



LEAF EPIDERMAL STRUCTURES IN SELECTED MEMBERS OF THE SOLANACEAE FAMILY

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Abstract

The research work was carried out on the leaf epidermal structures of some members of the Solanaceae family in the Department of Biological Sciences Bayero University, Kano. It involved the use of some leaf epidermal structures in order to determine the extent of relationship within the members of *Solanum*, *Lycopersicon* and *Capsicum* genera studied.

Emphasis was given to the measurement of stomata dimensions, stomata and trichome types and the calculation of stomata index on the lower surfaces of the leaves of the species. Analysis of the results of stomata measurement showed differences and in some cases showed relationship between the members of different genera in the Solanaceae family studied. Results showed anomocytic and anisocytic types of stomata in *Solanum melongena*, paracytic stomata were found in *Lycopersicon esculentum*. Diacytic stomata was found in *Solanum tuberosum*. Stellate trichomes were found in *Solanum melongena*, uniseriate trichomes were found in *Capsicum annum*, *Solanum tuberosum* and *Lycopersicon esculentum*. The results justified the Linnean classification in agreement with the separation of the respective genus.

Keywords: Solanaceae, Stomata index, Trichomes, Relationship, Classification

INTRODUCTION

Classification in the family Solanaceae has been the subject of intensive taxonomic research by many taxonomists. There are many discrepancies regarding taxonomic ranks assigned to



some taxa. One of such controversies concerns hierarchical rank assigned to the tomato and its wild relatives. The correct Latin name for this specie has been subject to much discussion which has not been fully resolved (Artherton *et al.*, 1986). This has resulted as in the separation of taxa from *Solanum* genera and put in the new genera *Lycopersicon* and back again to *Solanum*. *Solanaceae* is of great economic importance as it includes many species that yield vegetables of common use. Amongst these are potato (*Solanum tuberosum*), tomato (*Lycopersicon esculentum*), sweet and hot peppers (*Capsicum* spp) and egg plant (*Solanum melongena*). Other species found in West Africa include *Physalis angulata* (Wild space gooseberry), *P. micrants* (slender wild gooseberry). Many species contain alkaloids which are used medicinally. Through histochemical tests following the techniques of Jahansen (1940), it has been confirmed that the family *Solanaceae* is rich in alkaloids and this coincided with report by Dominquez (1979). Some members are also cultivated as garden ornamentals. Therefore, this research was aimed at determining the leaf epidermal structures of three species of the family solanaceae in order to ascertain the existing grouping of the species.

MATERIALS AND METHOD

Collection and Handling of Materials

Seeds of various members of the family Solanaceae representing different varieties were obtained from Kano State Agricultural and Rural Development Authority (KNARDA) and Yankaba market. The plant species studied include different varieties of *Capsicum* spp, *Lycopersicon* spp and *Solanum* spp. The seeds were first planted in pots and after two weeks were transplanted to beds on the soil. The plants were grown to sixth week. At that time, the plant parts began to be collected for the research work. The work was carried out in the botanical garden of the Biological Sciences department, Bayero University Kano. The parts of the plant that were obtained for the laboratory examination included the leaves and the stems. Representative members of the family *Solanaceae* studied include the following genera with their respective species or varieties.

1	<i>Solanum melongena</i>	Striped Garden egg (Yalon Bello)	A1
2	<i>Solanum melongena</i>	Green Garden egg	A2
3	<i>Solanum melongena</i>	White Garden egg	A3
4	<i>Solanum melongena</i>	Black Garden egg	A4
5	<i>Lycopersicon esculentum</i>	Local Tomato	B1
6	<i>Lycopersicon esculentum</i>	U.C.B. Tomato	B2
7	<i>Lycopersicon esculentum</i>	Roma Tomato	B3
8	<i>Solanum tuberosum</i>	Nicola Irish Potato	C1
9	<i>Solanum tuberosum</i>	R.C. Irish Potato	C2
10	<i>Solanum tuberosum</i>	Kondor Irish Potato	C3
11	<i>Capsicum annum</i>	Barkono Chilli Pepper	D1
12	<i>Capsicum annum</i>	Tattasai Sweet Pepper	D2
13	<i>Capsicum annum</i>	Attarugu Hot Pepper	D3

Each species was represented by an alphabet and a number.



