



# Assessment of Lab Performance and Analytical Equivalence in Milk Testing in North America

ICAR, June 16, 2008

Niagara Falls, New York



Paul Sauvé

Canadian Lab Services

Capital Laboratory Services

Ottawa, Ontario, CA

[jpsauve@bellnet.ca](mailto:jpsauve@bellnet.ca)

# DHI Testing in North America - Facts and Figures

The title is positioned at the top left of the slide. Below it, there are three horizontal bars of varying lengths and shades of blue, extending from the left edge of the slide towards the right. The top bar is the longest and darkest blue, the middle bar is shorter and a medium blue, and the bottom bar is the shortest and a lighter blue.

# DHI Testing in North America - Facts and Figures



- 55 official (accredited/certified) DHI laboratories in North America

# DHI Testing in North America - Facts and Figures

- 55 official (accredited/certified) DHI laboratories in North America
- 44 in USA (including 1 in Puerto Rico), 8 in Canada, 1 in Mexico \*

# DHI Testing in North America - Facts and Figures

- 55 official (accredited/certified) DHI laboratories in North America
- 44 in USA (including 1 in Puerto Rico), 8 in Canada, 1 in Mexico \*
- approximately 115 infrared analyzers (fat, protein, MUN)

# DHI Testing in North America - Facts and Figures

- 55 official (accredited/certified) DHI laboratories in North America
- 44 in USA (including 1 in Puerto Rico), 8 in Canada, 1 in Mexico \*
- approximately 115 infrared analyzers (fat, protein, MUN)
- approximately 130 somatic cell counters

# DHI Testing in North America - Facts and Figures

- 55 official (accredited/certified) DHI laboratories in North America
- 44 in USA (including 1 in Puerto Rico), 8 in Canada, 1 in Mexico \*
- approximately 115 infrared analyzers (fat, protein, MUN)
- approximately 130 somatic cell counters
- approximately 40 MUN analyzers (IR, differential pH, FIA, etc.)

# DHI Testing in North America - Facts and Figures

- 55 official (accredited/certified) DHI laboratories in North America
- 44 in USA (including 1 in Puerto Rico), 8 in Canada, 1 in Mexico \*
- approximately 115 infrared analyzers (fat, protein, MUN)
- approximately 130 somatic cell counters
- approximately 40 MUN analyzers (IR, differential pH, FIA, etc.)
- approximately 70,000,000 samples tested annually \*

# DHI Testing in North America - Facts and Figures


- 55 official (accredited/certified) DHI laboratories in North America
- 44 in USA (including 1 in Puerto Rico), 8 in Canada, 1 in Mexico \*
- approximately 115 infrared analyzers (fat, protein, MUN)
- approximately 130 somatic cell counters
- approximately 40 MUN analyzers (IR, differential pH, FIA, etc.)
- approximately 70,000,000 samples tested annually \*
- several DHI labs offering additional services

# DHI Testing in North America - Facts and Figures


- 55 official (accredited/certified) DHI laboratories in North America
- 44 in USA (including 1 in Puerto Rico), 8 in Canada, 1 in Mexico \*
- approximately 115 infrared analyzers (fat, protein, MUN)
- approximately 130 somatic cell counters
- approximately 40 MUN analyzers (IR, differential pH, FIA, etc.)
- approximately 70,000,000 samples tested annually \*
- several DHI labs offering additional services

(forage analysis, Johnes screening, water analysis, component payment testing, drug residues, bacteria, added water, vet services, nutritional consulting, etc.)

# Accreditation / Certification


The slide features three horizontal bars of varying lengths and shades of blue, extending from the left edge towards the right. The top bar is the longest and darkest blue, the middle bar is shorter and a medium blue, and the bottom bar is the shortest and lightest blue.

# Accreditation / Certification

Two horizontal bars of different shades of blue, one darker than the other, extending across the top of the page.

Canada


# Accreditation / Certification



## Canada

- DHI labs are accredited under ISO 17025.

# Accreditation / Certification



## Canada

- DHI labs are accredited under ISO 17025.
- Accreditation is delivered by the *Standards Council of Canada* and coordinated by *CLS*.

# Accreditation / Certification

---

## Canada

- DHI labs are accredited under ISO 17025.
- Accreditation is delivered by the *Standards Council of Canada* and coordinated by *CLS*.
- On-site assessments are conducted every two years.

# Accreditation / Certification

---

## Canada

- DHI labs are accredited under ISO 17025.
- Accreditation is delivered by the *Standards Council of Canada* and coordinated by *CLS*.
- On-site assessments are conducted every two years.

## USA and Mexico

# Accreditation / Certification

---

## Canada

- DHI labs are accredited under ISO 17025.
- Accreditation is delivered by the *Standards Council of Canada* and coordinated by *CLS*.
- On-site assessments are conducted every two years.

## USA and Mexico

- DHI labs are certified under guidelines developed by the *Council on Dairy Cattle Breeding*.

# Accreditation / Certification

---

## Canada

- DHI labs are accredited under ISO 17025.
- Accreditation is delivered by the *Standards Council of Canada* and coordinated by *CLS*.
- On-site assessments are conducted every two years.

## USA and Mexico

- DHI labs are certified under guidelines developed by the *Council on Dairy Cattle Breeding*.
- Certification is delivered and coordinated by *QCS*.

