

Effects of Particle Size and Feed Form on Broiler Performance

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Introduction

- **Overall, feed represents 65-75% of animal production costs.**
- **If we could improve the utilization of feed then we could lower production costs.**

Introduction

- **One option to improve feed utilization and reduce cost is to reduce particle size to improve the efficiency of digestion.**

Introduction

- **Reducing particle size:**
 - **Increases the surface area of grains.**
 - **Allows the feed to have a greater interaction with the digestive enzymes and nutrients.**

Introduction

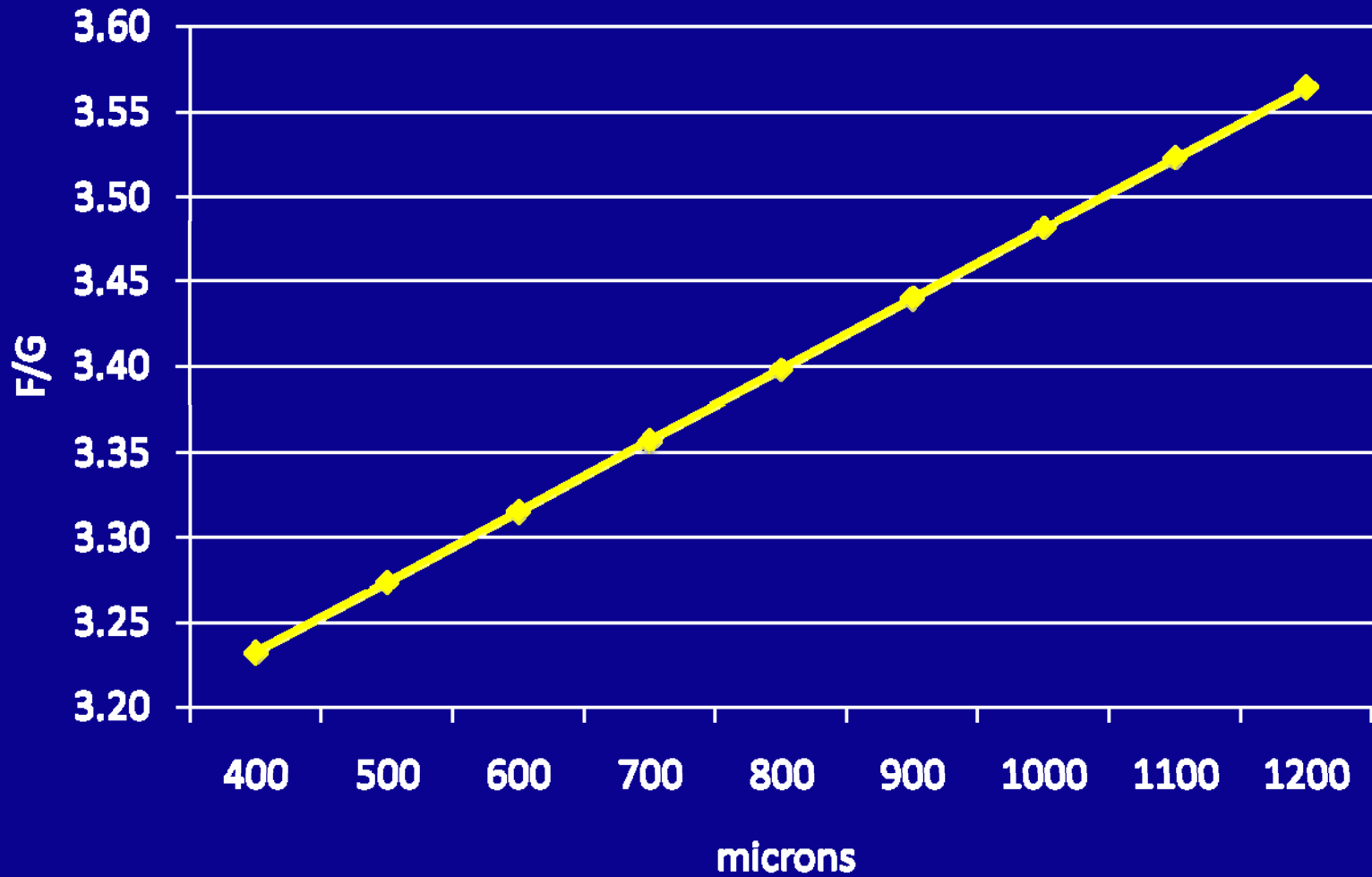
- **Reducing particle size:**
 - **Improves mixing and handling of ingredients.**
 - **Uniform particles have less tendency to separate.**
 - **Increases pelleting efficiency and quality.**

