What's New With Feed Additives For Dairy Cows

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Rumensin

- Improved feed conversion
- Reduced ketosis
- Targeted dosage about 350 mg/cow/d
- Relatively low cost feed additive
- Reduced SARA?
- Milk fat test issues trans-FA related

Dietary Bicarbonate Buffers

- Neutralize diet & ruminal acidity
- Reduce post-feeding decline in ruminal pH
- Reduce ruminal pH fluctuation
- 0.75% - 1.0% of diet DM
- SARA does not ↑ free-choice intake
  (Keunen et al., 2003, JDS)

•K-carbonate can partially replace Na-bicarbonate if DCAD testing & formulating for lactating cow diets

•Neither ingredient should be fed to dry cows

Yeast

Desnoyers et al., 2009 JDS

- Meta-analysis of Yeast trial data
  - 110 papers, 157 trials, 376 treatments, > 50% were Alltech Yeast trials
    - 0.3 kg/d greater DMI for +Y
    - 0.7 kg/d greater Milk Yield for +Y
    - Greater total tract OM digestibility

Yeast

Adapted from Fetrow 2009 4-State Conf.

- From meta-analysis of DV Yeast trials (60 papers) & Type I/Type II Error Analysis
  - 84% likelihood of a breakeven response
    - $0.16/cow/d profit if used
  - 16% likelihood of a non-breakeven response
    - $0.01/cow/d loss if used

Direct-Fed Microbials

Recent application

- Targeted for enhancing ruminal lactate utilization
- Relatively high-cost feed additives
- Most research with feedlot type diets
- Acute acidosis or SARA?
- Nocek et al., 2002, JDS—specific DFM dose reduced diurnal pH variation
- More controlled research needed with SARA in dairy cows

Complexed Traces & Hoof Health

Reference	Source	Response
Moore et al., 1989 JDS abstr.	ZinPro®	Improved Hoof Disorder Scores
Nocek et al., 2000 JDS	4-Plex®	Improved Hoof Disorder Scores
Ballantine et al., 2002 PAS	4-Plex®	Improved Hoof Disorder Scores

Production effects?
Reproductive effects?
Mastitis effects?

Rumen-Protected Amino Acids

- Too expensive to use as feed additive in a shot gun approach
- Use should be in conjunction with AA model

Dry Cow DCAD Products

- Use of Straw/Corn Silage dry cow diets has made the discussion of these products a bit academic

Niacin

- Schwab et al., 2005 PAS Meta-Analysis
  - 6 g/cow/d unprotected-NA ineffective
  - Unfavorable economic response to 12 g/cow/d unprotected-NA
- Extensive ruminal degradation—if supplemented must be ruminally protected
- More research needed with RP-NA products
- Effective dose to reduce NEFA is high and not well established & NEFA rebound occurs if cow goes off feed—NA not recommended for preventing fatty liver/ketosis (Grummer, 2009 4-State Conf.)

Choline

- Extensive ruminal degradation—if supplemented must be ruminally protected
- RP-Choline may prevent & alleviate fatty liver and reduce ketosis (Grummer, 2009 4-State Conf.)
- RP-Choline may increase milk yield and fat%, but responses are variable
- Supplementing transition cow diets with RP-Choline increases milk and FCM yields

(Grummer, 2009 4-State Conf.)

Biotin

- Improvements in hoof health at 20 mg/cow/d
  - Reduced WLS (Midla et al., 1998; Hedges et al., 2001)
  - Improved locomotion scores (Fitzgerald et al., 2000)
  - Reduced sole ulcers (Bergsten et al., 2003)
- Increased milk yield
  - +6.2 lb/d early lactation (Zimmerly & Weiss, 2001)
  - +3.7 lb/d mid lactation (Majee et al., 2003)
  - +4.3 lbs/d average across all studies
- Rumen-protection appears unnecessary

Supplemental Biotin - Economics

	Gross Milk Revenues	Feed Cost
Early Lactation Zimmerly & Weiss, 2001	+0.62/cow/d	+0.28/cow/d
Mid Lactation Majee et al., 2003	+0.39/cow/d	+0.21/cow/d
Low Production Ferreira et al., 2005 JDS abstr	+$0.15/cow/d	+$0.13/cow/d

Better hoof health may be added benefit

- Assumed $10/cwt milk price
- Feed cost included costs of biotin and increased DMI

Essential Oils

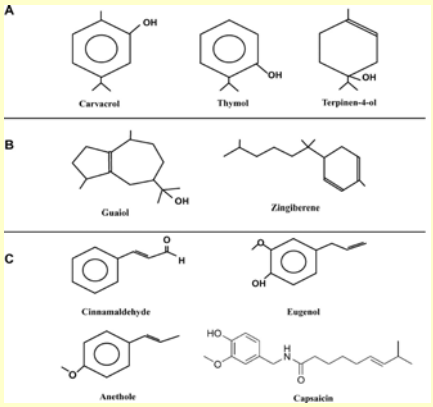
- Volatile aromatic compounds with oily appearance extracted from plant materials typically by steam distillation
- Alcohol, ester or aldehyde derivatives of phenylproponoids and terpenoids
- Anti-microbial activity
- Modify rumen microbial fermentation

