Effects of methionine supplement sources and crude protein on Ross 708 male broiler performance

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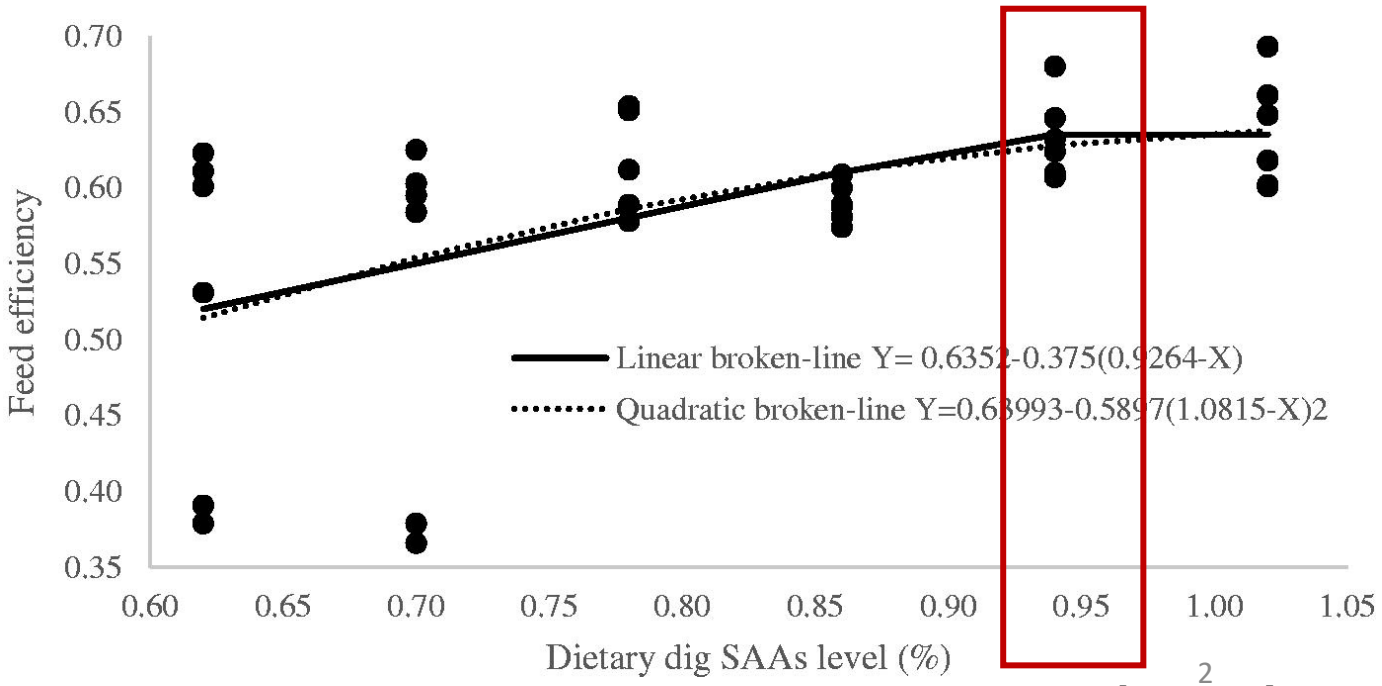
Background: Progress Towards Synthetic Methionine

- Synthetic forms of methionine have been used in the diets of agricultural animals since the 1950s. Kidd et al., 2013
  - Reduce CP → Least-cost formulation Hutton et al., 1958
  - Inclusion of non-bound AA allows for formulation closer to the bird's requirement.

Broiler starter TSAA requirement = 0.95%



Ghavi et al., 2020

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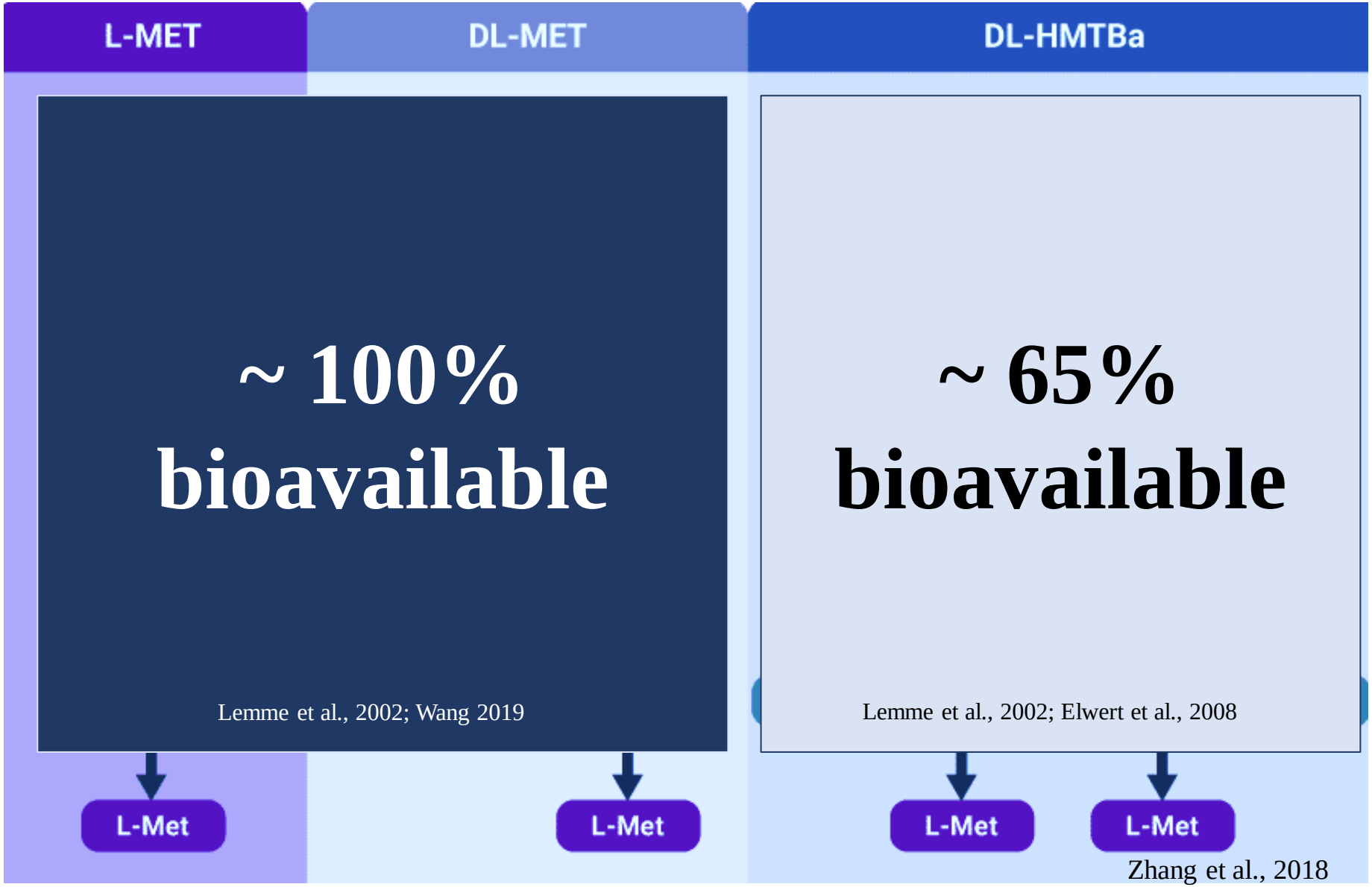
Background: Methionine Sources



Zhang et al., 2018

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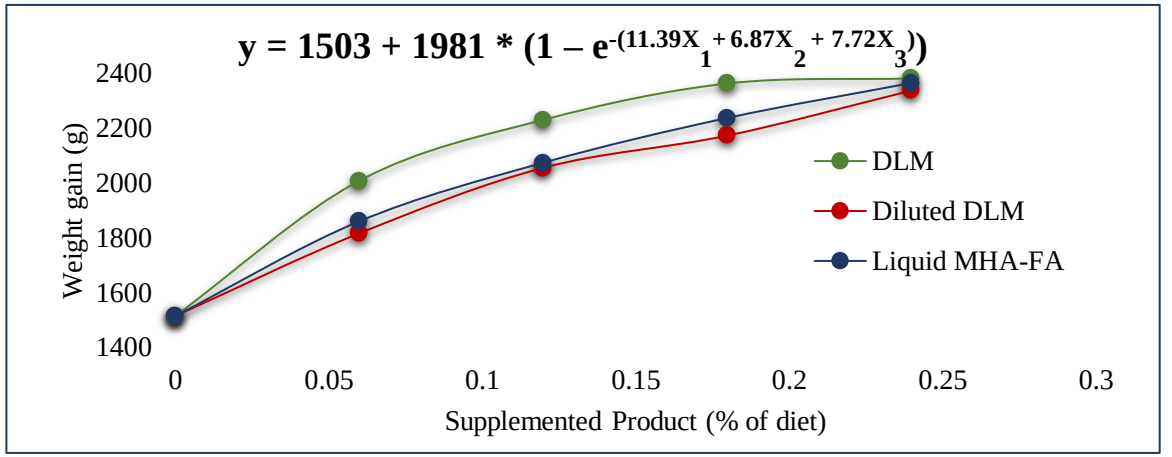
Background: An Alternative Methionine Source