Methods of Studying the Leaves and the Stems

For each species the epidermis of the leaves was removed from the leaf surface at the third middle of the central leaflet of the fresh leaf by peeling technique as described by Colares and Mujika (1997). The adaxial or upper epidermis (UE) and the abaxial or lower epidermis (LE) were removed from the same sector but of different leaves using the peeling technique. Staining was done using Safranin and the peel was then mounted in 50% glycerin jelly. The slides were examined for both stomata and trichome using an Olympus microscope specially equipped with camera lucida. The magnification used was at x400. Epidermal peels were obtained from the stem using the method described above.

Examination of Stomata and Associated Structures

The prepared slide of the plant material was used for the study. The parameters studied were as follows.

1. Size of the guard cells and the stomatal aperture was measured using micrometer and eye piece graticule.
2. Number of stomata and epidermal cells per field of the microscope was taken in ten replicates.
3. The arrangement of subsidiary cells was observed and the nature of their arrangement was described.
4. The type of epidermal cells was also examined.
5. Stomatal index was calculated using the following formula

$$\frac{\text{Number of stomata} \times 100}{\text{number of stomata} + \text{number of epidermal cell}}$$

Trichome Study

Using the micrometer eyepiece graticule and stage micrometer, the prepared plant material was studied for the nature and size of the trichome. Ten replicates were taken. Photomicrographs were also made.

Statistical Analysis

The different measurements magnified (X400) presented in millimeter (mm) were subjected to an analysis of variance (ANOVA) with (P<0.001).

RESULTS AND DISCUSSION

Stomata Measurement in Leaves

The result of stomata measurement in leaves and stems signifies existing differences and also similarities between the various genera and species in the members of the Solanaceae studied. This has emphasized the fact that classification in the Solanaceae family is controversial.

The stomata length measurement in leaves (Table 1) has shown that significant differences exist between genera of *Solanum tuberosum* and *Lycopersicon esculentum*, *Solanum tuberosum* and *Solanum melongena* species, *Capsicum annum* and *Lycopersicon esculentum*, *Lycopersicon esculentum* and *Solanum melongena* as well as *Capsicum annum* and *Solanum melongena* genera.



There is however no significant difference between *Solanum tuberosum* and *Capsicum annum* (D1 and D2) and between *Lycopersicon esculentum* (B1) and *Solanum melongena* (A3). Stomata breadth showed significant differences between *Solanum* and *Lycopersicon* genera.

Analysis of the leaf measurement has shown that a significant difference exists between the genera based on the stomatal index. It has shown that significant difference exist between the varieties of *Solanum melongena* and *Lycopersicon esculentum* (except in A2 where similar index was calculated with B2 and B3). This also applies to *Lycopersicon esculentum* and some varieties of *Capsicum annum*. The stomatal index has proved to be important in the separation of the *Lycopersicon esculentum*, *Solanum melongena* and *Solanum tuberosum* genera. Based on these results the stomata index calls for reclassification of *Solanum melongena* and *Solanum tuberosum* genera and agrees with the independent status of the *Lycopersicon* genera. This is shown in Table 1.

