

trodes and on the same solutions, the free hydrogen ion concentration was also measured by using a glass electrode.

Experimental data could be explained by assuming the presence of mononuclear complexes in the cation, of the type  $ML_n$ . However complexes with participation of protons were also formed. It seems remarkable that even in neutral or moderately alkaline (pH ~8–9) solutions, protonated complexes are still present.

The behaviour of zinc(II) was a subject of specific investigation.

The inspection of polarographic analysis of aqueous solutions equilibrated with homogenized flour or grain shows also

the presence of zinc(II). However the wave relative to this cation appears at more negative  $E_{(1/2)}$  than the corresponding one measured in 1.00 M NaCl.

To find an explanation of the shift of  $E_{(1/2)}$ , several series of polarographic analysis of solutions containing zinc(II) and different aminoacids were carried out and the results were compared with those obtained from solutions equilibrated with flour or grain.

Among the studied aminoacids, histidine seems to give shifts of  $E_{(1/2)}$  comparable with those obtained for grain.

This study will be a subject of further investigation.

## Erratum

The following abstract was published in *Amino Acids* (1993) 5/1: 116 without authors' names

### *Synthesis and Biosynthesis*

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#### Synthetic approaches to functionalised pyrrolidines

This research concerns the application of a [3 + 2] cycloaddition reaction to the synthesis of chiral functionalised pyrrolidines, and attempts to elaborate these to a class of organic compounds known as the kainic acid family. Kainic acid and closely related congeners – domoic acid and acromelic acid – have attracted considerable interest due to their potent insecticidal, anthelmintic and neuroexcitatory properties. The morpholinone (1) reacted with paraformaldehyde to give the chiral, stabilized azomethine ylid (2) which was trapped by a dipolarophile to give cycloadducts of type (3) (see scheme below).

The morpholinone (1) was reacted in this manner with a range of dipolarophiles. NOE difference experiments have permitted the assignment of the *endo*- and *exo*-stereochemistries of the adducts obtained. In addition, three structures have been confirmed by x-ray crystallographic analysis.

Electron-poor alkenes (eg where R is a carbonyl functionality) gave higher yields than electron rich alkenes (eg where R is a phenyl group). In all the reactions discussed there was complete facial selectivity with respect to the azomethine ylid; approach of the dipolarophile was always from the face opposite to the bulky phenyl group of the ylid. The observed regioselectiv-

ities were, in general, what was expected from application of FMO theory. The dominant stereochemistry of addition was *exo*.

A number of these cycloadducts were then deprotected by hydrogenolysis to give the free amino acids (4). The elaboration of these products towards kainic acid, and related structures, is currently under review.

