

Building Your Diet Around Forage

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Outline

- Poultry foraging behavior considerations
 - Breed
 - Pasture accessibility
 - Feeding management
- How can forage quality be defined?
 - Total vs. digestibility nutrient formulation
 - Assessing forage quality is a moving target
- Current Research
 - West Virginia University
 - University of Nebraska
 - Penn State University
 - University of Guelph, Ontario
 - University of Lisbon, Portugal

Poultry Foraging Behavior Considerations

- Breed characteristics



Poultry Foraging Behavior Considerations

- Breed characteristics
 - Age / familiarity



Poultry Foraging Behavior Considerations

- Pasture encouragement



Poultry Foraging Behavior Considerations

- Pasture accessibility



Poultry Foraging Behavior Considerations

- Pasture accessibility



Poultry Foraging Behavior Considerations

- Pasture accessibility



Poultry Foraging Behavior Considerations

- Feeding management



- Feed restriction
- Nutrient deficient feed
- Choice feeding

So What's Wrong with Forage?

Dehydrated Alfalfa vs. Corn grain (both at ≈ 90% DM)

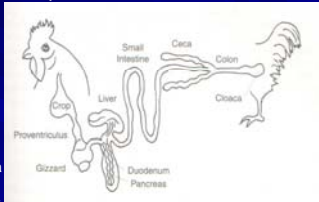
	Methionine (%)	Fiber(%)
Dehydrated Alfalfa	0.24	24.1
Corn Grain	0.18	2.2

1994 NRC Nutrient Requirements of Poultry

So What's Wrong with Forage?

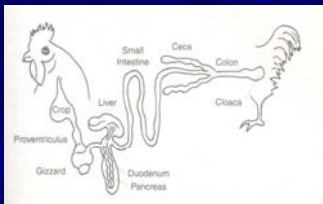
- Fiber - plant cell wall components i.e., cellulose, lignin, pectin and non starch polysaccharides (NSP)

Cellulose and lignin are not digestible by poultry enzymes



- NSP's can imbibe water in the digesta
- leads to a more viscous digesta
- decreases contact between all dietary nutrients and intestinal enzymes / points of absorption
- Increases endogenous enzyme and bile production
- explosive bacterial growth in lower gi tract
- leads to sticky wet excreta

So What's Wrong With Forage?



	methionine digestibility (%)	ME (kcal/kg)
Dehydrated Alfalfa	73	1,200
Corn grain	91	3,350

1994 NRC Nutrient Requirements of Poultry

Care needs to be taken when taking nutrient values of forage at face value

Negative effects on other nutrients must also be considered

Currently, Many Nutritionists Formulate Diets Based on Digestible Nutrients

- This method ensures that poultry are receiving the precise quantity of nutrients that they require
- However, estimating digestible nutrients of forage is even more complicated...

Forage Digestibility (Quality) Changes Throughout and Among Seasons

- High ambient temperature
 - Promotes lignification
 - 1st cut hay is of higher digestibility than 2nd cut hay
- Short days and long nights
 - Reduces total photosynthesis
 - Spring grass is typically more digestible than fall grass from the same field

Based on Confounded Effects of...

- Foraging behavior (breed, access, feed management and bird age)
- High fiber (NSP) content of forage that decreases nutrient digestibility
- Changing nutrient characteristics of forage due to growth, temperature and season

❖ I cannot recommend basing your nutrient plan on forage

Pasture Has Been Documented as an Important Nutrient Source

➤ Vitamins and Minerals

- Morrison, 1956

➤ Protein

- Duckworth, 1954

- Morrison, 1956



New York State College of Agriculture, Cornell University
circa 1950

Genetics, Nutrient Requirements,
Grow-out times (all different compared to today)

Forage Used to Replace Synthetic Methionine for Organic Broilers (Ross 308)

West Virginia University 2005

Forage to Replace Methionine

- 4 treatments
 - With synthetic methionine, ad libitum
 - With synthetic methionine, 50% feed restricted
 - Without synthetic methionine, ad libitum
 - Without synthetic methionine, 50% feed restricted
- Study was conducted in Summer and Fall months

West Virginia University 2005

Forage to Replace Methionine

- Pasture
 - Tall fescue
 - Retains palatability when mature
 - Orchard grass
 - Tolerates shade but loses palatability when mature
 - Red clover
 - Similar to alfalfa in nutritional value but continuous grazing will eliminate it from pasture
 - White clover
 - Resistant to grazing pressure

West Virginia University 2005



Forage to Replace Methionine

- Results
 - Feed restriction increased foraging
 - Ad libitum (7.3 g of DM/bird/d) vs. 50% feed restricted (12.8 g of DM/bird/d)
 - A 75% increase in forage intake
 - Fall forage was of lower (total nutrition) value compared to Summer forage
 - Foraging contributed to maintaining performance among birds fed diets with methionine and birds fed diets without methionine

West Virginia University 2005

Using Reduced Dietary Energy, Forage and a NSP Enzyme to Reduce Organic Broiler Feed Cost (Ross 308)

West Virginia University 2007

Forage and an NSP Enzyme to Increase Dietary Energy

➤ 4 treatments

- Normal energy without NSP enzyme
- Normal energy with NSP enzyme
- Low energy (7%) without NSP enzyme
- Low energy (7%) with NSP enzyme

➤ Study was conducted in Spring and Summer months

West Virginia University 2007

Forage and an NSP Enzyme to Increase Dietary Energy

➤ Pasture

- Tall fescue
 - Retains palatability when mature
- Kentucky bluegrass
 - Most growth in spring and fall, semi-dormant in summer
- Red clover
 - Similar to alfalfa in nutritional value but continuous grazing will eliminate it from pasture
- White clover
 - Resistant to grazing pressure

