TAXONOMIC EVALUATION OF SOME SPECIES IN THE FAMILY CUCURBITACEAE

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B.Sc. (Ife)

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CERTIFICATION

This is to certify that this research study was carried out by OMOTAYO TITILAYO COMFORT as part of the requirement for the award of Master of Science degree in Botany of the Obafemi Awolowo University, Ile – Ife.

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DEDICATION

This marvelous work is dedicated to God almighty the giver of LIFE.

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ABSTRACT

Ten species with four varieties in the family Cucurbitaceae were subjected to morphological, anatomical and palynological assessment with a view to finding additional diagnostic characters of taxonomic importance.

The species studied were ***Telfairia occidentalis*** (Hook. f)**,** ***Trichosanthes anguina*** Linn.*, Citrullus lanatus* (Thunb.) Matsum. and Nakai., ***Cucumis melo*** Linn., *Lagenaria siceraria* (Molina) Stand., *Cucumeropsis edulis* (Hooker.f) cogn.*,* ***Cucurbita maxima*** Duch.ex Lam.*, Cucumis sativus* Linn.*, Luffa cylindrica* M.(Roem) and *Momordica charantia* Linn. The habits of the species were noted while other qualitative morphological characters were studied by direct observation and quantitative morphological characters were measured. For anatomical studies, epidermal peels and venation study were carried out using standard methods. The palynological study was also carried out using standard methods. Quantitative data obtained were subjected to Analysis of Variance, Duncan Multiple Range Test and Palaentological Statistics (PAST).

The result of the morphological study revealed many morphological similarities among the species with few variations. The Single Linkage Cluster Analysis using morphological quantitative data revealed the clustering of the taxa based on generic similarities with few overlaps. Characters delimiting species based on foliar anatomy include: epidermal cell shape and size on adaxial and abaxial surfaces, anticlinal wall pattern, stomata index and areole size. The plant species were all amphistomatic except in *Telfairia occidentalis* which was hypostomatic. Stomata type was largely brachyparacytic and anomocytic with anisocytic type occurring often. Staurocytic type of stomata was unique to ***Cucumeropsis edulis*** while contiguous stomata were unique to *Cucumeropsis edulis* and ***Telfairia occidentalis*** (Female). Glandular multicellular and nonglandular multicellular trichomes were encountered in all the species studied except

in *Trichosanthes anguina* with only nonglandular trichomes. The palynological study revealed the following type of pollen grain shapes in the species studied: Spheroidal, Sub – Spheroidal, Sub – prolate, Sub – oblate, Prolate, Spheroidal to Oblate – Spheroidal, Prolate – Sphereoidal, Sub – Oblate, Oblate – Spheroidal. Acolpate, monocolpate, monoporate, bicolporate, tricolporate and tetracolporate pollen types were observed and documented. Tetracolpate pollen was encountered in *Cucumeropsis edulis* only. Classification based on size reveals that all the species studied belong to the Media group except *Momordica charantia* and *Cucurbita maxima.* Many morphological, anatomical and palynological characters separated the male and the female *Telfairia occidentalis* and the varieties of *Lagenaria siceraria, Citrullus lanatus* and *Cucumis melo* studied.

The study provided additional information on the characters and relationships between the species and varieties in the family Cucurbitaceae, using taxonomic evidences derived from morphology, anatomy and palynology.

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Species in the Family Cucurbitaceae

The order Cucurbitales in the eurosid I clade comprises almost 2600 species in 109 or 110 genera in eight tropical and temperate families of very different sizes, morphology and ecology (Zhang *et al.*, 2006; Filipowicz and Renner, 2010; Schaefer and Renner, 2011). More than half of the species are in the mega-diverse genus *Begonia* of Begoniaceae with 2 genera and 1500 species (Forrest and Hollingsworth, 2003; Forrest *et al.*, 2005; Goodall-Copestake *et al.,* 2009). The remaining species are distributed among the genera of the Cucurbitaceae, a family of mainly herbaceous climbers and woody lianas with 95 genera and 950–980 species (Schaefer and Renner, 2011) and six other families which are: Anisophylleaceae, a group of medium-sized to large trees with 4 genera and 29–34 species (Zhang *et al.*, 2007); holoparasitic Apodanthaceae with 2 or 3 genera and 19 species (Filipowicz and Renner, 2010); small shrubs in Coriariaceae with 1 genus and 15–20 species (Yokoyama *et al.*, 2000); evergreen trees in Corynocarpaceae with 1 genus and 5–6 species (Wagstaff and Dawson, 2000); perennial herbs in Datiscaceae with 1 genus and 2 species (Swensen *et al.*, 1998); and huge rainforest trees in Tetramelaceae with 2 genera and 2 species (Swensen *et al.*,1998). Cucurbitaceae Juss., which is a moderately large family of flowering plants (Yamaguchi, 1983) and also a very interesting and an outstanding family of dicotyledons, is distributed widely over the tropical parts of the world (Cobbley *et al.*, 1976). They have common features which are large leaves, creeping or climbing

stems usually with simple or branched tendrils, fleshy fruits called pepo, with leathery exocarp, containing numerous seeds, and a woody root stock.

