TECHNICAL BULLETIN 1

U.S. Soy Center for Animal Nutrition and Health - A Scientific Summary

Do High-Oleic Soy Diets Improve Economics? A Look at Real-World Dairy Formulations.

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Abstract

For more than a decade, university research has demonstrated the nutritional advantages of feeding high-oleic soybean ingredients to lactating dairy cows. While these controlled studies provide valuable scientific evidence, the questions remained: *How do experienced field nutritionists use high-oleic soy when balancing real-world dairy rations — and do they see economic improvements?*

To answer that question, the U.S. Soy Dairy Advisory Team initiated a project to evaluate the financial impact of different ration formulations with high-oleic soy. The project included two rounds and more than 50 diet formulations from eight field nutritionists.

The project clearly showed high-oleic soy ingredients improved income over feed cost (IOFC).

Background and Overview

The project began in January 2026 by asking eight of the country's leading dairy nutritionists from across the Northeastern and Upper Midwestern United States to formulate practical, economically optimized diets using the same tools they use every day with commercial dairy clients. After the conclusion of round one, the learnings were used to initiate a second round, which standardized costs and milk pricing, plus added raw high-oleic soybeans into the exercise.

1. **Dietary Comparison**
   Compare diets containing no high-oleic soy, roasted high-oleic soy and high-oleic expeller meal.
2. **State-Of-The-Art Diets**
   Demonstrate how heat-treated high-oleic soy is used in state-of-the-art dairy diets.
3. **IOFC Optimization**
   Provide insight into best practices and potential trade-offs for optimal IOFC.
4. **Future Insights**
   Uncover potential challenges and opportunities for future research and education.

Details and Results

Round 1: Eight Nutritionists, Three Formulations

Each nutritionist was asked to formulate three rations for the same hypothetical group of dairy cows, using a CNCPS-driven nutrition model – seven nutritionists used NDS Professional and one used AMTS.

Three Ration Formulations

1. **Control:** Diet containing **no high-oleic soy** ingredients
2. **High-Oleic Roasted Soybeans:** Diet containing **4–6 lbs/cow/day**
3. **High-Oleic Expeller Meal:** Diet containing **2–4 lbs/cow/day**

- Comparable nutrient specifications to include: crude protein, metabolizable protein (MP), metabolizable energy (ME), rumen undegradable protein, total fatty acids, MP and ME allowable milk production.
- Ingredient prices reflected each nutritionist's local market while the value placed to the composition of milk was $21.50/cwt.

Herd Parameters

Parity Multiparous Holstein Cows	**Days in Milk (DIM)** 140 DIM	**Target DMI** 63 lbs/day
Milk Production 110 lbs/cow/day	**Milk Components** 4.1% fat / 3.2% true protein	**Milk Quality** 150,000 SCC

Each ration included an analysis of: amino acid profile, fatty acid profile, metabolizable protein allowable milk, metabolizable energy allowable milk, feed cost and, most importantly, income over feed cost.

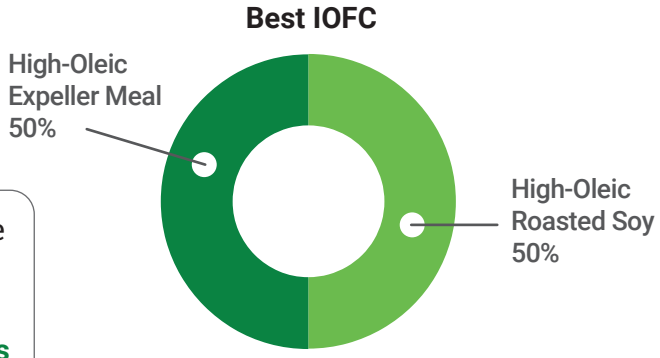
Round 1 Results: IOFC Improved with High-Oleic Soy for all Nutritionists

In all eight nutritionist's diet comparisons, at least one of the two rations with high-oleic soy diets produced the highest IOFC.

This was primarily accomplished by a combination of reduced costs from reduction in commercial fat supplements through the inclusion of high-oleic soybean oil contained in the high-oleic soy products or from improvements in ME or MP allowable milk compared to the control ration that did not contain high-oleic soy.

Round 1 Ration with Highest IOFC

- High-oleic roasted soybeans: 4 of 8 nutritionists
- High-oleic expeller meal: 4 of 8 nutritionists
- Control: 0 of 8 nutritionists



Although the nutritional strategies differed among nutritionists, the overall conclusion from round 1 was clear: **when experienced nutritionists balanced comparable rations, high-oleic soy ingredients improved IOFC. The unexpected discovery was a large variation in costs and nutrient values.**

Round 1 Nutrient Composition Comparisons

The tables below compare nutrient values used by the eight different nutritionists for the high-oleic feed ingredients.

