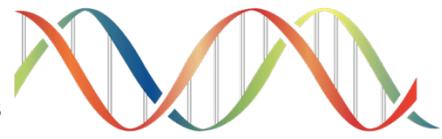




Community BioRefineries
The Epitome of American Innovation



The Power of Sugar Beets: A Sustainable Path to Biofuel Innovation with Community BioRefinery's Cutting-Edge Mechanical Reduction Technology (MRT)

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“The fuel of the future is going to come from fruit like that sumac out by the road, or from apples, weeds, sawdust—almost anything. There is fuel in every bit of vegetable matter that can be fermented. There's enough alcohol in one year's yield of an acre of potatoes to drive the machinery necessary to cultivate the fields for a hundred years.”

~Henry Ford, 1925

From Wartime Necessity to Modern Innovation

In a world thrown into chaos by blockades and embargoes amid the Napoleonic Wars (1803–1815), Europe faced a dire sugar shortage due to British naval dominance. This crisis ignited a transformation: the humble sugar beet (*Beta vulgaris*), once a modest fodder crop, was elevated to a strategic asset. French scientists and farmers, spurred by imperial decrees, unlocked its potential to produce sucrose ($C_{12}H_{22}O_{11}$), birthing an industry that defied colonial dependencies and reshaped global agriculture. Fast forward to 2025, and this resilient root inspires as a cornerstone of sustainable biofuels, exemplifying how sugar beets—with exceptional per-acre yields of fermentable sucrose—meet demands for eco-friendly energy, much like the sumac, a shrub or small tree from the genus *Rhus* in the cashew family (*Anacardiaceae*), in Ford's vision of untapped plant fuels.

1. Advanced Organic Fermentation

Sugar beets serve as a sustainable feedstock for advanced organic fermentation processes, such as acetone-butanol-ethanol (ABE) production.

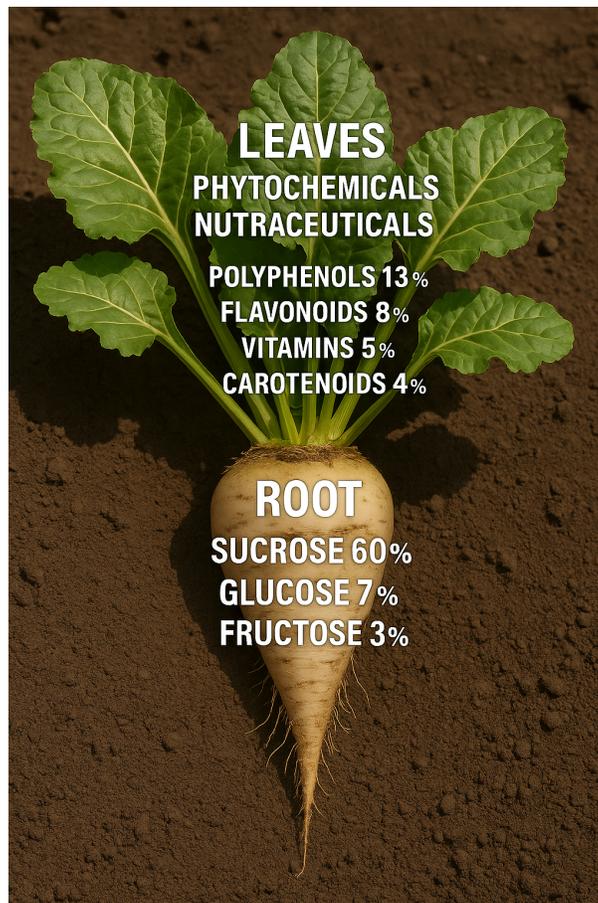
2. Zymobac™ Bacterium

This is enabled by Zymobac™, a proprietary gram-positive, spore-forming anaerobic bacterium that converts sucrose directly into Bio-Acetone, Bio-Butanol, and Ethanol through glycolysis and biphasic phases.

3. Fuel Cells for Renewable Electricity

The resulting Bio-Butanol and Ethanol can then fuel innovative cells to generate renewable electricity, including direct ethanol fuel cells (DEFCs), solid oxide fuel cells (SOFCs), alkaline fuel cells (AFCs), phosphoric acid fuel cells (PAFCs), direct butanol fuel cells (DBFCs), direct alcohol fuel cells (DAFCs), molten carbonate fuel cells (MCFCs), and others.

