Holsteins Behaving Like Jerseys and Thoughts on the Capacity of Dairy Cattle to Make Milk Components

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Conclusion

You ain’t seen nothin’ yet.

Higher Fat Content Raw Milk: Options to React as a Cheese Maker

Dave Barbano
Cornell University

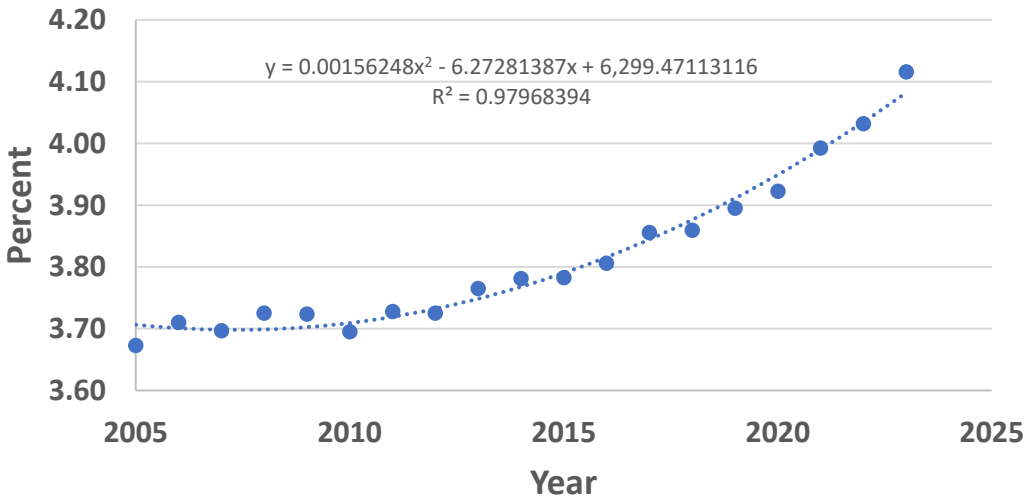
NYS Cheese Manufacturers' Association Meeting
March 5, 2024

Barbano1@aol.com

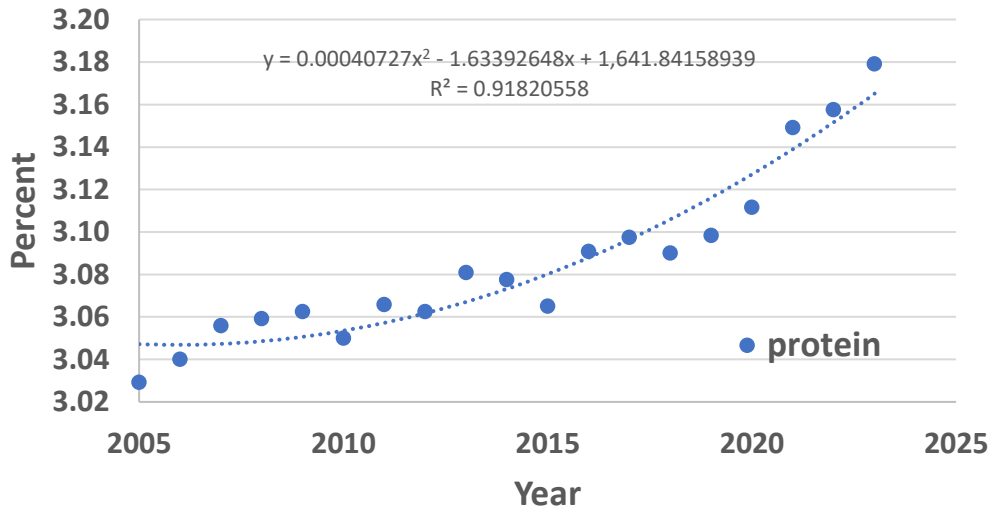
NORTHEAST DAIRY FOODS RESEARCH CENTER

Change in Northeast Federal Milk Market Fat and True Protein Tests 2005 thru 2023

NE Federal Order Milk Fat



NE Federal Order True Protein



- **Northeast Milk Marketing Area Statistical Handbook**

  https://fmmone.com/Statistical_Report.htm

  Tables A18 and A19 in the downloadable Excel spreadsheet

Development of real-time milk analysis tools for management of nutrition, herd health, and reproduction in large dairy herds.