	Nutritionist A		Nutritionist B		Nutritionist C		Nutritionist D	
	HO-RSBs*	HOEM**	HO-RSBs	HOEM	HO-RSBs	HOEM	HO-RSBs	HOEM
DM (%)	93.15	88.09	91.9	95.9	90	88	91.25	95.9
CP (%)	41.7	49.84	40.06	46.4	39.6	48.9	39.3	46.4
RUP (%)	55.4	66.5	55.4	75	56.1	36.7	55.4	77.2
Lys (g/d)	2.56	3.11	2.46	2.9	2.1	2.93	2.41	2.9
Met (g/d)	0.56	0.77	0.53	0.73	0.55	0.68	0.52	0.73
EE (%)	21.69	7.02	19.47	8	19.4	6.82	21.69	7.67
TFA (%)	17.71	6.35	13.32	7.24	15.85	6.64	17.71	6.94
18:1 (g/d)	9.45	2.8	9.84	1.42	10.05	1.2	13.73	5.62

	Nutritionist E		Nutritionist F		Nutritionist G		Nutritionist H	
	HO-RSBs	HOEM	HO-RSBs	HOEM	HO-RSBs	HOEM	HO-RSBs	HOEM
DM (%)	91.25	89	93	96.75	93	88.55	93	95.9
CP (%)	39.3	40	39.97	46.96	41.74	47.45	41.7	46.4
RUP (%)	55.4	75.1	60.2	62.5	NA	NA	55.4	75
Lys (g/d)	2.41	2.5	2.46	2.89	2.46	2.89	2.6	2.9
Met (g/d)	0.52	0.63	0.55	0.65	0.53	0.73	0.6	0.7
EE (%)	21.69	21.35	21.98	7.75	19.37	7.12	21.7	8
TFA (%)	17.71	19.31	17.95	7.01	17.95	7.01	17.7	7.2
18:1 (g/d)	13.73	15.17	13.46	5.26	13.46	5.26	9.3	3.8

* HO-RSBs: High-Oleic Roasted Soybeans
** HOEM: High-Oleic Expeller Meal

While reviewing the submitted rations for Round 1, another important finding emerged:
The variation among nutritionists was greater than anticipated – not only in ingredient costs but also in nutrient values assigned to high-oleic soy ingredients.

- **Variations in high-oleic nutrient values (ingredient libraries):**
  These ingredients are relatively new to the dairy industry and the commercial ration software databases have not been fully updated with validated high-oleic soy product nutrient values. Some nutritionists relied on existing software libraries while others had entered values from various independent sources.
- **Regional difference in feed pricing:**
  Variations resulted from regional differences in forage pricing, corn grain pricing, protein and fat supplements.
- **Federal Milk Marketing Order (FMMO) pricing:**
  The project also highlighted another practical reality. Feed ingredient prices in the Northeast were generally higher than those in the Upper Midwest and the Northeast FMMO (order 1) is higher than the Upper Midwest FMMO (order 30).

Although these differences increased variation among nutritionists, they did not change the overall conclusion within each nutritionist's comparison. High-oleic soy ingredients still generated the greatest IOFC in seven of the eight cases.

However, these observations in variations led the U.S. Soy Dairy Advisory Team to conclude that a second round of ration formulation was warranted.

Round 2: Standardizing Variables for Four Formulations

To help reduce variability, a few standardizations were implemented in Round 2.

Regional FMMO Prices

Regional Federal Milk Marketing Order prices were incorporated rather than using one national milk price.

- **Northeast – FMMO 1:** $21.15/cwt
- **Upper Midwest – FMMO 30:** $19.40/cwt

Standardized Feed Pricing

- **Corn silage:** $117.50/T of DM
- **Alfalfa haylage:** $185/T of DM
- **Dry alfalfa hay:** Priced at a 10% premium per ton of DM compared to alfalfa haylage
- **Corn grain:** Priced using nearby month CME corn futures plus local basis with a $10/T grinding fee

Standardized HO Nutrient Values

Established a common set of nutrient values for the three high-oleic soy ingredients to ensure consistency across model comparisons.

- **Crude Protein**
- **RUP**
- **Fatty Acid Profile**

Added HO Raw Soybeans

A fourth diet was added to evaluate the inclusion of high-oleic raw soybeans in the diet comparisons.

