Effect of TMR chemical composition on milk yield lactation curves using a random regression animal model

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Introduction

- Test-day (TD) models are used worldwide to perform national genetic evaluations for dairy cattle
  - provide 4 to 8% more accurate genetic evaluations of cows over evaluations from 305-d yields (Schaeffer et al., 2000)
  - **random regression** TD models are an extension to allow the shape of the lactation curve to differ for each cow by the inclusion of random regression coefficients for each animal (Schaeffer and Dekkers, 1994; Jamrozik et al., 1997)
  - higher accuracy of estimating non genetic parameters
  - reliable prediction of single test-day production

Introduction

- Potential application of TD models for management evaluation has been investigated (Koivula et al. 2006, Caccamo et al. 2008, Halasa et al. 2008)
- Large herd curve variance (between herds) was found in Ragusa and Vicenza province (Caccamo et al. 2008)

Introduction

- Sources of variation that explain differences between herds in milk, fat, and protein production curves were investigated (Caccamo et al. 2010):
  - Animal breed (Holstein Friesian vs Brown Swiss) influenced persistency for all traits and peak and mean milk herd curves
  - Feeding system (Separate Feeding vs TMR) influenced peak and mean for all traits
  - TMR chemical composition (Crude Protein) influenced peak and mean herd curve
  - Dry Matter x Crude Protein influenced persistency

Motivation

- Higher impact of energy (starch) and forage quality (ADL, ADF, and NDF) were expected on herd curve traits (Hristov et al. 2002):
  - average chemical composition may have reduced the variability between TMRs within herd
  - combination of nutrition information with herd curve needs to take into account the stage of lactation (beginning, peak, or end)
  - energy in the diet affects milk production at cow level (?)

Objective

- To investigate the relationship between TMR chemical composition and milk yield curves estimated at individual cow level using a random regression test-day model

Materials & Methods

- Data Collection (March 2006 through December 2008)

	Nr Herds	Nr Cows				
		Total	Avg	St. Dev.	Min	Max
All herds	37	2049	55.38	33.76	19	157
Feeding system						
TMR	28	1804	64.43	33.81	22	157
SF	9	245	27.22	9.50	19	48
Breed						
Holstein Friesian	28	1716	61.29	36.25	20	157
Brown Swiss	9	333	37.00	13.77	19	57

- TMRs were analyzed for ash, Crude Protein (CP), Soluble Nitrogen (SN), Acid Detergent Lignin (ADL), Neutral Detergent Fiber (NDF), Acid Detergent Fiber (ADF), and starch (on DM basis)

