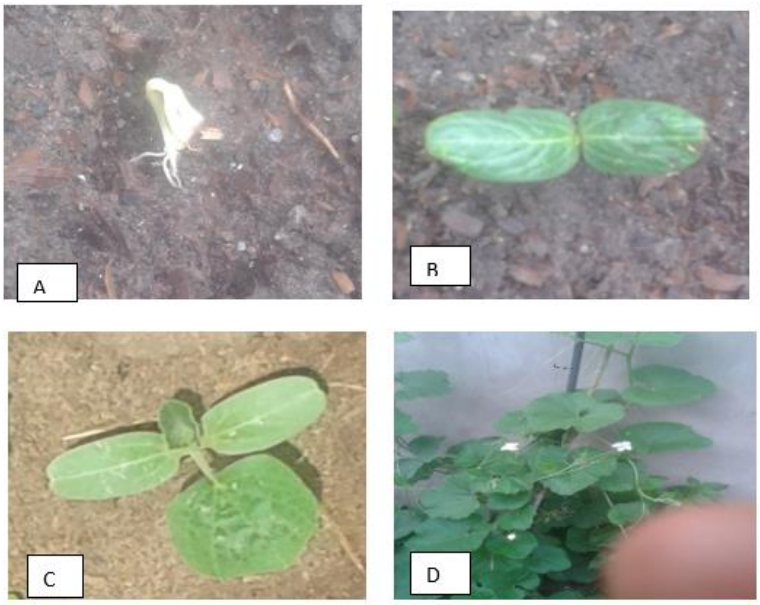

Plate 1: *L. siceraria* (Mol.) Standl. growing in the field. A: Epigeal germination, B: Dicotyledonous seed leaves, C: Growth of other leaves, D: Creeping vegetative part with alternate phylotaxy.

The surfaces are highly pubescent on the inner and outer sides. The petal is also epigeneous and pentamerous, it is ovate, the margin is entire and obtuse at the apex. The petal is white in colour and pale yellow at the base, highly pubescent at the surface. Pedicel is pubescent, green and hollow. It is longer in male than in female flowers. The male flower consists of a dark mucilage that enables the pollen to adhere to the stigma during pollination. The androecium is pentastaminate. The anther lobe is yellowish brown having two monotheca flowers that are united and broader to form a bitheca anther lobe. A single, simple monotheca anther lobe that is narrower is also present. The filament is whitish and short. The gynoecium is formed from three united carpels, it is syncarpous and possesses an inferior ovary that is unilocular. The ovules are numerous, anatropous with three fleshy placentas meeting in the middle. The ovary is highly pubescent and green, the shape varies from one fruit shape to another. The stigma is three, short, free, yellow and bilobed. It is covered with stringy mucilage.

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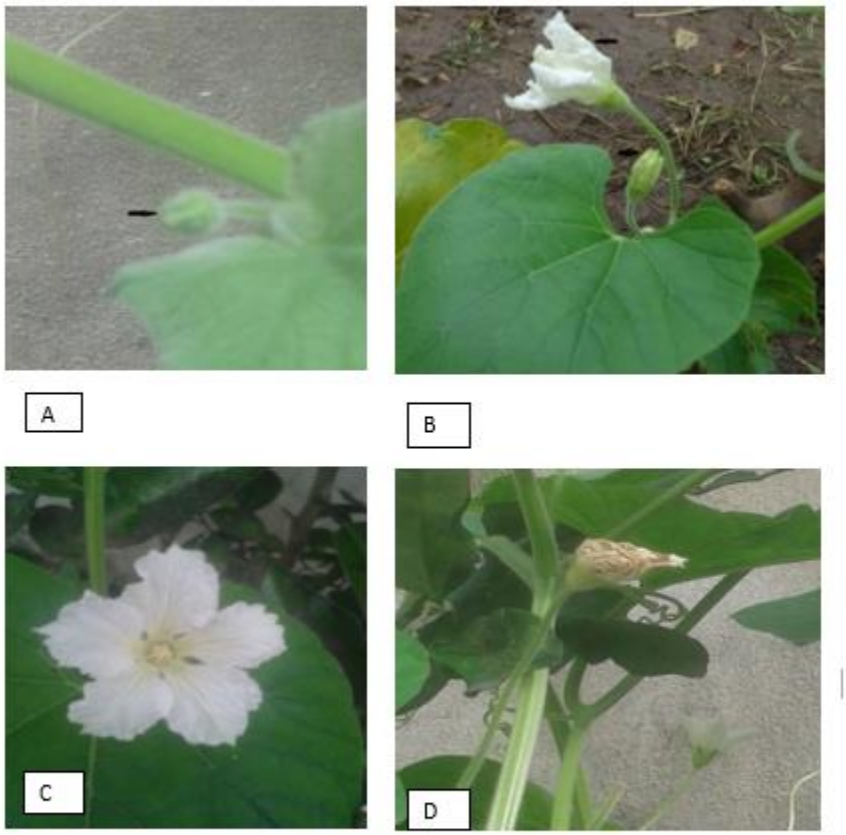