Literature

- **Research in finisher swine showed an improvement in feed efficiency when pigs were fed a smaller particle size, depending on the type of grain.**

Model

Particle Size Reduction - Finishing Pig



Literature

- **Poultry diets have shown a mixed improvement in feed efficiency when particle size was reduced.**
- **The effect of particle size on broiler performance has been thought to be mediated through gizzard function.**

Literature

- **It has been reported that birds fed pelleted diets have a better feed:gain ratio than those fed mash diets.**
- **Birds fed coarse grain mash diets have better feed:gain compared to those receiving medium-ground grain mash diets.**

Literature

Form – Texture	Gain (g)	FI (g)	FCR (g:g)	Gizzard (g/kg of BW)
Mash – Medium	453	777	1.72	22
Mash – Coarse	539	877	1.63	20
Pellet – Medium	834	1271	1.53	11
Pellet – Coarse	824	1253	1.52	11

Wheat Based Diets, 21 d Cage Study

Literature

Grain – Microns	Gain (g)	FI (g)	FCR (g:g)	Gizzard (g/kg of BW)
Wheat – 284	888	1357	1.53	9
Wheat – 890	872	1262	1.47	10
Corn – 297	823	1191	1.45	9
Corn – 528	870	1173	1.36	13

Pelleted Diets, 21 d Cage Study

Literature

Micron	Gain (kg)	FCR (g:g)	Breast (%LW)	Gizzard (%LW)
781	1568	1.92	17.3	1.51
950	1590	1.95	17.2	1.54
1042	1619	1.93	17.0	1.60
1109	1566	1.97	17.3	1.61
2242	1610	2.08	16.0	1.81

Starter Diet 1042 microns
21 day floor pen study
Mash diets

Literature

- **Benefits to feeding pelleted diets to animals:**
 - **Decreased feed wastage**
 - **Reduced selective feeding**
 - **Decreased ingredient segregation**
 - **Improved palatability**

Literature

- **Benefits of Gizzard Development:**
 - Improved nutrient utilization
 - Improved gut motility
 - Prevented pathogenic bacteria from entering the intestine
 - Reduced enteric diseases

Hypothesis

Pelleted feed and reduced particle size improves broiler performance.

Objective

To determine the effect of particle size and feed form on broiler performance.

Materials and Methods



Materials and Methods

- **Corn was ground with a 30 hp hammermill equipped with screen sizes:**
 - **7.9 mm (20/64")**
 - **1.6 mm (4/64")**



Materials and Methods

- Particle size measurement have been termed fine, small, medium, large, and coarse.
- The standard method for particle size measures the geometric mean diameter (d_{gw}) and the standard deviation (S_{gw}).

Materials and Methods

- **Standard Particle Size Analysis:**
 - Split the sample using a riffle divider
 - 100 ± 5 g sample
 - Dispersing agent and sieve agitators were added
 - Run for 10 minutes
 - Measure material on the sieves

Materials and Methods



Dispersing Agent



Ro-Tap



Sieve Agitators



Materials and Methods

Pellet Durability Index



Experimental Design

- **2 x 2 Factorial**
 - **Particle size:**
 - **300 microns**
 - **600 microns**
 - **Feed form:**
 - **Mash**
 - **Pellet**

Treatments

	Mash	Pellet
300	M300	P300
600	M600	P600

Experimental Design

- **The diets were created from a corn-soy basal diet.**
- **Starter pellet diets were crumbled; grower and finisher were fed as pellets.**
- **Mash diets were fed as mash throughout the experiment.**

Feeding Program

Diets	Actual Amount	Approximate Days Fed
Starter	1.5 lbs	0-14
Grower	6.0 lbs	14-35
Finisher	6.0 lbs	35-44