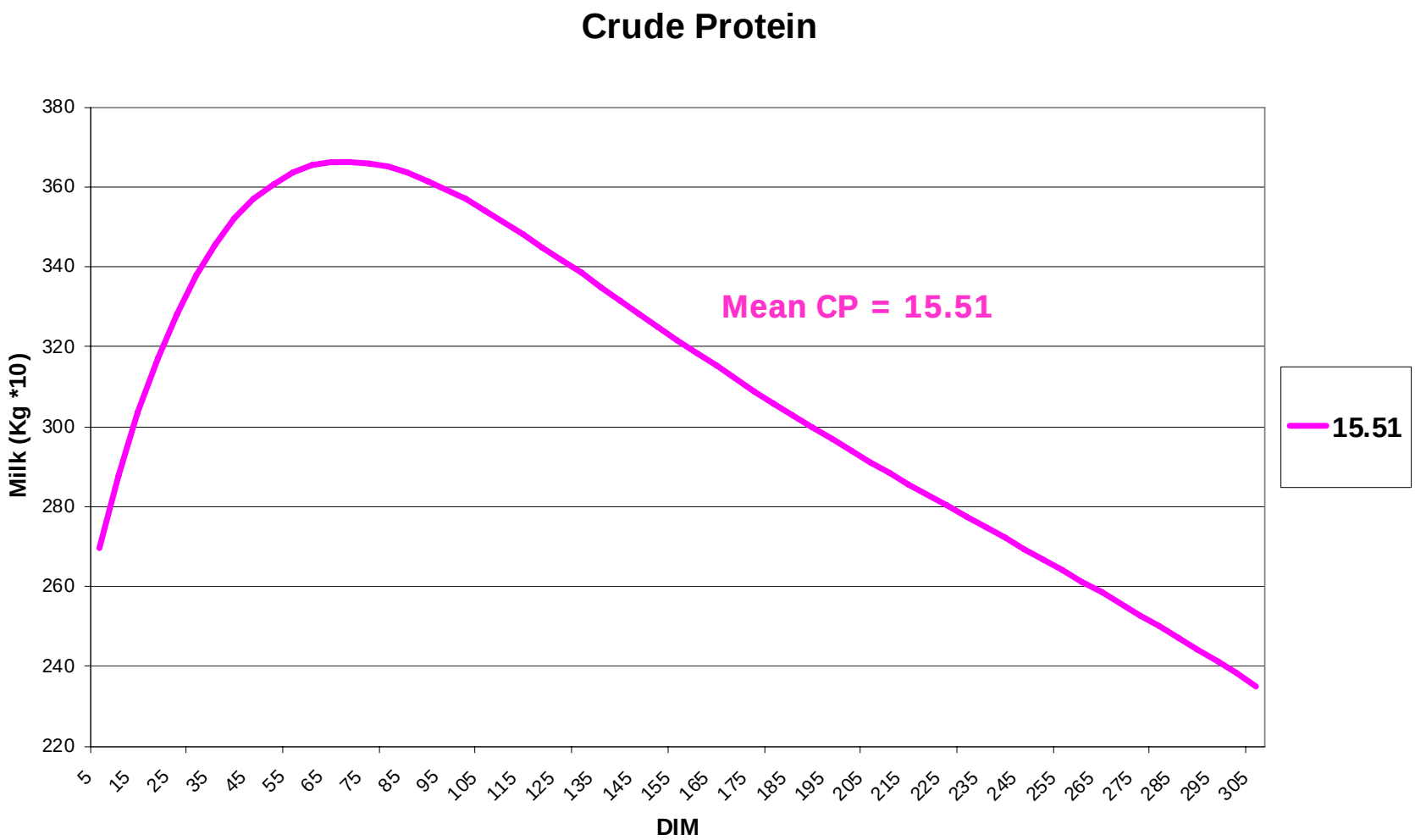
Materials & Methods

- Model
  - fixed effects
    - parity, DIM, year x season of calving, age at calving, year of calving, calving interval, stage of pregnancy, year x week of test, days dry
  - random effects
    - herd x test date
  - random regression effects (3-order Legendre polynomial)
    - additive sire and maternal grandsire, permanent environment
- Model fitting for milk yield trait was carried out using ASREML