1.2 Subfamilies of the Family Cucurbitaceae

The family was divided into two subfamilies by Jeffrey (2005), sub-family Nhandiroboideae representing a single tribe Zanonieae (Zanonioideae) and subfamily Cucurbitoideae which is subdivided into ten tribes which are, Joliffieae, Bryonieae, Trichosantheae, Herpetospermeae, Schizopeponeae, Luffeae, Sicyeae, Coniandreae, Benincaseae, Cucurbiteae. The most recent subfamilial and tribal classification of Cucurbitaceae (Jeffrey, 2005) is largely supported by molecular data (chloroplast data).

1.3 Features of the Species in the Family Cucurbitaceae

Species of the family Cucurbitaceae are usually hairy climbers with simple or branched lateral tendrils, yellow or whitish unisexual flowers, inferior ovary with parietal placentation and numerous relatively large seeds (Schaefer and Renner, 2011). Most Cucurbitaceae are perennial, herbaceous vines (rarely shrubs or trees) that usually climb by means of branched or unbranched tendrils. Shoot growth is monopodial (Bugnon, 1956; Kumazawa, 1964 and Lassnig, 1997). Tendrils in the Cucurbitaceae are generally considered to be part of an axillary complex (Lassnig, 1997), but their morphology differs between the two subfamilies in Cucurbitaceae. In subfamily Nhandiroboideae, a bifid tendril forms as part of the lateral shoot, which arises in the leaf axil (Lassnig, 1997). In contrast, in Cucurbitoideae, the "axillary" complex arises in an extra-axillary position. Cucurbits are among the largest and the most diverse plant families, having a large range of fruit characteristics, and are cultivated worldwide in a variety of

environmental conditions. Cucurbits are associated with the origin of agriculture and human civilizations and are also among the first plant species to be domesticated in both the Old and the New World. In Cucurbitaceae, 50% of the species are monoecious and 50% dioecious; very few species are androdioecious or bisexual (Schaefer and Renner, 2011). Shifts between monoecy and dioecy occur, both within genera e.g., *Bryonia*, (Volz and Renner, 2008); *Luffa*, (Schaefer and Renner, 2011); *Momordica*, (Schaefer and Renner, 2010) and within species e.g. *Ecballium*, (Costich, 1995). Cucurbitaceae are most diverse in tropical and subtropical regions with hotspots in Southeast Asia, West Africa, Madagascar, and Mexico (Schaefer and Renner, 2011).

1.4 Economic Importance of the Species in the Family Cucurbitaceae

Cucurbit species are among the economically most important vegetable crops worldwide and are grown in both temperate and tropical regions (Pitrat *et al*., 1999 and Paris, 2001). They are an important source of vegetables, fruits, edible seeds and seed oil, domestic utensils, medicines, water, animal fodder and fuel. Many Begonias are popular ornamentals and the Family Cucurbitaceae include some of the World's most important vegetable crops, such as melon (*Cucumis melo* L.), cucumber (*C. sativus* L.), water melon (*Citrullus lanatus* (Thunb.) Matsumura and Nakai), squash and pumpkin which are *Cucurbita* spp. Some species of family Tetramelaceae are sources of a relatively soft timber, used for pulp and container production, and their young leaves are eaten as vegetables (Soerianegara and Lemmens, 1995). Examples of species grown as food crops include the Cucumber (*Cucumis sativus*), Rock and Honeydew melons (*Cucumis melo* var. *melo*), Water Melon (*Citrullus lanatus*), West Indian Gherkin (*Cucumis anguria*), Pumpkins and Squashes (*Cucurbita moschata* and *C. maxima*), Snake Gourd (*Trichosanthes anguina*), Bitter Gourd (*Momordica charantia*) and Pepitos (*Cucurbita pepo*). Other uses include medicinal applications, *e.g.* as an abortifacient, as a treatment for diabetes,

and for ear ache. Gourds in the family are used as containers and as resonators in musical instruments such as the sitar (Vaughan & Geissler (1997).

Cucumis sativus are consumed raw or pickled (gherkin). Mature uncooked cucumbers bring relief for individuals suffering from celiac disease, and promote skin health. Edible oil can be extracted from the seeds and used for cooking. Immature cucumbers can be cooked and consumed to treat dysentery. The fruit is also valued in the cosmetic industry, used to soften the skin. A poultice made from fresh cucumbers can be applied to burns and open sores. The seeds can be used to expel parasitic worms. Cucumber peel when eaten by cockroaches is reported to kill them after several nights, the juice from the leaves induce vomiting and aid digestion. The seedlings are toxic and should not be consumed (Grubben, 2004). The fiber of a mature loofah fruit (*Luffa sp.)* can be used as a sponge for personal hygiene, household cleaning and various other purposes, including filtration. Seeds or fruit parts of some Cucurbits are reported to possess purgatives, emetics and antihelmintics properties due to the secondary metabolite Cucurbitacin content (Robinson and Decker-Walters, 1997). The importance of "Egusi" crops has been raised under various circumstances by other authors like Schippers (2000; 2004) and Vodouhe *et al*. (2001) as a weed