Microbiological Determinations of Amino Acids in Foodstuffs. III

GUNNAR ÅGREN

Department of Medical Chemistry, University of Uppsala, Sweden

The present paper in continuing the work started in 1949 describes the results obtained by the microbiological determinations of amino acids in foodstuffs which are commonly used for nutritional purposes in this country.

Source and preparation of material. The rape meal, meadow fescue and red clover were obtained from the National Animal Experimental Station, Uppsala. The yeast autolysate was produced by Jästbolaget, Stockholm. The rape meal was the rest left after the commercial production of rape oil. Each one of the two plant materials were derived from the third crop. They were harvested 3 weeks after the second crop and before any flowers had developed. The whole plants with an average height of about 20 cm were used. The yeast autolysate was prepared from baker's yeast. All materials were freed from lipids as previously described [1]. The methods of hydrolysis were described in the same paper. Constant moisture values were obtained by drying at 70° *in vacuo* and in the presence of P_2O_5.

Microbiological procedures. Microorganisms, basal media, ranges of standard curves, incubation times and some other details were described in a previous paper [2].

Results and Discussion. In Table 1 the nitrogen values and content of crude protein are recorded in the usual way. Comparing the two plant materials, the red clover should contain more of crude protein. However, when the figures are calculated for 100 g of fresh material the meadow fescue contains 3.8 g and the red clover 3.6 g of crude protein.

To facilitate a comparison with previous data of the amino acid composition in foodstuffs the microbiological values are calculated as described in the first paper of this series [1]. The values are given in Table 2.

With regard to the content of essential amino acids the rape meal compares favourably with the previously analyzed

Table 1. Nitrogen and crude protein content of the foodstuffs. Percentages calculated for ash- and moisture-free material.

Material	N per cent	Crude protein N × 6.25	Ash per cent	Moisture per cent
Rape (*Brassica Napus* L. var. *Oleifera* Metzg.) whole meal	9.10	57.0	26.2	6.2
Yeast autolysate	12.2	76.2	7.4	25.0
Meadow fescue (*Festuca pratensis*) whole plant	3.18	19.7	2.4	79.3
Red clover (*Trifolium pratense*) whole plant	4.52	28.3	1.6	86.2

Table 2.

1. — Values expressed as percentage for ash- and moisture- free material.
2. — Values expressed as percentage in crude protein (total nitrogen in hydrolysate × 6.25).
3. — Amino acid nitrogen in percentage of total nitrogen in hydrolysate.

Amino acid	Rape meal			Yeast autolysate			Meadow fescus			Red clover		
	1	2	3	1	2	3	1	2	3	1	2	3
Alanine	0.9	1.9	1.8	3.6	9.2	8.9	1.0	5.4	5.3	1.0	4.8	4.8
Arginine	3.0	5.6	11.2	1.7	4.3	8.6	0.5	2.7	5.6	0.5	2.1	4.3
Aspartic acid	6.8	9.7	6.5	5.4	13.7	9.0	—	—	—	—	—	—
Cystine	0.9	1.7	1.2	0.6	1.5	1.1	—	—	—	—	—	—
Glutamic acid	9.0	17.1	10.2	4.2	10.7	6.3	—	—	—	—	—	—
Glycine	3.3	6.3	7.3	2.0	5.0	5.8	1.3	5.7	6.7	1.2	5.6	6.5
Histidine	1.4	2.6	4.5	0.8	2.1	3.6	0.3	1.7	2.9	0.4	1.9	3.2
Isoleucine	2.0	3.7	2.4	2.0	4.8	3.2	1.0	4.9	3.2	1.1	4.8	3.2
Leucine	3.0	5.7	3.8	2.7	6.9	4.6	1.6	8.0	5.4	1.8	8.1	5.4
Lysine	1.8	3.5	4.2	2.9	7.4	8.9	1.0	5.2	6.1	0.9	4.1	4.9
Methionine	0.6	1.1	0.7	0.5	1.2	0.7	0.2	0.8	0.5	0.2	0.7	0.4
Phenylalanine	2.1	4.0	2.1	1.5	3.5	1.9	0.9	4.7	2.5	1.1	5.1	2.7
Proline	4.2	8.0	6.1	1.4	3.4	2.6	—	—	—	—	—	—
Serine	4.5	8.6	7.2	2.1	5.3	4.3	—	—	—	—	—	—
Threonine	2.0	3.8	2.8	1.1	2.9	2.1	0.7	3.4	2.5	0.6	2.5	1.9
Tryptophan	0.8	2.0	1.7	0.9	1.3	1.1	0.5	2.5	2.1	0.5	1.8	1.5
Tyrosine	1.2	2.3	1.1	0.9	2.3	1.1	0.5	2.4	1.2	0.7	3.0	1.5
Valine	3.0	5.7	4.3	2.1	5.2	3.9	1.0	5.0	3.7	1.2	5.6	4.2
NH_3-N			12.5			12.0						
Total	50.5	93.3	91.6	36.4	105.3	89.6	10.6	52.4	47.7	11.1	50.1	44.5

lupine meals and bean meal [1,2]. The amino acid composition of the autolyzed baker's yeast closely resembles that found in brewer's yeast. There are no figures available for a comparison with the results obtained in the two plants. Lugg [3] in his recent review only gives some average figures for the bulk proteins prepared from leguminosae and graminae plants. However, with the exception of arginine and methionine our values for the other amino acids fall fairly well within the ranges given by Lugg.

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1. Ågren, G. *Acta Chem. Scand.* **3** (1949) 931.
2. Ågren, G. *Acta Chem. Scand.* **5** (1951) 766.
3. *Advances in Protein Chem.* **5** (1949) 237.

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