<u>REPORT TITLE</u>

CORN AND SORGHUM CELLULOSIC D3 RIN STUDY

<u>REPORT DATE</u>

February 6, 2026

Edeniq, Inc.
1105 North Nevada Street
Visalia, CA 93291

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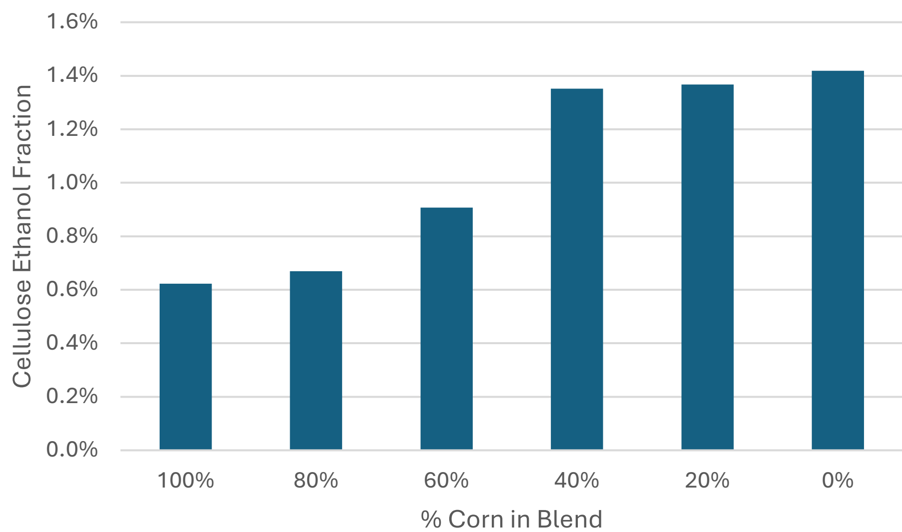
SUMMARY

This study investigated whether there is an optimum blend ratio of corn and sorghum feedstock to maximize cellulosic D3 RIN (Renewable Identification Number) production. It was sponsored by the Renewable Fuels Foundation, United Sorghum Checkoff Program, and the Kansas Grain Sorghum Commission.

IFF conducted liquefaction and simultaneous saccharification and fermentation of the corn and sorghum feedstock. Afterwards, Edeniq, Inc. performed their Intellulose EPA testing suite for conversion calculations using a mass balance approach.

The results show an increase in inlet cellulosic material that correlates with a higher percentage of sorghum in the feedstock composition. This is mirrored by an increase in the cellulose ethanol fraction (CEF).



The cellulose converted fraction shows a maximum value of 27.4% at a feedstock ratio of 40% corn and 60% milo. This agrees with the largest improvement in CEF between blend ratios, with diminishing returns with additional sorghum content.

This study shows that, under the tested fermentation conditions, that inlet cellulosic content increases with the addition of sorghum into the fermentation blend. A maximum cellulosic conversion was observed at a blend ratio of 40% corn and 60% sorghum, while CEF continued to improve until the sole feedstock source was sorghum.

EXPERIMENTAL DESCRIPTION

Feedstock Source

Flour and backset of both feedstocks were provided by two domestic bioethanol producers. Corn flour and corn backset were provided by Lincolnway Energy, while sorghum flour and sorghum backset were provided by Western Plains Energy. These materials were shipped directly to IFF for liquefaction. Both flour samples were also provided to a third-party laboratory for compositional analysis (Midwest Laboratories), as shown in Table 1.

Test	Corn Flour	Sorghum Flour	Test	Corn Flour	Sorghum Flour
Moisture (Absolute %)	13.48%	12.30%	**Dry Matter (Absolute %)**	86.52%	87.70%
Protein (Crude)	7.71%	11.10%	**Starch (Total)**	73.51%	69.36%
Fat (Crude)	3.59%	3.55%	**Fiber (Crude)**	1.56%	2.82%
Fiber (Acid Detergent)	3.08%	6.86%	**Fiber (Neutral Detergent)**	8.54%	9.76%
Ash	1.35%	1.75%	**Sulfur (Total)**	0.09%	0.11%
Iron (Total) (ppm)	25.86	46.04	**Phosphorous (Total)**	0.26%	0.28%
Manganese (Total) (ppm)	4.82	18.80	**Potassium (Total)**	0.37%	0.39%
Copper (Total) (ppm)	2.14	4.32	**Magnesium (Total)**	0.09%	0.13%
Zinc (Total) (ppm)	21.50	22.48	**Calcium (Total)**	0.02%	0.02%

Table 1: Corn and Sorghum Flour Compositional Analysis. Unless otherwise stated, all measurements are on a dry weight basis.