Dave Barbano, Caterina Melilli, Tom Overton,
Northeast Dairy Foods Research Center,
Cornell University, Ithaca, NY.
Melissa Woolpert, Kurt Cotanch, Heather Dann, Rick Grant
Miner Institute, Chazy, NY

NYS Cheese Makers
Annual Meeting
March 3, 2015

Syracuse, NY

Evaluation and Controlling Cheese Yield in Large Factories

Dave Barbano and Brenda Margolies
Department of Food Science
[1]Cornell University, Ithaca, NY, USA

NYS Cheese Manufacturers' Association

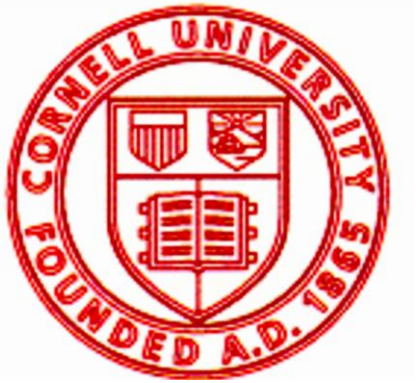
Syracuse, NY

March 7, 2016

New Milk Analysis Technologies to Improve Dairy Cattle Performance

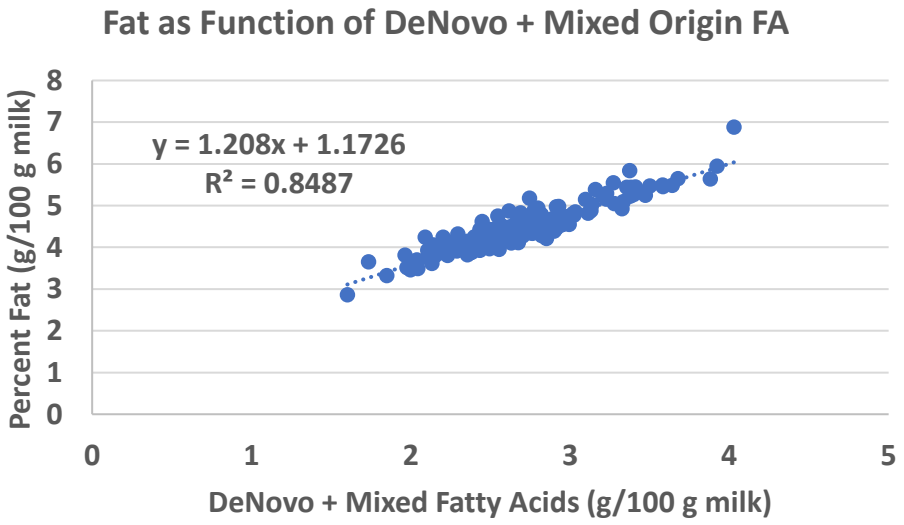
D. M. Barbano and C. Mellili - Cornell

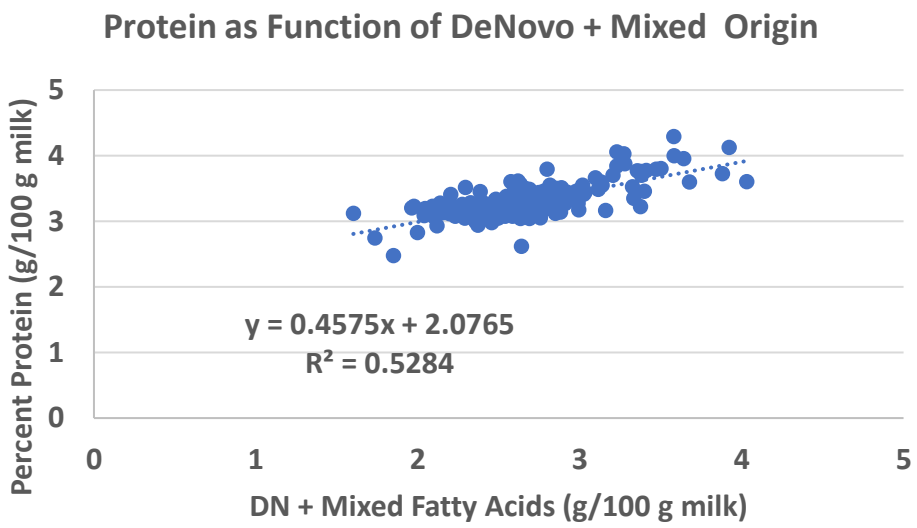
H. M. Dann and R. J. Grant - Miner



