SUCCESSFUL USE OF A HIGH-PROTEIN CO-PRODUCT (Still Pro 50™) IN TURKEY POULT DIETS

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Who We Are

Fluid Quip Process Technologies, LLC (FQPT)® provides fully integrated custom technologies and services to dry-grind ethanol and biochemical facilities which include full plant design, process optimization studies, yield improvement technologies, new co-product technologies, and turnkey capital projects.

- 1.9 billion gallons per year of biofuels production using FQPT technologies
- Active projects and client support in the USA, Canada, South America and Europe
- 70+ industry leading pinch-point and de-bottlenecking projects
PROTEIN?
Successful use of a high-protein co-product for turkey poults

- Global protein demand for feed
- Production of a high-protein co-product
- Impact of high-protein co-product production on DDGS quality
- Successful use of a high-protein co-product in turkey poult starter feed
Global protein demand for feed
Is it correct to refer to the Dry Grind Ethanol plant?

An established global feed and energy industry

27 bill gallons ethanol
60 mill metric tons DDGS
20 mill metric tons PROTEIN

World soy meal 234 mill metric tons

DDGS global volume greater than rapeseed plus fishmeal
US feed industry has high demand for quality protein

USA 23.6 mill tonnes of compound feed

13 mill tonnes demands specialist protein (55%)
4 mill tonnes high conc and benign protein
Alternative sources of protein to replace animal protein
Focus on plant derived proteins

By 2025 fishmeal and other animal protein sources an exception in livestock diets

<table>
<thead>
<tr>
<th>Animal derived proteins</th>
<th>Market Concerns</th>
<th>Plant proteins</th>
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<tbody>
<tr>
<td>• Highly digestible</td>
<td>• Sustainability issues</td>
<td>• Safer alternative</td>
</tr>
<tr>
<td>• Ideal amino acid</td>
<td>• Political and public concern over safety</td>
<td>• Invariably cheaper</td>
</tr>
<tr>
<td>composition</td>
<td></td>
<td>• Less digestible</td>
</tr>
<tr>
<td>• Variation in composition</td>
<td></td>
<td>• Anti Nutritional Factors</td>
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<tr>
<td>• Biogenic amines products</td>
<td></td>
<td>• Products with improved digestibility</td>
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<tr>
<td>• History of use</td>
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Dioxin content
Bacterial contamination (Ecoli/Salmonella)
Viral issues (African Swine Fever)

Long term trend to replace animal derived proteins with plant protein
Alternative sources of protein to increase supply
Insects; Algae; Single cell proteins; Designer Crops (plant proteins) (Simm 2017)

**What constitutes commercially viable?**

### Nutritional
- Regulatory Compliant (safe and efficacious/ absence of ANF’s)
- Highly consistent quality
- Least cost formulation cost competitive
- Well suited to market demands

### Market
- Resilience in the supply chain
- Critical volume (>100K tons per annum)
- Established logistics
- Realistic return on investment
- Consumer acceptable
Soybean meal is not the ideal alternative protein supplement

- SBM has a dose dependent impact on gut microbiota
- High levels of SBM reduce lactic acid bacteria and increase levels of opportunistic pathogens
- High levels of SBM have negative impact on histology
- Possible contributory agent to enteritis

- SBM has a significant impact on gut morphology
- >10% SBM induced severe morphological changes
- Increased SBM levels reduced digestive enzyme capacity
- Possible causative agent of enteritis

Shuyan Miao 2018

Kroghdahl et al 2003
Fore and Against DDGS

**Fore**
- Volume
- Logistics
- Regulation
- Safety
- Discounted price
- Established feed adoption
- Location

**Against**
- Nutritional Composition
- Inconsistent quality
- Median value
- By-product reputation
- Discounted price
- Imperfect feed
- Limited feed application
- Energetically expensive production

*Strong incentive to do better*
MSC™ process
Commercial alternative protein SP 50