Bio-Acetone (CH₃)₂CO surpasses petroleum-derived acetone with its renewable process, lower carbon footprint, and is impurity-free. This sustainability suits food processing, where biodegradability reigns. In food science, Bio-Acetone excels at decaffeinating coffee and tea for purer caffeine with minimal off-flavors; supercritical extractions of flavors from herbs, preserving terpenoids; dewaxing for clear gourmet oils with extended shelf-life; isolating bio actives for antioxidant superfoods; and purifying natural colorants like anthocyanins for vibrant, clean-label confectionery—all aligned with circular economy and GRAS (Generally Regarded As Safe) standards.



The sugar beet plant, a resilient crop central to sustainable biofuel innovation.

The sugar beet, when fermented using Zymobac™ in a bioreactor to produce ABE bio-alcohols, the resulting ethanol from beets can power direct ethanol fuel cells (DEFCs), solid oxide fuel cells (SOFCs), alkaline fuel cells (AFCs), and phosphoric acid fuel cells (PAFCs). Bio-butanol fuels direct butanol fuel cells (DBFCs), direct alcohol fuel cells (DAFCs), molten carbonate fuel cells (MCFCs), and SOFCs. Bio-hydrogen, derived from beet biomass fermentation, supports proton exchange membrane fuel cells (PEMFCs), AFCs, SOFCs, PAFCs, MCFCs, and microbial fuel cells (MFCs).

Meanwhile, direct biomass utilization from beet pulp energizes MFCs, SOFCs, DBFCs, MFCs, and enzymatic fuel cells (EFCs). These technologies generate clean electricity with efficiencies up to 60%, producing minimal pollutants like water and CO₂. These technologies are viable for vehicular propulsion, stationary power, portable devices, and grid applications—all while leveraging beets' sustainability attributes such as lower water and nitrogen requirements (compared to corn), enhanced soil health through crop rotation, and potential for negative carbon emissions when integrated with biogas from residual pulp. At Community BioRefineries, LLC, we draw from this legacy of ingenuity, transforming seasonal challenges into community-driven energy solutions. Our journey echoes that historical pivot, where necessity bred innovation, leading us to develop cutting-edge technologies that empower local farmers and reduce reliance on fossil fuels.

This reality epitomizes the valorization of the whole sugar beet and guiding paradigm of enology—the interdisciplinary science and artistry of organic fermentation, wherein microbial bio-transformations harness biochemical pathways to convert substrates into value-added metabolites. Ford's prescient insight reverberates profoundly in contemporary bio-technological pursuits, as we exploit the saccharide-rich composition of sugar beets for sustainable biofuel production, synergistically fusing the evolutionary resilience of historical agronomic practices with advanced molecular engineering and systems biology.

The Rich History of Biofuels from Sugar Beets

The history of producing biofuels from sugar beets dates back to the 19th century, when sugar beets were first developed as a sugar crop in Europe amid geopolitical disruptions like the British blockade, which spurred beet sugar industries in France and Germany; this later expanded globally, with about 35% of world sugar from beets by the early 21st century. Interest in biofuels emerged in the early 20th century but gained traction post-1970s oil crises, with Europe leading in ethanol production from beets. In the U.S., sugar beet cultivation began in the 19th century, reaching 26.7 million tons by 2009 across 12 states, but biofuel efforts were limited due to sugar's higher value. Key developments include 1980s trials comparing fodder beets to corn and sweet sorghum, showing beets' superior ethanol yields (up to 9,400 L/ha vs. corn's 4,660 L/ha). Post-2000, U.S. studies (e.g., 2006 USDA) highlighted beets' potential for 103.5 L ethanol per ton but noted higher costs than corn; 2009 Washington State feasibility studies and California Imperial Valley winter beet trials (yields up to 142 tons/ha) confirmed 2-3 times more ethanol per acre than corn, with co-products like pulp adding value via enzymatic conversion or biogas. In Europe, post-2007 Sugar Regime reforms boosted ethanol output, with life-cycle analyses showing 40 g CO₂/MJ emissions (better than corn's 43 g). Past results have been mixed: technically promising with high yields and GHG reductions, but economically challenged by production costs, sugar market priorities, and scale limitations, leading to minimal U.S. commercial adoption despite successful pilots; globally, beets contribute modestly to biofuels, favoring integrated biorefineries for sustainability.

