Can proteases play a role in enteric health?

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HEALTH · NUTRITION · MATERIALS

Issue in the broiler industry

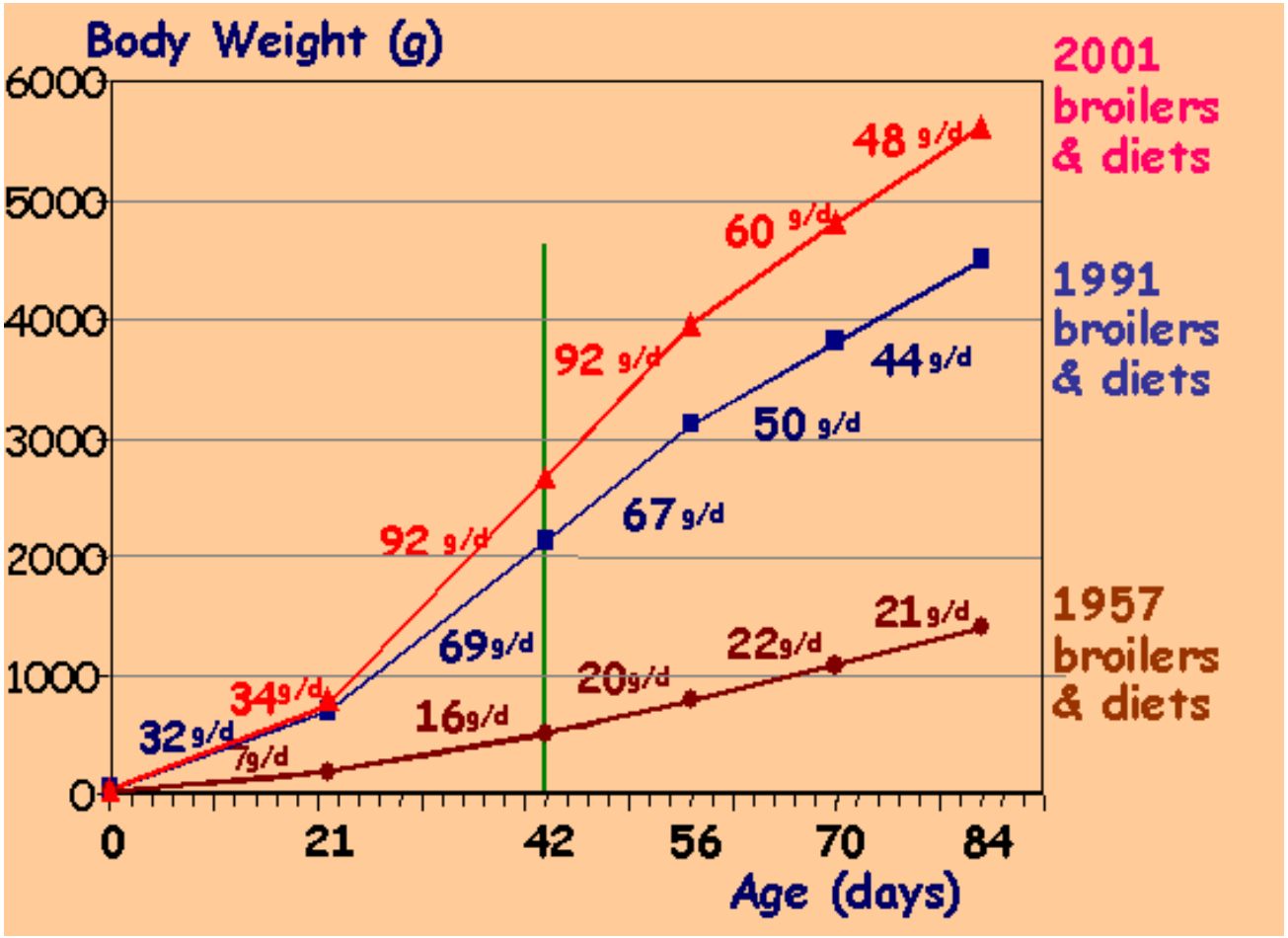
- Wet litter, associated with poor gut health main concern in broiler industry

- The Paradox:
  - Decreased dietary protein levels:
    - Reduces problem with wet litter
    - Impair broiler performance

- Is there a solution?

