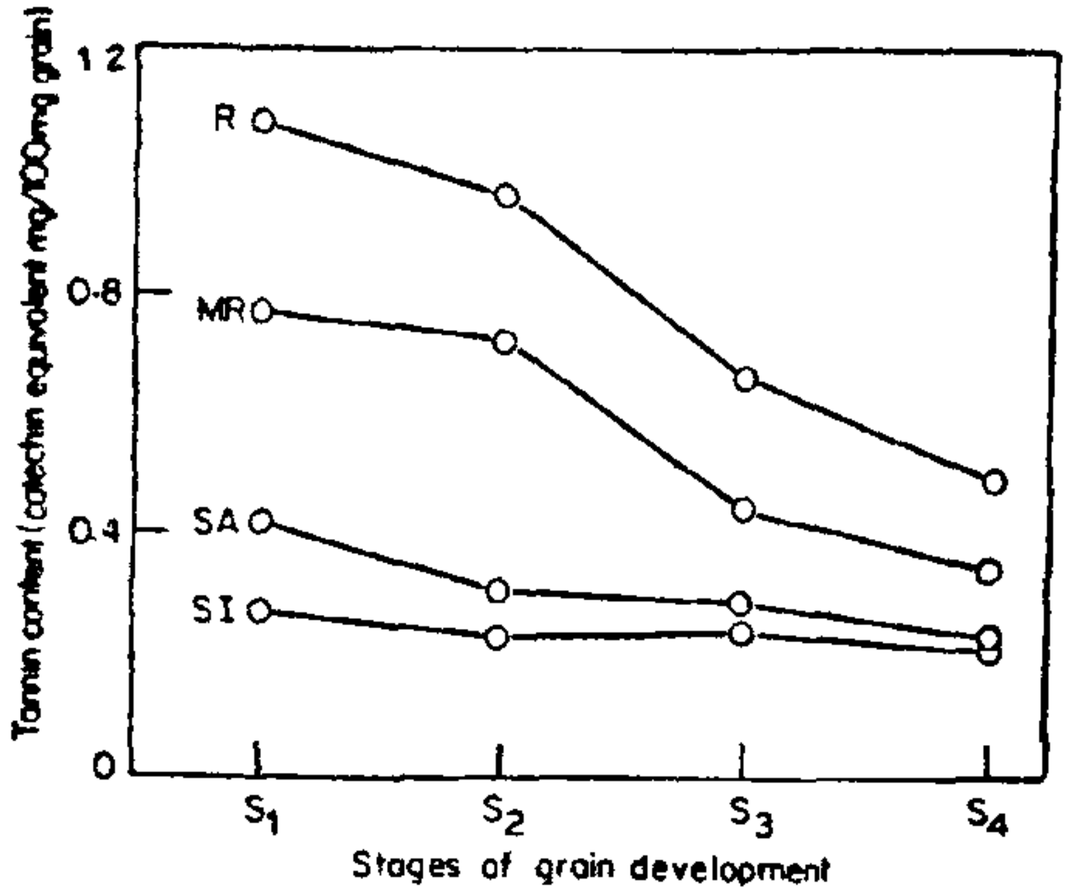

Figure 1. Average tannin content of bird resistant (R), moderately resistant (MR) and susceptible varieties of East African (SA) and India (SI) varieties at milk (S_1), soft dough (S_2), dought (S_3) and maturity (S_4) stages.

A comparison of the group means shows that tannin content of Indian hybrids was the lowest and fairly stable over the stages of grain development (figure 1). But after the initial reduction in mean tannin content of EA white grain varieties from 0.422 mg to 0.313 mg per 100 mg grain, the tannin content did not change significantly. In bird-tolerant brown grain varieties, significant reduction in tannin content was observed after both S_2 and S_3. The bird resistant varieties exhibited sharp decline in tannin content after each stage.

The tannin content per 100 mg grain of resistant, moderately resistant and susceptible varieties was 1.07 mg, 0.77 mg and 0.35 mg at milk stage and 0.658 mg, 0.436 mg and 0.262 mg at dough stage respectively. The white rain varieties from India and East Africa are not much different in tannin content at latter stages of grain development but differences between white and brown varieties are remarkably high. Within the group, differences do occur among brown grain varieties, but the bird-resistant varieties are higher in tannin content as compared to moderately resistant varieties. Although decline of tannins over stages is higher in bird-resistant varieties, their tannin content remains higher at all the stages of grain development.

The tannins are agronomically important in the field to impart resistance to birds[1], insects[3] and diseases[4] but nutritionally harmful. The tannins can be removed by processing. Dehulling and antitoxication are costly processes and require organized efforts. While brown testa offers insufficient repellency to birds, the varieties which potentially repel the birds, have high level of tannins from milk stage to maturity. The bird-resistant varieties show significant decline in tannin content after each stage. Should it degrade much faster, to reach the level of white grain varieties at maturity, this mechanism can ensure the resistance to birds up to dough stage and acceptable nutritional quality at maturity.