To delve deeper, the sugar beet's biofuel legacy is rooted in wartime innovation. During World War I, Germany utilized beet molasses for acetone production via bacterial fermentation, a precursor to ABE processes that produced solvents for explosives. This (Dr. Chaim) Weizmann process, yielded acetone, butanol, and ethanol, demonstrating beets' versatility beyond sugar. Dr. Weizmann's process was used by the British to create bio-butanol for their fighter planes. By the mid-20th century, post-WWII fuel shortages in Europe revived interest, with France and Germany experimenting with beet ethanol blends for vehicles. The 1973 oil crisis accelerated this, leading to EU mandates for bioethanol, where beets' high sugar content (15-20%) offered yields 50% higher than grain crops per hectare. In the U.S., the Energy Policy Act of 2005 spurred pilot-level research, but beets' seasonal harvest and high processing costs (e.g., \$2.35/gallon vs. corn's \$1.05) limited scale. Recent advancements, like truly integrated biorefineries converting pulp to biogas, have improved economics, with net GHG reductions of 35-60% compared to gasoline. Yet, challenges persist: Beets require specific climates, facing competition from subsidized corn; and, global production is concentrated in Europe (70% of world beets),

limiting U.S. expansion. As climate change intensifies, beets' low water use (30% less than corn) and soil benefits position them for growth in sustainable fuel strategies.

The Science and Biology of Sugars in Biofuel Feedstocks

In biofuel production, the type and structure of sugars in the feedstock play a pivotal role in determining fermentation efficiency, microbial compatibility, and overall yields. Corn and sugar beets, two prominent feedstocks, contain distinct sugar profiles that influence their suitability for biofuel processes. Corn primarily provides C₆ sugars like glucose, derived from its starch content, along with C₅ sugars such as xylose from hemicellulose in cellulosic components. In contrast, sugar beets are rich in sucrose, a C₁₂ disaccharide (C₁₂H₂₂O₁₁), which constitutes the majority of their extractable sugars. Understanding the science and biology behind these sugars reveals why tailored approaches, like those in our Community BioRefinery, are essential for optimal conversion.

Biologically, sugars in plants originate from photosynthesis, where carbon dioxide and water are converted into glucose using sunlight energy, catalyzed by chlorophyll in leaves. This process, occurring in chloroplasts, produces glucose (C₆H₁₂O₆), a hexose or C₆ sugar, as the primary product via the Calvin-Benson cycle. In corn (*Zea mays*), a C₄ plant adapted for efficient carbon fixation in warm climates, glucose is polymerized into starch granules stored in the endosperm of kernels.

Starch, an alpha-linked polymer of glucose units, comprises about 70-80% of corn's dry weight and is the main source of C₆ sugars for biofuel. When hydrolyzed enzymatically (using amylases), starch breaks down into maltose and ultimately glucose, a monosaccharide readily fermented by microbes. Corn's cell walls also contain hemicellulose (15-20%), a branched polymer yielding C₅ pentoses like xylose (C₅H₁₀O₅) and arabinose upon depolymerization. These C₅ sugars, less abundant in grain but prominent in stover (stalks, leaves, cobs), require specialized microbes for fermentation, as traditional yeasts like *Saccharomyces cerevisiae* prefer C₆ hexoses.

The biology of C₅ and C₆ sugars in corn reflects evolutionary adaptations for energy storage and structural support. Glucose, a key C₆ sugar, is central to plant metabolism, fueling respiration and growth via glycolysis and the Krebs cycle. In seeds, starch serves as a compact energy reserve for germination, with amylopectin (branched) and amylose (linear) chains allowing efficient packing and enzymatic access. Hemicellulose, rich in C₅ sugars, provides matrix support in cell walls alongside cellulose (another C₆ polymer of glucose) and lignin, enhancing rigidity. In biofuel contexts, accessing these requires pretreatment (e.g., acid hydrolysis) to break lignocellulosic bonds, releasing mixed C₅/C₆ streams. This complexity makes corn versatile but energy-intensive for full utilization, with C₅ sugars often underused in conventional ethanol production, leading to yields of about 2.8 gallons per bushel from grain starch alone.

