other efficient sources of essential amino acids, as far as possible without the disadvantages of the known products or only having them to a reduced extent.

Furthermore, various novel and flexible synthesis routes should be developed for dipeptides containing only one methionine residue, in particular for L-EAA-DL-methionine (**I**) and DL-methionyl-L-EAA (**II**). Typical precursors and by-products from the commercial DL-methionine production process should be used as starting material for a synthetic route.

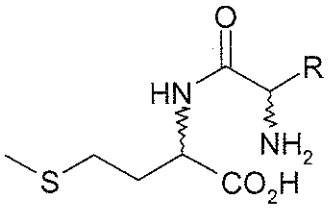
Summary

In one aspect, there is provided a feed additive containing dipeptides or salts thereof, characterized in that one amino acid residue of the dipeptide is a DL-methionyl residue and the other amino acid residue of the dipeptide is an amino acid in the L-configuration selected from the group comprising lysine, threonine, tryptophan, histidine, valine, leucine, isoleucine, phenylalanine, arginine, cysteine and cystine.

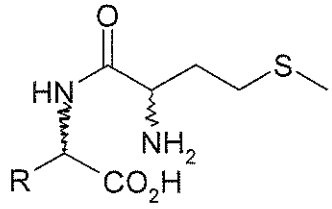
In another aspect, there is provided a feed mixture containing a feed additive as defined above.

In another aspect, there is provided a dipeptide or a salt thereof of general formula DL-methionyl-DL-EAA or DL-EAA-DL-methionine, characterized in that EAA is an amino acid, preferably in the L-configuration selected from the group comprising lysine, threonine, tryptophan, histidine, valine, leucine, isoleucine, phenylalanine, arginine, cysteine and cystine.

In another aspect, there is provided a method of production of a dipeptide containing only one methionyl residue according to the formula DD/LL/DL/LD-**I** or DD/LL/DL/LD-**II**:

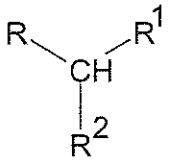


(DD/LL/DL/LD-**I**)



(DD/LL/DL/LD-**II**)

by reacting an amino acid with a urea derivative of general formula **III** to **V**,



(**III** to **V**)

where R is defined as follows:

Ia to **Va**:	R = 1-methylethyl-	(valine)	
Ib to **Vb**:	R = 2-methylpropyl-	(leucine)	
Ic to **Vc**:	R = (1*S*)-1-methylpropyl-	(isoleucine)	**Id**
to **Vd**:	R = (1*R*)-1-hydroxyethyl-	(threonine)	
Ie to **Ve**:	R = 4-aminobutyl-	(lysine)	
If to **Vf**:	R = 3-[(aminoiminomethyl)-amino]propyl-	(arginine)	
Ig to **Vg**:	R = benzyl-	(phenylalanine)	
Ih to **Vh**:	R = (1*H*-imidazol-4-yl)methyl-	(histidine)	
Ij to **Vj**:	R = (1*H*-indol-3-yl)methyl-	(tryptophan)	
Ik to **Vk**:	R = $-CH_2-SH$	(cysteine)	
Im to **Vm**:	R = $-CH_2-S-S-CH_2-CNH_2-COOH$	(cystine)	
IIIn to **Vn**:	R = $-CH_2-CH_2-S-CH_3$	(methionine)	

with the residues R^1 and R^2 in the urea derivatives **III**, **IV** and **V** being defined as follows:

where **IIIa-n**: $\mathbf{R^1}$ = COOH, $\mathbf{R^2}$ = $NHCONH_2$
IVa-n: $\mathbf{R^1}$ = $CONH_2$, $\mathbf{R^2}$ = $NHCONH_2$
Va-n: $\mathbf{R^1}$-$\mathbf{R^2}$ = -CONHCONH-

and

where R either denotes a methionyl residue and the added amino acid is selected from the group comprising lysine, threonine, tryptophan, histidine, valine, leucine, isoleucine, phenylalanine, arginine, cysteine and cystine

or

the added amino acid is methionine and R is an amino acid residue selected from the group comprising lysine, threonine, tryptophan, histidine, valine, leucine, isoleucine, phenylalanine, arginine, cysteine and cystine.

In another aspect, there is provided a method of isolation of the diastereomeric mixture of the dipeptides of formula **I** and **II** by crystallization from basic reaction solutions that were obtained as defined above, preferably in that the solution is adjusted with an acid to a pH value from 2 to 10, especially preferably to a pH value from 3 to 9, quite especially preferably to the corresponding isoelectric point of the respective dipeptide of formula **I** or **II**, and the adjustment of pH preferably takes place with an acid selected from the group comprising the mineral acids, HCl, H_2CO_3, CO_2/H_2O, H_2SO_4, phosphoric acids, carboxylic acids and hydroxycarboxylic acids.

In another aspect, there is provided a method of isolation of the diastereomeric mixture of the dipeptides of formula **I** and **II** by crystallization from acidic reaction solutions that were obtained as defined above, preferably in that the solution is adjusted by adding a base to a pH value from 2 to 10, especially preferably to a pH value from 3 to 9, quite especially preferably to the corresponding isoelectric point of the respective dipeptide of formula **I** or **II**, characterized in that the base is preferably selected from the group comprising NH_4HCO_3, $(NH_4)_2CO_3$, nitrogen-containing bases, NH_4OH, carbamate salts, $KHCO_3$, K_2CO_3, carbonates, alkali and alkaline-earth bases.

In another aspect, there is provided the use of the compounds **I** and **II** as defined above as feed additive for useful animals, preferably for poultry, pigs, ruminants, fresh-water or seawater fishes, Crustacea or pets.

Description of the invention

The problem is solved with feed additives containing dipeptides or salts thereof, where one amino acid residue of the dipeptide is a DL-methionyl residue and the other amino acid residue of the dipeptide is an amino acid in the L-configuration selected from the group comprising lysine, threonine, tryptophan, histidine, valine, leucine, isoleucine, phenylalanine, arginine, cysteine and cystine.

Preferably the feed additive contains dipeptides of general formula DL-methionyl-L-EAA (= mixture of D-methionyl-L-EAA and L-methionyl-L-EAA) and/or L-EAA-DL-methionine (= mixture of L-EAA-D-methionine and L-EAA-L-methionine), where L-EAA is an amino acid in the L-configuration selected from the group comprising lysine, threonine, tryptophan, histidine, valine, leucine, isoleucine, phenylalanine, arginine, cysteine and cystine.

The invention further relates to a feed mixture containing said feed additive.

The feed additive containing L-EAA-DL-methionine and/or DL-methionyl-L-EAA and salts thereof is suitable as feed