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WATER HYACINTH AS A PROSPECTIVE SOURCE OF STIGMASTEROL

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STIGMASTEROL is an important starting material for conversion to biologically active steroids. Because of the presence of a double bond in the side chain, it is relatively easy to remove the side chain for conversion to steroid hormones[1]. It is estimated that stigmasterol accounts for 15% of the total steriod precursors used in the world[2]. The principal commercial sources of stigmasterol are calabar or ordeal bean (*Physostigma venenosum* Salf) and soybean oil (*Glycine max* Merril syn. *G.soja* Sieb & Zucc)[3]. Though soybean seeds contain only 0.030–0.035% (dry weight basis) stigmasterol, soap stock or foot containing 25% stigmasterol is available as a by-product of alkali refining of soybean oil from which stigmasterol ls recovered com-

mercially in the U.S.A. In India, where the above sources are not available in sufficient quantities, leaves and stems of *Laptadenia reticulata* Wight & Arn (dori) yielding 0.04% (dry wt) stigmasterol in free form[3] and seeds of *Dolichos lablab* Linn. (lablab bean), *Dolichos bulbosus* Linn, *Vigna cotiang* Walp (cowpea) containing 0.027, 0.023, 0.025% stigmasterol on dry weight basis respectively, are considered possible sources of stigmasterol[4]. This communication reports comparatively high content of stigmasterol (0.07% dry weight) in *Eichhornia crassipes* (Mart) Solms (Water hyacinth) and the possibility of its enrichment ten-fold by anaerobic digestion of the plant material.

Water hyacinth plants collected from various locations were oven-dried at 80°–90° C and powdered after separating the shoot and root parts (including rhizome). Total sterol extraction was carried out from about 5 g of powdered material with benzene and 2 N ethanolic KOH under reflux for 5 hr. For free sterol, the extraction was done without saponification with ethanolic KOH. The extract was desolvetised under reduced pressure and the residue was extracted thrice with acetone under reflux for 1 hr. The acetone extracts were pooled and concentrated to obtain the crude sterol[5] and assayed for sterol by Liebermann-Buchard reaction[6].

The crude sterol mixture was purified by column chromatography on neutral alumina using solvent mixtures of petroleum ether, benzene, ethyl acetate and methanol as eluting agents. Fractions containing sterol (Bz: EtO Ac, 15:1 elute) as identified by co-tlc on silicagel G coated plates were pooled and desolvetised to obtain a white crystalline sterol mixture. The composition of the individual sterols in the purified sterol mixture was analyzed by gas liquid chromatography on a Varian 3700 gas chromatograph equipped with flame ionisation detector and using a glass column packed with Chromosorb W (HP), 80–100 mesh and 3% OV-17 at a column temperature of 275° C[7]. The chromatographic peaks were identified by using authentic samples.

Anaerobic digestion of water hyacinth with the production of biogas methane was carried out in the laboratory digesters of 5 lit capacity, containing 2 kg of macerated freshwater hyacinth and seeded with digester fluid from a running water hyacinth digestion set up at 31 ± 2° C. After various periods of digestion, the contents of the digesters were removed and oven-dried at 80–90° C. Dried and powdered digested material was analyzed for total sterol and individual sterols according to the procedure described above.

TABLE 1

Sterol content of water hyacinth

	Sterol content, % of dry biomass Average values (5 samples) ± S.E.		
	Shoot	Root	Whole plant
Free sterol	0.134 ± 0.010	0.044 ± 0.008	0.128 ± 0.005
Total sterol	0.170 ± 0.012	0.068 ± 0.003	0.139 ± 0.007

TABLE 2

Enrichment of sterol during anaerobic digestion of water hyacinth

	Period of digestion, days				
	0	8	16	35	90
	Sterol content, per cent of dry material				
Free sterol	0.160	0.176	0.181	0.210	1.635
Total sterol	0.170	0.208	0.228	0.394	1.680

TABLE 3

Sterol constituents of purified sterol mixture isolated from water hyacinth before and after anaerobic digestion

	Campesterol	Stigmasterol	β-sitosterol
	Percent of total sterol		
Whole plant undigested	11.0	55.6	33.4
Whole plant digested for 90 days	10.9	54.4	34.7