# Accreditation / Certification

## Canada

- DHI labs are accredited under ISO 17025.
- Accreditation is delivered by the *Standards Council of Canada* and coordinated by *CLS*.
- On-site assessments are conducted every two years.

## USA and Mexico

- DHI labs are certified under guidelines developed by the *Council on Dairy Cattle Breeding*.
- Certification is delivered and coordinated by *QCS*.
- On-site audits are conducted every two years.

# Proficiency Testing Programs

The title is positioned at the top left of the slide. Below it, there are three horizontal bars of varying lengths and shades of blue, extending from the left edge towards the right. The top bar is the longest and darkest blue, the middle bar is shorter and a medium blue, and the bottom bar is the shortest and a lighter blue.

# Proficiency Testing Programs

The title is followed by two horizontal bars. The top bar is a thick, solid blue line. The bottom bar is a thinner, lighter blue line that is shorter than the top bar, starting from the same left edge but ending further to the right.

Canada

# Proficiency Testing Programs



## Canada

- Analytical performance is assessed monthly using samples provided by *Canadian Lab Services*.

# Proficiency Testing Programs

---

---

## Canada

- Analytical performance is assessed monthly using samples provided by *Canadian Lab Services*.
- Data analysis and reporting is coordinated by *CLS*.

# Proficiency Testing Programs

---

---

## Canada

- Analytical performance is assessed monthly using samples provided by *Canadian Lab Services*.
- Data analysis and reporting is coordinated by *CLS*.

## USA and Mexico

# Proficiency Testing Programs

---

---

## Canada

- Analytical performance is assessed monthly using samples provided by *Canadian Lab Services*.
- Data analysis and reporting is coordinated by *CLS*.

## USA and Mexico

- Analytical performance is assessed monthly using samples provided by *Eastern Lab Services*.

# Proficiency Testing Programs

---

---

## Canada

- Analytical performance is assessed monthly using samples provided by *Canadian Lab Services*.
- Data analysis and reporting is coordinated by *CLS*.

## USA and Mexico

- Analytical performance is assessed monthly using samples provided by *Eastern Lab Services*.
- Data analysis and reporting is coordinated by *QCS* with involvement of an outside contractor.

# Proficiency Testing - Schedules and Samples

The title is positioned at the top left of the slide. Below it, there are three horizontal bars of varying lengths and shades of blue, extending from the left edge of the slide towards the right. The top bar is the longest and darkest blue, the middle bar is shorter and a medium blue, and the bottom bar is the shortest and a lighter blue.

# Proficiency Testing - Schedules and Samples

The title is positioned at the top left. Below it, there are three horizontal bars of varying lengths and shades of blue, extending from the left edge of the slide towards the right.

Canada

# Proficiency Testing - Schedules and Samples



## Canada

- Six times annually sets of 20 blind duplicate samples are circulated according to a pre-arranged schedule.

# Proficiency Testing - Schedules and Samples

## Canada

- Six times annually sets of 20 blind duplicate samples are circulated according to a pre-arranged schedule.
- Six times annually sets of 16 individual samples are circulated unannounced. \*

# Proficiency Testing - Schedules and Samples

## Canada

- Six times annually sets of 20 blind duplicate samples are circulated according to a pre-arranged schedule.
- Six times annually sets of 16 individual samples are circulated unannounced. \*
- Samples are sent by overnight courier.

# Proficiency Testing - Schedules and Samples

## Canada

- Six times annually sets of 20 blind duplicate samples are circulated according to a pre-arranged schedule.
- Six times annually sets of 16 individual samples are circulated unannounced. \*
- Samples are sent by overnight courier.

## USA and Mexico

# Proficiency Testing - Schedules and Samples

## Canada

- Six times annually sets of 20 blind duplicate samples are circulated according to a pre-arranged schedule.
- Six times annually sets of 16 individual samples are circulated unannounced. \*
- Samples are sent by overnight courier.

## USA and Mexico

- Every month sets of 24 duplicate samples are circulated according to a pre-arranged schedule.

# Proficiency Testing - Schedules and Samples

## Canada

- Six times annually sets of 20 blind duplicate samples are circulated according to a pre-arranged schedule.
- Six times annually sets of 16 individual samples are circulated unannounced. \*
- Samples are sent by overnight courier.

## USA and Mexico

- Every month sets of 24 duplicate samples are circulated according to a pre-arranged schedule.
- Samples are sent by overnight courier.

# Proficiency Testing - Data submission and Reporting

The title is positioned at the top left of the slide. Below it, there are three horizontal bars of varying lengths and shades of blue, extending from the left edge of the slide towards the right. The top bar is the longest and darkest blue, the middle bar is shorter and a medium blue, and the bottom bar is the shortest and a lighter blue.

# Proficiency Testing - Data submission and Reporting

Two horizontal bars of different shades of blue, one darker than the other, extending across the top of the slide.

Canada

# Proficiency Testing - Data submission and Reporting

---

---

## Canada

- Test results are submitted electronically and performance reports are returned electronically.

# Proficiency Testing - Data submission and Reporting

## Canada

- Test results are submitted electronically and performance reports are returned electronically.
- Reports include coded data from all participating labs.

# Proficiency Testing - Data submission and Reporting

## Canada

- Test results are submitted electronically and performance reports are returned electronically.
- Reports include coded data from all participating labs.
- Turn around time from deadline to circulation of reports < 3 days.

# Proficiency Testing - Data submission and Reporting

## Canada

- Test results are submitted electronically and performance reports are returned electronically.
- Reports include coded data from all participating labs.
- Turn around time from deadline to circulation of reports < 3 days.

