A feed additive containing mixed enzymes and direct fed microbial combination in comparison with AGPs in broiler chickens

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DFM's and Antibiotics

- Over-use of antibiotics in commercial poultry:
  - Drug-resistant bacteria (Sorum and Sunde, 2001)
  - Drug residues in the body of the birds (Burgat,1999)
  - Imbalance of normal microflora (Andremont, 2000)

- Growing use of direct fed microbials (probiotics) worldwide throughout the industry

Direct Fed Microbials (DFMs)

- What are DFMs?

- Modes of action include:
  - Maintaining a beneficial microbial population by competitive exclusion and antagonism
    - (Fuller, 1989)
  - Improving feed intake and digestion
    - (Nahanshon et al., 1992, 1993)
  - Altering bacterial metabolism
    - (Cole et al., 1987; Jin et al., 1997)

Direct Fed Microbials (DFMs)

- Probiotic effect
  - *Lactobacillus, Bifidobacterium, Bacillus, Enterococcus, Lactococcus, Streptococcus, Saccharomyces cerevisae*
- Influence the intestinal microbiota as well as host health and welfare
  - Competitive exclusion of pathogenic bacteria
  - lowering the pH through acid fermentation
  - competing for mucosal attachment and nutrients
  - stimulating the immune system associated with the gut
  - increasing epithileal integrity
  - stimulating the intra-epithileal lymphocytes
    - (Salim et al, 2013)
- Alternative to AGP's

DFM's on Broiler Performance

- Compared with control, supplementation of DFM did not affect FI and BW gain of the birds
  - (Waititu et al., 2014)
- DFM inclusion improves performance
  - (Yeo and Kim, 1997; Santoso et al., 2001; Salim et al, 2013;)
- Proper DFM supplementation may provide a favorable condition in the intestines for the colonization of beneficial microflora
  - (Mohnl, 2011)

Antibiotic Growth Promoters (AGP's)

- Bacitracin Methylene Disalicylate
  - Branched, cyclic deca-peptide that interferes with cell membrane function
  - suppresses cell wall formation by preventing the formation of peptidoglycan strands
  - Inhibits protein synthesis
    - (Kahn et al., 2005)

Antibiotic Growth Promoters (AGP's)

- Virginiamycin
  - Effective antibiotic against gram-positive microorganisms
    - (De Sommer and Van Dijck, 1955)
  - Two major components: factor m1 and s1
    - (Cocito, 1979)
  - Shown to improve broiler growth rate and feed efficiency
    - (March et al., 1978; Miles et al., 1984; Harms et al., 1986; Woodward et al., 1988)
  - Efficacy more pronounced in broilers fed low calorie diets
    - (Buresh et al., 1984)

AGP's on Broiler Performance

- Broilers given AGP's were significantly heavier than those fed control diets
  - (Miles et al., 2006)
- Broilers fed AGP's showed no significant differences in FCR and BW when compared to the control
  - (Baurhoo et al., 2009)

Xylanase, Amylase, Protease

- What is a mixed enzyme?
- Mixed enzymes have proven to increase starch digestibility and improve broiler growth performance and feed conversion ratio
  - (Meng et al., 2005; Olukosi et al. 2007; Cowieson and Ravindran, 2008)

Objective and Hypothesis

- The objective of the current experiment was to evaluate the effect of a feed additive containing mixed enzymes and a DFM on broiler growth performance as compared to antibiotic growth promoters.

- The working hypothesis is that the inclusion of mixed enzymes and DFM will improve broiler growth performance similar to that observed with AGP inclusion.

Experimental Design

- Experimental design consisted of 4 experimental treatments:
  - 8 replicates per treatment
  - 40 chicks per replicate
  - 1280 straight-run (50:50 ratio) Ross 708 chicks were placed in floor pens for a 42 day-assay period

*Care was provided in accordance with IACUC Texas A&M approved protocol

Materials and Methods

- 4 dietary treatments:
  - Negative Control – US standard w/ 10% wheat inclusion and 5% DDGs inclusion containing 500 FTU/kg phytase
  - Negative Control + XAP & DFM (XAP: xylanase, amylase and protease, DFM: three *Bacillus* strains)
  - Negative Control + BMD (50g/ton)
  - Negative Control + Virginiamycin (20g/ton)

- Measurements were taken on days 10, 21, 42
  - Body Weight
  - Feed Conversion Ratio (FCR)

Feed Phases

- Starter Phase
  - Days 0-10
- Grower Phase
  - Days 11-21
- Finisher Phase
  - Days 22-42

- All birds were fed a mash diet *ad libitum* throughout the duration of the trial

Dietary Formulation

	Starter	Grower	Finisher
Corn	47.852	52.033	60.026
SBM	31.001	24.886	17.989
DL-Methionine	0.314	0.270	0.202
Lysine	0.285	0.249	0.213
Threonine	0.098	0.078	0.045
Fat	0.607	2.101	1.486
Wheat	10.00	10.00	10.00
Limestone	1.352	0.909	0.682
Monocalcium Phosphate	0.654	0.290	--

	Starter	Grower	Finisher
Salt	0.338	0.252	0.096
Sodium Bicarbonate	--	0.073	0.283
Trace Minerals	0.050	0.050	0.050
Vitamins	0.250	0.250	0.250
Choline Chloride	0.100	0.100	0.100
Coban 90	0.050	0.050	0.050
LO-DDGS	5.00	5.00	5.00
Pork MBM	2.038	3.00	3.519
Phytase	0.01	0.01	0.01

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Phytase	0.01	0.01	0.01

Dietary Formulation

Calculated Nutrient Concentration %			
	Starter	Grower	Finisher
Protein	23.34	21.15	18.66
Crude Fat	3.62	5.31	4.99
Calcium	1.05	0.90	0.80
AV Phosphorous	0.50	0.45	0.40
AME (kcal/kg)	2905	3030	3080
AV Methionine	0.63	0.56	0.47
AV TSAA	0.94	0.84	0.72
AV Lysine	1.27	1.10	0.91
AV Tryptophan	0.23	0.20	0.17
AV Threonine	0.83	0.73	0.61
AV Arginine	1.35	1.20	1.02
Sodium	0.20	0.19	0.19