TABLE 1. MEAN STOMATA MEASUREMENT (mm Mg X400) IN LEAVES OF SOME MEMBERS OF THE SOLANACEAE FAMILY

S/NO.	SPECIES/VARIETIES	STOMATA		PORE		STOMATAL PER FIELD	BREADTH	EPIDERMAL	STOMATAL INDEX
		LENGTH	BREADTH	LENGTH	BREADTH		/GUARD CELL	CELLS /FIELD	
1	<i>Solanum melongena</i> (Egg plant) A1	1.93	1.50	1.26	0.48	66.60	0.50	240.00	21.72
2	<i>Solanum melongena</i> (Green) A2	2.04	1.45	1.23	0.40	93.60	0.49	225.00	29.38
3	<i>Solanum melongena</i> (white) A3	2.22	1.66	1.37	0.46	66.50	0.55	226.20	22.72
4	<i>Solanum melongena</i> (Black) A4	2.12	1.45	1.23	0.43	53.90	0.54	234.30	18.70
5	<i>Lycopersicon</i> <i>esculentum</i> (Local) B1	2.25	1.55	1.34	0.36	67.70	0.67	143.40	32.07
6	<i>Lycopersicon</i> <i>esculentum</i> (UCB) B2	2.41	1.66	1.69	0.29	58.50	0.66	138.70	29.67
7	<i>Lycopersicon</i> <i>esculentum</i> (Roma) B3	2.38	1.69	1.66	0.32	61.00	0.67	143.70	29.80
8	<i>Solanum tuberosum</i> (Nicola) C1	2.89	1.79	1.93	0.47	35.70	0.54	140.50	20.26
9	<i>Solanum tuberosum</i> (RC) C2	2.92	2.09	2.14	0.56	34.40	0.75	153.50	18.31
10	<i>Solanum tuberosum</i> (Kondor) C3	3.16	2.22	2.20	0.60	32.00	0.78	139.20	18.69
11	<i>Capsicum annum</i> (Barkono) D1	2.97	1.90	1.93	0.43	43.00	0.68	128.50	25.07
12	<i>Capsicum annum</i> (Tattasai) D2	2.84	2.04	1.77	0.52	35.00	0.64	219.00	13.78
13	<i>Capsicum annum</i> (Attarugu) D3	2.68	1.85	1.79	0.54	74.60	0.56	216.00	25.67
	LSD 5% interaction	0.20	0.15	0.19	0.06	6.90	0.04	14.40	2.24

Nature of Stomata

Species studied presented diverse type of epidermal structures. *Anomocytic* and *anisocytic* types of stomata were found in *Solanum melongena*, *Lycopersicon esculentum*, *Solanum tuberosum* and *Capsicum annum*, as seen in Figs.1, 2, 3 and 4.

