Constituents

- Nutritive Constituents: Earlier preliminary investigation of the aquatic plant called "water pansy" or "Madagascar pansy" (*Pistia aegyptiaca* Schleid = *Pistia stratiotes* L.) revealed that the leaves and roots contain water 90.15,80; organic matter 7.5, 12.31; minerals 2.35, 7.69% respectively. Dry matter contained N 2.39% and 2.27% for leaves and roots respectively. The ash of leaves and roots contain P_2O_5 3.36, 1.81; K_2O 15.09, 9.10 and CaO 4.69, 1.61% respectively. The nutritive constituents of the leaves are water 90.12, ash 2.58, fiber 3.14, N-free extract 2.52, fats 0.16 and crude protein 1.48% (De Villele, 1916). The study of the plant, growing in North East Nile Delta, Egypt, revealed the following: moisture, 11.43; total ash, 33.90; water soluble ash, 9.10; acid insoluble ash, 10.26, lipid, 0.29; crude fiber 13.45 %; total nitrogen, 195.30; total protein, 66.89; total soluble sugars, 90.70; glucose, 0.90; sucrose, 44.80; polysaccharides, 359.30 and total carbohydrates, 495.70 mg g^{-1}. The concentrations of the elements were: Na, 2040.00; K, 2111.20; Ca, 1844.00; Mg, 9.64.00; Fe 224.20; Mn, 27.60; Zn, 6.60; Cu, 1.600; Ni, 0.078; Cd, 0.010 and Pb, 0.054 (Abu Ziada *et al.*, 2008).

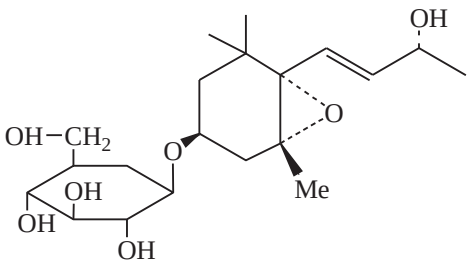
A 3% level of supplementation of leaf protein extracted from *P.stratiotes* significantly improved the nutritive value of a wheat flour diet, thereby indicating that it could be used as supplements in feeds or foods to improve the quality as well as protein levels of deficient diets (Dewanji and Matai, 1996). The nutritive value of the plant, growing as animal forage in Venezuela, was found as follows: 8.62% crude protein, 1.32% total N, 1.16% ether extract, 46.62% N-free extract, 21.12% ash and 19.13% crude fibre. The mineral contents are 5.56% K, 3.24% Ca, 1.00% Mg, 0.26% P, 0.61% Na, 0.26% Fe, 0.12% Mn, 42 ppm Cu and 181 ppm Zn (Rodríguez *et al.*, 2000). The proximate composition of the plant, growing in India, as animal forage was: dry matter, 5.3; crude protein, 20.5; ash, 17; crude fat, 3.8; crude fiber, 19.1 and nitrogen-free extract, 39.6% (Banerjee and Matai, 1990). *P. stratiotes*, collected fron south of Manzalah Lake, north eastern Egypt, contains Fe, 10.73±0.0; Mn, 142.43:0.07 mg/g; Zn, 123.23±0.02µg/g and Cu, 126.24± µg/g (Daboor and Haroon, 2012).

Arifkhodzhaev and Shoyakubov (1995) reported yields and sugar composition for water-soluble polysaccharides, pectic substances and hemicelluloses of the plant, growing in Uzbekistan. It is rich in proteins, carbohydrates, lipids, vitamins and various mineral substances. It contains protein 20.2, fat 8.38, NNES 13.24, cellulose 21.8, ash 26.2, Ca 0.69, P 0.59 and carotene 341 mg/kg. The biomass of the plant can be recommended for the production of granulated foods (Shoyakubov and Aitmetova, 1999). The chemical constituents of *Pistia stratiotes* have been also reported by Liu *et al*. (2008). The proximate composition of the leaf and root samples of *P. stratiotes* (growing in Nigeria) were as follows: moisture (4.50±0.50% and 4.50±0.10%), crude fibre (17.50±0.87% and 20.50±1.80%), crude lipid (2.17±0.29% and 1.83±0.29%), crude protein (6.96±0.13% and 3.18±0.14%), ash (35.20±1.56% and 44.50±0.50%) and carbohydrate (38.20±2.08% and 30.00±1.46%) respectively. The minerals determined were Na (373.00±0.50 mg/100g and 113.00±0.06 mg100/g), K (3283.00±0.76 mg100/g and 1750.00±0.50 mg100/g), P (336.00±0.10 mg/100g and 313.00±0.03 mg/100g), Ca (230.00±0.01mg/100g and