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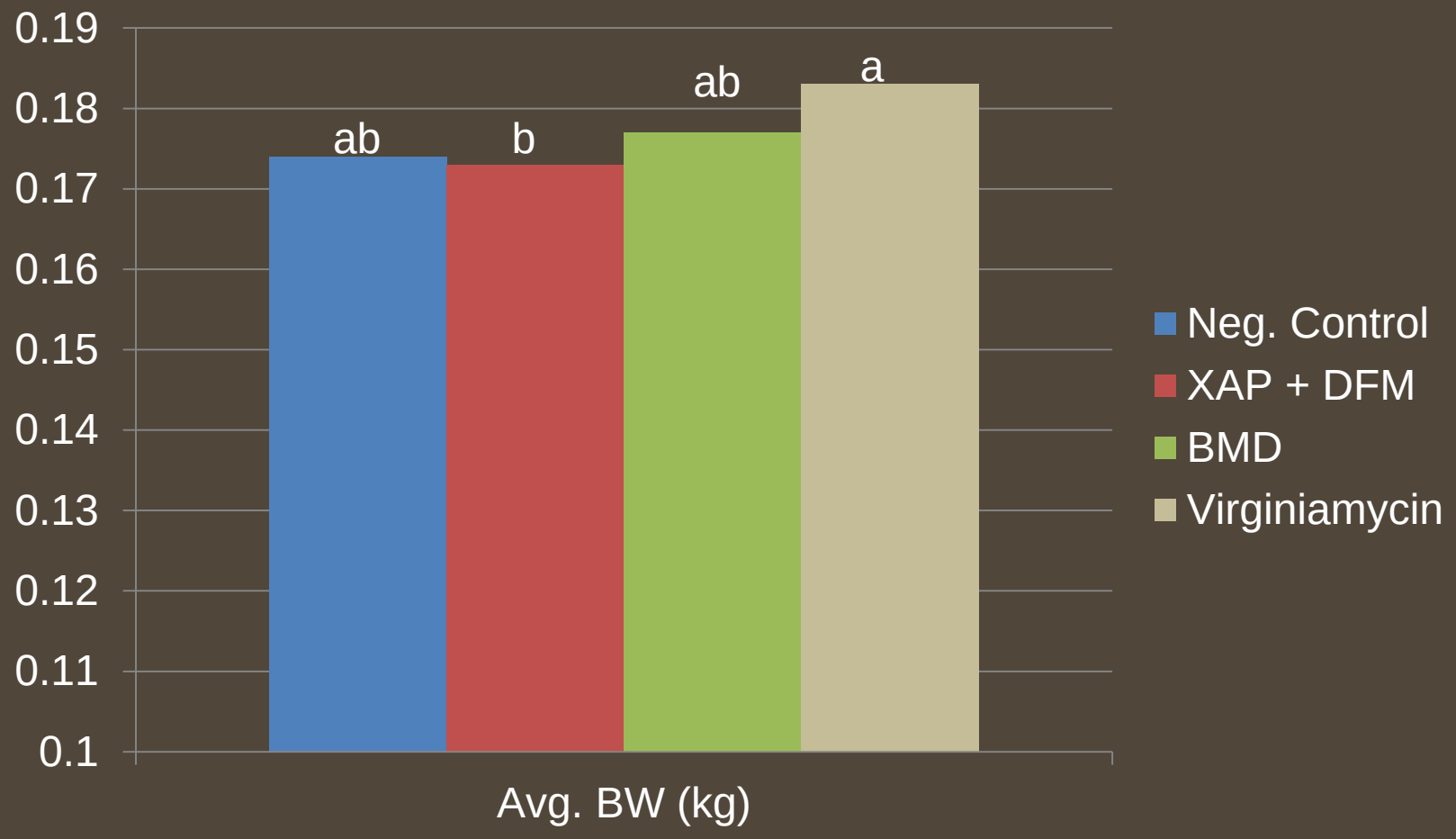
Statistical Analysis

- All data was analyzed via one-way ANOVA and means were deemed significantly different at $P \leq 0.05$. Means were separated using Duncan's Multiple Range Test.

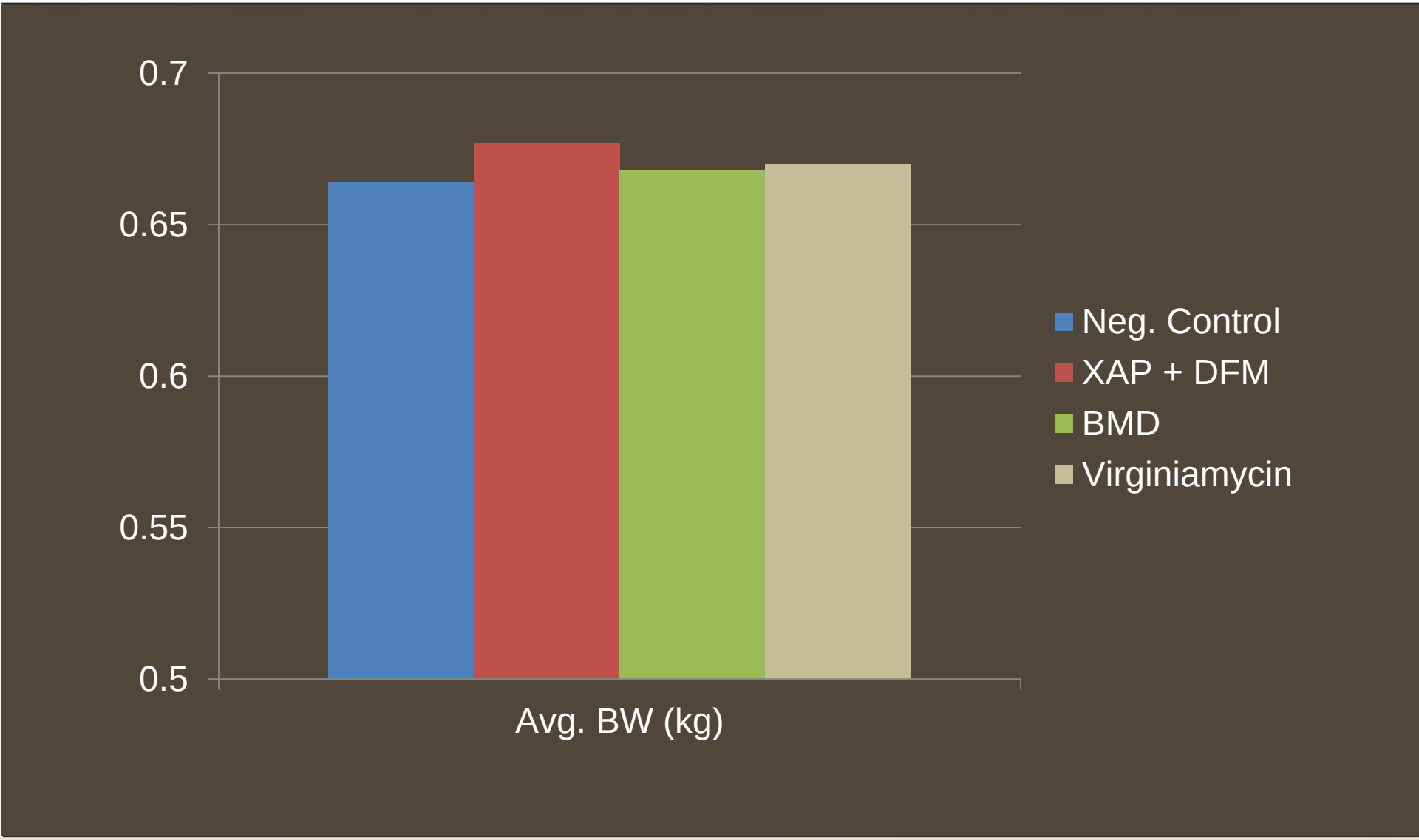
- Parameters Evaluated:
  - Body Weight Gain
  - Feed Conversion Ratio (FCR)
  - Foot Pad Lesion Score