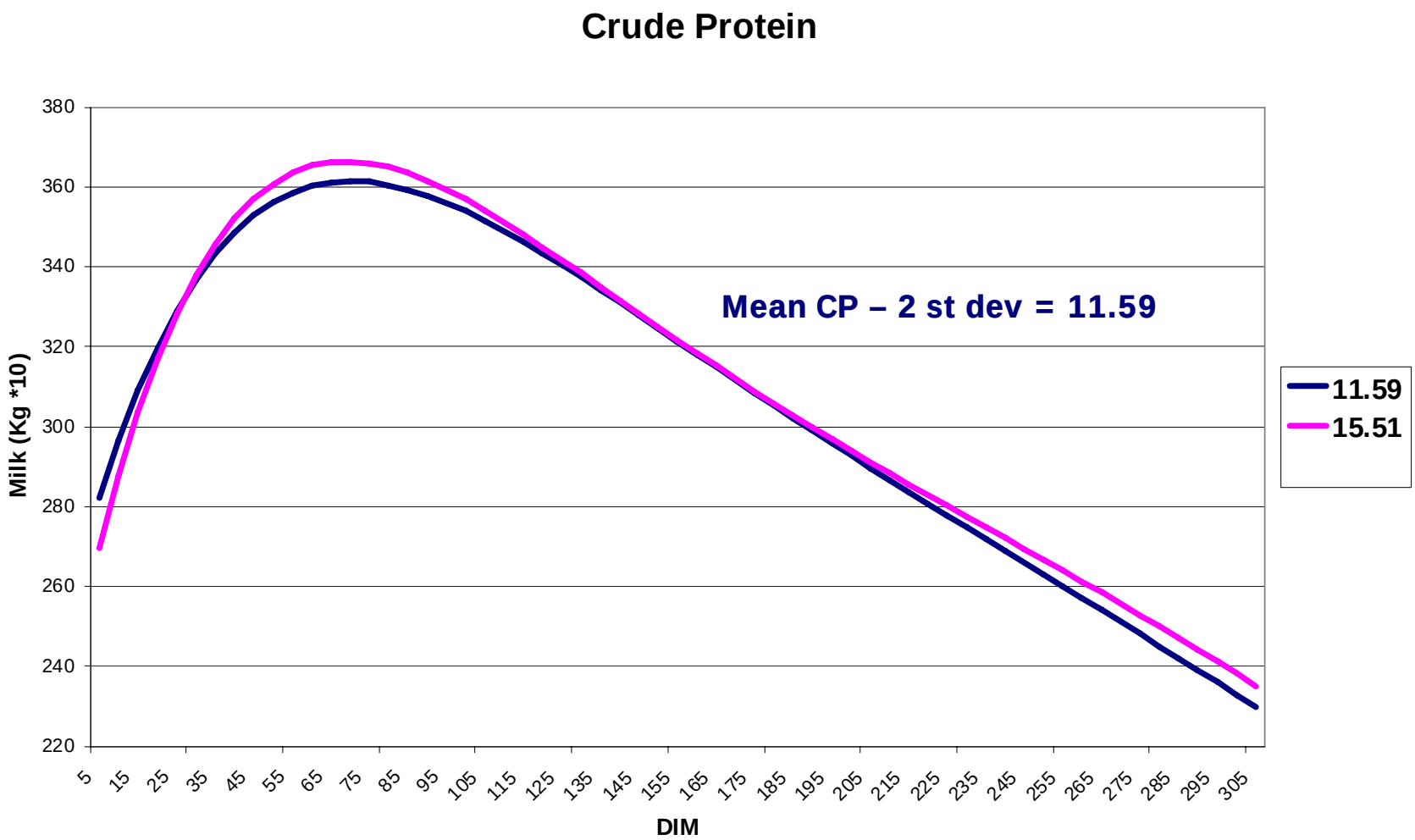
Materials & Methods

- Variance components
  - 241,153 test-day records
  - 9,809 cows
  - 42 herds
  - 1995 through 2008
- Model run
  - 46,531 test-day records
  - 3,554 cows
  - 27 herds
  - 2006 through 2008
  - {ash, CP, SN, ADL, NDF, ADF, starch} x DIM (9-order Legendre polynomial)
  - predictions for mean ± 2 st dev