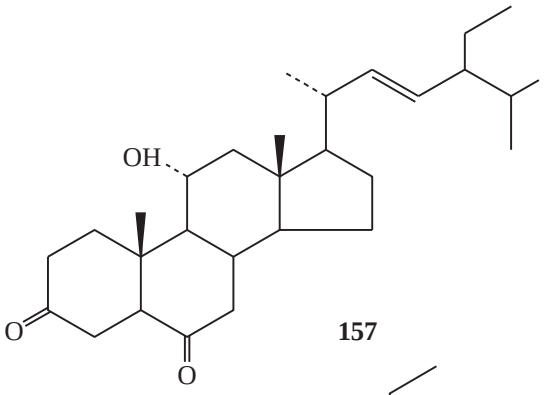
230.00±0.03mg/100g) and Mg (370.00±0.03 mg/100g and 230.00±0.03 mg/100g) respectively. The antioxidant compounds estimated are vitamin A (480.0±1.50 mg/100g and 1050.00±1.50mg/100g), vitamin C (560.00±0.20mg/100g and 3130.00±0.31mg/100g) and vitamin E (8260.00±3.00mg/100g and 3060±1.83mg100/g) respectively (Wasagu *et al.*, 2013).

Partial substitution of fish meal can be done by utilizing *P. stratiotes* meal as an ingredient in diets of fish. A study revealed that utilization of the plant up to 45% level to replace fish meal, promotes growth in the diets of the common carps. Further, the aquatic weed, provides an easy, practical and cheaper fish feed stuff because of its easy availability (Mohapatra and Patra, 2014).The plant is able to remove (assimilate) both inorganic nitrogen and organic nitrogen species in the form of complex proteins (Tan *et al.*, 2014).

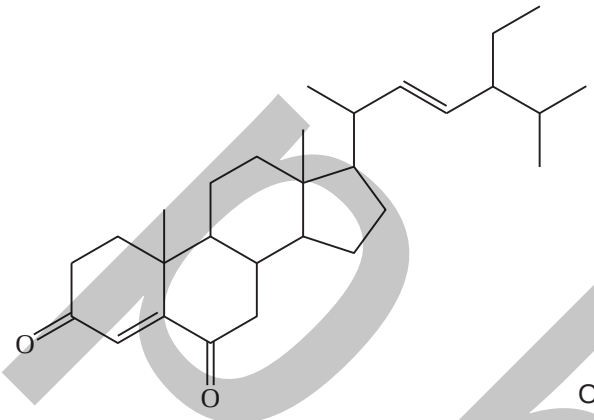
- Lipids and Essential Oil: Palmitic acid was identified from the plant (Ling *et al*., 1999). Thirty components were detected in the essential oil of the leaves; 26 of which were identified. The relative content of the constituents identified accounted for 95.20% (Fan and Song, 2006). The yield of some aquatic angiosperms having submerged leaves, emergent leaves (including *Pistia stratiotes*) and floating leaves was low (1.1 - 16.1 µg cm^{-2}). The carbon chains of the alkanes of the species with submerged leaves are, on average, shorter than those of the species with air-exposed leaves. The distribution of alkanes (separated from the wax) of the latter species is similar to the alkane profile of foliar waxes of terrestrial plants (Estanislau do Amaral *et al*., 1990). Soya-cerberoside was also identified from the plant (Liu *et al.*, 2008).
- Terpenoids and Steroids: Two C13 norterpene glycosides have been isolated from the plant identified as stratioside I (**156**), [(3*S*,5*R*,6*S*,7*E*,9*R*)-3-hydroxy-5,6-epoxy-β-ionyl-3-*O*-β-D-glucopyranoside)] (Della Greca *et al*., 1995) and stratioside II ((5*S*,5*R*,6*R*,7*E*,9*R*)-3,5,6-trihydroxy-β-ionyl-3-*O*-β-D-glucopyranoside) (Della Greca *et al*., 1996).
- The plant contains several steroids *viz*. sitosterol-3-*O*-[2′,4′-*O*-diacetyl-6′-*O*-stearyl]-β-D-glucopyranoside, sitosterol-3-*O*-[2′-*O*-stearyl]-β-D-xylopyranoside and sitosterol-3-*O*-[4′-*O*-stearyl]-β-D-xylopyranoside (Della Greca *et al*., 1991), a stigmastane (11α-hydroxy-24*S*-ethyl-5α-cholest-22-ene-3,6-dione, (**157**) (Monaco and Previtera, 1991), stigmasterol, stigmast-4,22-dien-3,6-dione (**158**), stigmasteryl stearate (Ling *et al*., 1999), 6β-hydroxystigma-4,22-diene-3-one (**159**), 7β-hydroxy-4,22-stigmastadien-3-one (**160**) together with a norisoprenoid (Ayyad, 2002), (24*R*)-ergosta-7,22-diene-3β,5α,6β-triol, 7β-hydroxysitosterol, sitoindoside (**161**), β-sitosterol and daucosterol (Liu *et al.*, 2008). A norisoprenoid have been iaolated from the plant growing in Egypt (Ayyad, 2002).
- Flavonoids: The plant contains large amounts of 2 di-*C*-glycosylflavones of the vicenin and lucenin type, a luteolin 7-glycoside plus 2 unidentified compounds, lesser amounts of the anthocyanin cyanidin-3-glucoside, and traces of the mono-*C*-glycosylflavones vitexin and orientin (Zennie and McClure, 1977), luteolin and chrysoeriol 4'-*O*-β-D-glucopyranoside (Liu *et al.*, 2008).
- Nitrogenous Compounds: Four aquatic whole plants, including *P.stratiotes* ubiquitously contained norspermidine, homospermidine, norspermine, and thermospermine, in addition to usual polyamines such as diaminopropane, putrescine, spermidine, and spermine. Aminopropylhomospermidine and cladopentamine were also detected (Hamana *et al*., 2000).