Plate 2: A: Male flower bud, B: The left arrow shows the matured male bud. The right arrow shows the opening of male flower C: A fully opened male flower, D: A closed male flower

Plate 3: A: Female flower bud, B: Matured female bud
C: A fully opened female flower, D: A closed female flower

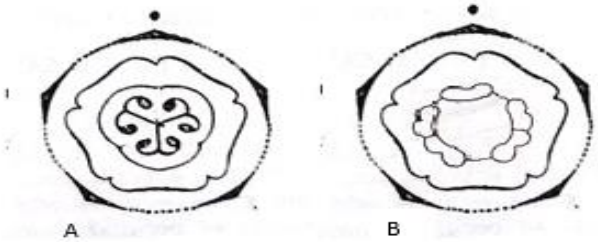

Fig. 2: Floral Diagram of a Typical *Lagenaria siceraria*

A: Floral diagram of female flower; B: Floral diagram of male flower.

*Floral Formulae: Female Flower: $K_5\ C_5\ A_0\ G_3$

Male Flower: $K_5\ C_5\ A_{2+2+1}\ G_0$

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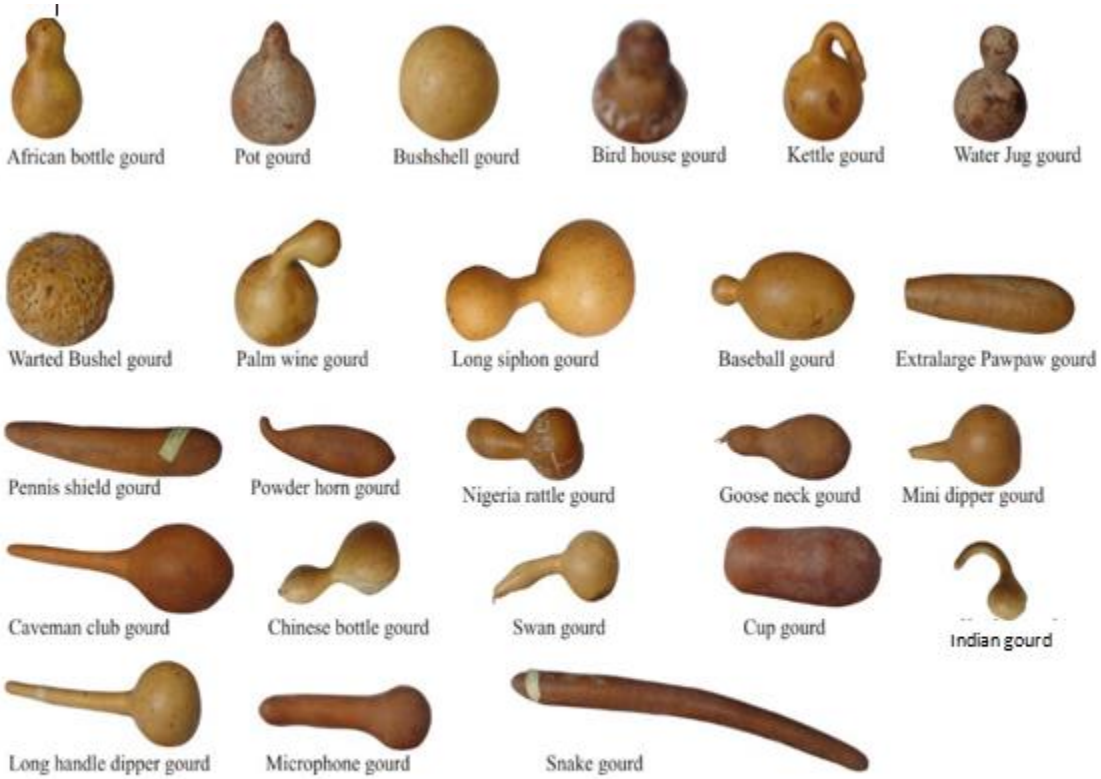

Fig. 3: Diversity of Fruit Shapes

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Table 1: Summary of Qualitative Morphological Characters