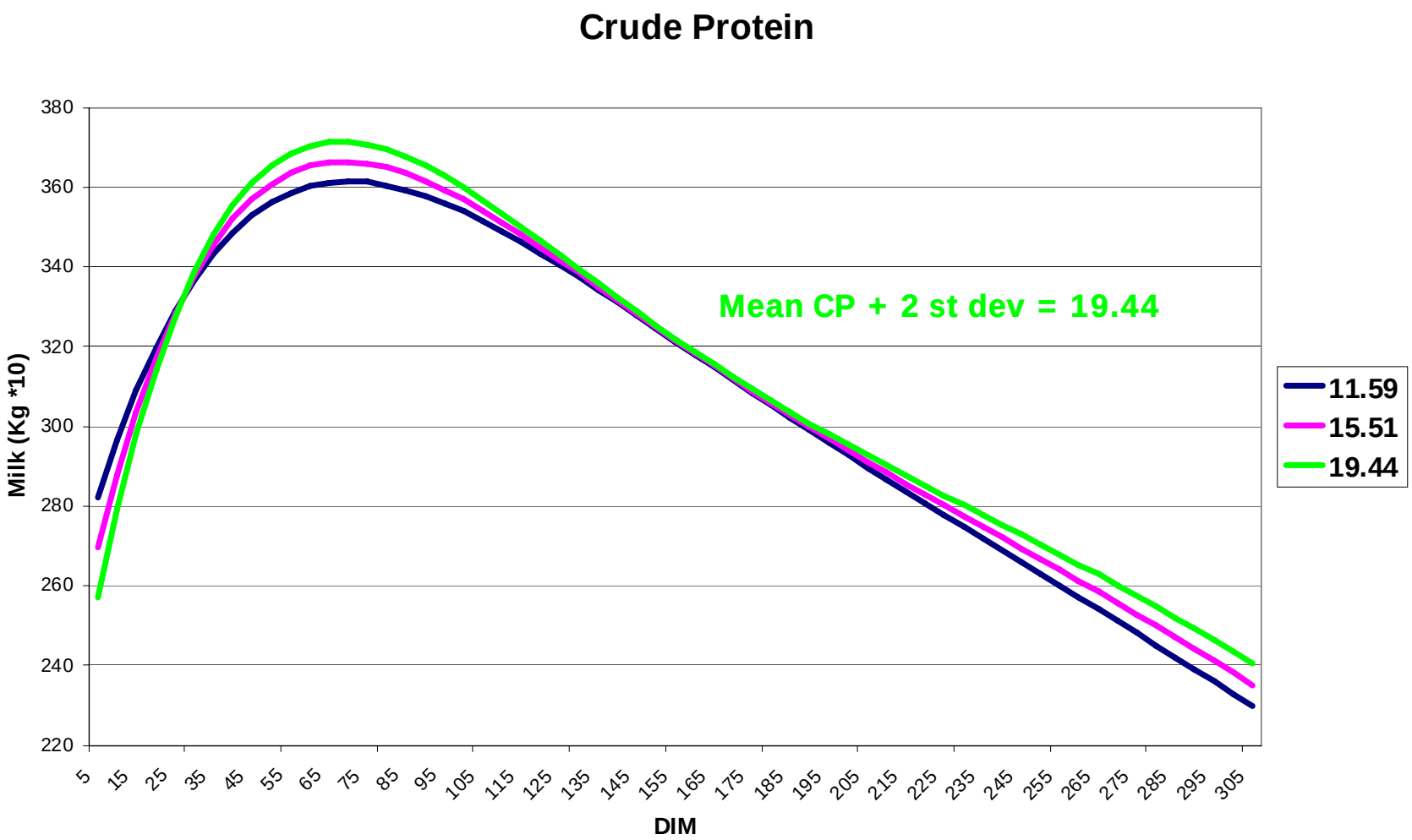
Results


Crude Protein
Mean CP = 15.51
Milk (Kg *10)
380
360
340
320
300
280
260
240
220
5
15
25
35
45
55
65
75
85
95
105
115
125
135
145
155
165
175
185
195
205
215
225
235
245
255
265
275
285
295
305
DIM
15.51

