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Feeding Programs for Broiler Breeders in the Start Phase

ABSTRACT

The fast-growing Brazilian aviculture requires studies to improve zootechnical performance indexes for broiler breeders. The purpose of this study was to assess different feeding programs for broiler breeders on performance and development of digestive organs. A total of 48,000, 1d-old, Cobb 500 broiler breeders were divided into two sheds with 24,000 birds each. The experiment was randomized in block design, considering each shed a block, with 4 treatments and 6 replications per treatment with 2,000 birds in each. Treatments consisted of: Shed 1) T1 = starter feed; T2 = T1 + probiotics; Shed 2) T3 = pre-starter feed; T4 = T3 + probiotics. The productive performance characteristics (bird weight, weight gain, feed intake and feed conversion), the development of digestive organs (gizzard, proventriculus, spleen, bursa of Fabricius and small bowel) as well as the small bowel length were assessed weekly for all experimental groups, in samples of 10 birds per treatment. The best feed conversion and weight gain were observed with pre-starter feed in the first 7 days of age, with or without probiotic. Small bowel, gizzard and proventriculus development at 28 days was better for birds on pre-starter feed compared to those on starter feed alone. It is possible to conclude that broiler breeders on pre-starter feed during the first 7 days of age are likely to show better physical and productive performances in the adult phase.

INTRODUCTION

The broiler breeder segment has been going through oscillations due to the combination of a reduction in supply (as a result of problems in parent and grandparent broiler houses, or sanitation issues) and an increase in demand (due to high beef prices, for example). In these cases, eggs or chicks that were likely to be excluded in a more detailed selection, are maintained for growing and finishing. Eggs from new breeders will provide one-day chicks with more substantial weight variation, which might compromise the performance of the flock (Burnham *et al.*, 2001).

The bird's size and weight, 1-d-old are considered key factors for flock uniformity; broiler breeders between 30-55 weeks of life produce chicks of 40-45g of live weight, considered ideal for development (Cobb 500). Thus, the post-hatch feeding of birds is very important for this purpose.

Due to limitations in the digestion and absorption of nutrients, several factors influence growth rates in the first week – percentage of yolk, feed and water intake, nutritional value, amount of feed and microbiota colonization (Dibner *et al.*, 2008).

High quality feed in the first days of age may contribute to maximum genetic performance. Different feeding programs have been assessed



considering the nutritional requirements at each stage of life, so that birds reach maximum zootechnical indexes while reducing costs and improving growth (Godoy, 1994).

The feed is the main cost in aviculture, reaching up to 70% of costs, therefore, several companies are focusing on specific feeds for each stage of life, meeting nutritional requirements and improving bird uniformity and performance. However, several factors affect nutrient utilization, such as the age of the birds, digestibility of feed ingredients and management practices (Lilburn, 1998).

Brake (1999), demonstrated the importance of the relationship between the cumulative nutrition during the period of breeding and rearing and future reproductive performance of females. This period ranges from accommodation to photostimulation.

The aim of this study was to assess different feeding programs for broiler breeders in the starter phase (1 to 28 day old), considering performance and digestive organs development.

MATERIAL AND METHODS

The experiment was performed in the Agua Vermelha Poultry House, partner of Globoaves, located near the city of Sao Carlos - SP (Brazil), from August to September 2013. The study was approved by the Ethics Committee in Animal Use from UNICASTELO, under protocol number 0001/2014.

The fowl run has negative pressure, with black curtains, 18.8m in length and 16.5m in width and a commuting water cooler.

The total of forty-eight thousand female, 1 day old, Cobb broiler breeders were divided into two sheds, with twenty-four birds each. The experiment was randomized in block design, considering each shed a block, with four treatments and six replications per treatment with 2,000 birds each (eight birds/m² of creating density). The treatments consisted of: Shed 1) T1 = starter feed (1-7 days); T2 = T1 + probiotic (in continuous water on day 1); Shed 2) T3 = pre-starter feed (1-7 days); T4 = T3 + probiotic (in continuous water on day 1). After 7 days, all birds were fed the same control diet (T1) without probiotic. Experimental diets were corn and soymeal-based, meeting the nutritional requirements of each feeding stage (Manual COBB-500) – Table 1.

Floramax (live lactobacillus) was the probiotics of choice. It includes *Lactobacillus Bulgaricus*, *Lactobacillus Casei*, *Lactobacillus Cellobiosus*, *Lactobacillus*

Table 1 – Centesimal and calculated composition of experimental feeds for broiler breeders in starter phase.