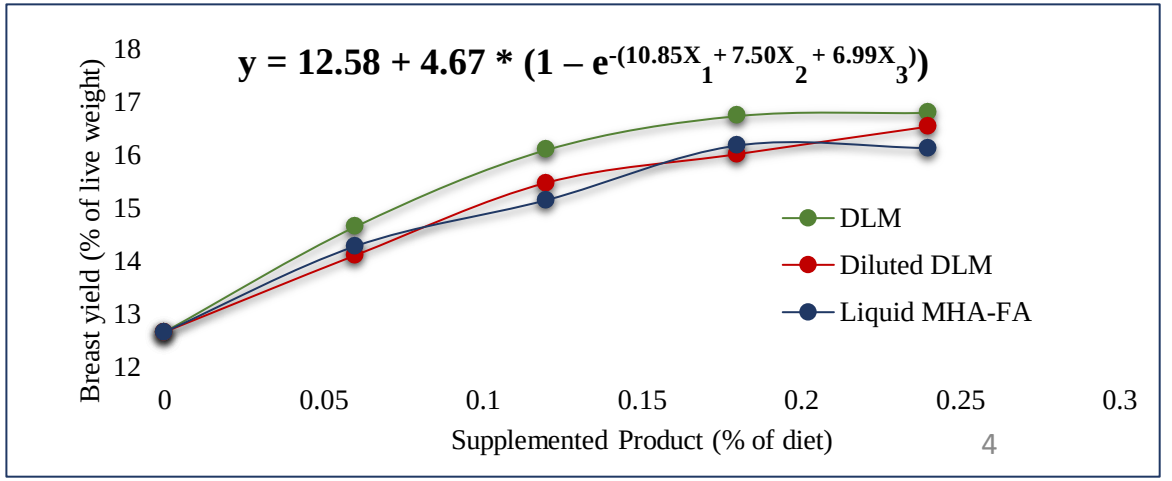
To validate the bioavailability of MHA and to create an alternative methionine source by diluting DL-methionine

65DLM

- 65:100
  - 65 parts DLM
  - 35 parts limestone
  - Replace MHA with 65DLM, 1:1 ratio

Lemme et al., 2002





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Background: Reduced Crude Protein

Replace a portion of intact AA with non-bound AA

Litter quality
Lemme et al., 2019

Efficiency of protein and AA utilization
Beski et al., 2015

Ammonia emissions
Liu et al., 2021

Nitrogen excretion
Nahm, 2007

Footpad lesions
Van Harn et al., 2019

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Hypotheses

- Broilers fed 65DLM will perform similarly to MHA when supplemented in a diet at the same inclusion level.

- Broilers fed reduced CP diets will perform at the same level as birds fed standard CP diets.

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- Broilers fed 65DLM will perform similarly to MHA when supplemented in a diet at the same inclusion level.
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Objectives

- Determine the efficacy of using 65DLM compared to MHA when included in a diet deficient in total sulfur AA.
- Determine how production efficiency is impacted by dietary crude protein levels.

Materials and Methods: Experimental Design

- D 1-42
  - Starter (D 1-10)
  - Grower (D 11-24)
  - Finisher (D 25-42)
- 3,072 Ross 708 male broilers
- 96 pens
- RCBD

Crude Protein	Methionine Source	Replicates	Birds/pen
Standard	None	16	32
	MHA	16	32
	65DLM	16	32
Reduced	None	16	32
	MHA	16	32
	65DLM	16	32

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Materials and Methods: Diet Formulation

Ingredients	Starter (1-10)		Grower (11-24)		Finisher (25-42)	
	Standard	Reduced	Standard	Reduced	Standard	Reduced
	%					
Corn	57.41	63.96	61.39	67.79	66.90	73.35
SBM, Solv. Ext.	36.23	30.13	32.86	26.78	27.69	21.67
Soybean Oil	1.50	0.45	1.91	0.91	1.81	0.80
MHA	0.26	0.31	0.21	0.27	0.20	0.26
65DLM	--	--	--	--	--	--
Sand	--	--	--	--	--	--
Other[1]	4.60	5.15	3.62	4.26	3.40	3.94
Calculated Nutrients						
ME (kcal/kg)	2,975	2,975	3,050	3,050	3,125	3,100
Crude Protein (%)	23.00	21.00	21.50	19.50	19.50	17.50
Dig. Lysine (%)	1.32	1.32	1.18	1.18	1.08	1.08
Dig. TSAA (%)	0.80	0.80	0.74	0.74	0.69	0.69
Dig. Threonine (%)	0.88	0.88	0.79	0.79	0.72	0.72
Dig. Valine (%)	1.00	1.00	0.91	0.91	0.84	0.84
Dig. Isoleucine (%)	0.88	0.88	0.80	0.80	0.75	0.71

↓ 2%-pt

[1] Dicalcium Phosphate, Limestone, Salt, BioLys®, Vit/min premix, ThreAMINO®, Sodium bicarbonate, L-Valine, L-Isoleucine

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Proximate Analyses

Phase	Methionine Source	Nutrients									
		CP[1] (%)		Crude Fat[2] (%)		Crude Fiber[3] (%)		Ash[4] (%)		Moisture[5] (%)	
		Crude Protein									
		Standard	Reduced	Standard	Reduced	Standard	Reduced	Standard	Reduced	Standard	Reduced
Starter	None	22.34	19.80	4.3	3.3	2.5	2.5	6.3	6.3	11.63	11.93
	MHA	21.87	20.76	4.0	2.9	2.6	2.4	6.1	6.5	11.81	11.92
	65DLM	22.23	19.82	4.1	3.4	2.5	2.4	6.4	6.0	11.77	11.95
Grower	None	20.11	18.10	4.8	3.8	2.6	2.5	5.7	5.5	11.76	12.06
	MHA	20.80	18.08	4.5	3.5	2.6	2.2	5.8	5.6	11.75	12.17
	65DLM	19.64	17.76	4.6	3.7	2.5	2.3	5.6	5.6	11.94	11.94
Finisher	None	18.23	16.29	4.5	3.8	2.1	2.2	5.2	5.0	11.69	11.79
	MHA	17.52	16.03	5.0	3.4	2.3	2.2	4.9	4.7	12.06	11.97
	65DLM	18.87	17.07	4.8	3.7	2.5	2.3	5.4	4.9	11.78	11.91

[1]AOAC. 2000. Method 990-03. Evonik Corporation, Kennesaw, GA 30144
[2]AOAC. 2000. Method 920.39. Evonik Corporation, Kennesaw, GA 30144
[3]ISO. 2000. Method 6865. Evonik Corporation, Kennesaw, GA 30144
[4]AOAC. 2000. Method 942.05. Evonik Corporation, Kennesaw, GA 30144
[5]ISO. 1999. Method 6496. Evonik Corporation, Kennesaw, GA 30144

Amino Acid Analysis

Crude Protein	Methionine Source	Finisher Phase (D 25-42)					
		MET	MET+CYS	LYS	THR	ILE	VAL
Standard	None	0.259	0.498	1.038	0.655	0.708	0.805
	MHA	0.256	0.493	1.054	0.685	0.716	0.811
	65DLM	0.400	0.633	1.063	0.674	0.708	0.804
Reduced	None	0.237	0.457	1.063	0.665	0.678	0.809
	MHA	0.232	0.455	0.975	0.711	0.647	0.782
	65DLM	0.392	0.608	1.086	0.643	0.668	0.785

AOAC. 2006. Method 994.12. Evonik Corporation, Kennesaw, GA 30144
The total AA were converted to digestible AA (estimated) using SID coefficients

Materials and Methods: Measured Variables

Day 1
BW

Day 24
- BW, LWG, FI, FCR
- Footpad scores
- Litter moisture

Day 10
BW, LWG, FI, FCR

Day 42
- BW, LWG, FI, FCR
- Footpad scores
- Litter moisture
- Processing yields

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Materials and Methods: Statistical Analysis

- GLM procedure in SAS
- Two-way ANOVA
- $\alpha = 0.05$
- Post Hoc Analysis
  - Fisher's LSD
- Frequency Procedure
  - Footpad lesion scores