S/No.	Landraces	Duration and Habit	Stem	Leaf	Flower	Other Remarks
1	Snake Gourd	Annual succulent herb	Succulent, highly pubescent, climbing, axillary bifid tendril and hollow	Simple, alternate, pubescent, undulating margin with an accuminate apex and palmately veined	White, solitary, unisexual, epygenous, monoecious, actinomorphic, pentamerous, gamosepalous, gamopetalous, imbricate aestivation, syncarpous pistil, three unilocular, inferior ovary, one style and three stigma forked together, many ovules, pentastaminate, synandrous and sinous anther lobes	Snake-shaped fruit, pepo, parietal placentation.
2	Pot Gourd	Annual succulent herb	Angular hollow stem, succulent, trailing, spiral axillary bifid tendril and hispid	Simple, multicostate, with pinantified incision, alternate, hispid with an accuminate apices	Unisexual, white, solitary, epygenous, monoecious, regular, pentamerous, gamosepalous, gamopetalous, imbricate aestivation, syncarpous pistil, three unilocular, inferior ovary, one style and three stigma forked together, many ovules, synandrous, pentastaminate, sinous anther lobes	Pot-shaped fruit, pepo, parietal placentation
3	Bushel Gourd	Annual succulent herb	Climbing, succulent, curly axillary bifid tendril, highly pubescent and hollow	Alternate, simple, palmately veined, aacuminate, hispid and pinnatipartite incision	Solitary, unisexual, white, epygenous, monoecious, actinomorphic, pentamerous, gamosepalous, gamopetalous, imbricate aestivation, syncarpous pistil, three unilocular, inferior ovary, one style and three stigma forked together, many ovules, synandrous, pentastaminate, sinous anther lobes	Bushel-shaped fruit, pepo, parietal placentation
4	African Bottle Gourd	Annual succulent herb	Highly hispid, spiral bifid tendril at the axis, trailing and hollow	Multicostate, alternate, simple, pubescent, accuminate apices and pinatified incision	Monoecious, white, solitary, unisexual, epygenous, radially symmetrical, pentamerous, gamosepalous, gamopetalous, imbricate aestivation, syncarpous pistil, three unilocular, inferior ovary, one style and three stigma forked together, many ovules, synandrous, pentastaminate, sinous anther lobes	African bottle-shaped fruit, pepo, parietal placentation
5	Indian Gourd	Annual succulent herb	Curly bifid tendril at the axis, pubescent, hollow, climbing and succulent	Palmately veined, simple, alternate, hispid, petiolate, with accuminate apices and pinnatipartite incision	White, solitary, unisexual, epygenous, monoecious, regular, pentamerous, gamosepalous, gamopetalous, imbricate aestivation, syncarpous pistil, three unilocular, inferior ovary, one style and three stigma forked together, many ovules, synandrous, pentastaminate, sinous anther lobes	Indian Gourd shaped fruit, pepo, parietal placentation
6	Caveman Club Gourd	Annual succulent herb	Highly pubescent, spiral, axillary bifid tendril, angular hollow stem, trailing and succulent	Simple, alternate, pubescent, petiolate, undulating margin with an accuminate apex and palmately veined	White, solitary, unisexual, epygenous, monoecious, actinomorphic, pentamerous, gamosepalous, gamopetalous, imbricate aestivation, syncarpous pistil, three unilocular, inferior ovary, one style and three stigma forked together, many ovules, synandrous, pentastaminate, sinous anther lobes	Caveman Club shaped fruit, pepo, parietal placentation
7	Long Handle Dipper Gourd	Annual succulent herb	Succulent, highly pubescent, curly axillary bifid tendril, trailing and hollow	Alternate, simple, palmately veined, aacuminate, petiolate hispid and pinnatipartite incision	Actinomorphic, white, solitary, unisexual, epygenous, monoecious, pentamerous, gamosepalous, gamopetalous, imbricate aestivation, syncarpous pistil, three unilocular, inferior ovary, one style and three stigma forked together, many ovules, synandrous, pentastaminate and a sinous anther lobes	Long Handle Dipper fruit shape, pepo, parietal placentation
8	Extra Large Pawpaw Gourd	Annual succulent herb	Hispid, succulent, climbing, spiral bifid tendril at the axis and pithed	Multicostate, alternate, simple, petiolate, pubescent, accuminate apices and pinatified	White, solitary, unisexual, epygenous, monoecious, radially symmetrical, pentamerous, gamosepalous, gamopetalous, imbricate aestivation, syncarpous pistil, three unilocular, inferior ovary, one style	Extra Large Pawpaw shaped fruit, pepo, parietal placentation

