Estimating the Relative Value of In-shell Hazelnuts as a Feedstuff for Pigs

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Background

Hazelnut (*Corylus spp)* is a perennial, multi-use crop, that is being grown in Wisconsin, Minnesota, and Iowa. Hazelnuts with a diameter less than 10 mm have been identified as unsuitable for processing into oil or other products intended for human consumption due to challenges in separating the shell from the kernel. It has been demonstrated that in-shell hazelnuts can be ground and mixed into complete pig feed using existing on-farm technology and that when finishing pigs are fed diets including up to 10% in-shell hazelnuts growth and performance is maintained (Lammers et al. 2021 and 2022). Pork fat from pigs fed diets containing 10% in-shell hazelnuts during finishing was found to contain less palmitic acid (16:0) and more oleic acid (18:1) (Lammers et al. 2021 and 2022). This altered fatty acid profile may offer some further value-added opportunities for entrepreneurial growers. However, it is anticipated that most pork producers initially considering hazelnut products as a feedstuff for pigs will value this alternative based on its ability to replace known feedstuffs in terms of dietary energy. The purpose of this paper is to summarize what is known about the nutritional characteristics of hazelnut products available in the Upper Midwest and propose a method for valuing in-shell hazelnuts based on predicted dietary energy value.

Nutritional Characteristics of Hazelnut Products

Samples of hazelnut kernels, hazelnut shells, and in-shell hazelnuts used in the previously mentioned feeding trials were analyzed by the University of Missouri-Columbia Agricultural Experiment Station Chemical Laboratory. Each sample was analyzed using proximate analysis and related fiber procedures as recommended by the Association of Official Analytical Chemists, International (AOAC) (AESCL, 2022). Nutritional profile of hazelnut kernels, hazelnut shells, and in-shell hazelnuts from two different years are presented in table 1.

The nutrient profiles of corn grain, roasted soybeans, and soybean hulls are summarized in Table 2. These three feedstuffs were selected for comparison because they are commonly grown, processed, and fed to livestock throughout the Midwest and local market prices for these commodities are readily available.

Predicting Dietary Energy from Chemical Analysis

Energy is an important component of pig diets and most hazelnut products would be considered sources of energy rather than protein concentrates. There are multiple ways of thinking about and comparing dietary energy, but the terms Digestible Energy (DE) and Metabolizable Energy (ME) are widely used and recognized by pork producers and nutritionists. Equations for predicting dietary energy in pig diets using chemical analysis were proposed and evaluated by Noblet and Perez (1993). The most recent NRC (2012b) suggests two of these equations be used to predict DE and ME respectively when the crude protein, crude fat, ash, and neutral detergent fiber content of a feedstuff are known (Table 3). While prediction equations are an imperfect replacement for replicated digestibility and feeding trials, they are an expedient way to begin to value feedstuffs.

Energy prediction equations were incorporated into a Microsoft Excel™ spreadsheet to develop a worksheet for comparing energy values of feedstuffs based on crude protein, crude fat, ash, and neutral detergent fiber content. While these are certainly not the only nutrients of interest, they have been shown to be predictive of animal performance (Noblet and Perez 1993; NRC 2012b) and are also relatively economical to assay. Commercial feed laboratories regularly perform these analyses using approximately 100 g of material at a cost of around $50 per sample at the time of this publication. When available, wet-chemistry analysis is preferred over near infrared reflectance spectrometry (NIRS) for hazelnut products as NIRS curves may not be accurately calibrated for this novel feedstuff. Table 4 presents the estimated energy value of selected feedstuffs based on chemical analysis. This table can be used to place a relative value on various feedstuffs as energy sources for pigs.

The nutrient profile of hazelnut products was variable across years. Based on nutrient profile and energy value the average kernel size of hazelnuts may have been larger in 2021 than in 2019. Both hazelnut-kernels and in-shell hazelnuts from 2021 had more fat and less fiber than the same product in 2019. The variable nutrient content of hazelnut products, particularly fat and fiber resulted in a large range of predicted energy values. For example 2019 in-shell hazelnuts were predicted to deliver 62% of the energy value of corn grain, but 2021 in-shell hazelnuts were predicted to deliver nearly 80% of the energy value of corn grain on a dry matter basis. Wet-chemistry analysis of in-shell hazelnuts prior to predicting energy content and relative market value is highly recommended because of this variability.

Estimating Relative Market Value of In-Shell Hazelnuts

A second Microsoft Excel™ spreadsheet was developed to calculate a proposed value of in-shell hazelnuts (or other alternative feedstuffs) based on predicted dietary energy values and market prices for known commodities. This spreadsheet was used to generate predicted market values for in-shell hazelnuts relative to corn grain (Table 5). Table 5 presents the value of 100 lb of in-shell hazelnuts compared to 1 bushel of corn grain. Based on this analysis a pork producer may be willing to pay as much as 1.57X the price of a bushel of corn grain for 100 lb of in-shell hazelnuts grown in 2021. The relative value of 100 lb of in-shell hazelnuts grown in 2019 is closer to only 1.22X the price of a bushel of corn. Table 5 does not include transportation or processing cost considerations and so is best used as a starting point for negotiations. As more samples of in-shell hazelnuts grown in the Midwest are added to the data set this price ratio may change, but currently a suggested value for 100 lb of in-shell hazelnuts is 1.4 X the price of a bushel of corn. If the in-shell hazelnuts have been analyzed for moisture, crude protein, crude fat, ash, and neutral detergent fiber, the two spreadsheets can be used to calculate a more precise relative value.

