The first part of the study focuses on the systematic hierarchy of three infraspecific taxa of *Thevetia peruviana* of family Apocynaceae, distinguished by different colour blooms produced in yellow, orange and white shades. The similarities and differences among the three morphovariant taxa were assessed through ‘Biosystematics’ studies, taking evidences from various disciplines of morphology, anatomy, embryology, palynology, phytochemistry and DNA sequencing, in order to place at suitable hierarchical levels. After thorough systematic studies, a suitable trinomial nomenclature was given to orange and white forms of yellow oleander giving sub varietal and varietal status, following the ‘Melbourne code’ generated in 2012.

Being a plant with a wide range of pharmacological activities, both phytochemical and pharmacological evaluations were carried out. The physico-chemical profile includes assessment of ash values, extractive values using polar solvents, and composition of selected essential elements (Na, K, Ca, Mg) and heavy metals (As, Hg, Cd, Pb). Results revealed a higher ash content in the leaves, good amount of extractable phyto-constituents using ethanol and water, and a higher content of Ca and K in leaves and fruit rinds, offer great pharmacological value in folk medicine.

Preliminary phytochemical screening of various plant parts for the detection of primary and secondary metabolites was carried out in successive soxhlet fractions prepared using petroleum ether, chloroform, ethyl acetate and methanol. Primary metabolites are concentrated in the rind fractions and most of the secondary metabolites were distributed throughout the plant body. Total cardiac glycosides were estimated highest in seed kernels of all three morphovariants. *Peruvoside*, the selected cardiac glycoside for the present study, was quantified in the
positive fractions (chloroform, ethyl acetate) using HPTLC fingerprinting in all the plant parts, after detecting its presence in TLC plates using the mobile solvent mixture chloroform-methanol (8:2). The study revealed that a higher percentage of extractable *peruvoside* exist in the seed kernels, followed by flowers, leaves and fruit rinds.

Pharmacological properties of the plant extracts were evaluated by various methods. The antimicrobial properties of different plant parts of three morphovariants were assessed by agar well diffusion method against seven pathogenic microbes that causes common skin infections. Most of the tested bacterial strains (*Nocardia asteroids*, *Proteus mirabilis* and *Pseudomonas aeruginosa*) and fungal pathogens (*Candida albicans* and *Trichophyton rubrum*) showed higher sensitivity to ethyl acetate fraction, moderate sensitivity to methanol fraction, and the chloroform fraction was highly effective at very low doses. Obviously, each plant part is a promising source of antimicrobials, which can be profitably extracted for skin protection.

Antioxidant efficacy was evaluated by DPPH free radical scavenging method. Methanol fraction of flowers and leaves showed higher efficacy followed by ethyl acetate and chloroform fractions. But both rind and kernel extracts were ineffective at the studied concentrations.

*In vitro* cytotoxic effects of plant extracts against two mouse tumour cell lines, Dalton’s Lymphoma Ascites (DLA) and Ehrlich’s Ascites Carcinoma (EAC) revealed that 70% crude methanol extracts of seed kernels showed highest effectiveness against both cell lines, followed by leaf and flower extracts. Among the successive fractions, ethyl acetate fraction of seed kernels provided promising cytotoxic effects against both cell lines.

The toxic nature of the seed kernels was assessed on Wistar rat animal models, using acute and subacute oral drug exposure studies, and
the LD$_{50}$ value was detected as 375mg/kg body wt. During subacute drug exposure, both haematological and biochemical parameters, antioxidant enzyme levels in organ homogenates, cardiac marker enzyme levels and histopathology of vital organs were recorded as normal, except the elevations noted in the level of cardiac marker enzymes.

*In vitro* regeneration studies were successfully carried out from the young leaf and internode explants through somatic embryogenesis and indirect organogenesis cultured on MS medium supplemented with different concentrations and combinations of plant growth regulators. A lower concentration of 2,4-D + KIN combinations favoured higher frequency of somatic embryogenesis than the 2,4-D + BA combinations. An average shoot induction response was achieved in lower IBA + BA medium by indirect organogenesis. The best response of maximum shoot induction was obtained with BA (1.0 mg/l) medium supplemented individually for leaf explants, but the number of macro-shoots formed was lesser for internode explants. IBA (1.0 mg/l) on full strength MS medium showed better root induction and 68% of the acclimatized plantlets survived in greenhouse conditions. A pilot study was carried out for the quantification of *peruvoside* from selected calli developed on various hormonal combinations, showed that maximum drug was present in the callus grown in BA supplemented medium than in combinations.

**Key Words**: *Thevetia peruviana*, infraspecific, physico-chemical, cardiac glycosides, peruvoside, HPTLC, skin pathogens, antioxidant, tumour cell lines, cardiac marker enzymes, calli, somatic embryogenesis, indirect organogenesis.