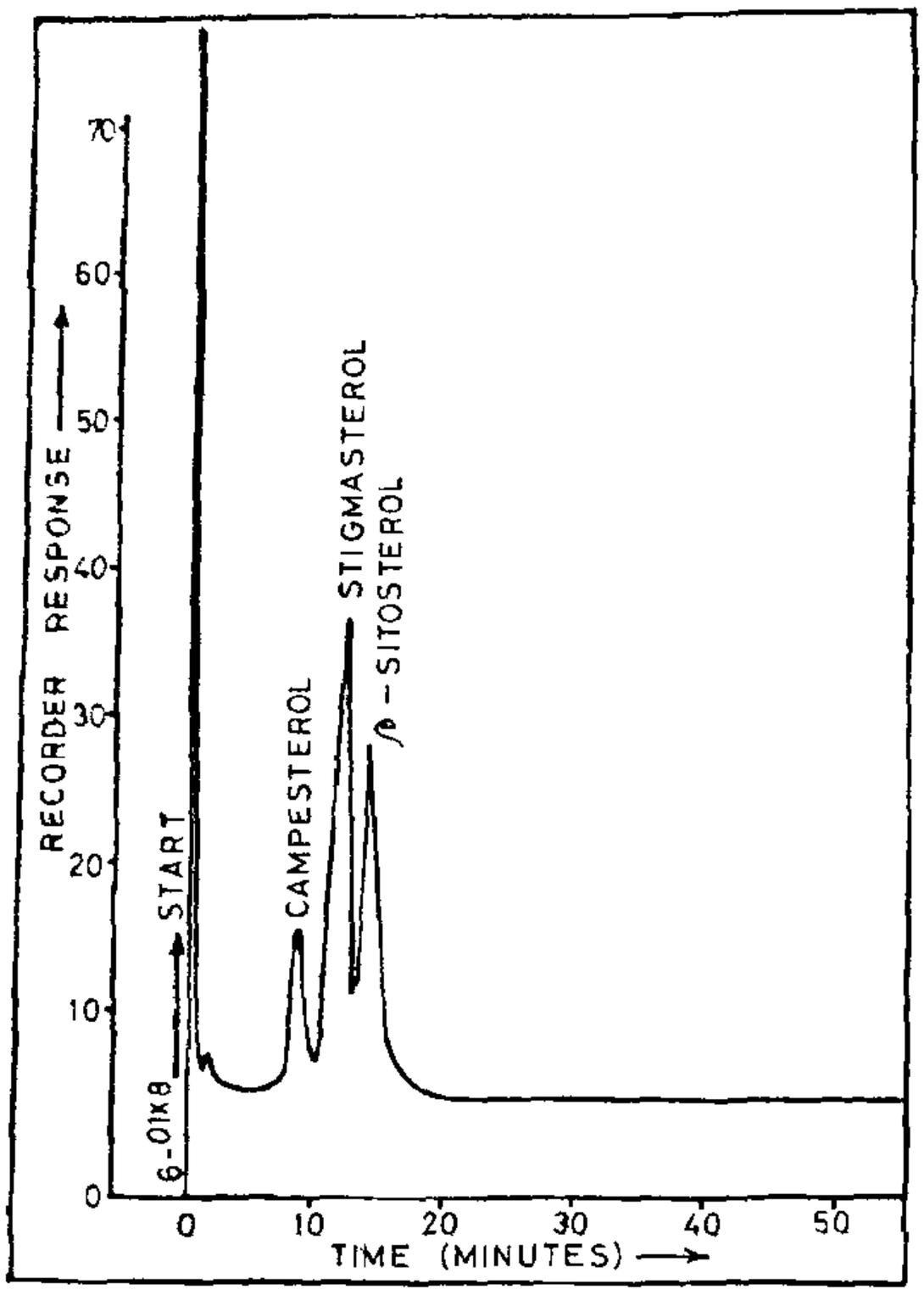

Figure 1. GLC separation of individual sterols from purified sterol mixture obtained from water hyacinth.

Sterol content of different parts of water hyacinth collected from five different locations is shown in table 1. Roots of water hyacinth contain less of sterol than the shoot portion. Most of the sterols are present in the free form which is of significance in considering water hyacinth as a source of sterol. Gas chromatographic analysis of the purified sterol mixture showed three sterol peaks which were identified as campesterol, stigmasterol and β–sitosterol (figure 1). Stigmasterol was by far the largest component constituting 55% of the total sterols (table 3). With a stigmasterol content of about 0.07%, water hyacinth is a richer source of this sterol than other sources mentioned above.

Anaerobic digestion of the water hyacinth progressively enriched the sterol content so that after 90 days of digestion ten fold increase of sterol in the digested material was obtained (table 2). Apparently sterols were not degraded during the digestion and with the reduction of other organic matter through conversion to methane and CO_2, relative increase in sterol content occurred. Relative percentage of individual sterols did not change during digestion (table 3). The possibility of generating biogas along with the recovery of stigmasterol through anaerobic digestion of water hyacinth is promising.

Water hyacinth has, however, a distinct disadvantage as a source of stigmasterol because of its high water content (95%). On the other hand, it is widely available in large quantities as weed and it is one of the fastest growing plant.

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ICELANDSPAR OCELLI FROM SKARN ROCK OF GARIGAIPALLI AREA, TAMIL NADU.

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OCELLI remain rather puzzling igneous small scale structures[1] which are subspherical areas, filled with eye-like radiating prisms of minerals, often similar to those found in the enclosing rock but in different proportions. Since the ocelli are composed of the same materials as that of their matrixes but in different proportions, ocelli are the most convincing evidence for the coexistence of two immiscible liquids. These eye shaped ellipsoids are particularly impressive, and readily suggest the formation from immiscible globules of magma[2]. The ocelli are often filled with rather younger minerals. Ocelli may be crystallized from gaseous contents of the cavity in which they occur[1]. Minerals inside the ocelli grow under