Experimental Design

- **There were 32 experimental pens of 16 males and 16 females Ross 344 X Ross 708 chicks each.**
- **There were eight replicate pens for each of the four treatments total.**
- **Birds were raised on old litter in floor pens.**

Experimental Design

- **BW and feed intake were recorded at 0, 14, 21, 35, and 44 d.**
- **FCR was adjusted for mortality (AdjFCR).**

Basal Diets

Ingredients	Starter	Grower	Finisher
Corn	59.3	67.19	71.47
Soybean Meal (48%)	35.8	28.15	23.90
Dicalcium (18.5%)	2.09	1.85	1.57
Calcium Carbonate	0.97	1.02	1.07
Salt	0.50	0.50	0.50
Vit/TM/Med	0.40	0.40	0.40
Amino Acids	0.24	0.19	0.39
Choline Chloride	0.20	0.20	0.20
Poultry Fat	0.50	0.50	0.50

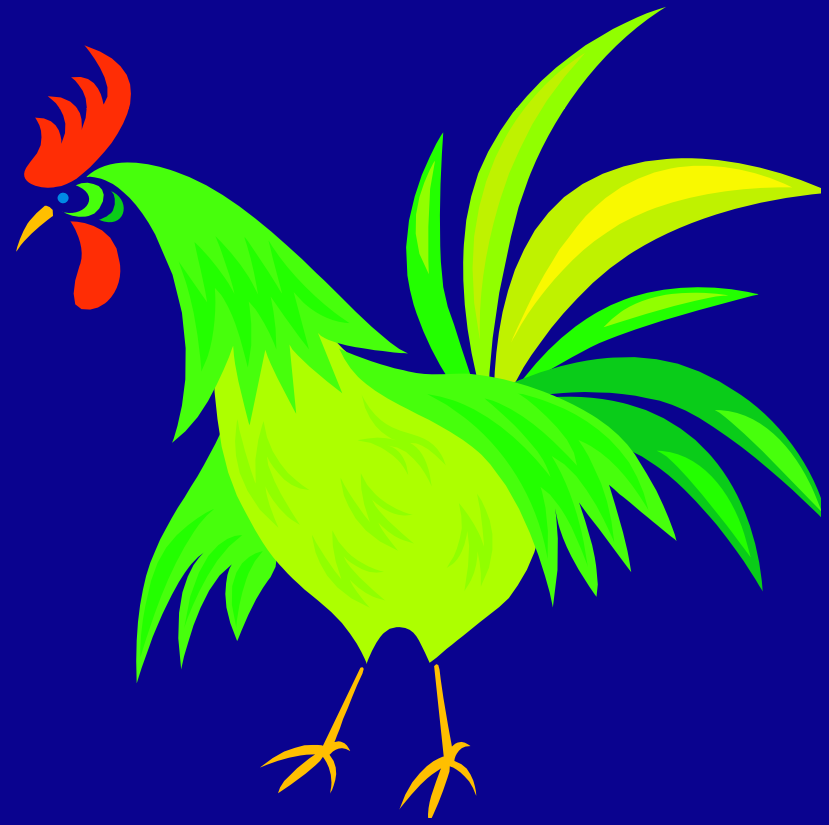
Dietary Specifications

Nutrient	Starter	Grower	Finisher
ME, kcal/kg	2935	3016	3068
CP, %	23.00	20.00	18.50
Lysine, %	1.26	1.10	1.10
Met + Cys, %	0.96	0.83	0.75
Calcium, %	0.90	0.85	0.80
Total P, %	0.75	0.67	0.60
AvP, %	0.45	0.40	0.35

Statistical Design

- **Completely Randomized Design**
- **Proc GLM procedure of SAS**
- **Means were partitioned by LS Means**
- **Significance set at $P < 0.05$**

Results and Discussion



Feed Processing

- Pellet quality as determined by the PDI:
 - The P300 treatment had a PDI of 90%, 85%, and 88%.
 - The P600 treatment had a PDI of 87%, 83%, and 84%.

Feed Processing

- **Particle size of the basal diets:**
 - 300 diets had a PS of 261, 263, and 269 microns.
 - 600 diets had a PS of 615, 536, and 519 microns.

