Feeding Hazelnuts to Pigs

and a little poultry

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Thank you to collaborators

Krista Eiseman and Ryan Pralle, UW-Platteville

Chris Beedle, Iowa State University

Jim Magolski, Niman Ranch

Jason Fischbach, UW-Extension

Jeff Jensen, Iowa Nut Growers Association

Upper Midwest Hazelnut Development Initiative

SARE Sustainable Agriculture Research and Education

- https://projects.sare.org/sare_project/onc19-056/
- Project Number ONC19-056
- Jason Fischbach Bayfield County, UW-Extension

UNIVERSITY OF WISCONSIN PLATTEVILLE

Division of Extension
University of Wisconsin-Madison

Midwest Hazelnut (*Corylus spp)*

- Processing can be a challenge
- Undersized (<10 mm)
- Incomplete separation

Preparing Hazelnuts

2 HP Roller Mill

~ 60 bushels of barley/hour

Apollo Machine https://www.apollomills.com/

Preparing Hazelnuts

200 lb of hazelnuts/ton of feed

2 passes

15 minutes

1772 microns

Feeding In-shell Hazelnuts to Broilers

- ANSCI 4090 Nonruminant Nutrition F2021
- 12 pens of 5 broilers
- 4 ft × 4 ft
- Fed 1 of 3 diets
- 1.6 lb → 5.4 lb, 19 d

Broiler Diets, fed 16 days pre-harvest

- Control (commercial crumble)
- 90% Control + 10% in-shell hazelnuts
- Control + Free Choice in-shell hazelnuts (2 feeders)

Hazelnuts ground to 1,800 microns

Hazelnut products did not impact broiler growth (1.6 lb – 5.5 lb)

Diet	Control	Free Choice	10% Hazelnut	SEM	P-value
ADG, g/d	94	97	97	9	0.95
ADFI, g/d	217	214	217	12	0.98
Gain:Feed	0.43	0.45	0.45	0.03	0.85

- Growth rate and performance not impacted by adding in-shell hazelnut
- Birds fed 10% in-shell hazelnuts consumed 21.7 g/d in-shell hazelnuts = 0.9 lb over 19 day trial… Commercial diet $0.25/lb
- Birds fed free choice refused to consume ground in-shell hazelnuts

Nutrient Profile of Hazelnut products

Samples from 2019	Kernels	Shells	< 10 mm in-shell hazelnut
Crude protein, %	18.4	1.3	7.6
Crude fat, %	61.2	< 0.1	21.1
Neutral detergent fiber, %	12.2	96.8	68.7
Acid detergent fiber, %	9.9	81.3	56.7

NDF can be used to predict feed intake… ↑NDF = ↓ Feed Intake
ADF can be used to predict digestibility… ↑ADF = ↓ Digestibility

Nutrient profile of selected pig feeds

	Corn	Soybean Meal	Roasted Soybeans	< 10 mm in-shell hazelnut
Crude protein, %	9.3	53.0	35.2	7.6
Crude fat, %	3.9	1.7	19.6	21.1
Neutral detergent fiber, %	10.3	9.1	11.7	68.7
Acid detergent fiber, %	3.3	5.9	6.9	56.7

NDF can be used to predict feed intake… ↑NDF = ↓ Feed Intake
ADF can be used to predict digestibility… ↑ADF = ↓ Digestibility