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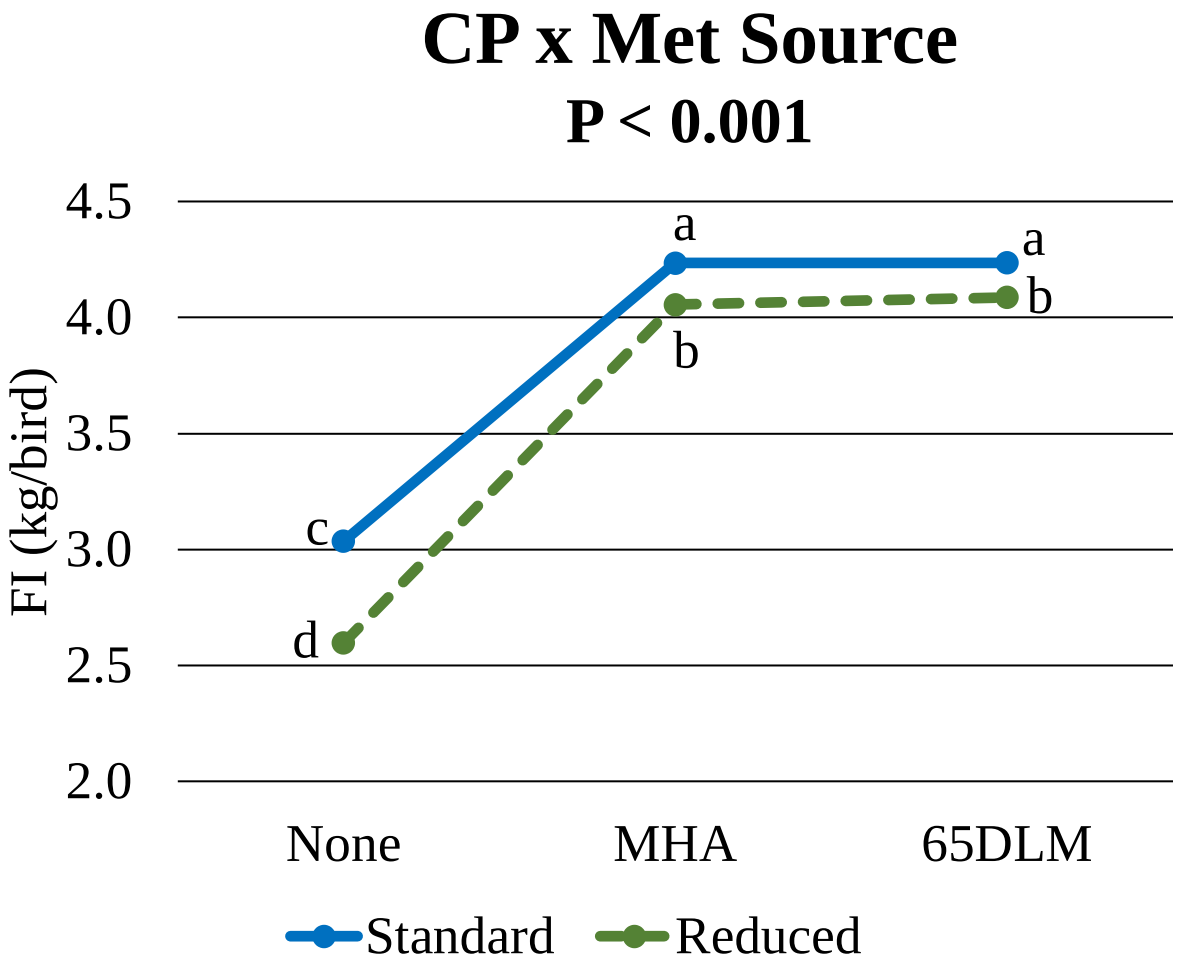
Results

D1-42 Feed Intake and Live Weight Gain



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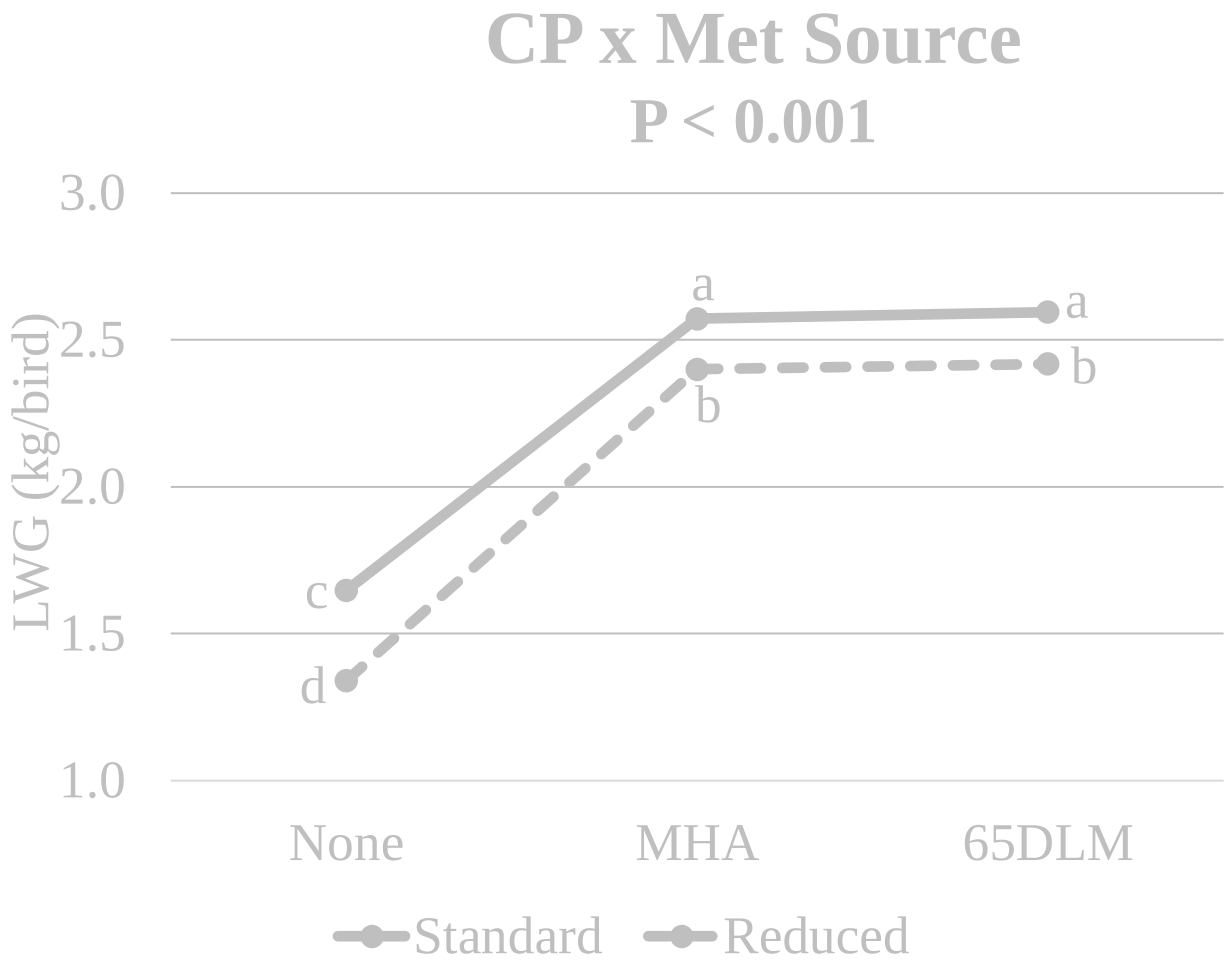

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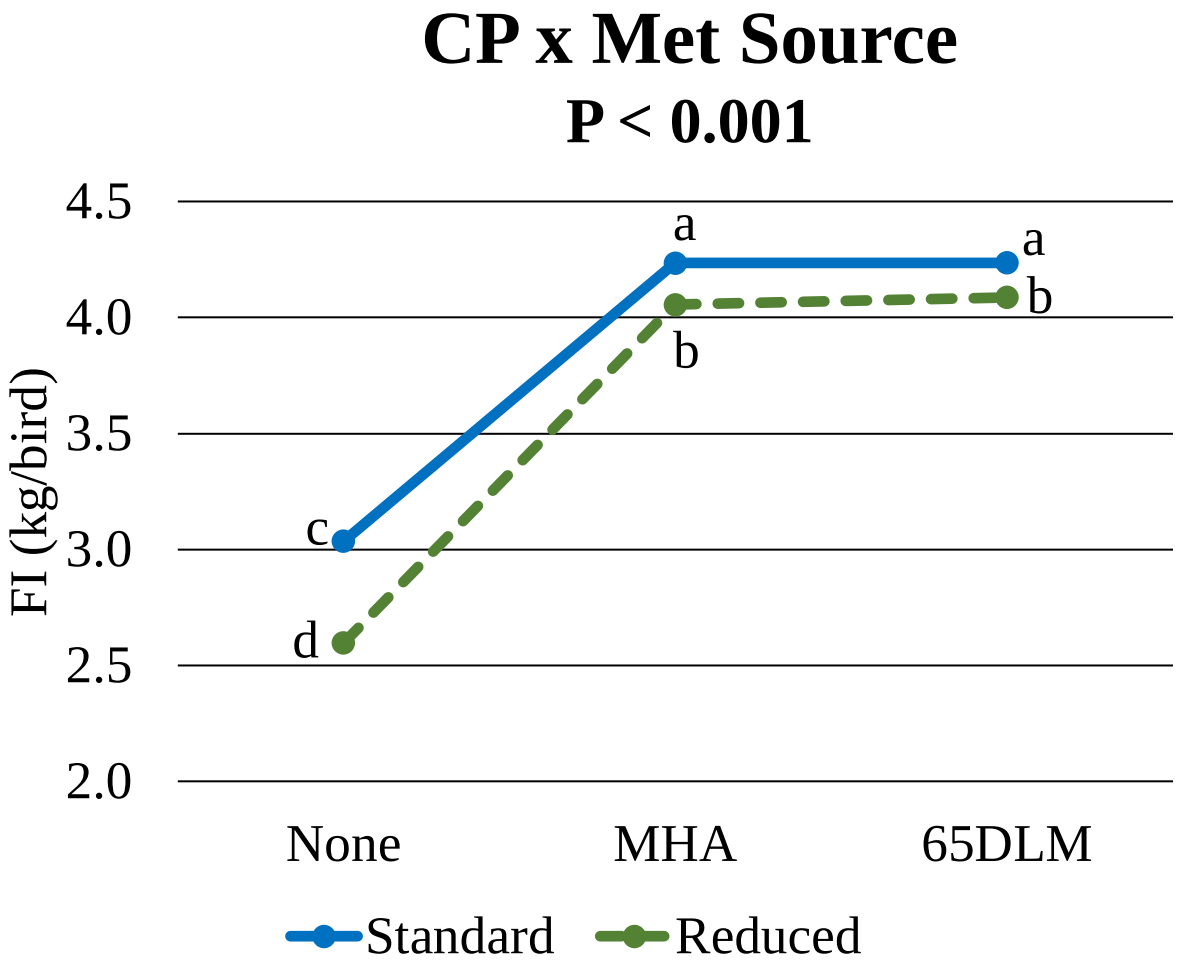
D1-42 Feed Intake and Live Weight Gain



