

Formulating feeds with a protease

Feed proteases - Science into Practice Seminar -
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Amino acid digestibility is not optimal!

Ingredient*	Lys	SAA	Thr	Val	Arg	Ile	Trp	Avg
Corn	92	90	85	92	93	95	81	88
Sorghum	90	84	83	87	88	90	87	87
Wheat	86	91	87	90	85	94	86	88
Soybean m.	90	86	85	88	93	89	89	89
Canola m.	80	80	73	79	87	79	80	80
Cotton m.	65	73	68	74	88	71	80	74
Sunflower	87	87	82	87	93	89	87	87
Wheat m.	80	78	73	77	80	82	79	78
Rice m.	76	68	66	68	78	66	50	67
MBM	69	62	62	70	77	69	55	66
Feather m.	57	51	53	67	68	73	46	59

*Ileal amino acid digestibility coefficients from various sources

Digestibility of AA represents the portion of total amino acids hydrolysed and absorbed by gastro-intestinal tract

Undigested protein fraction is potential substrate for an exogenous protease

Ingredient*	Lys	SAA	Thr	Val	Arg	Ile	Trp	Avg
Corn	8	10	15	8	7	5	19	12
Sorghum	10	16	17	13	12	10	13	13
Wheat	14	9	13	10	15	6	14	12
Soybean m.	10	14	15	12	7	11	11	11
Canola m.	20	20	27	21	13	21	20	20
Cotton m.	35	27	32	26	12	29	20	26
Sunflower	13	13	18	13	7	11	13	13
Wheat m.	20	22	27	23	20	18	21	22
Rice m.	24	32	34	32	22	34	50	33
MBM	31	38	38	30	23	31	45	34
Feather m.	43	49	47	33	32	27	54	41

*Ileal amino acid digestibility coefficients

- Amino acids reaching ileum without digestion in presence of endogenous enzymes = substrate for exogenous protease and opportunity for economic benefit
- Amount and profile of substrate varies with ingredient

How do we capture the value of a protease for formulation purposes?

- Generate a database of 'lift' value for protease to allow:
 - direct upgrade of raw materials in LCF programs using DIF values
 - Calculation of matrix values for specific diets based on ingredient inclusion and/or nutrient specification
 - Best estimation of a matrix value



Measuring amino acid digestibility

- Difference between AA input [feed] and output [faeces/Ileal digesta]
- Faecal - confounded by influences of urine, hindgut microbes
- Ileal - removes confounding factors and greater correlation between Ileal than faecal N digestibility and weight gain

1

Apparent

- Doesn't differentiate between undigested and endogenous AA
- Not additive in mixed diets
- More simple than standardized and true methods

2

Standardized

- Corrected for basal Ileal endogenous loss
- Additive in mixed diets
- More accurate than apparent values (Adeola, 2013)
- More simple than true approach