Liquefaction and Blending Procedure

Corn liquefact and milo liquefact were prepared independently by mixing ground corn or milo with their respective backset. Water was added to each slurry (mash) to target a final dry solids value of approximately 33%. Each slurry (mash) was mixed with an impeller and pH adjusted to approximately 5.1, then continually agitated at 87.8 °C. The first dose of alpha amylase was added to each mash and held at 87.8 °C for 20 minutes, followed by heating at 100 °C for 10 minutes with agitation. Each mash was then moved back to 87.8 °C, and a second dose of alpha amylase was added after 10 minutes. The resulting mash was agitated for an additional 2 hours at 87.8 °C to mimic liquefaction. After this step, the resulting mashes were agitated in an ice bath for 20 minutes to cool down.

The quality of the corn and milo liquefacts were evaluated by determining their starch solubility and dextrose equivalents. The results are shown in Table 2 and indicate good liquefaction performance.

Liquefact Sample	Soluble Starch	Dextrose Equivalent
Corn	93.2%	15.5
Sorghum	96.0%	17.7

Table 2: Starch Solubility and Dextrose Equivalent of Corn and Sorghum Liquefact

To make the representative feedstock blends, corn and milo liquefacts were adjusted to pH 5.0 with sulfuric acid and diluted to a standard dry solids value of 33%. Urea was added to a final concentration of 240 ppm nitrogen. Following this, blends of corn and sorghum were prepared as described in Table 3.

Blend #	Corn Liquefact (w/w)	Sorghum Liquefact (w/w)
1	100%	0%
2	80%	20%
3	60%	40%
4	40%	60%
5	20%	80%
6	0%	100%

Table 3: Corn and Sorghum Liquefact Blends

Simultaneous Saccharification and Fermentation Procedure

The blends of corn and sorghum liquefacts were evaluated in simultaneous saccharification and fermentation (SSF). Commercially relevant doses of yeast, glucoamylase, protease, and cellulase were added to each blend. 200 grams of each blend was weighed into quadruplicate 250-mL Erlenmeyer flasks. The flasks were then capped with pinhole rubber stoppers and placed into a forced air shaking incubator set to 32.2 °C and allowed to ferment for 72 hours.

Flasks were sampled at the end of fermentation, diluted to a final concentration of 0.01 N sulfuric acid, and filtered for analysis by high-performance liquid chromatography using an organic acid column. The results are shown in Table 3.

Blend #	DP4+	DP3	DP2	Glucose	XGM	Lactic Acid	Glycerol	Acetic Acid	Ethanol
1	0.732	0.134	0.172	0.236	0.050	0.076	0.878	0.114	14.028
2	0.754	0.146	0.178	0.232	0.048	0.084	0.902	0.116	14.076
3	0.740	0.148	0.170	0.222	0.050	0.096	0.880	0.116	13.830
4	0.752	0.158	0.172	0.222	0.050	0.102	0.882	0.120	13.828
5	0.762	0.164	0.182	0.226	0.052	0.112	0.886	0.116	13.778
6	0.784	0.174	0.186	0.224	0.052	0.122	0.884	0.124	14.056

Table 4: HPLC Profile of End of Fermentation Samples. XGM is the combined concentration of xylose, galactose, and mannose. Concentrations are listed as % w/v.

The end of fermentation broth was pooled across quadruplicate flasks into 1-L plastic bottles, frozen, and shipped to Edeniq.

Intellulose EPA Procedure

Upon receipt, the condition of the samples was confirmed before being analyzed by the Intellulose EPA testing suite. The samples were prepared and distributed to perform the analytical methods required for Edeniq's proprietary mass balance calculation. This includes the inlet and outlet density, the inlet and outlet dry weight, the inlet and outlet starch, the outlet ethanol, and the inlet and outlet cellulose/hemicellulose-derived glucan and galactan (CHDGG).

CHDGG was determined by ASTM Standard E3417-25a, which is under the jurisdiction of ASTM Committee E48 on Bioenergy and Industrial Chemicals from Biomass. In brief, a cold caustic extraction is first used to selectively solubilize non-cellulosic polysaccharides in the biomass sample. α-Glucans (such as starch and glycogen) are enzymatically removed using a combination of alpha amylase and amyloglucosidase. Next, yeast β-glucans are enzymatically removed using a yeast-degrading cocktail, followed by the precipitation of the cellulosic pellet in ethanol. The cellulosic pellet is then isolated via filtration and undergoes a two-stage acid hydrolysis. The sample is subsequently neutralized and filtered for analysis by HPLC to measure the glucose and galactose derived from cellulose and hemicellulose. This method includes a sugar recovery standard and reagent blank.

For full method details, please reference ASTM Standard E3417-25a, which fully covers the experimental range of corn to sorghum blends in this study.