Round 2 Diet Comparisons

	Nutritionist A				Nutritionist B			
	No HO Soy	HO-RSBs*	HOEM**	HO Raw SBs***	No HO Soy	HO RSBs	HO Expeller Meal	HO Raw SBs
CP (%)	14.76	14.75	14.77	14.75	16.59	16.59	16.46	16.6
RUP (%)	38.96	35.59	38.79	35.11	36.5	36.6	37.6	36.2
Lys (g/d)	164.2	184	163.2	187.4	234.4	234.4	234.7	234.5
Met (g/d)	68	61.4	67.3	62.2	84.1	84.1	92.2	84.1
ME Allowable ECM	113.08	115.56	113.76	116.33	113.04	112.87	112.72	112.89
MP Allowable ECM	105.11	106	105.79	105.93	116.55	116.51	118.85	116.65
TFA (%)	3.8	3.59	3.72	3.55	4.15	4.46	4.37	4.15
EE (%)	5.14	5.13	5.16	5.07	5.3	5.3	5.29	5.31
18:1 (g/d)	186.85	415.31	273.12	412.22	246.53	476.5	237.46	478.09
Cost/head/day ($)	$6.15	$6.14	$5.86	$6.11	$8.43	$8.49	$8.66	$8.36
Cost/lb. DM ($)	$0.10	$0.10	$0.09	$0.10	$0.13	$0.13	$0.14	$0.13
IOFC ($)	$14.24	$14.42	$14.66	$14.44	$15.87	$15.77	$15.57	$15.91

	Nutritionist C				Nutritionist D			
	No HO Soy	HO RSBs	HOEM	HO Raw SBs	No HO Soy	HO RSBs	HO Expeller Meal	HO Raw SBs
CP (%)	16.53	16.73	16.69	16.73	16.56	16.62	16.8	16.09
RUP (%)	34.9	37.36	35.3	36.9	39.1	36.52	41.01	39.84
Lys (g/d)	220.4	221	221	220.4	219.4	212.3	229.5	220.48
Met (g/d)	93.8	91	93.6	91.1	84.72	82.2	86.28	83.98
ME Allowable ECM	108.78	110	111.37	109.98	117.45	117.16	117.64	119.36
MP Allowable ECM	115.55	122.71	117.27	122.18	119.86	113.98	126.81	111.24
TFA (%)	4.47	4.31	4.34	4.31	4.03	3.92	3.79	4.14
EE (%)	5.3	5.52	5.28	5.52	5.2	5.21	4.98	5.49
18:1 (g/d)	184.86	517.7	276.4	517.7	185.91	208.79	248.84	366.11
Cost/head/day ($)	$8.67	$8.36	$8.78	$8.30	$7.34	$7.27	$7.33	$7.17
Cost/lb. DM ($)	$0.14	$0.13	$0.14	$0.13	$0.12	$0.12	$0.12	$0.11
IOFC ($)	$12.43	$12.98	$12.83	$13.04	$15.44	$14.84	$15.49	$14.41

	Nutritionist E				Nutritionist F			
	No HO Soy	HO RSBs	HO Expeller Meal	HO Raw SBs	No HO Soy	HO RSBs	HO Expeller Meal	HO Raw SBs
CP (%)	16.06	16.11	15.99	16.26	16.09	16.08	15.93	16.14
RUP (%)	38.28	37.12	37.94	36.7	NA	NA	NA	NA
Lys (g/d)	192.6	191.5	191	190.8	235.9	236	235.9	236.1
Meth (g/d)	68.6	67.9	68.1	67.8	88.2	88.2	88.2	88.2
ME Allowable ECM	109.61	111.96	108.41	111.7	116.5	116.56	116.49	116.54
MP Allowable ECM	111.22	111.02	109.28	110.55	118.18	118.06	118.51	118.21
TFA (%)	3.72	3.58	3.68	3.63	4.27	3.96	3.79	3.95
EE (%)	5	5.04	4.98	5.11	4.96	4.84	4.54	4.83
18:1 (g/d)	169.72	387.98	199.77	392.28	212.4	330.8	242.04	330.49
Cost/head/day ($)	$6.73	$6.62	$6.72	$6.95	$8.38	$8.22	$7.99	$8.27
Cost/lb. DM ($)	$0.11	$0.11	$0.11	$0.11	$0.13	$0.13	$0.13	$0.13
IOFC ($)	$14.54	$14.91	$14.31	$14.50	$16.66	$16.84	$17.06	$16.79