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				incision	and three stigma forked together, many ovules,pentastaminate, sinous anther lobes and synandrous	
9	Cup Gourd	Annual succulent herb	Pithed, trailing, succulent, curly axillary bifid tendril and highly pubescent	Simple, multicostate, with pinantified incision, alternate, petiolate, hispid with an accuminate apices	White, solitary, unisexual, epygenous, monoecious, actinomorphic, pentamerous, gamosepalous, gamopetalous, imbricate aestivation, syncarpous pistil, three unilocular, inferior ovary, one style and three stigma forked together, many ovules, synandrous, pentastaminate, sinous anther lobes	Cup-shaped fruit, pepo, parietal placentation
10	Kettle Gourd	Annual succulent herb	Hollow, spiral bifid tendril at the axis, pubescent, climbing and succulent	Palmately veined, simple, petiolate, alternate, hispid, with accuminate apices and pinnatipartite incision	White, solitary, unisexual, epygenous, monoecious, actinomorphic, pentamerous, gamosepalous, gamopetalous, imbricate aestivation, syncarpous pistil, three unilocular, inferior ovary, one style and three stigma forked together, many ovules, synandrous, pentastaminate, sinous anther lobes	Kettle-shaped fruit, pepo, parietal placentation
11	Warted Bushel Gourd	Annual succulent herb	Curly axillary bifid tendril, trailing, pithed, Succulent and highly pubescent	Simple, alternate, pubescent, undulating margin, petiolate, with an accuminate apices and palmately veined	White, solitary, unisexual, epygenous, monoecious, actinomorphic, pentamerous, gamosepalous, gamopetalous, imbricate aestivation, syncarpous pistil, three unilocular, inferior ovary, one style and three stigma forked together, many ovules, synandrous, pentastaminate, sinous anther lobes	Warted Bushel-shaped fruit, pepo, parietal placentation
12	Pennis Shield Gourd	Annual succulent herb	Pubescent, spiral, axillary bifid tendril, pithed, trailing and succulent	Palmately veined, petiolate, simple, alternate, hispid, with accuminate apices and pinnatipartite incision	White, solitary, unisexual, epygenous, monoecious, actinomorphic, pentamerous, gamosepalous, gamopetalous, imbricate aestivation, syncarpous pistil, three unilocular, inferior ovary, one style and three stigma forked together, many ovules, synandrous, pentastaminate, sinous anther lobes	Pennis Shield shaped fruit, pepo, parietal placentation
13	Palm Wine Gourd	Annual succulent herb	Highly hispid, curly bifid tendril at the axis, trailing and pithed	Simple, multicostate, with pinantified incision, alternate, petiolate, hispid with an accuminate apices	White, solitary, unisexual, epygenous, monoecious, actinomorphic, pentamerous, gamosepalous, gamopetalous, imbricate aestivation, syncarpous pistil, three unilocular, inferior ovary, one style and three stigma forked together, many ovules, synandrous, pentastaminate, sinous anther lobes	Palm Wine shaped fruit, pepo, parietal placentation
14	Swan Gourd	Annual succulent herb	Angular hollow stem, succulent, climbing, spiral axillary bifid tendril and highly hispid	Multicostate, alternate, simple, petiolate, pubescent, accuminate apices and pinatified incision	White, solitary, unisexual, epygenous, monoecious, actinomorphic, pentamerous, gamosepalous, gamopetalous, imbricate aestivation, syncarpous pistil, three unilocular, inferior ovary, one style and three stigma forked together, many ovules, synandrous, pentastaminate, sinous anther lobes	Swan-shaped fruit, pepo, parietal placentation
15	Water Jug Gourd	Annual succulent herb	Hispid, trailing, curly bifid tendril at the axis, succulent and pithed	Alternate, simple, palmately veined, petiolate, accuminate, hispid and pinnatipartite incision	White, solitary, unisexual, epygenous, monoecious, actinomorphic, pentamerous, gamosepalous, gamopetalous, imbricate aestivation, syncarpous pistil, three unilocular, inferior ovary, one style and three stigma forked together, many ovules, synandrous, pentastaminate, sinous anther lobes	Water Jug shaped fruit, pepo, parietal placentation
16	Mini Dipper Gourd	Annual succulent herb	Curly bifid tendril at the axis, hispid, hollow, trailing and succulent	Simple, alternate, petiolate, pubescent, undulating margin with an accuminate apices and	White, solitary, unisexual, epygenous, monoecious, actinomorphic, pentamerous, gamosepalous, gamopetalous, imbricate aestivation, syncarpous pistil, three unilocular, inferior ovary, one style and	Mini Dipper shaped fruit, pepo, parietal placentation