RESULTS

Intellulose EPA Assay Results

The results of the Intellulose EPA testing suite for the inlet samples are shown in Table 5.

Blend #	Inlet Density (mg/mL)	Inlet Dry Weight (w/w)	Inlet Starch (w/w)	Inlet CHDGG (w/w)
1 ***(100% Corn)***	1.126	32.247%	69.091%	2.491%
2 ***(80% Corn, 20% Sorghum)***	1.125	32.353%	68.582%	2.627%
3 ***(60% Corn, 40% Sorghum)***	1.124	32.451%	66.714%	2.875%
4 ***(40% Corn, 60% Sorghum)***	1.124	32.516%	66.086%	3.238%
5 ***(20% Corn, 80% Sorghum)***	1.126	32.792%	64.821%	3.453%
6 ***(100% Sorghum)***	1.125	32.662%	63.812%	3.555%

Table 5: Intellulose EPA Results for Inlet Parameters

There is a clear increase in the overall CHDGG amount with the addition of sorghum into the blend, as shown in Figure 2. This is to be expected given the respective content of these feedstocks from the compositional analysis.

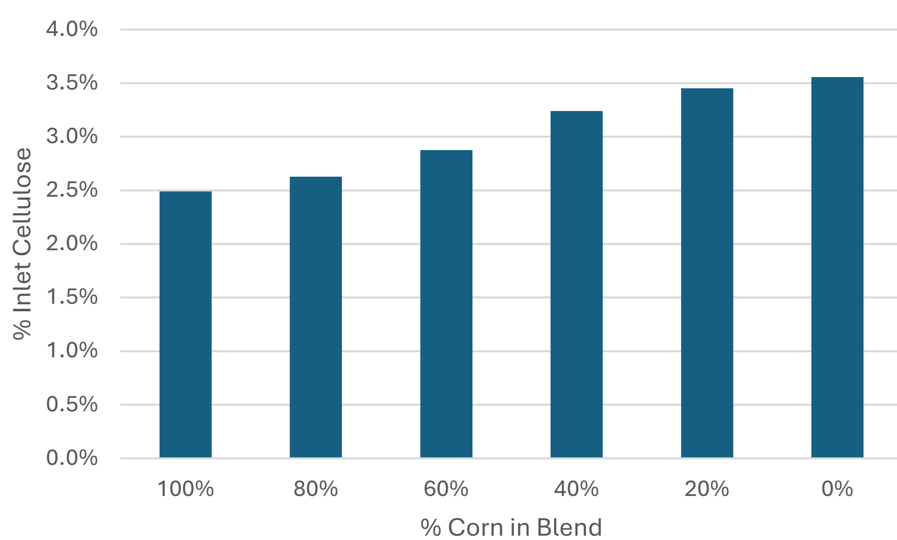


Figure 1: Inlet Cellulose Results Compared with Ratio of Corn to Sorghum

The results of the Intellulose EPA testing suite for the outlet samples are shown in Table 6.

Blend #	Outlet Density (mg/mL)	Outlet Dry Weight (w/w)	Outlet Starch (w/w)	Outlet Ethanol (w/w)	Outlet CHDGG (w/w)
1 ***(100% Corn)***	1.006	11.220%	4.698%	13.096%	6.648%
2 ***(80% Corn, 20% Sorghum)***	1.005	11.436%	4.503%	13.131%	6.891%
3 ***(60% Corn, 40% Sorghum)***	1.010	12.091%	4.388%	12.933%	6.835%
4 ***(40% Corn, 60% Sorghum)***	1.010	12.269%	4.134%	13.119%	6.971%
5 ***(20% Corn, 80% Sorghum)***	1.011	12.995%	3.972%	12.788%	7.262%
6 ***(100% Sorghum)***	1.012	12.751%	3.831%	12.528%	7.607%

Table 6: Intellulose EPA Results for Outlet Parameters

Once again, there is an upwards trend in cellulosic content with additional sorghum in the blend composition, as shown in Figure 2

