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Growth Performance of Broiler Quails Fed with Enriched Probiotic Feed

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ABSTRACT

Probiotic can help in stimulating the growth and development of immune organs, improve level of immunoglobulin and antibody as well as improve immune system in animal. This present study was carried out to determine the effect of feed enriched with probiotics on the growth performance and hepatosomatic index of broiler quails. A total of 240 quails were divided into four groups with three replicates per group. Each treatments group has a different feeding treatment in which treatment 1 (T0) act as control with no probiotic, treatment 2 (T1) with 0.05% probiotic, treatment 3 (T2) with 0.20 % probiotic added and treatment 4 (T3) with 0.35 % probiotic, respectively. Probiotic was mixed in feed of quails starting from day 14 until day 42 and quails were fed ad-libitum twice per day. Results showed that there were significant differences between treatment groups and control in weight gain ($p<0.05$), average daily gain (ADG), feed conversion ratio (FCR) and feed intake (FI). T2 showed the best growth performances among groups after day 42. There were no significant differences in hepatosomatic index between treatment group and control ($p<0.05$). This may suggest that different concentration of probiotic has no adverse effect on liver of quails. In conclusion, the study suggests that probiotic can improve growth performance with no adverse effect on the liver of the quails.

Keyword: Growth performance, probiotic, body weight, feed intake, feed conversion ratio, average daily gain and Hepatosomatic index

ABSTRAK

Probiotik boleh membantu merangsang kadar tumbesaran dan perkembangan organ imun, meningkatkan imunoglobulin dan antibodi serta meningkatkan sistem imun haiwan. Kajian ini dilakukan untuk menentukan kesan makanan bersama probiotik ke atas tumbesaran dan indeks hepatosomatik puyuh pendaging. Sebanyak 240 burung puyuh dibahagikan kepada empat kumpulan di mana setiap satu kumpulan mempunyai tiga ulangan. Setiap kumpulan diberi makanan yang berbeza , kumpulan satu(T0) bertindak sebagai kumpulan kawalan di mana tidak mempunyai probiotik, kumpulan 2 sebanyak 0.05% probiotik (T2), kumpulan 3 sebanyak 0.20% probiotik(T3) dan kumpulan 4 sebanyak 0.35% probiotik(T4). Probiotik dicampurkan dalam makanan puyuh bermula dari hari ke -14 hingga hari ke-42 dan puyuh diberi makan secara ad-libitum. Keputusan menunjukkan terdapat perbezaan signifikan di antara kumpulan dalam peningkatan berat, purata berat harian, nisbah penukaran makanan dan pengambilan makanan. Kumpulan 3 menunjukkan tumbesaran terbaik berbanding kumpulan lain selepas hari ke-42. Tambahan pula, indek hepatosomatik tidak menunjukkan signifikan di antara kumpulan rawatan dan kumpulan kawalan. Ini menunjukan bahawa perbezaan peratusan probiotik tidak menunjukkan kesan buruk ke atas hati burung puyuh. Oleh itu, kajian ini mencadangkan probiotik boleh meningkatkan tumbesaran dan tidak memberi kesan negatif ke atas hati burung puyuh.

Kata kunci: Prestasi pertumbuhan, probiotik, berat badan, pengambilan makanan, nisbah penukaran makanan,purata kenaikan harian dan indeks hepatosomatik

INTRODUCTION

Quail, *Cortunix japonica* is classified as bird type animal and come from pheasant family. They are warm blooded animal and small bird that inhabits woodland and forest area around the world (Poynter et al., 2009). Quail meat has a good taste and quite popular among Malaysian people. As increasing of human population in both rural and urban areas, demand for protein source also increase and it is not possible for the broiler chicken farming to supply meat sufficiently to Malaysian people. Quail production is one of the poultry industry sectors that will be highly looked upon in future. Otherwise, quail meat is also one of the demanding and favorable sources of

protein in Malaysia but the production was very limited. Furthermore, many researchers have reported that both meat and eggs from quail give more benefit compared to chicken meat. Their meat contains numerous amounts of micronutrients with wide range of vitamins including B complex, folate, vitamin E and vitamin K (Imchen, 2013), while quail egg has 3 to 4 time high nutritional value than chicken egg as it contain 135 of protein and 140ug of vitamin B1 (Tavaniello et al., 2014). Other advantages of quail are they have early sexual maturity, and high egg production (Manafi et al., 2016). Igado et al. (2010) also reported that quail meat promotes body and brain development in children. Therefore, efforts should be done to increase the production of quails to meet the demand especially for Malaysian.

