Current Trends in Beverage Distiller's Grains Production and Value for the Beverage Alcohol Industry

May 16, 2018

Dr. Luke Adam

BeamSuntory Inc.

Important Concepts to Take Away with Regards to Beverage Distiller's Grains

Is beverage distiller's grains different from distiller's grains for fuel production? If so, how and why?

Do beverage distiller's grains vary from distillery to distillery? If so, why?

What are beverage distiller's doing or not doing to drive more value of their co-products?

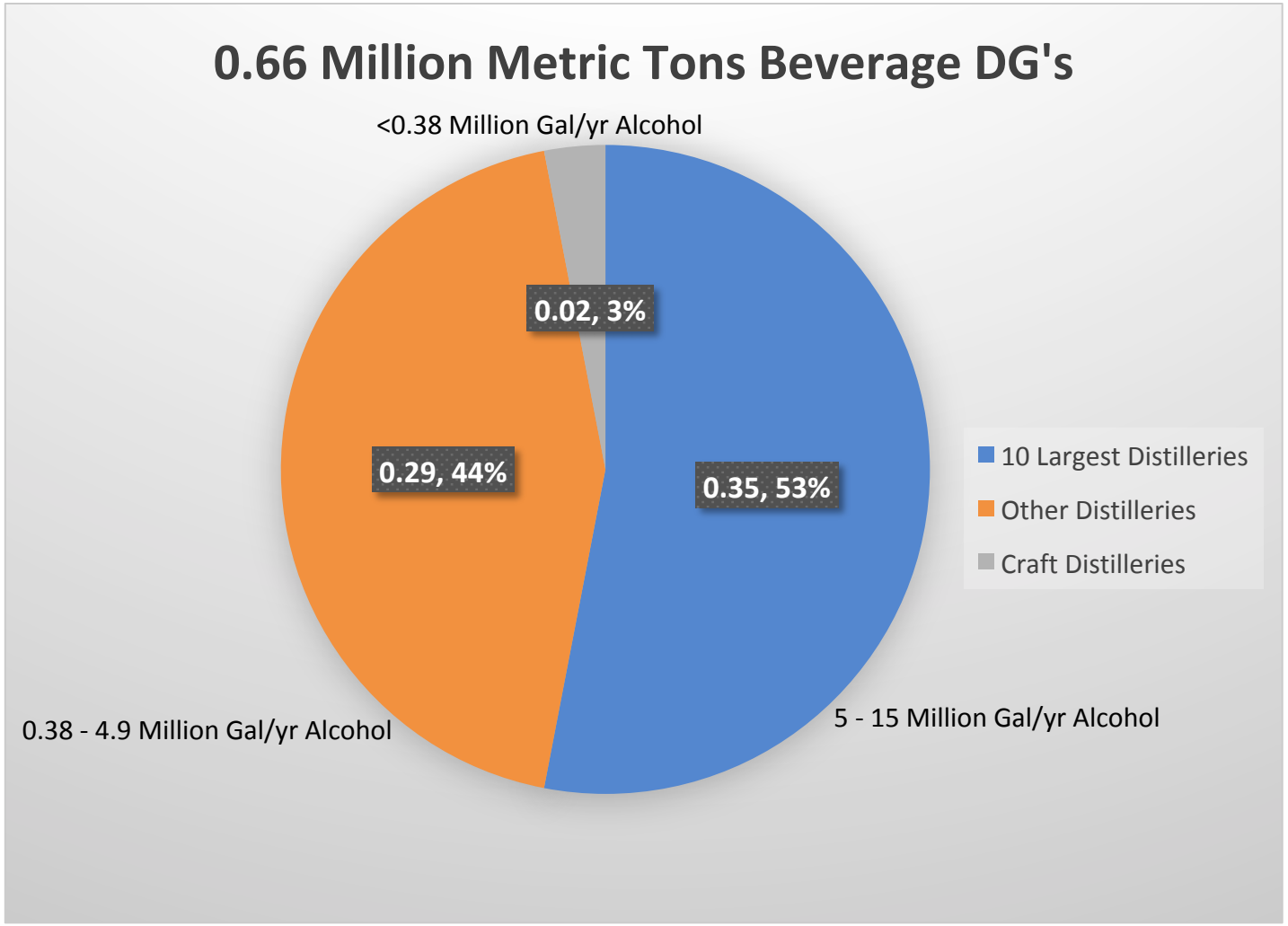
Overview

- Beverage Distiller’s Grains Production
- Comparison of Fuel and Beverage DDGS
- Survey of Large Beverage Distilleries
- Current Production Practices
- Challenges for Beverage Distiller’s Grains Value
- Options for Increasing Value
- Beverage Distiller’s Grains composition

Beverage Distiller's Grain Production

1.8% of total US Distiller's grains production

- Only 10 American whiskey distilleries produce 53% of the distilled spirits and DG's in the United States
- 8 of these are in KY where 95% of all bourbon is made.
- There are ~1600 craft distilleries <375,000 gal/yr. 92% of these are less than 5,000 gal alcohol/yr.