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				palmately veined	three stigma forked together, many ovules, synandrous, pentastaminate, sinous anther lobes	
17	Chinese Bottle Gourd	Annual succulent herb	Trailing, succulent, curly axillary bifid tendril, highly pubescent and hollow	Simple, multicostate, with pinantified incision, alternate, hispid, petiolate, with an accuminate apices	White, solitary, unisexual, epygenous, monoecious, actinomorphic, pentamerous, gamosepalous, gamopetalous, imbricate aestivation, syncarpous pistil, three unilocular, inferior ovary, one style and three stigma forked together, many ovules, synandrous, pentastaminate, sinous anther lobes	Chinese Bottle shaped fruit, pepo, parietal placentation
18	Long Siphon Gourd	Annual succulent herb	Succulent, highly pubescent, climbing, axillary bifid tendril and hollow	Palmately veined, simple, alternate, hispid, with accuminate apices, petiolate and pinnatipartite incision	White, solitary, unisexual, epygenous, monoecious, actinomorphic, pentamerous, gamosepalous, gamopetalous, imbricate aestivation, syncarpous pistil, three unilocular, inferior ovary, one style and three stigma forked together, many ovules, synandrous, pentastaminate, sinous anther lobes	Long siphon-shaped fruit, pepo, parietal placentation
19	Powder Horn Gourd	Annual succulent herb	Highly hispid, spiral bifid tendril at the axis, trailing and pithed	Accuminate, simple, alternate, petiolate, palmately veined, hispid and pinnatipartite incision	White, solitary, unisexual, epygenous, monoecious, actinomorphic, pentamerous, gamosepalous, gamopetalous, imbricate aestivation, syncarpous pistil, three unilocular, inferior ovary, one style and three stigma forked together, many ovules, synandrous, pentastaminate, sinous anther lobes	Powder Horn shaped fruit, pepo, parietal placentation
20	Goose Neck Gourd	Annual succulent herb	Angular hollow stem, succulent, trailing, spiral axillary bifid tendril and highly pubescent	Multicostate, alternate, simple, pubescent, petiolate, accuminate apices and undulating margin	White, solitary, unisexual, epygenous, monoecious, actinomorphic, pentamerous, gamosepalous, gamopetalous, imbricate aestivation, syncarpous pistil, three unilocular, inferior ovary, one style and three stigma forked together, many ovules, synandrous, pentastaminate, sinous anther lobes	Goose Neck shaped fruit, pepo, parietal placentation
21	Base Ball Gourd	Annual succulent herb	Climbing, succulent, curly bifid tendril at the axis, highly hispid and hollow	Simple, alternate, petiolate, pubescent, accuminate apices, palmately veined and pinatified incision	White, solitary, unisexual, epygenous, monoecious, actinomorphic, pentamerous, gamosepalous, gamopetalous, imbricate aestivation, syncarpous pistil, three unilocular, inferior ovary, one style and three stigma forked together, many ovules, synandrous, pentastaminate, sinous anther lobes	Base Ball shaped fruit, pepo, parietal placentation
22	Bird House Gourd	Annual succulent herb	Highly pubescent, spiral, axillary bifid tendril, pithed, trailing and succulent	Hispid, alternate, petiolate, simple, palmately veined, aacuminate,and pinnatipartite incision	White, solitary, unisexual, epygenous, monoecious, actinomorphic, pentamerous, gamosepalous, gamopetalous, imbricate aestivation, syncarpous pistil, three unilocular, inferior ovary, one style and three stigma forked together, many ovules, synandrous, pentastaminate, sinous anther lobes	Bird House shaped fruit, pepo, parietal placentation
23	Nigeria Rattle Gourd	Annual succulent herb	Curly bifid tendril at the axis, pubescent, hollow, climbing and succulent	Palmately veined, simple, petiolate, alternate, hispid, with accuminate apices and pinantified incision	White, solitary, unisexual, epygenous, monoecious, actinomorphic, pentamerous, gamosepalous, gamopetalous, imbricate aestivation, syncarpous pistil, three unilocular, inferior ovary, one style and three stigma forked together, many ovules, synandrous, pentastaminate, sinous anther lobes	Nigeria Rattle shaped fruit, pepo, parietal placentation
24	Microphone Gourd	Annual succulent herb	Hispid, succulent, climbing, spiral bifid tendril at the axis and pithed	Alternate, simple, petiolate, multicostate, with pinnatipartite incision, accuminate	White, solitary, unisexual, epygenous, monoecious, actinomorphic, pentamerous, gamosepalous, gamopetalous, imbricate aestivation, syncarpous pistil, three unilocular, inferior ovary, one style and	Microphone-shaped fruit, pepo, parietal placentation

	apices and hispid	three stigma forked together, many ovules, synandrous, pentastaminate, sinous anther lobes

