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PERFORMANCE, CARCASS YIELD AND LITTER QUALITY OF BROILERS RAISED ON LITTERS TREATED WITH MICRO-ORGANISMS

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ABSTRACT

The present paper aimed at evaluating the effect of adding beneficial micro-organisms to the litters on litter quality, performance and carcass yield for broilers. A total of 240 one-day chicks were used, and randomly distributed in blocks with four treatments and four replications. The following treatments were carried out in the housing: Treatment 1 – Control with weekly spraying of water on the litters; Treatment 2 – Litter treated with a mixture of inoculated and fermented meal by micro-organisms and weekly spraying of water; Treatment 3 – Litter treated by weekly spraying of micro-organisms; Treatment 4 – Litter treated with the same mixture of meals from treatment two and weekly spraying of micro-organisms. Performance was evaluated by the feed consumption, weight gain, feed conversion, viability and carcass, breast and leg yield. From litter samples, pH, dry matter, ashes and nitrogen were evaluated. No differences were found among the treatments. In the conditions the animals were raised, it can be concluded that the treatment on the litter does not affect performance, carcass yield and quality of the litter for broilers.

KEYWORDS: feed conversion; *Gallus gallus*; litter pH; probiotic.

DESEMPENHO, RENDIMENTO DE CARCAÇA E QUALIDADE DA CAMA DE FRANGOS CRIADOS EM CAMA TRATADA COM MICRO-ORGANISMOS

RESUMO

O presente trabalho objetivou avaliar o efeito da adição de micro-organismos benéficos na cama sobre o desempenho, rendimento de carcaça e a qualidade da cama de frangos de corte. Foram utilizados 240 pintos de um dia de idade distribuídos em um delineamento em blocos casualizados com quatro tratamentos e quatro repetições. Os tratamentos foram: Tratamento 1 – Controle com aspersão de água na cama no alojamento e semanalmente; Tratamento 2 – Cama tratada com uma mistura de farelos inoculados e fermentados por micro-organismos no alojamento e aspersão de água na cama semanalmente; Tratamento 3 – Cama tratada por aspersão de micro-organismos no alojamento e semanalmente; Tratamento 4 – Cama tratada com a mesma mistura de farelos do tratamento 2 no alojamento e aspersão de micro-organismos no alojamento e semanalmente. O desempenho foi avaliado pelo consumo de ração, ganho de peso, conversão alimentar, viabilidade e rendimento de carcaça, peito e pernas. Das amostras de cama foram avaliados o pH, a matéria seca, cinzas e nitrogênio. Não foram verificadas diferenças entre os tratamentos. Nas condições em que os animais foram criados, pode-se concluir que o tratamento da cama não altera o desempenho, o rendimento de carcaça e a qualidade da cama de frangos de corte.

PALAVRAS-CHAVE: conversão alimentar; *Gallus gallus*; pH da cama; probiótico

INTRODUCTION

One of the main objectives of poultry production is to keep high productivity at low cost, along with the quality of final products. In order to meet these objectives, growth promotion additives, such as antibiotics, were added to broiler diets.

Nevertheless, the uncontrolled use of antibiotics in animal feed has resulted in the development of resistant bacteria populations (FULLER, 1989), determining an unbalance in the symbiosis between the desirable microbiota and the animal (MULDER, 1991), which has contributed to the reduction in its use in animal feed, and completely banishment of its usage in some countries.

The current levels of technification and productivity makes it difficult to imagine animal production without the use of feed additives for preventing diseases or as growth promoters (GIL de los SANTOS & GIL-TURNES, 2005). Therefore, the need of studies of alternative products that may replace antibiotics without causing productivity loss and decrease in quality of end products is evident. Among the different alternatives that are currently being studied, probiotics are among the most promising ones (PATTERSON & BURKHOLDER, 2003).

Probiotics are beneficial bacteria which help to increase the desirable bacteria population in the organism. Several papers about the use of probiotic bacteria in the production of different species of farm animals have been published (DESNOYERS et al., 2009; VEIZAJ-DELIA et al., 2010; FARAMARZI et al., 2011; RIGOBELO et al., 2011), as well as the range of products now available for this purpose in the market has grown.

