What We Know About Feeding Liquid By-Products to Pigs

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Introduction

 Liquid feeding systems have been used for many years in Europe

Increasing in popularity in North America

- record high feed ingredient prices
- increased availability of liquid by-products from biofuels production



Benefits of Liquid Feeding vs. Dry Feeding

- □ Improved nutrient utilization (Jensen and Mikkelsen, 1998)
- Utilize inexpensive liquid by-products (Canibe and Jensen, 2003)
- Reduce environmental impact (Brooks et al., 2001)
- □ Improve animal performance (Lawlor et al., 2002)
- Enhance gut health (Brooks et al., 2001)
- Reduce the need for feed medications (Canibe and Jensen, 2003)
- □ Improve animal well-being (Canibe and Jensen, 2003)



Consistency of by-product supply

- Premixes and supplements are custom formulated for specific by-products being used
- Switching between some by-products may reduce growth performance due to a need for adaptation of the digestive system



High water content of liquid by-products

- Difficult to transport long distances due to cost
- Increases manure volume and humidity in facilities



Variability in nutrient content

 Need for frequent sampling and nutrient analysis to adjust formulations

Obtain certificates of quality from supplier(s)

High salt content of some by-products

- Can be as high as 10% in liquid whey and bakery by-products
- Provide ad libitum access to water to avoid salt toxicity
- Cause more rapid deterioration of concrete floors and steel equipment



Loss of synthetic amino acids

Can occur during storage of fermented liquid feed

• To minimize losses:

- Add after stable fermentation is achieved
- Add to liquid feed > 75 mMol lactic acid
- Add to liquid feed with pH < 4.5</p>

Homogeneity of mixed feed

- Minerals can separate from the rest of the feed mixture
- Less of a problem
 - Using modern feeding equipment
 - Using higher viscosity liquid by-products
 - Condensed distillers solubles
 - □ Steep water



Common By-Products Used in Liquid Feeding Systems

Liquid whey

- Highly digestible protein and energy source
- High dietary levels can cause digestive upset in older pigs
- High salt content

Buttermilk

- □ High protein (30-35%)
- □ High energy (5-6% fat)

Common By-Products Used in Liquid Feeding Systems

- Bakery waste
 - Bread
 - High in energy
 - May require special handling equipment to remove wrappers
 - Limit to < 30% of dry matter intake</p>
 - Cookies and crackers
 - High in energy (fat and sugars)
 - Salt content can be high in chips and crackers
- Sugar syrup
 - High energy but devoid of other essential nutrients
 - □ Limit to 5% of the diet to avoid digestive upsets

Common By-Products Used in Liquid Feeding Systems

- Brewer's wet yeast
 - High quality, highly digestible protein source
 - Added to diet at 2-5%
 - Can replace up to 80% of protein if economical
 - Contains active yeast
 - Add organic acids to kill yeast and lower pH before shipping to pig farm
 - Prevents further fermentation and frothing
 - Contains enzymes and co-factors which benefit pig health and performance
 - Can cause diarrhea in nursing pigs when fed to lactating sows

Liquid By-Products from the Ethanol Industry

- Condensed distiller's solubles
- Steep water





Comparison of the Nutrient Content of Corn Condensed Solubles and Corn Steep Water (100% Dry Matter Basis)





Nutritional composition of fresh and stored corn CDS samples collected on commercial pig farms in Ontario Canada (100 % dry matter basis, Braun and de Lange, 2004).

Nutrient	Fresh CDS	Stored CDS*	
No. samples	5	5	
Dry matter, %	30.5 (29.7-31.1)	27.2 (22.5-31.2)	
Crude protein, %	22.3 (20.8-24.1)	25.2 (23.5-27.8)	
Crude fat, %	18.9 (17.4-20.9)	22.4 (20.7-23.7)	
Ash, %	8.4 (7.8-9.1)	10.0 (9.0-11.8)	
Ca, %	0.04 (0.02-0.06)	0.06 (0.04-0.07)	
P, %	1.43 (1.25-1.58)	1.64 (1.47-1.85)	
Na, %	0.21 (0.15-0.27)	0.21 (0.18-0.25)	

*CDS stored on-farm without additives for > 1 day

Nutritional composition of fresh and stored corn CDS samples collected on commercial pig farms in Ontario Canada (100 % dry matter basis, Braun and de Lange, 2004).