Genetic development in broilers

Changes in the body weight curve and growth rate (in grams/day) of broiler chickens from 1957 to 2001



source: Havenstein *et al* , 2003

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Responds modern broilers on protein/AA levels

- Increasing protein and AA levels improve broiler performance
- Enhanced protein + AA levels in the starter diet increase weight gain of the bird.
- FCR, breast and abdominal fat yield are mainly affected by protein + AA levels in the grower diet.




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Protein and AA levels in nowadays broiler programs

- Protein and amino acid levels in broiler diets increased over the last 10 years
  - Birds able to utilize higher protein/amino acid levels
- Increase mainly in the first weeks of life

Using high protein levels increased risks for gut health

- Increase in protein also results in higher undigested protein levels in the diet
- Protein impairs balance in gut microflora
  - Increased protein levels increase the risk for imbalance microbial community (Laudadio et al., 2012)
  - Crude protein, protein source and amino acid content of diets affect growth rate of *C. perfringens* (Drew et al., 2004)
  - Protein in lower part GIT results in more proteolytic fermentation
  - High protein increase risk for lower gut integrity
- Result: high protein results in increase of wet litter (observation in practice)

Undigested protein in broiler diets results in lower performance

Undigested Protein (g/kg)	29.1	32.4	34.2	36.3
Weight gain (g/d)	67.7[a]	67.1[ab]	65.5[bc]	63.7[c]
FCR	1.630[a]	1.674[b]	1.693[bc]	1.724[c]

[1] Undigested protein was from feather meal, diets were fed during the age period of 11 – 28 days.

abc Means within a column not sharing a common superscript differ significantly (P<0.05).

Source: De Lange et al., 2003

Influence of dietary protein level on bacterial activity

CP (%)	22.5	20.5	18.5
Gain (g/d)	59.2	59.6	57.2
FCR	1.55	1.54	1.59
Feacal pH	6.22^{a}	6.11^{ab}	5.80^{b}
Total aerobic bacteria (log_{10} CFU/g)	4.16^{a}	3.95^{b}	3.42^{c}
E. Coli (log_{10} CFU/g)	3.89^{a}	3.73^{a}	2.97^{b}

[1] Source: Laudadio et al., 2012
Experimental diets were fed between 14 – 42 days of age
Bacterial measurements were done in feaces of chickens at 42 days of age
[abc] Means within a column not sharing a common superscript differ significantly (P<0.05).

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Dietary protein and microbial activity

- Data indicate that higher protein levels show increased microbial activity in the GIT of broilers (Laudadio et al., 2012)
- Particularly detrimental bacteria increase such as E. Coli (Laudadio et al., 2012) and Clostridium (Drew et al., 2004)
- Data indicate that the effect of dietary protein on microbial activity depends on the protein source used in the diet (Wilkie et al., 2005):
  - Fish meal, Meat and Bone meal, Feather meal and potato protein concentrate showed significant higher clostridium levels in the GIT as compared to Soya protein concentrate, pea protein concentrate and corn gluten meal

How to avoid negative effects “high” protein in the diet ?

- Increase AA balance to avoid high levels of fermentable protein in the diet
  - Use only synthetic AA
  - Use soya isolates
  - Above options too expensive
- Strategy should be to improve protein utilization, enabling lower dietary CP levels
  - Slow down emptying gizzard
  - Improve gut integrity
  - Improve protein digestion

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Slow down emptying gizzard; Improve structure of the diet

- Diet longer in the crop and gizzard
  - lower pH in gizzard
- Gizzard “pace-maker” for motility intestine (coarse particles stimulate reflux)
- Better pre-digestion protein in gizzard
- Less fermentation in small intestine

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Effect of particle size on weights and pH values in different parts of the gastrointestinal tract[1].

	Fine particles[2]	Coarse particles[3]
Weight gizzard, g	20.4[a]	32.8[b]
Weight gizzard contents, g	13.4[a]	49.8[b]
Weight duodenum + jejunum, g	52.2[b]	47.8[a]
Weight ileum, g	23.7	21.2
Weight ceaca, g	10.0	11.4
PH gizzard contents	3.4[b]	2.8[a]
PH duodenum + jejunum contents	5.8	6.2
PH ileum contents	6.3[a]	7.0[b]

[1] Source: Langhout, 2004
[2] Fine particles: ingredients were ground on a 3 mm sieve (speed hammer mill 1500 rpm).
[3] Coarse particles: one ingredient was ground on an 8 mm sieve.
[ab] Means within a row not sharing a common superscript differ significantly (P<0.05).