Commercial products containing probiotics are generally used in feed, water or inoculated through spraying on birds (SCHNEITZ, 1992). Besides these administration forms, other options are starting to appear for inoculation a spraying on the litter and utensils with the aim of promoting a balanced ecosystem in broiler´s housing. Effective Micro-organisms (EM), currently registered as Embiotic, is a product used to accelerate the composting process, is one example.

This product is the result of composed cultivation of anaerobic, aerobic and other micro-organisms with different actions (the main ones are bacteria producing lactic acid, yeast, photosynthetic bacteria, fungi and actinomycets). These micro-organisms exist abundantly in nature, and most of them have already been used in food industrialization, and therefore are harmless to humans and animals (FUNDAÇÃO MOKITI OKADA, 2002).

In recent years, several studies have shown extremely positive results of the use of probiotics in broiler feed. However, little research has been carried out about spraying products on the litter.

Regarding the productive performance, bacteria from the genre *Lactobacillus* added to feed have increased weight gain and improved feed conversion of supplemented animals (JIN et al., 1998a, b; KALAVATHY et al., 2003). Likewise, OZCAN et al. (2003) confirmed improvement in feed efficiency and increase in carcass weight of broilers supplemented with *Enterococcus faecium* Cernelle 68. On the other hand, HINKLE (2010) did not find differences in feed consumption, average gain and feed conversion of broiler chickens when microbial compound (mixture of bacteria and humic acids) was sprayed onto the poultry litter in relation to control.

Regarding the improvement of carcass and cut (breast, legs and back) yield, the use of probiotics in the feed of broilers does not produce beneficial effects, according to the literature (LODDI et al., 2000; AWAD et al., 2009; APPELT et al., 2010; SOUZA et al., 2010; NUNES et al., 2012). However, in studies developed by CORRÊA et al. (2003) and PELICANO et al. (2003), there was an improvement of leg yield with the addition of probiotics to the feed. There are no reports on the use of probiotic sprayed on the litter on the carcass yield.

In Brazil, there are few studies about the influence of probiotics on the quality of broiler litter. Thus, the aim of this paper was to evaluate the effect of adding beneficial micro-organisms to the litters of broilers on performance, carcass yield and quality of litter for broilers.

MATERIAL AND METHODS

This research was developed at the Experimental Aviary in the Veterinary Hospital at Universidade Paranaense (Unipar) – Campus II, in the period between September and November, 2011. During the experimental period, the average temperature recorded was 24.5^{o}C. A total of 240 one-day *Cobb* chicks were used in a randomized block design with four treatments and four replications. Each experimental unit had 15 animals.

The treatments consisted of Treatment 1 – control with water spraying on the litter on the first

day of experiment and at 7, 14, 21, 28 and 35 days of age; Treatment 2 – litter treated with *Bokashi*® on the first day and water spraying on the litter at 7, 14, 21, 28 and 35 days of age; Treatment 3 – litter treated with *Embiotic*® on the first day and at 7, 14, 21, 28 and 35 days of age; and Treatment 4 – litter treated with *Bokashi*® on the first day and *Embiotic*® on the first and at 7, 14, 21, 28 and 35 days of age. Micro-organisms were added to the litter through sprinkling of activated liquid and/or in the form of inoculated meal fermented by micro-organisms (Bokashi®).

In order to meet the nutritional requirements of the broilers, the breeding period was divided into two phases: initial (1 to 21 days) and growth (22 to 42 days).Water and feed were supplied *ad libitum*. Feed supplied to the animals was acquired from a regional company and had 21% crude protein, 2.37% lysine, 0.4% methionine, 0.65% total phosphorus, 0.15% calcium for the period of 1 to 21 days and 19% crude protein, 1.2% lysine, 0.4% methionine, 0.8% total phosphorus, 0.35% calcium for the period of 22 to 42 days of age. Aiming at determining the performance, we weekly evaluated feed consumption, weight gain, feed conversion and viability rate, and after calculation, we analyzed the data for the periods of 1 to 21, and 1 to 42 days of age.