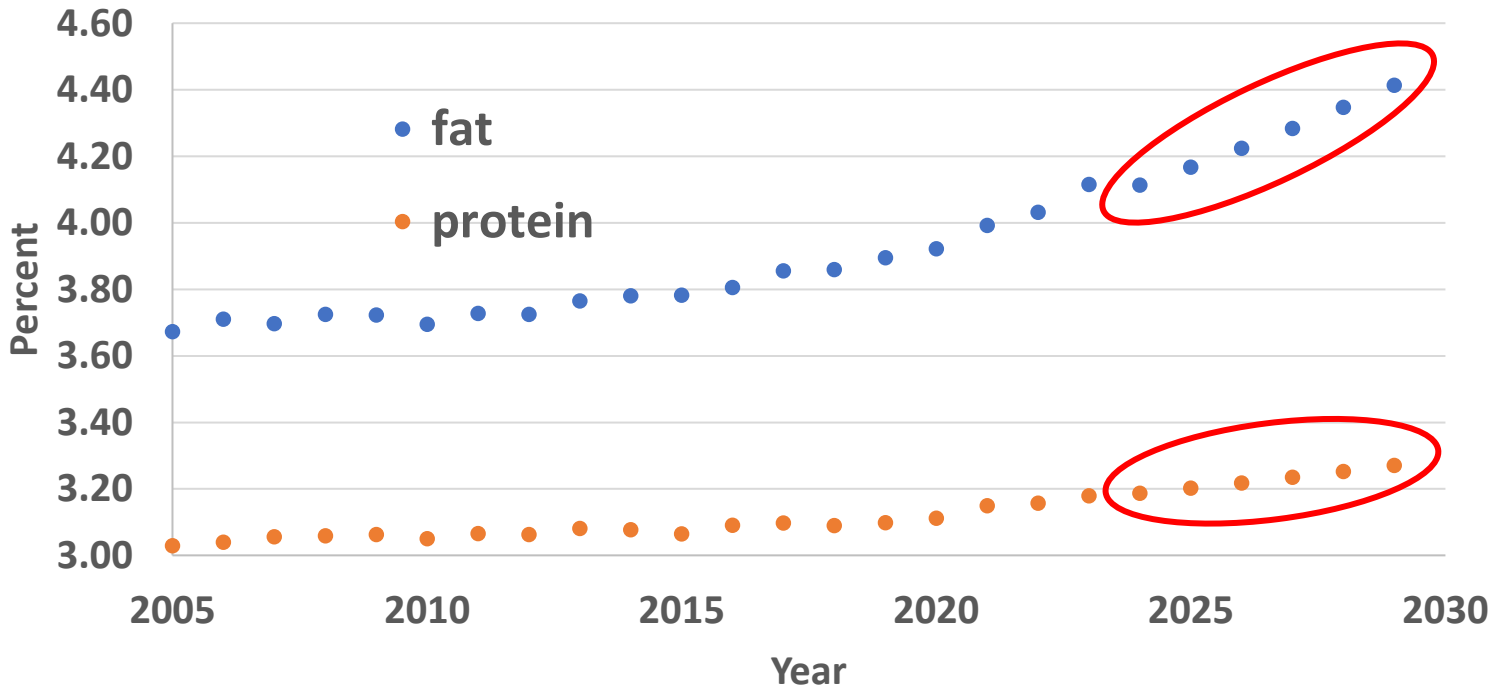
NYS Cheese Makers Meeting

March 6, 2017


Fat as Function of DeNovo + Mixed Origin FA
y = 1.208x + 1.1726
R² = 0.8487
Percent Fat (g/100 g milk)
DeNovo + Mixed Fatty Acids (g/100 g milk)
0
1
2
3
4
5
6
7
8


Protein as Function of DeNovo + Mixed Origin
y = 0.4575x + 2.0765
R² = 0.5284
Percent Protein (g/100 g milk)
DN + Mixed Fatty Acids (g/100 g milk)
0
1
2
3
4
5

Northeast Federal Milk Market Fat and True Protein Projection 2024 thru 2029



Fat concentration is increasing at a faster rate than protein concentration.

As concentration of fat and protein increase, cheese yield increases.

Calculation of Theoretical Cheese Yield – VanSlyke Formula

What is the relationship between theoretical Cheddar Cheese Yield and Milk Composition?