A high (50%) protein product derived from bioethanol stillage

- Corn gluten proteins plus post fermentation yeast (25%)
  - Growth-promoting and immunomodulatory properties
- Applications in neonate and aquaculture nutrition
- Commercial tons growing (300K tons in 2019)
- High consistency within and between plants

(SP 50: Sill Pro 50™)
Fermentation generates yeast in producing ethanol

An operational bioethanol plant produces ~8k tons spent yeast / annum

0.7M gal
1000 tons
grain

~39 tons yeast
per fermentation

275 tons DDGS:
31% protein
85 tons protein

⅓ EtOH
⅓ DDGS
⅓ CO₂

20% of DDGS protein is yeast protein*
~16.5 t yeast protein (39 tons yeast)

*Han and Liu 2010
SP 50™ contains yeast cell wall and cell content material

Yeast
- Appetite stimulant – high glutamic acid content
- As a probiotic – modulation of gut microbiota, improved innate immunity, improved disease resistance, improved growth performance

Yeast β-glucan
- Improved innate immunity, improved disease resistance, improved growth performance.

Yeast MOS

Yeast nucleotides
- Modulation of gut microbiota, improved innate immunity, improved disease resistance, improved growth, improved gut morphology and immunity, improved mucus production

Vitamins & Minerals
- B group vitamins; yeast biocomplexed minerals
$ value of residual DDGS is key

Proximate composition of DDGS pre and post MSC™ installation

Improved consistency of DDGS product (30%)
Pre and Post MSC\textsuperscript{TM} the nutrient composition of DDGS remains very similar
Post MSC™ gentle drying improves protein value

The MSC process impact on DDGS

- MSC Process recovers protein, fiber (NSP) and oil
  - Removal of fiber/fat/protein concentrates remaining nutrients
- ProFat 1.3 unit drop
- Increased number of control points
  - Significantly improved product consistency – 30% improvement
- Reduced (30%) dryer loading
  - Higher digestibility of amino acids
Feeding trial summary
Summary FQPT feeding trials with Still Pro 50™
In total 29 trials completed with partner organizations
**Comprehensive portfolio of trials demonstrates efficacy**

<table>
<thead>
<tr>
<th>Trial Title</th>
<th>Centre and trials leader</th>
<th>Results</th>
</tr>
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<tr>
<td>Analytical data</td>
<td>Prof P. Williams</td>
<td>49% protein</td>
</tr>
<tr>
<td>Ileal digestibility of SP 50 and standard DDGS</td>
<td>Univ of Illinois: Prof C. Parsons</td>
<td>89% ileal protein digestibility</td>
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<td>Effect of SP 50 on broiler performance</td>
<td>Colorado Quality Research CQR</td>
<td>5% inclusion of SP50</td>
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<tr>
<td>Swine digestibility of SP 50</td>
<td>Univ of Illinois: Prof H. Stein</td>
<td>Standardised ID of aa 77.1%</td>
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<td>Fishmeal replacement with SP 50 for young swine</td>
<td>Univ of Illinois: Prof H. Stein</td>
<td>Partial replacement of FM</td>
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<td>Replacement of SPC with Still Pro50 in trout diets</td>
<td>University of Idaho: Prof R. Hardy</td>
<td>Replacement of soya isolate</td>
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<td>Still Pro50 as a protein supplement for shrimp and Tilapia</td>
<td>Univ of Auburn: Prof A Davis</td>
<td>15% inclusion of SP50</td>
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<td>Evaluation of SP 50 as a ruminal protein</td>
<td>Cumberland labs</td>
<td>74% RUP</td>
</tr>
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<td>Comparison of SP 50 with commercial RPAA in gas test</td>
<td>Univ of Nottingham: Dr J. Margerison</td>
<td>Equivalent to market leader</td>
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<tr>
<td>Measurement of yeast content in SP 50</td>
<td>Englyst carbohydrates: Dr K. Englyst</td>
<td>24% yeast in DM</td>
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<tr>
<td>Available lysine in SP 50 (Carpenter Lysine)</td>
<td>Sciantec: Prof P. Williams</td>
<td>Average available lysine 98%</td>
</tr>
<tr>
<td>SP 50 Protein supplement for turkey poults</td>
<td>Univ Nottingham Trent: Dr E. Burton</td>
<td>Improved N &amp; R retention</td>
</tr>
<tr>
<td>SP50 Protein supplement for Atlantic salmon</td>
<td>CATC New Brunswick Canada</td>
<td>Pending</td>
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<tr>
<td>Impact of MSC on DDGS quality</td>
<td>FQT data</td>
<td>Improved DDGS quality</td>
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Replacement of soybean meal with Still Pro 50™