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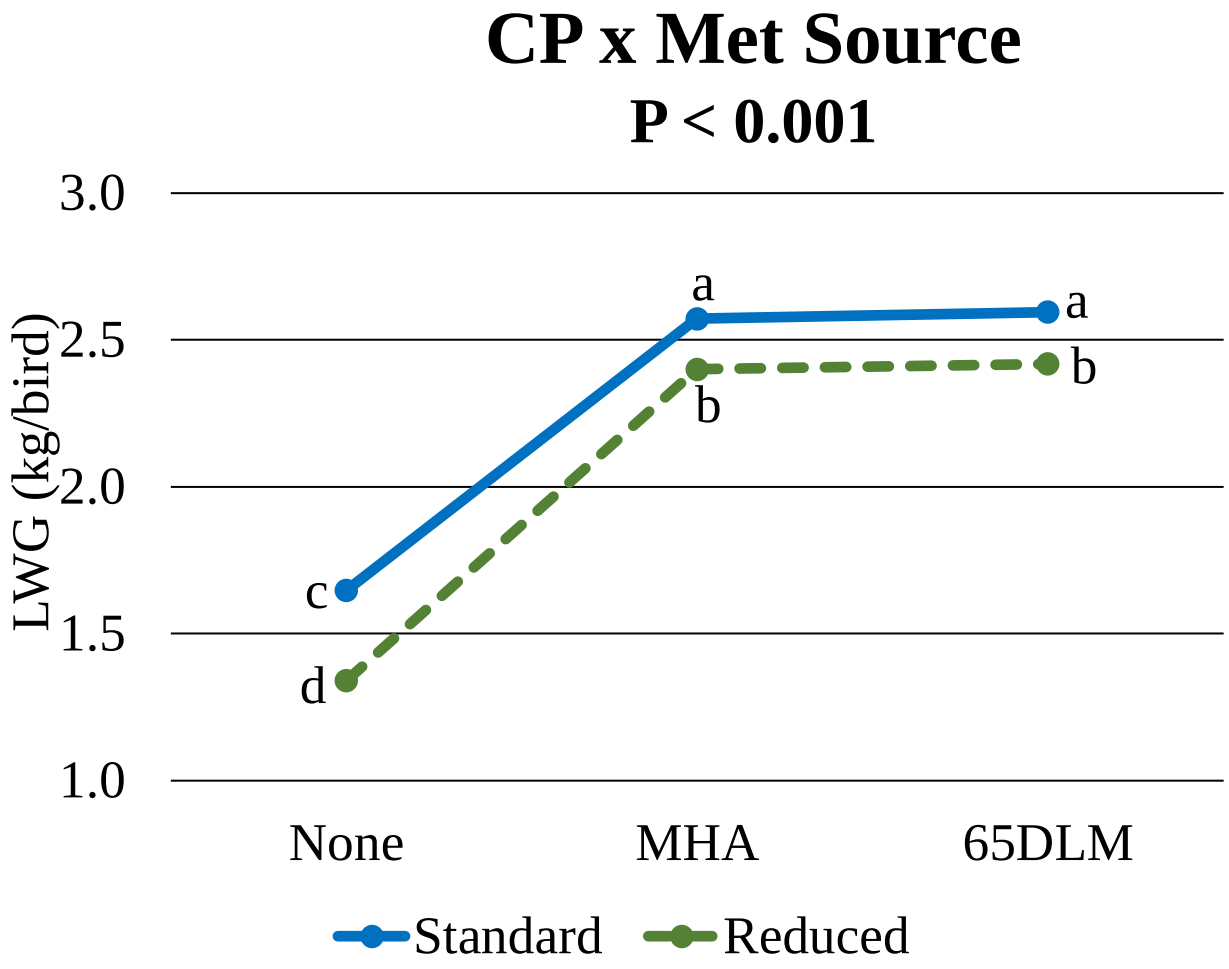

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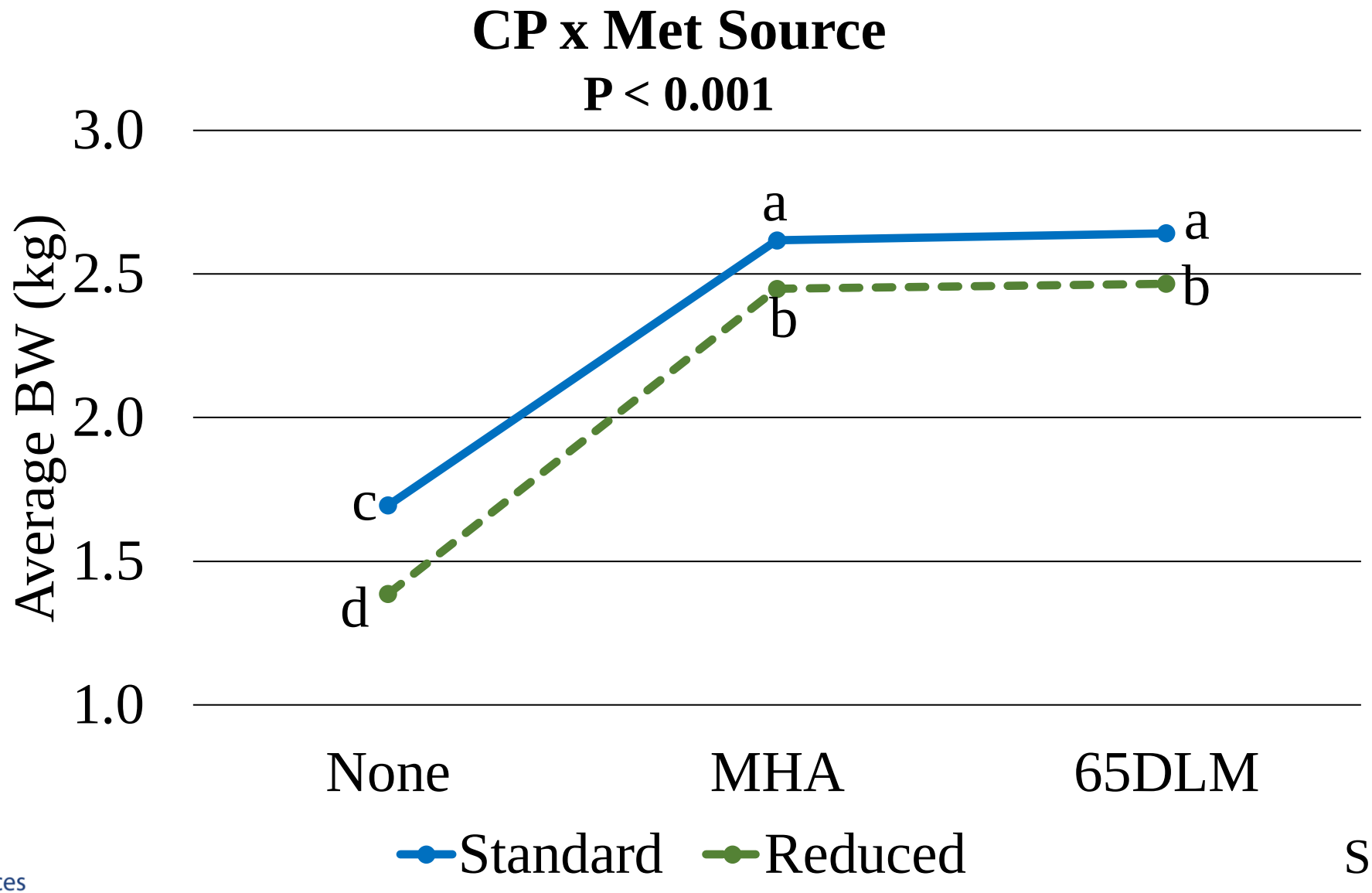
D42 Average Body Weight