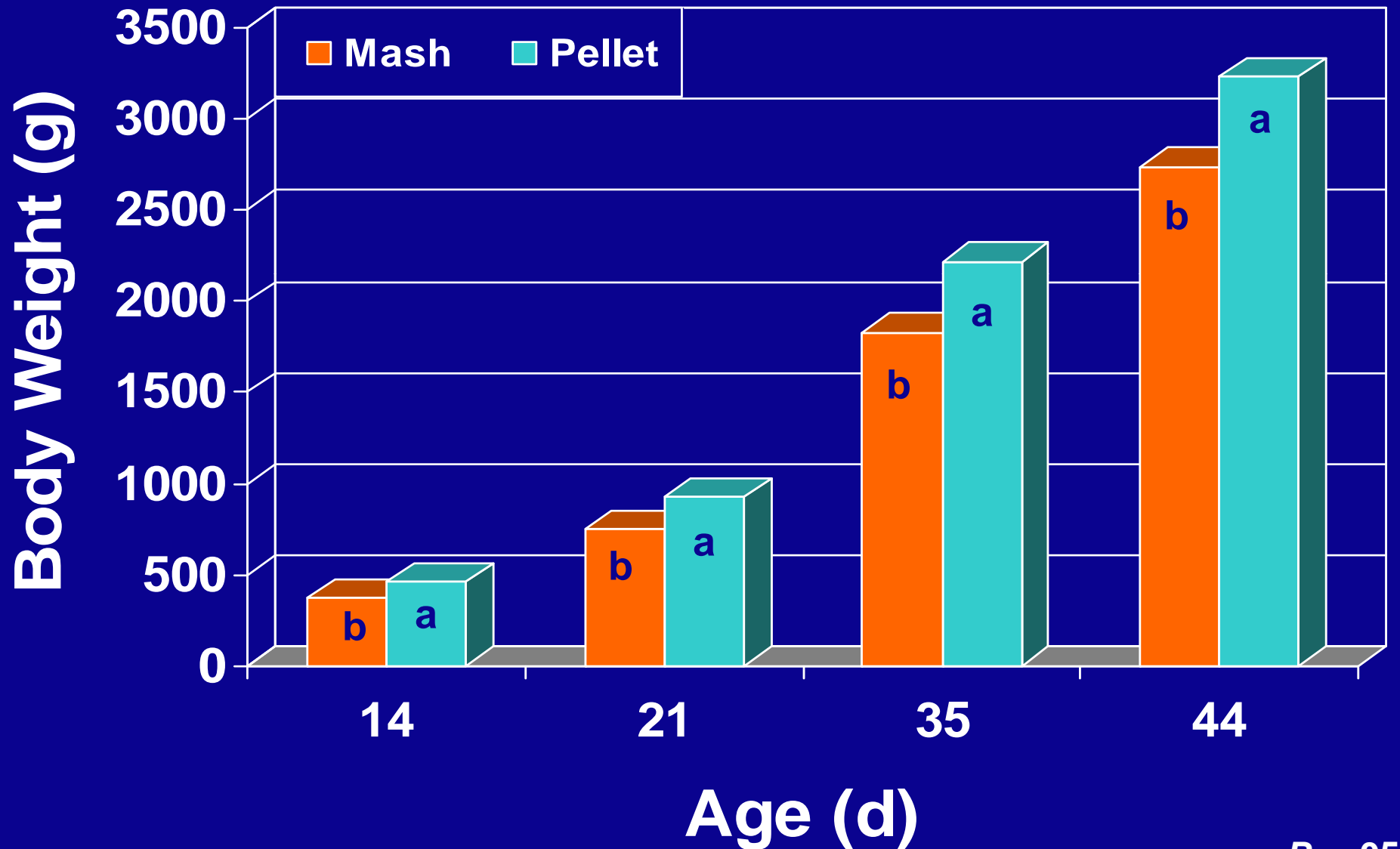
Male Body Weight



Female Body Weight