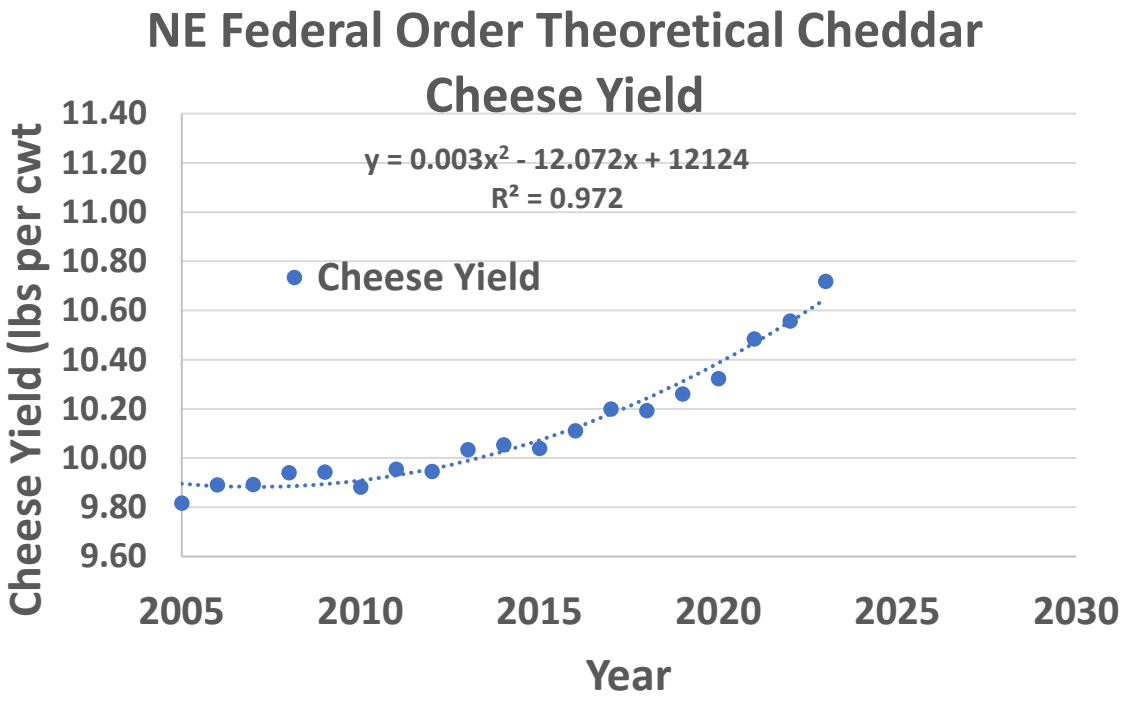
$$\text{Yield} = \frac{[((\%\ \text{Fat recovery in cheese} \times \%\ \text{fat in milk}) + ((\text{true protein} \times 0.815) - 0.1))] \times 1.09}{1 - (\text{target cheese moisture}/100)}$$

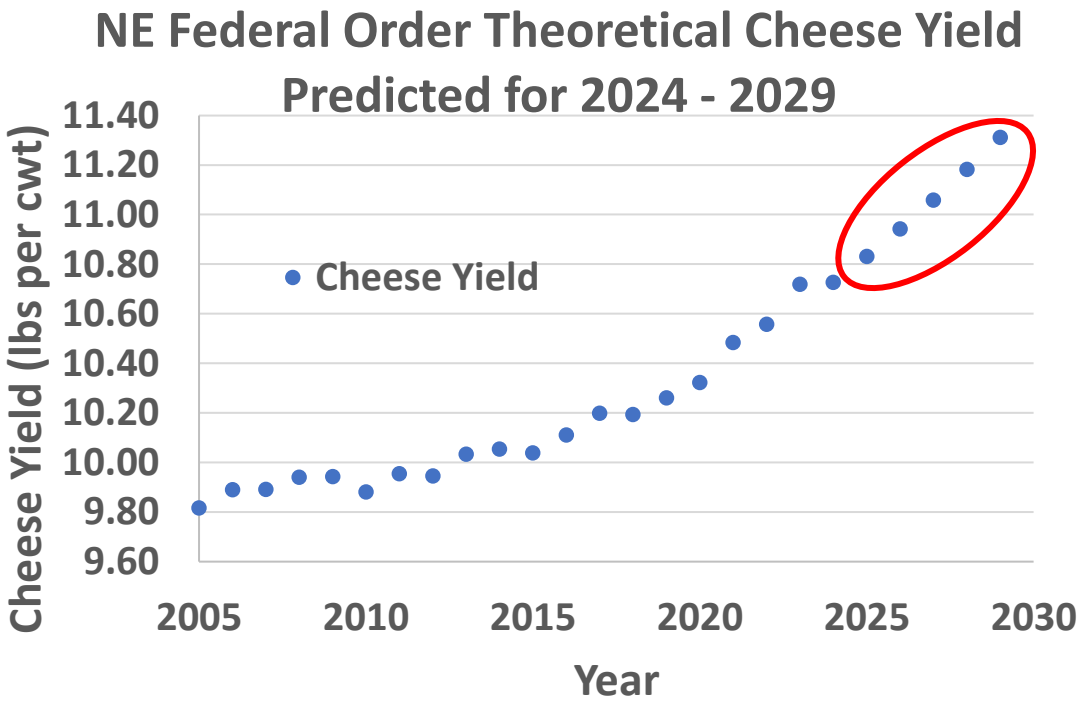
Assume 90% fat recovery in the cheese and a target cheese moisture of 37% and cheese salt of 1.7% and the milk composition in the year 2005

$$\text{Yield} = \frac{[((0.90 \times 3.673) + ((3.029 \times 0.815) - 0.1))] \times 1.09}{1 - (37/100)} = \frac{6.185}{.63} = 9.82 \text{ pounds per 100 pounds milk}$$