Source: Newbold et al., 2006 & Calsamiglia et al., 2007

Some Common Essential Oils

Compound	Source
Thymol	Thyme, Oregano
Eugenol	Clove
Pinene	Juniper
Limonene	Dill
Cinnamaldehyde	Cinnamon
Capsaicin	Hot Peppers
Terpinene	Tea Tree
Allicin	Garlic
Anethol	Anise

Source: Newbold et al., 2006 & Calsamiglia et al., 2007



Source: Calsamiglia et al., JDS, 2007

Essential Oils as Modifiers of Rumen Microbial Fermentation

- Calsamiglia et al. (JDS; 2007) from extensive review of in vitro, in situ & continuous culture based literature concluded the following:
  - Inhibition of deamination & methanogenesis
    - Lower ammonia-N, methane & acetate concentrations
    - Higher propionate & butyrate concentrations
  - Effects may vary depending on the specific EO or combination of EO supplemented
  - Effects of some EO are pH & diet dependent

CRINA RUMINANTS

- Mixture of natural & synthesized essential oils including:
  - Thymol
  - Eugenol
  - Vanillin
  - Guaiacol
  - Limonene

Tassoul & Shaver Meta Analysis

- Data from 8 published trials
- MIXED procedure of SAS
  - Fixed effect of EO & Random effect of Trial
  - Each response weighted according to number of cows used to test for it using the WEIGHT statement
  - St. Pierre, 2001, JDS

Tassoul & Shaver Meta Analysis

LS Means	Control	EO	P<
DMI, kg/d	22.3	22.4	NS
Milk, kg/d	36.7	37.9	0.01
Milk/DMI	1.64	1.67	NS

Tassoul & Shaver Meta Analysis

LS Means	Control	EO	P<
Fat, %	3.68	3.71	NS
kg/d	1.35	1.41	0.01
Protein, %	3.00	3.02	NS
kg/d	1.10	1.15	0.04

Calculated Income Minus Feed Cost Using Meta Analysis Average Responses

Milk	1.2 kg/d @ $0.22-$0.44/kg	$0.26-$0.53
DMI & EO	0.1 kg/d @ $0.22/kg	-$0.09
Income Minus Feed Cost/cow/day		$0.17-$0.44

Pancosma

- Xtract™ Dairy-Mixture of synthesized & encapsulated essential oils including:
  - Cinnamaldehyde
  - Eugenol

Bravo & Doane Meta Analysis

2008 JDS abstract

- Data from 16 unpublished trials
- Pancosma Xtract™ Dairy-eugenol and cinnamaldehyde
- MIXED Model
  - Fixed effect of EO & Random effect of Trial

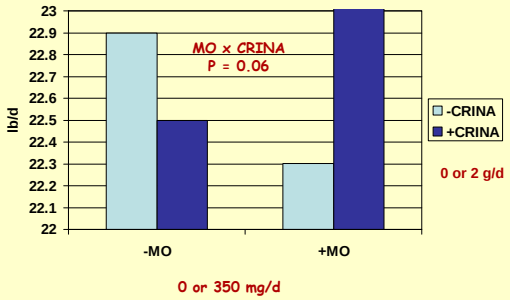
Bravo & Doane Meta Analysis

2008 JDS abstract; updated data from ADSA/ASAS Breakfast seminar by Bravo

LS Means	Control	EO	P<
DMI, kg/d	21.2	22.4	0.001
Milk, kg/d	34.5	35.4	0.004
Fat, %	3.66	3.60	0.10
kg/d	1.26	1.27	NS
Protein, %	3.04	3.00	NS
kg/d	1.07	1.09	0.08

Effect of Monensin & CRINA on DMI

Benchaar et al., 2006, JDS 89:4352-4364



Conclusions

- EO influenced lactation performance
- Cost of EO & magnitude of lactation responses show potential for positive economic returns
- Benefits as an additive for transition cows were not observed in UW-Madison trial
- Research on mode of action for improved feed efficiency in UW-Madison trial is needed
- Research regarding potential interactions between basal diet, SOL, monensin addition, & EO dose and composition is warranted

