SGP+2.0™ Ration Part 13: Environmental Impacts
Based on analysis and scientific study, SGP+™ being shown to provide positive environmental impacts.

1. In the early stages of SGP+™, industrial grade methane detectors used in chemical plants and oil refineries were used to sample for methane produced from newly acquired F-1 Heifers being introduced to SGP+™. The intent was to ensure the efficiency of the new detectors before using in chemical plants and oil refineries (where these sensors were critical to worker safety).
   1.1. Over the course of 6 months, measurements were taken at regular intervals. Notwithstanding shifts in ambient conditions in the pasture, a steady decrease in methane levels where the heifers congregated was noted. This decrease was found to be undetectable in the pasture, at the heifers' rear during excretion, and on fresh manure pats.
      1.1.1. Several meters were used and calibrated against a methane standard before each application.
         1.1.1.1. All meters showed similar results.
      1.1.2. In that 6-month period, the heifers initially received 30% of SGP+™ in their ration and were ultimately transitioned to 60+% SGP+™.
      1.1.3. A reduction of flies was noted as the Manure Pats transitioned in Score 3.
      1.1.4. Herd Performance also improved significantly.
   1.2. Since that time, ranchers continually report a reduction if gaseous discharge from their herds, colloquially called "cow farts."
   1.3. Visitors to IFUS test ranches note the lack of smell. They also note a decrease in gaseous discharge from the herds.
   1.4. As methane in odorless and colorless, it must be instrumentally measured.
   1.5. However, the digestive processes that would produce "manure smells" is also related to the production of methane.
      1.5.1. "For example, tannins are plant polyphenols used in ruminant farming as growth and health promoter. Many forages and agricultural by-products are naturally rich in tannins, especially in plant species characterizing marginal areas or dry habitats6, but tannins can be also added as dietary supplement for a better control of dose and quality. Thanks to their antimicrobial and protein binding activities, tannins are known to affect ruminal biohydrogenation (BH) and N metabolism, with potential positive consequences on milk quality and N emissions7."
         1.5.1.1. "Effect of dietary tannin supplementation on cow milk quality in two different grazing seasons," R. Menci, A. Natalello, G. Luciano, A. Priolo,

B. Valenti, G. Farina, M. Caccamo, V. Niderkorn & M. Coppa, Scientific Reports volume 11, Article number: 19654 (2021)

1.5.2. "Anaerobic digestion characteristics of lignocellulosic components are described:

1.5.2.1. Hemicellulose was hydrolysed and acidified more quickly than cellulose.

1.5.2.2. The biomethane potential of cellulose was higher than that of hemicellulose.

1.5.2.3. Co-digestion of cellulose and hemicellulose had a synergistic effect on methane yield.

1.5.2.4. **Lignin caused more severe inhibition on methane yield of cellulose than hemicellulose**.

1.5.2.4.1. "Methane production through anaerobic digestion: Participation and digestion characteristics of cellulose, hemicellulose and lignin," Wanwu Li, Habiba Khalid, Zhe Zhu, Ruihong Zhang, Guangqing Li, Chang Che, Eva Thorin, Applied Energy, Volume 226, 15 September 2018, Pages 1219-1228 (https://doi.org/10.1016/j.apenergy.2018.05.055)

1.5.3. "Increasing the proportion of non-H2 producing fibrolytic microorganisms might decrease methane production without affecting forage degradability. Alternative pathways that use electron acceptors other than CO2 to oxidise H2 also exist in the rumen. Bacteria with this type of metabolism normally occupy a distinct ecological niche and are not dominant members of the microbiota; however, their numbers can increase if the right potential electron acceptor is present in the diet. "Microbial ecosystem and methanogenesis in ruminants," D.P. Morgavi, E. Forano, C. Martin, C.J. Newbold, Animal

1.5.3.1. Volume 4, Issue 7, 2010, Pages 1024-1036, https://doi.org/10.1017/S1751731110000546

1.6. Similar observations are made about the herds burping as well as an overall reduction of the ammonia odor associated with beef and dairy cows.