Avg. Body Weight (kg) – Day 10

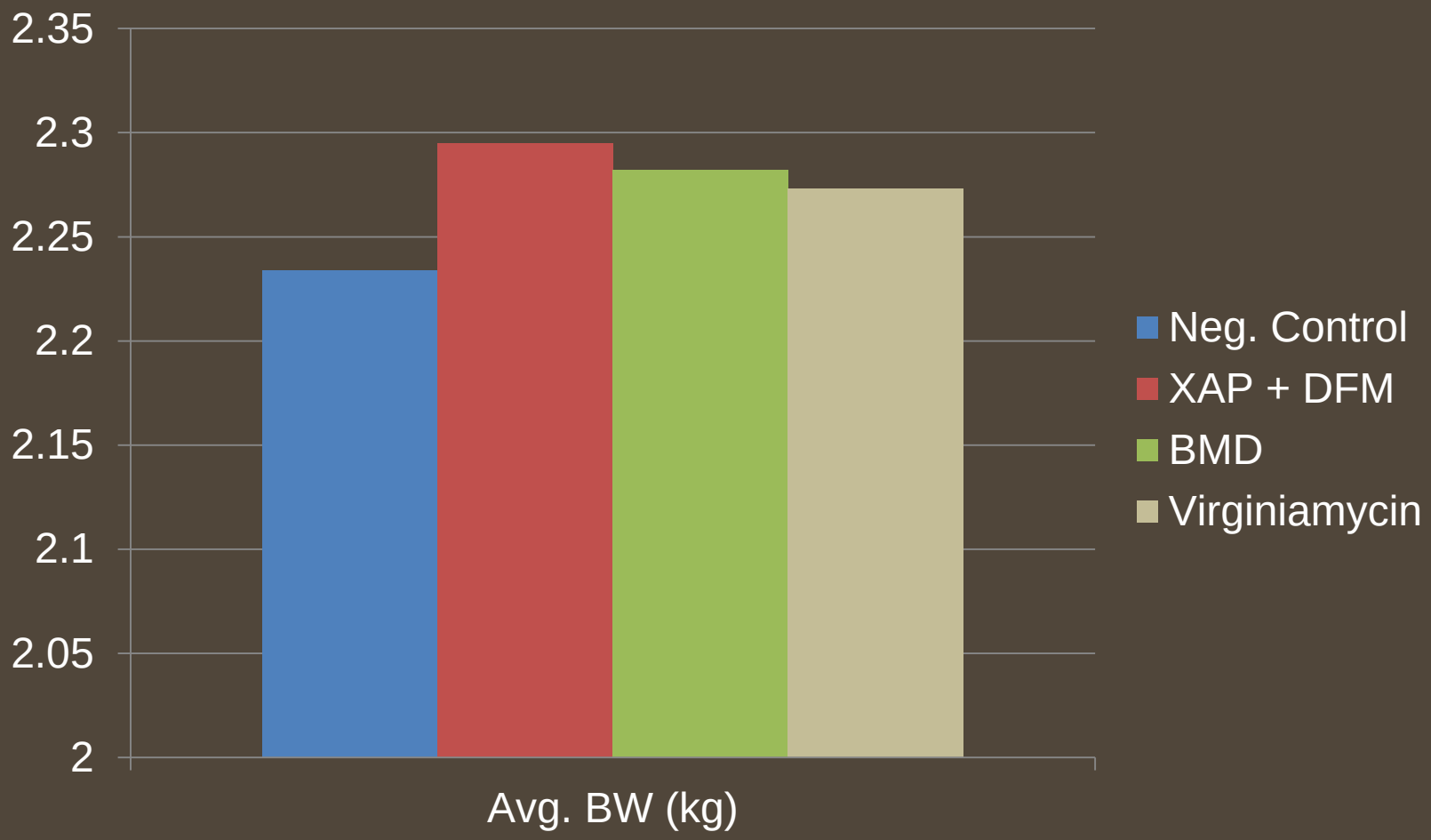


[a,b] Indicates significant difference at $p < 0.05$

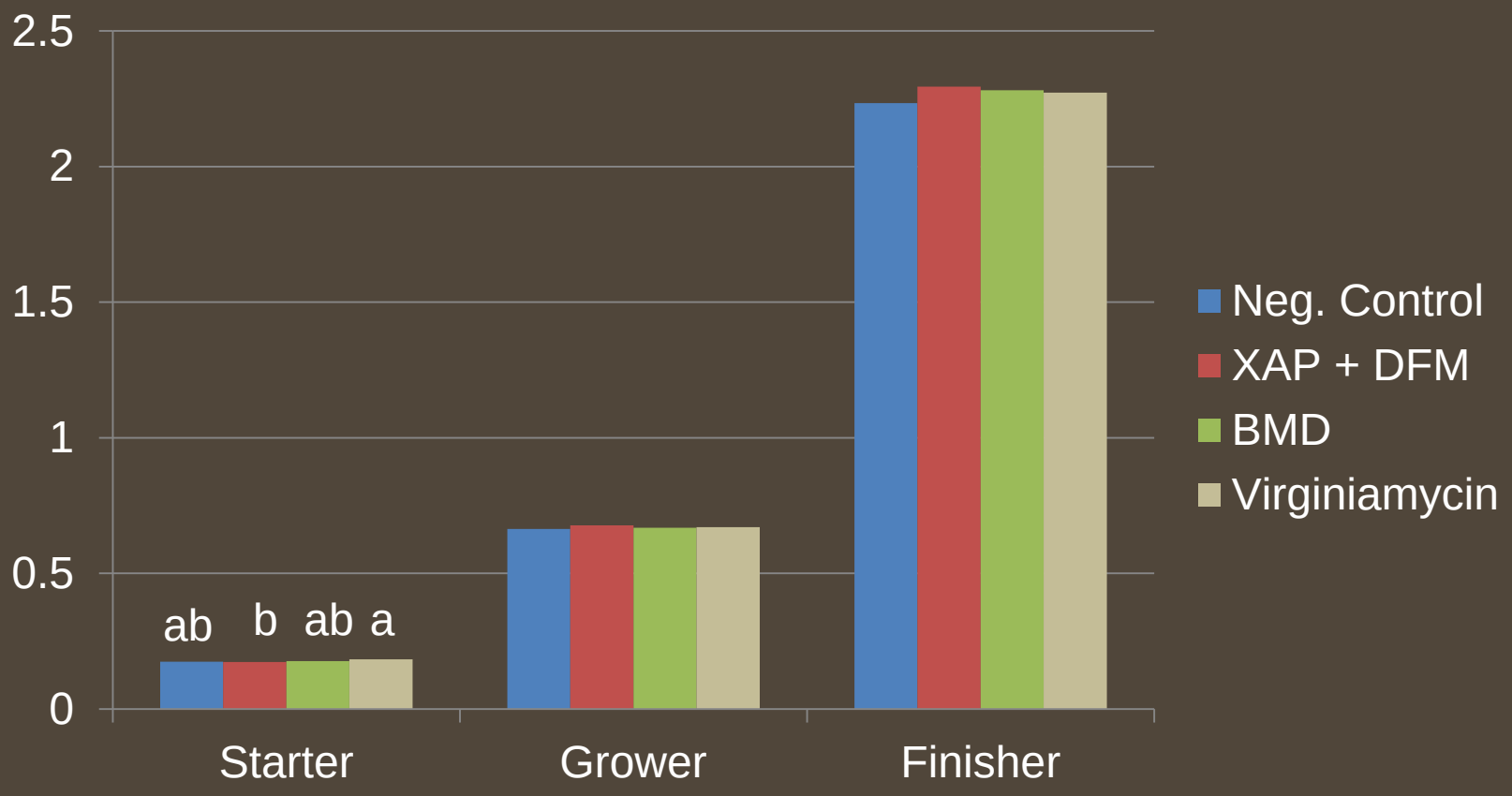
Avg. Body Weight (kg) – Day 21



Avg. Body Weight (kg) – Day 42



Average Body Weight (kg)