Comparison of Fuel and Beverage DG's

Fuel

- Goal #1: maximize ethanol yield
- Goal #2: optimize DG's value stream
- Raw Materials
  - Corn, enzymes, yeast
  - Municipal Water
- Additives
  - Antibiotics
  - Disinfectants
  - pH control Chemicals
  - sulfuric acid
- Significant portion of DDGS to the export market

Beverage

- Goal #1: create unique consistent appealing aroma and taste for human consumption
- Goal #2: do not let DG's interfere with beverage production and strive for break even COGS for DG's
- Raw Materials
  - Corn, rye, wheat, specialty grains, distiller's malted barley, proprietary yeast strains
  - Varied local/natural/purified water sources
- Additives – generally none
- Very little, if any, DDGS ends up in export market

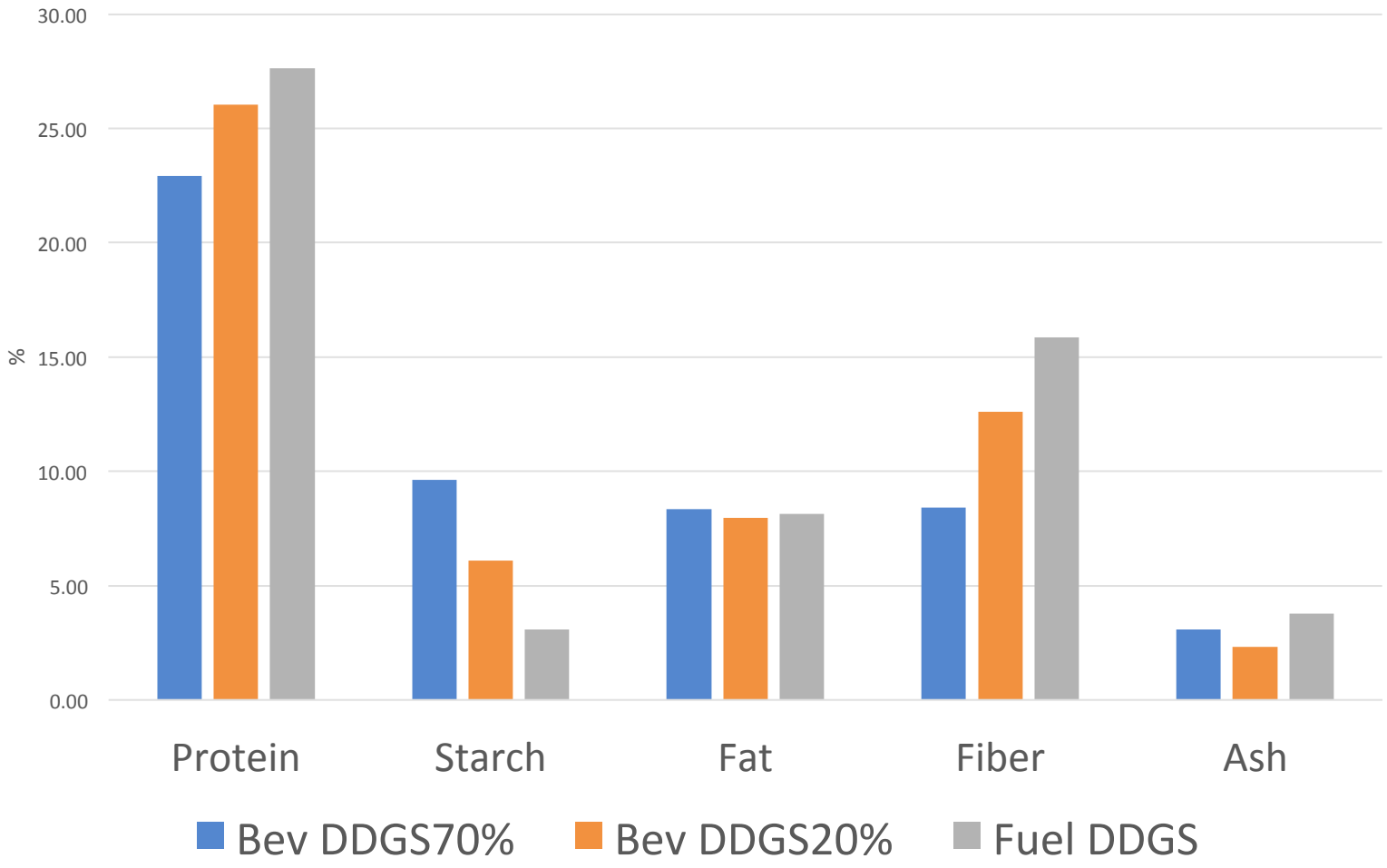
Comparison of Fuel and Beverage DG's *continued* – *Raw materials drive consistency and taste*

- Grains for beverage production are of highest quality in order to minimize detrimental off-notes that carry over into the distillate.
  - Geosmin, 2-methyl isoborneol, sulfides, aldehydes, phenols, acrolein….
- The (KY) limestone water source is historical, natural, protected, or at least processed on site to achieve the equivalent.
  - **Vital Yeast Nutrients**: Calcium and mineral rich to promote yeast health.
  - **Consistent pH Balanced fermentation**: Alkaline Limestone water balances the acidity of the set-back to create a highly buffered system capable of withstanding fluctuations in pH from batch to batch and resistance to pH change during fermentation.
- Impact on distiller's grain for beverage makers is:
  - unique product streams
  - lack of additives
  - low mycotoxin potential
  - lack of impurities for potential use as a human food ingredient.