Sugar beets, a plant thriving in temperate zones, store energy differently, accumulating sucrose in vacuoles of root parenchyma cells. Sucrose biosynthesis begins with glucose and fructose-6-phosphate combining via sucrose phosphate synthase and phosphatase enzymes, forming the non-reducing disaccharide sucrose (α-D-glucopyranosyl-(1→2)-β-D-fructofuranoside). This C₁₂ sugar, comprising 15-20% of fresh beet weight, evolved as an osmotic regulator and transport molecule, translocated from leaves to roots via phloem. Biologically, sucrose's stability (no free aldehyde group) prevents unwanted reactions, making it ideal for long-term storage without metabolic drain. In beets, selective breeding has boosted sucrose content from wild relatives' 5-8% to modern cultivars' 18-22%, optimized for biennial growth where roots swell in the first year.

Scientifically, sucrose's structure—a glycosidic bond between glucose (C₆ aldehyde) and fructose (C₆ ketose)—requires hydrolysis by invertase to yield equimolar invert sugar for fermentation. This contrasts with corn's polymeric starch, needing multi-step enzymatic breakdown. Sucrose's high solubility (up to 67% at 20°C) enables concentrated juices but poses osmotic challenges. In biology, beets' betaine and organic acids (e.g.,

oxalate) aid sucrose accumulation by maintaining turgor and pH, but these can inhibit microbes. For biofuels, sucrose's direct accessibility post-extraction simplifies processing compared to corn's starch, yet its concentration demands tolerant strains.

In integrated biorefineries, combining C₅/C₆ from corn stover with beet sucrose enhances yields, but microbial engineering is key for co-fermentation. Our Zymobac™ excels here, metabolizing diverse sugars efficiently. Ultimately, these sugars' biology—rooted in photosynthetic efficiency and storage strategies—underpins feedstock choice, with science guiding conversion to sustainable fuels.

Expanding on this, photosynthesis in beets occurs, fixing CO₂ via RuBisCO, (RuBisCO is Ribulose-1,5-bisphosphate carboxylase/oxygenase) is a key enzyme in photosynthesis that catalyzes the first major step of carbon fixation, converting carbon dioxide into organic molecules in the Calvin-Benson cycle, but with photorespiration losses in hot conditions—hence temperate preference. Corn's C₄ mechanism minimizes this, allowing higher yields in warmer climates (9-12 t/ha grain vs. beets' 50-80 t/ha root). However, beets' sugar is 99% extractable, vs. corn starch's 70%, offering 7,000-9,000 L/ha ethanol potential. Beets also accumulate betaine for osmotic stress tolerance, aiding drought resistance but complicating fermentation by inhibiting yeast. In contrast, corn's hemicellulose C₅ sugars require pentose-fermenting strains, a bottleneck in traditional processes where only 60-70% of biomass is utilized. Advanced biorefineries address this through pretreatment like steam explosion for corn stover or diffusion for beets, enabling 85-95% sugar recovery. Biologically, both crops' sugars fuel microbial glycolysis, but beets' sucrose allows direct ABE, bypassing amylase needs, reducing energy inputs by 20%. This underscores beets' edge in integrated systems, where pulp co-fermentation boosts overall efficiency to 90%.

Challenges with Traditional Yeast Fermentation for Sugar Beets

While traditional ethanol production often relies on brewer's yeast, scientifically known as *Saccharomyces cerevisiae*, this organism faces significant limitations when applied to sugar beets in a manner similar to ethanol plants processing corn. The primary sugars in sugar beets are sucrose, which differs from the starch-derived glucose in corn (requiring enzymatic hydrolysis to monosaccharides). In sugar beet processing, the juice or thick juice can reach high sucrose concentrations (up to 60-70%), leading to elevated osmotic pressure that inhibits *S. cerevisiae* growth and fermentation efficiency. This osmotic stress disrupts yeast metabolism, including alcohol dehydrogenase activity, resulting in lower ethanol yields and potential stuck fermentations. In contrast, corn ethanol processes release glucose gradually during saccharification, avoiding such high initial sugar levels. Additionally, sugar beet juices may contain natural inhibitors like betaine or organic acids, further challenging *saccharomyces cerevisiae* performance without extensive pretreatment or strain optimization. These differences highlight why traditional yeast-based ethanol production from sugar beets is less straightforward and efficient compared to corn, paving the way for innovative approaches like our ABE fermentation with Zymobac™ that better handle these substrate characteristics.

