Research, Validation and Commercialization of Technologies

Evidence of SGP+™ Efficacy in Bovine Ration Management and Herd Performance

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Preface: SGP+™ is NOT simply Sugarcane Bagasse, BUT a proprietary formulation containing Nutri-Mastic™ (Mastic Gum, Ionic Minerals, Water), Carob, and Sugarcane Bagasse processed through IFUS's proprietary method, whereby Sugarcane Bagasse at 135-145°F shifts in less than 2-minutes, transforming the material into SGP+™ with lowered temperatures of 92-94°F, and continued cooling to 84-86°F for several minutes within 2000-lb bales.

1. Note the steam coming off the Sugarcane Bagasse before it is formulated, then processed into SGP+™ in Pic. 1:

Pic 1:

2. It is said that a picture can be worth a thousand words. Below are pictures of structurally intact 2000-lb bales of SGP+™ freshly produced in Pic 2-1 and 2-2:

Pic 2-1

Pic 2-2

3. Pictures of SGP+™ 6-months after production. Unlike untreated bagasse (or hay) compressed into bales, SGP+™ bales begin to collapse with darkened water produced (an indication of lignin depolymerization by microbes naturally occurring in the Sugarcane Bagasse). Pic 3-1 and 3-2:

Pic 3-1:

NOTE: “Under anaerobic conditions, major bacterial decomposition occurs, leading to the formation of black or dark grey colored wastewater [30],” Abdoul Wahab Nouhou Moussa, et.al., “Critical State of the Art of Sugarcane Industry Wastewater Treatment Technologies and Perspectives for Sustainability,” Membranes (Basel). 2023 Jul 31;13(8):709. doi: 10.3390/membranes13080709
Normally, this black-water from Sugarcane Bagasse results from pile maceration to prevent spontaneous combustion. This effluent would be filled with Iron Sulfides with a characteristic Sulfide smell. Where the dark color is attributed to Iron, there is NO Sulfide smell in the IFUS facility from the black-water as well as NO water added to prevent combustion as the bales are cool.

Pic 3-2:

NOTE: “A taxonomic classification of the bagasse metagenome reviews the predominance of Proteobacteria, which are also found in high abundance in other aerobic environments. Based on the functional characterization of biomass-degrading enzymes, we have demonstrated that the bagasse microbial community benefits from a large repertoire of lignocellulolytic enzymes, which allows them to digest different components of lignocelluoses into single molecule sugars.” Wuttichai Mhuantong, et.al., “Comparative analysis of sugarcane bagasse metagenome reveals unique and conserved biomass-degrading enzymes among lignocellulolytic microbial communities,” Biotechnol Biofuels. 2015 Feb 8;8:16. doi: 10.1186/s13068-015-0200-8

The IFUS SGP+™ storage areas routinely have scents of a Starbucks Coffee Shop, and/or a bit of sweetened molasses, and in time just simply a fresh earthy smell.

4. SGP+™ after several years (2012). Unlike untreated Sugarcane Bagasse (of hay), SGP+™ disintegrates into dust as shown by Pic 4-1 and 4-2:

Pic 4-1:

Pic 4-2

IFUS has since modified its formulation method and the creation of the dust-like product is now occurring in 18-24 months.

5. Pictures of Untreated Sugarcane Bagasse in Pic 5:

Pic 5:

The Sugarcane Bagasse is hot to the touch.

6. Contrasted to 4-month-old SGP+™ broken apart out of a 2000-lb bale in Pic 6:

Pic 6:

The SGP+™ is cool to the touch.

7. What's happening? Accelerated lignin degradation and depolymerization!

Sugarcane Bagasse in unlike any grass on earth as it produces high levels of starch. When the Sugarcane Bagasse suspends its growth (typically due to cooler temperatures), the starch converts into sucrose. Once the sucrose is extracted from the Sugarcane, the residual sugars are quickly fermented in the remaining pulp (or Bagasse). Over time, microbes in the Sugarcane Bagasse mat use the remaining nutrients and chemicals to degrade the cellulose, hemicellulose, and lignin. However, this can take years and is particularly exothermic.

If Sugarcane Bagasse is compressed into a fiber board or bale, these products remain nondegradable for decades. For nearly a century, Sugarcane Bagasse was converted into brown paper, cardboard, and insulation board.

As a U.S.D.A. ND-40 fiber, most ranchers and dairymen would be ill-advised to use Sugarcane Bagasse as part of their respective Ration Management. This is clearly established by the non-use of Sugarcane Bagasse by ranchers and dairymen in Southeast Louisiana where both cattle and Bagasse are plentiful.