## USA and Mexico

# Proficiency Testing - Data submission and Reporting

## Canada

- Test results are submitted electronically and performance reports are returned electronically.
- Reports include coded data from all participating labs.
- Turn around time from deadline to circulation of reports < 3 days.

## USA and Mexico

- Test results are submitted and reports are returned via a secure web site.

# Proficiency Testing - Data submission and Reporting

## Canada

- Test results are submitted electronically and performance reports are returned electronically.
- Reports include coded data from all participating labs.
- Turn around time from deadline to circulation of reports < 3 days.

## USA and Mexico

- Test results are submitted and reports are returned via a secure web site.
- Reports include individual data and summary graphs from all labs.

# Proficiency Testing - Data submission and Reporting


## Canada

- Test results are submitted electronically and performance reports are returned electronically.
- Reports include coded data from all participating labs.
- Turn around time from deadline to circulation of reports < 3 days.


## USA and Mexico

- Test results are submitted and reports are returned via a secure web site.
- Reports include individual data and summary graphs from all labs.
- Turn around time < 3 days.

# Proficiency Testing - Components included


The title is followed by three horizontal bars of varying lengths and shades of blue, extending from the left edge of the slide towards the right.

# Proficiency Testing - Components included

The title is followed by two horizontal bars. The top bar is a solid, dark blue color and spans the width of the slide. The bottom bar is a lighter blue color and is shorter, starting from the left edge and ending about 100 pixels before the right edge.

Canada

# Proficiency Testing - Components included



## Canada

- 6 times annually: fat, protein, lactose, total solids, MUN, SCC

# Proficiency Testing - Components included

---

---

## Canada

- 6 times annually: fat, protein, lactose, total solids, MUN, SCC
- 6 times annually: fat, protein, SCC, MUN

# Proficiency Testing - Components included

---

---

## Canada

- 6 times annually: fat, protein, lactose, total solids, MUN, SCC
- 6 times annually: fat, protein, SCC, MUN
- monthly: MUN

# Proficiency Testing - Components included

---

---

## Canada

- 6 times annually: fat, protein, lactose, total solids, MUN, SCC
- 6 times annually: fat, protein, SCC, MUN
- monthly: MUN
- A program for Johnes screening is under development.

# Proficiency Testing - Components included

---

---

## Canada

- 6 times annually: fat, protein, lactose, total solids, MUN, SCC
- 6 times annually: fat, protein, SCC, MUN
- monthly: MUN
- A program for Johnes screening is under development.

## USA and Mexico

# Proficiency Testing - Components included

## Canada

- 6 times annually: fat, protein, lactose, total solids, MUN, SCC
- 6 times annually: fat, protein, SCC, MUN
- monthly: MUN
- A program for Johnes screening is under development.

## USA and Mexico

- monthly: fat, protein, SCC, MUN \*

# Proficiency Testing - Components included

## Canada

- 6 times annually: fat, protein, lactose, total solids, MUN, SCC
- 6 times annually: fat, protein, SCC, MUN
- monthly: MUN
- A program for Johnes screening is under development.

## USA and Mexico

- monthly: fat, protein, SCC, MUN \*
- A program for Johnes screening is under development.

# Proficiency Testing - Tolerances (fat and protein)

The title is positioned at the top left of the slide. Below it, there are three horizontal bars of varying lengths and shades of blue, extending from the left edge of the slide towards the right.

# Proficiency Testing - Tolerances (fat and protein)

The title is followed by three horizontal bars of varying lengths and shades of blue, extending from the left edge of the slide.

Canada

# Proficiency Testing - Tolerances (fat and protein)

## Canada

- MD < +/- .04% and SDD < .04% in three of the last four trials

# Proficiency Testing - Tolerances (fat and protein)

## Canada

- MD < +/- .04% and SDD < .04% in three of the last four trials
- RMD (rolling mean difference) < .02% across the last six trials

# Proficiency Testing - Tolerances (fat and protein)

## Canada

- MD < +/- .04% and SDD < .04% in three of the last four trials
- RMD (rolling mean difference) < .02% across the last six trials

## USA and Mexico

# Proficiency Testing - Tolerances (fat and protein)

## Canada

- $MD < +/- .04\%$  and  $SDD < .04\%$  in three of the last four trials
- RMD (rolling mean difference)  $< .02\%$  across the last six trials

## USA and Mexico

- $MD < +/- .04\%$  and  $SDD < .04\%$  in three of the last four trials

# Proficiency Testing - Tolerances (fat and protein)


## Canada

- $MD < +/- .04\%$  and  $SDD < .04\%$  in three of the last four trials
- $RMD$  (rolling mean difference)  $< .02\%$  across the last six trials


## USA and Mexico

- $MD < +/- .04\%$  and  $SDD < .04\%$  in three of the last four trials
- $RMD$  (rolling mean difference)  $< .02\%$  across the last six trials

# Proficiency Testing - Tolerances (SCC)

The slide features three horizontal bars of varying lengths and shades of blue, extending from the left edge of the slide towards the right. The top bar is the longest and darkest blue, the middle bar is shorter and a medium blue, and the bottom bar is the shortest and lightest blue.

# Proficiency Testing - Tolerances (SCC)

The header is followed by three horizontal bars of varying lengths and shades of blue, extending from the left edge of the slide.