In poultry industry, antibiotics were used worldwide with the aim to prevent diseases and improve the growth performance. However, the use of antibiotic in animal feeds can led to bacterial resistant to antibiotics, and resulted in residues in animal products and the environment (Papatsiros et al., 2012). Probiotic seem to be a good alternative to replace the use antibiotics as growth promoters which have been used on poultry and livestock in order to increase weight gain (Tannock et al., 1999; Tomasik & Tomasik, 2003). At the same time, probiotic helps farmers to reduce investment in animal feed as it promotes growth performance of the animals by utilising all nutrients present in the feed even though feeds are consumed in small amounts. This is because 70% of the culturing cost is come from feeding (Linge, 2005; Ohimain & Ofongo, 2012). Microorganisms in probiotic also can be used to reduce the mortality rate of livestock due to their competitive exclusion behaviour in the intestine. Therefore, to overcome these problems, the used of probiotic has been introduce into poultry farming.

Probiotic is a substance that contains useful microorganism and can give a lot of benefit in term of health to it host or animal. Probiotic seem to act as new supplement industry, but they have been with animal from first breath. Animal bodies mutually inhabits by microflora such as *Escherichia coli*, *Lactobacillus*, *Bifidobacterium* and others. Each bacterium has their own role in body and they help a lot to fulfil body requirement. For instance, *E. coli* helps body to break down and digest food to enter the body. Therefore, probiotic also can be defined as live microorganism that beneficially affect host by improving the balance of the intestinal microflora (Vandana et al., 2013). It has been suggested Singh et al. (1999), there is beneficial effect on body weight of animal be fed with enriched probiotic feed. Other researchers also have same opinion as they have similar finding in their studies (Murry et al., 2004; Sieo et al., 2005). Hence, this study aims to determine the growth performances of broiler quail fed with different percentage of probiotics and the effect of probiotics to their hepatosomatic index.

MATERIALS AND METHODS

Experimental design

A total of 240 broiler quail were selected and separated into four treatment groups with 60 quails per group. Each treatments group has a different feeding treatment in which treatment 1 (T0) act as a control with no probiotic added, treatment 2 (T1) with 0.05% probiotic added, treatment 3 (T2) with 0.20 % probiotic added and treatment 4 (T3) with 0.35 % probiotic added, respectively. Each group was divided into three replicate in which contain 20 quails per cage in order to get a better results. The treatment can be summarized as follows:

T0 = commercial pellet + No added probiotics

T1 = commercial pellet + 0.05 % probiotic

T2 = commercial pellet + 0.20 % probiotic

T3 = commercial pellet + 0.35 % probiotic

The quails were given poultry commercial diet feed and water *ad-libitium* based on their groups. The probiotic were mixed in the mixer about 30 mins to one hr to mix it well with the feed. No vaccinations were given to quails throughout the study period. The quails were reared for 6 consecutive weeks and the treatments started after the brooding period of two weeks. The arrangements of cage in rearing area of the quails were done randomly to minimize the effect of other parameters such as wind, sunlight and others.

Data collection

The body weight of quails for each treatment was measured weekly and mortality was recorded. At the end of the rearing period, all quails were slaughtered and the liver was removed from the carcass. The livers were then drained with filter paper and weighted. Body weight gain, average daily gain, feed intake, feed conversion ratio and hepatosomatic index were calculated based on the formulas (Malik et al., 2012; Manafi et al., 2016);

Body Weight Gain (BWG) = Average final weight - Average initial weight

$$\text{Average Daily Gain (ADG)} = \frac{\text{Average final weight – Average initial wWeight}}{\text{Days of experiments}}$$

Feed Intake = Initial weight of feed (g) – Remaining weight of feed (g)

$$\text{Feed Conversion Ratio} = \frac{\text{Total feed intake}}{\text{Total weight gain}}$$

$$\text{Hepatosomatic index} = \frac{\text{Drained mass of liver (g)}}{\text{Total weight of the liver (g)}} \times 100$$

Data Analysis

Data obtained from the study was analysed for analysis of variance (ANOVA) with significant value of $p<0.05$ using SPSS version 20.

