Short Communications / Kort Mededelings

Biological activity of maleic methionine and methyl maleic methionine in chickens

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In a chick growth assay over a 10-day period, no significant difference could be established between the effects of DL methionine, methyl maleic methionine and the methyl hydroxy analogue of methionine on growth rate and efficiency of feed conversion. However, maleic methionine was unable to support growth rate to the same extent as the other products tested.

In 'n kuikengroeiproef gedurende 'n periode van 10 dae kon geen betekenisvolle verskille in effektiwiteit tussen DL-metionien, metielmaleïelmetionien of die metielhidroksie-analoog van metionien ten opsigte van groei en voeromsetting gevind word nie. Maleïelmetionien het egter betekenisvolle swakker resultate tot gevolg gehad.

Keywords: Chick growth assay, maleic methionine, methionine, methionine-hydroxy analogue, methyl maleic methionine.

Owing to the microbial degradation of pure methionine in the rumen, various derivatives of this amino acid have been tested in the past in an attempt to supplement methionine, the amino acid most limiting in the diet of the wool sheep and the milking cow (Clark, 1975). Two compounds, viz. maleic methionine (C4MM), described by Butler, Harris, Hartley & Leberman (1969), and methyl maleic methionine (C5MM), described by Dixon & Perham (1968), appear to be suitable sources of this amino acid. The value of C4MM as supplement of methionine in the diet of sheep was evaluated by Bonifacino (1979) and Smith (1979), who both found that it significantly increased wool growth. On the other hand, Landman (1981) was unable to detect any beneficial effect of this product on hair growth of Angora goats. As far as could be established from the literature, C5MM has not been tested as a methionine source for ruminants.

Due to the fact that experiments of this nature in sheep and cattle normally require sophisticated techniques and results must often be based on a limited number of animals, it was thought that some clarity may be obtained on the efficacy of these compounds by testing their biological activity in chickens. Both compounds tend to be stable at pH values between 6 and 7; conditions which prevail in the rumen of the ruminant. However, in the abomasum where the pH is below 3, spontaneous hydrolysis occurs and methionine is liberated and thus utilized. Provided that conditions are similar in the chicken (pH in the gizzard is also below 3), C4MM and C5MM should be able to support normal growth.

A growth assay with chickens was carried out (Miller, Carpenter, Morgan & Boyne, 1965) in which the biological availability of C4MM and C5MM was compared to DL methionine as standard. The Ca salt of methionine-hydroxy analogue was included as an additional control. The C4MM and C5MM were added on an equimolar basis with DL methionine. Four levels, corresponding to increases of 0,05% of DL methionine in the diet, were added to a semi-synthetic methionine-deficient diet which contained only 0,15% methionine, i.e. 50% of the accepted methionine requirement of growing chickens.

It was not possible to use the method of Campbell (1966) to determine methionine availability owing to the fundamental invalidity with regard to linearity (F ratio of 27,4 in Table 1). Therefore, an analysis of variance was performed on the data and significant differences were identified by means of Tukey's *t* test. Results of mass gains are shown in Table 2.

Table 1 Analysis of variance of growth responses of chickens on different levels of methionine and methionine derivatives

Source of variance	D.F.	Sum of squares	Average	F ratio
Regression	4	1718749,093		
Blank	1	21430,761		
Validity				
MHA	3	20725,897	6908,63	4,5
C4MM	3	5969,651	1989,85	1,3
C5MM	3	12933,359	4311,23	2,8
Linearity	1	42215,357	52215,357	27,4*
	15			
Error	103	156549,330	1539,31	
Model	15	1812054,367	120803,6	78,5
Total corrected	118			

$F_{(3,100)}(5\%) = (2,70)$.
$F_{(1,102)}(5\%) = (3,94)$.

Table 2 Average gain in mass per group of three chickens over 10 days on the different levels of methionine supplements

	Levels of added methionine equivalent as % of diet				
	0,00%	0,05%	0,10%	0,15%	0,20%
Methionine	182	363^{defg}	438^{cde}	557^{ab}	596^{a}
MHA	182	323^{fgh}	450^{bcde}	470^{bcd}	540^{abc}
C4MM*	182	237^{hi}	253^{i}	320^{gh}	342^{efgh}
C5MM*	182	313^{gh}	432^{cdef}	470^{bcd}	529^{abc}

[a]—[i] Values with a common letter in the superscript do not differ significantly.

* C4MM – Maleic methionine; C5MM – methyl maleic methionine.

Increasing amounts of DL methionine consistently resulted in increases in weight gain (Table 2). The same applied to MHA and C5MM. There were, in fact, no significant differences in the ability of these products to support growth rate. The exception was C4MM, where growth was significantly reduced, especially at higher levels (0,15% and 0,2%) of supplementation. The apparent decrease in gains at the two higher levels of MHA and C5MM, however, were not significantly different from that of DL methionine.

In the present experiment, maleic methionine was poorly utilized as a source of methionine by the chicken. It is possible that the rate of food passage is too rapid to allow hydrolysis in the proventriculus and gizzard and that only very little methionine is liberated.

In the ruminant, the pH of the ingesta in the abomasum varies between 2 and 3 (Mason & Philipson, 1952), and from proximal duodenum there is a gradual increase from 2,7 to 4 along the length of the small intestine (Harrison & Hill, 1962). These conditions are more favourable for hydrolysis of maleic methionine and it has, in fact, been found that wool growth was stimulated (11% increase) by maleic methionine (Coetzee, 1987; personal communication). On the other hand, methyl maleic methionine increased wool growth by 29%, which may indicate a greater availability of methionine in this product. The latter finding is in accordance with the results of the chick assay. From these preliminary results, it does seem that this chick assay is capable of providing some information on the suitability of methionine derivatives as a methionine source for the ruminant.

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