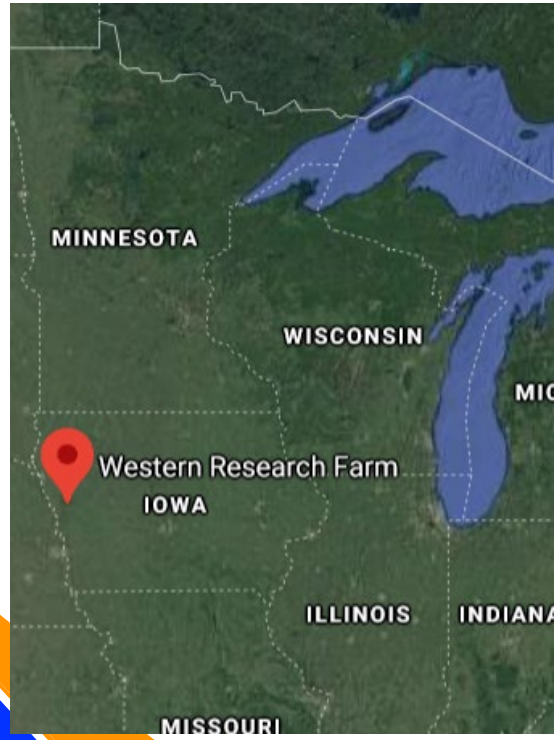
Fatty acid profile of three products

	Hazelnut kernels	In-shell hazelnuts	Soybeans
Crude Fat, %	61.2	21.1	19.6
	% of fat	% of fat	% of fat
Palmitic (16:0)	4.0	3.8	10.5
Oleic (18:1)	77.1	74.9	21.8
Linoleic (18:2)	16.0	18.0	49.8
Saturated FA	6.0	6.2	14.5
Unsaturated FA	93.5	93.6	78.0

Fatty acid profile of three products

	Hazelnut kernels		In-shell hazelnuts		Soybeans	
Crude Fat, %	61.2		21.1		19.6	
	% of fat	g/kg	% of fat	g/kg	% of fat	g/kg
Palmitic (16:0)	4.0	24	3.8	8	10.5	21
Oleic (18:1)	77.1	472	74.9	158	21.8	43
Linoleic (18:2)	16.0	98	18.0	38	53.1	98
Saturated FA	6.0	37	6.2	13	15.5	30
Unsaturated FA	93.5	572	93.6	197	84.5	166

Iowa State Univeristy
Western Research Farm
36515 Hwy E34 Castana, IA 51010
Deep bedded hoop barns for pigs



Three mini-hoop barns

- 3 barns ~ 20 ft × 36 ft
- 2 pens/barn ~10 ft × 28.8 ft
- 6 barrows/pen ~ 48 ft^2/pig

2 Replicated Feeding Trials

- 36 barrows, 6 pens of 6
- Start weight 128 lb
- All pigs marketed 69 days later
- Corn-SBM control diet
- Control + 10% in-shell hazelnuts

Growth and performance

	Dietary Treatment			
	Control	10% Hazelnut	SEM	*P*-value
End wt, lb	286.6	284.5	3.1	0.44
ADG, lb/d	2.3	2.3	<0.1	0.37
ADFI, lb/d	8.2	8.6	<0.1	0.36
F:G, lb/lb	3.5	3.8	< 0.1	0.03
G:F g/kg	286	263	---	---

Pigs grew and similar rates

Pigs consumed similar amounts of feed

✡ Control grew slightly more efficiently

	Dietary Treatment			
	Control	10% Hazelnut	SEM	*P*-value
End wt, lb	286.6	284.5	3.1	0.44
ADG, lb/d	2.3	2.3	<0.1	0.37
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G:F g/kg	286	263	---	---

Dietary treatment did not impact carcass attributes

	Dietary Treatment			
	Control	10% Hazelnut	SEM	*P*-value
Hot carcass wt, lb	216	217	3.5	0.79
Fat depth				
10th rib, in	1.52	1.52	0.1	0.97
Last rib, in	1.35	1.30	< 0.1	0.41

Dietary treatment did not impact chop quality attributes

	Dietary Treatment			
	Control	10% Hazelnut	SEM	*P*-value
Color score	3.01	3.01	0.04	0.93
pH	5.75	5.78	0.02	0.17
Marbling, %	1.80	1.71	0.09	0.70
WB shear force	3.51	3.51	0.11	0.99
Cook loss, %	17.00	16.70	0.60	0.75

Dietary treatment impacted fatty acid profile of pork fat

	Dietary Treatment			
	Control	10% Hazelnut	SEM	*P*-value
Palmitic (16:0)	25.60	24.60	0.25	0.01
Oleic (18:1)	41.00	43.30	0.47	< 0.01
Saturated fatty acids	42.00	39.80	0.55	< 0.01
Monounsaturated fatty acids	45.40	47.50	0.49	0.01

Take Home Results

Feeding 10% in-shell hazelnuts for 10 weeks

- Pig growth and pork quality maintained
- Fatty acid profile of pork fat impacted in the desired direction…

Nutrient Profiles of Hazelnut Products are Variable!