Looking deeper into the biochemical incompatibilities, the high sucrose levels in sugar beet juice create a hyperosmotic environment that triggers stress responses in *saccharomyces cerevisiae*. Yeast cells respond by accumulating compatible solutes like glycerol, which diverts carbon away from ethanol production, reducing yields by up to 20-30% in high-sugar media. Studies have shown that at concentrations above 20-25% sugar, fermentation efficiency drops sharply, with incomplete sugar utilization and increased byproducts like acetic acid, which further inhibit the yeast. Corn mash, on the other hand, typically maintains sugar levels below 15% during fermentation due to simultaneous saccharification and fermentation (SSF) processes, allowing *saccharomyces cerevisiae* to operate optimally. Moreover, sugar beets' sucrose must be inverted to glucose and fructose by invertase, an enzyme *saccharomyces cerevisiae* produces, but in high concentrations, this step can be rate-limiting, leading to fructose accumulation that is less efficiently fermented than glucose, exacerbating yield losses.

Beyond biochemistry, the technical challenges extend to processing and handling. Sugar beets are harvested seasonally, typically from late summer to early winter in the US, and must be processed quickly to prevent sucrose degradation from respiration and microbial spoilage in storage piles. This results in a short operational window for factories—often just 3-6 months—compared to corn ethanol plants that run year-round on storable grain. Stored beets can lose up to 10-15% of their sucrose content over months due to freezing, thawing, or rot, necessitating expensive climate-controlled storage or immediate processing, which is not feasible for large-scale ethanol production without significant infrastructure investments. Corn, being a dry grain, can be stored for years with minimal loss, enabling consistent feedstock supply. Furthermore, sugar beet processing generates viscous juices that require clarification and evaporation steps to concentrate sugars, adding energy costs and complexity not present in corn liquefaction and saccharification.

Economically, sugar beets are profoundly incompatible with the US ethanol industry, which is dominated by corn due to entrenched subsidies, infrastructure, and market dynamics. As of 2006, ethanol production costs from sugar beets were estimated at \$2.35 per gallon (excluding capital), with feedstock alone accounting for \$1.58 per gallon or 67% of total expenses, based on beet prices of \$39.15 per ton and 15.5% sucrose recovery. In stark contrast, corn dry-mill ethanol costs \$1.05 per gallon, with net feedstock at \$0.53 after byproduct credits like distillers dried grains with solubles (DDGS). This cost disparity persists because US sugar policy, including non-recourse loans and marketing allotments under farm bills, maintains domestic beet sugar prices at 25-35 cents per pound—double world levels—prioritizing food markets over fuel diversion. Diverting beets to ethanol would forgo this premium, making it uneconomical unless ethanol prices spike dramatically, as seen briefly in 2006 when spot prices hit \$4 per gallon. Long-term projections show ethanol futures around \$2.40, barely breakeven for beets.

The US ethanol boom, fueled by the Renewable Fuel Standard (RFS) mandating 7.5 billion gallons by 2012 (now expanded), has built an ecosystem around corn: over 92 plants in 2006, mostly in the Midwest Corn Belt, with capacities optimized for starch hydrolysis. Retrofitting for beet juice would require new equipment for diffusion extraction, juice purification, and handling viscous molasses, inflating capital costs to \$2.10-\$2.20 per gallon capacity for a 20 million gallon/year plant—40-47% higher than corn's \$1.50. Moreover, sugar beet acreage is limited to 1.3 million acres (2005), yielding 27.5 million tons, concentrated in regions like the Upper Midwest (51%), far from major fuel markets and lacking the rail/pipe infrastructure of corn country. Scaling to match corn's 81.8 million acres is improbable due to climatic constraints—beets require specific cool, irrigated conditions—and competition for land with higher-value crops.