The material used as litter in all treatments was made of coarse wood shavings. Litter collection for analysis was made in three points in each box (1.5 x 1.85 m), avoiding the areas near and below the feeders and drinkers, at 21 and 42 days. Moisture, ashes and nitrogen content of the litter were determined according to methodology described by SILVA & QUEIROZ (2002).

We analyzed Litter pH weekly, starting one week after the implementation of the experiment. In order to determine pH, we used methodology by BENABDELJELIL & AYACHI (1996), in which 10 grams of litter were agitated and suspended in deionized water (in the ratio 1:2.5), and left to rest for one hour; the reading was done in a pH-meter.

At the end of the experimental period (42 days of age), two broilers from each experimental unit were euthanized, according to protocol 20676/2011 approved by the Research Ethics Committee involving Animal Experimentation (CEPEEA), using the anesthetic protocol (xylazine as pre-anesthetic medication in a 4 mg/Kg - IM, and thiopental for euthanasia at 25 mg/Kg - IV). Afterward, the animals were sent to bleeding and plucking for the evaluation of carcass and cuts (breast and legs) yield.

For the calculation of carcass yield, we considered the weight of the eviscerated carcass, without feet, head or abdominal fat, in relation to live weight. For the yield of meat cuts, we considered the yield of whole breast with skin and the yield of legs (thighs and drumsticks with skin), being calculated in relation to the eviscerated carcass weight.

Data statistical analysis was made using Variance Analysis (two criteria) for block designs, using the statistic program BioEstat 5.0 (AYRES et al., 2007).

RESULTS AND DISCUSSION

There were no differences in the performance of broiler chickens raised on litters treated or not with micro-organisms (Table 1).

Table 1: Performance of broiler chickens raised on litter treated or not with micro-organisms in the periods of 1 to 21 and 1 to 42 days of age

Period (days)	Variables	Treatments				CV%
		1	2	3	4	
1 to 21	Weight gain (g)	855.79±11.1	873.35±8.5	875.26±13.4	843.38±13.6	2.7
	Feed intake (g)	1383.94±23.2	1375.05±15.4	1404.77±9.1	1335.20±16.5	2.3
	Feed conversion	1.62±0.03	1.57±0.01	1.61±0.02	1.58±0.006	2.2
	Viability (%)	95.0±3.19	100±0.0	96.7±1.92	96.7±1.92	3.7
1 to 42	Weight gain (g)	2512.65±21.0	2526.73±40.5	2603.97±112	2575.82±12.8	3.6
	Feed intake (g)	4584.48± 135	4350.63±72.4	4415.72±95.5	4379.65±118	4.7
	Feed conversion	1.83±0.07	1.72±0.05	1.71±0.09	1.70±0.05	7.6
	Viability (%)	90.0± 4.30	96.7± 1.92	93.3± 4.71	95± 3.19	7.6

Treatment 1 – control with water spraying on the litter on the first day of experiment and at 7, 14, 21, 28 and 35 days of age; Treatment 2 – litter treated with *Bokashi*® on the first day and water spraying on the litter at 7, 14, 21, 28 and 35 days of age; Treatment 3 – litter treated with *Embiotic*® on the first day and at 7, 14, 21, 28 and 35 days of age; and Treatment 4 – litter treated with *Bokashi*® on the first day and *Embiotic*® on the first and at 7, 14, 21, 28 and 35 days of age.

Lactic acid and yeast producing bacteria, present in EM (Effective Micro-organisms), ferment organic materials that are part of Bokashi®, and produce substances which improve the balance of intestinal flora (FUNDAÇÃO MOKITI OKADA, 2002), performing, therefore, a probiotic role. However, no differences were found due to the use of product comprised of micro-organisms contained in Bokashi® or Embiotic®.

Similarly, HINKLE (2010) did not find differences in feed consumption, average gain and feed conversion of broiler chickens receiving microbial litter additive (mixture of bacteria and humic acids) sprayed onto the poultry litter in relation to control.

In literature, there are several reports of the use of probiotics in broiler chickens. The results presented are very different, since there are many commercial products with varied probiotic micro-organism composition and different strains of the same micro-organism.