What about actual compositional differences?

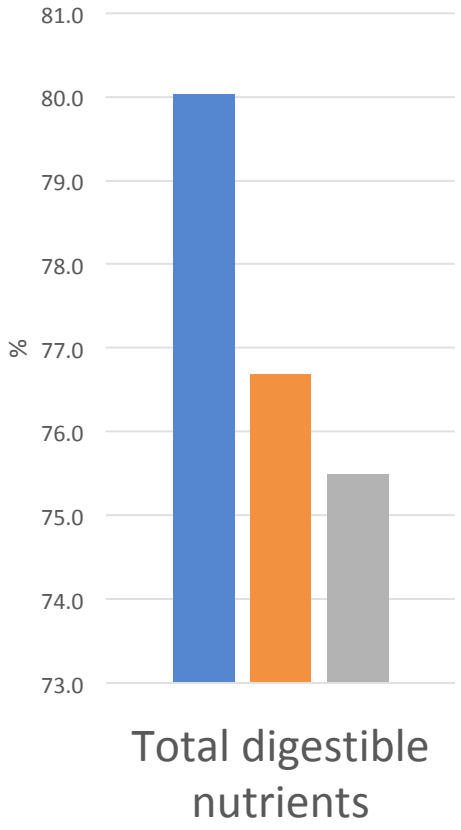
Comparison of Fuel and Beverage DG's Composition

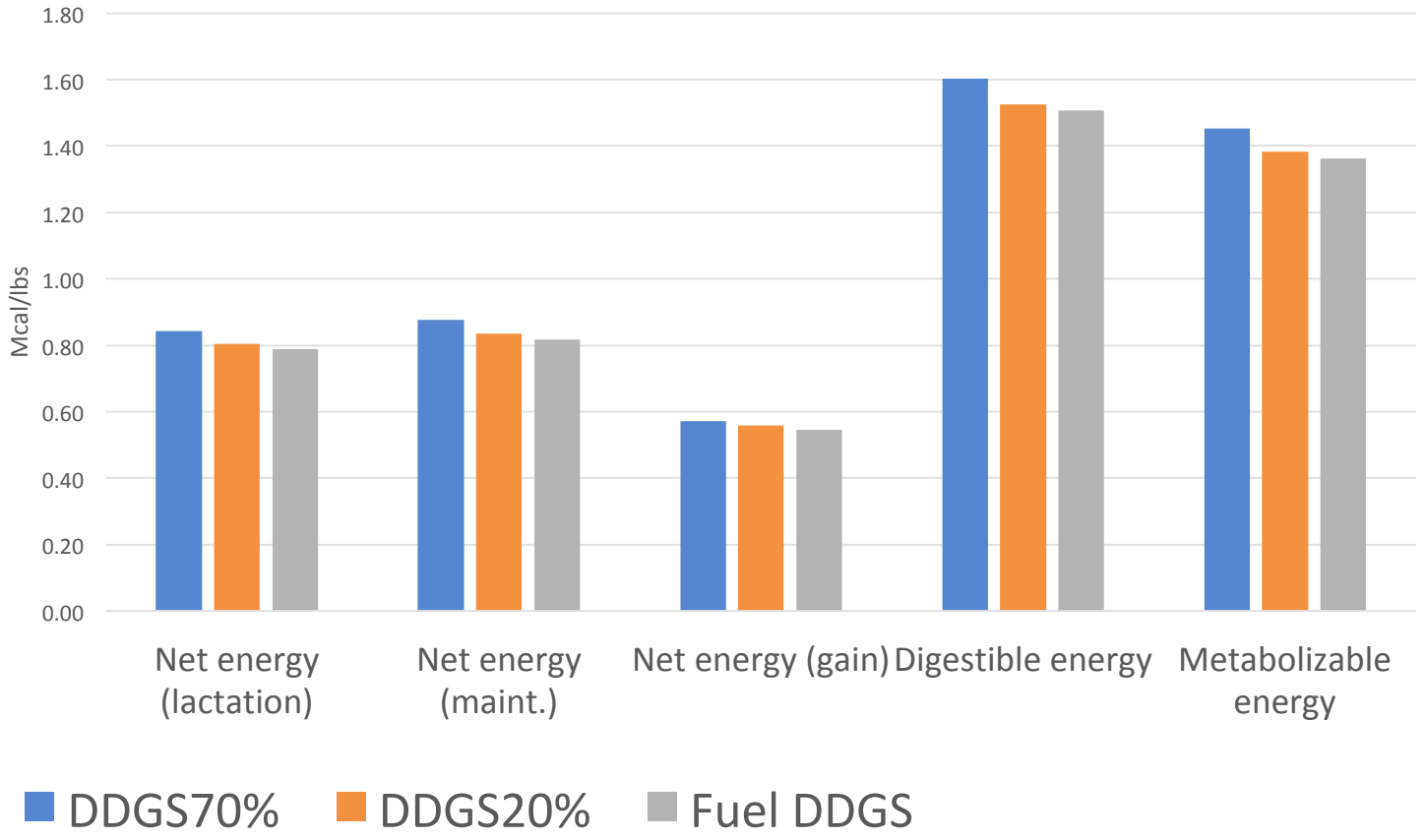
- Differences in common COA / Label Data
- Varies with amount of solubles added back to DDG
- Higher Bev DDGS starch results in lower protein and fiber (acid detergent)



