



ABSTRACT

Solanum nigrum Complex is the name given to a group of closely related plants whose taxonomic status is an International controversy among different taxonomists. But no chemotaxonomic relationship has so far been studied due to lack of comprehensive investigation of chemical composition of the individual plant taxa.

The present chemotaxonomic studies, alongwith nutritional and biological evaluation, of the five locally available plant taxa of *S. nigrum* Complex viz.: *S. americanum* Mill., *S. chenopodioides* Lam., *S. nigrum* L., *S. retroflexum* Dunal and *S. villosum* Mill. were carried out in order to resolve the controversy on their taxonomic status and to reveal the medicinal importance of the individual taxa. In these studies the morphologically different plant taxa were grown under controlled conditions in the Botanic Garden, GC University Lahore, Pakistan, and third accession of each taxon was taken for the chemotaxonomic investigations. Comparative analyses of these plant samples were undertaken with respect to the Alkaloids, Flavonoids and Epicuticular wax as potential characters. The HPLC and GC-MS analyses of these constituents had not been reported previously. Also, with the exception of *S. nigrum*, literature is silent on the detailed chemical analysis of the taxa under study. Statistical analyses of results grouped taxa into different clusters.

The comparison of alkaloidal profile of the five taxa was used to establish the boundaries among close taxonomic groups. Yield of total glycoalkaloids in the five taxa ranged from 68.9±0.6 to 25±0.8% as determined by Titrimetric method. Glycoalkaloids analysed by HPLC demonstrated that the concentration of β-Solamargine was much higher in *S. villosum* (9.8 mg/g) than other samples but that of α-Solamargine was relatively higher in *S. nigrum* (5.03 mg/g). There was a gradual change in Solasonine concentration ranging from 2.01 mg/g (*S. villosum*) to 5.8 mg/g (*S. nigrum*). α-Solanine concentration was maximum in *S. retroflexum*. GC-MS of the aglycones depicted that percentage of Solanidine in the samples varied from 8.85-20.31% (being highest in *S. retroflexum*) while that of Solasodine from 66.99-85.67% (being highest in *S. americanum*). Significant distances were shown between *S. chenopodioides* and *S. villosum* as well as in



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americanum and *S. nigrum* in their respective clusters. However *S. retroflexum* did not show such a marked difference with respect to *S. nigrum*.

In order to further compare the differences among the five plant taxa, their flavonoid compositions were investigated. Total flavonoid contents in the taxa were calculated by two complementary colorimetric methods and ranged from 0.883 ± 0.020 to 2.116 ± 0.032 . From HPLC, it was found that *S. americanum* had the highest concentration of both Quercetin-3-glucoside (0.03520 mg/100mL) and Quercetin-3-galactoside (0.00750 mg/100mL) as well as of Quercetin aglycon (6.46 ± 0.01 mg/100g) when determined by GC-MS. Percentage of quercetin in the samples varied from 7.28 ± 0.33 to $92.92 \pm 0.45\%$. Statistical analyses of the results showed marked distances among *S. americanum*, *S. chenopodioides*, *S. nigrum* and *S. villosum* but indicated similarity between *S. nigrum* and *S. retroflexum*.

Epicuticular wax, a complex mixture of different constituents, is considered another important parameter for chemotaxonomic studies. The yields and physicochemical characters like Colour, Melting point, Refractive index, Saponification value, Acid value and Ester value of waxes extracted were compared. TLC indicated the presence of different classes of compounds in the waxes. GC-MS analysis showed the presence of Squalene, Phytol, Palmitic acid, Linolenic acid, ester of Palmitoleic acid along with a variety of hydrocarbons as the chemical constituents of these epicuticular waxes. The hydrocarbons, alcohols, some of the esters, acids, aldehyde and ketone identified had been reported for the first time in *S. nigrum*. The cluster analysis indicated significant differences between *S. chenopodioides* and *S. villosum* as well as in between *S. americanum* and *S. nigrum* in their respective clusters. Again *S. retroflexum* depicted great resemblance with *S. nigrum* in its epicuticular wax composition.

The similarity index and the Euclidean distance among the clusters formed by Multivariate cluster analysis of the above discussed parameters helped drawing the conclusion that *S. americanum*, *S. chenopodioides*, *S. nigrum* and *S. villosum* are distinct species of genus *Solanum* but *S. retroflexum* might be regarded as a variety/subspecies of *S. nigrum*.

The nutritional potentials of the plants were assessed through their proximate and mineral analyses. The results of this research indicated that the plants had nutritional qualities that could provide the users with additional



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nutrients. Comparatively, because of the relatively high contents of total protein, total ash and crude fibres, the taxon *S. nigrum* could be good source of nutrients.

Antibacterial and antioxidant activities were carried out to evaluate the medicinal value of the plants. The methanolic extracts of the five taxa had shown significant antibacterial activity against the Gram +ve and Gram -ve bacteria used. Infact, the methanolic extracts of *S. villosum* showed a higher MIC value against *Proteus mirabilis* compared to standard Benzyl penicillin. The extracts of *S. nigrum* and *S. retroflexum* demonstrated matching results which supported our conclusion that *S. retroflexum* may be considered as a variety of *S. nigrum*. *S. chenopodioides* and *S. villosum* also gave comparable but less coordinated results. Antioxidant activity of the plant extracts was evaluated using six different antioxidant assays. Results suggested that all taxa have moderate effects on scavenging DPPH free radical. Total Phenolic Contents of the five samples showed slight variations, ranging from 20.31-26.58 mg of GAE/100 g DW. In ABTS assay, *S. retroflexum* had highest antioxidant capacity (33.88 mM/100 g DW). The effect of the *S. chenopodioides* (70.37%) on metal chelation was found to be more than all the other taxa. These activities were attributed to the appreciable amounts of alkaloids, flavonoids and phenolic components present in these plant samples.

The incredible morphological and chemical diversity, fundamental economic importance and worldwide distribution make the Solanaceae one of the most fascinating groups of flowering plants.