References

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Acknowledgements

This project was supported by the USDA North Central Regional Sustainable Agriculture Research and Education (SARE) Partnership Grant Program. The author acknowledges assistance and support from the Upper Midwest Hazelnut Development Initiative, the American Hazelnut Company, Jason Fischbach with UW-Extension, and the ISU Western Research Farm in Castana, IA.

Table 1. Nutrient profile of hazelnut products from 2019 and 2021[1]

	Hazelnut Kernels		Hazelnut Shells		In-shell Hazelnuts	
% As Fed Basis	2019	2021	2019	2021	2019	2021
Moisture	3.88	4.45	9.34	7.63	6.02	5.70
Dry Matter	96.12	95.55	90.66	92.37	93.98	94.33
Crude Protein	17.71	20.89	1.19	4.11	7.11	7.91
Crude Fat	58.85	61.16	0.05	8.83	19.84	27.59
Ash	2.78	2.46	0.93	1.32	1.88	1.87
Neutral Detergent Fiber	11.76	6.59	87.76	80.45	64.53	55.88
	Hazelnut Kernels		Hazelnut Shells		In-shell Hazelnuts	
% Dry Matter Basis	2019	2021	2019	2021	2019	2021
Moisture	0.00	0.00	0.00	0.00	0.00	0.00
Dry Matter	100.00	100.00	100.00	100.00	100.00	100.00
Crude Protein	18.42	21.86	1.31	4.45	7.57	8.39
Crude Fat	61.23	62.96	0.06	9.56	21.11	29.26
Ash	2.89	2.57	1.03	1.43	2.00	1.98
Neutral Detergent Fiber	12.23	6.90	96.80	87.10	68.66	59.26

[1]Hazelnut products provided by American Hazelnut Company, Gays Mills, WI

[2]Nutrient analysis using wet-chemistry technique as described by AOAC (AESCL, 2022)

Table 2. Nutrient profile of commonly feed feedstuffs for pigs

% As Fed Basis	Corn Grain	Roasted Soybeans	Soybean hulls
Moisture	11.69	7.64	9.41
Dry Matter	88.31	92.36	90.59
Crude Protein	8.24	37.56	10.27
Crude Fat	3.48	20.18	1.29
Ash	1.30	4.89	4.46
Neutral Detergent Fiber	9.11	10.00	59.39
% Dry Matter Basis			
Moisture	0.00	0.00	0.00
Dry Matter	100.00	100.00	100.00
Crude Protein	9.33	40.67	11.34
Crude Fat	3.94	21.85	1.42
Ash	1.47	5.29	4.92
Neutral Detergent Fiber	10.32	10.83	65.56

[1]From NRC, 2012a

Table 3. Prediction equations for energy value of pig feed using chemical analysis[1]

Digestible Energy = 4,168 − (91× Ash)
+ (19 × Crude Protein)
+ (39 × Crude Fat)
− (36 × Neutral Detergent Fiber)

Where Digestible energy is expressed as kcal/kg dry matter and all chemical components are expressed as % DM basis

Metabolizable Energy = Digestible Energy – (6.8 × Crude Protein)

Where Metabolizable energy is expressed as kcal/kg dry matter and crude protein is expressed as % DM basis

[1] Based on Noblet and Perez, 1993

Table 4. Predicted energy value of various feedstuffs for pigs[1]

Feedstuff	Digestible Energy kcal/kg DM	Metabolizable Energy kcal/kg DM
Corn Grain	3994	3930
Roasted Soybeans	4921	4645
Soybean Hulls	1631	1554
Hazelnut Kernels, 2019	6202	6077
Hazelnut Kernels, 2021	6556	6408
Hazelnut Shells, 2019	617	608
Hazelnut Shells, 2021	1360	1330
In-shell Hazelnut, 2019	2481	2430
In-shell Hazelnut, 2021	3155	3098

[1] Calculated from nutrient profile and prediction equations presented in Tables 1-3

Table 5. Predicted value of hazelnut products as an alternative feedstuff for pigs compared to corn grain at different market prices.

Corn, $/bushel[1]	Corn, $/cwt As Fed[2]	2019 In-shell Hazelnuts, $/cwt as Fed[3]	2021 In-shell Hazelnuts, $/cwt as Fed[4]
4.50	8.04	5.53	7.07
6.50	11.61	7.98	10.21
8.50	15.18	10.44	13.35
10.50	18.75	12.89	16.49
12.50	22.32	15.35	19.64

[1] 56 pounds of corn grain at 15.5% moisture
[2] 100 pound of corn grain at 15.5% moisture
[3] 100 pounds of in-shell hazelnuts at 6.02% moisture (2019)
[4] 100 pounds of in-shell hazelnuts at 5.70% moisture (2021)