The obstacle to using Sugarcane Bagasse as part of Bovine Ration is the recalcitrant lignin. However, if the lignin is degraded and depolymerized (as IFUS claims), then Sugarcane Bagasse becomes as per Dr. Pat Bagley, "the holy grail of energy and nutrition for bovines." Dr. Bagley is the former Dean of Tennessee Tech School of Agriculture and now serves as Director, SUAREC Beef Research Unit as well as Acting Vice Chancelor of Institutional Development. He is one of the authors of LA HCR-42 2024, commonly referred to as the Bagasse Utilization Bill.

IFUS holds that is has discovered a commercially viable process by which lignin from Sugarcane Bagasse can be degraded and depolymerized *in vitro* prior to bovine consumption making Sugarcane Bagasse, when combined with Mastic Gum, Carob, Ionic Minerals, and Water, a potential power food…one IFUS named SGP+™.
Furthermore, Manure Scoring coupled with Herd Performance as reported to IFUS by ranchers and dairymen blending SGP+™ with the respective rations, strongly suggests further degradation and depolymerization of the lignin *in vivo.*

Furthermore, a study offered by the Noble Research Institute states, "Manure scoring determines supplementation needs".

"When combined with other estimates such as forage availability and quality, a diet can be quickly changed to meet the cow's nutrient requirements rather than waiting for body condition to fall low enough that the producer will notice a change. Manure scoring can

indicate the quality of nutrition a cow has had in the past one to three days, while body condition score will indicate the nutritional history of the past several weeks to months. “Manure is scored on a 1 to 5 basis, with a score of 1 being very fluid and 5 being extremely dry and segmented. The next few paragraphs will detail each score and associated diet quality. Reference photographs have been included with approximate levels of dietary protein and energy (TDN) listed.

“A manure score of 1 is of cream soup consistency. It can indicate a sick animal or a highly digestible ration that contains excess protein, carbohydrates or minerals, and low fiber. The addition of hay will slow down the rate of passage and thicken the manure.

“Score 2: >20% CP; >68% TDN of diet

“Manure that will score a 2 doesn’t stack; the pat is usually less than 1 inch thick and will lack consistent form. This manure has the consistency of cake batter. Excess protein, carbohydrates and low fiber characterize the diets that produce this manure. Rate of passage is very high, and adding hay to this diet will slow it down to allow for more absorption in the intestinal tract.

“Score 3: 12-15% CP; 62-70% TDN of diet

“Manure score 3 is ideal and will typically start to take on a normal pat form. The consistency will be similar to thick pancake batter. It will exhibit a slight divot in the middle. The pat will be deeper than a score 2 pat, but will not stack. This diet is not lacking nutritionally, yet is not in excess for the cow and her physiological stage.
“Score 4 manure is thick and starting to become somewhat deeper, yet is not stacking. The consistency of the manure will be equivalent to peanut butter. This manure indicates a lack of degradable rumen protein, excess low quality fiber or not enough carbohydrates in the diet. Supplementation of additional protein with high rumen-degradable protein can increase total diet digestibility. Cottonseed meal and soybean meal are excellent sources of this type of protein.

Score 5: <6% CP; <55% TDN of diet

“The highest and least desirable score is 5. This manure is firm and stacks over 2 inches in height. It will also have clearly defined segments and is very dry. This manure indicates the cow is eating a poor quality forage diet that is inadequate for protein and carbohydrates, and high in low quality fiber. Rate of passage has slowed down to the point that excess water has been reabsorbed in the intestines. The rancher will need to consider additional supplementation to meet the cow’s protein and energy requirements.”

This work was led by Robert S. Wells, formerly of the Noble Research Institute, and now “Professor of Practice and the Paul C. Genho Endowed Chair in Ranch Management, Beef Cattle Management and Ruminant Nutrition. Dr. Well, PAS is a South Texas native who has spent his career consulting with ranchers to meet their ranch management and profitability goals across the Southern Great Plains and internationally. Wells earned a bachelor’s degree in Animal Science from Stephen F. Austin State University, his Master of Science degree with a focus on ruminant nutrition from Texas Tech University, and his Ph.D. from the University of Illinois in beef cattle management and ruminant nutrition.”

Here is a comparative slide of three types of manure as provided by the Noble Research Institute:

Comparatively, here are Score 3 Manure Pats from Deer Run Ranch with 90%SGP+™ / 10% Cracked Corn:

Additionally, here is a Manure Pat from Joe Wilcox as he pushes SGP™ to 92% with 8% DG. Notice pats moving from Score 3 to Score 3.4/4.0. Hence, Joe will back down to 90% SGP+™/10% DG until Score 3 pats return. Joe is conducting his 4th trial (a blind trial this round), whereby he bulked half the herd on SGP+™ to sell weight in 60 days vs. the control group at 90+ days.