Ingredients	Pre-starter	Starter
Corn, ground	51.405	60.865
Wheat bran	0.000	4.000
Soy bran - 45%	40.550	29.800
Soy oil	3.650	0.250
Calcitic limestone - 38%	1.475	1.525
Monocalcium phosphate - 20%	1.250	1.025
Salt	0.295	0.305
Sodium bicarbonate	0.310	0.140
Methionine ¹ – 88%	0.320	0.285
Lysine ² – 54,6%	0.100	0.190
L-threonine ³ – 98%	0.045	0.015
Vitamin-mineral premix ⁴	0.400	0.400
Kaolin	0.000	1.000
Antifungals ⁵	0.200	0.200
Total	100.00	100.00
Calculated composition		
Metabolizable Energy (kcal/kg)	2.999	2.850
Crude Protein (%)	23.00	19.49
Crude Fiber (%)	3.10	3.13
Calcium (%)	1.05	1.00
Total phosphorus (%)	0.61	0.56
Digestible lysine (%)	1.18	1.00
Digestible methionine (%)	0.54	0.47
Digestible tryptophan (%)	0.25	0.21
Digestible treonine (%)	0.81	0.65
Digestible methionine+cysteine (%)	0.85	0.75
Sodium (%)	0.23	0.19
Chlorine (%)	0.24	0.25
Potassium (%)	0.95	0.80
DEB (mEq/kg) ⁶	277	195

¹ DL-methionine (Ajinomoto Int. ®); ²Biolys (Evonik Degussa ®); ³L-Threonine (Ajinomoto Int. ®)

⁴Vitamin-mineral premix composition (per kg) – Pre-starter/starter: vitamin A 11250000 IU/kg, Vitamin D3 3750000 IU/kg, Vitamin E 37500 mg/kg, Vitamin K3 3125 mg/kg, Vitamin B1 3125 mg/kg, Vitamin B2 10000 mg/kg, Vitamin B6 5000 mg/kg, Vitamin B12 25000 mcg/kg, Niacin 50000 mg/kg, Pantothenic Acid 18750 mg/kg, Folic Acid 2000 mg/kg, Biotin 150 mg/kg, Colin chloride 60% 1250 g/kg, Copper 10000 mg/kg, Iron 50000 mg/kg, Manganese 120000 mg/kg, Zinc 100000 mg/kg, Iodine 2000 mg/kg, Selenium 300 mg/kg; ⁵EBD 100 mg/kg 125 mg/kg; ⁶ Electrolyte Balance of Diet, according to Mogin (1981).

Fermentum, *Lactobacillus Helveticus* and inulin (Vetanco®), one sachet of 50ml to 10.000 birds.

The lighting program was defined as 24 hours of light on the first day of lodging, with 2 hours/day reductions until 10 hours/day of light was reached. Maximum and minimum temperatures were recorded daily with a mercury thermometer, with averages of 32°C and 20°C, respectively.

On day 3, beaks were trimmed and the birds were vaccinated via eye drop against infectious bronchitis, Newcastle, Gumboro, and coccidiosis; at 21 days the birds were given a Gumboro booster via drinking water.



Zootechnical performance indexes (body weight, feed consumption, feed conversion and flock viability) were assessed weekly throughout the experimental period. The feed was offered *ad libitum* in the first week. From the second week onwards, the feed was controlled when each bird received the required amount according to lineage and age. The amounts were adjusted weekly according to the Lineage Manual.

At 7, 14, 21 and 28 days, 10 birds per treatment were euthanized and necropsied, and the following variables were assessed: bird weight, weight of proventriculus, gizzard, cloacal bursa, small bowel and gut length. The organ's weights were given relative to the bird's weight.

Data were submitted to variance analysis in a randomized block design, and means were compared by t test at 5% probability level, with SAS statistical package (2002).

RESULTS AND DISCUSSION

The results of performance characteristics of breeders in starter phase are shown in Table 2. Higher body weight was observed ($p < 0.05$) at 7, 14 and 21 days for birds fed with pre-starter feed in the first 7 days of age, regardless of probiotics use. Feed conversion was also better for these groups at 14 and 21 days, even though feed was controlled after 7 days of age.

For broiler breeders, controlled feed is crucial for flock uniformity, the modern strains of high performance have large capacity on muscle growth, and even when mature birds can still convert the excess of amino acids and proteins in muscles, impairing egg production (Jensen, 1986).

In the whole assessment period (1-28 days, Table 3), higher daily weight gain can be observed for birds on pre-starter feed when compared to those receiving starter feed alone, with direct influence on feed conversion.