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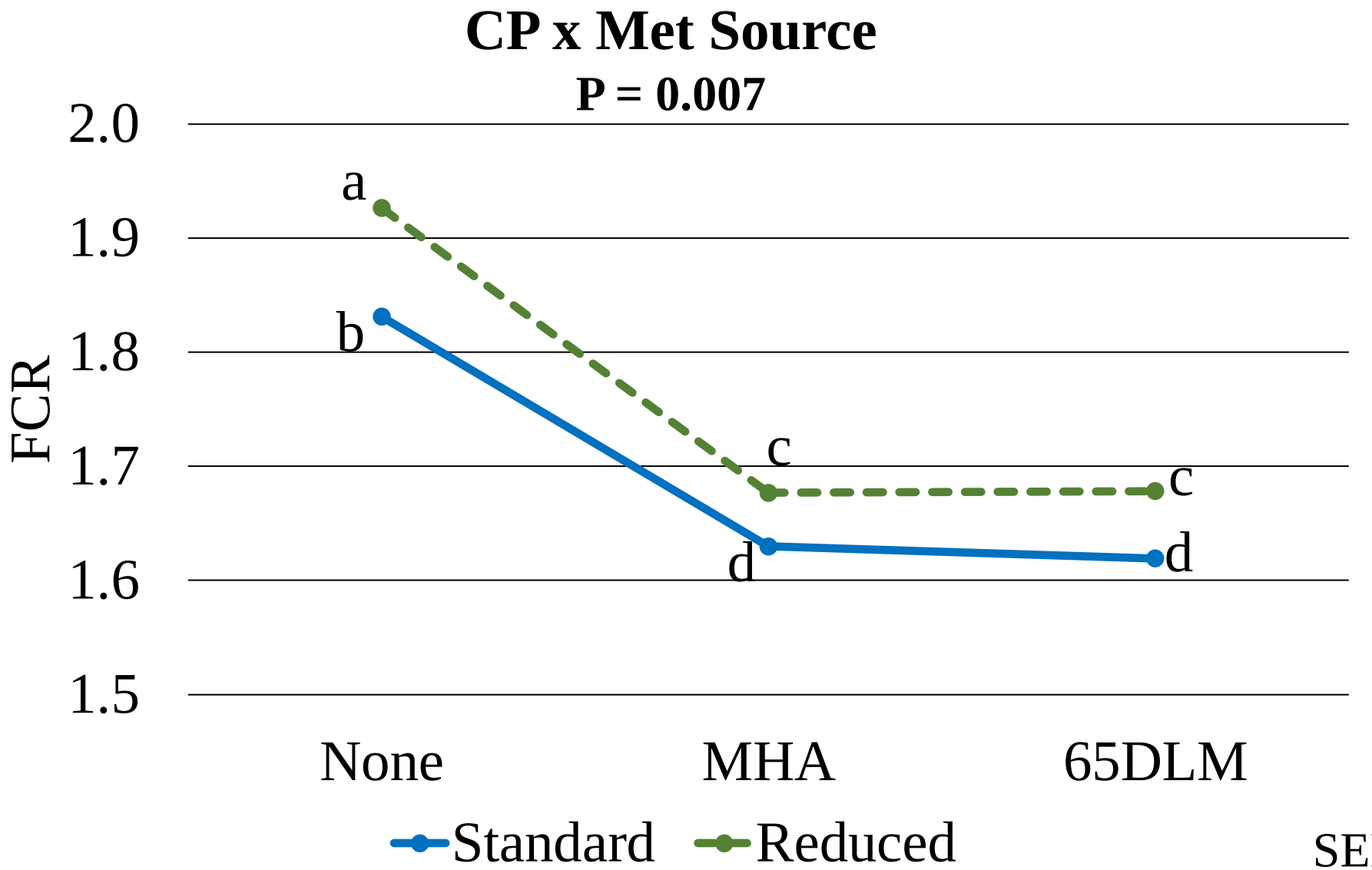
D1-42 Feed Conversion Ratio



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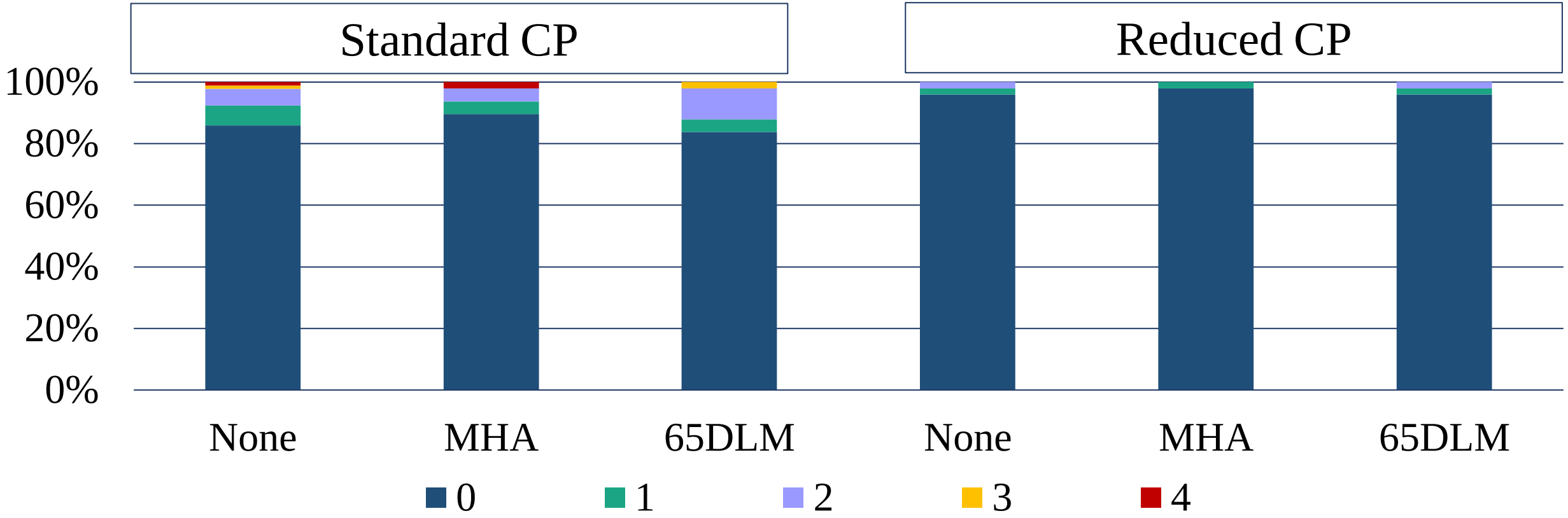
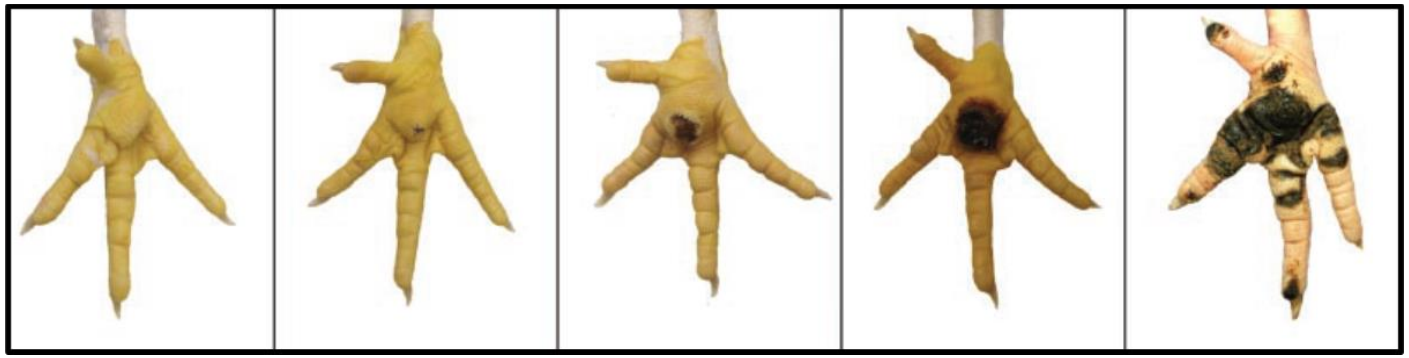
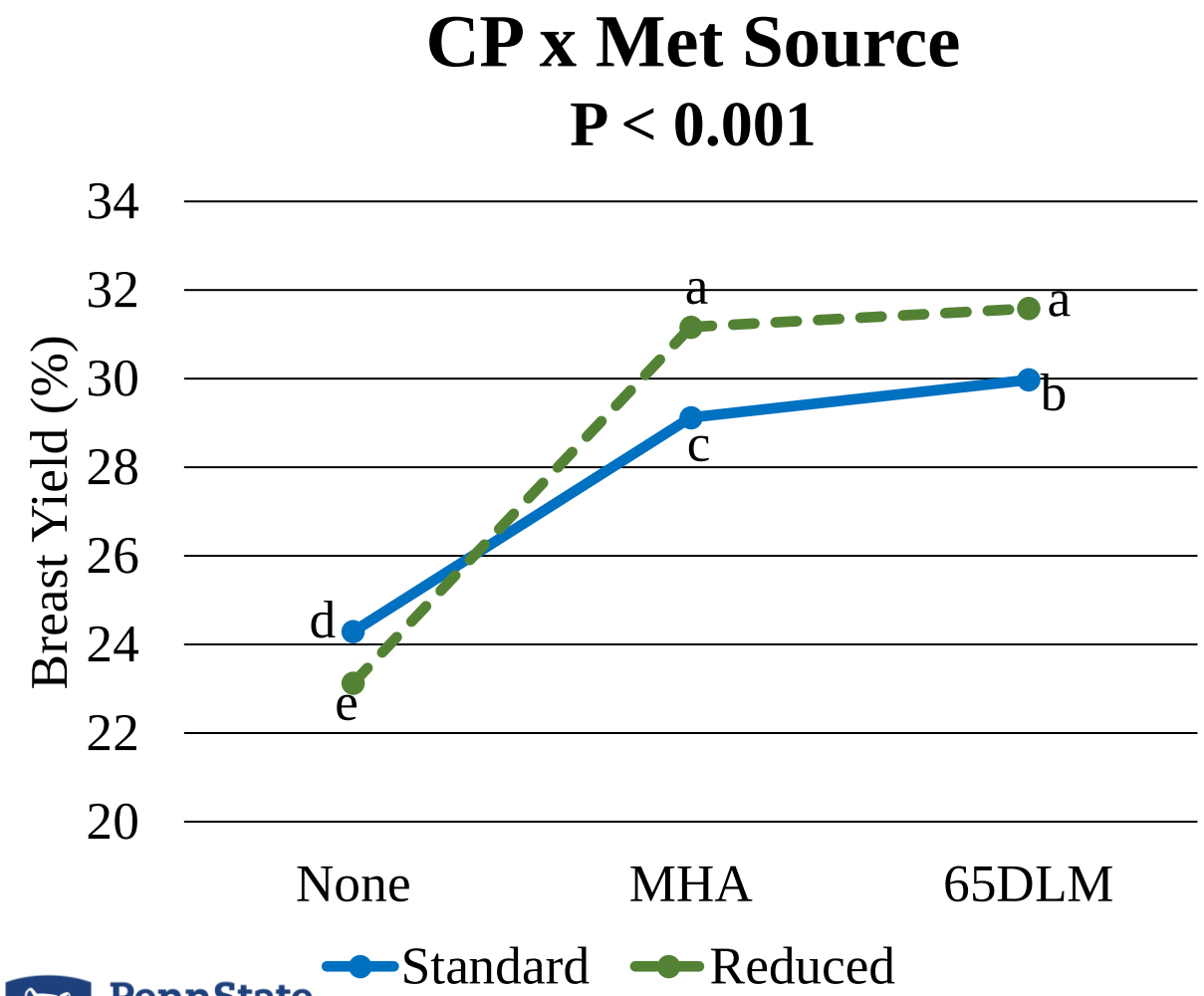
D42 Footpad Lesion Scores