Canada

# Proficiency Testing - Tolerances (SCC)

## Canada

- $M\%D < +/- 10\%$  and  $SD\%D < 10\%$  in three of the last four trials

# Proficiency Testing - Tolerances (SCC)

## Canada

- $M\%D < +/- 10\%$  and  $SD\%D < 10\%$  in three of the last four trials
- $RM\%D$  (rolling mean difference)  $< 5\%$  across the last six trials

# Proficiency Testing - Tolerances (SCC)

## Canada

- $M\%D < +/- 10\%$  and  $SD\%D < 10\%$  in three of the last four trials
- $RM\%D$  (rolling mean difference)  $< 5\%$  across the last six trials

## USA and Mexico

# Proficiency Testing - Tolerances (SCC)

## Canada

- $M\%D < +/- 10\%$  and  $SD\%D < 10\%$  in three of the last four trials
- $RM\%D$  (rolling mean difference)  $< 5\%$  across the last six trials

## USA and Mexico

- $M\%D < +/- 10\%$  and  $SD\%D < 10\%$  in three of the last four trials

# Proficiency Testing - Tolerances (SCC)

## Canada

- $M\%D < +/- 10\%$  and  $SD\%D < 10\%$  in three of the last four trials
- $RM\%D$  (rolling mean difference)  $< 5\%$  across the last six trials

## USA and Mexico

- $M\%D < +/- 10\%$  and  $SD\%D < 10\%$  in three of the last four trials
- $RM\%D$  (rolling mean difference)  $< 5\%$  across the last six trials

# Proficiency testing - Example

<u>Sample</u>	<u>Fat (ref)</u>	<u>Fat (IR)</u>	<u>Diff.</u>
1	3.685	3.715	0.030
2	3.790	3.820	0.030
3	3.882	3.910	0.028
4	3.898	3.910	0.012
5	3.998	4.035	0.037
6	4.006	4.040	0.034
7	4.063	4.105	0.042
8	4.157	4.170	0.013
9	4.286	4.300	0.014
10	4.368	4.395	0.027
		MD	0.027
		SDD	.0010

# Proficiency testing - Example

<u>Sample</u>	<u>Fat (ref)</u>	<u>Fat (IR)</u>	<u>Diff.</u>
1	3.685	3.715	0.030
2	3.790	3.820	0.030
3	3.882	3.910	0.028
4	3.898	3.910	0.012
5	3.998	4.035	0.037
6	4.006	4.040	0.034
7	4.063	4.105	0.042
8	4.157	4.170	0.013
9	4.286	4.300	0.014
10	4.368	4.395	0.027
		MD	0.027
		SDD	.0010

# Proficiency testing - Example

<u>Sample</u>	<u>Fat (ref)</u>	<u>Fat (IR)</u>	<u>Diff.</u>
1	3.685	3.715	0.030
2	3.790	3.820	0.030
3	3.882	3.910	0.028
4	3.898	3.910	0.012
5	3.998	4.035	0.037
6	4.006	4.040	0.034
7	4.063	4.105	0.042
8	4.157	4.170	0.013
9	4.286	4.300	0.014
10	4.368	4.395	0.027
	MD	0.027	
	SDD	.0010	

MD < +/- .04% in three of the last four trials

# Proficiency testing - Example

<u>Sample</u>	<u>Fat (ref)</u>	<u>Fat (IR)</u>	<u>Diff.</u>
1	3.685	3.715	0.030
2	3.790	3.820	0.030
3	3.882	3.910	0.028
4	3.898	3.910	0.012
5	3.998	4.035	0.037
6	4.006	4.040	0.034
7	4.063	4.105	0.042
8	4.157	4.170	0.013
9	4.286	4.300	0.014
10	4.368	4.395	0.027
		<b>MD</b>	<b>0.027</b>
		<b>SDD</b>	<b>.0010</b>

# Proficiency testing - Example

<u>Sample</u>	<u>Fat (ref)</u>	<u>Fat (IR)</u>	<u>Diff.</u>
1	3.685	3.715	0.030
2	3.790	3.820	0.030
3	3.882	3.910	0.028
4	3.898	3.910	0.012
5	3.998	4.035	0.037
6	4.006	4.040	0.034
7	4.063	4.105	0.042
8	4.157	4.170	0.013
9	4.286	4.300	0.014
10	4.368	4.395	0.027

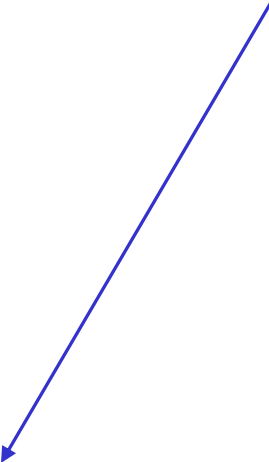
MD 0.027

SDD .0010

# Proficiency testing - Example

<u>Sample</u>	<u>Fat (ref)</u>	<u>Fat (IR)</u>	<u>Diff.</u>
1	3.685	3.715	0.030
2	3.790	3.820	0.030
3	3.882	3.910	0.028
4	3.898	3.910	0.012
5	3.998	4.035	0.037
6	4.006	4.040	0.034
7	4.063	4.105	0.042
8	4.157	4.170	0.013
9	4.286	4.300	0.014
10	4.368	4.395	0.027
	MD		0.027
	SDD		.0010

SDD < .04% in three of the last four trials



# Proficiency Testing - Example

The title is positioned at the top left of the slide. Below it, there are three horizontal bars of varying lengths and shades of blue, extending from the left edge of the slide towards the right. The top bar is the longest and darkest blue, the middle bar is shorter and a medium blue, and the bottom bar is the shortest and a lighter blue.