Table 4 shows the relative weights of the digestive tract organs at 1, 7, 14, 21 and 28 days for the different treatments. The difference was significant ($p \leq 0.05$) for all variables, except relative liver weight. In agreement with the studies of Penz *et al.* (1998) and Stringhini *et al.* (2003), higher development of small bowel can be observed in the first week for all birds, regardless of treatment, highlighting the importance of specific diets which meet the nutritional requirements of posthatch birds. However, gut relative weight was higher ($p \leq 0.05$) at 28 days for the birds which received pre-starter feed with or without probiotics, when compared to birds fed only with starter feed, regardless of probiotics.

The small bowel was longer at 28 days for birds on pre-starter feed without probiotics when compared to birds fed with starter feed with or without probiotic.

Table 2 – Average scores¹ for weekly performance of broiler breeders in grower phase on different feeding programs.

Characteristics	Starter			Starter+probiotics			Pre-starter			Pre-starter + probiotics		
	Between days 1-7											
BW - day 1 (g)	37.92	±	1.24	37.92	±	1.24	36.96	±	1.00	36.96	±	1.00
BW - day 7 (g)	125.00	±	10.23 b	125.00	±	10.23 b	133.00	±	10.65 a	133.00	±	10.65 a
DWG (g)	12.44	±	1.04	12.44	±	1.04	13.72	±	1.87	13.72	±	1.87
DFI (g/bird/day)	22.00	±	0.00	22.00	±	0.00	22.00	±	0.00	22.00	±	0.00
FCR (g/g)	1.768	±	0.65	1.768	±	0.65	1.603	±	0.40	1.603	±	0.40
Liveability (%)	99.58	±	0.45	99.67	±	0.32	99.20	±	0.50	99.11	±	0.80
	Between days 8-14											
BW - day 7 (g)	125.00	±	10.23 b	125.00	±	10.23 b	133.00	±	10.65 a	133.00	±	10.65 a
BW - day 14 (g)	220.00	±	18.5 b	220.00	±	18.5 b	273.00	±	17.8 a	273.00	±	17.8 a
DWG (g)	13.57	±	1.9 b	13.57	±	1.9 b	20.00	±	2.1 a	20.00	±	2.1 a
DFI (g/bird)	34.00	±	0.00	34.00	±	0.00	34.00	±	0.00	34.00	±	0.00
FCR (g/g)	2.505	±	0.78 a	2.505	±	0.78 a	1.700	±	0.62 b	1.700	±	0.62 b
Liveability (%)	99.54	±	0.40	99.79	±	0.25	99.64	±	0.32	99.65	±	0.45
	Between days 15-21											
BW - day 14 (g)	220.00	±	18.5 b	220.00	±	18.5 b	273.00	±	17.8 a	273.00	±	17.8 a
BW - day 21 (g)	330.00	±	20.3 b	330.00	±	20.3 b	400.00	±	23.5 a	400.00	±	23.5 a
DWG (g)	15.71	±	1.36 b	15.71	±	1.36 b	18.14	±	1.8 a	18.14	±	1.8 a
DFI (g/bird)	42.00	±	0.00	42.00	±	0.00	42.00	±	0.00	42.00	±	0.00
FCR (g/g)	2.673	±	0.56 a	2.673	±	0.56 a	2.315	±	0.42 b	2.315	±	0.42 b
Liveability (%)	99.91	±	0.15	99.92	±	0.10	99.73	±	0.26	99.77	±	0.15

¹Means ± Standard Deviations. Values followed by different letters on the same line indicate differences in T test ($p \leq 0.05$); DWG: Daily weight gain; DFI: Daily feed intake; FCR: Feed conversion ratio; BW: Body weight.

**Table 3** – Mean values¹ of performance characteristics of broiler breeders throughout grower phase (days 1-28) receiving different feeding programs.

Characteristics	Starter			Starter+probiotics			Pre-starter			Pre-starter + probiotics		
BW - day 1 (g)	37.92	±	1.24	37.92	±	1.24	36.96	±	1.00	36.96	±	1.00
BW - day 28 (g)	491.00	±	23.5 b	491.00	±	23.5 b	543.00	±	20.3 a	543.00	±	20.3 a
DWG (g)	16.18	±	1.23 b	16.18	±	1.23 b	18.07	±	1.48 a	18.07	±	1.48 a
DFI (g/bird)	36.00	±	0.00	36.00	±	0.00	36.00	±	0.00	36.00	±	0.00
FCR (g/g)	2.225	±	0.38 a	2.225	±	0.38 a	1.992	±	0.32 b	1.992	±	0.32 b
Liveability (%)	98.96	±	0.56	99.32	±	0.20	98.40	±	0.65	98.40	±	0.75

¹Means ± Standard Deviations. Values followed by different letters on the same line indicate differences in T test ($p \leq 0.05$); DWG: Daily weight gain; DFI: Daily feed intake; FCR: Feed conversion ratio; BW: Body weight.