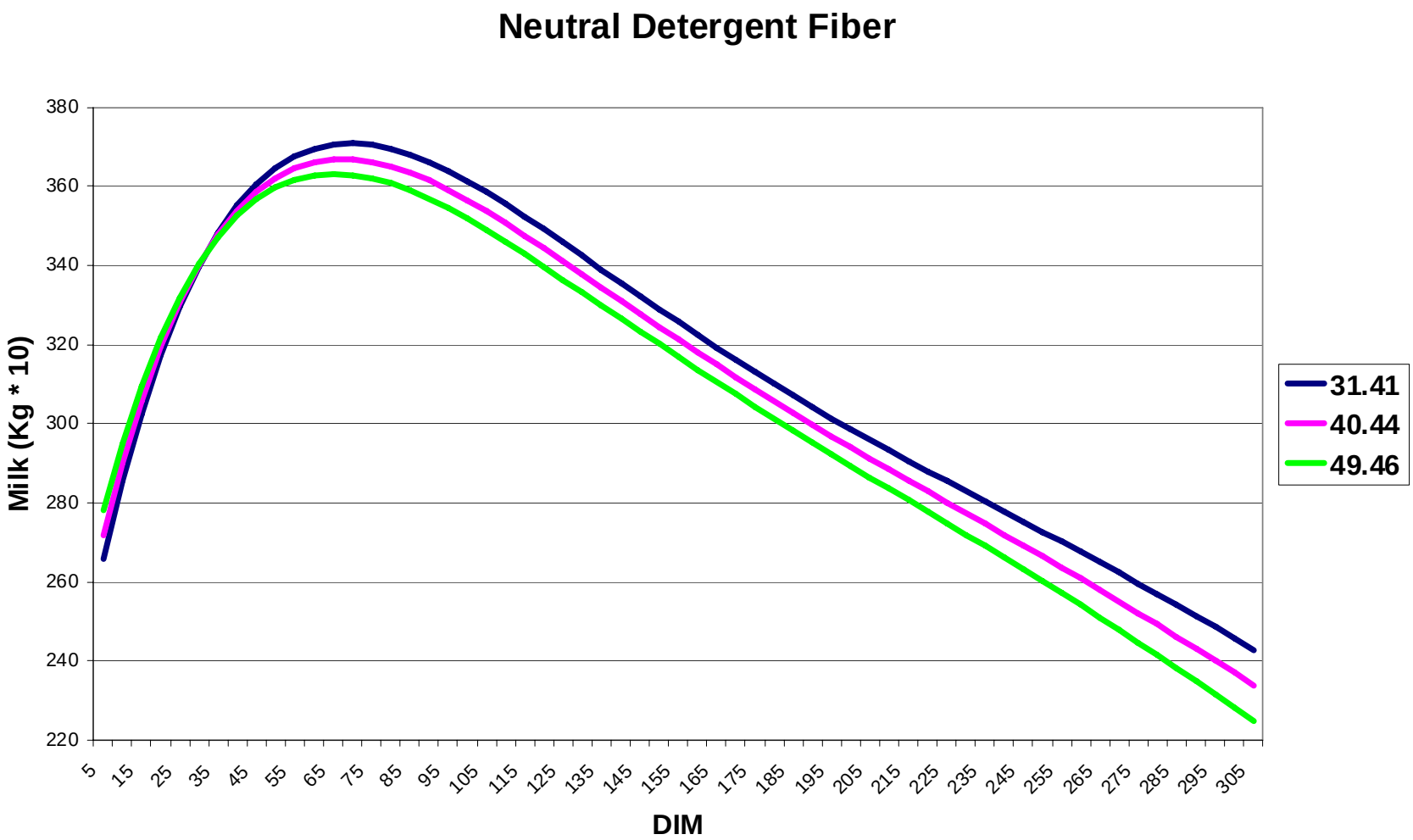
Results


Crude Protein
Mean CP – 2 st dev = 11.59
Milk (Kg *10)
DIM
11.59
15.51
380
360
340
320
300
280
260
240
220
5
15
25
35
45
55
65
75
85
95
105
115
125
135
145
155
165
175
185
195
205
215
225
235
245
255
265
275
285
295
305