Using Optigen® in commercial dairy herd diets

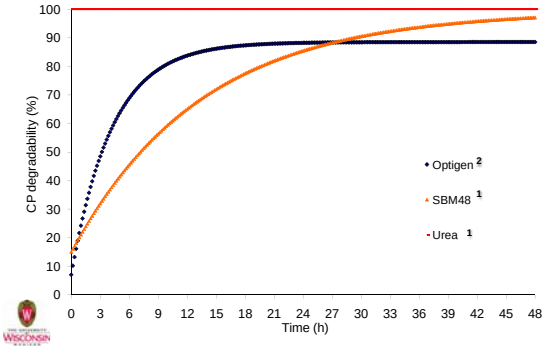
Background

➢**Optigen®**

- Nitrogen-dense feed ingredient (41% N, 256% CPE)
- Production controlled to provide a standardized slow ruminal release of N
- Use creates formulation space

Calculated Crude Protein Degradability

([1] NRC, 2001; [2] García-Gonzalez *et al*. 2007)



Methods

- 16 commercial WI dairy herds
- ✓ Milking herds averaged 148 cows (58 – 550)
- Diet formulation by 8 collaborating herd nutritionists from 2 companies
- ✓ Two iso-nitrogenous treatments: Control TMR (CON) or Optigen® TMR (OPT; 114 g/cow/day)
- All milking cows fed CON & OPT
- Trial conducted Spring 2008

Methods

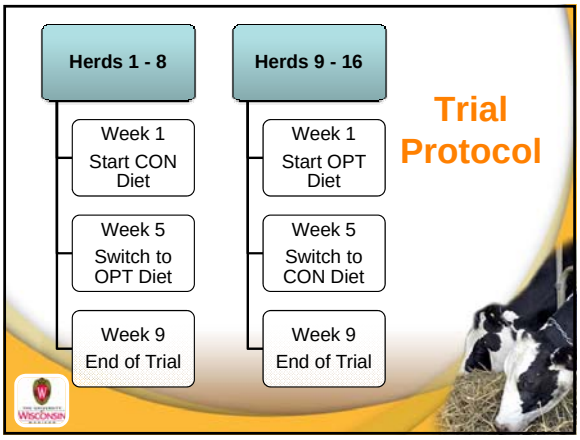
- Diet formulation space created by the use of Optigen® filled with DM from either corn silage or corn grain at the discretion of the herd nutritionist in the treatment TMR
- Control TMR contained 56±3% forage (43±9% corn silage), 17.1±0.4% CP, and 30.5±1.7% NDF (DM basis) as formulated

Methods

- Herds were randomly assigned to either OPT - CON or CON - OPT treatment sequence in Crossover design
- ✓ Experimental unit was Herd
- Two 30-d feeding periods
- ✓ Daily bulk tank records for milk yield & composition

The 2 X 2 Crossover design (COD)

	PERIOD	
SEQUENCE	I 30 d	II 30 d
1	CON	OPT
2	OPT	CON



Methods

- Data were analyzed using Proc Mixed of SAS with period, sequence and treatment as fixed effects and herd as a random effect

Results

Least Squares Means

	CON	OPT	SEM	*P - Value*
Milk Yield, kg/d	35.4	35.9	0.2	< 0.01
Fat, %	3.72	3.69	0.02	0.07
g/d	1317	1322	8	NS
Protein, %	2.98	2.97	0.01	NS
g/d	1055	1065	6	0.13
MUN, mg/dL	12.4	13.2	0.3	0.01

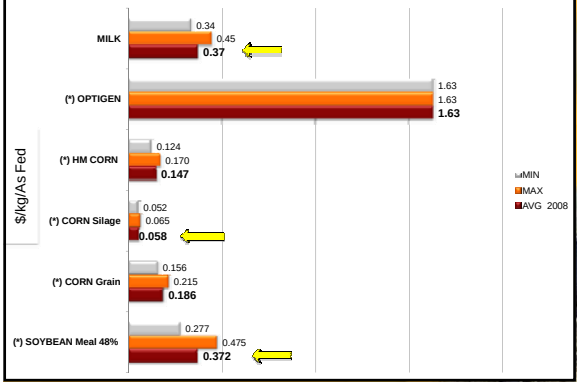
Economic Evaluation

➢ **Simulation analysis:**

- Trial Optigen® feeding rate 114 g/cow/d
- Optigen® price of $ 1.63 kg
- Trial milk yield response
- Monthly milk & feed prices for period Jan. – Dec. 2008
- 32 combinations of varying feed & milk prices simulated

Feed & Milk Prices Variation Jan 2008 – Dec 2008

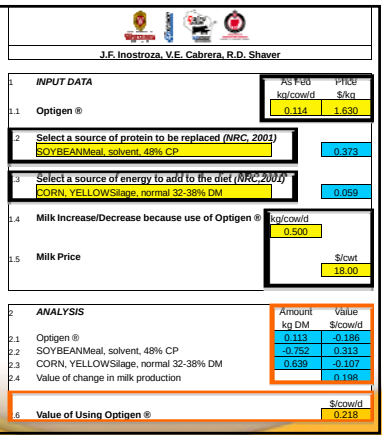
(Source: Brian Gould, Agricultural & Applied Economics, UW Madison, 2009)