Comparison of Fuel and Beverage DG's Composition

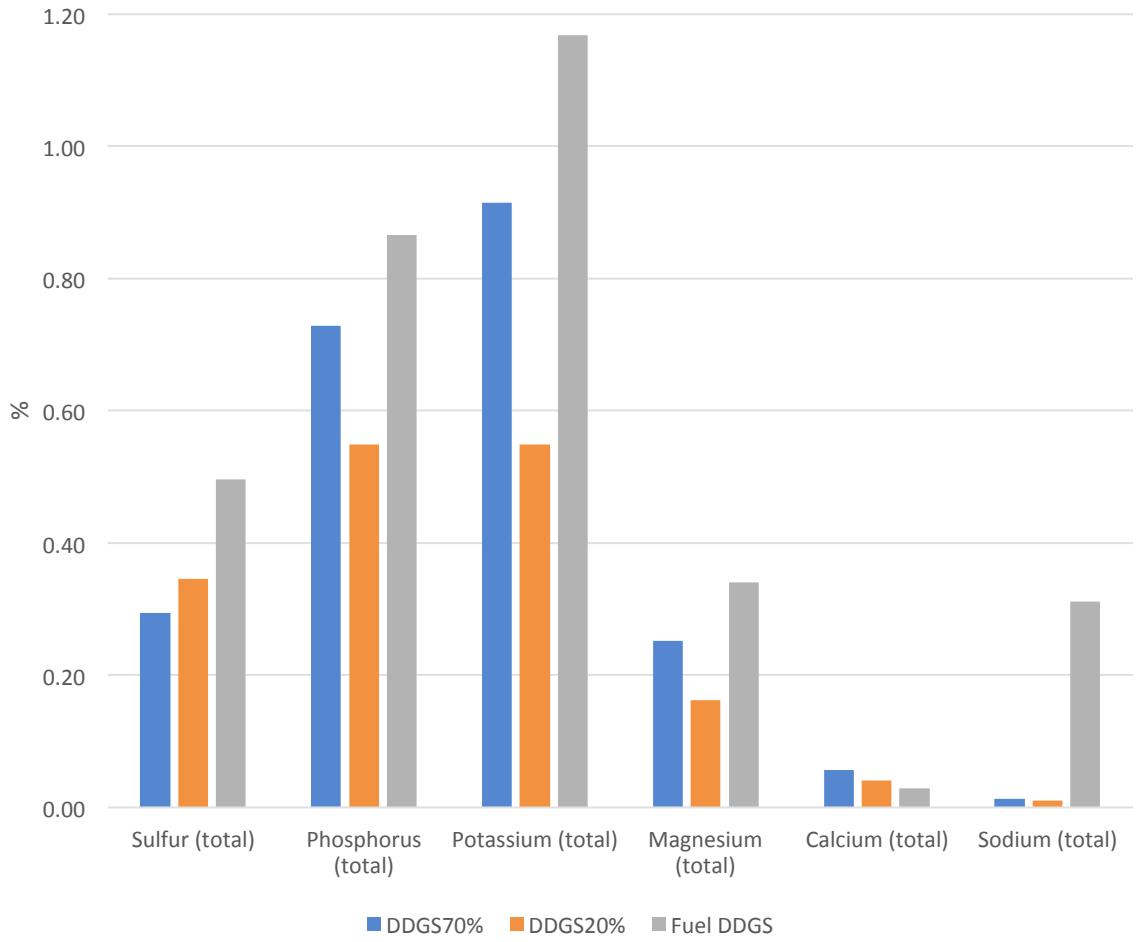
- Favorable Bev Nutritional values. Magnitude depends on amount of solubles present.