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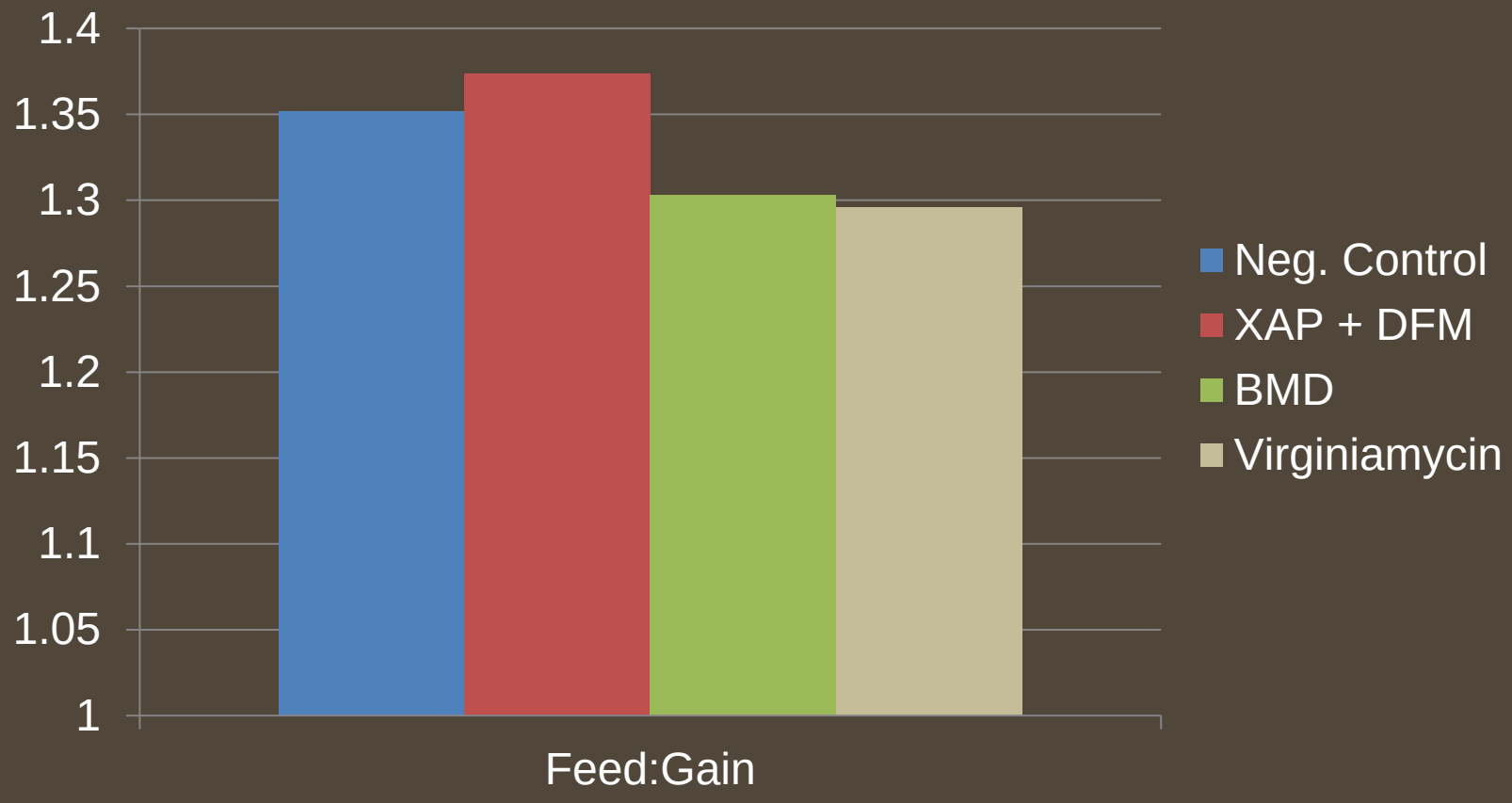