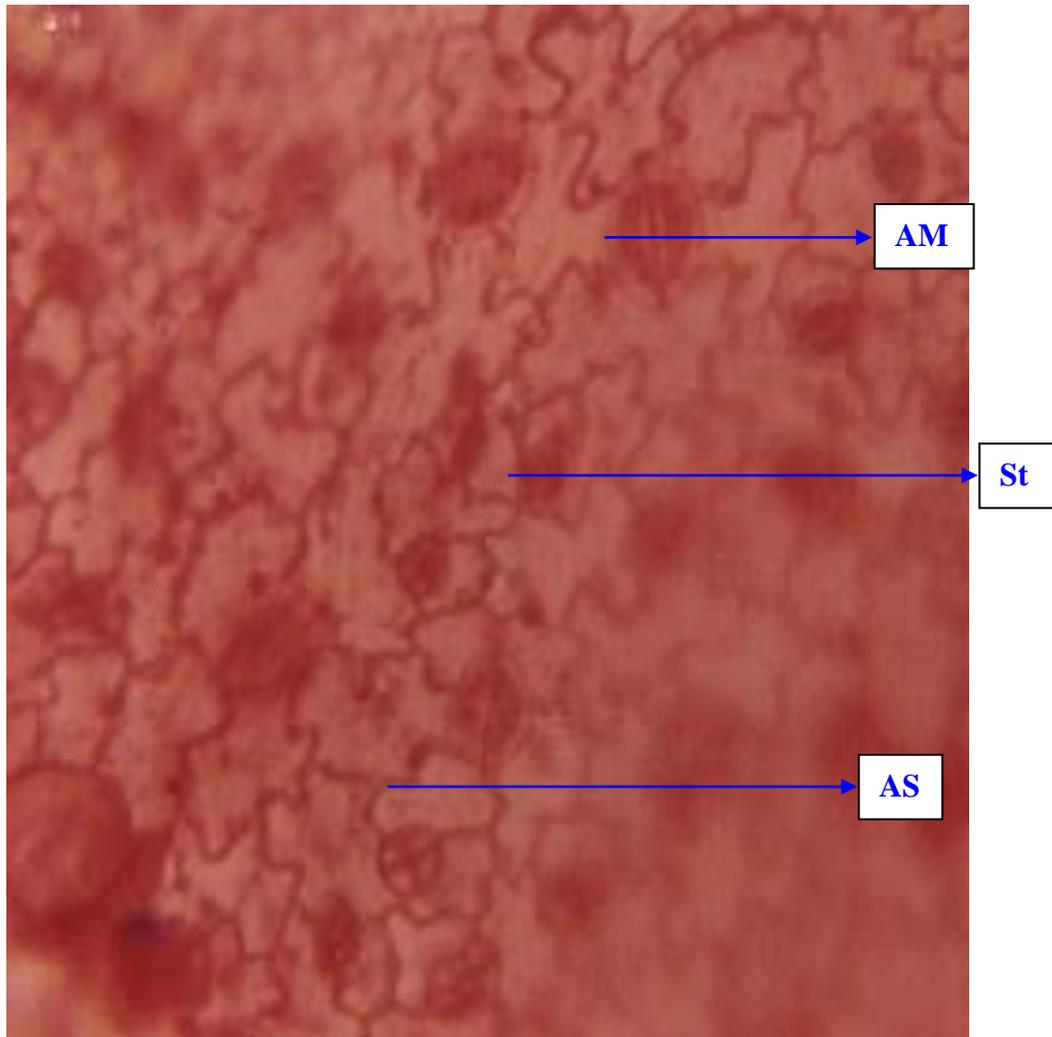


Fig 1: Leaf epidermal peel of *Solanum melongena* (Yalon Bello) showing stomata type (Mg X400)

Key:

