ENERGY CONTENT OF U.S. CORN: A 12-YEAR ANALYSIS OF KEY NUTRITIONAL COMPONENTS

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Understanding the energy content of corn is crucial for predicting its value in livestock feed. Corn serves as a primary energy source for animals, and its energy profile—largely determined by the levels of starch, protein, oil, and other carbohydrates—directly affects the performance of dairy, poultry, and swine. Accurate estimation of energy content allows nutritionists and livestock producers to formulate rations that meet the nutritional needs of their animals efficiently and cost-effectively.

Inconsistent energy values in corn can lead to challenges in feed formulation, as small changes in protein, oil, or starch levels may require adjustments in rations to ensure the correct balance of nutrients. Moreover, fluctuations in energy content can impact animal productivity, affecting outcomes such as milk yield, growth rates, and overall health. For industries relying on U.S. corn, knowing the precise composition is essential not only for maximizing livestock performance but also for maintaining competitiveness in global markets. Therefore, the ability to accurately predict energy values, as demonstrated in this analysis using a 12-year dataset from the U.S. Grains Council, helps ensure that U.S. corn continues to be a reliable and valued component in animal nutrition.

ESTIMATING THE ENERGY VALUE OF US CORN

To estimate energy, we used the Atwater factors with starch and protein providing approximately 4 kcal per gram each, and oil contributing about 9 kcal per gram. Other carbohydrates, including cellulose and hemicellulose (recovered in the NDF) as well as water-soluble carbohydrates, were assumed to contribute also 4 kcal per gram. Ash, which constitutes about 1.2% of the dry matter, does not contribute any energy but reduces the proportion of other components in the overall nutritional profile. In this analysis, digestible energy was estimated to be approximately 90% of the gross energy for corn, while metabolizable energy about 84% of the digestible energy. Net energy of lactation was calculated at around 63% of metabolizable energy. Table 1 presents the calculated gross energy (GE), digestible energy (DE), metabolizable energy (ME), and net energy of lactation (NEL) for each year. A total of 13,366 samples spanning 12 years were used in developing these calculations.

Table 1. Yearly Trends in U.S. Corn Nutrient Content 2011-2023

Year	Protein (%)	Oil (%)	Starch (%)	NDF + WSC (%)	GE (kcal/kg)	DE (kcal/kg)	ME (kcal/kg)	NEL (Mcal/kg)
2011	8.72	3.63	73.75	12.70	4133	3720	3124	1.97
2012	9.32	3.72	73.20	12.56	4138	3724	3128	1.97
2013	8.69	3.70	73.56	12.85	4137	3723	3127	1.97
2014	8.53	3.8	73.56	12.91	4142	3727	3131	1.97
2015	8.09	3.83	73.74	13.14	4143	3729	3132	1.97
2016	8.56	4.02	72.43	13.79	4153	3737	3139	1.98
2017	8.64	4.14	72.23	13.79	4159	3743	3144	1.98
2018	8.49	4.02	72.41	13.88	4153	3737	3139	1.98
2019	8.28	4.05	72.27	14.20	4154	3739	3140	1.98
2020	8.45	3.86	72.18	14.31	4145	3730	3133	1.97
2021	8.51	3.85	72.10	14.34	4144	3730	3133	1.97
2022	8.74	3.90	71.92	14.24	4147	3732	3135	1.98
2023	8.83	3.84	71.84	14.29	4144	3729	3132	1.97

NDF: *Neutral Detergent Fiber;* ***WSC:*** *Water Soluble Carbohydrates;* ***GE:*** *Gross Energy (kcal/kg);*
DE: *Digestible Energy (kcal/kg);* ***ME:*** *Metabolizable Energy (kcal/kg);* ***NEL:*** *Net Energy of Lactation (Mcal/kg), Garcia A. 2024*

Average composition of US corn

Protein	Oil	Starch	NDF + WSC	Digestible Energy	Metabolizable Energy	Net Energy of Lactation
%				Kcal/kg		Mcal/kg
8.60	3.87	72.71	13.62	3730.77	3133.62	1.97

Based on a total of 13,366 samples spanning 12 years we were also able to calculate the following formulas to predict the energy content of US grain.

DE = 3982.73 + {-3.42 × Protein (%)} + {5.88 × Oil (%)} + {-3.58 × Starch (%)} + {1.13 × NDF + WSC (%)}
ME = 3351.13 + {-2.81 × Protein (%)} + {5.01 × Oil (%)} + {-3.09 × Starch (%)} + {0.90 × NDF + WSC (%)}
AME = 3351.13 + {-2.81 × Protein (%)} + {5.01 × Oil (%)} + {-3.09 × Starch (%)} + {0.90 × NDF + WSC (%)}
NEm = 2.06 + {-0.00259 × Protein (%)} + {0.00800 × Oil (%)} + {-0.00477 × Starch (%)} + {-0.00064 × NDF + WSC (%)}
NEg = 1.66 + {-0.00259 × Protein (%)} + {0.00800 × Oil (%)} + {-0.00477 × Starch (%)} + {-0.00064 × NDF + WSC (%)}
NEL = 2.17 + {-0.00124 × Protein (%)} + {0.00410 × Oil (%)} + {-0.00271 × Starch (%)} + {-0.00015 × NDF + WSC (%)}
TDN = 94.99 + {-0.11 × Protein (%)} + {0.36 × Oil (%)} + {-0.09 × Starch (%)} + {0.03 × NDF + WSC (%)}

IMPLICATIONS

The analysis revealed remarkably stable values for the energy content of U.S. corn over the years. Gross energy averaged around 4,146 kcal/kg, with only minor annual fluctuations. Similarly, the calculated values for digestible, metabolizable, and net energy of lactation also showed minimal changes over time. This consistency underscores the reliability of U.S. corn as a dependable energy source in livestock feeding programs, regardless of variations in growing conditions. It also provides reassurance to traders, nutritionists, and livestock producers that US corn remains a reliable energy source for animal feed formulation.