

Studies in Organic Acid Metabolism in *Portulaca Oleracea* Linn

In a comprehensive review of the literature on the subject upto 1933, BENNET-CLARK¹⁾ established the fact that succulents in general, with exception of *Portulaca* and Halophytes, exhibit diurnal fluctuations in the acid content of their chlorophyllous parts and thereby exhibit a special type of metabolism, of which the Crassulacean plants are classical examples. Even though the nature of acid metabolism in Crassulacean succulents is well understood, however the problem remains still obscure for *Portulaca* and Halophytes. Therefore an attempt has been made to study organic acid metabolism in the roots, young and old stems and leaves of *Portulaca oleracea*. As organic acid metabolism is intimately related to carbohydrate and nitrogen metabolisms, investigations have been extended to them also. Titratable acidity, total nitrogen and reducing and total sugars were estimated by the usual analytical methods while the paper chromatographic techniques were employed for the identifications of organic acids, free amino acids and sugars. Table 1 given below summarizes the results obtained.

Table 1. T.A.N. sugars, nitrogen and moisture in different parts of *Portulaca oleracea*

| Part of the plant | Mg. eq. of acid per 100 g. of fresh tissue | Sugar in g. per 100 of fresh tissue | | Nitrogen percentage per dry weight | Moisture percentage |
|------------------------|--------------------------------------------|-------------------------------------|-------|------------------------------------|---------------------|
| | | Reducing | Total | | |
| Roots | 1.45 | 0.09 | 0.81 | 1.89 | 81.4 |
| Young Stems | 1.85 | 0.5 | 1.17 | 2.74 | 93.4 |
| Old Stems | 1.22 | 0.78 | 0.9 | 1.54 | 90.0 |
| Young Leaves | 1.72 | 0.22 | 0.22 | 4.59 | 89.3 |
| Old Leaves | 1.67 | 0.1 | 0.1 | 4.09 | 84.8 |

Results and Discussion. From the table it is clear that T.A.N. and sugar values are low while moisture and nitrogen percentages are high. The low T.A.N. values may be due to reason that *Portulaca oleracea* is an oxalate plant where most of the oxalic acid is fixed in the form of insoluble calcium oxalate and very little acid is present in free state. The free oxalic acid appears as a trace acid on paper chromatograms where the citric and malic acids appear as prominent acids. Malic acid is most prominently present in all parts and is the major acid of the roots.

When chromatograms were developed with pentanol formic acid system for identification of organic acids and sprayed with indicator sprays (indophenol dye or bromophenol blue), it was found that there was a thick band below tartaric acid. On treating the fresh chromatograms with ninhydrin it was revealed that the thick band was due to the presence of aspartic and glutamic acids. RANSON²⁾ has already stated that strongly acidic amino acids react with pH indicators used for detection of organic acids and their identities should be confirmed by ninhydrin. It was also observed that glutamic and aspartic acids are dominant free amino acids present in all parts. Recent paper chromatographic investigations³⁾ have shown that glutamic and aspartic acids are most dominant free amino acids of plant tissues and PEARSALL⁴⁾ is of the opinion that alanine with glutamic and aspartic acids represent suitable building stones for many amino acids. Dominance of these free amino acids in *Portulaca* indicates that they may play the role of precursors of other amino acids ultimately resulting into vigorous nitrogen metabolism. High percentage of moisture is generally accompanied by low percentage of nitrogen. However opposite is the case in *Portulaca*. This may be due to vigorous free amino acid synthesis in the tissues of this plant. Recent biochemical investigations of the Halophytes of Bombay undertaken in this laboratory shows that like *Portulaca* in Halophytes also free amino acid synthesis is vigorous in all parts.

While investigating phytosociological and biochemical aspects of nitrophilous plants of Bombay, BHARUCHA and DUBASH⁵⁾ found that in constancy of nitrates and in the average nitrate content *Portulaca* stood high. However due to low frequency the nitrophily number of the species in the association was low. The high nitrate contents recorded by BHARUCHA and DUBASH can now be attributed to vigorous free amino acid synthesis in all parts of *Portulaca*.

Only three sugars could be detected, namely the glucose, fructose and sucrose. The sucrose is the dominant sugar of

roots and young stems while it is entirely absent in the leaves. In conclusion it can be said that *Portulaca oleracea* is an oxalate succulent which does not show diurnal fluctuations in acid content of leaves. There is a vigorous free amino acid synthesis in all parts which results in high nitrogen metabolism. The oxalic, citric and malic acids are present in free state and the last two are the major free acids of the plant tissues.

Department of Botany, Institute of Science, Bombay, India

F.R. BHARUCHA and G.V. JOSHI

Eingegangen am 8. März 1957

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