sidering the organic matter of the soils to be the adsorbing medium, as proposed by Lambert. Mean values of k for each compound could thus be calculated from the figures obtained with the two soils. A correlation of 0.83 was found between the log of the mean k values and (parachor-45N). The equation of the line of best fit was:

$$\log k = 0.0067 \text{ (parachor-45}N\text{)-0.65}$$

The standard deviation was ± 0.30.

It is clearly not valid to consider, as has been done here, that the contribution of every possible hydrogen-bonding site is equal and the assumption that the mechanism of adsorption is the same for each compound is questionable. In addition, Lambert's original derivation of the relationship disregarded the effects of entropy terms in comparing the free energies of partition of compounds between two phases. Recent observations of Miller and Hildebrand (1968) make this assumption debatable.

Lambert's suggestion and this modification of it apply only to situations where organic matter is the soil component primarily responsible for adsorption, as the recent results of Bailey *et al.* (1968) show that adsorption by montmorillonite follows a different pattern. All the molecules considered here contained aromatic structures. The field observations of Upchurch *et al.* (1966) suggest that aliphatic molecules such as CDAA and CDEC behave differently.

However, the use of an empirical relationship of this sort enables some prediction of the adsorptive behavior of a molecule to be made, merely from inspection of its structural formula, and to this extent this approach may be justified until enough information becomes available to enable a more rigorous approach to be made.

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Methionine Loss during Protein Hydrolysis of Plant Material

The high degree of methionine loss during the acid hydrolysis of protein in plant material has been demonstrated by comparing methionine recovery figures from leaf material hydrolyzed with and without prior oxidative protection treatment. The range of methionine loss was 30 to 59%. The results indicate the necessity of prior methionine protective treatment for the accurate determination of this amino acid in hydrolyzates of plant material.

Although it is known that methionine as well as cystine is damaged during acid hydrolysis in the presence of carbohydrates (Schram *et al.*, 1953), the extent to which methionine can be damaged during the hydrolysis of plant material does not appear to be fully realized by many workers in the protein nutritional field. This is evident from the number of recently published analytical figures for methionine derived from analyses of plant material in which no adequate form of methionine preservation has been used.

To indicate the seriousness of this loss, results of methionine assays on hydrolyzates of leaf material prepared with and without prior oxidation of methionine to the sulfone are compared below.

MATERIALS AND METHODS

Methionine determinations were made on duplicate hydrolyzates of untreated leaf material and leaf material previously oxidized with performic acid under controlled conditions.

Unprotected Methionine Assays. A known quantity of lyophilized leaf powder containing approximately 10 mg. of nitrogen was hydrolyzed with 15 ml. of 6N glass-distilled HCl for 24 hours under nitrogen in a sealed hydrolyzate flask. The hydrolyzate was filtered, freeze-dried, and dissolved in 100 ml. of pH 2.2 buffer. Of this solution 0.2 ml. was assayed for methionine on a Beckman-Spinco Model 120C amino acid analyzer. The buffers used for chromatography contained thiodiglycol to prevent oxidation of the sulfur amino acids on the ion-exchange column (Moore and Stein, 1954).

Protected Methionine Assays. The same quantity of lyophilized leaf powder was oxidized with performic acid and hydrolyzed as described by Lewis (1966). The final lyophilizate was dissolved in 100 ml. of pH 2.2 buffer and the methionine content of 0.2 ml. was determined as methionine sulfone on the analyzer.

RESULTS AND DISCUSSION

Table I shows that up to 59% of the methionine content of a sample of leaf material can be destroyed during acid hydrolysis. The actual degree of destruction seems to be unpredictable, as evidenced by the wide range of methionine losses shown and the poor correlation be-

Table I. Methionine Content of Protected (Oxidized) and Unprotected (Unoxidized) Samples of Leaf Material Following Acid Hydrolysis

Leaf Material Source	N_2 Content, % Dry Wt.	Methionine Content, Mg./G. N_2						Methionine Loss in Unprotected Material, %
		Unprotected Material			Protected Material			
		Hydrolyzate		Mean	Hydrolyzate		Mean	
		1	2		1	2		
Scutia myrtina (Burm. f.) Kunz. (locality A)	2.58	41	43	42	103	100	102	59
Scutia myrtina (Burm. f.) Kunz. (locality B)	2.02	70	59	65	115	120	118	45
Cussonia spicata Thunb. (locality A)	3.16	83	88	86	120	124	122	30
Cussonia spicata Thunb. (locality B)	2.41	54	54	54	122	120	121	55
Cussonia spicata Thunb. (locality C)	1.81	62	47	55	137	132	135	59
Halleria lucida L. (locality A)	1.93	50	51	51	126	126	126	59

tween some of the unprotected methionine assay duplicates. Methionine recovery from unprotected hydrolyzates can be slightly improved by adding the contribution of the methionine sulfoxide peak which is eluted immediately before aspartic acid on the analyzer. In no case, however, did this reduce the methionine loss by more than 10%.

These results indicate the necessity of prior methionine oxidative treatment for the accurate determination of this amino acid in plant material.

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