	Kernels		Shells		In-shell hazelnut	
Year	2019	2021	2019	2021	2019	2021
Crude protein, %	18.4	20.9	1.3	4.1	7.6	7.9
Crude fat, %	61.2	60.2	< 0.1	8.8	21.1	27.6
Neutral detergent fiber, %	12.2	55.9	96.8	80.5	68.7	55.9
Acid detergent fiber, %	9.9	46.9	81.3	70.1	56.7	46.9

Summer 2021… Demonstration

- 24 pigs 6 pens of 4 pigs
- Start weight 150 lb
- 77 day feeding trial
- Corn-soybean meal diet with Hazelnut products

Six Demonstration Diets (no replication)

- Corn-SMB Control Diet
- Control + 10% hazelnut kernels
- Control + 10% hazelnut shells
- Control + 10% in-shell hazelnuts
- Control + 20% in-shell hazelnuts
- Control + 30% in-shell hazelnuts

Pig Performance Similar

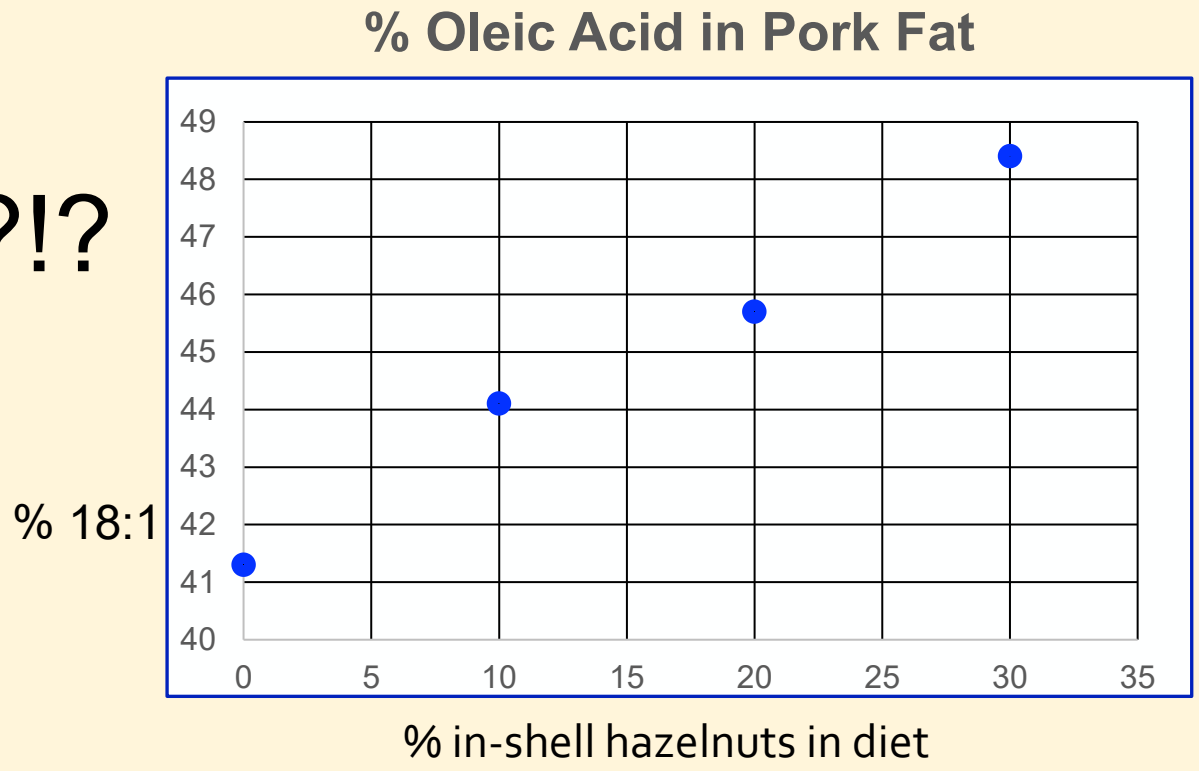
	Control	Kernel	Shells	In-shell Hazelnuts		
% Control Diet	100	90	90	90	80	70
%Test Ingredient	0	10	10	10	20	30
Predicted ME, kcal/kg	3867	3954	3514	3624	3507	3376
CP:ME , g:Mcal	**38.0**	**38.9**	**39.6**	**38.4**	**37.4**	**38.2**
Average daily gain, lb/d	2.0	2.0	2.1	2.1	2.0	2.1
Average daily feed intake, lb/d	7.0	6.8	7.3	7.7	7.9	7.5
Gain:Feed	3.5	3.4	3.5	3.7	4.0	3.6
Hot carcass weight, lb	232	227	238	236	236	236

Intriguing trend in fatty acid profile

	Control	Kernel	Shells	In-shell Hazelnuts		
% Control Diet	100	90	90	90	80	70
%Test Ingredient	0	10	10	10	20	30
Crude fat, %	2.8	8.2	2.9	4.3	6.3	7.8
CP:ME , g:Mcal	38.0	38.9	39.6	39.2	37.4	32.7
Palmitic (16:0)	25.1	21.7	25.0	23.6	22.2	20.1
Oleic (18:1)	41.3	46.8	41.9	44.1	45.7	48.4

Pigs are Robust!