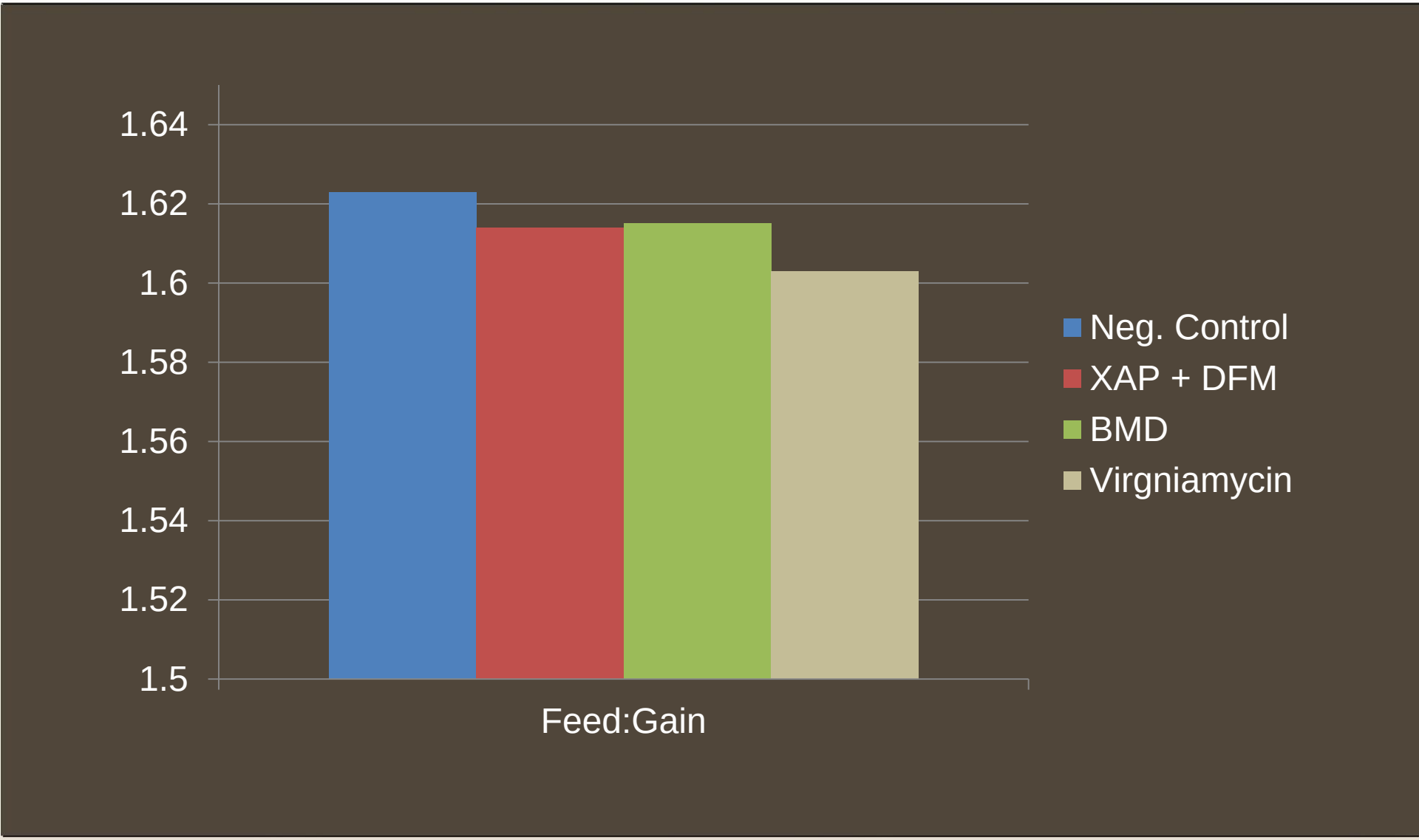
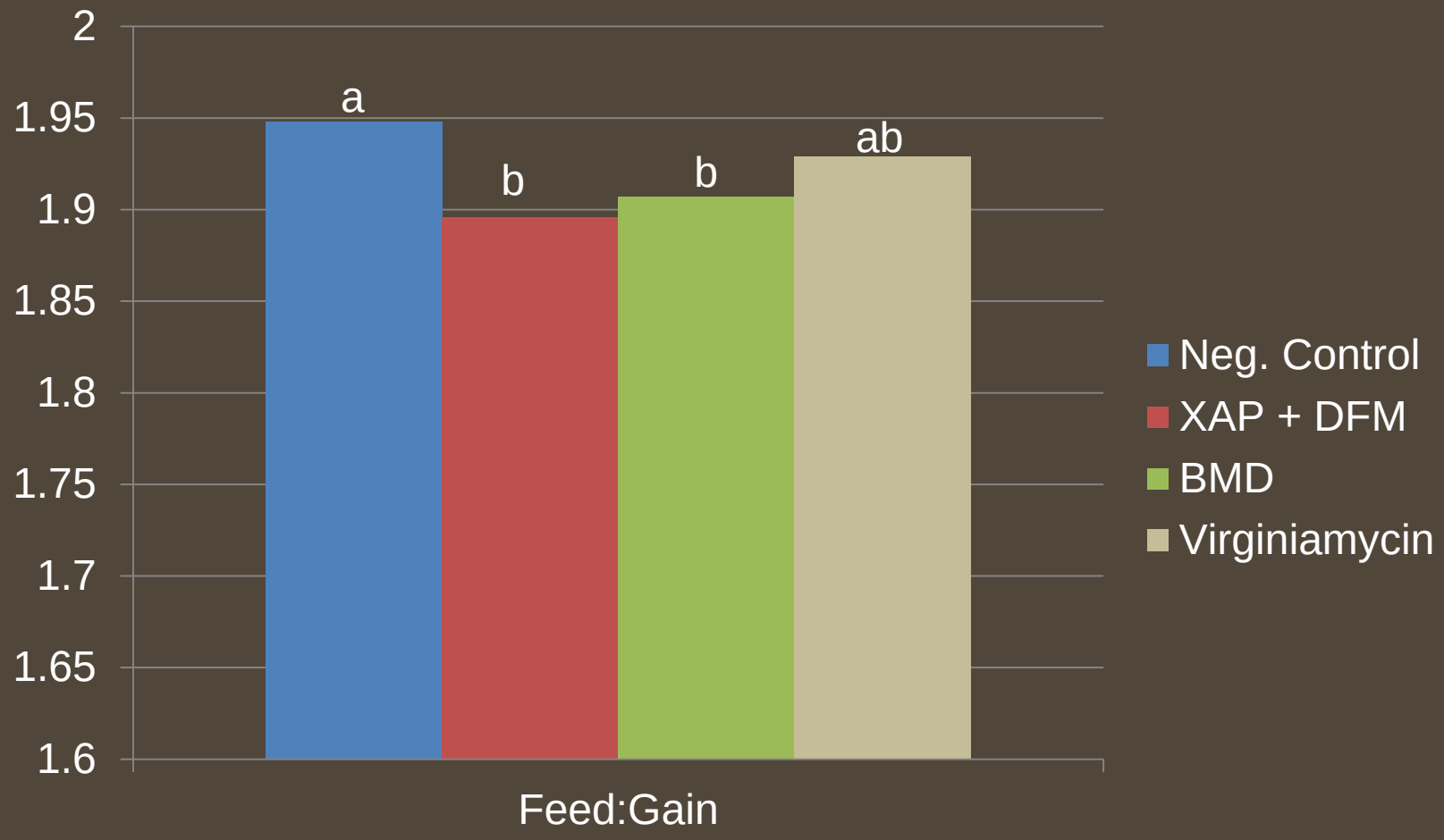
Mortality Corrected FCR - Starter



