INDOLE DERIVATIVES IN TOMATOES

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Received May 2, 1959

DURING systematic examination of edible fruits, the banana[1] and the tomato[2,3] have been found to contain indole derivatives. Whereas the banana contained much 5-hydroxytryptamine (5-HT), the predominant indole derivative in the tomato was shown to be tryptamine. This communication describes the initial work being carried out to trace the formation and assess the importance of these indole compounds in the life history of the tomato plant.

As soon as the first flowers had formed on young tomato plants the different parts were dissected for extraction. The tomato fruit was collected at different stages of maturation, from green and about 1 in. in diameter till over-ripe and very soft. Each of these fruits was then dissected into the skin, the pulp and the pips. Extracts were made with acetone (1 g./5 ml.) for 24 hours. After reducing the extracts to a small volume, aliquots were either tested for 5-HT activity on the isolated uterus of the rat in oestrus or subjected to two-dimensional paper chromatography. The solvents were sodium chloride solution (8 per cent w/v), isopropanol : ammonia : water (20 : 1 : 2), and *n*-butanol : acetic acid : water (4 : 1 : 5). The indoles were detected on the chromatograms with Ehrlich's reagent. Duplicate spots were eluted and the eluates tested biologically for 5-HT activity. The concentrations of other indole derivatives were estimated visually by comparison with the colours produced by known amounts of standard substances. These were 5-HT creatinine sulphate, tryptamine hydrochloride (T), tryptophan (TP), 5-hydroxytryptophan (5-HTP), 5-hydroxyindoleacetic acid (5-HIAA), and indoleacetic acid (IAA). All values shown are the means of three observations.

Young tomato plants. No indole derivatives were detected in extracts of the roots of these plants. In the main stem, TP was found in a concentration of 2·5 μg./g. The concentration of 5-HT in this region was less than 0·01 μg./g. When the leaf stems were examined, the concentration of TP had not increased but that of 5-HT was 0·3 μg./g. In the leaves and leaflets 5-HT was present in an even higher concentration (0·5 μg./g.). Lastly, in the flowering tip, both TP (2·5 μg./g.) and 5-HT (0·3 μg./g.) were detected. These results are shown in Table I. T, 5-HTP, 5-HIAA and IAA were not detected in any of the extracts obtained from the parts of the young tomato plants.

Tomato fruit. When the green tomato fruit was examined, the predominant indole was T (1 μg./g.), and smaller amounts (0·2 μg./g.) of both 5-HT and TP were also present. In the ripe fruit, the concentration of T

always exceeded that of 5-HT, the highest ratio of the two levels being in the pips (see Table I). When washed free from pulp, the pips on extraction were found to possess more than nine times as much T and 5-HT. The concentrations of TP in these extracts were relatively small. Ripe tomatoes secured from the Canary Islands gave results which were similar to those described above for the variety obtained from the Channel Islands. The results with extracts of over-ripe fruits indicated a slight loss in the 5-HT activity and in the T content. Tinned Italian tomatoes also contained 5-HT and T but the concentrations of each varied widely.

TABLE I

ESTIMATES OF 5-HT AND T (μg./g.) IN PARTS OF THE TOMATO PLANT AND FRUIT

Indole compound	Young plant			Fruit			
	Main stems	Leaf stems	Leaves	Unripe pulp	Ripe skin	Ripe pulp	Ripe pips
5-HT	0	0·3	0·5	0·2	1·5	3·4	1·0
T	0	0	0	1·0	1·8	4·0	4·8
TP	2·5	2·5	2·0	0·2	0·2	0·8	0·4

The high concentration of T, an indole compound, in the fruit of the tomato, and especially in the pips of the ripe specimens examined, suggests that it may play a role in metabolism such as regulating or stimulating new growth. However, no T has so far been detected in extracts of the young plant so it is probable that one of the other indole compounds performs this function at this stage of growth. On the other hand, T may be a precursor of 5-HT which itself may be the important stimulator of growth in the tomato. It is of particular interest that 5-HTP was not detected as this amino acid is generally recognised as an intermediate in the formation of 5-HT in animals, and T is not often found in the animal kingdom. It is probable that 5-HT in the tomato is formed from the stores of TP.

A suggestion that 5-HT is possibly the counterpart in animals of auxin (3-indoleacetic acid, IAA) in plants was put forward by Woolley[4] in 1957. Auxin causes plant cells to grow, most probably as it increases the uptake of water. 5-HT also alters the permeability of the animal cell wall. Experiments by Pickles and Sutcliffe[5] further showed that both auxin and 5-HT changed the permeability of the cells in slices of beetroot so that the red pigment was released into the surrounding medium. As no IAA has so far been detected in the tomato extracts, it may be that 5-HT which is present in the young plant as well as in the fruit is one of the hormones of growth in the tomato. 5-HT was not found in the main stems of the young plant, but this part of the plant is where transport (and not necessarily growth) is the essential process. Further work is now needed to determine at what stage in the life history of the plant the changeover from TP to T occurs and the role of T in the development of the fruit.

This work represents a fresh approach to the significance of 5-HT in nature. It may be possible to determine the type of cell producing 5-HT and so reach a stage nearer to finding its function in biology.

REFERENCES

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After the Author presented the communication there was a DISCUSSION.