High Concentration of (−)-Noradrenaline in *Portulaca oleracea* L.

Portulaca oleracea L. is one of the plants reputed to be of value in the treatment of cardio-vascular diseases in Jamaican folk-lore[1]. It was therefore examined for the possible occurrence of pharmacologically active substances.

A crude protein-free extract was prepared as follows: the fresh plant was macerated in cold 2 *N* hydrochloric acid with a Waring blender. Protein was precipitated by adding ethanol (to approximately 75 per cent) and the supernatant was evaporated at low temperature, under reduced pressure, and in the absence of oxygen to remove the ethanol. The concentrate was diluted with water to an appropriate volume. A strong pressor response was observed when this crude extract was injected intravenously into a dog anæsthetized with nembutal. Because of this response, the possibility of the presence of catechol amines was examined.

The crude extract was examined by paper chromatography using three solvent systems as indicated in Table 1, common catechol amines being used as markers. When the paper was developed with potassium ferricyanide reagent[2], four spots were observed. Three of these spots corresponded to markers of dopa, noradrenaline, and dopamine while the fourth spot is as yet to be identified. The areas of these spots on chromatograms demonstrated approximately equal quantities of noradrenaline and dopamine to be present while the amount of dopa was much smaller.

In order to separate these catechol amines the following procedure was used: the crude protein-free extract was adjusted to *p*H 4 with 10 per cent sodium hydroxide solution and passed through a column of 'Dowex 50–*x*4' (hydrogen form). The catechol anines in the column were eluted with 2 *N* hydrochloric acid. The fraction which contained mainly noradrenaline was subjected to chromatography on sheets of Whatman 3*MM* paper using *n*-butanol/acetic acid/water (4 : 1 : 5) as the solvent system. The appropriate strips from these sheets (located by trial cuttings developed with the ferricyanide reagent) were cut and eluted with 2 *N* hydrochloric acid. The eluates were pooled and were freeze-dried to a brown powder which gave a single spot on the paper in the same position as a marker of noradrenaline. Quantitative comparison of the extracted material with synthetic noradrenaline hydrochloride on paper revealed that equal amounts of each gave comparable spot areas.

Table 1. Paper Chromatography of Catechol Amines of the Crude Extracts of *Portulaca oleracea* L.

System	R_F value						
	Spot I	Dopa	Spot II	Noradrenaline	Spot III	Dopamine	Spot IV
n-Butanol/acetic acid/water (4 : 1 : 5)	0·21	0·21	0·34	0·34	0·41	0·42	0·61
Phenol–water (HCl vapour)	0·16	0·14	0·23	0·23	0·41	0·41	0·54
n-Butanol–0·5 *N* HCl	0·17	0·18	0·12	0·12	0·20	0·20	0·33

The biological activity of the extracted material was then examined. It was found to give a pressor response comparable with that of an equal amount of synthetic (−)-noradrenaline hydrochloride when administered intravenously into dogs anæsthetized with nembutal. This result not only supports the chromatographic evidence for the identity of noradrenaline but also suggests that the noradrenaline present is the biologically active (−)-isomer.

Dopa and dopamine are known to be common plant constituents, but noradrenaline in plants has only been reported previously in banana, plantain, and in potato[3–5]. However, the concentration of noradrenaline found in *Portulaca* is much greater than that in any of these plants. Both by paper chromatography and biological estimation it was found that one of the crude extracts contained noradrenaline approximately equivalent to 2·5 mgm./gm. of fresh plant. It is of interest to note that the concentration of noradrenaline in this plant might be greater than that extractable from suprarenal glands of mammals.

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HISTOCHEMISTRY

Sialic Acid as a Structural Component of Some Mammalian Tissue Cell Surfaces

When human erythrocytes are treated with trypsin, a sialomucopeptide is liberated from their surfaces[1]. It is a common observation that a mucoid material is liberated from mammalian cells by trypsin treatment; the release of this material is associated with a considerable loss of cellular dry mass[2], and alteration of the stickiness of cells for various surfaces *in vitro*[3]. Attempts to investigate the chemical nature of the liberated mucoid[4] have been largely unsuccessful, partly owing to the lack of sensitivity of the tests, and partly because the mucoid cannot be obtained free of cells.

In view of the possibility that the structure of ovine salivary gland mucoprotein put forward by Gottschalk[5] is a general model for the molecular arrangement of mucoprotein at the cell surface, it is important to know whether sialic acid is present at the surfaces of mammalian tissue cells, and if so whether it occurs as a structural element as opposed to a cellular excretion.

A method has recently been developed for measuring the strength of attachment to glass of tissue cells in culture[6]. It consists of growing cells covered by a fluid medium, in circular culture vessels; a rotating disk is lowered into the fluid covering the cells and a shearing stress, transmitted through the