AVIAGEN BRIEF

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EFFECTS OF FEED TEXTURE ON BROILER BIOLOGICAL AND ECONOMIC PERFORMANCE

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Introduction

Trials and field experience have consistently shown an economic advantage of feeding Aviagen broiler products good quality pellets. Therefore, Aviagen's recommendation for achieving optimal broiler performance is to feed a pellet of good physical quality. However, a significant proportion of producers globally feed mash to their broilers and many of these are not in a position to provide a pelleted diet of good physical quality.

Mash Types around the World

Mash feeds vary significantly around the world. They range from the most basic farm-mixed mash from areas such as Iran, which are usually low energy, fine particle sized feeds produced using non-aerated hammer mills, through to those produced in Western Europe using a roller mill (often a coarse mash texture with a high energy/high oil formulation). In between, there is that typified by the mash produced in South America which is made in large scale mills with an intermediate particle size and energy level.

Aviagen Mash Feeding Trial

To assess the impact of different mash types on the performance of Aviagen male broiler products a study was conducted at the Bangkok Animal Research Centre (BARC) in Thailand.

The trial compared four feed types (see **Figure 1**); Pellets, Coarse Mash, Medium Mash and Fine Mash.

Figure 1: Photo showing the different feed forms used in the trial (energy density as recommended in the 2009 Broiler Management Manual).

All feeds were corn/soybean meal based. All treatments in the trial received a crumb starter up to 10 days of age.

The differing mash feeds were derived by altering grinder speeds and screen sizes (see **Appendix 1**). The particle size distribution of the three mash types is presented in **Appendix 2**.

The Effect of Feed Type on Broiler Performance

The results show that optimal performance was achieved on the pelleted feed (see **Figures 2a** and **2b**). Feed intake and live weight were reduced and FCR increased, on all mash diets relative to pellets. However, there were response differences among mash types. Feed intake and live weight were reduced more on the fine mash feed than on the coarse or medium mash feed.

***Figure 2a**: The effect of pellets and mash on male broiler feed intake at 35 days.*

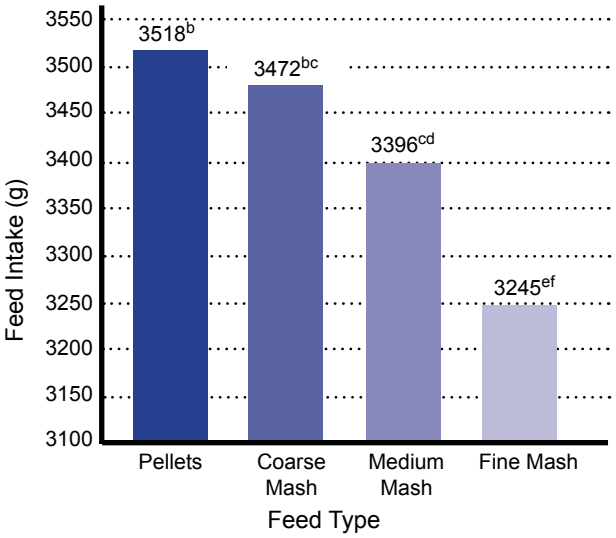
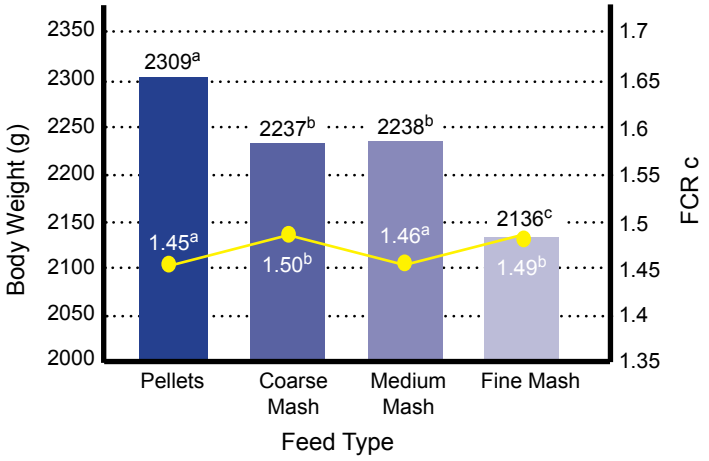


***Figure 2b**: The effect of pellets and mash on male broiler body weight at 35 days and FCR (2kg).*



The difference in performance between the mash and pelleted feeds in the BARC trial was smaller than has been seen in other trials. The magnitude of the reduction in performance that occurs on a mash feed will differ due to, for example, differing environmental temperature and humidity conditions. However, it is clear from this trial that the feeding of a poor quality mash diet (one with a high proportion of fine particles below 1mm in size) will lead to a reduction in performance.