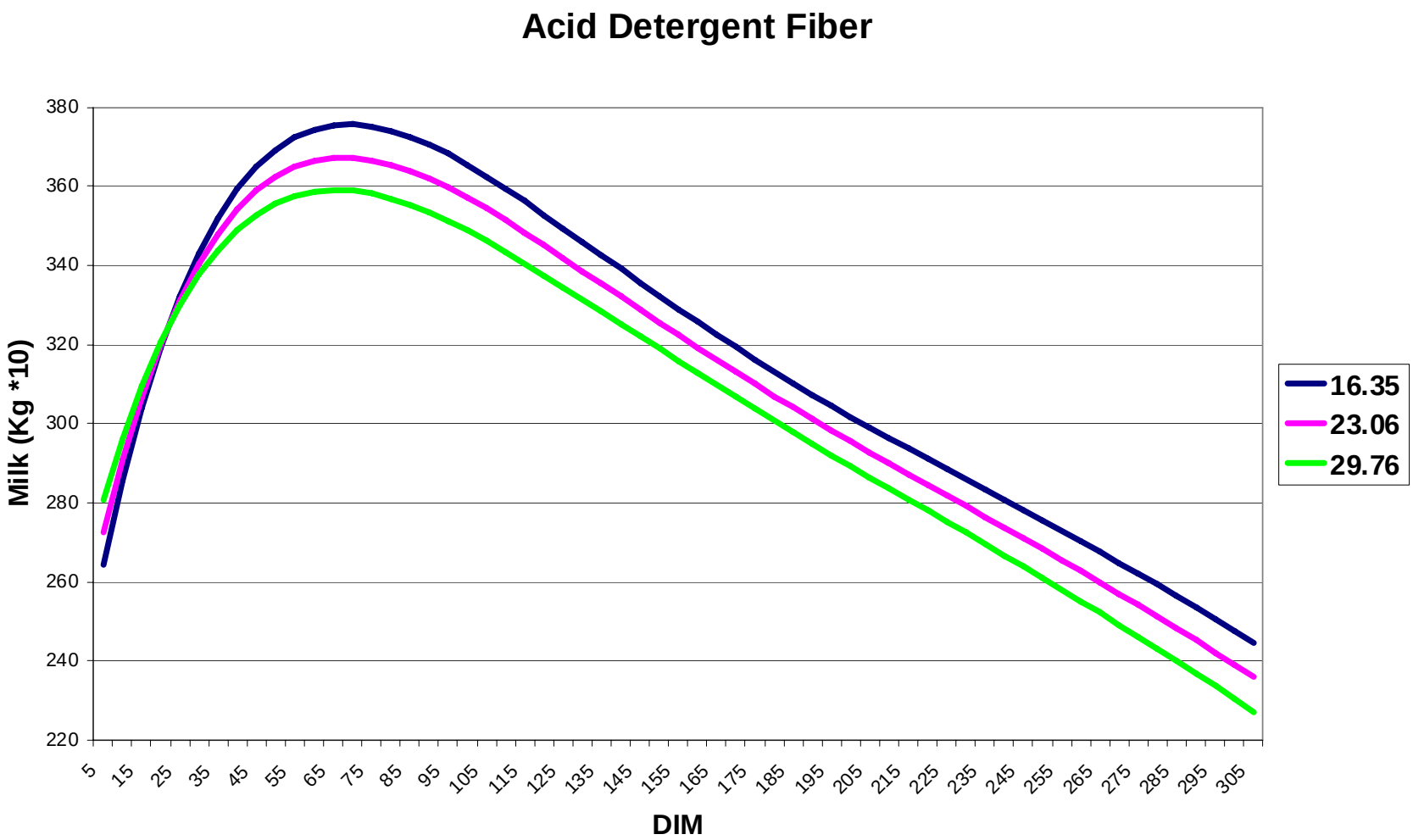
Results


Crude Protein
Milk (Kg *10)
380
360
340
320
300
280
260
240
220
5
15
25
35
45
55
65
75
85
95
105
115
125
135
145
155
165
175
185
195
205
215
225
235
245
255
265
275
285
295
305
DIM
Mean CP + 2 st dev = 19.44
11.59
15.51
19.44