Table 2: Summary of Quantitative Morphological Characterization

FRUIT SHAPE	LEAF	LEAF	INTERNODE	FLOWER STALK	TENDRIL	FLOWER BUD	MALE PETALS		MALE SEPALS	FEMALE PETALS		FEMALE SEPALS	FRUIT	FRUIT	SEED	SEED	SEED THICKNESS	HELIUM
	L.	W.					L	W			W		L.	W.	L.	W.		
Snake Gourd	9.53	13.04	2.63	6.26	15.93	2.77	3.35	4	1.2	3.58	1.18	2.19	60.21	5.26	1.57	0.72	0	0.4
Pot Gourd	10.01	13.89	2.72	6.35	14.87	2.71	3.4	3.8	1.21	4	1.18	2.3	17.73	17.72	1.92	1.11	0.2	0.4
Bushel Gourd	9.61	13.26	2.77	6.55	14.06	2.74	2.93	4.9	1.29	3.79	1.38	2.24	18.2	18.24	1.96	1	0.1	0.6
African Bottle	9.65	13.51	2.54	6.34	14.17	2.69	3	6	1.37	3.73	1.26	2.3	21.25	14.32	1.72	0.71	0.1	0.4
Indian Gourd	9.66	13.18	2.84	6.58	15.97	2.48	2.61	5.8	1.26	3.95	1.22	2.33	25.71	12.71	2.48	0.82	0.2	0.5
Caveman Club Gourd	10.8	14.56	2.86	7.16	17.06	2.74	2.85	5.6	1.31	3.85	1.3	2.09	30.56	9.6	1.92	0.91	0.3	0.2
Long Handle Dipper Gourd	11.01	14.6	2.55	6.93	15.42	2.71	2.65	4.7	1.29	3.98	1.28	2.3	22.52	11.32	2.01	0.93	0.2	0.4
Extra Large Pawpaw Gourd	11.29	14.99	2.77	6.64	17.15	2.99	2.84	6.2	1.29	4.03	1.34	2.3	14.54	12.39	1.84	0.96	0.4	0.5
Cup Gourd	12.26	16	2.79	6.58	17.95	2.69	2.72	5	1.38	3.92	1.33	2.31	11.43	5.95	1.1	0.72	0.1	0.2
Kettle Gourd	11.91	15.64	2.7	7.1	17.94	2.86	2.74	4	1.31	3.99	1.32	2.34	17.37	9.54	1.6	0.78	0.2	0.3
Warted Bushel Gourd	11.39	15.07	2.83	7.01	16.24	2.72	2.88	4.4	1.33	3.95	1.31	2.37	13.62	30.05	2.12	1.11	0.2	0.4
Pennis Shield Gourd	11.47	15.32	2.64	6.75	16.52	2.55	2.71	5.7	1.25	4	1.34	2.32	16.75	8.42	2.05	0.84	0.4	0.3
Palm Wine Gourd	11.92	15.34	2.54	6.91	17.84	2.82	2.89	6	1.32	3.88	1.36	2.31	18.23	17.93	1.51	0.74	0.3	0.3
Swan Gourd	11.24	15.11	2.83	7.34	18.19	2.75	2.84	4.6	1.28	3.91	1.35	2.31	20.62	18.34	2.82	0.9	0.2	0.6
Water Jug Gourd	11.84	15.69	2.44	7.26	17.29	2.99	35.65	4.9	1.29	4.02	1.32	2.28	22.63	13.92	1.93	0.7	0.2	0.3
Mini Dipper Gourd	11.68	15.26	2.75	6.46	17.24	2.99	2.93	5.4	1.28	3.93	1.26	2.36	5.32	4.55	0.91	0.53	0.2	0.2
Chinese Bottle Gourd	11.56	13.8	2.67	7.12	17.84	2.84	2.88	6.2	1.33	4.06	1.3	2.48	15.74	6.26	1.39	0.76	0.3	0.3
Long Siphon Gourd	11.43	14.73	2.68	7.01	16.54	2.7	2.69	5.7	1.31	3.91	1.27	2.31	5.81	5.48	1.12	0.62	0.2	0.2
Powder Horn Gourd	11.93	15.95	2.66	6.74	17.96	2.71	2.67	4.6	1.3	3.59	1.3	4.42	18.72	6.93	1.81	0.87	0.3	0.2
Goose Neck Gourd	11.45	13.91	2.68	7.16	16.56	2.65	2.7	4	1.26	4.02	1.29	2.3	13.22	6.71	1.42	0.62	0.2	0.2
Base Ball Gourd	11.76	14.55	2.66	6.47	18.39	2.71	2.8	5	1.31	3.93	1.29	2.28	5.54	3.46	0.97	0.51	0.1	0.1
Bird House Gourd	11.56	15.5	4.28	6.84	18.27	2.55	2.58	4.5	1.37	3.87	1.32	2.29	9.83	4.67	1.23	0.64	0.2	0.3
Nigeria Rattle Gourd	11.87	15.85	2.84	7.11	17.12	2.77	2.89	3.8	1.27	3.84	1.33	2.29	5.78	5.22	1.14	0.61	0.3	0.2
Microphone Gourd	11.77	15.61	6.17	7.13	17.69	2.78	2.97	6	1.31	3.88	1.2	2.28	5.44	3.64	1.03	0.42	0.2	0.1