RESULTS

Effect on body weight gain and average daily gain

Figure 1 shows that there are increasing in Body Weight Gain (BWG) of quail throughout the study period. Statistical analysis reveals that there was significant different ($p<0.05$) between T2 and T, respectively. There were no significance different ($p<0.05$) between control, T1 and T3 in week 4. Quail fed with T2 showed the lowest body weight in week one compared to other groups but it increased gradually and showed the highest body weight in week 4. Therefore, this study showed that the used of 0.20% probiotic in T2 gave the best effect on body weight. Meanwhile, Figure 2 showed the Average Daily Gain (ADG) of quail within 4 weeks of study period. At week 1 of the experiment, T2 have the lowest ADG value compare to other treatment group at 150g

while T3 showed the highest ADG at 174g followed by C and T1 at 167g and 161g, respectively. There was significant differences ($p<0.05$) between T2 and T0 where T2 has the highest value at 267g while T0 at 256g in week 4. Table 1 summarized the value for BWG and ADG throughout the study period.

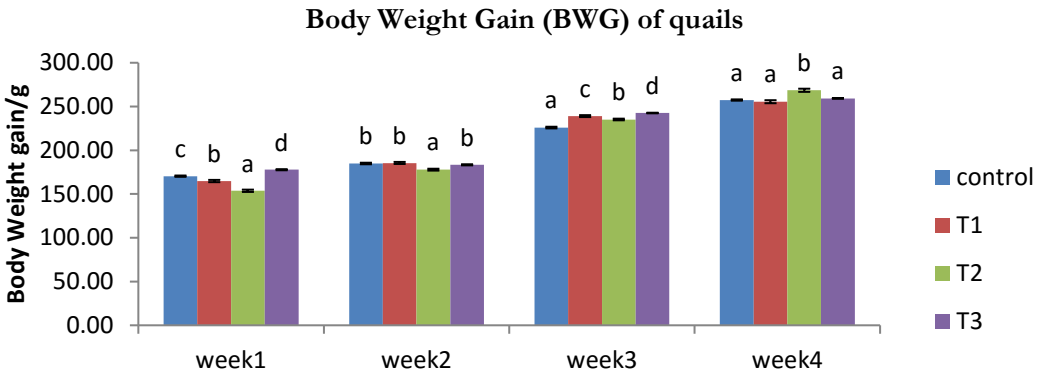

Figure 1 Body Weight Gain (BWG) of quail within 4 weeks of study period. a, b c and d in the graph means having different superscripts within the same column differ significantly ($p<0.05$)

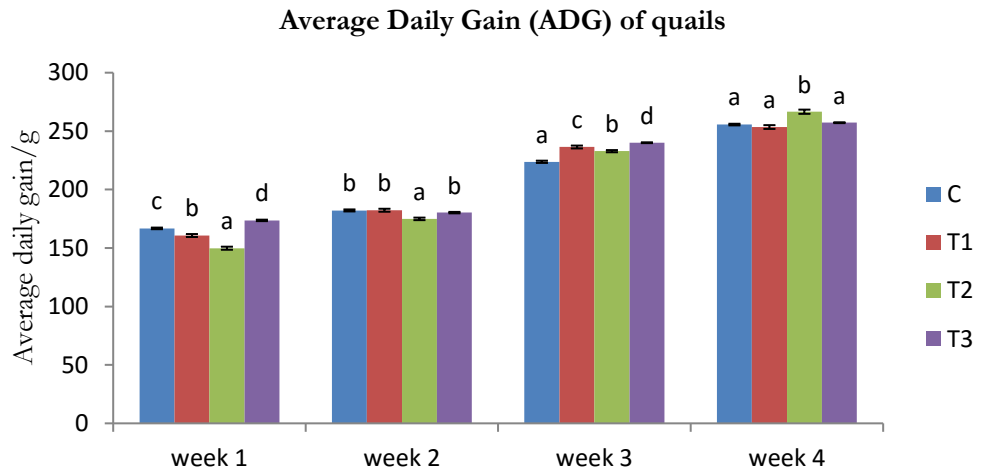

Figure 2 Average Daily Gain (ADG) of quails within 4 weeks of study period. a, b, c and d in the graph means having different superscripts within the same column differ significantly ($p<0.05$)