# Proficiency Testing - Example

- The rolling mean difference (RMD) must be less than .02 percent across the last six trials.

# Proficiency Testing - Example

- The rolling mean difference (RMD) must be less than .02 percent across the last six trials.

Date	MD
Jan 2008	-0.020
Feb 2008	0.015
Mar 2008	0.022
Apr 2008	-0.031
May 2008	0.024
<u>Jun 2008</u>	<u>0.011</u>

RMD

# Proficiency Testing - Example

- The rolling mean difference (RMD) must be less than .02 percent across the last six trials.

Date	MD
Jan 2008	-0.020
Feb 2008	0.015
Mar 2008	0.022
Apr 2008	-0.031
May 2008	0.024
<u>Jun 2008</u>	<u>0.011</u>
RMD	0.004

# Canadian Program - Individual Data, Tabular Presentation

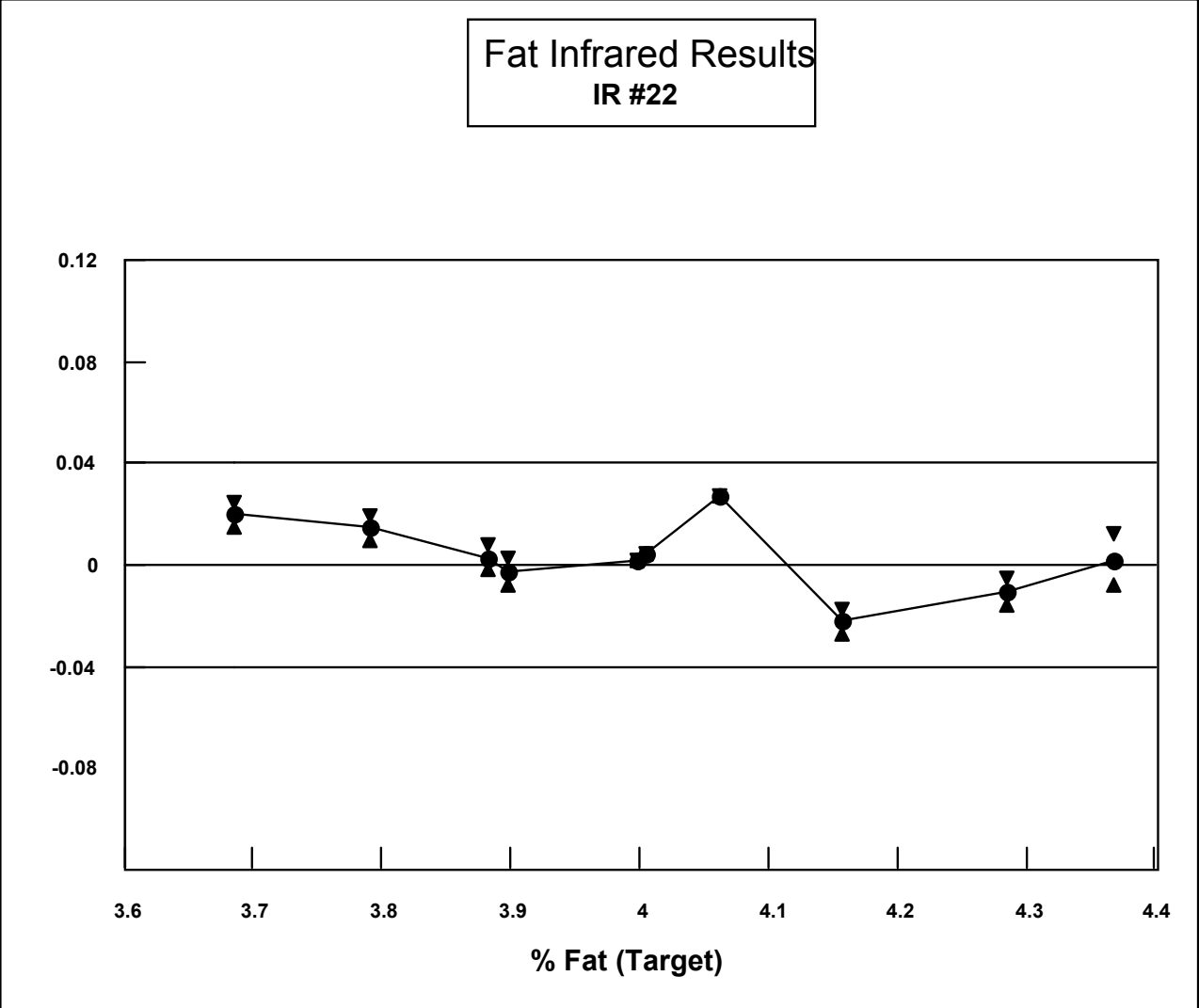
## Fat Infrared Results

IR #22

May 2008

<b>SAMPLE</b>	<b>TARGET</b>	<b>REP. 1</b>	<b>REP. 2</b>	<b>MEAN</b>	<b>RANGE</b>	<b>SD</b>	<b>RES.</b>
MS-2	3.685	3.710	3.700	3.705	0.010	0.007	0.020
MS-8	3.790	3.810	3.800	3.805	0.010	0.007	0.015
MS-6	3.882	3.880	3.890	3.885	0.010	0.007	0.003
MS-9	3.898	3.890	3.900	3.895	0.010	0.007	-0.003
MS-7	3.998	4.000	4.000	4.000	0.000	0.000	0.002
MS-10	4.006	4.010	4.010	4.010	0.000	0.000	0.004
MS-4	4.063	4.090	4.090	4.090	0.000	0.000	0.027
MS-5	4.157	4.130	4.140	4.135	0.010	0.007	-0.022
MS-3	4.286	4.270	4.280	4.275	0.010	0.007	-0.010
MS-1	4.368	4.380	4.360	4.370	0.020	0.014	0.002
						MD	0.004
						SDD	0.014
						SDA	0.007