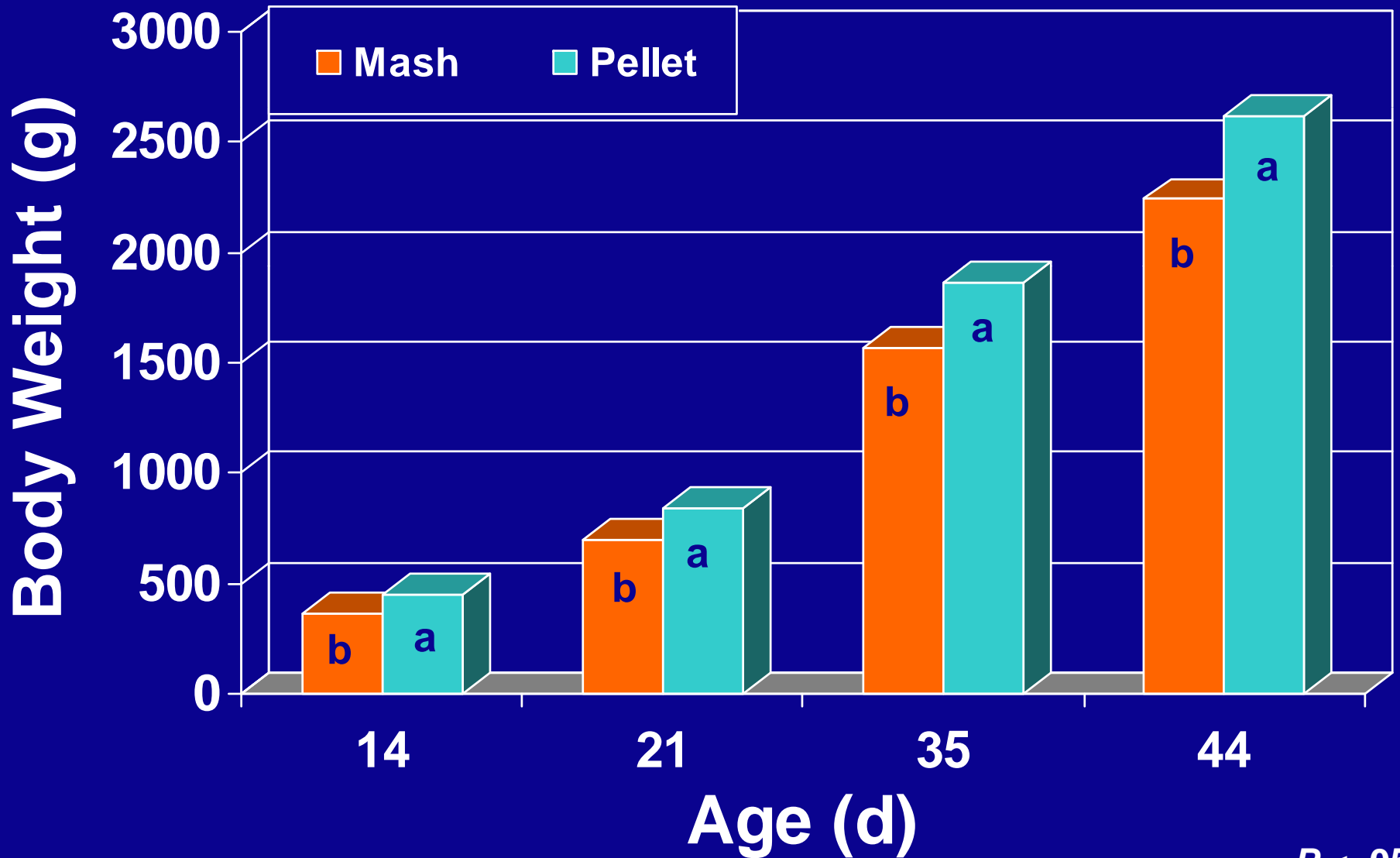


Male Body Weight



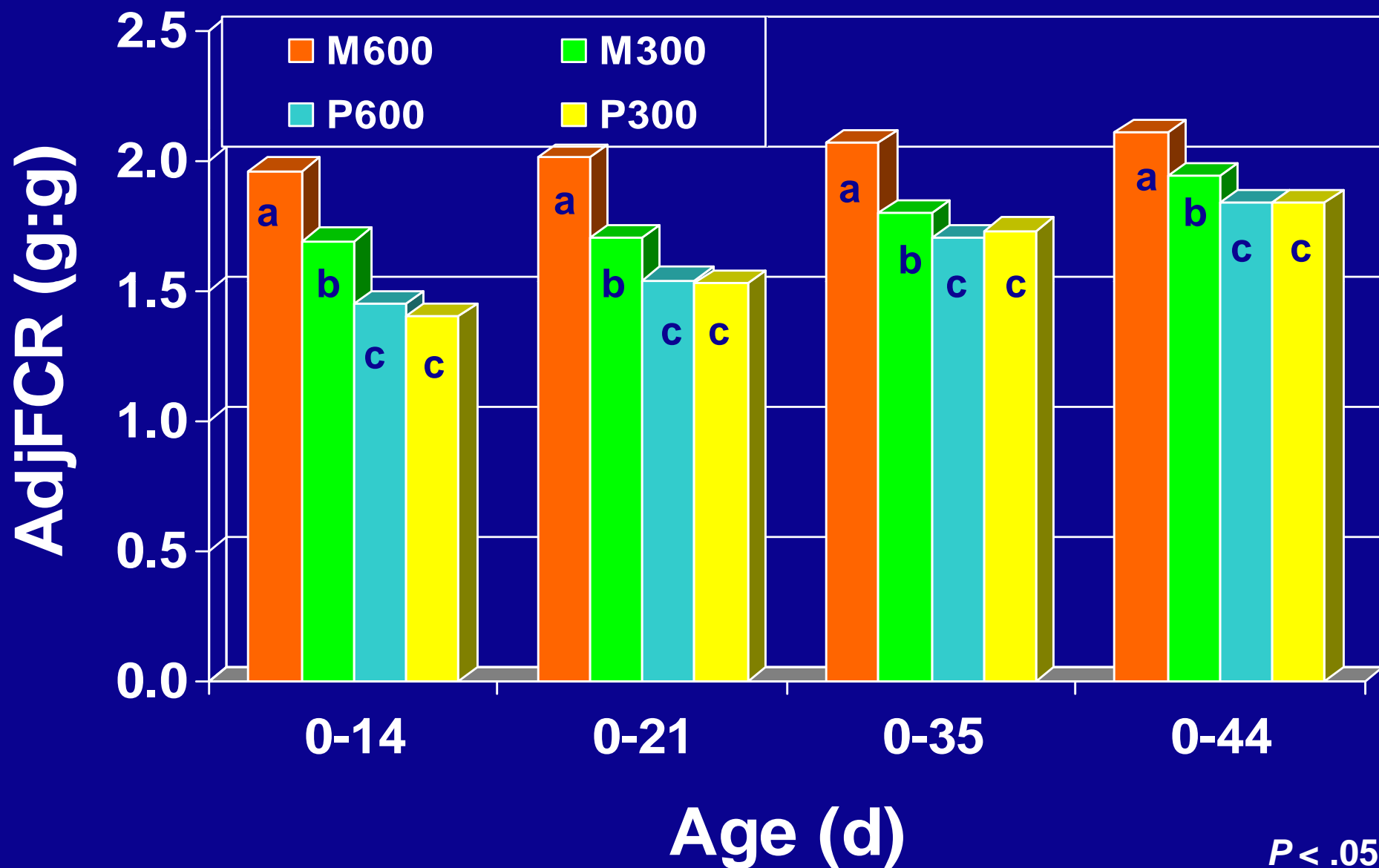