3

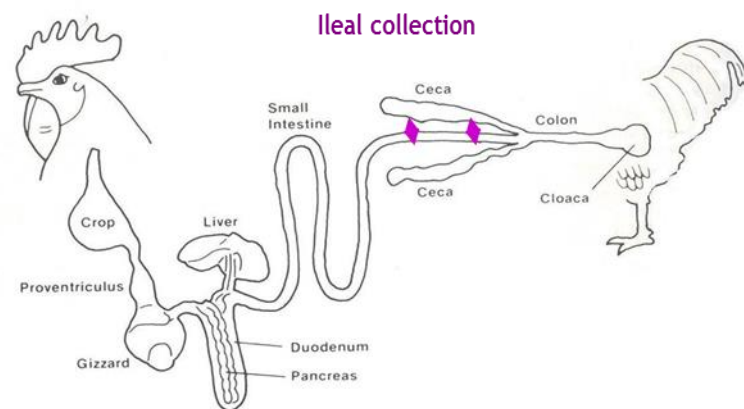
True

- Corrected for specific and basal endogenous loss
- Onerous/time consuming

To evaluate RONOZYME ProAct we chose SIAAD methodology

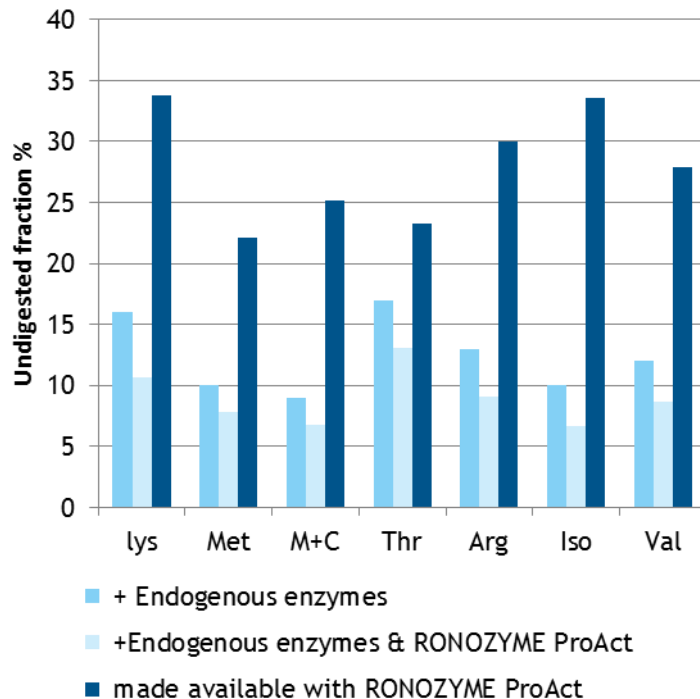
DSM protocol for SIAAD studies with a protease

- Male broilers
- Ross 308 or Cobb 500
- SIAAD methodology
- Semi-synthetic diets based on corn starch
- Test ingredient is sole protein source
- Nitrogen free diet
- 4 day adjustment period
- Titanium dioxide marker
- 10-12 birds per cage
- 8-12 replicates per treatment
- Digesta collected from distal 2/3 of ileum