# Canadian Program - Individual Data, Graphical Presentation

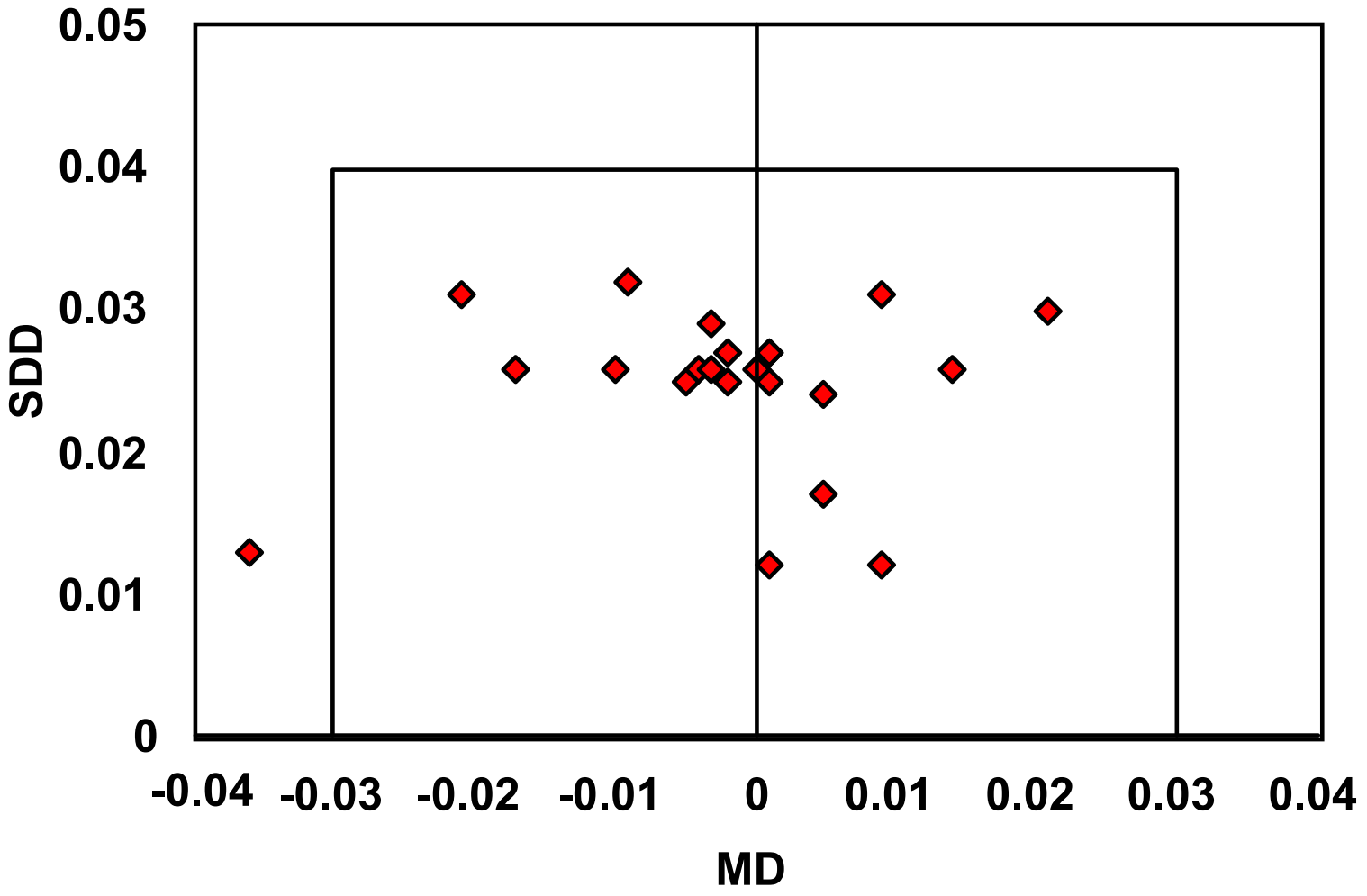


# Canadian Program - Summary Table

## Protein Infrared Results

IR#	MD	SDD	SDA	S
IR#2	-0.036	0.013	0.009	0.023
IR#14	-0.021	0.031	0.006	0.022
IR#6	-0.017	0.026	0.009	0.019
IR#13	-0.010	0.026	0.005	0.016
IR#19	-0.009	0.032	0.015	0.021
IR#10	-0.005	0.025	0.006	0.015
IR#3	-0.004	0.026	0.009	0.016
IR#17	-0.003	0.029	0.003	0.017
IR#8	-0.003	0.026	0.006	0.016
IR#11	-0.002	0.027	0.007	0.016
IR#22	-0.002	0.025	0.007	0.015
IR#12	0.000	0.026	0.007	0.016
IR#18	0.001	0.027	0.004	0.016
IR#4	0.001	0.027	0.005	0.016
IR#5	0.001	0.025	0.004	0.015
IR#1	0.001	0.012	0.005	0.008
IR#15	0.005	0.024	0.008	0.015
IR#20	0.005	0.017	0.005	0.011
IR#7	0.009	0.031	0.003	0.019
IR#21	0.009	0.012	0.002	0.009
IR#16	0.014	0.026	0.007	0.018
IR#9	0.021	0.030	0.007	0.022
			Mean	0.016