Effect on feed intake and feed conversion ratio

Figure 3 showed that the feed intakes (FI) increased from week 1 until week 4. In week 1, there were significant differences ($p<0.05$) between the control group (T0) with T1 and T2 in which were 190g, 188g, and 183g, respectively. Throughout the study period, there were significant differences ($p<0.05$) between control group and other treatment group. Figure 3 also shows that T2 group significantly consume less feed compared other group. It can be suggested that feed enriched with 0.20% of probiotic can reduce the feed consumption. Furthermore, Figure 4 showed Food Conversion Ratio (FCR) for each treatment gradually decreased from week 1 until week 4. Weekly FCR showed that FCR in week 1 was the highest while FCR in week 4 was the lowest. In week 1 there

were significant different ($p<0.05$) between T0 and other treatment group where T2 showed the highest FCR at 1.23 while T3 showed the lowest FCR at 1.10, respectively. In week 2 until week 4, T2 showed gradually decrease in FCR compare to other group. There was significance different between T2 and other group in week 4 where T2 has the lowest FCR value at 0.74. Table 1 summarized the value for FI and FCR throughout the study period.

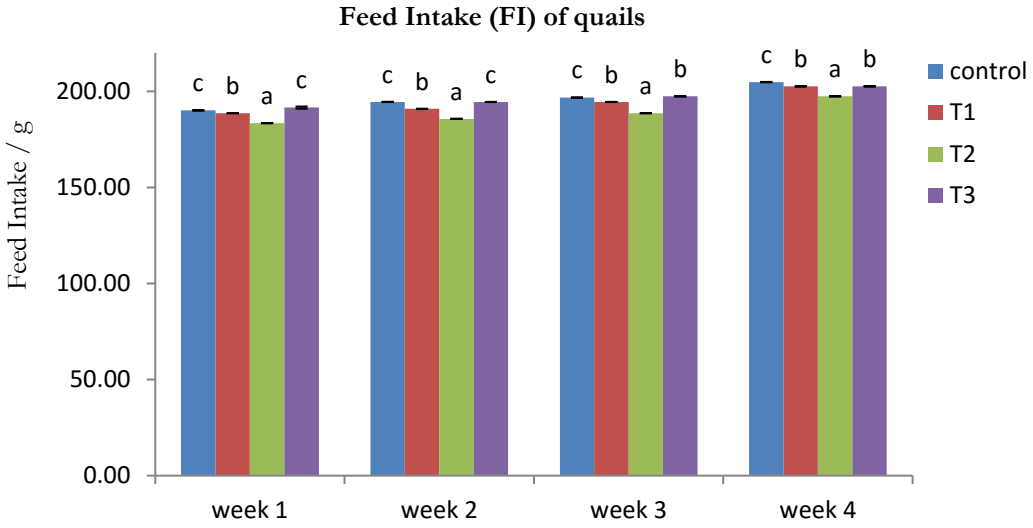

Figure 3 Feed Intake (FI) of quail within 4 week of study period. a, b and c in the graph means having different superscripts within the same column differ significantly ($p<0.05$)