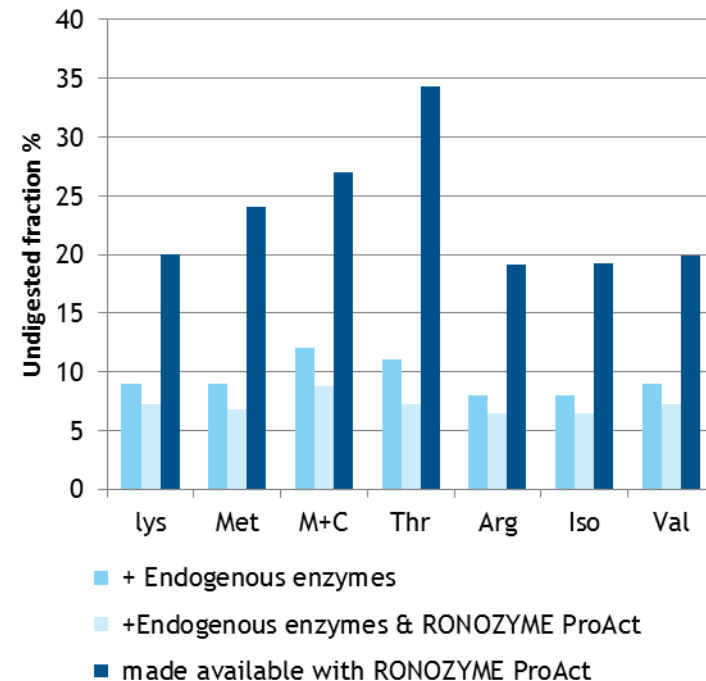


Example effects of RONOZYME ProAct on undigested protein measured in ileum

Wheat



Soybean meal



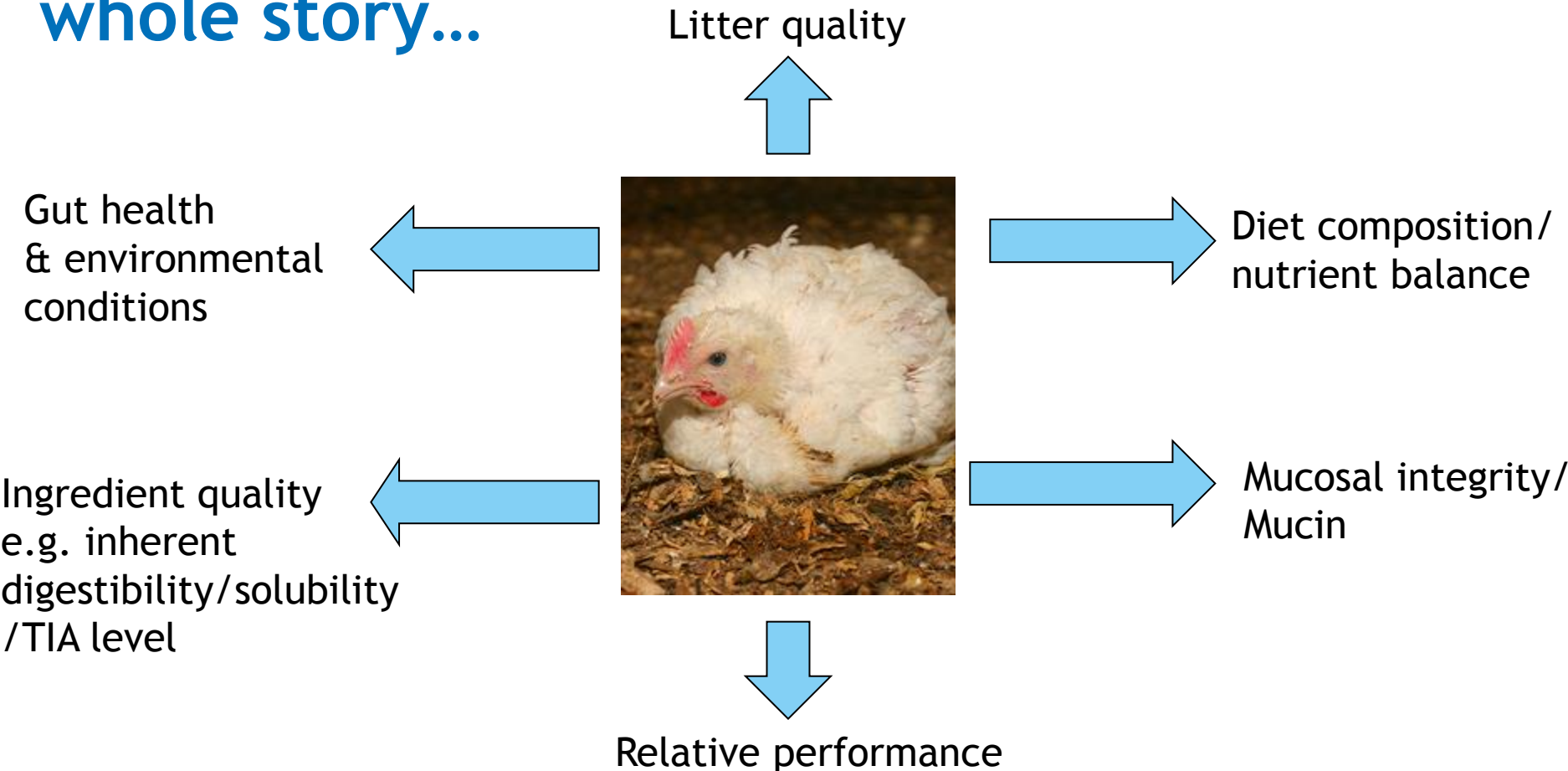
20-35% of those amino acids undigested by endogenous enzymes made available to the animal when RONOZYME ProAct is used

Heat map of broiler ileal amino acid digestibility improvement factors with RONOZYME® ProAct