# Canadian Program - Summary Graph



# QCS Program, Individual Data, Tabular Presentation

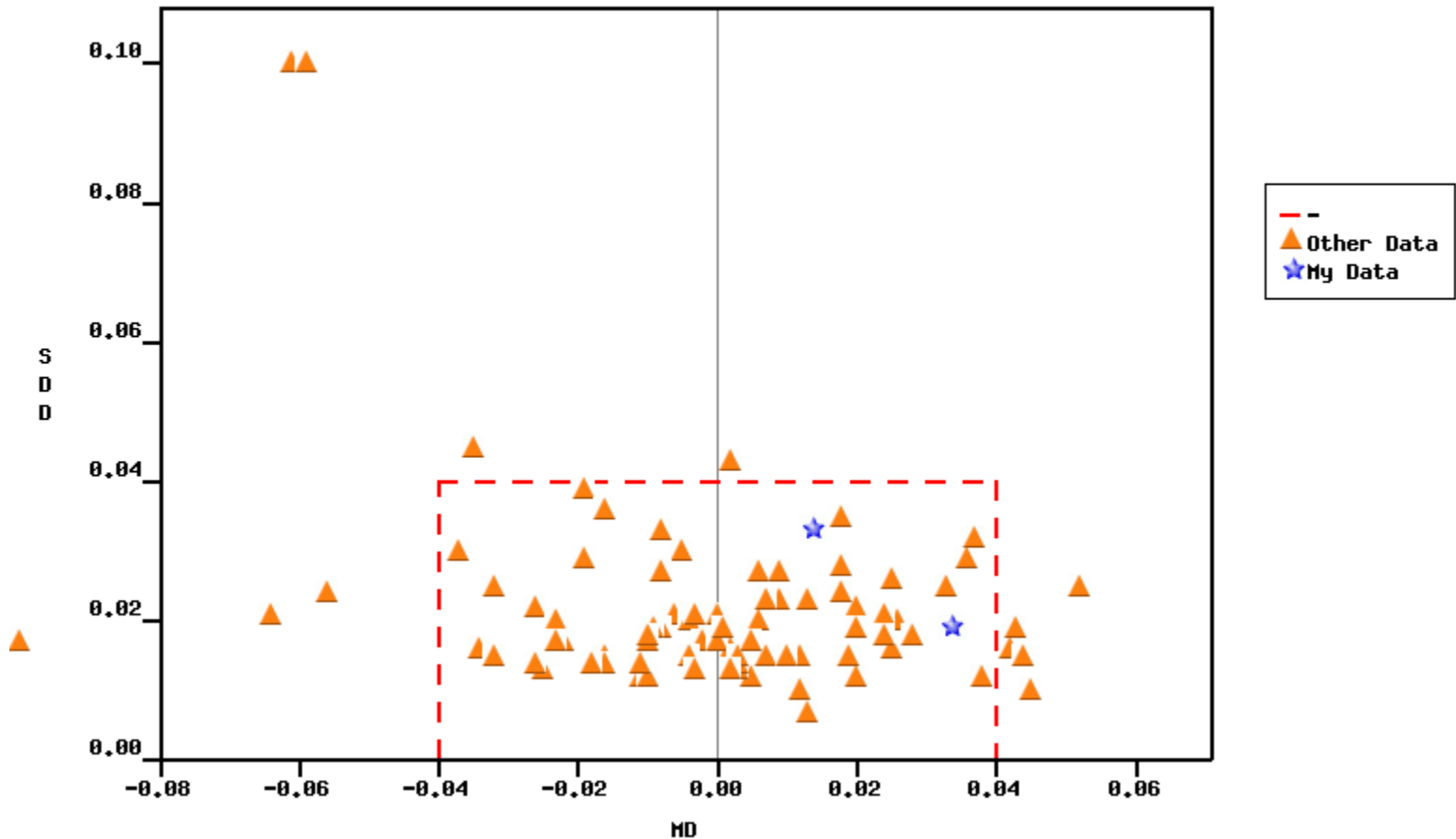
**B2500 A  
Butterfat**

Sample Number	Lab/Instrument		Avg Diff	Instr Results		Prec Stats		Accuracy Stats		
	Ref	Inst		Rep1	Rep2	Range	SD	Reps	IR Mean Diff	
1	3.557	3.564	0.007	3.56	3.58	0.020	0.014	3.570	0.013	
2	3.907	3.909	0.002	3.91	3.90	0.010	0.007	3.905	-0.002	
3	2.990	2.990	0.000	3.01	3.03	0.020	0.014	3.020	0.030	
4	4.153	4.138	-0.015	4.20	4.20	0.000	0.000	4.200	0.047	
5	3.547	3.550	0.003	3.57	3.59	0.020	0.014	3.580	0.033	
6	3.797	3.782	-0.015	3.78	3.79	0.010	0.007	3.785	-0.012	
7	3.707	3.723	0.016	3.74	3.77	0.030	0.021	3.755	0.048	
8	3.223	3.224	0.001	3.26	3.26	0.000	0.000	3.260	0.037	
9	3.640	3.649	0.009	3.68	3.67	0.010	0.007	3.675	0.035	
10	4.297	4.289	-0.008	4.28	4.27	0.010	0.007	4.275	-0.022	
11	4.817	4.800	-0.017	4.75	4.76	0.010	0.007	4.755	-0.062	
12	4.370	4.382	0.012	4.40	4.39	0.010	0.007	4.395	0.025	
			MD	0.000		SDA	0.006		MD	0.014
			SDD	0.011				SDD	0.033	