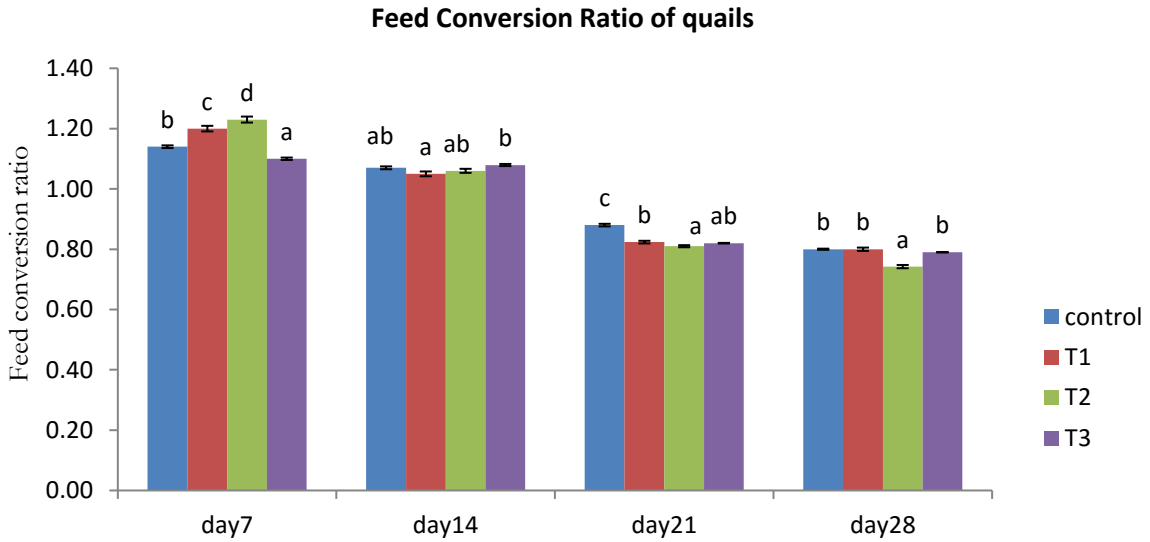

Figure 4 Feed Conversion Ratio (FCR) of quails within 4 week of study period. a, b, c, d and ab in the graph means having different superscripts within the same column differ significantly ($p<0.05$)

Table 1 Mean value summarization of BWG, ADG, FI and FCR

	Week 1				Week 2				Week 3				Week 4			
	T0	T1	T2	T3	T0	T1	T2	T3	T0	T1	T2	T3	T0	T1	T2	T3
BWG	170.41* ± 0.72	164.83*± 1.30	153.70*± 1.30	177.77*± 0.62	184.87 ± 0.89	185.41 ± 1.26	177.83* ± 1.08	183.37 ± 0.62	225.93* ± 0.95	238.90* ± 1.25	235.17* ± 0.95	242.57* ± 0.36	257.40 ± 0.72	255.57 ± 1.65	268.5* ± 1.80	259.27 ± 0.36
ADG	167.00* ± 0.69	161.00*± 1.26	150.00* ± 1.30	174.00* ± 0.61	182.00 ±0.855	182.00 ± 1.26	175.00* ± 1.07	180.00 ± 0.61	224.00* ± 0.96	236.00* ± 1.23	233.00* ± 0.95	240.00* ± 0.35	256.00 ± 0.70	253.00 ± 1.63	267.00* ± 1.80	257.00 ± 0.36
FI	190.09 ± 0.06	188.63* ± 0.06	183.44* ± 0.06	191.55 ± 0.57	194.52 ± 0.07	190.89* ± 0.09	185.70* ± 0.06	194.48 ± 0.06	196.74* ± 0.11	194.48* ± 0.06	188.63* ± 0.06	197.41* ± 0.06	204.81* ± 0.11	202.59 ± 0.06	197.41* ± 0.06	202.59 ± 0.06
FCR	1.14* ±0.01	1.20* ±0.01	1.23* ±0.01	1.10* ±0.00	1.07 ±0.01	1.05* ±0.01	1.06 ±0.01	1.08* ±0.00	0.88* ±00	0.82* ±0.00	0.81* ±0.00	0.82* ±0.00	0.80 ±0.00	0.80 ±0.00	0.74* ±0.01	0.79 ±0.00

*mean significant different ($p<0.05$), BWG = Body Weight Gain, ADG = Average Daily Gain, FI = Feed Intake, FCR = Feed Conversion Ratio, T0 = control, T1 = enriched with 0.05 % probiotic, T2 = enriched with 0.20 % probiotic, T3 = enriched with 0.35 % probiotic.

Effect on hepatosomatic index

Figure 5 showed that the hepatosomatic index (HIS) were not significantly different ($p>0.05$) between the treatment. It suggested that different concentration of probiotic has no adverse effect on liver of quails. Based on table 2, T3 showed the lowest HSI at 1.56 while T1 has the highest value at 1.73.