	Samples tested	CP	Met	Cys	M+C	Lys	Thr	Arg	Val	Ile	Leu
Corn	11	3.42%	2.85%	6.75%	4.73%	3.58%	7.21%	3.31%	4.14%	3.62%	1.40%
Wheat	12	3.47%	2.46%	2.52%	2.49%	6.44%	4.77%	4.48%	3.81%	3.73%	3.31%
Barley	6	1.33%	1.68%	0.50%	1.02%	1.75%	2.55%	1.44%	1.59%	1.11%	1.17%
Soy Bean Meal	20	2.21%	2.38%	4.52%	3.68%	1.98%	4.24%	1.66%	1.97%	1.63%	1.13%
Full Fat Soy	5	6.43%	4.67%	17.37%	11.02%	2.52%	8.49%	5.30%	4.47%	3.17%	0.40%
Rapeseed Meal	18	1.62%	1.80%	1.56%	1.66%	2.05%	1.86%	1.19%	2.05%	1.93%	1.68%
DDGS Corn	7	3.14%	3.13%	5.05%	4.09%	5.45%	5.92%	3.36%	2.49%	2.23%	0.37%
Sunflower Meal	11	2.04%	0.41%	1.17%	0.66%	3.35%	2.32%	0.85%	0.85%	0.72%	0.94%
Meat Bone Meal	3	5.41%	5.47%	20.48%	12.97%	4.66%	6.43%	5.58%	3.86%	1.76%	1.54%
Poultry by-prod.	1	3.89%	6.12%	6.83%	6.47%	0.76%	2.31%	1.67%	3.24%	14.43%	1.09%
Feather Meal	2	1.96%	14.59%	1.06%	7.82%	1.11%	0.91%	0.67%	0.65%	2.71%	1.16%
Fishmeal	1	3.89%	3.74%	15.24%	9.39%	4.91%	1.76%	2.76%	4.89%	3.70%	3.69%
Sorghum	1	0.95%	0.13%	0.50%	0.32%	2.06%	0.36%	1.27%	1.55%	1.69%	0.77%
Wheat Midds.	1	2.16%	0.12%	0.00%	0.06%	0.00%	4.55%	1.09%	1.74%	2.77%	1.63%
Pura	1	1.76%	1.00%	2.46%	1.73%	1.40%	3.23%	0.76%	1.67%	1.59%	1.45%

- Over 100 batches of ingredients tested
- SIAAD methodology
- €4 million investment
- Database still being developed
- Unique 'fingerprint' of RONOZYME ProAct
- Conservative estimate of protease value

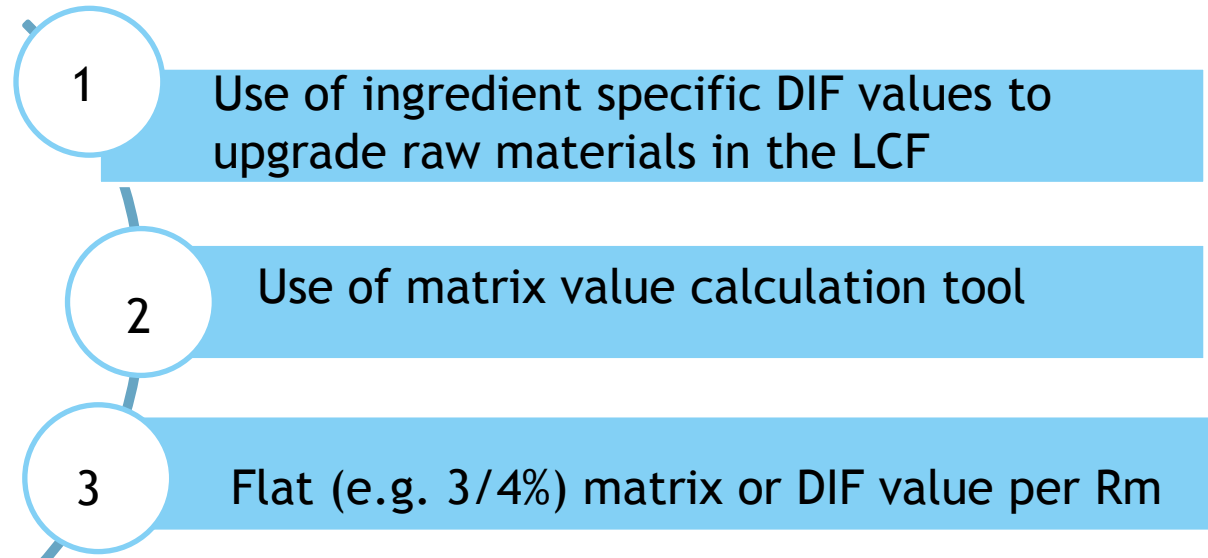
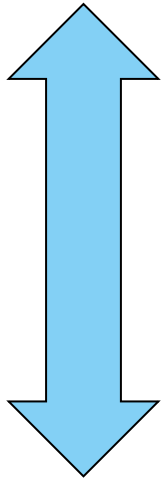
Digestibility: important but not the whole story...