Rushen et al., 2011

D42 Breast Yield and Weight



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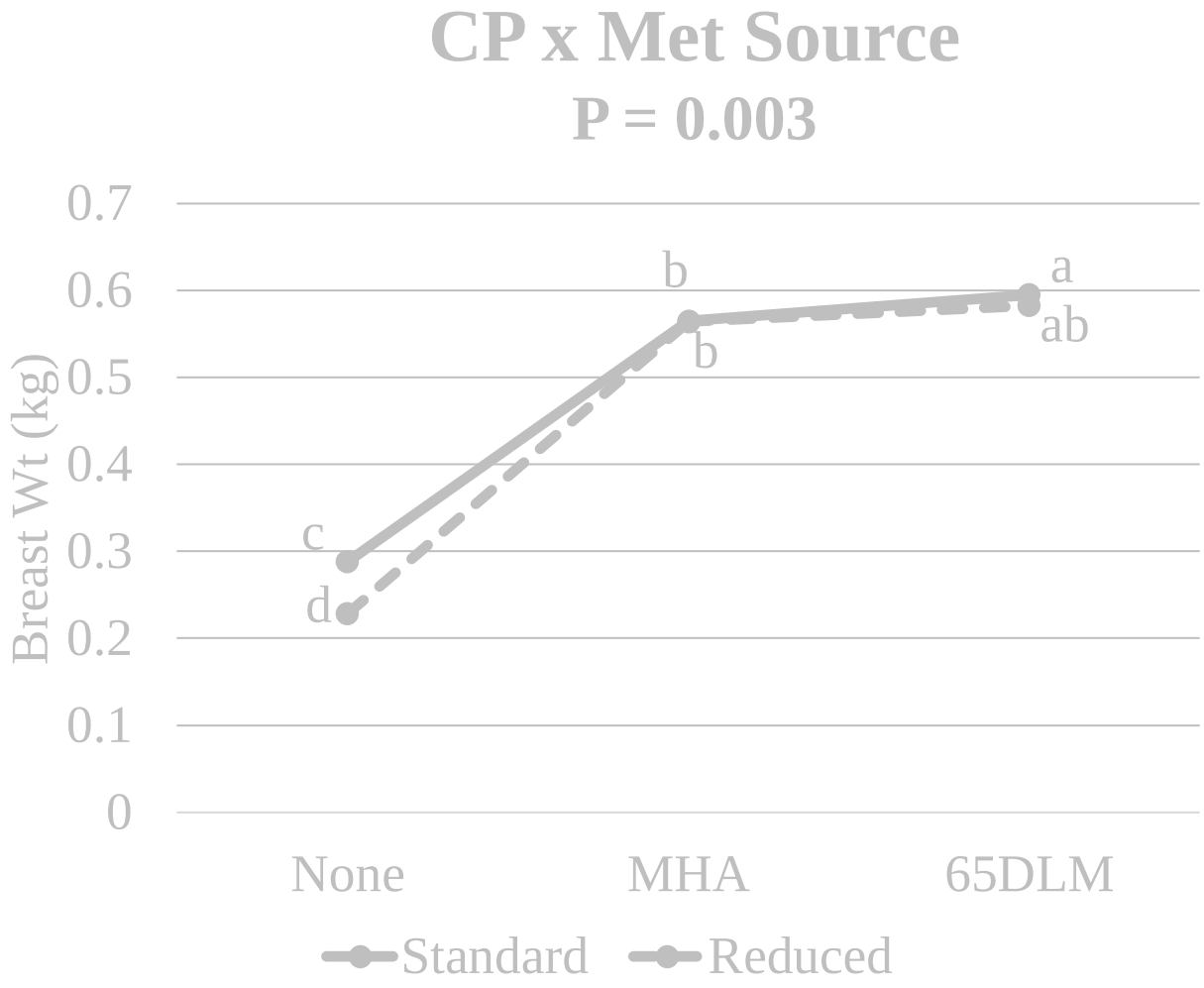

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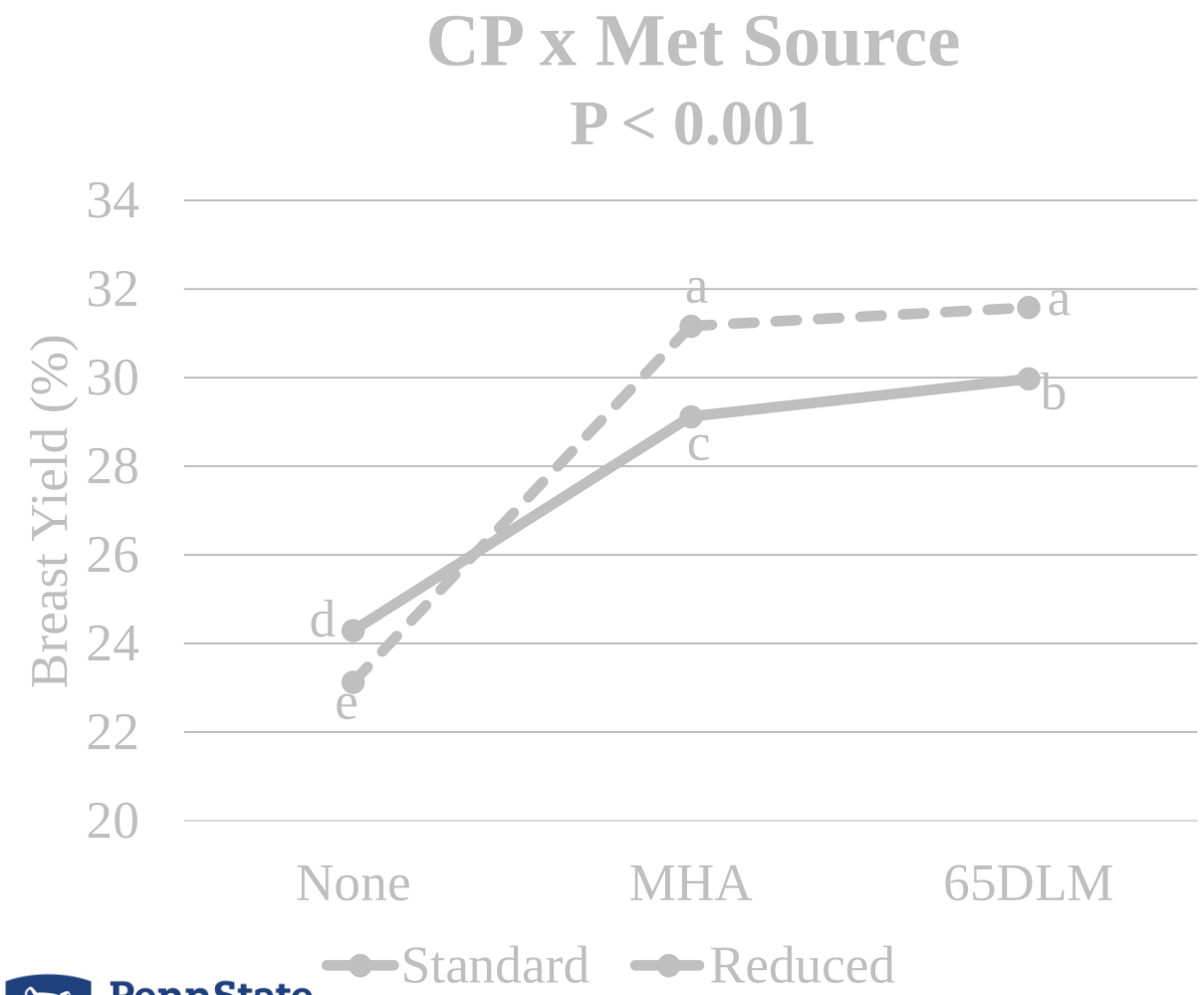
D42 Breast Yield and Weight