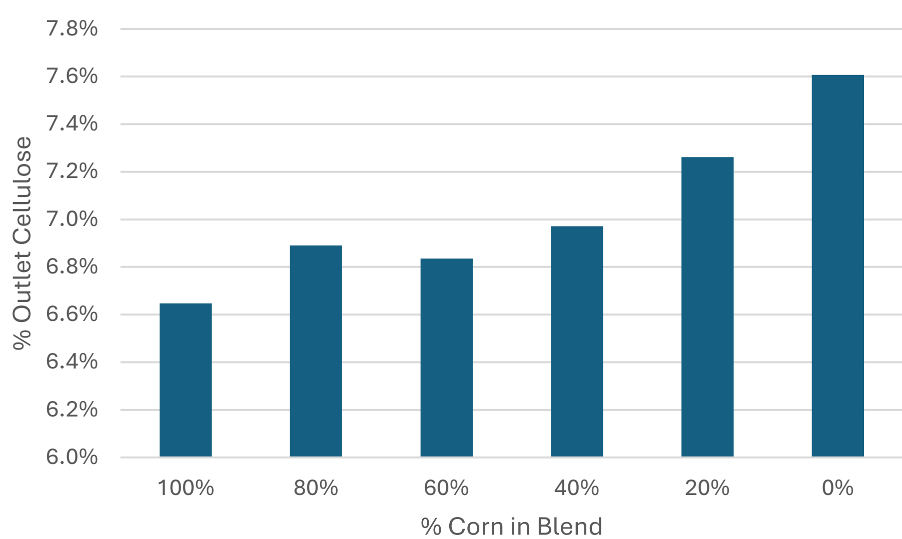


Figure 2: Outlet Cellulose Results Compared with Ratio of Corn to Sorghum

Mass Balance and Conversion Calculations

ASTM Standard E3181-24 establishes the requirements for producers to quantify the amount of renewable fuel that is derived specifically from cellulosic content and from starch to determine their representative converted fractions, including the mass balance approach.

Edeniq has developed a proprietary mass balance calculation to determine the starch converted fraction, cellulose converted fraction, and cellulose ethanol fraction. A separate calculation of cellulose ethanol allocation was performed for each ratio of corn to sorghum and are presented in full in Appendices A – F. A summary of those results is shown in Table 7.

Blend #	Starch Converted Fraction	Cellulose Converted Fraction	Cellulose Ethanol Fraction	Appendix
1 ***(100% Corn)***	97.885%	17.006%	0.622%	A
2 ***(80% Corn, 20% Sorghum)***	97.928%	17.222%	0.669%	B
3 ***(60% Corn, 40% Sorghum)***	97.808%	20.787%	0.908%	C
4 ***(40% Corn, 60% Sorghum)***	97.889%	27.365%	1.351%	D
5 ***(20% Corn, 80% Sorghum)***	97.828%	25.465%	1.368%	E
6 ***(100% Sorghum)***	97.904%	25.296%	1.419%	F

Table 7: Intellulose EPA Calculation of Cellulose Converted Fraction, Starch Converted Fraction, and Cellulose Ethanol Fraction

The starch converted fraction is consistently above 97%, which is indicative of the high efficiency of current starch-degrading enzymes in the industry. For the cellulose converted fraction, the maximum was observed as 27.4% for Blend 4, which had a blend ratio of 40% corn and 60% milo, as shown in Figure 3.

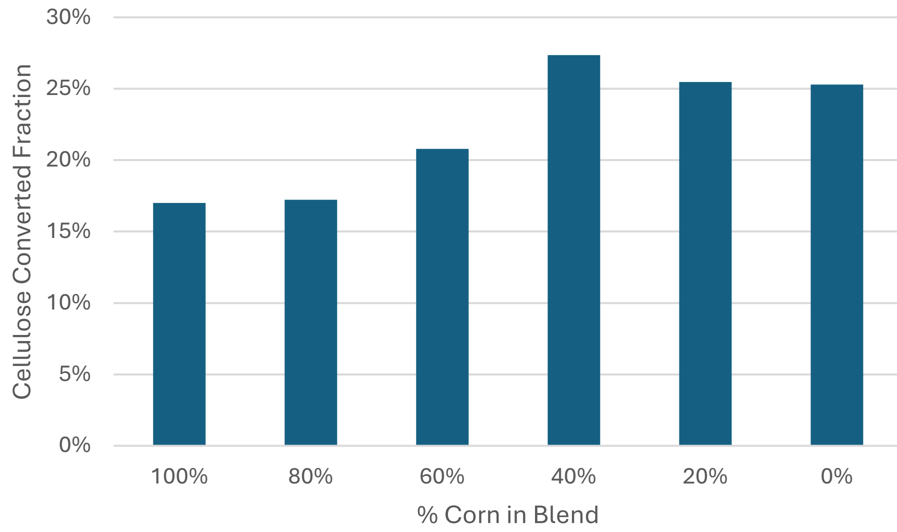


Figure 3: Cellulose Converted Fraction Compared with Ratio of Corn to Sorghum

Despite this being the maximum observed conversion, due to the impact of the larger inlet cellulose values (providing more material to convert), the cellulose ethanol fraction does increase across the blends from 0% to 100% sorghum, as shown in Figure 4.