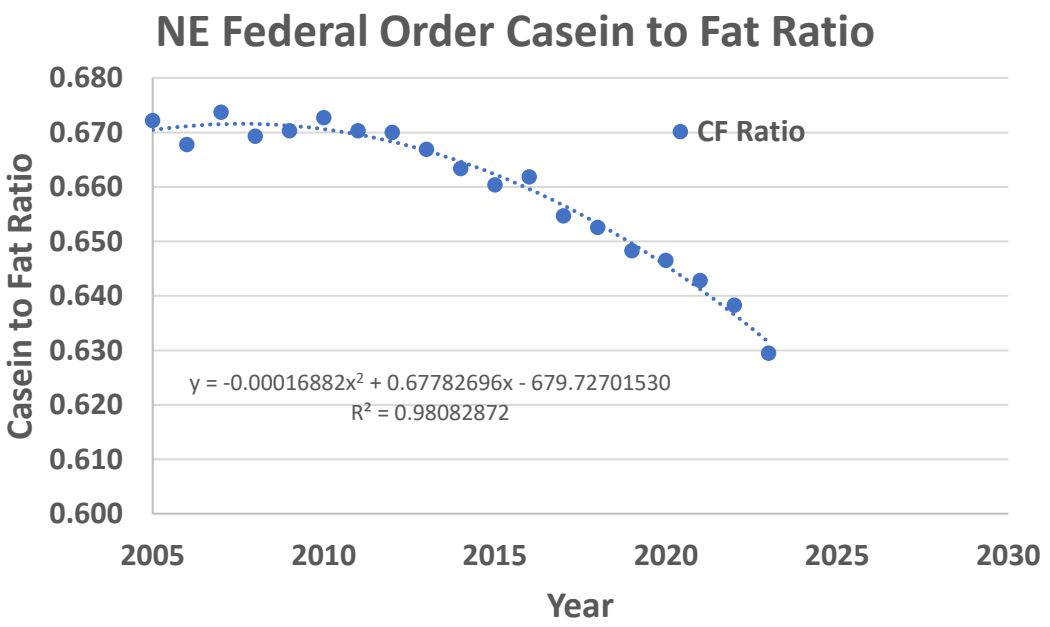
Barbano,D.M.,and J.W.Sherbon. 1984.Cheddar cheese yields in New York. J. Dairy Sci. 67:1873-1883.

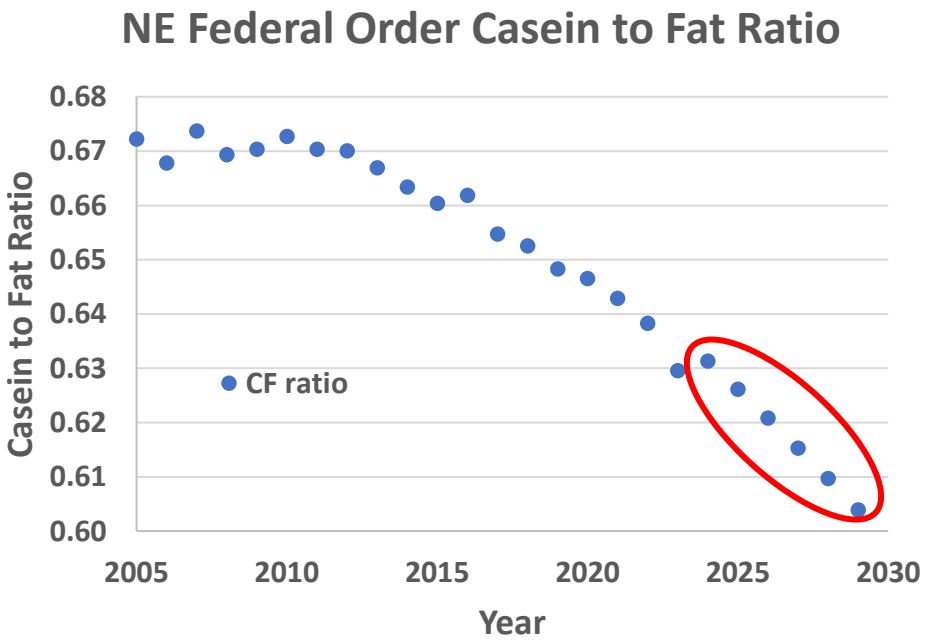
How much is cheese yield increasing?