Diet formulation for turkey poults

Dietary inclusion of SP50™ reduced the soybean inclusion by 11%
Replaced a soy protein isolate in Premium diet

University of Nottingham Trent UK

<table>
<thead>
<tr>
<th>Period</th>
<th>Starter 0-21</th>
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<th>Grower 21-42</th>
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<tr>
<td></td>
<td>Control</td>
<td>SP50 4%</td>
<td>SP50 8%</td>
<td>Premium</td>
<td>Control</td>
<td>SP50 4%</td>
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<tr>
<td>Still Pro 50</td>
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<td>Soy isolate</td>
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<td>5.0</td>
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<tr>
<td>HIPRO</td>
<td>47.3</td>
<td>44.6</td>
<td>41.9</td>
<td>41.1</td>
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<tr>
<td>SOYAMEAL</td>
<td>37.7</td>
<td>36.6</td>
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<td>39.3</td>
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<td>TG MAIZE</td>
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<td>3.0</td>
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<tr>
<td>HI-PRO</td>
<td>27.6</td>
<td>28.2</td>
<td>28.8</td>
<td>27.6</td>
<td>24.9</td>
<td>25.5</td>
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<tr>
<td>PROTEIN</td>
<td>11.9</td>
<td>11.9</td>
<td>11.9</td>
<td>11.9</td>
<td>12.2</td>
<td>12.2</td>
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<tr>
<td>ME MJ/kg</td>
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Application of Still Pro 50™ in neonates

Replacement of 15% soy protein with SP 50™ resulted in 6% increase in growth of turkey poults

Improvements in nitrogen and energy retention
Application of Still Pro 50™ in aquaculture

SP50™ replacement of 16% soy protein concentrate in juvenile trout diets

Tendency for SP50™ to outperform controls
Countering soy-induced enteritis?

- Mean weight gain (%)
- Survival (%)
- Feed consumed (g/fish)
- Weight gain (g/fish)
- Final weight (g/fish)
- Condition factor
- Protein efficiency ratio (PER)
- Feed conversion ratio
- Daily feed consumption (%...)
- Daily growth index (DGI, g1/3/d)
- Specific growth rate (SGR, %/d)

R. Hardy: Aquaculture Research Institute
U of Idaho
Conclusions: A commercial protein supplement for turkey poults from dry grind corn ethanol processing

- SP 50™ high density protein meal separated from whole stillage
- A suitable protein supplement in starter diets (turkey poult, aqua etc.)
- BW gain and N retention improved by replacing 15% of soybean dietary N with SP 50™
- Partial replacement of soybean meal;
  - Reduced exposure to soya antigenic factors
  - Reduced intestinal inflammation
  - A positive change in gut architecture
  - Changed gut microbiota to a more positive microbiome
- Significant growth and health benefits from SP 50™ inclusion
A paradigm shift in nutrition strategy for feed and food

Feeding the high performing Olympic athlete

Whole grains based feed
Traditional feed formulation
Minimal raw material complexity
Strong regional identity

Designer Feeds
Functional ingredient based feeds
Target functional characteristics
Complex raw material matrix
No regional identity

Increase in production cost requires economies of scale
More complex diets are more profitable

Simple grain processing to accommodate mixing
Pelleting to eliminate selection
20 – 25% protein

High tech/fractionation/extrusion/
conditioning/isolates/
enzymes/pre-digestion/coating
Nutrient dense: 40-80% protein
DEMAND high quality nutrients SP 50™

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pwilliams@fluidquiptechnologies.com