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	LEAF LENGTH > or =10.5	LEAF WIDTH > or =14.5	INTERNODE .> or = 2.5	FLOWER STALK > or = 6.5	TENDRIL > or =16.5	FLOWER BUD >or= 2.6	MALE PETALS LENGTH > or =2.6	MALE PETALS WIDTH > or =4.5	MALE SEPALS > or = 1.3	FEMALE PETALS LENGTH > or = 3.5	FEMALE PETALS WIDTH > or =1.3	FEMALE SEPALS > or = 2.3	FRUIT LENGTH > or = 20.5	FRUIT WIDTH > or = 20.5.	SEED LENGTH > or = 1.5	SEED WIDTH > or =0.9	SEED THICKNESS > or =0.3	HELIUM > or = 0.3	HELIUM POINTED	DOUBLE PROTRUSION ON SEED
Snake Gourd	0	0	1	0	0	1	1	0	0	1	0	0	1	0	1	0	0	1	0	1
Pot Gourd	0	0	1	0	0	1	1	0	0	1	0	1	0	0	1	1	0	1	0	0
Bushel Gourd	0	0	1	1	0	1	1	1	0	1	1	0	0	0	1	1	0	1	0	0
African Bottle	0	0	1	0	0	1	1	1	1	1	0	1	1	0	1	0	0	1	0	1
Indian Gourd	0	0	1	1	0	0	1	1	0	1	0	1	1	0	1	0	0	5	0	0
Caveman Club Gourd	1	1	1	1	1	1	1	1	1	1	1	0	1	0	1	1	1	0	0	0
Long Handle Dipper Gourd	1	1	1	1	0	1	1	1	0	1	0	1	1	0	1	1	0	1	1	0
Extra Large Pawpaw Gourd	1	1	1	1	1	1	1	1	0	1	1	1	0	0	1	1	1	1	0	1
Cup Gourd	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
Kettle Gourd	1	1	1	1	1	1	1	0	1	1	1	1	0	0	1	0	0	1	0	0
Warted Bushel Gourd	1	1	1	1	0	1	1	0	1	1	1	1	0	1	1	1	1	1	0	0
Pennis Shield Gourd	1	1	1	1	1	0	1	1	0	1	1	1	0	0	1	0	1	1	0	1
Palm Wine Gourd	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	0	1	1	0	0
Swan Gourd	1	1	1	1	1	1	1	1	0	1	1	1	1	0	1	0	0	1	1	0
Water Jug Gourd	1	1	0	1	1	1	1	1	1	1	1	0	1	0	1	0	0	1	0	1
Mini Dipper Gourd	1	1	1	0	1	1	1	1	0	1	0	1	0	0	0	0	0	0	1	1
Chinese Bottle Gourd	1	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	1	1	0	1
Long Siphon Gourd	1	1	1	1	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0
Powder Horn Gourd	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	0	1	0	1	0
Goose Neck Gourd	1	0	1	1	1	1	1	0	0	1	0	1	0	0	0	0	0	0	0	0
Base Ball Gourd	1	1	1	0	1	1	1	1	1	1	0	0	0	0	1	0	0	0	0	0
Bird House Gourd	1	1	1	1	1	0	1	1	1	1	1	0	0	0	0	0	0	1	1	1
Nigeria Rattle Gourd	1	1	1	1	1	1	1	0	0	1	1	0	0	0	0	0	1	0	0	0
Microphone Gourd	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1	0

Fig. 4: Data Matrix involving 24 OTUs (t) and 20 Characters (n) and hence 480 attributes (t x n). Presence = 1; Absence = 0

Morphological Relationship of Characters

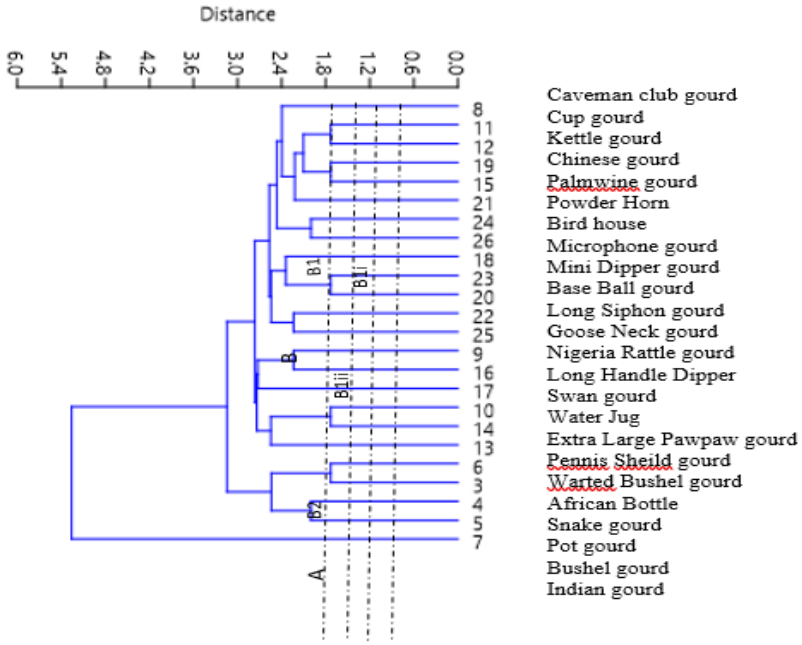

Fig. 5: A dendrogram showing morphological relationship of the different fruit shapes.