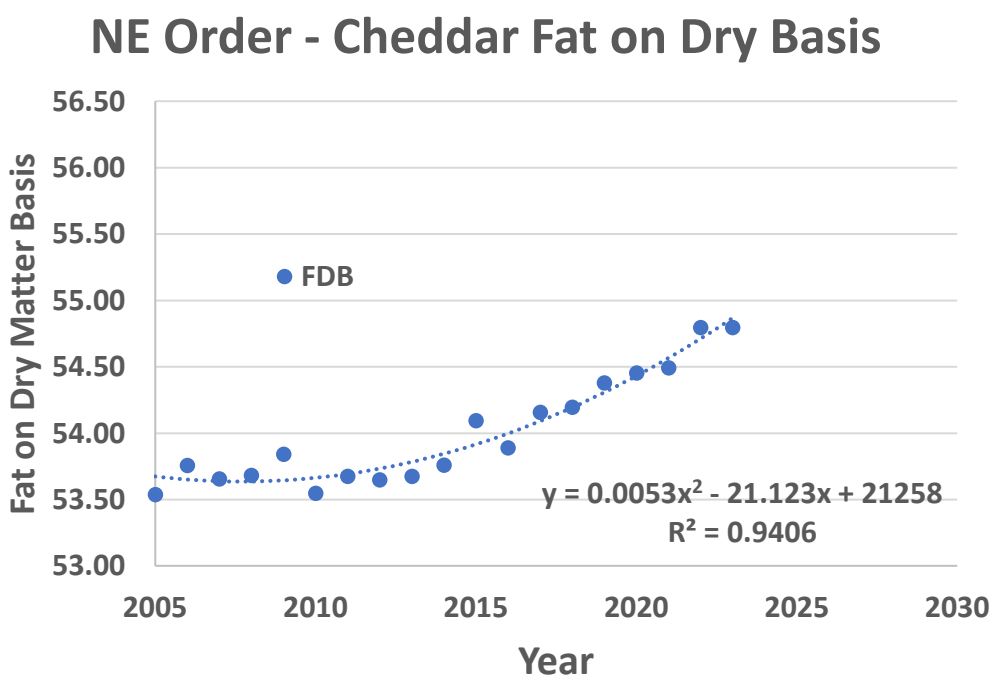


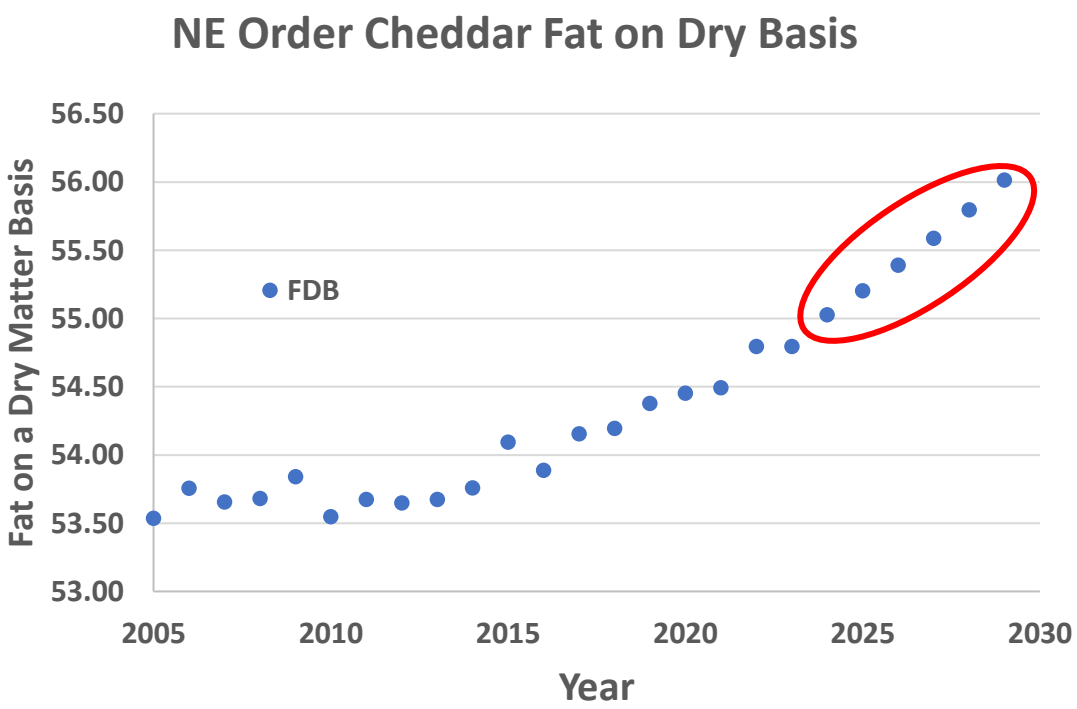
How much is milk casein to fat ratio decreasing?





How will cheese fat on dry (FDB) basis change?





	Fast Forward to the Year 2029				
			Casein to		
year	fat	protein	Fat Ratio	FDB	yield
2005	3.673	3.029	0.672	53.54	9.82
2015	3.783	3.065	0.660	54.10	10.04
2023	4.116	3.179	0.630	54.80	10.72
2029	4.414	3.271	0.604	56.02	11.31

Casein to fat ratio is decreasing because of the milk composition change

Fat on dry basis in the cheese will increase as casein to fat ratio decreases

What is the impact of an increase in Fat on Dry Basis (FDB) on Cheddar cheese quality?