Mortality Corrected FCR - Grower



Mortality Corrected FCR - Finisher



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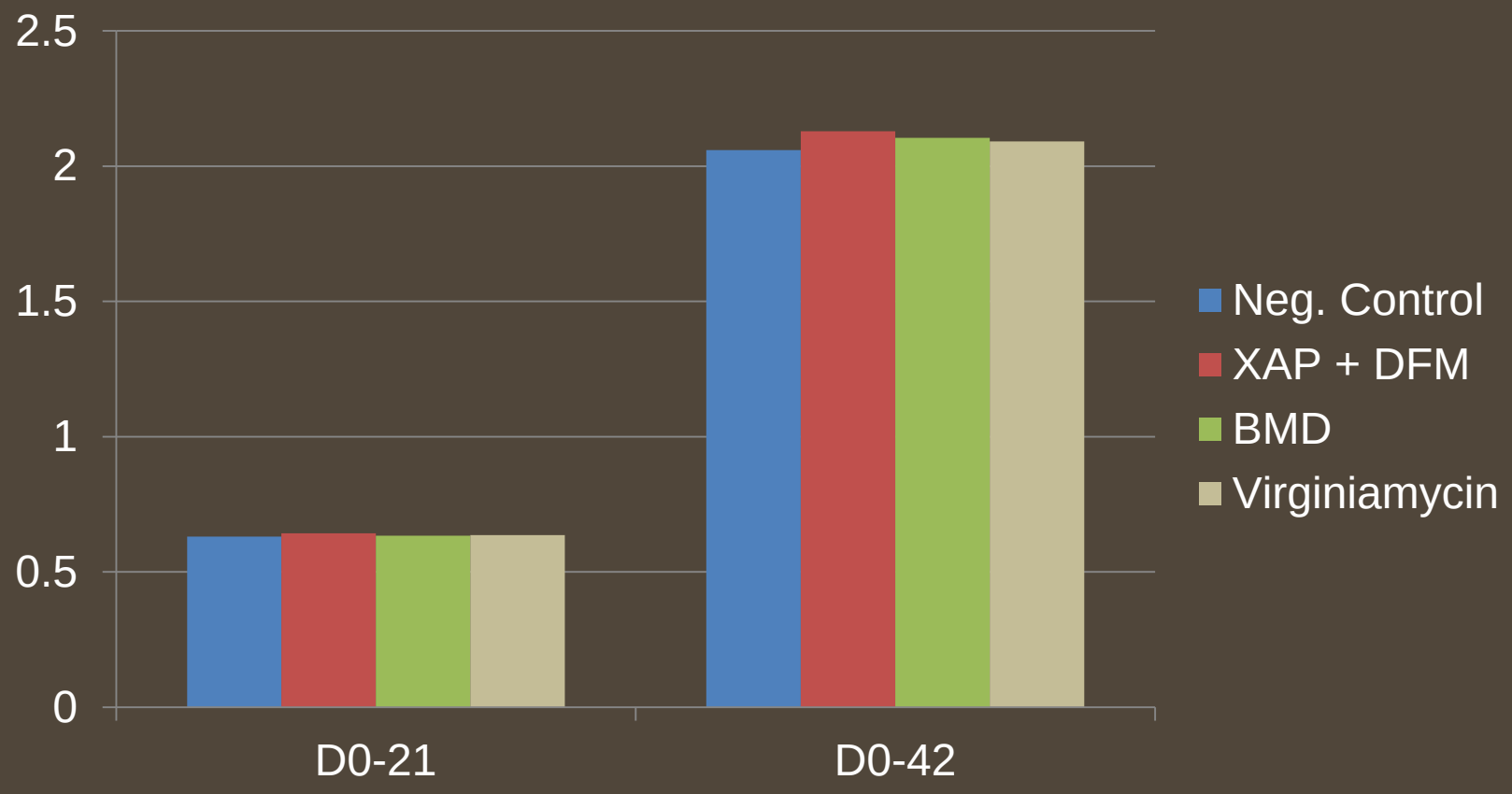
Mortality Corrected FCR

