

ISSN 1682-8356
ansinet.org/ijps



INTERNATIONAL JOURNAL OF
POULTRY SCIENCE

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Use of *Serratia marcescens* for Feed Processing: Broiler Performance and Pathogenicity Assay

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Abstract: *Serratia marcescens* is a bacterium able to produce chitinase for degrading chitin. Broiler chickens can not digest significant amounts of chitin because they produce very little chitinase in their digestive tract. Therefore, broiler feed containing chitin must be processed first with chitinase. *Serratia marcescens* is an opportunistic pathogenic bacterium and a pathogenicity test is required before using its chitinase for processing of feed containing chitin. An experiment was conducted by using broiler. A split-plot, completely randomized design is used in this experiment. The *Serratia marcescens* dosages (0, 40, 80, 160 and 320 mg/kg body weight) were the main plot and observation lengths (2, 4, 8, 16 and 22 days) were the sub plot factor. The ration for different treatments had the same protein (23%) and energy (3000 kkal/kg) content. Feed consumption, average daily gain, body temperature and mortality were parameters. Results showed that feed consumption and average daily gain were significantly affected ($p < 0.05$) by presence of *Serratia marcescens*. The highest feed consumption (123.10 g/broiler) and average daily gain (76.75 g/broiler/day) were found for the highest bacterium dosage of 320 mg/kg body over 22 days observation. Body temperature range from 39.82-40.08°C and there was no affect of *Serratia marcescens* on mortality. In conclusion, the *Serratia marcescens* had no negative effect on broiler performance.

Key words: *Serratia marcescens*, broiler, ration consumption, average daily gain, body temperature, mortality

INTRODUCTION

Serratia marcescens is a gram negative bacterium which produces chitinase for degrading chitin (Carter and John, 1992). Chitinase from *Serratia marcescens* has been tested as a biocontrol agent of microbial pathogens of food crops (Kobayashi, 1995). *Serratia marcescens* belong to the *Enterobacteriaceae* family, *Serratia* genus, *Serratia marcescens* species (Buchanan and Gibbons, 1974). *Serratia marcescens* is found naturally in the intestines of humans, animals and in various environments (Volk and Wheeler, 1993; Guentzel, 2004). *Serratia marcescens* is usually not harmful to human health, but can be pathogenic under circumstance of low immunity. Shrimp waste is a by product from frozen shrimp processing and contains high levels of protein, chitin and calcium carbonate. This waste could be used as an alternative animal protein source for broiler by treating the chitin by chitinase.

Serratia marcescens could be used as a source of chitinase for hydrolyzing chitin in shrimp but it is necessary to know whether this bacterium is an opportunistic pathogens in broiler chickens and so far there has been no research conducted to determine this.

MATERIALS AND METHODS

Bacterium *Serratia marcescens*, one week old unsexed Arbor Acre broilers CP 707 - 25 birds per treatment, Nutrient Agar (NA) media for growing bacteria and the commercial ration (code 511) produced by PT Charoen Pokphand, Indonesia. The ration contained 23% crude protein 3000 kcal metabolizable energy/kg.

Experimental design: The experiment was designed by using a split plot completely randomized design with two factors. The main plot factor was dosage of the bacterium *Serratia marcescens* (0, 40, 80, 160 and 320 mg/kg body weight) and the subplot factor was observation length (2, 4, 8, 16 and 22 days after force feeding of bacterium) with five replicates.

Bacterium growing and force-fed: The bacterium *Serratia marcescens* was grown on Nutrient Agar (NA) and incubated at 30°C for 3 days. The bacterium was force-fed to broilers at 1% of body weight (Thomson, 1985) using a funnel inserted into the crop.

Feed consumption, average weight gain: Feed consumption and the average weight gain were measured at 2, 4, 8, 16 and 22 days after bacterium force feeding.

Body temperature: Body temperature is measured every day through cloaca at 08.00 for 22 days.

Mortality: Mortality was monitored daily.

Data analysis: The difference among treatment was determined by Duncan's Multiple Range Test procedure according to Steel and Torrie (1980).

RESULTS

The feed consumption: Base on statistic analysis, there was significant interaction ($p < 0.05$) between *Serratia marcescens* bacterium dosage and observation length in affecting feed consumption (Graph 1).

For feed consumption, there was a significant interaction of observation on day 8 and on day 16 with bacterium dosage of 160 and 320 mg/kg body weight affected feed consumption ($p < 0.01$) and on day 22 with bacterium dosage at 80, 160 and 320 mg/kg body weight ($p < 0.01$). The highest feed consumption occurred on bacterium dosage 80, 160 and 320 mg/kg body weight at day 22 with total consumption respectively: 119.75 g/bird, 120.46 g/bird, 123.10 g/bird (at that time broiler were 5 weeks old) respectively.