Local adaptation of matrix/DIF for 'extra proteinaceous' effects appropriate - balance of performance and cost savings

Practical implementation into diet formulations

More precise/ initial implementation
more time consuming



Less precise/implementation
quick

- Balance of precision and simplicity
- Balance of performance and cost saving
- User specific

Some practical recommendations for optimal use with other enzymes

Phytase	<i>releases modest amounts of amino acids (AA) relatively independently of the mode of action of protease</i>
Calcium/av. phosphorus	☺
Moderate AA matrix	☺
Aggressive AA matrix*	☹

Carbohydrases	<i>improve solubility of protein in certain ingredients by 'decaging' and may also improve accessibility of substrate for a protease</i>
ME only	☺
50% AA matrix/DIF**	☺
100% AA matrix/DIF**	☺

* Scrutinise supporting literature

** target raw materials only

RONOZYME® ProAct Effect on Broiler Performance with AA DIF Values

Species: Broilers

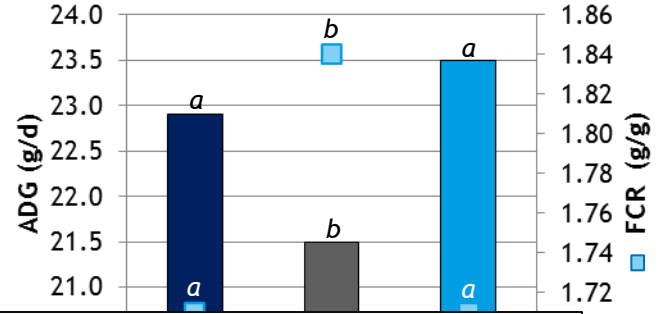
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Objective

- To determine the effect on broiler performance at 10 and 42 days of utilizing RONOZYME® ProAct in diets formulated using amino acid DIF values

Results

Performance at 10d.



Feed cost savings

0-21d - Euro3/MT

22-42d -Euro 2.2/MT

Trial details

- IMASDE Aviary
- Breed: Ross
- Basal diet: 18% CP, 10% CP pellets with 10% CP
- Experimental design: 12 replicates
- Treatments:
 - T1- Positive control
 - T2- Negative control
 - DSM ingredients: key raw materials, crude protein
 - T3- NC
- Parameters measured: Average daily gain and feed conversion ratio (FCR)
- Carbohydrase and phytase added to all diets

*Feed cost savings: for NC+200ppm RONOZYME® ProAct relative to PC= - 3€/MT (0-21d) and -2.2€/MT (22-42d)

acid DIF values but without enzyme addition reduced performance of broilers at 10 and 42d of age

- RONOZYME® ProAct supplementation to the NC diet compensated for the loss in performance compared to the PC at both ages and gave significant feed cost savings

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Formulating with a protease.....

- Undigested protein at Ileal level is a substrate for an exogenous protease and level differs by ingredient
- DSM have evaluated the potential of RONOZYME ProAct to reduce undigested protein in commonly used ingredients using SIAAD methodology
- Ingredient DIF values have been generated from SIAAD data for optimal formulation precision
- Conservative 'flat' matrix values can also work effectively and are more practical for some operations
- Adjustments to matrix/DIF values for non 'proteinaceous effects' of a protease can be made = balance of cost saving and performance
- Proteases generate significant feed cost savings with current ingredient prices

helping create a more economically and environmentally sustainable broiler industry.....



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