

m.p. 123–24°, a dimethylether ($\text{Me}_2\text{SO}_4 + \text{K}_2\text{CO}_3$ in Me_2CO , 30 hr.), m.p. 56–58° and a dibenzoate ($\text{C}_6\text{H}_5 \text{COCl} + \text{NaOH}$), m.p. 196–98°. The NMR spectrum of the compound showed signals of four aromatic protons (singlet, 7.2 ppm) and the acetate showed six acetyl protons (singlet, 2.3 ppm). The mass spectrum exhibited a parent peak at m/e 110 (M^+) and fragmentation at m/e 108 ($\text{M}^+ - 2\text{H}$) and 81 ($\text{M}^+ - \text{CHO}$). Based on these data, the compound was identified as hydroquinone (*p*-dihydroxy benzene) and the identity was finally established by direct comparison, co-PC and m.m.p. with an authentic sample.

The ethyl acetate extract yielded a mixture of two flavone glycosides (PC), which were separated by column chromatography over cellulose and elution with moist ethyl acetate containing varying percentage of MeOH. The pigment that came out first as pale yellow needles had m.p. 221–23°, λ_{max} 270, 337 nm (no shift with NaOAc) which yielded on hydrolysis (HOAc medium) dinatin and glucuronic acid. It was identified as dinatin-7-glucuronide and the identity confirmed by m.m.p. and co-chromatography with an authentic sample from *Pedaliium murex*.⁹ The second pigment that came on elution with ethyl acetate containing 25–50% MeOH melted at 210–12°, $[\alpha]_{\text{D}}^{28} - 93.3^\circ$ (C, 0.5%, Py.), λ_{max} 268, 340 nm (no shift with NaOAc). It gave diosmetin and glucuronic acid on acid hydrolysis. Its identity was confirmed as diosmetin-7-glucuronide by direct comparison with an authentic sample.⁹

The aq. mother liquor left after solvent extractions was refluxed with 7% H_2SO_4 for 30 minutes and extracted with EtOAc when

more of the same mixture of glucuronides were obtained.

This is the first record of isolation, from *Labiatae*, of hydroquinone which has been earlier recorded in *Ericaceae*, *Rosaceae*, *Proteaceae* and *Compositae*, and is considered as the only C_6 phenol of systematic interest.¹⁰ The occurrence of 6-hydroxy flavones¹¹ (and their glucuronides) and the presence of unusual flavones like 4', 5-dihydroxy-6, 7, 8-trimethoxy flavone¹² and 5-hydroxy-6, 7, 4'-trimethoxy flavone¹³ are known in *Labiatae* and the present isolation of majoranin is an addition to the list of unusual flavones.

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INTRUSION OF UPWELLED WATER IN THE MANDOVI AND ZUARI ESTUARIES

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IN the course of our investigation on the hydrological conditions of Mandovi and Zuari estuaries, cold water with low oxygen and with high inorganic phosphate content has been encountered in the estuaries extending to a distance of about 5 Km. This phenomenon was observed with varying degrees from the month of August extending upto September and October. This feature was very well

marked during the months of September and October. In both the estuaries surface waters were characterised by low temperature, oxygen and high inorganic phosphate during this period. These features were more marked in the bottom waters of the estuary.

Station positions from where water samples have been collected for various chemical analyses are shown in Fig. 1. An examination of