- Perform well on a wide range of diets…
- Interesting trend…
- Is 18:1 marketable?!?



Acorn Fed Iberian Ham

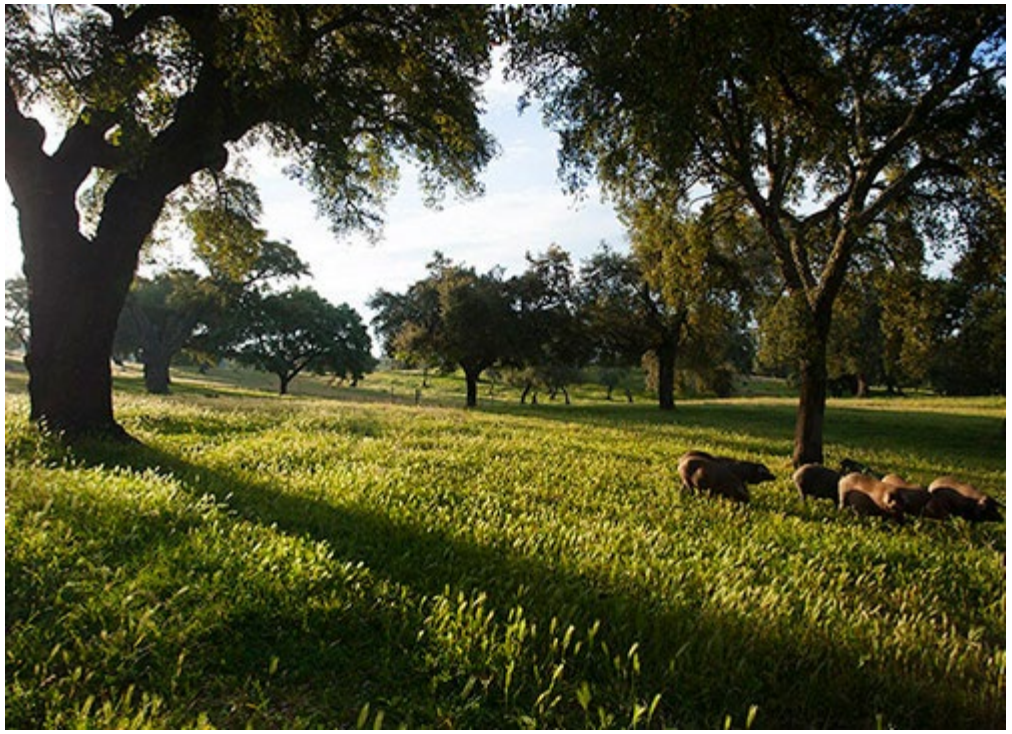
https:www.tienda.com

13-16 lb	$1,400	Feb 19, 2021	$88-108 per pound
15-16.5 lb	$1,099	Feb 23, 2022	$67-73 per pound

Jamón Ibérico de bellota
aka acorn fed ham from Iberia

- Specific region
- Specific breed
- Specific process

→High Value Niche



Pork fatty acids are impacted by diet

Dietary Treatment	Days	C 16:0	C 18:1
Corn-soybean meal control,	69	25.6	41.0
10% in-shell hazelnuts,	69	24.6	43.3
30% in shell hazelnuts	77	20.1	48.4
Acorn-fed, free range*	117	18.9	51.3
Commercial diet*	117	21.8	45.0

*Daza et al. 2007 DOI: https://doi.org/10.22358/jafs/66797/2007

Valuing hazelnuts based on Dietary Energy for Growing Pig

- Chemical analysis of feed sample
- Use prediction equation to estimate energy
- Start collecting data in field

  Pig performance, Feed Processing, Carcass Quality

Relative value of alternative feeds as an energy feedstuff for pigs

(enter information in yellow cells)

Step 1. Enter description and chemical analysis of your sample feedstuff

Sample Feedstuff	In-shell hazelnut 2021	
Moisture	5.7	%
Crude Protein	7.91	%
Crude Fat (ether extract)	27.59	%
Ash	1.87	%
Neutral Detergent Fiber	55.88	%