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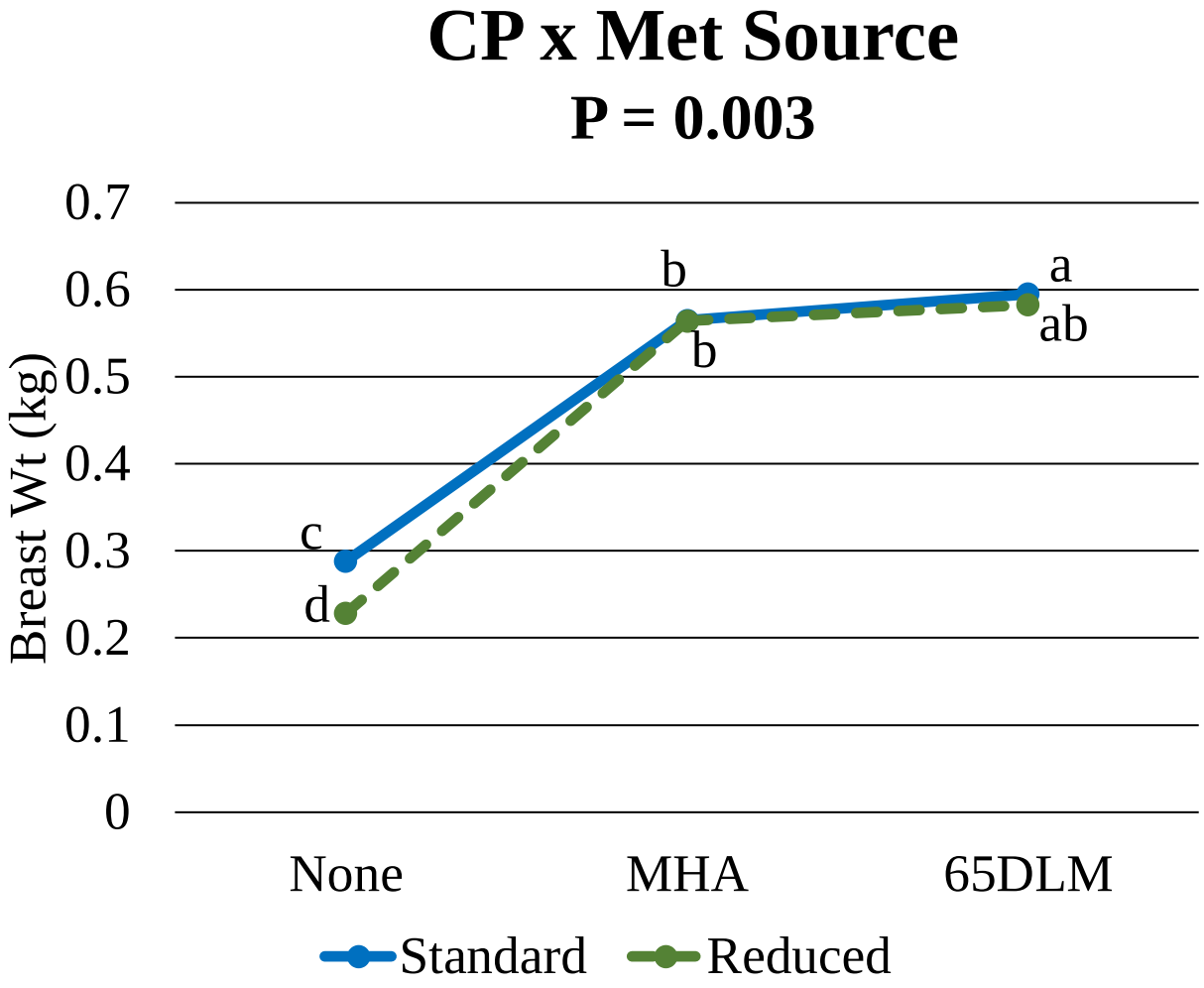

SEM = 0.008

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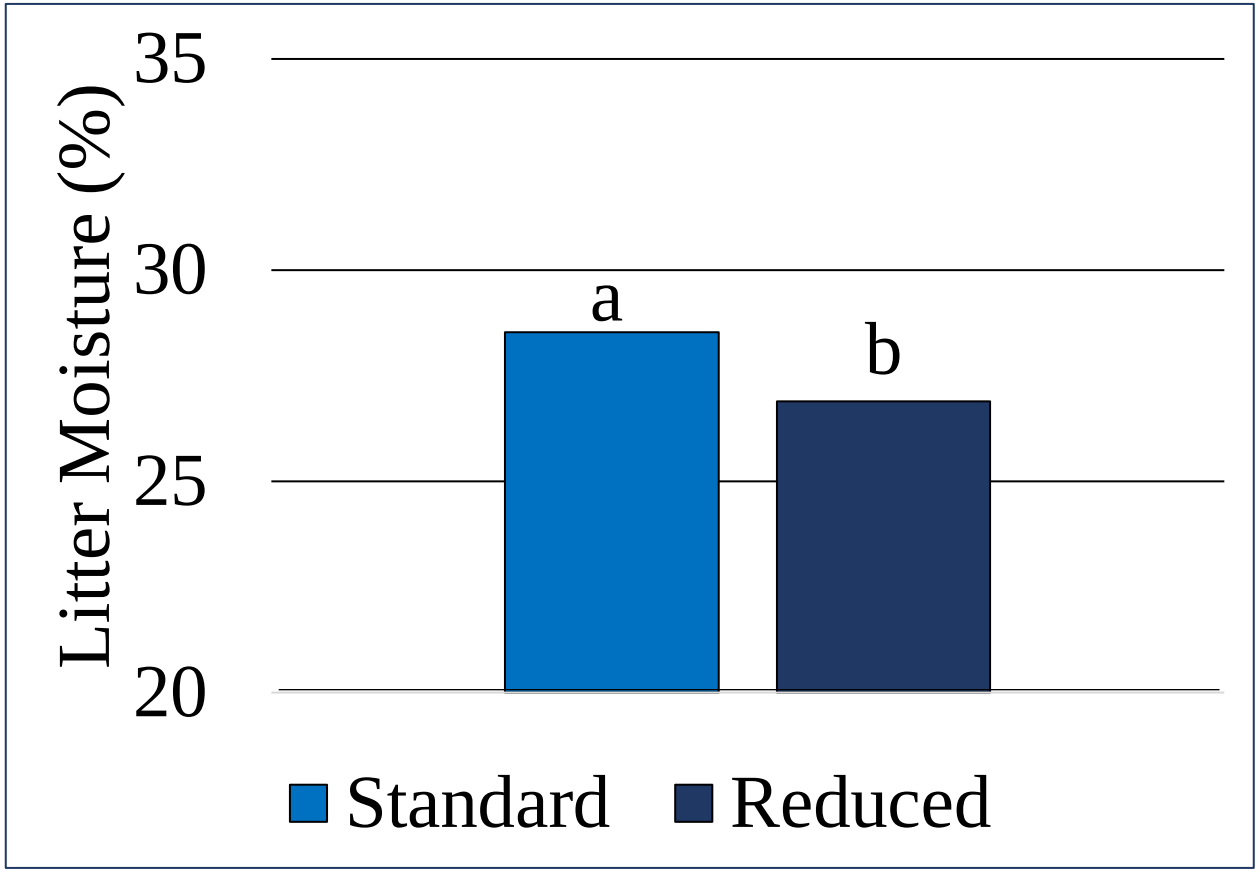
D42 Litter Moisture