Nutrient	Fresh CDS	Stored CDS*	
рН	3.7 (3.5-3.9)	3.5 (3.4-3.6)	
Acetic acid, %	0.11 (0.08-0.13)	1.66 (0.32-4.53)	
Propionic acid, %	0.63 (0.50-0.76)	0.88 (0.69-1.33)	
Butyric acid, %	0.01 (0.01-0.01)	0.01 (0.01-0.01)	
Lactic acid, %	9.8	15.4	
Total NSP, %	6.1 (5.9-6.3)	5.5 (3.5-6.7)	
Starch, %	9.9 (7.7-12.2)	6.8 (5.1-7.9)	
Total sugars, %	3.5 (3.2-4.0)	1.2 (0-2.7)	

*CDS stored on-farm without additives for > 1 day

Nutrient digestibility of pigs fed liquid diets containing corn and soybean meal with either non-fermented or fermented CDS at 15% dry matter (de Lange, 2006).

	Control	Non-fermented CDS	Fermented CDS
No. pens	6	6	6
Initial body wt, kg	23.5	23.3	23.4
Energy digestibility, %	81.6 ^{ab}	82.5 ^a	79.9 ^b
Protein digestibility, %	72.5 ^a	73.2 ^a	69.3 ^b
Fat digestibility, %	80.9 ^b	85.4 ^a	85.4 ^a

^{a,b} Means within rows with different superscripts differ (P < 0.05).



Growth performance of pigs fed liquid diets containing corn and soybean meal with either non-fermented or fermented CDS at 15% dry matter (de Lange, 2006).

	Control	Non-fermented CDS	Fermented CDS
No. pens	6	6	6
Initial body wt, kg	23.5	23.3	23.4
Final body wt, kg	50.1 ^a	47.5 ^b	48.6 ^{ab}
ADG, g/d	952 ^a	858 ^b	898 ^{ab}
ADFI, kg/d	1.62 ^a	1.49 ^b	1.61 ^a
F/G	1.70	1.73	1.80

^{a, b} Means within rows with different superscripts differ (P < 0.05).

Carcass characteristics of pigs fed liquid diets containing corn and soybean meal with either non-fermented CDS at 15% dry matter (de Lange, 2006).

	Control	Non-fermented CDS
Final body wt, kg	50.1 ^a	47.5 ^b
Carcass dressing, %	82.1	82.6
Backfat depth, mm	16.6	17.1
Loin depth, mm	54.3	53.7
Carcass lean yield, kg	61.1	60.9
Loin pH	5.74 ^a	5.80 ^b
Loin drip loss, %	9.63	8.83

^{a, b} Means within rows with different superscripts differ (P < 0.05).

Growth performance of pigs fed liquid diets containing increasing levels of phytase treated steep water (SW; de Lange, 2006).

	0% SW	7.5% SW	15% SW	22.5 % SW
No. of pens	4	4	4	4
Initial body wt., kg	69.1	68.8	68.8	69.3
Final body wt., kg	108.3	104.6	107.7	103.1
ADG, g/d	1191 ^a	1080 ^a	1063 ^a	899 ^b
ADFI, kg/d	2.76 ^a	2.49 ^{ab}	2.58 ^{ab}	2.29 ^b
F/G	2.33 ^a	2.30 ^a	2.42 ^{ab}	2.55 ^b

^{a,b} Means within rows with different superscripts differ (P < 0.05).

Carcass characteristics of pigs fed liquid diets containing increasing levels of phytase treated steep water (SW; de Lange, 2006).

	0% SW	7.5% SW	15% SW	22.5 % SW
No. of pens	4	4	4	4
Final body wt., kg	108.3	104.6	107.7	103.1
Carcass wt., kg	86.3	82.7	83.4	80.5
Loin depth, mm	58.2	58.9	56.4	58.3
Backfat depth, mm	18.1	18.7	18.0	17.1
Lean yield, %	60.3	60.3	60.5	60.1

^{a,b} Means within rows with different superscripts differ (P < 0.05).