- St Stomata
- AS Anisocytic
- AM Anomocytic

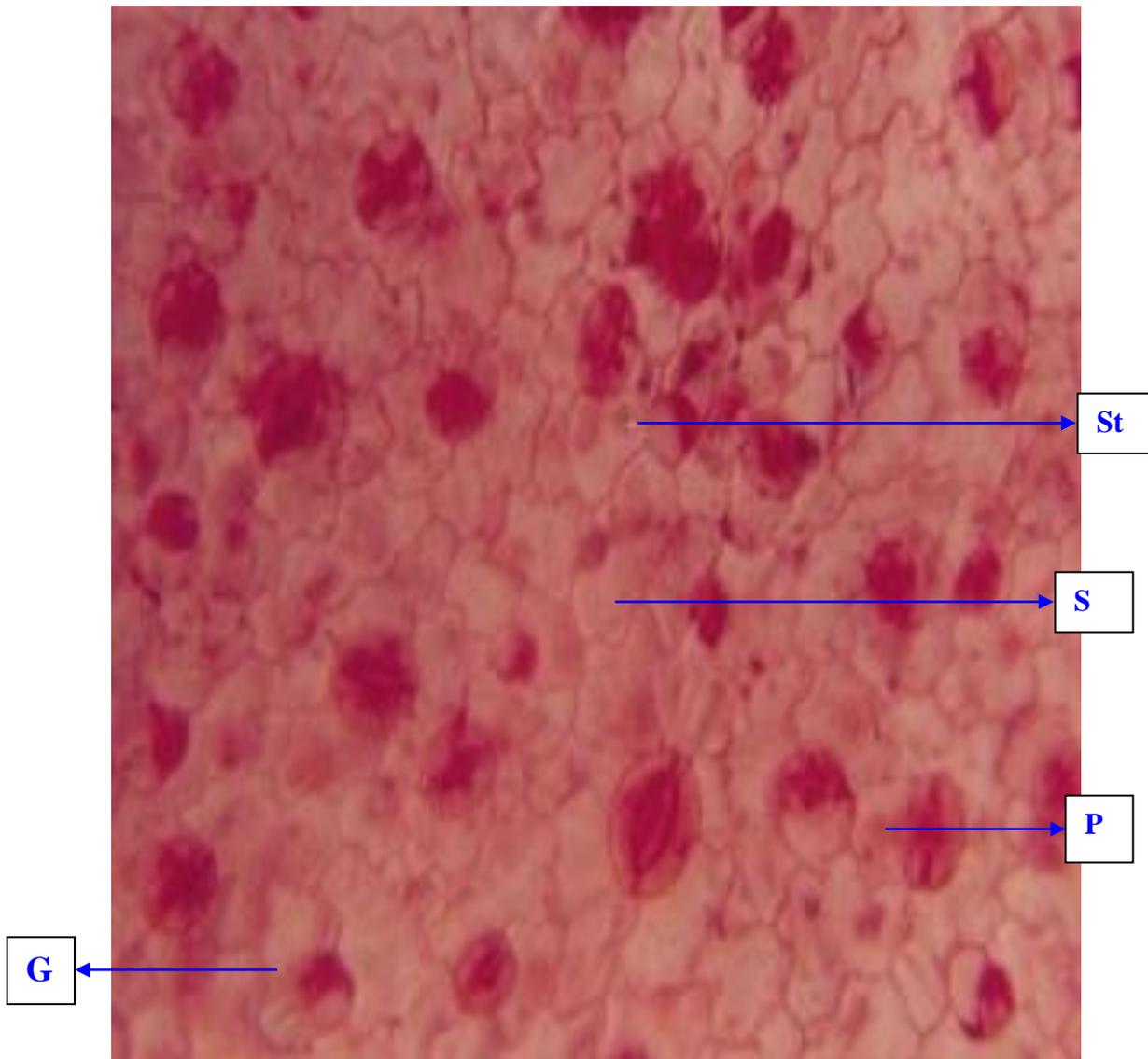


Fig. 2 Leaf epidermal peel of Lycopersicon esculentum (local) showing stomata type (Mg X400)

Key:

- St Stomata
- S Subsidiary cell
- G Guard cell mother cell
- P Paracytic Stomata

This is in accordance with the findings of Maiti *et al.*, (2001). This type of stomata reported by Sabnis as cited by Metcalfe and Chalk (1950) as being characteristic of the family. Diacytic stomata were found in *Solanum tuberosum* as seen in Fig. 3.