Policy further entrenches incompatibility. Corn ethanol benefits from a 51-cent/gallon excise tax credit, small producer incentives, and RFS carve-outs, while sugar beets receive no fuel-specific subsidies. The sugar program protects producers from imports via tariffs and quotas, keeping prices high (e.g., refined beet sugar at 25.63 cents/pound in 2005 vs. world 10.25 cents), but this discourages biofuel use as forfeiture to the USDA Commodity Credit Corporation becomes preferable during surpluses. Trade agreements like CAFTA-DR introduce competition, potentially flooding markets with cheaper foreign sugar, but without reforms, beets remain tied to food. Environmental policies, while favoring beets' lower GHG emissions (40 g CO₂/MJ vs. corn's 43 g), don't offset economics, as cellulosic mandates (250 million gallons by 2013) prioritize other residues over beet pulp.

Historically, the beet sugar industry has faced consolidation: 23 factories closed since 1981, leaving 21 by 2023, with recent closures like Sidney Sugars in Montana slashing acreage and jobs. Grower-owned cooperatives bear all risks, with no profits and rising inputs (e.g., fertilizers up 300% in recent years), squeezing margins. Succession issues loom, as younger farmers opt for less risky crops amid volatile weather—droughts, floods, freezes—that destroy unharvested beets or stored piles. Labor shortages for specialized harvesting and processing compound problems, unlike corn's mechanized, scalable operations.

In summary, sugar beets' incompatibility stems from biochemical hurdles (osmotic stress, inhibitors), technical/logistical barriers (seasonality, storage decay), economic disadvantages (high costs, lost sugar premiums), policy biases (corn subsidies, sugar protections), and infrastructural mismatches (corn-centric plants). Despite superior per-acre yields (750 gallons ethanol/acre vs. corn's 370-430) and environmental benefits, these factors render traditional integration unviable, with zero US beet ethanol production as of 2006 and minimal since.

A Practical Solution

This is where Community BioRefinery (CBR) emerges as the perfect solution, addressing every incompatibility through innovative, decentralized, and cost-effective technology tailored for sugar beets. Unlike centralized corn ethanol mega-plants, our Community BioRefinery model empowers local farmers with on-site, modular systems that process beets fresh from the field, eliminating storage losses and seasonal downtime. Our Mechanical Reduction Technology (MRT) mechanically ruptures beet cells to release sucrose directly into a fermentable mash, bypassing energy-intensive juice extraction and concentration steps that plague traditional methods. This low-cost, on-farm approach reduces transportation needs, leveraging existing agricultural equipment for scale-up without massive capital outlays—capital costs drop dramatically compared to \$2.10/gallon for conventional beet plants.

At the core is Zymobac™, our proprietary bacterium that thrives on high-sucrose substrates without osmotic inhibition, directly converting sucrose to acetone, butanol, and ethanol (ABE) via robust anaerobic pathways. Unlike *saccharomyces cerevisiae*, Zymobac™ handles 40-100 g/L sucrose effortlessly, yielding 10-25 g/L ABE with 85% efficiency from mechanical reduction mash, while producing valuable co-products like organic acids and gases for biogas. This biphasic fermentation—acidogenic to solventogenic—mitigates inhibitors like betaine through pH shifts and nutrient optimizations, achieving yields unattainable with yeast. By focusing on ABE rather than pure ethanol alone, we tap higher-value markets: butanol as a superior biofuel (higher energy density, less corrosive) and acetone for chemicals, diversifying revenue beyond ethanol's commodity pricing.

Economically, CBR flips the script: decentralized units minimize overhead, with feedstock costs offset by full biomass utilization—pulp fermented via SSF with enzymes like pectinase and cellulase, boosting yields >90% and generating biogas from residues. No reliance on corn subsidies; instead, we align with RFS advanced biofuel mandates and carbon credits for low-GHG processes (beets' 40 g CO₂/MJ baseline, enhanced by our efficiency). Policy-wise, our model navigates sugar protections by valorizing underutilized beets or off-contract acreage, turning economic pressures into opportunities for grower cooperatives facing closures.

In depth, consider the transformative impact: for a typical 1,000-acre farm, our MRT processes 20,000-30,000 tons annually, yielding 2-3 million gallons ABE equivalent, plus biogas powering operations—self-sustaining energy loops. This counters consolidation by revitalizing local factories, creating jobs in rural areas hit by closures, and ensuring succession through profitable, low-risk diversification. Environmentally, it maximizes beets' advantages: superior water/nitrogen efficiency, saline soil tolerance, and rotational benefits with crops like corn, reducing overall ag emissions. Overall, the CBR process uses no heat or chemicals and creates zero waste.