Lastly, here are Manure Pats from India with SGP+2.0™ at only 15% of ration mixed with Sugarcane Tops and Protein Concentrate. Also, during the 15-day trial, Manure Score Improved. Furthermore, where Milk fat percentage was the same, SNF (Solid-non-fat) percent increased by 0.6-0.8%. SNF typically ranges around 8%. Hence, for this Indian Trial, the 0.6-0.8% increase moved their respective milk fat to 7.5%. This provide to be an approximate increase of 10.0% increase in total SNF in their milk. The substantive nature of this cannot be understated considering that milk and milk-based products are the primary source of nutrition in India

Day 1 Manure

Day 15 Manure

To repeat: “When combined with other estimates such as forage availability and quality, a diet can be quickly changed to meet the cow’s nutrient requirements rather than waiting for body condition to fall low enough that the producer will notice a change. Manure scoring can indicate the quality of nutrition a cow has had in the past one to three days,

while body condition score will indicate the nutritional history of the past several weeks to months."

1. I.V.T.D. (*In Vitro* Total Digestibility) results of Sugarcane Bagasse as compared to SGP+™:
    a. Testing performed by the L.S.U. Southeast Research Station Forage Quality Lab demonstrated a marked I.V.T.D. improvement of SGP+™ as compared to Sugarcane Bagasse (47.5% vs 32.0%, respectively). Where by this analysis alone SGP+ should NOT produce the Herd Performance claimed by ranchers and dairymen, per Dr. Mike McCormick, it does beg the question as to what caused this significant improvement in I.V.T.D.
2. Lignin Analysis on Sugarcane Bagasse as Compared to Manure Lignin Analysis on Score 3 Manure Pats from a beef herd fed 90%SGP+™/10% Cracker Corn:
    a. Forage / Manure Analysis Comparison suggests SGP+™ is being digested and producing both CP and TDN required for Bovine Herd Performance.
    b. A series of Forage analyses performed by L.S.U. Southeast Research Station Forage Quality Lab showed Sugarcane Bagasse used in the formulation of SGP+™ to contain roughly 28% lignin.
    c. However, the lignin concentration decreased to 19% in an 85% SGP+™/15% Cracked Corn ration mix (as analyzed by Cumberland Valley Analytical Services).
    d. Furthermore, in Manure Analysis performed on Score 3 Manure Pats resulting from the 85/15 mix, showed a further decrease in lignin content to 7-9% (as analyzed by Cumberland Valley Analytical Services).
    e. Cumberland also noted undigested cracked corn in the original manure sample. Of interest Sugarcane Bagasse (SB) is high in S-Lignin, where Corn is high in G-Lignin. Studies indicate that White-Rot Fungi and other microbes naturally found in SB target the S-Lignin for degradation and depolymerization.
3. Manure Analysis performed by Texas A&M on 80%SGP+/20%DG (Distillers Grain):
    a. "Cow Weight and Body Condition: All sampled cows weighed around 1,250-1,300 lbs and had a Body Condition Score ~6 (on a 1-9 scale). A BCS of 6 means they were in good flesh - neither too thin nor overly fat, which is ideal for cows nursing calves. Maintaining this condition indicates the feed is keeping them healthy."
        i. Of note, is that these Score 6 cows were purchases as Score 1 & 2.
    b. However, other parts of the A&M analysis were reached based on a misunderstanding that SGP+™ is NOT untreated Sugarcane Bagasse.
    c. The A&M report continually refers to the SGP+™ as "bagasse". SGP+™ uses bagasse as one of multiple ingredients. And, based on photographic and

microscopic analysis, untreated Sugarcane Bagasse is VERY different from SGP+™. This confusion resulted from a miscommunication as to the nature of SGP+™.

d. Furthermore, the A&M analysis concludes that the results indicated that more study of SGP+™ is warranted due to seemingly unexpected positive Herd Performance outcomes.

Hence, if one considers (1) the photographic evidence presented above of the transformation of untreated Sugarcane Bagasse(SB) as compared to SGP+™, (2) I.V.T.D. improvements from untreated SB as compared to SGP+™, (3) Forage/Manure Analysis demonstrating a trend line of decreased lignin concentration when compared to untreated SB to SGP+™ to manure, (4) improvements to Manure Score 3 pats, and (5) reported improvements in overall Herd Performance, then IFUS holds that where present analysis methods in isolation cannot explain the efficacy of SGP+™, when taken as a series of data points and interconnected from starting ingredients to Herd Performance the overall trajectory demonstrates that:

1. Lignin in the Sugarcane Bagasse (SB) when transformed into SGP+™ is being degraded and depolymerized.
2. This SGP+™ is in fact being converted into CP and TDN as indicated by Score 3 Manure Pats and Herd Performance.
3. SGP+™ has demonstrated efficacy in the improvement of Herd Performance.

In consideration of this information, IFUS can provide deeper and plausible scientific explanations in support of the efficacy of SGP+™ as compiled in the competed White Paper.