1.7. Additional Data is Pending the Completion of Blind Trials presently underway.

2. Water

2.1. Lignin degradation and depolymerization for White Rot Fungi biochemically shown to produce water.

2.1.1. H2 necessary for the production of CH4 in protein metabolism, is converted in water.

2.1.1.1. This claim is supported ranchers feeding SGP+™ at 80% of total ration reporting:

2.1.1.1.1. Reduced hydration requirements

2.1.1.1.2. Improved heat tolerance

2.1.1.1.3. Reduced urinary output
2.1.1.1.4. Reduced NH4 smell
2.1.1.1.5. Improved overall herd performance

2.1.1.2. Ranchers who are also degreed Animal Scientists have calculated that the water being saved by the 80% application of SGP+™ to their ration mix would provide 20lbs of corn for the 8.55MM aquifer-fed head in the U.S. with 8% of the water remaining.

Plausible Explanations:

3. Decreased Ration Consumption
   3.1. Ranchers are reporting that herds are chewing their cuds on average 60 minutes earlier both after morning and afternoon grazing,
      3.1.1. Additionally, are reduction in overall ration (i.e., lbs of ration/head/feeding) is being reduced.
      3.1.2. Measurements from these ranchers range from as little as a 10% reduction in ration and grazing time to as much as 30%.
         3.1.2.1. Hence the average is a reduction in 20% ration consumption.
         3.1.2.2. When factored into calculations of methane production for beef and cattle herds, this reduction.
         3.1.2.3. "Invited review: Improving feed efficiency of beef cattle –the current state of the art and future challenges," D. A. Kenny, C. Fitzsimons, S. M. Water, and M. McGee , Animal (2018), 12:9, pp 1815–1826 © The Animal Consortium 2018, doi:10.1017/S1751731118000976

4. Lignin suppresses Methane Production
   1.1. "Methane production through anaerobic digestion: Participation and digestion characteristics of cellulose, hemicellulose and lignin," Wanwu Li, Habiba Khalid , Zhe Zhu, Ruihong Zhang, Guangqing Liu, Chang Chen, Eva Thorin, "Applied Energy," Volume 226, 15 September 2018, Pages 1219-1228, https://doi.org/10.1016/j.apenergy.2018.05.055
      1.1.1. "Anaerobic digestion characteristics of lignocellulosic components are described."
      1.1.2. "Hemicellulose was hydrolysed and acidified more quickly than cellulose."
      1.1.3. "The biomethane potential of cellulose was higher than that of hemicellulose."
      1.1.4. "Co-digestion of cellulose and hemicellulose had a synergistic effect on methane yield."
      1.1.5. "Lignin caused more severe inhibition on methane yield of cellulose than hemicellulose."

1.1.6. "Lignocellulosic biomass is the most abundant natural resource with high biomethane potential. However, complex structure of lignocellulosic biomass has hampered the efficient utilization of this bioresource."

1.1.7. The biochemical pathway whereby lignin is degraded and depolymerized by White Rot Fungi results in water production *in vivo.*

1.1.7.1. The H2 produced reacts with O2 with the interaction of Mn and Fe peroxidases to create the water.

1.1.7.2. The H2 is critical to methane production, and once converted to H2O is no longer available to produce methane.

1.1.7.3. Numerous studies show this to be scientifically valid.

1.1.7.4. Initial calculations as well as thermodynamic modeling assigns an extrapolated 20% overall reduction in Carbon load. This analysis includes the following estimates:

1.1.7.4.1. 20% reduced ration consumption

1.1.7.4.2. 17% reduced water consumption

1.1.7.4.3. 4% reduction in feeds, supplements, antibiotics

1.1.7.4.4. 5% increase in bagasse processing, handling, and utilization

1.1.7.4.5. 2.5% reduction in manure and urine handling, reuse, treatment, and/or disposal

1.1.7.4.6. 1.0% reduction from increased milk production; more liters of milk / cow

1.1.7.4.7. 1.0% reduction in other general carbon generators

Supporting Science:

2. "Ways to Reduce Methane Production in Cattle" through ration management using SGP+™/SGP+2.0™ (February 2014 Mandi Jones, Extension Assistant, University of Nebraska–Lincoln)

2.1. "Reducing the amount of methane produced by the livestock industry offers economic benefits to producers in addition to the environmental benefits. At the heart of methane production is the microbes that reside within the rumen."

2.2. "Diet can be used to alter microbial populations in the rumen and in turn increase animal performance and reduce methane emissions. Dietary factors such as type of carbohydrate, fat inclusion, processing of forages and level of feed intake has been shown to influence methane emission in cattle."