	Nutritionist G				Nutritionist H			
	No HO Soy	HO RSBs	HO Expeller Meal	HO Raw SBs	No HO Soy	HO RSBs	HO Expeller Meal	HO Raw SBs
CP (%)	16.51	16.53	16.53	16.51	16	16.5	16	16.5
RUP (%)	43.2	42.92	42.92	43.09	36.88	33.94	36.88	35.76
Lys (g/d)	245.1	241.3	241.3	243.6	200.4	195.5	199.5	202.1
Meth (g/d)	90.31	88.54	88.54	89.67	78.2	75.5	77.9	77.4
ME Allowable ECM	104.7	106.3	105.3	105.8	110.34	110.99	113.25	111.15
MP Allowable ECM	116.4	116.9	118.1	117.4	111.9	112.5	109.86	112.7
TFA (%)	4.12	4.11	4.11	4.11	3.94	3.56	3.94	3.88
EE (%)	4.83	5.16	5.16	4.98	NA	NA	NA	NA
18:1 (g/d)	233.2	546.1	294.8	339.3	164.7	434.54	203.94	350.42
Cost/head/day ($)	$8.31	$8.06	$8.06	$8.10	$7.40	$7.20	$7.40	$7.30
Cost/lb. DM ($)	$0.13	$0.13	$0.13	$0.13	$0.12	$0.11	$0.12	$0.12
IOFC ($)	$12.00	$12.56	$12.37	$12.43	$14.01	$14.33	$13.91	$14.26

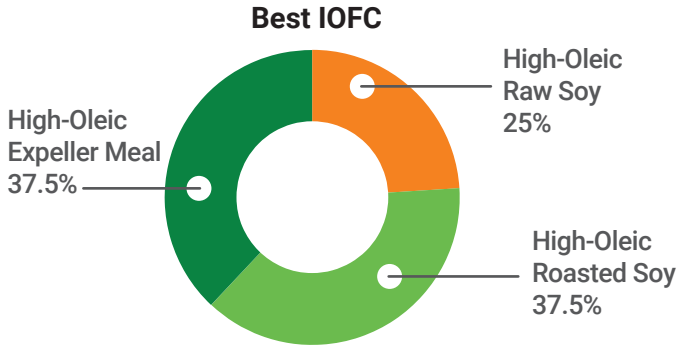
*HO – High-Oleic Soy
**HOEM – High-Oleic Expeller Meal
***HO RSB – High-Oleic Roasted Soybeans

Round 2 Results: IOFC Improved with High-Oleic Soy for All Eight Nutritionists

The second round produced strong results; all eight participating nutritionists identified one of the high-oleic soy ingredients as producing the highest IOFC compared to a diet without high-oleic soy.

The winning ingredient in round 2 varied according to each nutritionist's formulation strategy:

- High-oleic roasted soybeans: 3 of 8 nutritionists
- High-oleic expeller meal: 3 of 8 nutritionists
- High-oleic raw soybeans: 2 of 8 nutritionists



Round 2 Income Over Feed Cost Comparisons by Nutritionists

Nutritionist	No High-Oleic Soy	High-Oleic Roasted Soybeans	High-Oleic Expeller Meal	High-Oleic Raw Soybeans	Gain
A	$14.24	$14.42	**$14.66**	$14.44	**$0.42**
B	$15.87	$15.77	$15.57	**$15.91**	**$0.04**
C	$12.43	$12.98	$12.83	**$13.04**	**$0.61**
D	$15.44	$14.84	**$15.49**	$14.41	**$0.05**
E	$14.54	**$14.91**	$14.31	$14.50	**$0.37**
F	$15.44	$14.84	**$15.49**	$14.41	**$0.40**
G	$12.00	**$12.56**	$12.37	$12.43	**$0.56**
H	$14.01	**$14.33**	$13.91	$14.26	**$0.32**

Takeaway: Compared with the control diet, improvements in IOFC ranged from $0.04 to $0.56 per cow per day.

Discussion

Perhaps one of the most valuable outcomes of the project occurred outside the ration comparisons themselves.

The large variation observed in Round 1 prompted the U.S. Soy Dairy Advisory Team to work with the three major U.S. feed testing laboratories:

Cumberland Valley Analytical Services
Dairyland Laboratories
Rock River Laboratories

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Together, these laboratories shared their nutrient databases for conventional and high-oleic raw soybeans, roasted soybeans and expeller soybean meal. These average nutrient values are now available on the U.S. Soy Center for Animal Nutrition website.

Conclusion

With two rounds of dairy formulations, this project answered the important question — whether in the form of roasted soybeans, expeller meal or raw soybeans, **high-oleic soy ingredients repeatedly demonstrated the ability to improve IOFC while fitting successfully into nutritionally balanced, high-producing dairy cow diets.**

And, as high-oleic soy databases are incorporated into commercial ration software, nutritionists will be better equipped to capture the value these ingredients can provide on today's dairy farms.

Heat-Treating Increases Bypass Protein

While evaluation of raw high-oleic soybeans is warranted, U.S. Soy recommends high-oleic soybeans be heat-treated when processed to increase bypass protein values.

Take Home: High-oleic Soy Ingredients Improve Economic Performance in Real-World Dairy Formulations

Find more information and resources about high-oleic soybeans in dairy rations at can.ussoy.org/high-oleic.

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