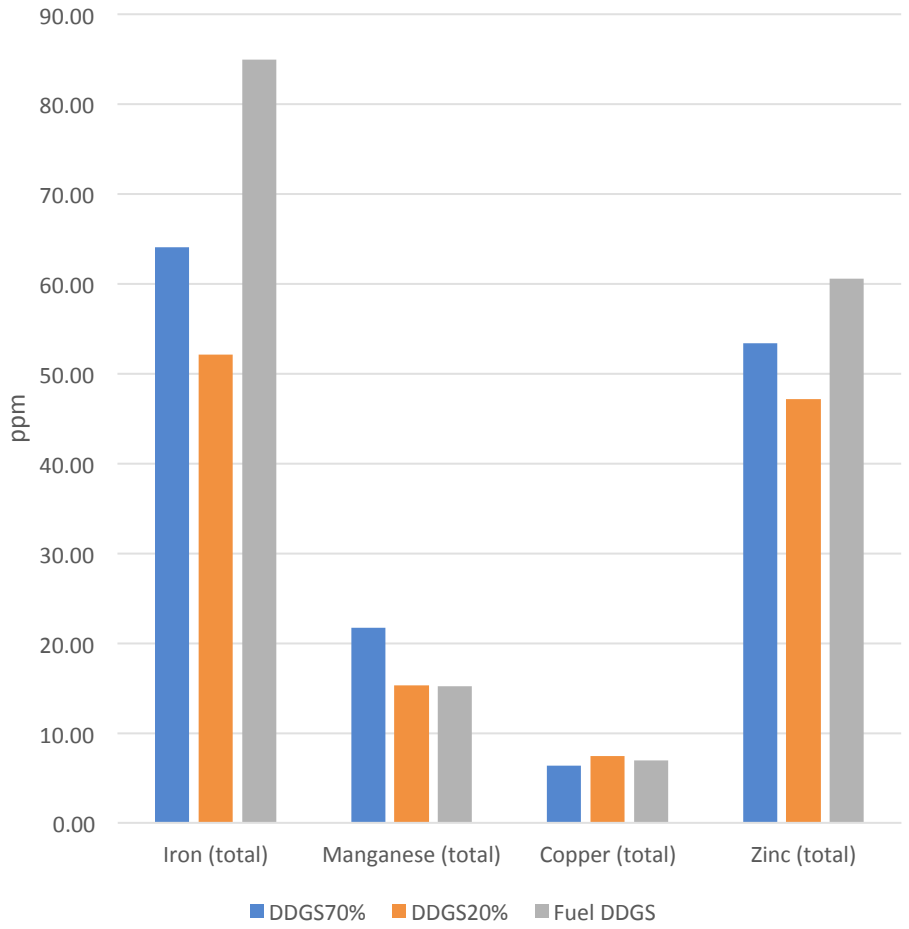




Comparison of Fuel and Beverage DG's Composition

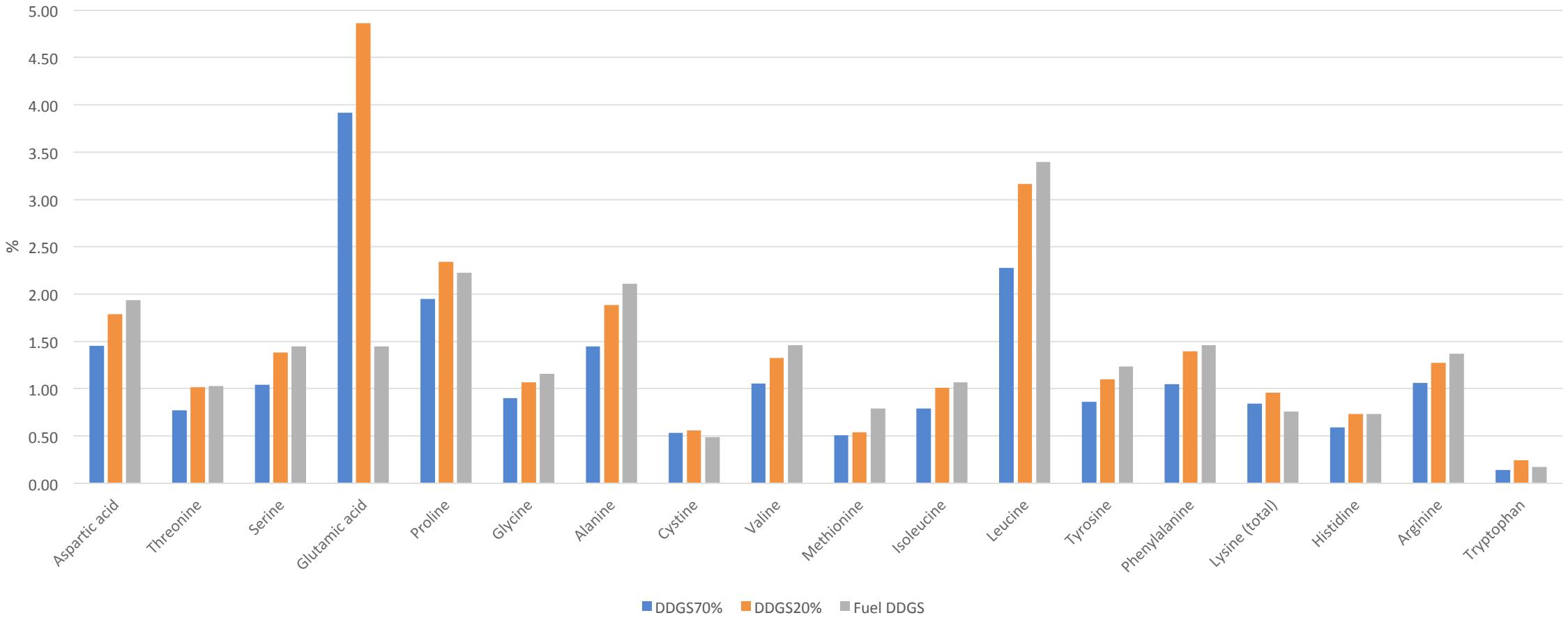
- Bev DDGS is lower in sulfur and most metals except for calcium and manganese