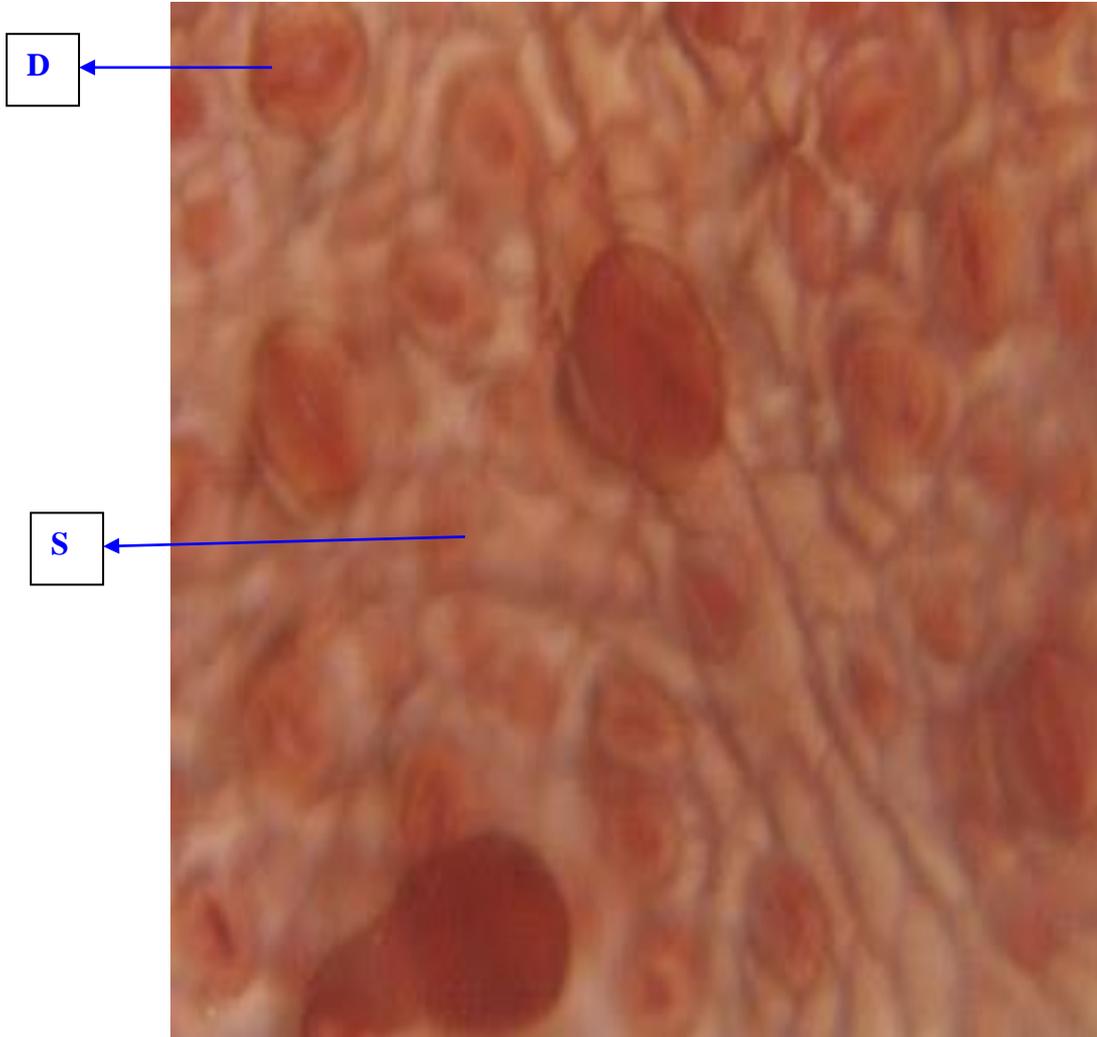


Fig. 3 Leaf epidermal peel of *Solanum tuberosum* (Nicola) showing Diacytic Stomata (Mg X400)

Key:

- S Subsidiary cell
- D Diacytic Stomata

Thus more than one type of stomata could be found in a single plant species.

Stomata Distribution

Stomata distribution is amphistomatic, with stomata on both the adaxial and abaxial surfaces. They are extremely few on the adaxial surfaces.



Fig. 4 Leaf epidermal peel of Capsicum annum (Tattasai) showing stomata type (Mg X400)

Key:

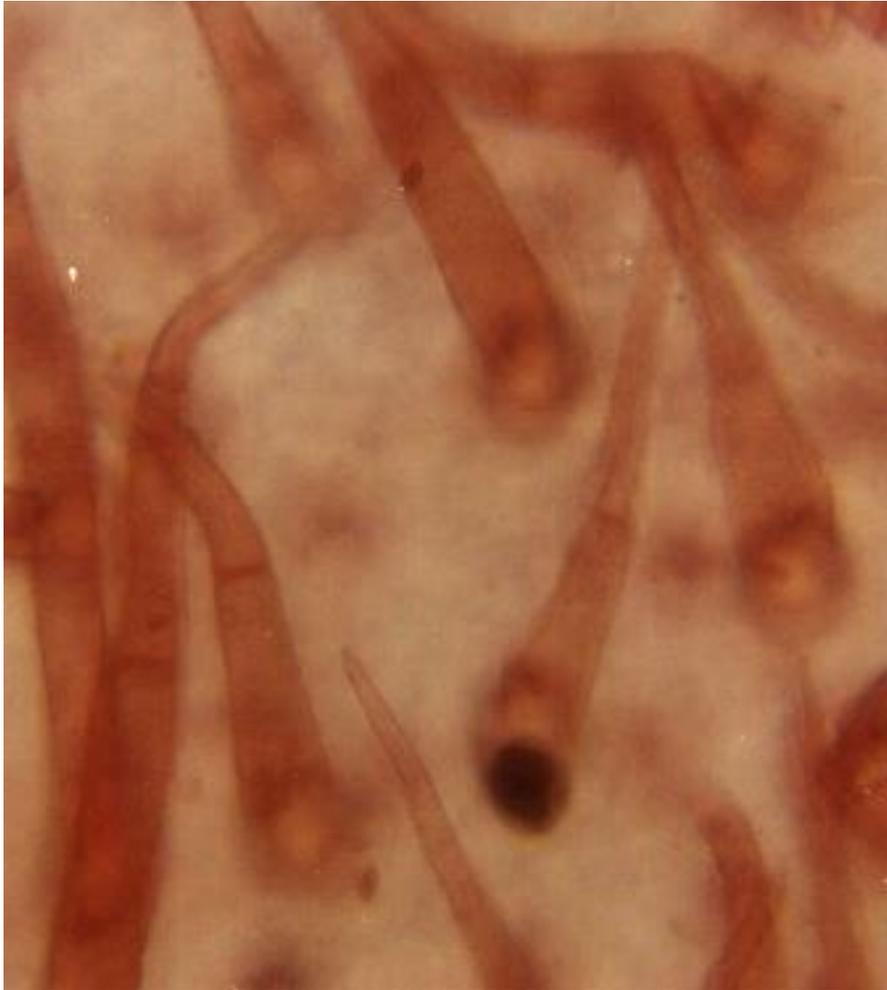
St Stomata

G Guard cell mother cell



Trichome Types

Trichomes observed were uniseriate in *Lycopersicon esculentum*, *Solanum tuberosum* and *Capsicum annum* as seen in the following figures: (Fig. 5, 6 and 7).



*Fig. 5 Leaf epidermal peel of Lycopersicon esculentum UCB
Uniseriate Trichomes (Mg X400)*



Fig. 6 Leaf epidermal peel of Solanum melongena (White) showing Stellate Trichome (Mg X400)

Another type of trichome found in *Lycopersicon esculentum* is a type with a stalk and unicellular head as seen in the figure that follows.



Fig. 7 Leaf epidermal peel of *Lycopersicon esculentum* UCB
Trichome with stalk and unicellular head Mg (x 400)

DISCUSSION

The species presented diverse types of epidermal structures.

Trichomes observed were uniseriate in *Lycopersicon esculentum* (Tomato), *Solanum tuberosum* (potato) and *Capsicum annum* (pepper), though extremely few in *Capsicum annum*. Vasquez (1985) had reported stellate trichomes to be found in *Solanum* genera. Another type of trichome found in *Lycopersicon esculentum* is a type with a stalk and unicellular head. This type of trichome was reported to be a characteristic of *Datura innoxia* (Trease and Evans, 1984) which is also a member of the Solanaceae family.

The shape of epidermal cells vary from irregular to square shape which was in accordance with the work of (Maiti *et al.*, 2001) though rectangular shapes were also found.

Anomocytic stomata were found in *Lycopersicon esculentum*. This was in accordance with the findings (Maiti *et al.*, 2001). Anisocytic stomata were also found and this type of stomata was reported by Sabris cited by (Metcalfe and Chalk, 1950) as being characteristic of the family. Diacytic stomata was found in *solanum tuberosum*. Watson and Dalwitz (1992) reported that stomata in the Solanaceae may be anomocytic, Anisocytic or diacytic. Paracytic stomata was found in *Lycopersicon esculentum*, *Capsicum annum* and *Solanum tuberosum*. Thus more than one type of stomata may be found in single plant species.



CONCLUSION

The stomatal type and distribution did not prove reliable in the separation of genera. The stomatal measurement in the leaves proved to be reliable in the separation of *Solanum* and *Lycopersicon* genera. This is more evident in the stomata index, stomata length and breadth as well as the pore sizes. The measurements also showed relationships between some of the members thereby justifying the Linnaeus Classification.

The only trichome found not to be a characteristic of the *Solanum* genera is that with a stalk and unicellular head which was found in *Lycopersicon* genera. Thus, it could be helpful in the separation of *Lycopersicon* from *Solanum* genera.

RECOMMENDATION

With regards to the results obtained in this research, it could be recommended that: The study of foliar epidermal structures of the members of the family Solanaceae should be encouraged in order to have a better understanding of classification in the family.



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