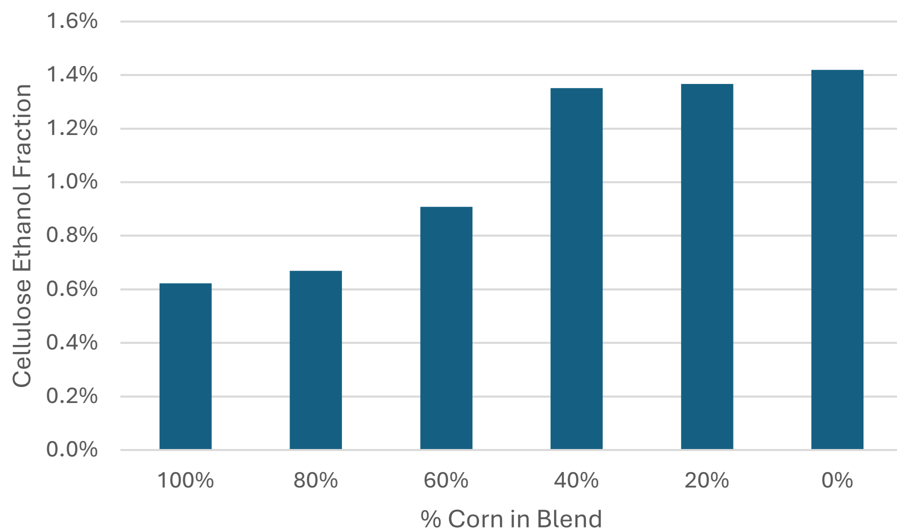


Figure 4: CEF Results Compared with Ratio of Corn to Sorghum

However, there are diminishing returns on the CEF once this ratio of corn to sorghum is reached. This suggests that, under the tested fermentation conditions, the optimal feedstock blend was 40% corn and 60% sorghum.

ASTM Standard E3181-24 also includes another approach for calculating the converted fraction of cellulosic material, known as mass of ash. When initiating this study, Edeniq stated their intent of obtaining ash analysis results for the samples for a full comparison between these approaches (despite this not being included in the scope of the experimental plan). However, the ash results obtained from a third-party laboratory were inconsistent and did not provide any meaningful results, so they are not included in this report.

REFERENCES

- "Standard Test Method for Determination of Cellulose/Hemicellulose-Derived Glucan and Galactan Content in Solid Corn, Corn-Sorghum Blended and Sorghum Biomass Samples," ASTM E3417-25a, ASTM International, 2025.
- "Standard Practice for Determination of the Converted Fraction of Starch and Cellulosic Content from a Fuel Ethanol Production Facility," ASTM E3181-24, ASTM International, 2024.

ACKNOWLEDGEMENTS

IFF would like to acknowledge the following team members who contributed to this study: Parmida Batmanghelench, Marina Chow, Jaclyn DeMartini, Chinmay Kurambhatti, and Monica Tse

Edeniq would like to acknowledge the following team members who contributed to this study: Courtney Allen, Maribel Angel, Denmark Antolin, Gabriela Casanova, Armando Flores, Bowya Lee, Emilie Garcia, Alejandro Herrera, Michael L. Hogard, Spencer Leb, Dahnelynn Mckay, Isaiah Olivas, Kenya Padilla, Tiffany Quiroz, Taurino Ramirez, Johann Venter, and Melissa Vela.

Edeniq would also like to acknowledge the Renewable Fuels Foundation, United Sorghum Checkoff Program and the Kansas Grain Sorghum Commission for funding this study, as well as Lincolnway Energy and Western Plains Energy for providing feedstock and backset samples.

APPENDIX A: INTELLULOSE EPA RESULTS FOR BLEND #1 (100% CORN)

November-2025 **Plant**	**IFF/Edeniq Study 100% Corn**		Key Inputs	
Capacity	0.4	MGPY	**Corn Composition**	
Performance	1.00	gal/bu of corn	Kernel Mass, lb/bu wet	56.1
Annual Corn	0.4	M Bu per Year	Corn Moisture	14.5%
Days per year	353	days per year	Kernel Mass, lb/bu dry	48.0
Conversion	1000	thousand per million	Starch, dry of mash	69.091%
Daily Corn	1.00	k Bu per day	Cellulose, dry of mash	2.491%
Daily Corn	48	k lb of corn per day @0% moisture		
Daily Denatured Ethanol Production	1.0	k gal of EtOH @Temp VM F per day		
Temp VM @ EtOH Measurement	60	(Adj. on Daily Basis to 60F)		
Daily Ethanol Production	1.0	k gal of EtOH @60F per day		
Enzyme Data Supplier	IFF	Enzyme Name	xxxx	
Dose	NA	kg enz per kg corn as-is		
	Ethanol from corn kernel starch	**Ethanol from corn kernel cellulose**		
RIN Category	6	3		
M = Mass of Feedstock	33.140	1.195	k lb feedstock/day dry of mash	
m = moisture content of Feedstock	0%	0%	mass	
	60	60	F	
Feedstock Converted Fraction	97.885%	17.006%	initial mass	
Theoretical Ethanol Production	18.433	0.115	k lb of EtOH per Day	
Ethanol Process Efficiency	35.678%		EtOH Produce/Feedstock Reduction	
Standardized Mass of Ethanol			k lb of EtOH per day	
Standardized Volume of Ethanol	0.994	0.006	k gal EtOH @60F per day	
Feedstock Energy Content	7600	7600	Btu/dry lb of feedstock	
Overall Conversion Efficiency	34.923%	6.067%	EtOH/Theo EtOH	
Feedstock Energy (FE)	87,958.698	550.881	k Btu per Day	
EV= Energy equiv. of EtOH to EtOH	1.00			
CE Fraction	99.378%	0.622%	FEn/(FEn+FEx)	
Vs = total volume of RIN Fuels	1.00	1.00	k gal of EtOH @60F per Day	
	V RIN RF 6 k Gallons	V RIN CB 3 k Gallons		
RIN Volume with 100% Compliance	0.994	0.006		