Key Points

- Feeding good quality pellets provides optimal biological performance.
- Feeding a mash has a negative effect on feed intake, live weight gain and FCR.
- Feeding a poor quality (fine) mash (one with a high percentage of particles below 1mm) causes the greatest reduction in performance.
- When feeding mash it is vital that the percentage of fine particles is minimized.

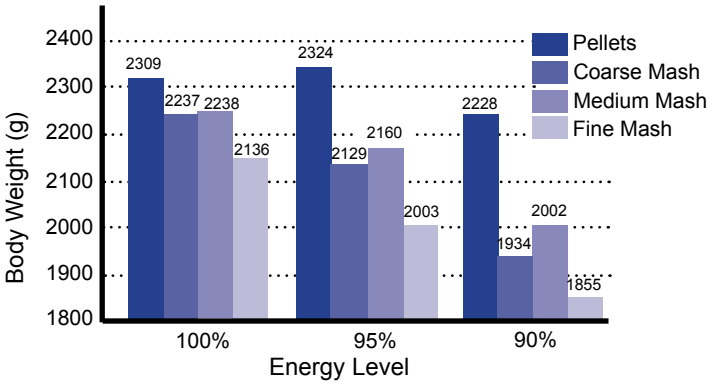
The Effect of Energy Level and Mash Diets on Broiler Performance

In many areas where mash feeds are used the energy concentration of the diet is lower than Aviagen recommends. To understand the implications of this for bird performance, lower energy level treatments were also evaluated in the trial run at BARC.

Energy density was reduced by replacing maize with rice bran and reducing supplementary oil levels in the diets. Starter diet energy levels were maintained at the level recommended by Aviagen (100%) in all treatments.

Figure 3 shows the effect of energy level and mash type on 35-day broiler performance. Clearly, reducing the energy level of mash diets (to below Aviagen recommendations) has a negative effect on body weight.

***Figure 3**: The effect of feed form and energy density on male broiler live weight at 35 days.*



Footnote: 100% energy level is Broiler Management Manual recommendations 12.65 MJ/kg (3025 kcal/kg), 13.20 MJ/kg (3150 kcal/kg), 13.40 MJ/kg (3200 kcal/kg) for Starter, Grower and Finisher feeds respectively. 95% energy is 12.65 MJ/kg (3025 kcal/kg), 12.54 MJ/kg (3000 kcal/kg) and 12.75 MJ/kg (3050 kcal/kg) and 90% energy is 12.65 MJ/kg (3025 kcal/kg), 11.88 MJ/kg (2840 kcal/kg) and 12.06 MJ/kg (2880 kcal/kg) for Starter, Grower and Finisher respectively.

FCR was similarly affected. As energy density was reduced, FCR deteriorated across all treatments but the effect of reduced dietary energy on FCR is more severe in mash diets than in pelleted diets. The best FCR was consistently achieved on the pelleted treatment (**Table 2**).

Table 2: Effects of feed type and energy density on FCR (adjusted to 2kg).

	Energy Density		
Treatment	100%	95%	90%
Pellets	1.45	1.52	1.59
Coarse Mash	1.50	1.60	1.79
Medium Mash	1.46	1.53	1.66
Fine Mash	1.49	1.58	1.65

The impact on performance of progressively lower energy densities highlights the need to carefully consider energy levels when feeding mash diets.

Key Points

- The negative effects of mash diets compared to pellets are magnified as dietary energy is lowered.
- The choice of energy level is vital when producing a mash diet.

The Economics of Mash Feed

It is clear that feeding mash diets will not achieve the same biological performance as feeding a pelleted feed. However, the cost of production is cheaper for mash diets.

Using the same trial data as above it is possible to make an economic assessment of mash diets. Results from the 100% energy density treatments were assessed because bird performance was best at this energy level. Mash feed

manufacturing costs were estimated at €5/tonne cheaper than pelleted products (see **Appendix 3** for breakdown).

Table 3: The effect of feed type on farm economics (margin/bird over feed cost) at 35 days.

		Mash		
	Pellets	Coarse	Medium	Fine
Live weight (kg)	2.309	2.237	2.238	2.136
Revenue (€/bird@€0.75/kg)	1.75	1.70	1.70	1.62
Feed cost (€ cents/bird)	82.9	80.2	78.5	75.0
Margin (€ cents/bird)	92.6	89.8	91.5	87.0

Mash diets resulted in lower live weights and reduced revenue per bird compared to pellets (**Table 3**). The highest margin per bird was achieved on the pelleted treatment (see **Appendix 4** for breakdown).