Improve gut integrity; Role of prestarter

- Young birds have low bacterial species and activity in intestine
  - In young birds micro flora easily disturbed
- In first week strong development intestinal tract and immune system
- A prestarter can help to develop good flora
  - selection of ingredients
  - better development intestinal tract
  - development beneficial micro flora
  - stimulation development immune system

Effect of prestarter on health status broilers

Cocc.	Clostr.	Prest.	daily feed intake	body weight	feed/gain ratio
-	-	-	89.7 ^{b}	2040 ^{b}	1.57 ^{ab}
-	-	+	92.9 ^{c}	2094 ^{b}	1.58 ^{b}
+	+	-	84.8 ^{a}	1949 ^{a}	1.56 ^{a}
+	+	+	91.3 ^{bc}	2059 ^{b}	1.58 ^{b}

[1] Source: Langhout,2007

[abc] Means within a column not sharing a common superscript differ significantly (P<0.05).

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Limitations coarse structure and prestarter diet

- Coarse particles:
  - In starter period limited because it limits feed intake and thus reduces 7 d weight
  - In grower finisher diets it may have negative effect on pellet quality
- Prestarter
  - Not all desired ingredients are available
  - Prestarter diet is expensive
  - Feeding only 100 g/bird often not practical
- Third option; improve protein digestion
  - Use of protein enzyme
  - Enzyme can improve protein utilization

Effect of RONOZYME® ProAct Supplementation in Broilers

RONOZYME® ProAct

Species: Broilers

Country: Belgium, ILVO

Objective

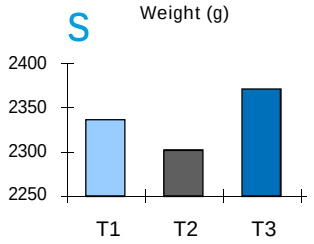
- To determine the effect of feeding reduced CP and AA diets with and without RONOZYME® ProAct on production performance, litter quality, footpad lesions and feather cleanliness

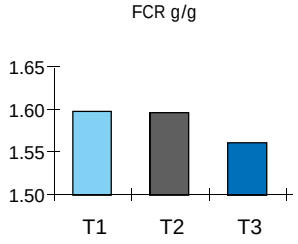
Trial details

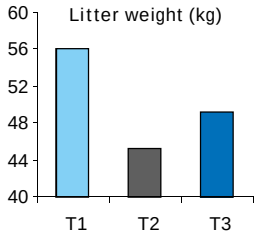
- Breed: 710 male Ross 308 broilers
- Basal Diet: Wheat, corn, soyabean meal, full fat soy based, (Non heat treated mash)
- Experimental: completely randomized design, 7 replicate pens (control diets) and 8 replicate pens (experimental diets) each with 32 birds
- Treatments*:
  - T1= Control diet (Industry standard)
  - T2 = Low protein diet diet - 3% less Crude protein (CP)/Amino acid (AA) than T1 from 11-39 days
  - T3 = T2 + 200 ppm RONOZYME® ProAct
- Parameters measured:
  - Liveweight and FCR
  - Litter weight
  - Scoring of footpad lesions and feather cleanliness (0 = clean birds, no footpad lesions; 3 = dirty birds, severe footpad lesions)

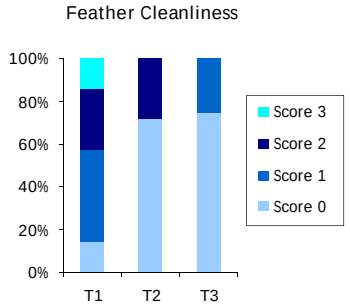
* *All diets contained xylanase and phytase*

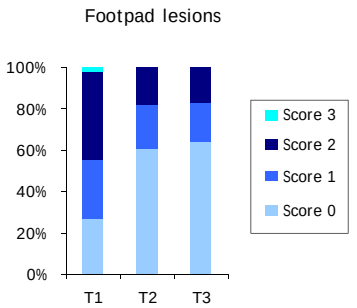
Results











Conclusions & Benefits

- A low protein diet reduced litter weight, severity of footpad lesions and improved feather cleanliness but reduced broiler performance when compared to an industry standard diet
- RONOZYME® ProAct improved litter weight, feather cleanliness and footpad lesion severity, and at the same time produced superior broiler performances compared to an industry standard diet

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Source: ILVO July 2011

Discussion:

- We cannot decrease protein without overcoming negative effect on performance
- Protease is new technology that allows reduction in protein without losing animal performance
- To test the effect on litter quality the protease needs to be fed under practical conditions

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