Step 2. Enter description and chemical analysis of your reference feedstuff

Reference Feedstuff	Corn Grain NRC	
Moisture	11.69	%
Crude Protein	8.24	%
Crude Fat (ether extract)	3.48	%
Ash	1.3	%
Neutral Detergent Fiber	9.11	%

Results Summary

Predicted Digestible Energy, kcal/kg

3155	kcal/kg	In-shell hazelnut 2021
3994	kcal/kg	Corn Grain NRC
0.79	Sample ÷ Reference	

Predicted Metabolizable Energy, kcal/kg

3098	kcal/kg	In-shell hazelnut 2021
3930	kcal/kg	Corn Grain NRC
0.79	Sample ÷ Reference	

The relative value of

In-shell hazelnut 2021

as compared to

Corn Grain NRC

is estimated as **0.79** to **0.79**

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In-shell hazelnut 2021

as compared to

Corn Grain NRC

is estimated as **0.79** to **0.79**

Enter information about feed 1

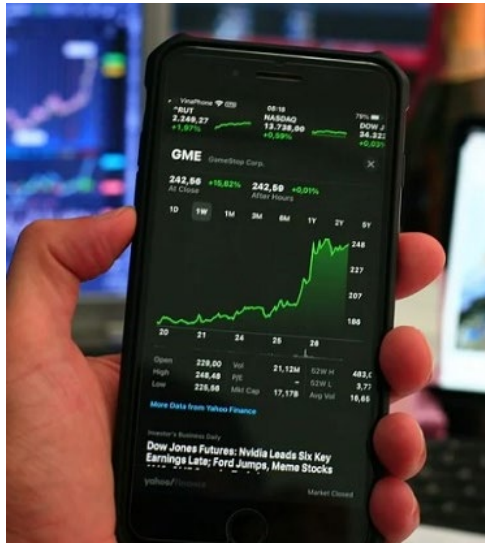
Enter information about feed 2

Interpret Results

Predicted energy value of feedstuffs

Feedstuff	Digestible Energy kcal/kg DM	Metabolizable Energy, kcal/kgDM
Corn Grain	3994	3930
Soybeans	4921	4645
Soybean hulls	1631	1554
Hazelnut kernels	6556	6408
Hazelnut shells	1360	1330
In-shell hazelnuts	3155	3098