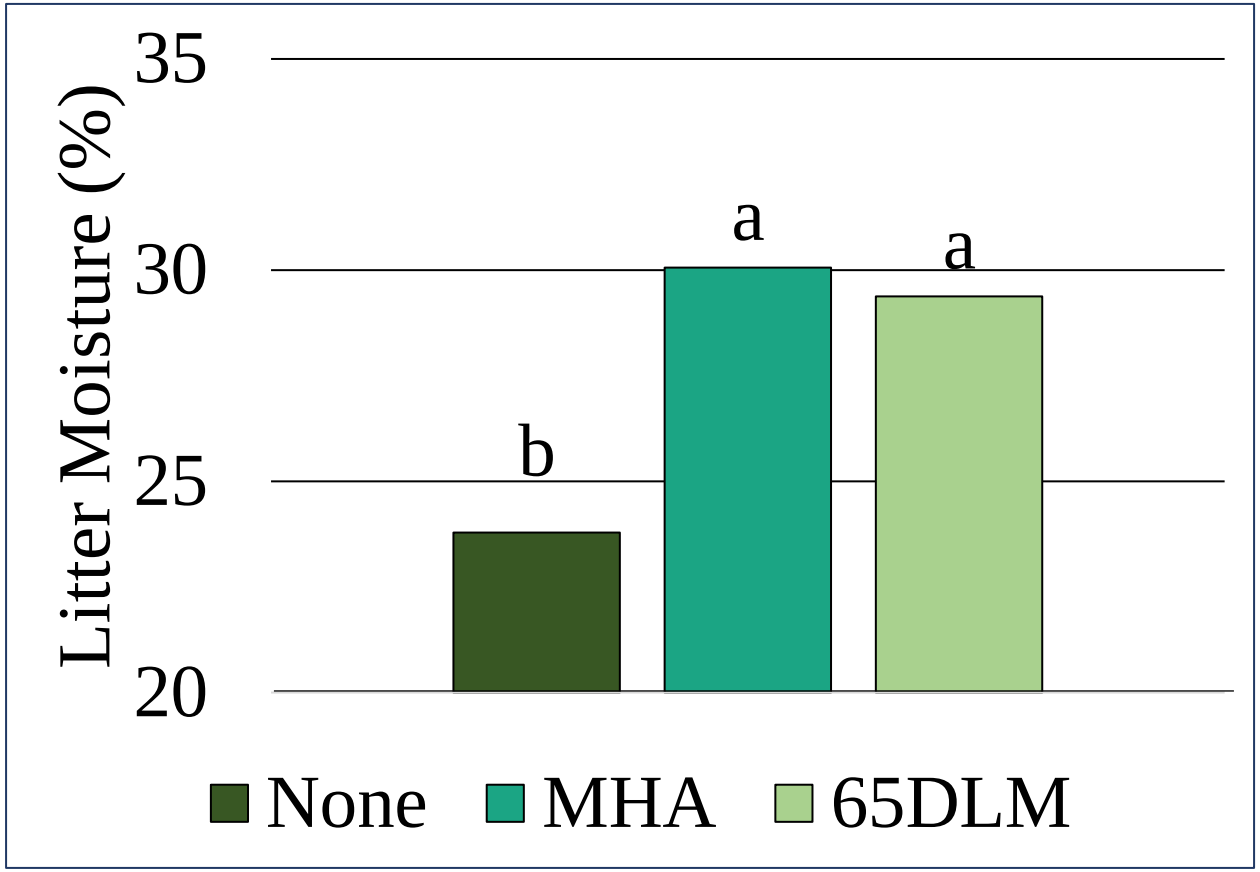
ME: CP

P < 0.001



ME: Met Source

P < 0.001



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Discussion: Crude Protein

Hypothesis:
Broilers fed reduced CP diets will perform at the same level as birds fed standard CP diets.

- The current study applied commercially relevant diets.

- Reducing CP resulted in:
  - Decreased BW by 55g Si et al., 2004
  - Worsened FCR from 1.538 to 1.642 Crystal et al., 2020

- Accessibility of AA to replace intact AA in reduced CP diets:
  - Costly
  - Limited

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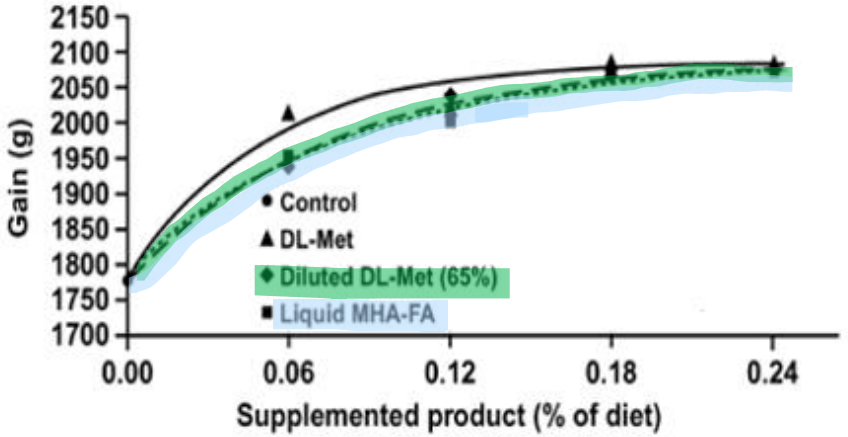
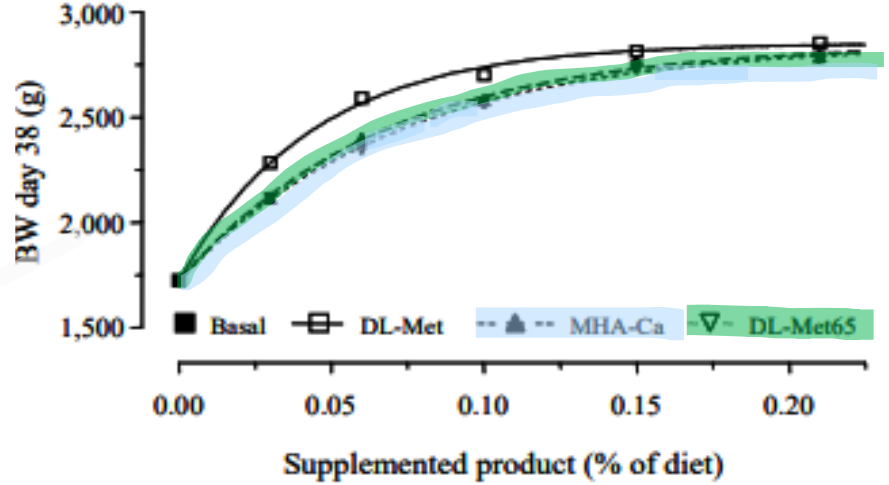
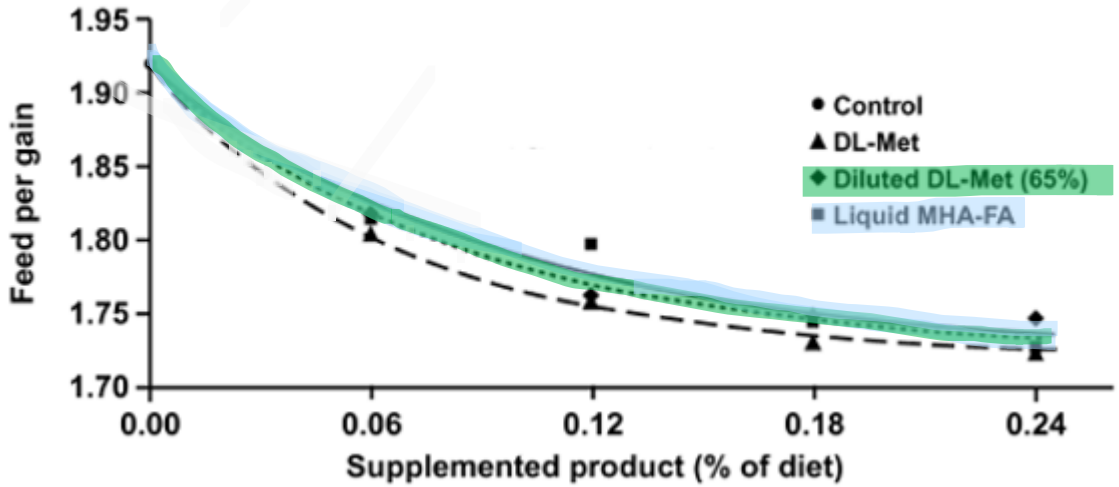
Discussion: Methionine Sources

- Lemme et al., 2002
- Hoehler et al., 2005
- Elwert et al., 2008
- Bertechini et al., 2019







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Descriptive Feed Cost Analysis

$/tonne						
Phase	**Reduced CP + None**	**Reduced CP + 65DLM**	**Reduced CP + MHA**	**Standard CP + None**	**Standard CP + 65DLM**	**Standard CP + MHA**
Starter	$524.72	$529.78	$531.49	$522.67	$526.92	$528.35
Grower	$516.30	$520.70	$522.19	$511.86	$515.29	$516.44
Finisher	$505.25	$509.50	$510.93	$506.96	$510.23	$511.33

Crude Protein	Methionine Source	**$/kg BW**	**$/kg breast meat**
Standard	None	$2.88	$5.37
	65DLM	$3.58	$3.65
	MHA	$3.61	$3.85
Reduced	None	$2.59	$5.82
	65DLM	$3.59	$3.62
	MHA	$3.57	$3.72

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Conclusions

- Methionine sources in a reduced CP diet had worsened FI, BW, and FCR compared to standard CP.
  - Reduced CP diets resulted in improved litter quality and footpad scores.

- The inclusion of 65DLM in either CP level resulted in greater breast accretion.

- 65DLM can be used as an alternative to MHA in formulation.

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Thank you!

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