2.3. "Cattle fed diets high in carbohydrates typically have a higher rate of gain. Highly digestible feeds like corn and distillers grains are more easily digestible than grass or hay."

2.4. "The microbes involved in digesting cellulose-rich diets (grass or hay) or carbohydrate-rich diets (corn or distillers grains) are different and will result in different levels of methane produced. **Less methane will be produced in carbohydrate-rich diets due to the fact that propionate production will remove H2 away from methane production (propionate is a hydrogen sink)**."

2.5.Cattle on carbohydrate -rich diets with high intake will produce less methane as a percentage of dietary gross energy.

2.6.**Grinding and pelleting of forages increases passage rate and reduces methane emitted by the animal.**

2.6.1. **The processing of SGP+™/SGP+2.0™ actually shears (grinds) the Sugarcane bagasse.**

2.7.Fats are a high energy source that can be included as part of the diet and have been shown to have an inhibitory effect on methane production as fat can be toxic to methane producing microbes. Unsaturated fat will remove H2 away from methane production to saturate the fat (H2 sink).

2.8.Producers can increase the profitability of their operation by incorporating carbohydrates in a cattle diet, increasing feed intake, processing forages and offering a diet that includes unsaturated fat. Each of these factors has been shown to improve feed efficiency and reduce methane production.

2.8.1.1. February 2014 Mandi Jones, Extension Assistant, University of Nebraska–Lincoln

2.8.2. SGP+™/SGP+2.0™ contains Mastic (an oil based product with essential fats/lips), Carob (another material containing essential fats/lipids plus high levels of carbohydrates), and Sugarcane bagasse (high in carbohydrates).

3. Lignin Degradation and Depolymerization: The production of the laccase enzyme to further release the caloric potential of lignin.

3.1.1. "MnP is a heme peroxidase produced by white rot basidiomycetes fungi land expresses the oxidation of phenolic compounds in the presence of Mn(II) and H2O2. In the MnP catalyzing oxidation, chelate complexes of Mn(III) with organic acid such as malonate, lactate, or tartarate oxldize phenolic compounds, including lignin."

3.1.1.1. Wariishi, H., Valli, K., Gold, M.H., 1992. Manganese (II) oxidation by manganese peroxidase from basidiomycete *Phanerochaete chrysosporium*, kinetic mechanism and role of chelators. J. Biol. Chem. 267, 23688-23695.

3.1.2. "A fungal laccase is a multicopper oxidase and catalyzes one-electron oxidation of phenolic compounds by reducing oxygen to water."

3.1.2.1. Reinhammar, B., 1984. Laccase. In: Lontie, R. (Ed.), Copper Proteins and Copper Enzymes, Vol. 3. CRC Press, Boca Raton, FL, pp. 1-35.

3.1.3. In reviewing the biochemical pathways by which lignin in Sugarcane bagasse is degraded and depolymerized, the production of water requires that Hydrogen be available and consumed.

3.1.4. “Methane emission from ruminants not only causes serious environmental problems, but also represents a significant source of energy loss to animals. The increasing demand for sustainable animal production is driving researchers to explore proper strategies to mitigate ruminal methanogenesis. Since hydrogen is the primary substrate of ruminal methanogenesis, hydrogen metabolism and its associated microbiome in the rumen may closely relate to low- and high-methane phenotypes. Using candidate microbes that can compete with methanogens and redirect hydrogen away from methanogenesis as ruminal methane mitigants are promising avenues for methane mitigation, which can both prevent the adverse effects deriving from chemical additives such as toxicity and resistance, and increase the retention of feed energy.”

3.1.4.1. “Ruminal methane production: Associated microorganisms and the potential of applying hydrogen-utilizing bacteria for mitigation,” Wei Lan, Chunlei Yang, “Science of The Total Environment”, Volume 654, 1 March 2019, Pages 1270-1283, https://doi.org/10.1016/j.scitotenv.2018.11.180

4. “Microbial ecosystem and methanogenesis in ruminants,” D.P. Morgavi, E. Forano, C. Martin , C.J. Newbold, “Animal”, Volume 4, Issue 7, 2010, Pages 1024-1036, https://doi.org/10.1017/S1751731110000546

   4.1. “Ruminant production is under increased public scrutiny in terms of the importance of cattle and other ruminants as major producers of the greenhouse gas methane. Methanogenesis is performed by methanogenic archaea, a specialised group of microbes present in several anaerobic environments including the rumen. In the rumen, methanogens utilise predominantly H2 and CO2 as substrates to produce methane, filling an important functional niche in the ecosystem. However, in addition to methanogens, other microbes also have an influence on methane production either because they are involved in hydrogen (H2) metabolism or because they affect the numbers of methanogens or other members of the microbiota.”