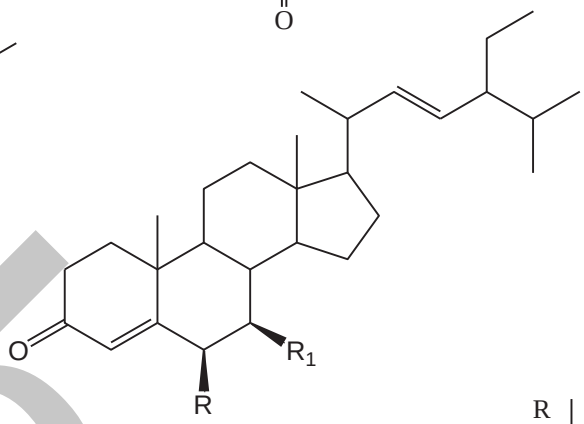
156 Stratioside I



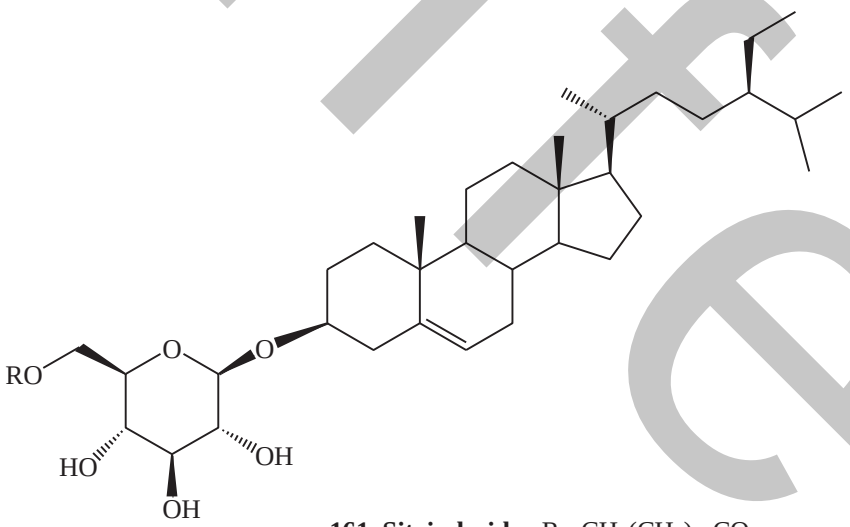
157



158 Stigmast-4,22-diene-3,6-dione



	R	R^1
159 6β-Hydroxystigmasta 4,22-diene-3-one	OH	H
160 7β-Hydroxystigmasta-4,22-diene-3-one	H	OH



161 Sitoindoside R= $CH_3(CH_2)_{14}CO$

note