According to Windhorst (2006), longer bowels may contribute to better nutrient absorption due to its increased surface.

The gastrointestinal tract is a site of significant growth during the bird's initial phase, then in the first days of post-hatch, the birds go through a period of

intense morphological and functional development, implying a limiting factor to the absorption of nutrients (Sell *et al.*, 1991).

For the proventriculus, differences in relative weight were significant ($p < 0.05$) at 7 and 28 days. The birds which received pre-starter feed showed better

Table 4 – Relative digestive system organ's weight (in body weight) of broiler breeders, in the starter phase, under different feeding programs.

Small bowel (%)				
Age	Starter	Starter+probiotics	Pre-starter	Pre-starter + probiotics
Day 1	5.33	4.92	5.33	4.92
Day 7	21.40	20.92	21.06	19.65
Day 14	10.74	12.66	10.49	9.94
Day 21	9.67	10.20	11.11	10.36
Day 28	6.10 b	6.40 b	9.20 a	9.10 a
Small bowel length (cm)				
Age	Starter	Starter+probiotics	Pre-starter	Pre-starter + probiotics
Day 1	42.6	41.8	42.6	41.8
Day 7	85.6	80.3	83.2	80.3
Day 14	106.1	103.1	107.8	107.1
Day 21	122.5	123.9	124.5	131.3
Day 28	128.2 b	130.9 b	138.2 a	133.0 ab
Proventriculus (%)				
Age	Starter	Starter+probiotics	Pre-starter	Pre-starter + probiotics
Day 1	1.11	1.03	1.11	1.03
Day 7	1.13 b	1.04 b	1.27 a	1.33 a
Day 14	0.78	0.80	0.86	0.82
Day 21	0.64	0.67	0.64	0.69
Day 28	0.36 b	0.38 b	0.64 a	0.63 a
Gizzard (%)				
Age	Starter	Starter+probiotics	Pre-starter	Pre-starter + probiotics
Day 1	7.28	7.47	7.28	7.47
Day 7	8.05	7.42	7.54	8.39
Day 14	6.39	5.87	5.83	6.18
Day 21	5.31	5.20	5.00	5.06
Day 28	2.90 b	3.54 b	4.32 a	4.75 a
Cloacal bursa (%)				
Age	Starter	Starter+probiotics	Pre-starter	Pre-starter + probiotics
Day 7	0.21	0.21	0.22	0.19
Day 14	0.25	0.28	0.28	0.27
Day 21	0.28 b	0.24 b	0.34 a	0.32 a
Day 28	0.17 b	0.20 b	0.32 a	0.28 a

Values followed by different letters on the same line indicate differences in T test ($p \leq 0.05$).



development of the proventriculus when compared to the groups on starter feed alone; this might lead to higher enteric secretion of HCl and pepsinogen, that ease in breaking protein, improving feed digestion.

Higher gizzard relative weight was observed at 28 days for birds fed with pre-starter feed, that has a higher level of protein than the starter feed, regardless of probiotics, when compared to other treatments. Better gizzard muscle development may contribute to mucosal protection against damages caused by feed and grain pressure; stronger gizzard muscles may also grind feed better, exposing nutrients for absorption (Lilja *et al.*, 1985).

The importance of protein intake on growth and body weight of the birds in the initial stages of development, will approve the diets with higher levels of protein and energy has been recommended by the strains (Sbanotto, 1999). In the present study, the pre-starter diets showed 3.50% more protein than the starter diets, and may have contributed to further development of the digestive organs.

Higher relative weight of the cloacal bursa was observed at 21 e and 28 days in birds fed with pre-starter feed when compared to those fed with starter feed, regardless of probiotics.

The small bowel weight: length ratio allows for an indirect assessment of bowel mucosa growth. Different mucosa densities may represent an increase or decrease in height and diameter of villus, influencing digestive and absorptive capabilities of the gastrointestinal tract (Uni *et al.*, 1998).

Bertechini & Hossain (1993), Suida (1999) and Zuanon (1995), did not observe an additive effect of probiotics in the start phase, corroborating with our results. This finding may be explained by the fact that no environmental contamination was observed in the first few days of age, and that cleaning and disinfection of floor pens was adequate.

CONCLUSION

It is possible to conclude that broiler breeder chicks on pre-starter feed during the first seven days of age, are likely to show better physical and productive performances in the adult phase.

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