7.3. *ALTERNANTHERA* Forssk.

Proximate Composition

The study of the nutritive value of seven tropical weed species during the dry season in USA revealed that chaff flower (*Alternanthera gullensis*) is useful as feed for grazing livestock during periods of limited feed supply and should not be removed indiscriminately (Nuwanyakpa *et al*., 1983). Bhatta and Das (1996) studied the chemical composition of alligator weed (*Alternanthera philoxeroides*) to explore the possibility of incorporation in the ruminant ration. They found that the critical amino acids like lysine and methionine were deficient in alligator weed and non-essential amino acids like glutamic and aspartic acids were higher. It was concluded that alligator weed (*Alternanthera philoxeroides*) can be incorporated up to 15% in the ration of ruminants (Bhatta and Das, 1996). The nutritional evaluation of protein extracted from the leaves of *Alternanthera philoxeroides* indicated that it could be used as supplement in feeds or foods to improve the quality as well as the protein levels of deficient diets (Dewanj and Matai, 1996). The level of total ash in leaves of *Alternanthera brasiliana* (L.) Kuntze is 13.2% ± 0.47. The macro and micronutrient contents in the leaves showed as main components, nitrogen (3.13%) and Mn (0.0296%), which support the use of the plant as nutritional agent (Delaporte *et al*., 2005). Methoxysucrose was identified from *Alternanthera tenella* (Silveira and Olea, 2009).

Sterols, Triterpenes and Related Substances

Stigmasteryl and stigmast-7-enyl-3-β-ol-3-*O*-β-D-glucopyranosides were identified from *Alternanthera maritima* (Mart.) St. Hil. (Salvador and Dias, 2004). Both α- and β-spinasterols were detected in *Alternanthera paronychoides* (Dogra *et al*., 1977). Several sterols and triterpenes have been isolated from *Alternanthera philoxeroides* (Mart.) Griseb. *viz.* α- and β-spinasterols (stigmasta 7,22-dien-3-ol), β-sitosterol, daucosterol, stigmasta-5,22-dien-3β-ol, 24*R*,5α-stigmast-3,6-dione, stigmas-22-en-3,6-dione, (22*E*, 20*S*, 24*R*)-5α,8α epidioxyergosta-6,22-dien-3β-ol, stigmasterol 3-*O*-β-D-glucopyranoside 3β-hydroxystigmast-5-en-7-one, $\Delta^{5,22}$-stigmast-3-*O*-β-D-glucopyranosyl-6'-hexadecanoate, stigmasterol 3-*O*-β-D-glucopyranoside, 6*S*,7*E*,9*R*-6,9-dihydroxymegastigma-4,7-dien-3-one-9-*O*-β-D-glucopyranoside, hederagenin 3-*O*-β-D-glucuronopyranoside-6'-*O*-methyl ester, cycloeucalenol, 24-methylenecycloartanol, oleanolic acid, oleanolic acid 3-*O*-β-D-glucuronopyranoside, oleanolic acid 28-*O*-β-D-glucopyranoside, oleanolic acid 3-*O*-β-D-glucopyranoside-6'-*O*-methyl ester, philoxeroic acid (3β,21β-dihydroxyolean-12-ene-28,29-dioic acid) and ursolic acid (He and Meng, 1995; Fang *et al*., 2006, 2007b, 2009b; Luo *et al*., 2007; Fan *et al*., 2008; Ma *et al*., 2008, Li *et al*., 2009; Mahboub *et al*., 2009). Hydroperoxysteroids were characterized from *Alternanthera tenella* Colla (Silveira and Olea, 2009). Desmethylsterols identified from other *Alternanthera* species are shown in Tables 1 and 2 (Patterson *et al*.,

1991).

Blumenol A (a carotenoid like compound), phaeophytin a, phaeophytin a' and phytol (Fang *et al*., 2006), octadecanoic acid, tetracosanoic acid (Ma *et al*., 2008), tetracosanoic acid 2,3-dihydroxypropyl ester, hexacosanoic acid 2,3-dihydroxypropyl ester, monostearin (Li *et al*., 2009) and 9'-octadecenyl 12-hydroxy-9-octadecanoate (Mahboub *et al*., 2009) were isolated from *Alternanthera philoxeroides*.

Saponins

Saponins have been identified from *Alternanthera* species, especially *Alternanthera philoxeroides*. A saponin, which on hydrolysis yielded glucose, ribose, rhamnose and the sapogenin oleanolic acid was isolated by Dogra and Ojha (1978). Zhao *et al*. (1999) isolated five saponins with pentacyclic triterpenoid and nortriterpenoid aglycones from the whole plant of the same species. Philoxeroidesides A-D (pentacyclic triterpene saponins), chikusetsusaponin IVa, chikusetsusaponin Iva methyl ester and calenduloside E were isolated from *Alternanthera philoxeroides* (Fang *et al*., 2007b, 2009b; Luo *et al*., 2007).

Phenolic Compounds

Several flavonoids, including *C*-glycosylated flavonoids have been identified from *Alternanthera* species (Table 12). The anthraquinones rubiadin, rubiadin-1-methyl ether, 2-hydroxy-3-methylanthraquinone, 2-hydroxy-1-methoxyl-anthraquinone (Fan *et al*., 2008; Li *et al*., 2009) and chrysophanol-8-*O*-β-D-glucopyranoside (Luo *et al*., 2007) were isolated from *Alternanthera philoxeroides*. *p*-Coumaric acid and azelaic acid [$(CH_2)_7(CO_2H)_2$] have been detected in the same species (Fan *et al*., 2008).

Alkaloids and Other Constituents

Indole-3-carboxyaldehyde, indole-3-carboxylic acid, *N-trans*-feruloyltyramine and *N-trans*-feruloyl-3,5-dimethoxytyramine were isolated from *Alternanthera philoxeroides* (Fang *et al*., 2007a,b; Fan *et al*., 2008). Blunden *et al*. (1991) reported the presence of glycinebetaine in both *Alternanthera philoxeroides* Griseb. and *Alternanthera polygonoides* R. Br. and trigonelline in the latter species only. Other constituents have been also identified from the same species *viz.* succinamide, succinic acid (He and Meng, 1995), rhaponticin (a stilbene glucoside) and lacceroic acid (dotriacontanoic acid) (Luo *et al*., 2007).

Alternanthera bettzichiana (Regel) Nicols is used as low cost, easily available and renewable adsorbent for the removal of Cr(VI) from aqueous solutions (Patil and Shrivastava, 2009). The same species has been also described as low cost and eco-friendly adsorbent prepared for the removal of congo red from aqueous solution (Patil and Shrivastava, 2010). The suitability of *Alternanthera philoxeroides* in purification and eutrophication problems of rivers and lakes in China was proved (He *et al*., 2010).