West Virginia University 2007

Forage and an NSP Enzyme to Increase Dietary Energy

➤ Results

- Low energy diets (7%) did not increase forage intake
- NSP enzyme inclusion enhanced performance in Spring months only (38 to 56d period)
- The use of low energy diets with an NSP enzyme did not compensate for the 7% energy dilution (21-56d period)

West Virginia University 2007

Digestibility of Forage (Spring) - Using the Precision Fed Rooster Model

➤ 2 treatments

- Spring forage without NSP enzyme
- Spring forage with NSP enzyme

West Virginia University 2007

Digestibility of Forages (Spring)

➤ Pasture

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West Virginia University 2007

Digestibility of Forage (Spring)

➤ Results - dry matter basis

	ME (kcal/kg)	Met (%)	Lys (%)
Forage w/ enzyme	2,085	87.4	78.6
Forage w/out enzyme	1,628	88.3	80.0

West Virginia University 2007

Use of Pasture to Decrease Dietary Cost

- May work with use of an NSP enzyme; however, a 7% energy reduction seems too much
- Enzyme use and less of a 7% dietary reduction may not be cost effective

West Virginia University 2007

Use of Pasture to Decrease Dietary Cost

- If dietary cost cannot be decreased, can forage consumption lead to other benefits?
- Functional Foods?

Increasing n-3 Fatty Acids in Poultry Meat and Eggs

➤ n-3 fatty acids

- Decrease risk of heart disease
- Inhibit growth of prostate and breast cancer
- Delays the loss of immunological function
- Required for normal fetal brain and visual development

University of Nebraska 2000

Increasing n-3 Fatty Acids in Poultry Meat and Eggs

➤ n-3 fatty acid containing foods

- Fish and seafood (primary)
- Chicken and eggs
- Canola and soybean oil
- Wheat grass, flaxseed, flaxseed oil
- Legumes, green vegetables, whole milk, ground beef

University of Nebraska 2000

Increasing n-3 Fatty Acids in Poultry Meat and Eggs

➤ Why poultry meat and eggs?

- A source that may be more readily consumed by the general public (children)
- Fish oil, flaxseed incorporation and vegetable oil into hen and broiler diets can enhance n-3 fatty acid content
- Green pastures are also a source of n-3 fatty acids

University of Nebraska 2000

Outdoor Coop Housing and Forage Based Diets vs. Cage Housing and Mash Diets (brown egg laying hens)

Penn State University 2003

Outdoor vs. Indoor Egg Characteristics

➤ 4 treatments

- Outdoor - alfalfa
- Outdoor - clover
- Outdoor - grass
- Indoor - all mash feed

➤ Study was conducted in Summer months

Penn State University 2003

Outdoor vs. Indoor Egg Characteristics

➤ Results

	Egg Production (%)	Ending hen wt (g)
Outdoor - alfalfa	73 ^b	} 1570 ^b
Outdoor - clover	74 ^b	
Outdoor - grass	69 ^b	
Indoor - all mash feed	85 ^a	1821 ^a


Penn State University 2003

Outdoor vs. Indoor Egg Characteristics

➤ **Results**

	yolk n-3 f.a.(%)	Vit A (IU/100g)
Outdoor - alfalfa	3.8 ^a	} 2932 ^a
Outdoor - clover	3.5 ^a	
Outdoor - grass	3.2 ^a	
Indoor - all mash feed	1.3 ^b	2075 ^b

Penn State University 2003



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Feeding Flaxseed on Egg n-3 Fatty Acid Composition (brown and white egg laying hens)

➤ **2 treatments**

- Corn/SBM based diet
- Corn/SBM based diet + 10% flaxseed

➤ **Birds were housed individually in laying cages**

University of Guelph, Ontario 2003

Feeding Flaxseed on Egg n-3 Fatty Acid Composition (brown and white egg laying hens)

➤ Results

whole egg n-3 f.a.(%)

Corn/SBM based diet	0.2 ^b
Corn/SBM based diet + 10% flaxseed	0.8 ^a

University of Guelph, Ontario 2003

Effect of Pasture on n-3 Fatty Acid Composition of Free Range Broilers (slow growing broilers)

University of Lisbon, Portugal 2008

Pasture Effects on Broiler n-3 Fatty Acid Composition

➤ 3 treatments

- Subterranean clover (portable floorless pens)
- White clover (portable floorless pens)
- No pasture access (floorless pen on wood shavings)

➤ Study was conducted in Spring and Fall months

➤ Commercial broiler (35d) vs. Label Rouge broilers (81d) fatty acid comparison

University of Lisbon, Portugal 2008

Pasture Effects on Broiler n-3 Fatty Acid Composition

➤ Results

- Day 56 pasture intake was estimated to be between 18-26% (as is basis)
- Low level of pasture intake had a low impact on fatty acid composition of meat (no differences)

- Commercial broilers had greater n-3 composition compared to label rouge broilers

University of Lisbon, Portugal 2008

Conclusions

- Forage utilization may be limited in the ability to lower broiler dietary cost
- Forage may be able to enhance n-3 fatty acids contents of eggs but not meat
- Pasture access allows for natural behaviors and enrichment and certainly separates the small grower from “commercial” free range or organic production

My recommendations

- In order to...
 - 1) provide your birds the most consistent nutrient profile possible
 - 2) to assure that your products are of consistent quality

Supply all required and potential enhancing nutrients in the diet

Thank you



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