The average weight gain: There was a significant interaction between bacterium dosage and observed days on average weight gain ($p < 0.05$) (Graph 2). There was no interaction between bacterium dosage (0 to 320 mg/kg body weight) and time for days 2 and 4 after bacterium force feeding, but on day 8, 160 and 320 mg/kg body weight, bacterium dosage increased the average weight gain ($p < 0.01$). The average weight gain was also affected ($p < 0.01$) by interaction of bacteria dosage (80, 160 and 320 mg/kg body weight) at days 16 and 22.

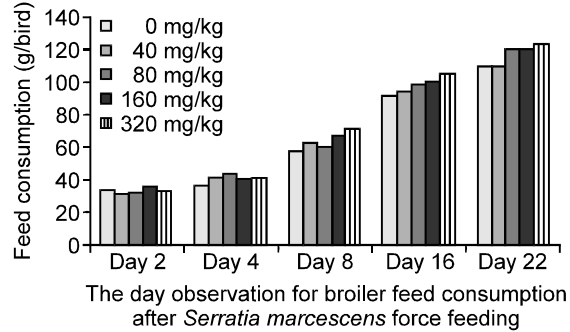
The highest body weight gain was 76.75 g/bird which occurred at bacterium dosage of 320 mg/kg body weight at day 22 after bacterium force feeding.

Body temperature: The average body temperatures of broilers chickens on days 2, 4, 8, 16 and 22 after bacterium forced feeding were between 39.82 and 40.08°C as shown in Graph 3.

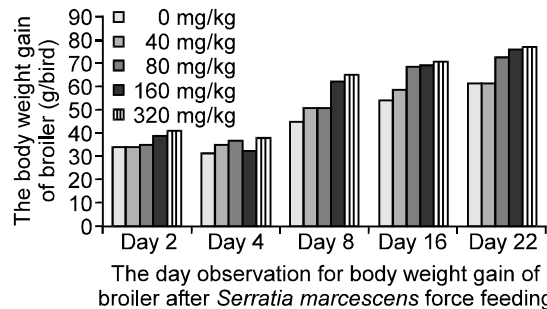
Mortality: There was no mortality of broiler chickens caused by interaction of the bacterium dosage with observation length (2, 4, 8, 16 and 22 after bacterium forced feeding).

DISCUSSION

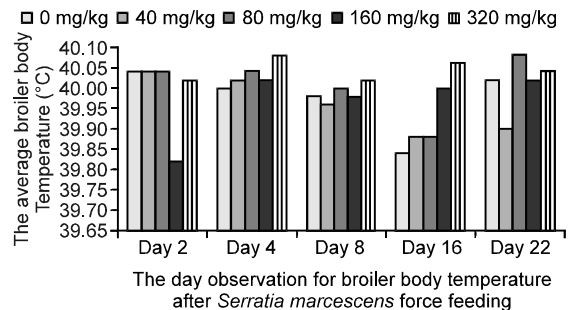
Broiler feed intake obtained in this study is slightly higher than broiler feed intake at 5 weeks old reported by NRC (1994) of 105.7 g/bird/day for female birds and by Scott *et al.* (1982) for male broilers 93 g/bird/day and female 69 g/bird/day. It is possible that *Serratia*



Graph 1: The effect of interaction between *Serratia marcescens* dosage with observation length on average of broiler feed consumption (g/bird)



Graph 2: The effect of interaction between *Serratia marcescens* dosage with observation length in average of body weight gain of broiler (g/bird)



Graph 3: The effect of interaction between *Serratia marcescens* dosage with observation length in average of body temperature of broiler (°C)

marcescens produced enzyme that accelerated the process of digestion of feed component into simple compounds in broiler's digestive tract, so that the nutrient in the diets were absorbed and metabolized rapidly. This condition accelerate the emptying of the gastrointestinal tract, so that appetite and feed consumption were increased. Broilers weight found in this study were slightly higher than body weight of male broilers chicken based on NRC standards (1994) and approached the body weight of male broiler chickens

reported by Scott *et al.* (1982). According to Sturkie (1965), normal chicken body temperature range from 37.5-40°C and Parkhurst and Mountney (1988) reported 41-43°C. In the present study, body temperatures were within the range reported for normal chicken body temperature. The dosage of *Serratia marcescens* up to 320 mg/kg of weight with observation length until day 22 after bacterium force feeding had no negative effect on broiler body temperature. This phenomenon indicate that the *Serratia marcescens* is not an opportunistic pathogenic bacterium in broilers. There was no mortality occurred in this study. This fact indicate that the bacterium *Serratia marcescens* is safe for broilers.

Conclusion: *Serratia marcescens* is not an opportunistic pathogen in broiler chickens. This bacterium increased feed consumption and weight gain, but did not affect body temperature or mortality.

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