APPENDIX B: INTELLULOSE EPA RESULTS FOR BLEND #2 (80% CORN, 20% SORGHUM)

November-2025 **Plant**	**IFF/Edeniq Study 80% Corn**		Key Inputs	
Capacity	0.4	MGPY	**Corn-Sorghum Composition**	
Performance	1.00	gal/bu of Corn-Sorghum	Kernel Mass, lb/bu wet	56.1
Annual Corn-Sorghum	0.4	M Bu per Year	Corn-Sorghum Moisture	14.5%
Days per year	353	days per year	Kernel Mass, lb/bu dry	48.0
Conversion	1000	thousand per million	Starch, dry of mash	68.582%
Daily Corn-Sorghum	1.00	k Bu per day	Cellulose, dry of mash	2.627%
Daily Corn-Sorghum	48	k lb of Corn-Sorghum per day @0% moisture		
Daily Denatured Ethanol Production	1.0	k gal of EtOH @Temp VM F per day		
Temp VM @ EtOH Measurement	60	(Adj. on Daily Basis to 60F)		
Daily Ethanol Production	1.0	k gal of EtOH @60F per day		
Enzyme Data Supplier	IFF	Enzyme Name	xxxx	
Dose	NA	kg enz per kg Corn-Sorghum as-is		
	Ethanol from Corn-Sorghum kernel	**Ethanol from Corn-Sorghum kernel**		
RIN Category	6	3		
M = Mass of Feedstock	32.895	1.260	k lb feedstock/day dry of mash	
m = moisture content of Feedstock	0%	0%	mass	
	60	60	F	
Feedstock Converted Fraction	97.928%	17.222%	initial mass	
Theoretical Ethanol Production	18.306	0.123	k lb of EtOH per Day	
Ethanol Process Efficiency	35.910%		EtOH Produce/Feedstock Reduction	
Standardized Mass of Ethanol			k lb of EtOH per day	
Standardized Volume of Ethanol	0.993	0.007	k gal EtOH @60F per day	
Feedstock Energy Content	7600	7600	Btu/dry lb of feedstock	
Overall Conversion Efficiency	35.166%	6.184%	EtOH/Theo EtOH	
Feedstock Energy (FE)	87,917.271	592.309	k Btu per Day	
EV= Energy equiv. of EtOH to EtOH	1.00			
CE Fraction	99.331%	0.669%	FEn/(FEn+FEx)	
Vs = total volume of RIN Fuels	1.00	1.00	k gal of EtOH @60F per Day	
	V RIN RF 6 k Gallons	V RIN CB 3 k Gallons		
RIN Volume with 100% Compliance	0.993	0.007		

APPENDIX C: INTELLULOSE EPA RESULTS FOR BLEND #3 (60% CORN, 40% SORGHUM)