Moreover, SCHNEITZ & NUOTIO (1992) and ZIPRIN et al. (1993) described several treatment methods using probiotics, such as feed, drinking water, spraying over the animals, inoculation via cloaca or in embryonic eggs (*in ovo*), inoculation in used litter, in gelatin capsules and intra-esophageal route. In the present study, the treatment was performed with the spraying of micro-organisms on the litter.

Thus, not only the different compositions of probiotic micro-organisms and strains of a single micro-organism, but also the application route might justify the differences in the results obtained. However, other factors limiting the efficacy of probiotics, such as nutrition, environment, animal quality, immunity, management and use of antibiotics should also be considered.

FULLER (1989) emphasized that the stressing agent must be present before any effect of the supplement can be observed, for instance, growth will only be stimulated if the depressing agent is present. Therefore, the non-detection of benefits in performance with the use of probiotics (LODDI et al., 2000; LIMA et al., 2003; MOUNTZOURIS et al., 2007; BITTERNCOURT et al., 2011) might be justified by the good sanitary conditions in which the animals were raised.

On the other hand, very promising results with the use of probiotic, with performance improvement were observed (WATKINS et al., 1982; JIN et al., 1996; MOHAN et al., 1996; YEO & KIM, 1997; SANTOSO et al., 1995; JIN et al., 1998a, b; FRITTS et al., 2000; RIGOBELO et al., 2011).

The litter treatment did not influence ($P>0.05$) the carcass, legs and breast yield (Table 2). These results are in agreement with those obtained by LODDI et al. (2000), AWAD et al. (2009), APPELT et al. (2010), SOUZA et al. (2010), NUNES et al. (2012), who did not observe an improvement of the carcass characteristics of broiler chickens with the use of probiotic in feed.

Table 2: Mean ± standard error of mean of carcass, legs and breast (%) yield in function of the treatment

Variables	Treatments				CV%	Value of P
	1	2	3	4		
Carcass yield (%)	76.47±0.51	76.16±0.68	76.54±0.88	77.03±0.97	1.99	0.89
Legs yield (%)	27.06±0.68	27.18±0.73	26.16±0.90	27.37±0.40	5.05	0.72
Breast yield (%)	33.49±0.43	34.44±1.02	34.13±0.91	35.19±0.52	4.19	0.56

Treatment 1 – control with water spraying on the litter on the first day of experiment and at 7, 14, 21, 28 and 35 days of age; Treatment 2 – litter treated with *Bokashi*® on the first day and water spraying on the litter at 7, 14, 21, 28 and 35 days of age; Treatment 3 – litter treated with *Embiotic*® on the first day and at 7, 14, 21, 28 and 35 days of age; and Treatment 4 – litter treated with *Bokashi*® on the first day and *Embiotic*® on the first and at 7, 14, 21, 28 and 35 days of age.

CORRÊA et al. (2003) and PELICANO et al. (2003) observed an improvement in the legs yield with the adding of probiotic to the feed. Rocha et al. (2010) verified that only the diet added probiotics commercial mixture promoted better breast yield of broilers in relation to a diet without additives ($P<0.05$).

The results of the pH analysis evaluated weekly did not show any differences among treatments (Table 3).

Table 3: pH values in broiler litter related to treatment at different ages of broiler chickens

pH values	Age in days					
	7	14	21	28	35	42
1	6.35±0.11	6.40±0.05	7.79±0.11	8.62±0.08	8.85±0.03	8.91±0.05
2	6.12±0.22	6.36±0.05	7.37±0.33	8.68±0.153	8.91±0.03	8.92±0.03
3	6.32±0.09	6.44±0.03	7.23±0.31	8.67±0.04	8.88±0.02	8.89±0.04
4	6.32±0.01	6.41±0.07	6.95±0.11	8.62±0.109	8.87±0.05	8.94±0.04
Value of P	P>0.05	P>0.05	P>0.05	P>0.05	P>0.05	P>0.05

Treatment 1 – control with water spraying on the litter on the first day of experiment and at 7, 14, 21, 28 and 35 days of age; Treatment 2 – litter treated with *Bokashi*® on the first day and water spraying on the litter at 7, 14, 21, 28 and 35 days of age; Treatment 3 – litter treated with *Embiotic*® on the first day and at 7, 14, 21, 28 and 35 days of age; and Treatment 4 – litter treated with *Bokashi*® on the first day and *Embiotic*® on the first and at 7, 14, 21, 28 and 35 days of age.