$P < .05$

Female Body Weight



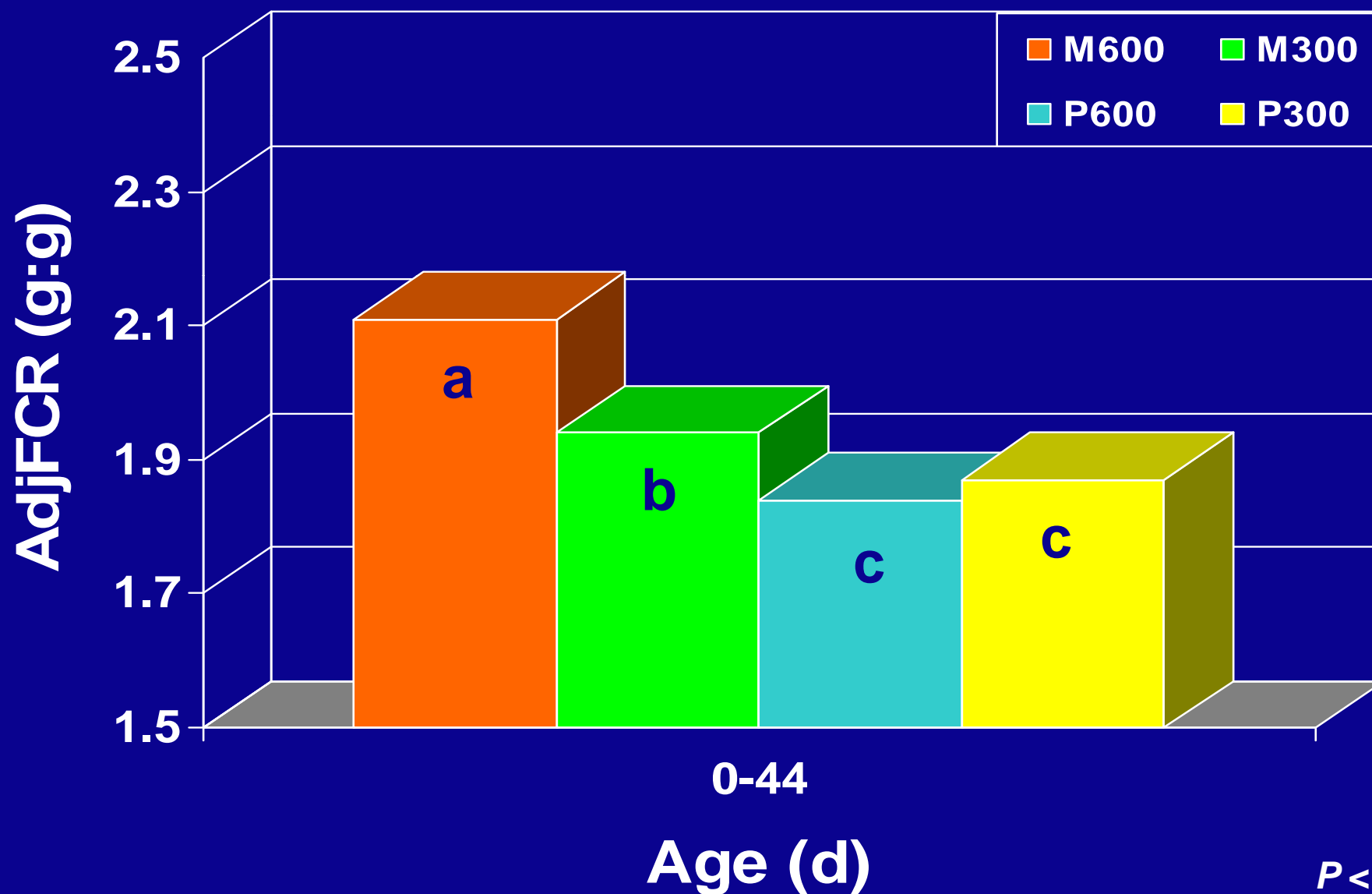
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Adjusted Feed Conversion Ratio