November-2025	**Plant**	**IFF/Edeniq Study 60% Corn**		Key Inputs	
	Capacity	0.4	MGPY	**Corn-Sorghum Composition**	
	Performance	1.00	gal/bu of Corn-Sorghum	Kernel Mass, lb/bu wet	56.1
	Annual Corn-Sorghum	0.4	M Bu per Year	Corn-Sorghum Moisture	14.5%
	Days per year	353	days per year	Kernel Mass, lb/bu dry	48.0
	Conversion	1000	thousand per million	Starch, dry of mash	66.714%
	Daily Corn-Sorghum	1.00	k Bu per day	Cellulose, dry of mash	2.875%
	Daily Corn-Sorghum	48	k lb of Corn-Sorghum per day @0% moisture		
	Daily Denatured Ethanol Production	1.0	k gal of EtOH @Temp VM F per day		
	Temp VM @ EtOH Measurement	60	(Adj. on Daily Basis to 60F)		
	Daily Ethanol Production	1.0	k gal of EtOH @60F per day		
Enzyme Data	Supplier	IFF	Enzyme Name	xxxx	
	Dose	NA	kg enz per kg Corn-Sorghum as-is		
		Ethanol from Corn-Sorghum kernel	**Ethanol from Corn-Sorghum kernel**		
	RIN Category	6	3		
	M = Mass of Feedstock	32.000	1.379	k lb feedstock/day dry of mash	
	m = moisture content of Feedstock	0%	0%	mass	
		60	60	F	
	Feedstock Converted Fraction	97.808%	20.787%	initial mass	
	Theoretical Ethanol Production	17.785	0.163	k lb of EtOH per Day	
	Ethanol Process Efficiency	36.872%		EtOH Produce/Feedstock Reduction	
	Standardized Mass of Ethanol			k lb of EtOH per day	
	Standardized Volume of Ethanol	0.991	0.009	k gal EtOH @60F per day	
	Feedstock Energy Content	7600	7600	Btu/dry lb of feedstock	
	Overall Conversion Efficiency	36.064%	7.664%	EtOH/Theo EtOH	
	Feedstock Energy (FE)	87,706.273	803.306	k Btu per Day	
	EV= Energy equiv. of EtOH to EtOH	1.00			
	CE Fraction	99.092%	0.908%	FEn/(FEn+FEx)	
	Vs = total volume of RIN Fuels	1.00	1.00	k gal of EtOH @60F per Day	
		V RIN RF 6 k Gallons	V RIN CB 3 k Gallons		
	RIN Volume with 100% Compliance	0.991	0.009		

APPENDIX D: INTELLULOSE EPA RESULTS FOR BLEND #4 (40% CORN, 60% SORGHUM)

November-2025 **Plant**	**IFF/Edeniq Study 40% Corn**		Key Inputs	
Capacity	0.4	MGPY	**Corn-Sorghum Composition**	
Performance	1.00	gal/bu of Corn-Sorghum	Kernel Mass, lb/bu wet	56.1
Annual Corn-Sorghum	0.4	M Bu per Year	Corn-Sorghum Moisture	14.5%
Days per year	353	days per year	Kernel Mass, lb/bu dry	48.0
Conversion	1000	thousand per million	Starch, dry of mash	66.086%
Daily Corn-Sorghum	1.00	k Bu per day	Cellulose, dry of mash	3.238%
Daily Corn-Sorghum	48	k lb of Corn-Sorghum per day @0% moisture		
Daily Denatured Ethanol Production	1.0	k gal of EtOH @Temp VM F per day		
Temp VM @ EtOH Measurement	60	(Adj. on Daily Basis to 60F)		
Daily Ethanol Production	1.0	k gal of EtOH @60F per day		
Enzyme Data Supplier	IFF	Enzyme Name	xxxx	
Dose	NA	kg enz per kg Corn-Sorghum as-is		

	Ethanol from Corn-Sorghum kernel	**Ethanol from Corn-Sorghum kernel**	
RIN Category	6	3	
M = Mass of Feedstock	31.699	1.553	k lb feedstock/day dry of mash
m = moisture content of Feedstock	0%	0%	mass
	60	60	F
Feedstock Converted Fraction	97.889%	27.365%	initial mass
Theoretical Ethanol Production	17.633	0.242	k lb of EtOH per Day
Ethanol Process Efficiency	37.025%		EtOH Produce/Feedstock Reduction
Standardized Mass of Ethanol			k lb of EtOH per day
Standardized Volume of Ethanol	0.986	0.014	k gal EtOH @60F per day
Feedstock Energy Content	7600	7600	Btu/dry lb of feedstock
Overall Conversion Efficiency	36.243%	10.132%	EtOH/Theo EtOH
Feedstock Energy (FE)	87,313.463	1,196.117	k Btu per Day
EV= Energy equiv. of EtOH to EtOH	1.00		
CE Fraction	98.649%	1.351%	FEn/(FEn+FEx)
Vs = total volume of RIN Fuels	1.00	1.00	k gal of EtOH @60F per Day
	V RIN RF 6 k Gallons	V RIN CB 3 k Gallons	
RIN Volume with 100% Compliance	0.986	0.014	

APPENDIX E: INTELLULOSE EPA RESULTS FOR BLEND #5 (20% CORN, 80% SORGHUM)