Comparison of Fuel and Beverage DG's Composition

- Bev DDGS is lower is several amino acids and higher in glutamic acid and slightly higher in lysine



Survey Results from 10 largest US whiskey producers

Current Practices and Activities	
9	centrifuge whole stillage (1 screen)
9	portion to DG out wet to farmers
7	syrup (condensed solubles) to farmers
6	wet cake to farmers
6	use dryer (4 rotary, 1 ring, 1 fluidized bed)
2	whole stillage to farmers
2	expanding dry houses
1	thin stillage to AD
1	thin stillage to land application
1	thin stillage to sewer
0	dry DDG with no syrup (condensed solubles)
0	send any portion to biotech

DG's impact to production Costs	
4	increase
4	neutral
1	decrease
1	no response

Most important Factor for DG's	
4	energy/utilities
3	farmer relationships
2	distillery expansion
2	brokers/transparency

Beverage DG's Current Production Practices

Production for Feed

- Current practices are based on:
  - Striving to build and sustain local farming communities
  - Composition varies significantly from plant to plant
  - Some plant have multiple value streams
- WDG and WDGS
  - Majority of plants sell all wet distiller's grains: all craft and small distilleries.
  - Relationship with farmers is key.
  - One of the largest distilleries uses an evaporator and puts the condensed soluble on the wet-cake and sells that product to the same farmers that deliver the corn.
- DDG and DDGS
  - Limited by drying capacity and DDGS price
  - Drying design in use vary: rotary drum, ring, fluidized bed, or other modified version of these

Non-Feed Alternatives

Land Application - Permit required, one plant utilizing
Landfill – In an emergency, landfill is an option that has been utilized
Aerobic Treat by municipality – Thin stillage only, expensive – one uses this option.
Anaerobic treatment – Methane production as potential secondary value stream – one in production

Challenges For Beverage Distiller's Grains

- Drying cost > DDGS value
- Older and undersized drying technologies, poor but expected yields, inconsistent pick up of wet or partially dried material
- Limited and inconsistent availability of farm animals
  - Beverage distiller's typically shut-down in the summer time
  - Many distilleries are in or near urban areas or farm and distant
- Permits for land application
  - No guarantee that permits will be given
  - Prior permitting is no assurance of future permits
  - Application closely monitored
- Odor issues, effluent violations, sewer costs
  - Aerobic solutions produce offensive odors
  - Effluent to surrounding streams is an issue in bad weather conditions
  - Discharge to sewer is expensive

Options for Increasing Value

- Marketing: low sulfur, no additives, no processing aids, high yeast content, build residual starch content into rations
- Human Food Ingredient - Move from animal feed only to include pet food, human food
  - ✓FMSA challenges and “by-product” mindset must be overcome
  - ✓Limited production volumes match up with more realistic potential production needs
- Fractionation - Isolate oil, fiber, protein, residual starch components
  - ❖Oil removal not in use by beverage alcohol facilities
  - ❖Must overcome reluctance to invest in unproven entrepreneurial processes
- Reduce Drying costs – Alternatives exist and being explored