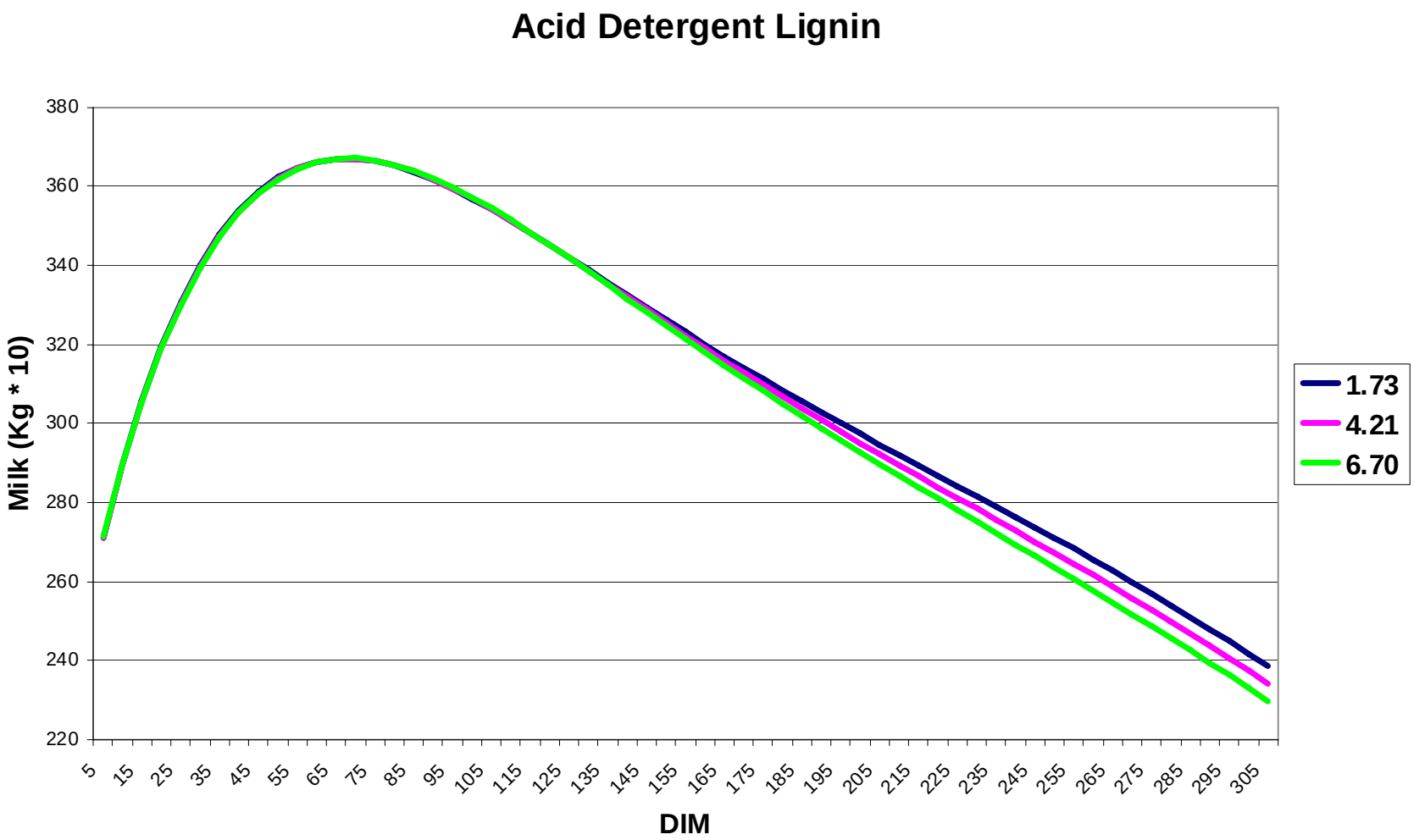
Results


Neutral Detergent Fiber
Milk (Kg * 10)
380
360
340
320
300
280
260
240
220
5
15
25
35
45
55
65
75
85
95
105
115
125
135
145
155
165
175
185
195
205
215
225
235
245
255
265
275
285
295
305
DIM
31.41
40.44
49.46