Grain market reports…



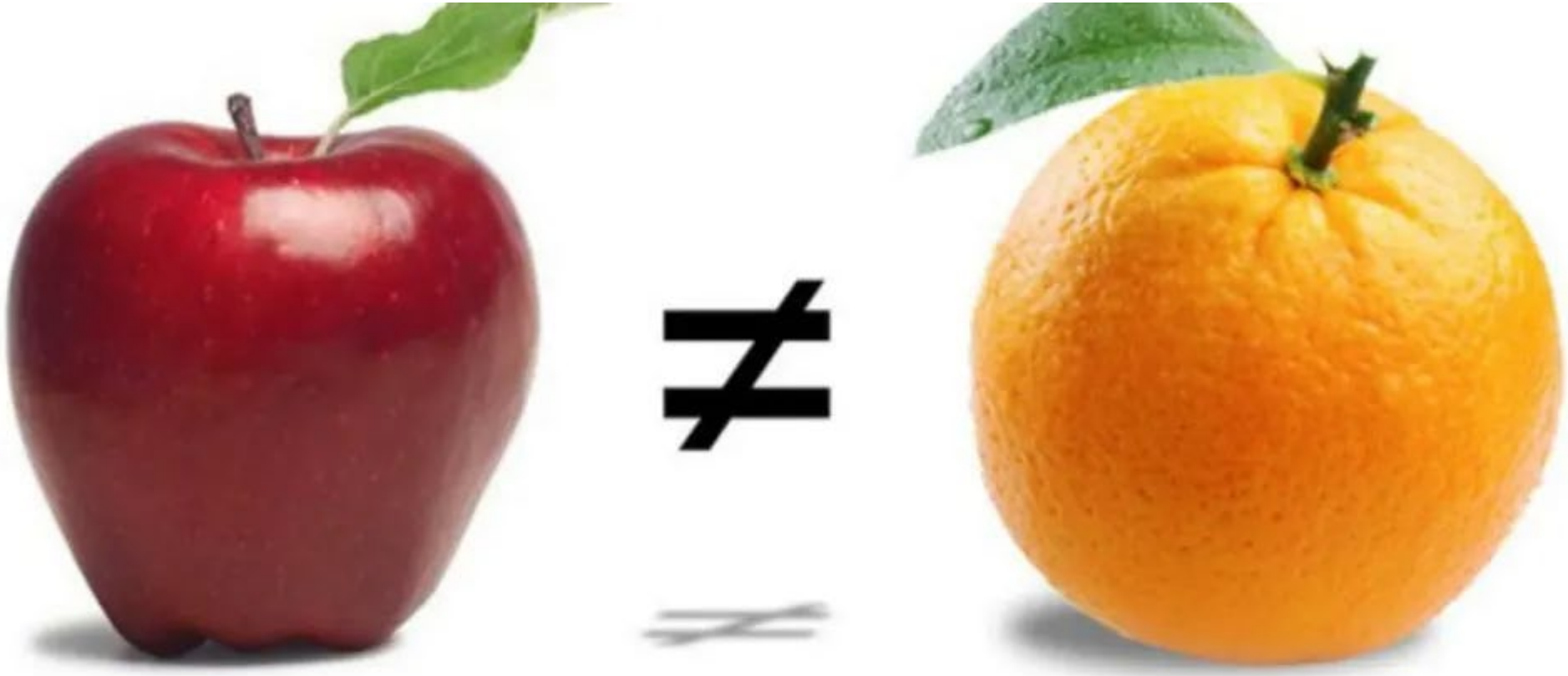
Corn Grain… $6.50/bushel

- 1 bushel = 56 lb @ 15.5% moisture

Soybeans… $16.50/bushel

- 1 bushel = 60 lb @ 13% moisture

$/bushel… is not a fair comparison



Comparative Price Generator

Step 1. Determine value per unit of DM for known commodity		
Name of Commodity	Corn Grain	
if known commodity is priced per bushel		
$	6.50	Value, $ per bushel
	56	Weight, lb per bushel
	15.5	Moisture content, %
$	0.1374	$ per lb of DM

Step 2. Enter results from Dietary Energy Worksheet		
Known Commodity	Corn Grain	
Dietary Energy Value	3930	kcal/kg DM
Novel Feedstuff Name	In-shell hazelnuts	
Dietary Energy Value	3098	kcal/kg DM
Moisture Content of Novel Feedstuff	5.7	%

Corn Grain	:	In-shell hazelnuts
1		0.788295

Comparative Price Generator

Step 1. Determine value per unit of DM for known commodity		
Name of Commodity	Corn Grain	
if known commodity is priced per bushel		
$	6.50	Value, $ per bushel
	56	Weight, lb per bushel
	15.5	Moisture content, %
$	0.1374	$ per lb of DM

If corn grain is $6.50/bushel may be worth willing to pay about $0.102/lb for in-shell hazelnuts

Step 2. Enter results from Dietary Energy Worksheet		
Known Commodity	Corn Grain	
Dietary Energy Value	3930	kcal/kg DM
Novel Feedstuff Name	In-shell hazelnuts	
Dietary Energy Value	3098	kcal/kg DM
Moisture Content of Novel Feedstuff	5.7	%

Corn Grain	:	In-shell hazelnuts
1		0.788295

Step 3. Enter price data from step 1 and evaluate result		
If		
Corn Grain	is valued at	
	$ 0.1374	per lb DM
Then		
In-shell hazelnuts		
may be worth	$ 0.1083	$ per lb DM
	$ 0.1021	$ per lb As Fed
	$ 10.83	per 100 lb DM
	$ 10.21	per 100 lb As Fed
	$ 216.56	$ per ton DM
	$ 204.22	$ per ton As Fed

Relative Value as fed basis…

Corn Grain	Corn Grain	In-shell hazelnuts		Hazelnut :Corn Grain
$/bushel	$/cwt	$/cwt		cwt:bu
$4.50	8.04	7.07		1.57
$6.50	11.61	10.21		1.57
$8.50	15.18	13.35		1.57
$10.50	18.75	16.49		1.57
$12.50	22.32	19.64		1.57

If we know the price of corn/bushel…

multiply by 1.57 to estimate what 100 lb of hazelnut is worth???

Relative Value as fed basis…

Corn Grain $/bushel	Corn Grain $/cwt	In-shell hazelnuts $/cwt	Hazelnut :Corn Grain cwt:bu
$4.50	8.04	7.07	1.57
$6.50	11.61	10.21	1.57
$8.50	15.18	13.35	1.57
$10.50	18.75	16.49	1.57
$12.50	22.32	19.64	1.57

Best to analyze the hazelnuts first!

Dr. Pete Lammers

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608-342-7650