November-2025 Plant	IFF/Edeniq Study 20% Corn		Key Inputs	
Capacity	0.4	MGPY	Corn-Sorghum Composition	
Performance	1.00	gal/bu of Corn-Sorghum	Kernel Mass, lb/bu wet	56.1
Annual Corn-Sorghum	0.4	M Bu per Year	Corn-Sorghum Moisture	14.5%
Days per year	353	days per year	Kernel Mass, lb/bu dry	48.0
Conversion	1000	thousand per million	Starch, dry of mash	64.821%
Daily Corn-Sorghum	1.00	k Bu per day	Cellulose, dry of mash	3.453%
Daily Corn-Sorghum	48	k lb of Corn-Sorghum per day @0% moisture		
Daily Denatured Ethanol Production	1.0	k gal of EtOH @Temp VM F per day		
Temp VM @ EtOH Measurement	60	(Adj. on Daily Basis to 60F)		
Daily Ethanol Production	1.0	k gal of EtOH @60F per day		
Enzyme Data Supplier	IFF	Enzyme Name	xxxx	
Dose	NA	kg enz per kg Corn-Sorghum as-is		
	Ethanol from Corn-Sorghum kernel	**Ethanol from Corn-Sorghum kernel**		
RIN Category	6	3		
M = Mass of Feedstock	31.092	1.656	k lb feedstock/day dry of mash	
m = moisture content of Feedstock	0%	0%	mass	
	60	60	F	
Feedstock Converted Fraction	97.828%	25.465%	initial mass	
Theoretical Ethanol Production	17.284	0.240	k lb of EtOH per Day	
Ethanol Process Efficiency	37.765%		EtOH Produce/Feedstock Reduction	
Standardized Mass of Ethanol			k lb of EtOH per day	
Standardized Volume of Ethanol	0.986	0.014	k gal EtOH @60F per day	
Feedstock Energy Content	7600	7600	Btu/dry lb of feedstock	
Overall Conversion Efficiency	36.944%	9.617%	EtOH/Theo EtOH	
Feedstock Energy (FE)	87,299.176	1,210.404	k Btu per Day	
EV= Energy equiv. of EtOH to EtOH	1.00			
CE Fraction	98.632%	1.368%	FEn/(FEn+FEx)	
Vs = total volume of RIN Fuels	1.00	1.00	k gal of EtOH @60F per Day	
	V RIN RF 6 k Gallons	V RIN CB 3 k Gallons		
RIN Volume with 100% Compliance	0.986	0.014		

APPENDIX F: INTELLULOSE EPA RESULTS FOR BLEND #6 (100% SORGHUM)

November-2025	**Plant**	**IFF/Edeniq Study 0% Corn**		Key Inputs	
	Capacity	0.4	MGPY	**Sorghum Composition**	
	Performance	1.00	gal/bu of Sorghum	Kernel Mass, lb/bu wet	56.1
	Annual Sorghum	0.4	M Bu per Year	Sorghum Moisture	14.5%
	Days per year	353	days per year	Kernel Mass, lb/bu dry	48.0
	Conversion	1000	thousand per million	Starch, dry of mash	63.812%
	Daily Sorghum	1.00	k Bu per day	Cellulose, dry of mash	3.555%
	Daily Sorghum	48	k lb of Sorghum per day @0% moisture		
	Daily Denatured Ethanol Production	1.0	k gal of EtOH @Temp VM F per day		
	Temp VM @ EtOH Measurement	60	(Adj. on Daily Basis to 60F)		
	Daily Ethanol Production	1.0	k gal of EtOH @60F per day		
Enzyme Data	Supplier	IFF	Enzyme Name	xxxx	
	Dose	NA	kg enz per kg Sorghum as-is		
		Ethanol from Sorghum kernel	**Ethanol from Sorghum kernel**		
	RIN Category	6	3		
	M = Mass of Feedstock	30.608	1.705	k lb feedstock/day dry of mash	
	m = moisture content of Feedstock	0%	0%	mass	
		60	60	F	
	Feedstock Converted Fraction	97.904%	25.296%	initial mass	
	Theoretical Ethanol Production	17.028	0.245	k lb of EtOH per Day	
	Ethanol Process Efficiency	38.312%		EtOH Produce/Feedstock Reduction	
	Standardized Mass of Ethanol			k lb of EtOH per day	
	Standardized Volume of Ethanol	0.986	0.014	k gal EtOH @60F per day	
	Feedstock Energy Content	7600	7600	Btu/dry lb of feedstock	
	Overall Conversion Efficiency	37.509%	9.691%	EtOH/Theo EtOH	
	Feedstock Energy (FE)	87,253.654	1,255.926	k Btu per Day	
	EV= Energy equiv. of EtOH to EtOH	1.00			
	CE Fraction	98.581%	1.419%	FEn/(FEn+FEx)	
	Vs = total volume of RIN Fuels	1.00	1.00	k gal of EtOH @60F per Day	
		V RIN RF 6 k Gallons	V RIN CB 3 k Gallons		
	RIN Volume with 100% Compliance	0.986	0.014		