Optigen® Evaluator Tool

Input data
- **Milk Price**
- **SBM price**
- **Corn Silage price**
- **Optigen® price**

Analysis
- **Feed Cost**
- **Milk Income**
- **Value of Use**



J.F. Inostroza, V.E. Cabrera, R.D. Shaver

		As Fed kg/cow/d	Price $/kg
1	***INPUT DATA***		
1.1	**Optigen ®**	0.114	1.630
1.2	**Select a source of protein to be replaced *(NRC, 2001)*** SOYBEANMeal, solvent, 48% CP		0.373
1.3	**Select a source of energy to add to the diet *(NRC,2001)*** CORN, YELLOWSilage, normal 32-38% DM		0.059
1.4	**Milk Increase/Decrease because use of Optigen ®**	kg/cow/d 0.500	
1.5	**Milk Price**		$/cwt 18.00

		Amount kg DM	Value $/cow/d
2	***ANALYSIS***		
2.1	Optigen ®	0.113	-0.186
2.2	SOYBEANMeal, solvent, 48% CP	-0.752	0.313
2.3	CORN, YELLOWSilage, normal 32-38% DM	0.639	-0.107
2.4	Value of change in milk production		0.198
2.6	**Value of Using Optigen ®**		$/cow/d 0.218

Concluding Remarks

- Optigen® use increased milk yield 0.5 kg/cow/d (P<0.01) in the field trial
- Optigen® use decreased feed cost when diet formulation space was filled with corn silage in the simulation analysis
- Optigen® use increased IOFC by up to $0.21/cow/d in the simulation analysis

Concluding Remarks

- The economics of Optigen® use depends greatly on milk & feed ingredient prices
- The Optigen® Evaluator can be used to evaluate the impact of fluctuating market price scenarios on the economics of Optigen® use in dairy cattle diets

An evaluation of exogenous enzyme with amylolytic activity for dairy cows fed reduced-starch diet

Gencoglu et al., 2009
Unpublished
University of Wisconsin - Madison

Lactation Trial

- 36 Multiparous Holstein cows
- DIM 51 ± 22 at trial initiation
- Treatments
  - 27% Starch TMR
  - 22% Starch TMR
  - 21% Starch TMR with amylase addition
- 3-wk covariate period on 27% Starch TMR followed by 12-wk treatment period

	Normal Starch	Reduced Starch
Ingredients	- - - % of DM - - -	
Corn silage	33.3	33.3
Alfalfa silage	16.7	16.7
Dry ground corn	22.8	14.8
SBM-48%	9.8	8.7
DDGS	11.0	11.0
Soy Hulls	3.6	12.7
Fat suppl.	0.6	0.6
Minerals & Vitamins	2.2	2.2

Lactation Performance

	NS	RS	RS +amy	NS vs. RS	NS vs. RS+	RS vs. RS+
				P<		
DMI						
kg/d	26.7	29.1	25.9	0.02	NS	0.002
% BW	3.88	4.16	3.69	0.05	NS	0.003

Lactation Performance

	NS	RS	RS +amy	NS vs. RS	NS vs. RS+	RS vs. RS+
				P<		
Milk						
kg/d	49.8	50.9	50.4	NS	NS	NS
3.5% FCM						
kg/d	46.2	49.1	48.2	0.02	0.10	NS

Lactation Performance

	NS	RS	RS +amy	NS vs. RS	NS vs. RS+	RS vs. RS+
				P<		
Milk/DMI						
kg/kg	1.91	1.77	1.98	0.06	NS	0.01
FCM/DMI						
kg/kg	1.77	1.70	1.90	NS	0.10	0.02

Lactation Performance

	NS	RS	RS +amy	NS vs. RS	NS vs. RS+	RS vs. RS+
				P <		
BW, kg	692	701	699	NS	NS	NS
BCS	2.2	2.2	2.1	NS	NS	NS

Lactation Performance

	NS	RS	RS +amy	NS vs. RS	NS vs. RS+	RS vs. RS+
				P <		
Fat, %	3.08	3.33	3.26	0.12	NS	NS
Protein, %	3.07	2.99	3.06	0.06	NS	0.10
MUN, mg/dL	11.1	13.0	12.2	0.01	0.01	0.02

- Potential for exogenous enzymes with amylolytic activity in dairy cattle diets?
  - Efficacy in low-starch diets?
  - Reduce our concerns about?
    - ✓ Maturity
    - ✓ Moisture Content
    - ✓ Particle Size
    - ✓ Length of Time in Storage
    - ✓ Type of Endosperm
    - ✓ Processing Methods
    - ✓ etc., etc.

Visit UW Extension
Dairy Cattle Nutrition Website
http://www.uwex.edu/ces/dairynutrition/

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