5. “Invited review: Advances in nutrition and feed additives to mitigate enteric methane emissions,” A.N. Hristov, “Journal of Dairy Science”, Volume 107, Issue 7, July 2024, Pages 4129-4146, https://doi.org/10.3168/jds.2023-24440

   5.1. “Methane, both enteric and from manure management, is the most important greenhouse gas from ruminant livestock, and its mitigation can deliver substantial decreases in the carbon footprint of animal products and potentially contribute to climate change mitigation. Although choices may be limited, certain feeding-related practices can substantially decrease livestock enteric CH4 emission. These practices can be generally classified into 2 categories: diet manipulation and feed additives. Within the first category, selection of forages and increasing forage digestibility are likely to decrease enteric CH4 emission, but the size of the effect, relative to current forage practices in the United States dairy industry, is likely to be minimal to moderate."

5.2. "An opportunity also exists to decrease enteric CH4 emissions by increasing dietary starch concentration, but interventions have to be weighed against potential decreases in milk fat yield and farm profitability. A similar conclusion can be made about dietary lipids and oilseeds, which are proven to decrease CH4 emission but can also have a negative effect on rumen fermentation, feed intake, and milk production and composition."

5.3. "Sufficient and robust scientific evidence indicates that some feed additives, specifically the CH4 inhibitor 3-nitrooxypropanol, can substantially reduce CH4 emissions from dairy and beef cattle."

5.3.1. Studies show that "the CH4 inhibitor 3-nitrooxypropanol" is unnecessary as degraded and depolymerized lignin found in Sugarcane bagasse suppresses methane production.

6. Beyond Methane Sequestration

6.1. "White-rot Fungi Eat All the Components of the Wood They Decompose," Davinia Salvachúa Rodríguez, Environmental Molecular Sciences Laboratory, March 8, 2021." National Renewable Energy Laboratory, Golden, Colorado

6.1.1. "Lignin accounts for 30 percent of the organic carbon on Earth. Therefore, white-rot fungi—the most efficient lignin-degrading organisms—play a critical role in global carbon cycling. A longstanding belief was that white-rot fungi convert lignin to CO_2 and H_2O outside their cells to simply gain access to the plant cell wall sugars that compose cellulose. The current study overturns this decades-old dogma by demonstrating that white-rot fungi also incorporate carbon from lignin-derived compounds. Furthermore, this study establishes a foundation for employing white-rot fungi in biotechnological applications, such as lignin bioconversion into value-added products, which is a key step toward enabling a sustainable plant-based bioeconomy.

6.1.2. The team used these 13C-labeled chemicals as the carbon source in fungal cultures to track their utilization through the central metabolism of fungal cells. The team selected two species of white-rot fungi that use different mechanisms to degrade lignin and cellulose. Using this system, they discovered that the fungi converted the 13C-labeled aromatic compounds into amino acids, which are the main components of proteins.

6.1.3. Environmentalist suggest that the CO2 is used to cool the earth and then consumed by the flora, fauna, shrubs, and trees in a perfectly balanced ecological cycle."

7. Ranchers are reporting that manure produced by herds being fed SGP+™ literally disintegrates into dust, while enhancing grass production where the cows are grazing.

8. Lastly, in discussions with representatives leading the U.S.D.A, IFUS has been enthusiastically encourage to pursue grant money to further this research.

    8.1. The caveat has proven to be that from feedback provided directly from the U.S.D.A, that IFUS is presently more advanced than present grant programs allow for funding.
    8.2. Yet, IFUS' claims remain intact.

9. All of the aforementioned findings and studies point to at least a 20% reduction in overall carbon-load, with solid evidence that the impacts of beef and dairy herds being fed 80% SGP+™/SGP+™ as part of their overall ration mix may in fact be significantly greater than that.