[a,b] Indicates significant difference at $p < 0.05$

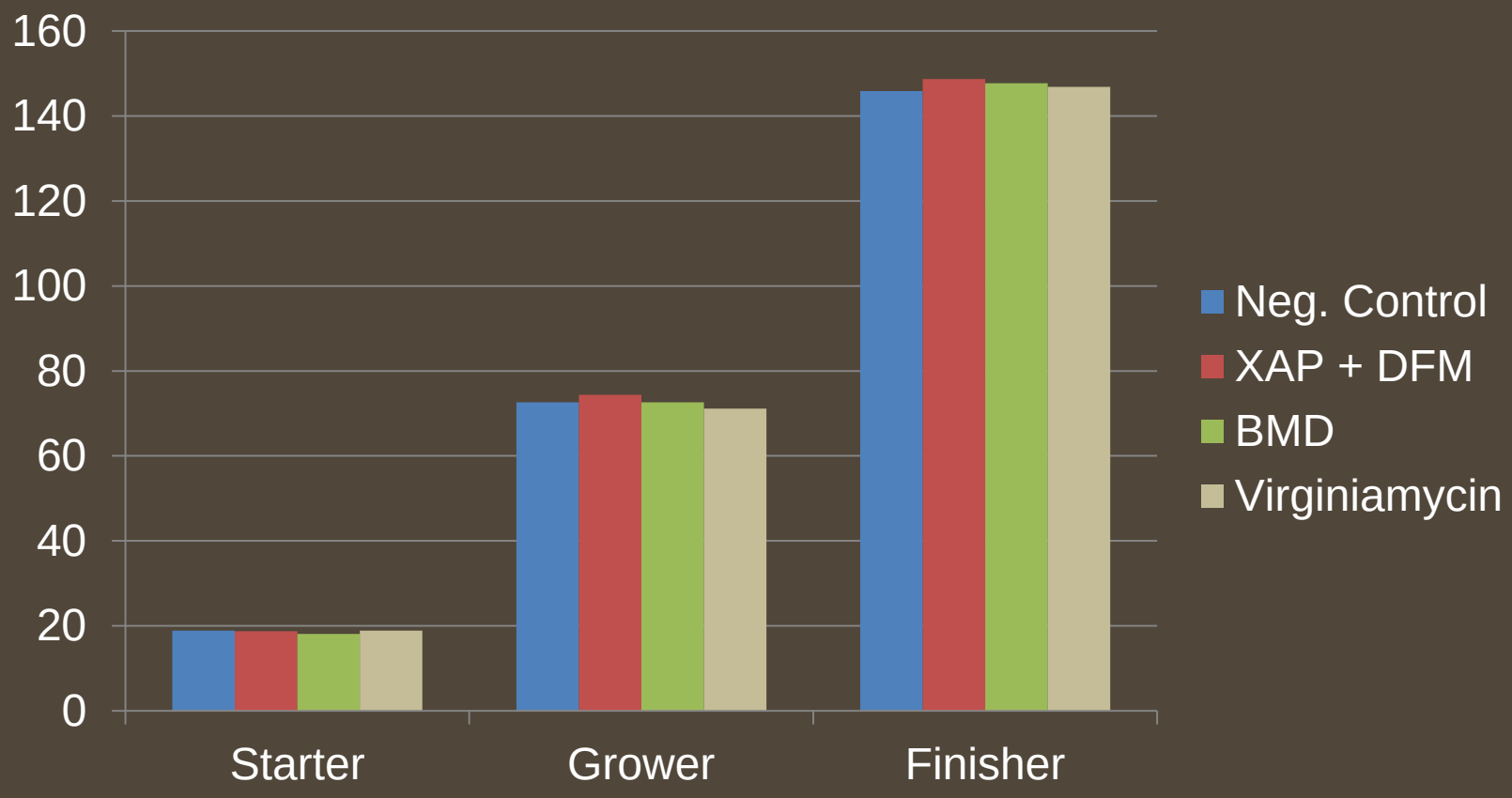
Cumulative Mortality Corrected FCR

[a,b] Indicates significant difference at $p < 0.05$

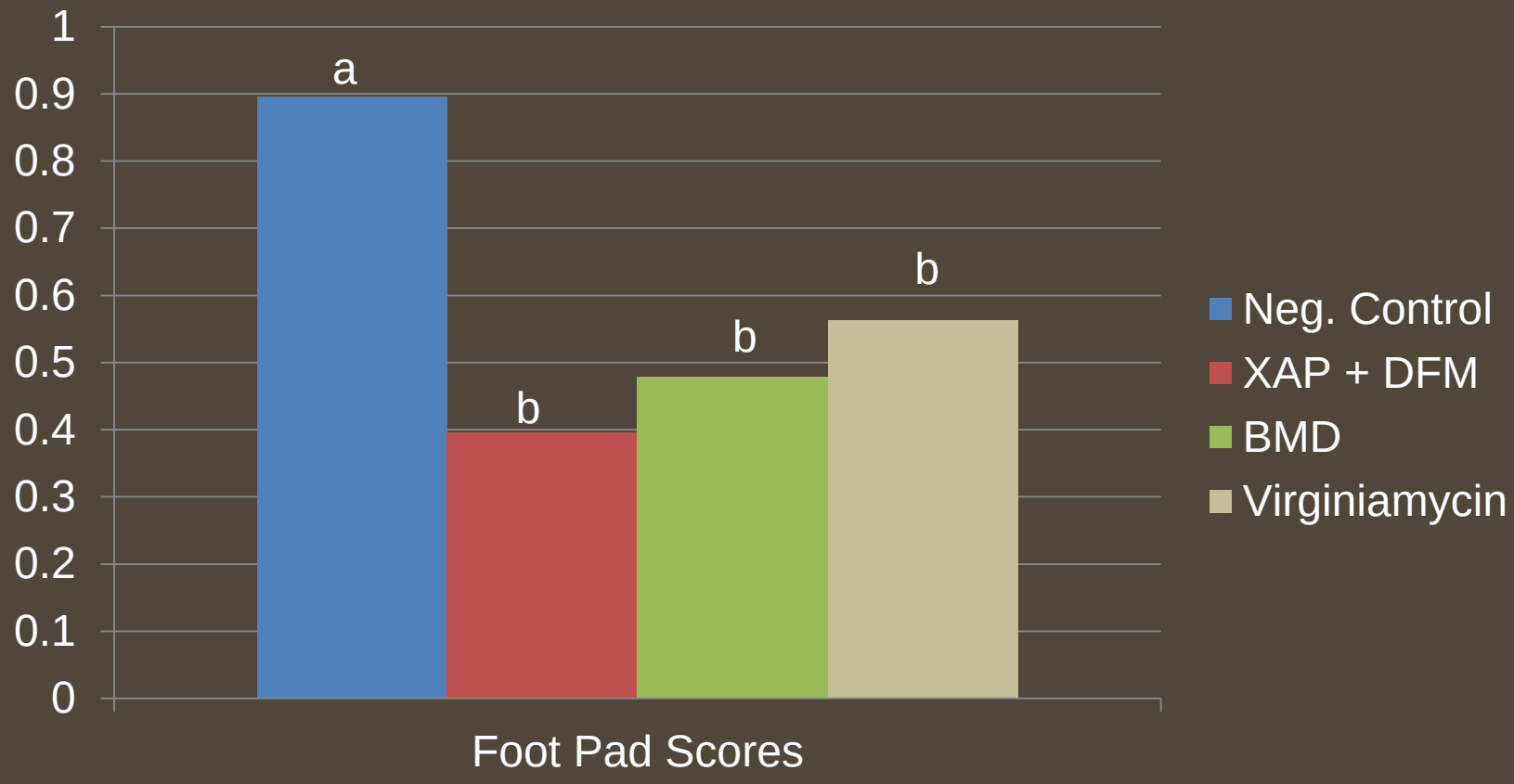
Cumulative Body Weight Gain



Feed Consumed

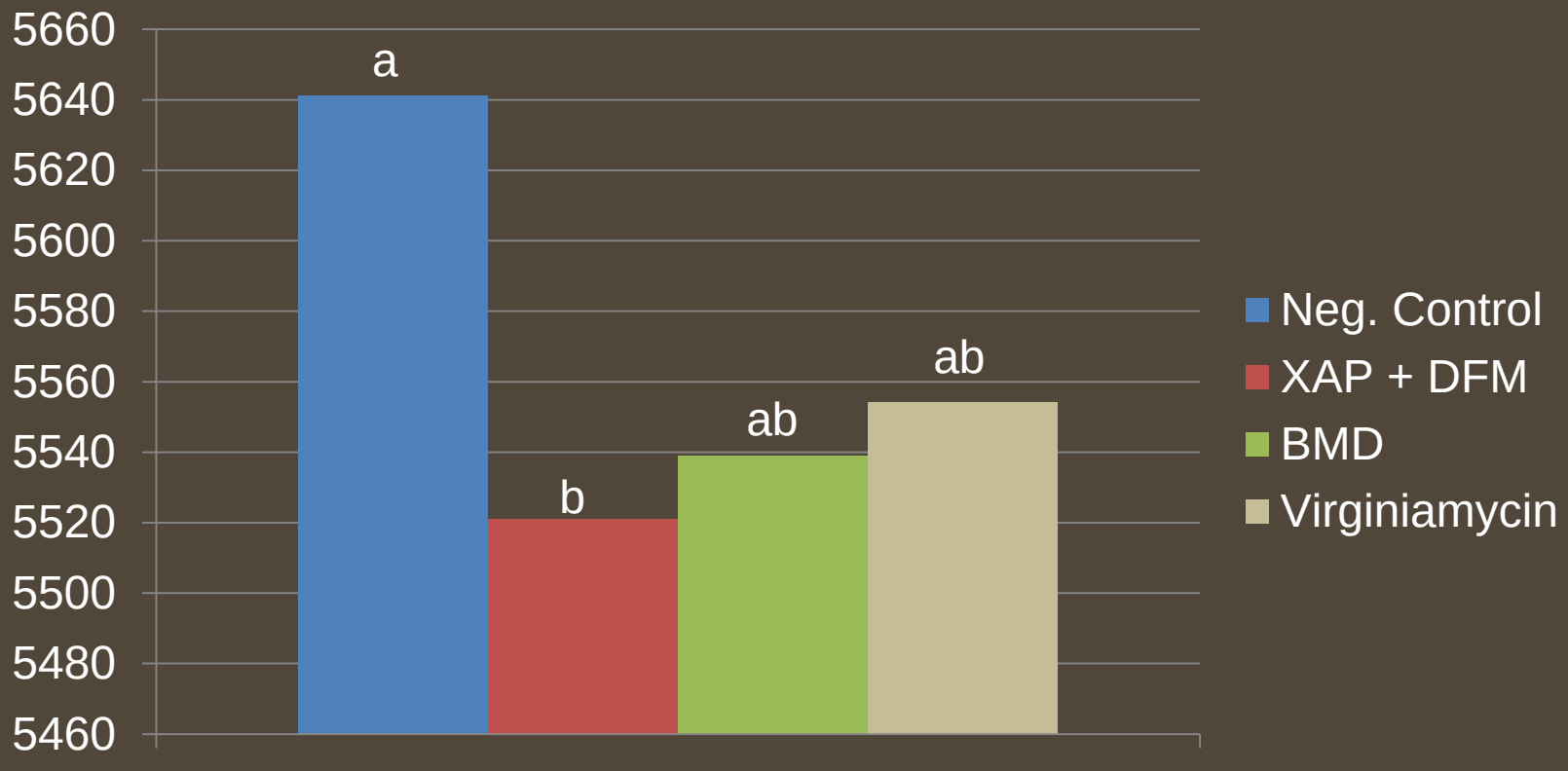


Foot Pad Lesion Scores



[a,b] Indicates significant difference at $p < 0.05$

Calorie Conversion



[a,b] Indicates significant difference at $p < 0.05$

Summary

- Supplementation of a feed additive with mixed enzymes and DFM did not significantly affect body weight, body weight gain, or feed consumed.
- Significant decreases in finisher FCR as well as cumulative FCR with inclusion of feed additive with mixed enzymes and DFM compared to control.
- Foot pad lesion scores were significantly lower than the control with inclusion of feed additive containing mixed enzymes and DFM.
- A significant reduction in kcal/kg body weight gain was observed with supplementation of mixed enzymes and DFM when compared to the control.

Discussion

- Body weight gain was not influenced by the addition of dietary DFM
  - (Lee et. al., 2010; Dersjant-Li et. al., 2014)
- Body weight gain was significantly increased during the first 3 wk of growth but not in the later stage with DFM supplementation.
  - (Salim et. al., 2013)
- An improvement in growth performance was observed when DFM was added to the finisher diet
  - (Mohan et. al., 1996)
- Supplementation with carbohydrases can decrease FCR by increasing feed efficiency
  - (de Toledo et al., 2007; West et al., 2007; Coppedge et al., 2012; Masey O' Neill et al., 2012)
- Combination of XAP + DFM can decrease caloric conversion ratio and improve performance
  - (Dersjant-Li et. al., 2014; Murugesan et. al., 2014)

Conclusion

- Administration of a feed additive with mixed enzymes and DFM improved broiler performance and caloric conversion yielding similar results to that of AGP's.

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