1) As FDB increases the cheese will get softer and this may impact cheese slicing in automated cheese cutting lines.
2) As FDB increases it becomes more difficult to keep moisture on target and cheese moisture will gradually decrease lowering cheese yield. Lower moisture will tend to make the cheese firmer.
3) If moisture decreases there is less water per 100 pounds of cheese and if salting rate is not decreased the salt concentration in the water phase of the cheese will increase. An increase in salt concentration in the water phase of the cheese will decrease Cheddar flavor development during aging.

Operationally what do I do to maintain cheese quality, cheese manufacturing productivity, and cost?

1. **Read and understand the standard of identity for Cheddar cheese to determine what options are available for dairy ingredients and how to modify the process in your factory to fit your needs.**

Cheddar Cheese Standard of Identity – What are the Rules?

Code of Federal Regulations (CFR)

§ 133.113 Cheddar cheese.

(a) *Description.*

(1) Cheddar cheese is the food prepared by the procedure set forth in paragraph (a)(3) of this section, or by any other procedure which produces a finished cheese having the same physical and chemical properties. The minimum milkfat content is 50 percent by weight of the solids, and the maximum moisture content is 39 percent by weight, as determined by the methods described in § 133.5. If the dairy ingredients used are not pasteurized, the cheese is cured at a temperature of not less than 35 °F for at least 60 days.

(b) *Optional ingredients.* The following safe and suitable ingredients may be used:

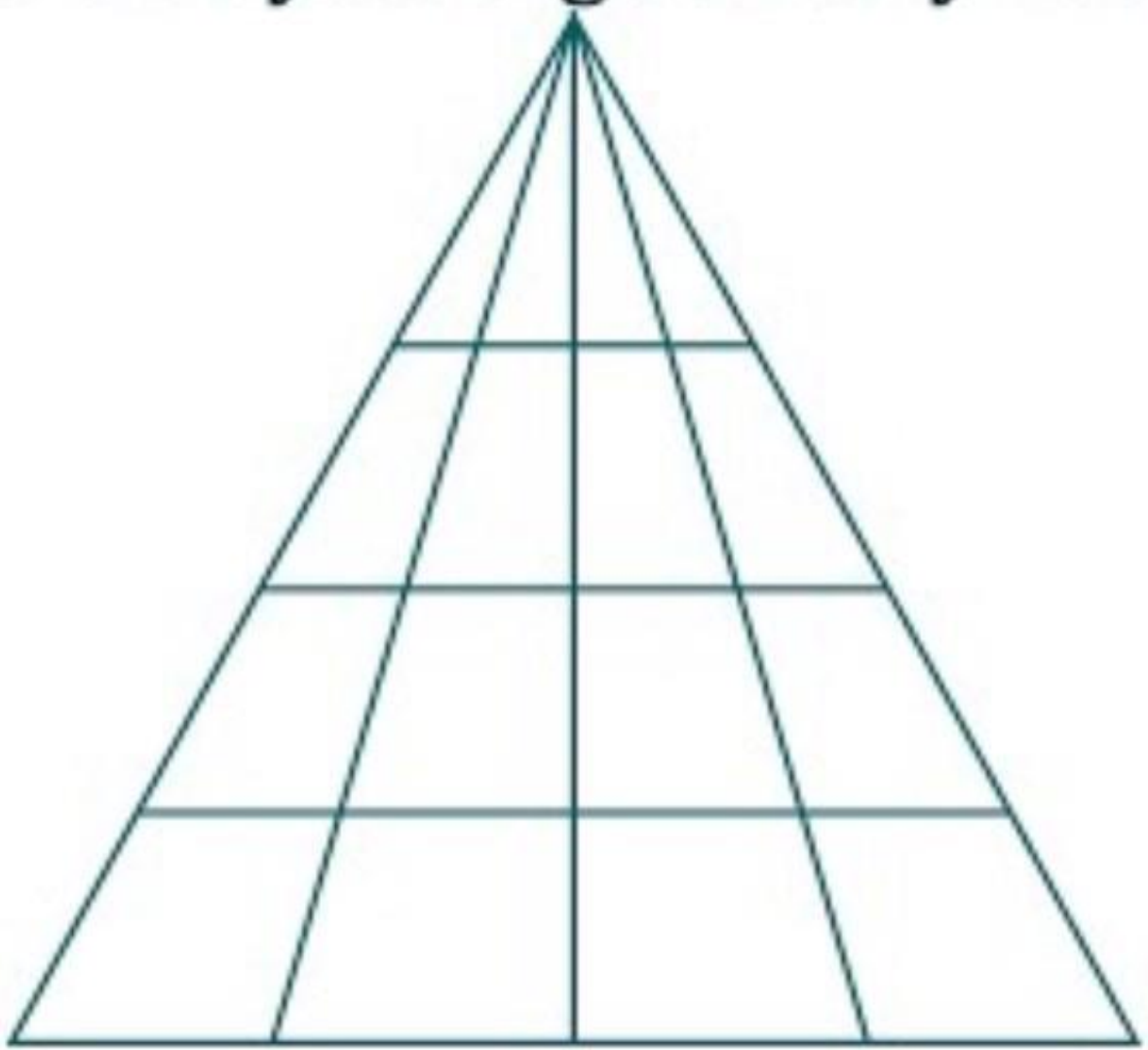
(1) *Dairy ingredients.* Milk, nonfat milk, or cream, as defined in § 133.3, used alone or in combination.

