demonstrated in other plant species by a binding protein assay [10–13], by radioimmunoassay [14] and by bioluminescence and protein kinase assays. Although the concentrations of cyclic AMP reported in these independent investigations are in reasonable agreement, these findings are disputed by other workers, e.g. Keates [15], and Amrhein [16].

Adenylate cyclase has been demonstrated in higher plants [8, 12, 14], as has cyclic nucleotide phosphodiesterase [12, 13, 16, 17]. Recent observations of the possible role of cyclic AMP as a 'secondary messenger' in plants is discussed.

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Pyrimidine Derivatives in Higher Plants

F. G. Brown

Department of Biochemistry, University College of Swansea, Wales

In addition to the base constituents of their nucleic acids, the tissues of higher plants contain various other pyrimidine derivatives. Many early reports of the occurrence of free pyrimidine bases in these tissues, however, are considered to be the result of the use of extraction methods which permitted hydrolysis of nucleic acids, nucleotides and nucleosides. The biochemistry is reviewed of some of the more unusual pyrimidine derivatives which appear to be peculiar to higher plants. Special attention is paid to the pyrimidine amino-acids, lathyrine [1], willardiine and isowillardiine [2–4]. Their metabolic origins are discussed and evidence presented of a biosynthetic relationship between willardiine, isowillardiine and the orotate pathway of pyrimidine biosynthesis. Evidence for the production of the pyrimidine moiety of thiamine and the formation of lathyrine, by pathways other than that involving orotate, is discussed. Recent work with seedlings of *Lathyrus tingitanus* L. [5] has, however, shown that there is a significant incorporation of radioactivity from 6-^{14}C-orotate into lathyrine although this does not exclude the possible parallel operation of the γ-hydroxyhomoarginine route proposed by Bell [6]. Preliminary work outlining the origin of pyrimidine glucosides, vicine and convicine, in the orotate pathway is also discussed.

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Isoxazolinones in Higher Plants

F. Lambein

Laboratorium voor Physiologische Chemie, Rijksuniversiteit Gent, Belgium

From *Pisum sativum* seedlings two amino acids have been isolated with some characteristic properties: instability in alkaline solution and high sensitivity towards UV irradiation. The structures of these compounds were found to be β-isoxazolin-5-one-2-yl)-alanine (**1**) and β-(2-β-D-glucopyranosyl-isoxazolin-5-one-4-yl)-alanine (**2**).

High concentrations of **1** (2% of dry wt) were found in 6-day-old pea seedlings (root + shoot) grown either in the dark or under continuous light. Both **1** and **2** were also found in seedlings of *Lens culinaris*, *Pisum arvense* and *Lathyrus odoratus*. From *Lathyrus odoratus* six new isoxazolinone derivatives have been isolated; together with **1** and **2** they account for 10% of the dry weight of 10-day-old seedlings (shoot + root).

The structures of these new compounds are: 2-γ-glutamyl-amino-ethyl-isoxazolin-5-one (**3**), α-amino-γ-isoxazolin-5-one-2-yl)-butyric acid (**4**), 2-amino-ethyl-isoxazolin-5-one (**5**), 2-cyanoethyl-isoxazolin-5-one (**6**), 2-β-D-glucopyranosyl-isoxazolin-5-one (**7**) and 2-carboxymethyl-isoxazolin-5-one (**8**). The structures of **5** and **7** have been confirmed by chemical synthesis [1].

The free isoxazolin-5-one ring and *o*-acetylserine are precursors for the enzymic synthesis *in vitro* of **1** [2]. The free ring and UDP-glucose are precursors for the *in vitro* enzymic synthesis of **7**, while **7** and *o*-acetylserine are precursors for the *in vitro* enzymic synthesis of **2**.*

In rats, compound **6** has the same lathyrogenic properties as its photoproduct, β-aminopropionitrile.†

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* In co-operation with Murakoshi *et al.*, University of Chiba, Japan.

† In co-operation with Ressler Ch., Inst. for Muscle Disease, New York, U.S.A.