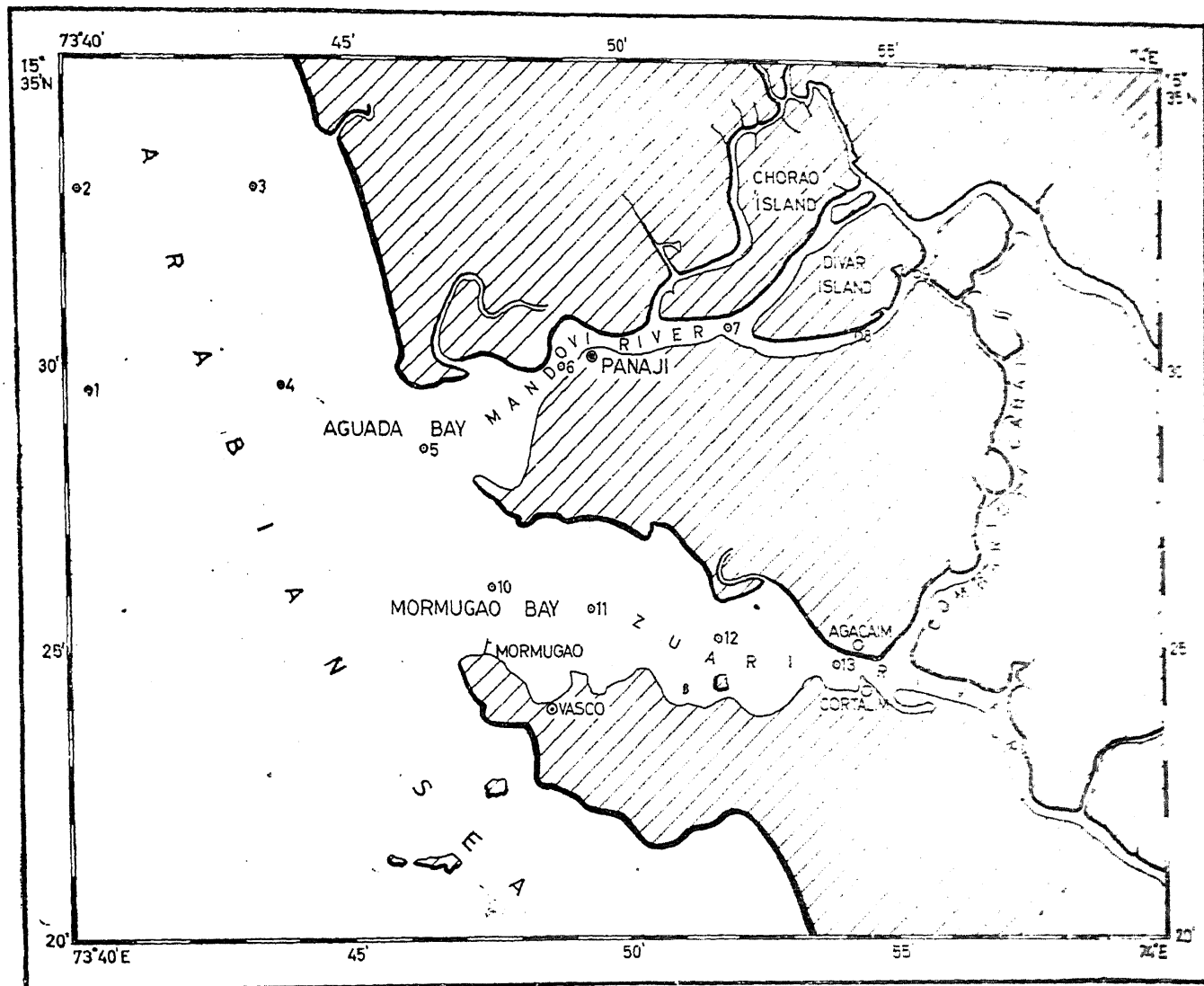


FIG. 1. Map showing the station locations where the samples were collected.

TABLE I
 Variations in the hydrographical factors in Mandovi estuary

Stn. No.	Depth	Temperature °C	Salinity ‰	Oxygen ml/l	Inorganic phosphate µg at/l
6	Surface	25.0	29.41	2.55	1.49
	Bottom (4 m)	23.88	33.49	1.13	1.54
7	Surface	26.0	26.29	2.60	1.41
	Bottom (4 m)	25.5	29.86	1.43	1.59
8	Surface	27.5	18.91	3.28	0.83
	Bottom (5 m)	26.6	24.51	2.49	0.99
9	Surface	19.5	8.35	5.24	0.50
	Bottom (5 m)	28.5	13.10	4.53	0.83

TABLE II
 Variations in the hydrographical factors in Zuari estuary

Stn. No.	Depth	Temperature °C	Salinity ‰	Oxygen ml/l	Inorganic phosphate µg at/l
10	Surface	27.0	26.43	4.50	0.50
	Bottom (8 m)	22.50	34.83	0.706	1.10
11	Surface	27.0	26.20	4.47	0.50
	Bottom (6 m)	22.85	32.21	1.17	0.90
12	Surface	27.50	20.16	4.59	0.57
	Bottom (6 m)	25.60	29.74	3.76	0.90
13	Surface	28.0	17.74	4.70	0.66
	Bottom (6 m)	26.0	25.33	3.76	0.90

the various parameters given in Tables I and II reveal that the low temperature water, with low dissolved oxygen content and high nutrient concentration is noticeable at the bottom of the estuaries extending to a distance of 5 Km and dissipating thereafter. The change in the bottom temperature clearly indicates that

the fresh water discharge alone is not responsible for the changes since the variation at the bottom is more pronounced. Such a change cannot occur unless there is an incursion of cold water from the sea into the estuary. The effect of this water is felt at varying intensities at different places.

It is well known that the phenomenon of upwelling is fairly widespread along the West Indian coast during the months June-September. Upwelling commences at deeper depths earlier in the month of February and upwelled water reaches the surface layers by the month of May or June. The upwelling sets in earlier in the south and progressively spreads towards north. The upwelled water is characterised by its low temperature, high salinity, low dissolved oxygen content and high nutrient concentration. Table III gives

TABLE III
Variations in the hydrographical factors in the inshore region

Stn. No.	Depth	Temperature °C.	Salinity ‰	Oxygen ml/l	Inorganic phosphate µg at/l
1	Surface	24.0	33.53	2.92	1.07
	17 m	21.6	35.53	0.59	1.69
2	Surface	24.0	33.95	2.47	1.69
	17 m	21.9	35.53	0.47	2.0
3	Surface	24.2	34.65	2.83	1.53
	16 m	21.6	35.35	0.23	1.69
4	Surface	24.5	33.95	3.18	1.69
	16 m	21.9	34.99	0.23	2.0
5	Surface	27.2	32.29	3.88	0.99
	10 m	23.4	32.34	2.12	3.08

the characteristics of the water at 40, 20, 10 meters in the Arabian Sea off Aguada and Calangute during the period reflecting the characteristic features of the upwelled waters. Similar incursion of upwelled water into the Cochin backwater has also been reported by Ramamirtham and Jayaraman (1963)³ and Sankaranarayanan and Qasim (1969)⁴ during the period June to September. In order to establish that the bottom water in the estuaries

is upwelled water, a few estimations were made on the Biochemical Oxygen Demand of waters collected from the estuary and the nearshore region. The experiments did not indicate any appreciable change in the concentration of oxygen even after 72 hours of incubation, thereby showing that the low oxygen of the waters is not due to pollution.

Fish mortality has been reported during this period off Mormugao, Vengurla and Malvan coasts (Dwivedi, personal communication). There are also instances of demersal fishes and prawns being caught in purse-seine in Goa coast during this period. Probably the low temperature and oxygen content of the water at the bottom cause asphyxiation and make them migrate to the surface layers.

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