Discussion

The landraces of *L. siceraria* as summarized in Table 1 show that they are annual plants, trailing, with highly pubescent leaves and moderately pubescent stems. The tendrils are bifid, with a simple palmate leaf and alternate phyllotaxy. The flower is unisexual, solitary, and monoecious. The male flower (Plate 2) is white and conical with long stalk and buds before the female flower. The female flower has an inferior ovary in the shape of the fruit and a short flower stalk (Plate 3). Morphological characterization of the species showed great diversity in fruit (Fig. 3) and seed shape in congruence with the work of Chimonye and Modi (2013), Morimoto and Mvere (2004), and Silitoe (2003). The fruit shapes in Nigeria have been so diverse that an attempt is made to name the twenty- four different landraces this therefore includes: Snake Gourd, Pot Gourd, Bushel Gourd, African Bottle, Indian Bottle Gourd, Caveman Club Gourd, Long Handle Dipper Gourd, Extra Large Pawpaw Gourd, Cup Gourd, Kettle Gourd, Palmwine Gourd, Pennis Shield Gourd, Swan Gourd, Warted Bushel Gourd, Water Jug Gourd, Long Siphon Gourd, Chinese Bottle Gourd, Mini Dipper Gourd, Powder Horn Gourd, Goose Neck Gourd, Baseball Gourd, Bird House Gourd, Nigeria Rattle Gourd, Microphone Gourd. The variation in seed shape was quite notable (Clarke et. al., 2006), some seeds of some landraces such as Cup Gourd, Kettle Gourd Palmwine Gourd, Warted Bushel Gourd, Long Siphon Gourd, Mini Dipper Gourd, Bird House Gourd, and Microphone Gourd, has side protrusions at the end and a furrowed seed coat, while some others which include Snake Gourd, Pot Gourd, African Bottle, Indian Bottle Gourd, Caveman Club Gourd, Extra Large Pawpaw Gourd, Swan Gourd, Water Jug Gourd, Baseball Gourd and Nigeria Rattle Gourd, have are like a square without protrusion but has a conspicuous seed coat furrow.

A final seed set which consists of a Bushel Gourd, Long Handle Dipper Gourd, Pennis Shield Gourd, Chinese Bottle Gourd, Goose Neck Gourd, and Powder Horn Gourd, possesses a visible round end with a smooth seed coat surface. The diagnostic characters considered in Table 2 include leaf length and width, internode, flower stalk, tendril length, flower bud length, male and female petal and sepal length and width, seed thickness, helium, number of seeds per pod, seed length and width and matured fruit length and width. A simple taximetric analysis using morphological characters showed similarities and dissimilarities that exist between the landraces of *L. siceraria* found in Nigeria which is in line with the method (Stace, 1991; Davis & Heywood, 1973). The qualitative and quantitative morphological characters were converted to character states of operational taxonomic unit (Fig. 4) which

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corroborates the report of Whitehead and Sinha, (1967). The dendrogram (Fig. 5) showed that the Indian gourd is an outgroup standing alone with a distance of 5.4 from other groups. At 3.4 they are grouped into two major groups, the first group having four landraces and the second group having nineteen landraces meeting at different distances. In the first group (A) pot gourd and bushel gourd meet at a distance of 2.0, while African bottle and snake gourd meet at a distance of 1.6. The second group (B) were divided into two groups B1 and B2, B2 comprised about six landraces joining at different distances; water jug gourd at 2.6, warted bushel gourd at 2.4, clustering together with Extra Large Pawpaw gourd and Pennis Shield gourd at 1.6, while Long Handle Dipper and Swan gourd clustered at a distance of 2.2. B1 consists of two major groupings with different clusters at different morphological distances, B1i and B1ii. B1ii is made up of five landraces, with Goose Neck gourd and Nigeria Rattle gourd clustering at a distance of 2.2, while Mini Dipper gourd is an out-group at a distance scale of 2.4 in the cluster of Base Ball gourd and Long Siphon gourd at various distances of 1.8, 1.8, respectively. The B1i has a total of eight landraces with two clusters and two out groups within the clusters at different distance scales. Birdhouse and Microphone gourd clustered at 2.0, while the second group which consists of Cup gourd, Kettle gourd, Chinese gourd and Palmwine gourd clustered at a distance of 1.8 each, having the first out group as Caveman club gourd at 2.0 and the second out-group as Powder Horn at a distance scale of 2.2. The morphological relationship as demonstrated on the data matrix (Fig. 4) and dendrogram (Fig. 5) shows that morphological characters can be characterized below the species level using taximetrics.

Conclusion

Taximetric evidence has been instrumental in improving the classification of *Lagenaria siceraria* landraces in Nigeria and understanding their evolution. The vegetative and floral characteristics of these landraces have been documented, providing valuable insights into their diversity and relationships. These findings can be used to guide future breeding and conservation efforts for this important crop.

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