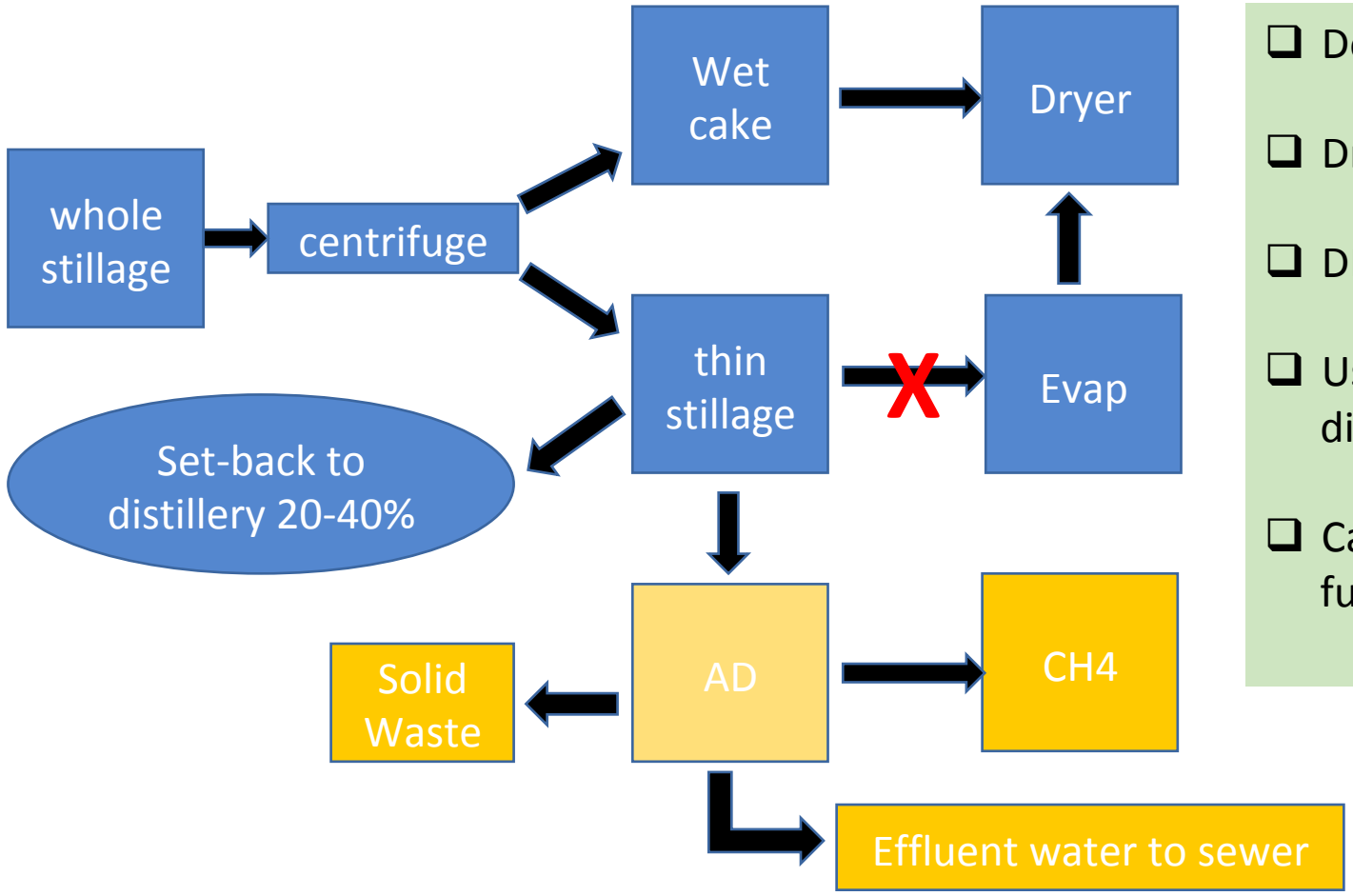
Options for Reduction of Drying Costs

- Promote WDG by Incentives and partnerships with Local farmers
  - Help farmers invest in their infrastructure and expansion plans
  - Expansion of use of evaporator syrup for feeding cattle and swine
  - Expansion of use of thin stillage for land application or other opportunities

- Shift Sales to DDG or DDG with less solubles with Thin Stillage Transformations Required
  - ❖**Wet cake contains 40% of the grain solids and 6% of the water**
  - ❖**Thin stillage contains 60% of the grain solids and 94% of the water**

Alternate Use for Thin Stillage – Anaerobic Digestion

- 94% of the energy to remove water is conserved to result in net profit center instead of break-even proposition or loss in some situations



- ❑ Do not return thin stillage to DDG
- ❑ Dry DDG without solubles
- ❑ DDG production reduced by 60%.
- ❑ Use thin stillage as feed source for anaerobic digestion
- ❑ Capture methane for use at local municipalities as fuel source or use internally to fuel boilers

Challenges to Anaerobic Digestion of Thin Stillage

- Technology acceptance
- High Capital Cost and slow rate of return
- Engineering controls for odor control – additional cost and complexity
- Maintaining microflora during shut-downs
  - Invest in cooling capacity and eliminate/shorten shut-down period
  - Alternate distillery shut-downs and reduce summary shutdown period
  - Bring in material from competitor distilleries
  - Introduce temporary alternative flora food sources
  - Regional facility, Co-Op, Manufacturer Sponsored
- Sludge removal, fate
- Effluent quality, fate

What about the impact on the DG's as a feed Source?

Composition of Typical Beverage DDG, Solubles, and DDGS

- Solubles stream contains elevated starch, Ash (minerals) and reduced protein, fiber, lysine.

	Common COA / Labelling Data	measured	measured	calculated	calculated	measured	
	Material Name	DDG	Solubles	DDGS70%	DDGS20%	DDGS20%	Units
Change	Dry Matter Basis	90	90	90	90	90	%
119.0%	Protein	27.31	16.87	22.94	26.06	26.03	%
99.0%	Fat	8.27	8.47	8.36	8.30	7.95	%
45.3%	Starch	4.35	16.94	9.62	5.86	6.10	%
169.2%	Fiber	14.24	0.33	8.42	12.58	12.61	%
116.3%	Lysine	0.98	0.65	0.84	0.94	0.96	%
56.3%	Ash	1.73	4.95	3.08	2.12	2.31	%

Nutritional and Energy Value Data of Typical Beverage DDG, solubles, and DDGS

- Similar nutritional and energy values regardless of whether solubles are included in the dried grains.