Key Points

- Based on the available data, feeding a mash diet resulted in lower feed intakes and live weights and also a lower revenue and margin (per bird) than pellets.
- In spite of the savings in manufacturing costs, feeding a mash diet of any texture reduced margin over feed cost compared to pelleted diets.
- Of the three mash types, a medium mash resulted in the best margins.
- The particle size distribution of mash diets can significantly affect margins.

Other Considerations

The BARC trial involved feeding mash feeds in the grower and finisher periods only, a good quality crumb was used in the starter period (0 to 10 days). Other trial results suggest that feeding a mash product in the starter period can have further detrimental effects on end performance.

Assessment of Mash Particle Size

Feed particle size is traditionally determined by dry sieving of a representative 200–250g sample. The sample is passed through a sieve stack on an automatic shaker for a set time (60–120 seconds depending on the device). The amount of particles retained on each screen size is then determined.

Aviagen is currently using 'manual shaker sieves' which can be used for a basic assessment of mash particle size in the field.

Ideally, the amount of fine particles (<1mm) in a mash feed should be minimized to below 25% of the feed. Achieving this when using a hammer mill for grinding may be more difficult than when using a roller mill; therefore, when using a hammer mill for grinding the goal should be to keep fine particles (<1mm) to less than 30% of the feed.

Conclusions

- These trial results indicate that biologically and economically, mash diets do not perform as well as pellets.
- Mash diets can perform well; however, it is clear that the particle size and energy density of mash has a significant affect on biological performance relative to pellets.
- Reducing dietary energy density will have more of a negative effect on performance in mash diets compared to pelleted diets.
- The distribution of particle sizes in mash diets can have a significant impact on biological performance and profitability.
- Make it a routine practice to assess mash quality in the mill and at the farm. Farm samples should be taken from the feeding system and the aim should be to minimize the levels of fine particles to below 25% (30% for a hammer mill).

Appendix 1: Grinder settings used to derive different mash types.

Feed Type	Screen Size (mm)	Grinder Speed (rpm)
Pellets (3mm die)	3	2800
Coarse Mash	6.5	1420
Medium Mash	3	1420
Fine Mash	2	2800

Soyabean meal was ground through a 1mm screen for the fine mash treatments, with all other treatments using "as is" material.

Appendix 2: Particle size distribution (% of feed) of mash diets.

	Mash Type								
	Coarse			Medium			Fine		
Energy Level (%)	100	95	90	100	95	90	100	95	90
> 3mm	19	29	29	1	4	1	0	0	0
2-3mm	17	13	18	10	17	13	3	0	0
1-2mm	28	24	25	43	35	45	26	7	4
< 1mm	36	34	28	46	44	41	71	93	96

Appendix 3: Calculation of manufacturing cost reductions when producing mash.

Item	Cost (€/tonne)
Electrical Cost	2.0
Steam Generation	1.5
Labor Costs	1.0
Maintenance and Repair	0.5
Total	5.0

Appendix 4: Economic calculations for different feed types.

Feed Type		Cost (€/tonne)	Feed Intake (kg/bird)	Feed Cost (€/bird)	Margin Calculation (€/bird)	
Pellet	Starter	252	0.297	0.07	Live weight (kg at 35 days)	2.309
	Grower	242	1.517	0.37	Revenue/kg	0.760
	Finisher	227	1.704	0.39	Revenue/bird	1.755
Total			**3.518**	**0.829**	**Margin (- feed cost)**	**0.926**
Coarse Mash	Starter	252	0.303	0.08	Live weight (kg at 35 days)	2.237
	Grower	237	1.474	0.35	Revenue/kg	0.760
	Finisher	222	1.695	0.38	Revenue/bird	1.700
Total			**3.472**	**0.802**	**Margin (- feed cost)**	**0.898**
Medium Mash	Starter	252	0.297	0.07	Live weight (kg at 35 days)	2.238
	Grower	237	1.470	0.35	Revenue/kg	0.760
	Finisher	222	1.629	0.36	Revenue/bird	1.701
Total			**3.396**	**0.785**	**Margin (- feed cost)**	**0.916**
Fine Mash	Starter	252	0.296	0.07	Live weight (kg at 35 days)	2.136
	Grower	237	1.356	0.32	Revenue/kg	0.760
	Finisher	222	1.593	0.35	Revenue/bird	1.623
Total			**3.245**	**0.750**	**Margin (- feed cost)**	**0.874**