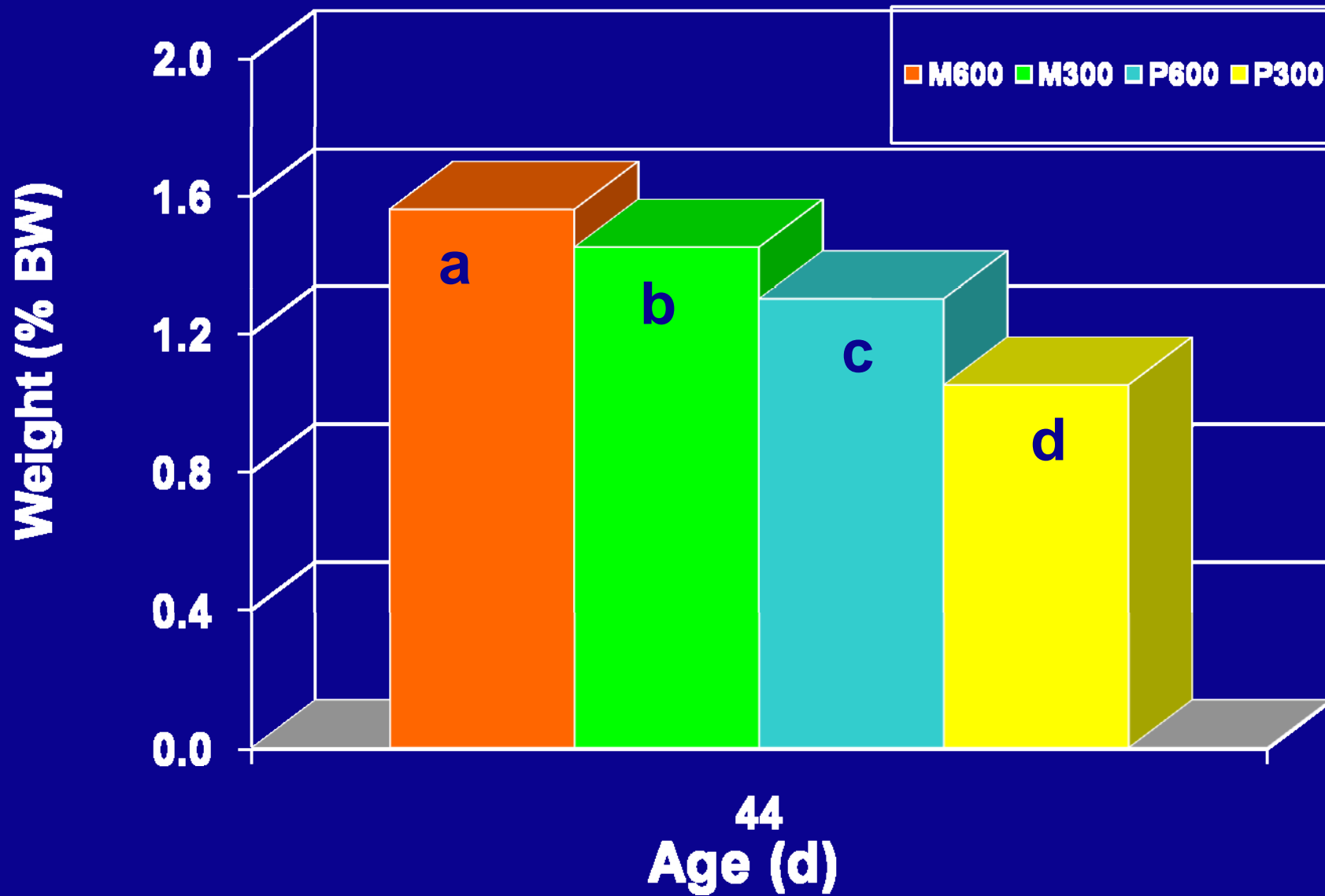


$P < .05$

Adjusted Feed Conversion Ratio



Gizzards



$P < .05$

Discussion

- **There was no difference in BW due to particle size in male and female broilers.**
- **The BW of the male and female broilers was higher for the pelleted diets as compared to the mash diets.**

Discussion

- **Treatments P300 and P600 had better AdjFCR compared to the M300 and M600.**
- **The P300 treatment had the lowest percentage gizzard;
the M600 treatment had the highest percentage gizzard.**

Discussion

- **A smaller particle size did not have a negative effect on broiler performance in pelleted feed.**
- **A smaller particle size improved feed conversion in mash feed only.**

Hypothesis

We accept the hypothesis that pelleted feed improves broiler performance.

We reject the hypothesis that reduced particle size improves broiler performance in a pelleted diet.

Conclusions

- **Reduced particle size does not improve broiler performance when birds were fed pelleted diets.**
- **Pelleted feed improved broiler performance.**
- **Coarser grain produced larger gizzards.**

Questions?