	Nutritional/Energy Values	measured	measured	calculated	calculated	measured	
change	Material Name	DDG	Solubles	DDGS70%	DDGS20%	DDGS20%	Units
97.3%	Total digestible nutrients	77.84	83.06	80.03	78.47	76.68	%
96.9%	Net energy (lactation)	0.82	0.88	0.84	0.82	0.80	Mcal/lbs
97.2%	Net energy (maint.)	0.85	0.91	0.88	0.86	0.83	Mcal/lbs
98.3%	Net energy (gain)	0.56	0.59	0.57	0.57	0.56	Mcal/lbs
97.4%	Digestible energy	1.56	1.66	1.60	1.57	1.53	Mcal/lbs
96.1%	Metabolizable energy	1.40	1.53	1.45	1.41	1.38	Mcal/lbs

Mineral Content Data of Typical Beverage DDG, solubles, and DDGS

- Reduced mineral content in absence of soluble is evident.

	Minerals	measured	measured	calculated	calculated	measured	
change	Material Name	DDG	Solubles	DDGS70%	DDGS20%	DDGS20%	Units
108.1%	Sulfur (total)	0.32	0.26	0.29	0.31	0.35	%
49.8%	Phosphorus (total)	0.36	1.24	0.73	0.47	0.55	%
25.8%	Potassium (total)	0.24	1.86	0.91	0.43	0.55	%
32.4%	Magnesium (total)	0.08	0.49	0.25	0.13	0.16	%
48.0%	Calcium (total)	0.03	0.10	0.06	0.04	0.04	%
-	Sodium (total)	0.00	0.03	0.01	0.00	0.01	%
68.0%	Iron (total)	43.6	92.5	64.0	49.4	52.1	ppm
42.6%	Manganese (total)	9.25	39.1	21.7	12.8	15.2	ppm
109.5%	Copper (total)	6.99	5.54	6.38	6.81	7.42	ppm
74.1%	Zinc (total)	39.6	72.6	53.4	43.5	47.2	ppm

Amino Acid Data of Typical Beverage DDG, solubles, and DDGS

- DDG without solubles contains a higher level of total amino acids

	Amino Acids	measured	measured	calculated	calculated	measured	
change	Material Name	DDG	Solubles	DDGS70%	DDGS20%	DDGS20%	Units
123.6%	Aspartic acid	1.80	0.98	1.45	1.70	1.79	%
129.4%	Threonine	1.00	0.46	0.77	0.93	1.02	%
124.7%	Serine	1.30	0.68	1.04	1.22	1.38	%
121.7%	Glutamic acid	4.76	2.74	3.92	4.52	4.86	%
111.8%	Proline	2.18	1.63	1.95	2.11	2.34	%
114.7%	Glycine	1.03	0.72	0.90	1.00	1.07	%
129.8%	Alanine	1.88	0.85	1.45	1.75	1.88	%
119.2%	Cystine	0.64	0.39	0.53	0.61	0.56	%
127.5%	Valine	1.34	0.65	1.05	1.26	1.32	%
116.4%	Methionine	0.59	0.39	0.51	0.57	0.54	%
130.5%	Isoleucine	1.03	0.46	0.79	0.97	1.01	%
140.0%	Leucine	3.18	1.01	2.27	2.92	3.16	%
128.4%	Tyrosine	1.11	0.52	0.86	1.04	1.10	%
131.7%	Phenylalanine	1.38	0.59	1.05	1.28	1.39	%
116.3%	Lysine (total)	0.98	0.65	0.84	0.94	0.96	%
124.4%	Histidine	0.73	0.39	0.59	0.69	0.73	%
121.2%	Arginine	1.29	0.75	1.06	1.22	1.27	%
155.2%	Tryptophan	0.22	0.03	0.14	0.20	0.24	%

Composition and Energy Value comparison Summary of Typical Beverage DDG and DDGS

- DDG contains more crude protein, fiber, similar nutritional and energy values, similar oil and sulfur, and reduced Ash (mineral) content.

DDG compared to DDGS
▪ 20% Increased crude protein and individual amino acids (16-55%)
▪ 97.2% of nutritional/energy values
▪ 56% of the Ash (mineral) content (50% P, 48% Ca, 32% Mg, 26% K)
▪ Large fiber increase from 8.4 - 14.2%
▪ Similar total fat and sulfur content

In Summary: Important Concepts to Take Away with Regards to Beverage Distiller's Grains

Multi Grain: The grains used are varied, very clean, select, and water is local, natural and each of these are important to final beverage taste and impacts distiller's grains composition.

Manufacturer Specific: Distiller's Grains product is different from each plant and can even vary from within the plant depending on the beverage being produced, yield/residual starch as well as the side streams being utilized.

Increasing co-product value: Through alternative processes like AD, beverage distiller's have an opportunity to have their co-product streams produce income for their facilities.

References

Distilled Spirits Council website; distilledspirits.org

Alcohol and Tobacco Tax and Trade Bureau website; TTB.gov

USDA ERS website; ERS.USDA.gov

Beam Suntory Beverage distiller’s 2018 survey

American Distilling Institute website; Distilling.com

MB Roland Distillery website; Mbroland.com

Beverage Industry website; Bevindustry.com

American Craft Spirits Association; personal communication