Ultimately, Community BioRefinery isn't just a workaround—it's a complete paradigm shift, making sugar beets viable where traditional systems fail, fostering sustainable, community-optimized renewable energy that honors Ford's vision while solving 21st-century challenges.

Sugar Beets as a Prime Feedstock: Composition and Challenges

Sugar beets are an ideal feedstock, boasting 15-20% sucrose by wet weight, which constitutes over 98% of the total sugars in the roots. This sucrose is stored intracellularly within the beet tissue, necessitating release for effective fermentation. Direct ABE from whole beets is challenging due to limited accessibility in intact forms, but our innovative approaches overcome this barrier.

Community BioRefineries embody decentralized, farmer-led systems like our CBR CORE model, where agricultural wastes such as sugar beet pulp or whole beets are processed on-site into biofuels, green electricity, and chemicals. These setups promote low-cost, seasonal crop utilization, integrating MRT, extraction, and fermentation—adaptable from ethanol to ABE.

Mechanical Reduction: The Key to Unlocking Sugars Directly

Our cutting-edge MRT—a mechanical reduction to micron-scale particles (<100 μm)—mechanically disrupts beet cells, releasing sucrose into a mash or slurry without relying on traditional hot-water diffusion. This enables direct ABE fermentation with Zymobac™, with efficiency tailored to goals like sucrose-only extraction or full biomass utilization.

- **Direct Process Feasibility:** MRT alone permits immediate inoculation and fermentation of the mash, rupturing cell walls to expose approximately 84% of dry biomass as fermentable sucrose—akin to advanced "exploding" technologies like vacuum extrusion. Under standard ABE conditions, this yields about 85% of theoretical solvents (e.g., 15-20 g/L ABE from 12-18% solids loading), with no intermediate hydrolysis required for sucrose. This process mirrors adapted ethanol fermentations from crushed beets or juices.

Conclusion: A Sustainable Future with Community BioRefineries

For Community BioRefineries employing mechanical reduction on sugar beets, direct ABE fermentation with Zymobac™ post-MTR is not only feasible but prioritizes sucrose conversion with minimal steps for economic viability. Incorporating enzymatic or pretreatment layers achieves full biomass valorization, supporting waste minimization and co-products like biogas from pulp. Potential yields of 10-25 g/L ABE underscore this as a sustainable avenue for local biofuel production.

At Community BioRefineries, LLC, we're committed to empowering communities with these technologies, fostering a greener tomorrow. Contact us to learn how our solutions can revolutionize your agricultural operations.

References

1. Acetone plus light creates a green jet fuel additive - ScienceDaily - <https://www.sciencedaily.com/releases/2020/01/200123152601.htm>
2. Acetone Prospect as an Additive to Allow the Use of Castor and ... - <https://pubmed.ncbi.nlm.nih.gov/articles/PMC7356534/>
3. Effects of the use of acetone as co-solvent on the financial viability of ... - <https://www.sciencedirect.com/science/article/pii/S2212982024002956>
4. Bio-based solvents on the rise - <https://www.biobasedpress.eu/2018/07/bio-based-solvents-on-the-rise/>
5. The Uses Of Food Grade Acetone | Lab Alley - <https://www.laballey.com/blogs/blog/the-uses-of-food-grade-acetone>