Operationally what do I do to maintain cheese quality, cheese manufacturing productivity, and cost?

1. Read and understand the standard of identity for Cheddar cheese to determine what options are available for dairy ingredients and how to modify the process in your factory to fit your needs.

2. **Develop a milk standardization strategy that is achievable for your plant. There are multiple options within the standard of identity. What is the best approach given the scale of your plant?**

How many triangles can you see?



Options for aged Cheddar cheese manufacture

1. Add skim milk to lower fat content control casein to fat ratio.

Approaches to consider

1) Bring in purchased “fresh” raw skim milk to add to the whole milk.
2) Buy a cream separator and make skim from incoming raw milk and sell surplus fresh cream while adding skim to the vats to lower the fat content.

Approaches that may be problematic

1) Buy nonfat dry milk powder and reconstitute
2) Use condensed skim to increase protein in milk

(not listed in the standard as allowed ingredients, will increase lactose content of vat milk, protein has had a high heat exposure.)

Options for aged Cheddar cheese manufacture

2. **Add retentate from ultrafiltration (UF) of skim milk to lower fat content control casein to fat ratio.**

Approaches to consider (positives)

1) UF of purchased raw skim. Bring in purchased "fresh" raw skim milk, UF that skim to increase protein concentration to add to the whole milk. This does not increase lactose concentration.
2) Buy a cream separator and make fresh skim from incoming raw milk, UF the skim to increase protein concentration and add to whole milk. Sell surplus fresh cream while adding skim to the vats to lower the fat content.

(possible negatives) (UF retentate is not listed in the standard as allowed ingredients)

Let’s look at the numbers on a per hundredweight of milk in the cheese vat.

		fat	protein	Casein	CF ratio	FDB	Yield/cwt
lbs	whole (2005)	3.67	3.03	2.47	0.672	53.54	9.82

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12.2	**skim**	0.06	3.42				
112.2	stndzed	3.94	3.29	2.68	0.680	53.12	10.60

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112.2	stndzed	3.94	3.29	2.68	0.680	53.12	
100	whole (2029)	4.41	3.27		0.604		
6.1	**UF skim (2X)**	0.12	6.84	5.58			
106.1	stndzed	4.17	3.48	2.83	0.680	53.07	11.22

Let's look at the numbers on the basis of 100 pounds of milk in the cheese vat.

		fat	protein	Casein	CF ratio	FDB	Yield/cwt
lbs	**whole (2005)**	**3.67**	**3.03**	**2.47**	**0.672**	**53.54**	**9.82**
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106.1	stndzed	4.17	3.48	2.83	0.680	53.07	11.22
100	whole (2029)	4.41	3.27		0.604		
3.05	**UF skim (4X)**	0.12	13.69	11.15			
103.05	stndzed	4.29	3.58	2.92	0.680	53.03	11.55

Let's look at the numbers on a per 50000 pound cheese vat and for a cheese plant at 2 million pounds of milk per day.

					Vats (lbs)	Plant				
					Milk	Milk		Cheese	Cheese	Cheese
				C/F	50000	2 million		Yield	pounds	pounds
		fat	protein	Ratio	1 vat	40 vats	FDB	per cwt	per vat	per day
whole (2005)		**3.67**	**3.03**	0.672	50000	2000000	53.54	9.82	4908	**196,339**

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stndzed (skim)		3.94	3.29	0.680	50000	2000000	53.12	10.60	5299	**211,943**

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UF skim (4X)		4.29	3.58	0.680	50000	2000000	53.03	11.55	5774	**230,959**

Conclusions

1. **Milk composition is increasing in fat content faster than protein content and that trend is likely to continue 5 to 8 years and then slow down.**
2. **The change in Protein (i.e., casein) to Fat ratio of milk will increase the FDB of Cheddar cheese and ultimately that will have a negative impact on aged Cheddar cheese quality**
3. **We SHOULD standardize milk for aged Cheddar cheese manufacture to maintain aged Cheddar cheese physical and chemical quality characteristics and quality.**
4. **We SHOULD NOT try to fix this by penalizing dairy farmers for producing milk with too high a fat content. This will have a negative impact on their production efficiency and ultimately raise the cost of a pound fat and protein for cheese making. We need to keep dairy farms efficient and control cheese quality at the cheese plant.**