CHANG & CHEN (2003) evaluated the effect of adding *Lactobacillus*-based probiotic to the feed of broiler chickens raised apart from chickens in control treatment aiming at avoiding the interaction between the two treatments, and noticed a reduction in excreta pH of broilers receiving probiotic in feed. This pH reduction can be explained according to the authors by the presence of metabolites produced by the lactic-acid bacteria such as lactic and acetic acid in the digestive system.

In the present study, no changes in the litter pH were observed, not even in the litter treated with acid solution containing micro-organisms. On the other hand, the animals were raised in the same breeding environment, with treatments randomly distributed, in four different blocks, differently from the study by CHANG & CHEN (2003).

TRALDI et al. (2007) did not observe the effect of the probiotic (*Bacillus subtilis* and *coagulans*) added to the diet of broiler chickens on the pH of new or reused litter. DO et al (2005) evaluated different chemical litter additives (ferrous sulfate, aluminum sulfate and aluminum chloride) and did not find differences in pH values comparing to control. HINKLE (2010) observed that an Litter Guard (mixture bacteria) sprayed on the litter of broiler chickens did not affect the pH.

The results of dry matter, ashes and nitrogen of the litter were not influenced by the treatment with micro-organisms (Table 4).

OLIVEIRA et al. (2009) found 72.32% dry matter and 2.95% total nitrogen in chicken litters composed by wood shavings at 42 days of age, which is similar to the results found in this experiment. However, it is important to note that the litter characteristics depend on litter moisture, number of batches housed, feed composition of feed, etc., showing that the results in literature might differ depending on the raising conditions.

Table 4: Characteristics of broiler chicken litters treated or not with micro-organisms at 21 and 42 days of age

Age (days)	Treatments				Value of P
	1	2	3	4	
			Dry matter (%)		
21	63.41±1.49	65.72±1.39	65.70±1.75	64.78±0.81	0.41
42	72.96±1.09	72.85±1.34	73.10±1.66	71.62±0.88	0.79
			Ashes (%)		
21	4.81±0.59	4.14±0.11	4.96±0.23	4.40±0.08	0.26
42	12.84±0.26	13.10±0.83	12.20±0.37	12.36±0.47	0.52
			Nitrogen (%)		
21	1.33±0.10	1.15±0.05	1.17±0.07	1.17±0.04	0.25
42	1.91±0.14	2.06±0.10	1.82±0.07	2.07±0.22	0.59

Treatment 1 – control with water spraying on the litter on the first day of experiment and at 7, 14, 21, 28 and 35 days of age; Treatment 2 – litter treated with *Bokashi*® on the first day and water spraying on the litter at 7, 14, 21, 28 and 35 days of age; Treatment 3 – litter treated with *Embiotic*® on the first day and at 7, 14, 21, 28 and 35 days of age; and Treatment 4 – litter treated with *Bokashi*® on the first day and *Embiotic*® on the first and at 7, 14, 21, 28 and 35 days of age.

Nitrogen loss in the litter happens through volatilization of ammonia due to the action of micro-organisms that decompose nitrogenized composts (NEME et al., 2000), which impairs animal´s performance.

One of the alternatives to lower nitrogen losses by ammonia volatilization would be to acidify it with the usage of, for example, products containing acid-producing micro-organisms.

On the other hand, NDEGWA et al. (2008) reported that the use of other acidifying additives such as aluminium potassium sulphate or alum, ferric chloride, sodium hydrogen sulphate, and calcium chloride reduce ammonia emission.

CONCLUSIONS

In the conditions of this experiment, we concluded that treating the litter with micro-organisms did not affect performance, carcass, leg and breast yield or the quality of the litter for broiler chickens.

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