# QCS Program - Summary Graph

FAT Comparison



# QCS Program - Historical Data, Tabular Presentation

## FAT Results

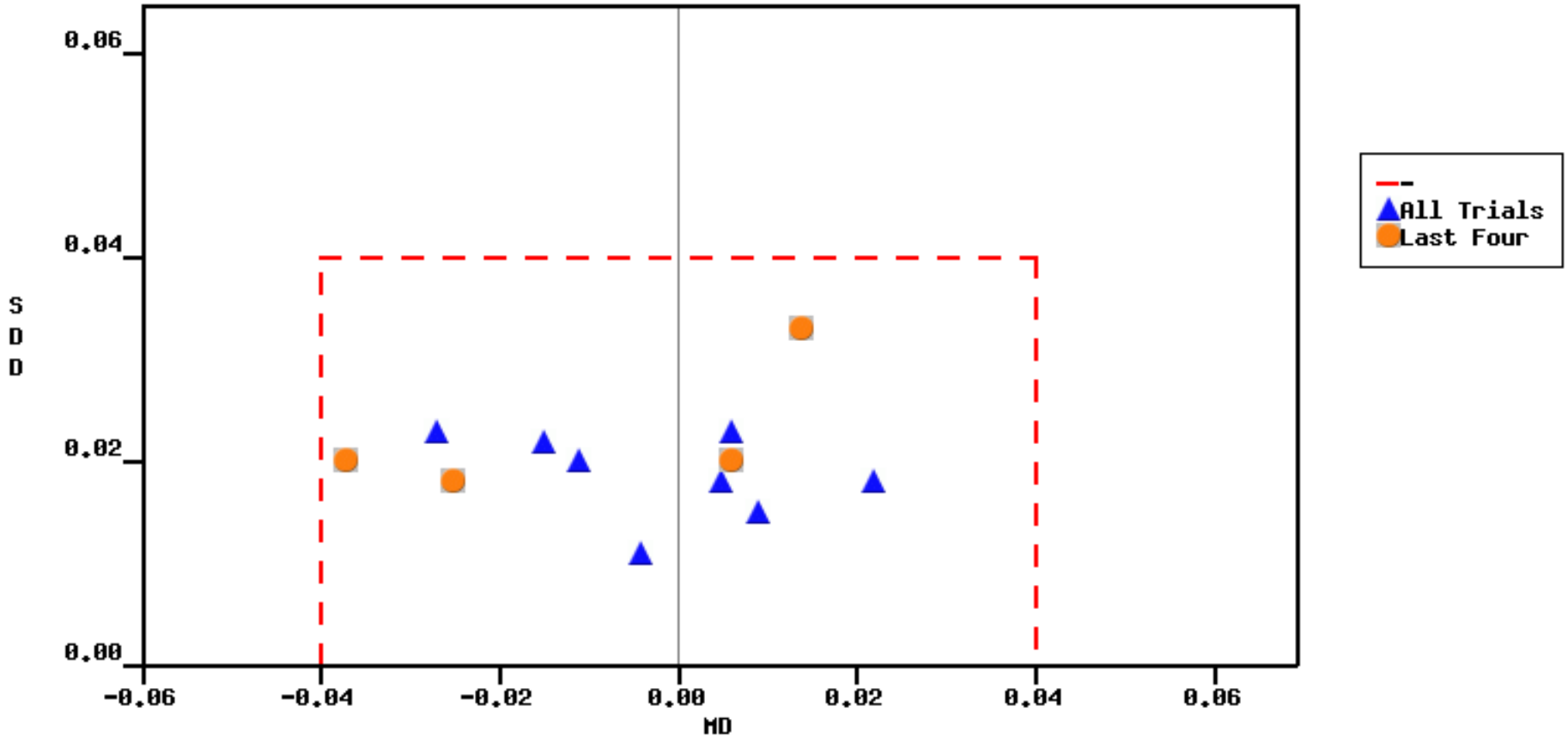
Month	MD	SDD	RMD
Jun	-0.011	0.020	0.002
Jul	0.009	0.015	0.008
Aug	-0.027	0.023	0.004
Sep	-0.004	0.011	0.002
Oct	0.005	0.018	-0.002
Nov	0.006	0.023	-0.004
Dec	0.022	0.018	0.002
Jan	-0.015	0.022	-0.002
Feb	-0.037	0.020	-0.004
Mar	0.006	0.020	-0.002
Apr	-0.025	0.018	-0.007
May	0.014	0.033	-0.006

Changed cell here!

# QCS Program - Historical Data, Graphical Presentation



FAT Results



# QCS Program - Historical Data, Graphical Presentation

FAT Results