6. Uses of acetone in the industry – Medicine/ Pharmaceutical - <https://byjus.com/chemistry/uses-of-acetone/>
7. Acetone Innovation: A Revival of 20th Century Technology - <https://www.resourcewise.com/chemicals-blog/acetone-innovation-a-revival-of-20th-century-technology>
8. Biobased ABE is making a comeback - Green Rose Chemistry - <https://greenrosechemistry.com/biobased-abe-is-making-a-comeback/>
9. What is Bio-Based Acetone? - Dazzle Dry - <https://dazzledryaustralia.com.au/blogs/blog/what-is-bio-based-acetone>
10. What is Acetone? Understanding Its Chemical Properties and Uses - <https://elchemy.com/blogs/personal-care/what-is-acetone-understanding-its-chemical-properties-and-uses>
11. Acetone-Butanol-Ethanol (ABE) fermentation with clostridial co ... - <https://www.sciencedirect.com/science/article/pii/S0957582024002441>
12. Acetone-Butanol-Ethanol (ABE) fermentation with Clostridial Co ... - <https://www.biorxiv.org/content/10.1101/2023.12.08.570763v1>
13. Integrated, systems metabolic picture of acetone-butanol-ethanol ... - <https://www.pnas.org/doi/10.1073/pnas.1423143112>
14. 100th Anniversary of Acetone-Butanol-Ethanol Fermentation - <https://analyticalsciencejournals.onlinelibrary.wiley.com/doi/toc/10.1002/%28ISSN%291097-0290.acetone-butanol-ethanol-fermentation>
15. Kinetic Study of Acetone-Butanol-Ethanol Fermentation in ... - <https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0158243>
16. Biobutanol Production from Acetone–Butanol–Ethanol Fermentation - <https://www.mdpi.com/2311-5637/9/9/847>
17. Pilot-scale acetone-butanol-ethanol fermentation from corn stover - <https://www.sciencedirect.com/science/article/pii/S2950155524000168>
18. NADH-based kinetic model for acetone-butanol-ethanol production ... - <https://www.frontiersin.org/journals/bioengineering-and-biotechnology/articles/10.3389/fbioe.2023.1294355/full>
19. Everything you needed to know about acetone for extraction - <https://www.laballey.com/blogs/blog/everything-you-needed-to-know-about-acetone-for-extraction>
20. The Extraction and Impact of Essential Oils on Bioactive Films and ... - <https://pmc.ncbi.nlm.nih.gov/articles/PMC10670266/>
21. The Extraction and Impact of Essential Oils on Bioactive Films and ... - <https://pmc.ncbi.nlm.nih.gov/articles/PMC10670266/>
22. [PDF] A Modern Dewaxing Technology For Edible Oils Refining - Kvk - <https://ojs.kvk.lt/index.php/DAV/article/download/191/169/1099>
23. Economics of Sugar Beet and Cane Biofuel - NDSU Agriculture - <https://www.ag.ndsu.edu/energy/biofuels/energy-briefs/economics-of-sugar-beet-and-cane-biofuel>
24. The economic feasibility of sugar beet biofuel production in central ... - <https://www.sciencedirect.com/science/article/abs/pii/S0961953411002984>
25. [PDF] Characteristics and Production Costs of U.S. Sugarbeet Farms - https://ers.usda.gov/sites/default/files/laserfiche/publications/47160/33292_sb974-8.pdf
26. The costs of sugar production from different feedstocks and ... - <https://scijournals.onlinelibrary.wiley.com/doi/10.1002/bbb.1976>
27. Industrial sugar beets to biofuel: Field to fuel production system and ... - <https://www.sciencedirect.com/science/article/abs/pii/S0961953415300143>
28. [PDF] Sugar Beet Costs and Returns Home Page - <https://www.sbreb.org/wp-content/uploads/2018/09/Production6.pdf>
29. [PDF] Economic Analysis of Bioethanol Production from Sugar Beet in ... - https://rsepconferences.com/wp-content/uploads/2024/11/8_BAYRAM.pdf

30. Comparative environmental analysis of sugar beet production using ...
- <https://www.sciencedirect.com/science/article/pii/S2666789424000242>
31. Soil greenhouse gas emissions, yield, and water-use efficiency ...
- <https://www.sciencedirect.com/science/article/abs/pii/S0378429025001261>
32. Effect of sugar beet (*Beta vulgaris* L.) cultivation on soil organic ...
- <https://bsssjournals.onlinelibrary.wiley.com/doi/10.1111/sum.70022>
33. Food Security — Special Report on Climate Change and Land - IPCC
- <https://www.ipcc.ch/srccl/chapter/chapter-5/>
34. Impact of Soil Ameliorants on Soil Chemical Characteristics, Sugar ... - <https://www.mdpi.com/2304-8158/12/12/2291>
35. Xylose Fermentation by *Saccharomyces cerevisiae*: Challenges and ...
- <https://pmc.ncbi.nlm.nih.gov/articles/PMC4813126/>
36. Ability of Yeast Metabolic Activity to Reduce Sugars and Stabilize ... - <https://www.mdpi.com/2311-5637/7/3/105>