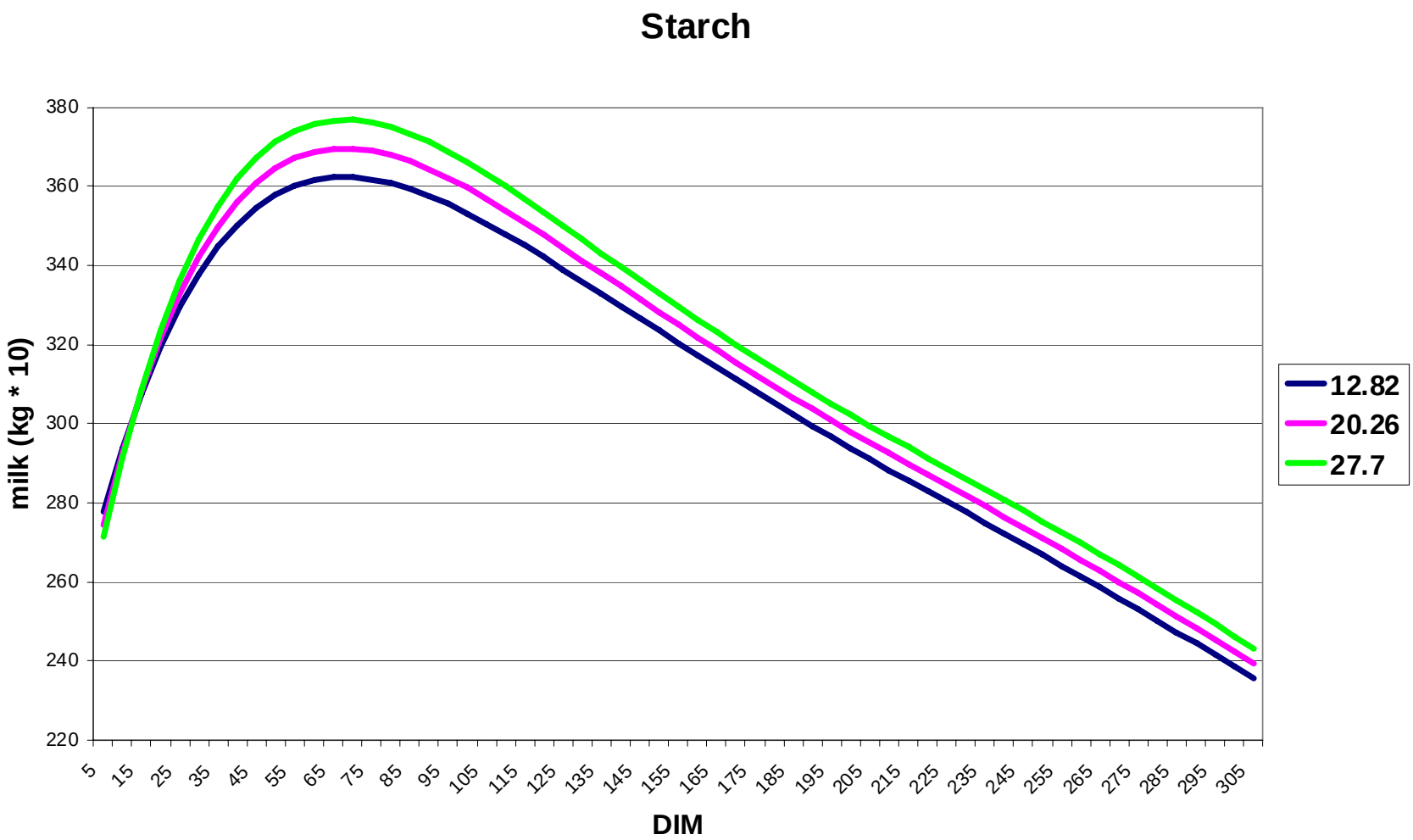
Results


Acid Detergent Fiber
Milk (Kg *10)
380
360
340
320
300
280
260
240
220
5
15
25
35
45
55
65
75
85
95
105
115
125
135
145
155
165
175
185
195
205
215
225
235
245
255
265
275
285
295
305
DIM
16.35
23.06
29.76

Results


Acid Detergent Lignin
Milk (Kg * 10)
380
360
340
320
300
280
260
240
220
5
15
25
35
45
55
65
75
85
95
105
115
125
135
145
155
165
175
185
195
205
215
225
235
245
255
265
275
285
295
305
DIM
1.73
4.21
6.70

Results


Starch
380
360
340
320
300
280
260
240
220
milk (kg * 10)
5
15
25
35
45
55
65
75
85
95
105
115
125
135
145
155
165
175
185
195
205
215
225
235
245
255
265
275
285
295
305
DIM
12.82
20.26
27.7

Conclusions

- CP and starch were positively associated with milk yield
- ADF and NDF were negatively associated with milk yield
- ADL and SN influenced respectively negatively and positively lactation persistency
- TMR chemical parameters influence milk yield depending on lactation stage
- attention has to be paid to cows lactation stage when formulating rations (feeding groups)
- management advice

Acknowledgements

Thank you!

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