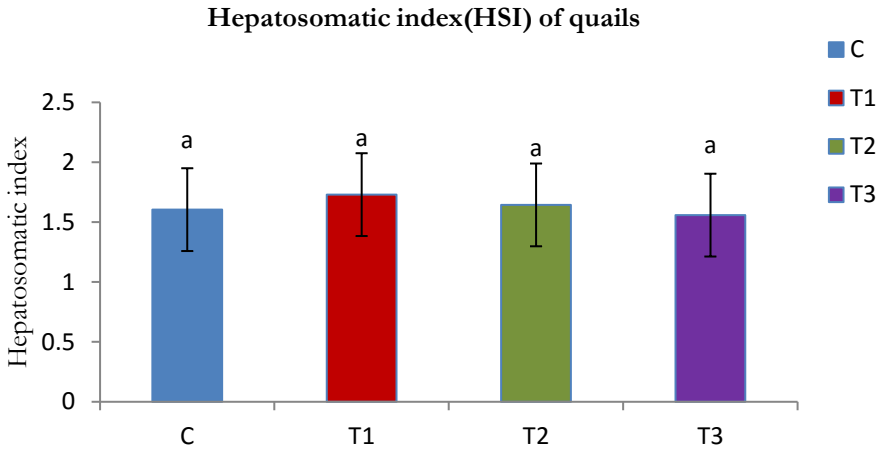

Figure 5 Comparison of Hepatosomatic Index among treatments

Table 2 Hepatosomatic index (HSI) value between treatments

	T0	T1	T2	T3
HSI	1.60±0.346	1.73±0.699	1.64±0.699	1.56±0.699

T0 =control, T1 = enriched with 0.05 % probiotic, T2 = enriched with 0.20 % probiotic, T3 = enriched with 0.35 % probiotic

DISCUSSION

According to the definition by Food and Agriculture Organization/World health organization (FAO/WHO), probiotics are living microorganisms which when administered to the host in adequate amounts confer-a health benefit toward it (Fuller, 1989). In this experiment, *Bacillus subtilis natto* was used as probiotic to test its effect towards the growth performance and hepatosomatic index of quails. *Bacillus subtilis* is a spore forming bacteria having resistance to high temperature and harsh storage conditions and generally regarded as safe strain for use as probiotic in poultry production (Fuller, 1989) while natto is a type of fungus that produces a Japanese traditional fermented soybean foodsalt (Tsukamoto et al., 2001). Combination of *Bacillus subtilis* and *natto* is called *Bacillus subtilis natto*.

In this study, there were significant different in body weight between control and treatment groups ($p<0.05$) especially in quails fed pellet enriched with 0.20 % *Bacillus subtilis natto*. This study agreed with Molnár et al (2011) who study the effect of *Bacillus subtilis* on growth performance of broiler chickens where it had significantly increased chicks fed with enrich probiotic compared to control. Improvement in growth performance and feed efficiency of broiler chicken supplemented with different strain of probiotic are due to

being introduced with cumulative effect of probiotic that can help to enhance digestibility, maintenance of beneficial microbial population (Fuller, 1989) and alteration of bacterial metabolism (Jin et al,. 1997) in gastrointestinal of the birds. Based on Li et al. (2014), *Bacillus subtilis* can secrete highly-active protease, lipase and amylase to decompose plant complex carbohydrates, increase the digestibility of nutrients and provide more nutrition to animals. Thus, these may be possible reason improvement of body weight in quail supplemented with *Bacillus subtilis natto* in this experiment. In contrast, Afsharmanesh et al. (2013), reported that there was no significant different in the used of probiotic in growth performance of birds. This might be due to the inclusion of probiotic in wet wheat-based diets in the experiment compared to this current study that used dry feed form.

Sen et al. (2012) also reported that birds supplemented with increasing levels of *Bacillus subtilis* showed higher body weight gain, feed intake and better FCR. However, this study showed that quail fed pellet enriched with 0.35% *Bacillus subtilis natto* results in increasing of body weight until week 3 but not in week 4. This situation happen due to the bigger size of quails resulting in limited space area. Thus, it can lead to presence of stress in the animals and they cannot have better growth performance in week 4. Bilgilli & Hes (1995) also suggested that birds will perform better when they are given more space to move.

The FCR was significantly difference between treatment group and control in this study. Similarly, Fritts et al. (2000) also reported that inclusion of *B. subtilis* C-3102 in broiler diets resulted in improvement in FCR at 21–42 days and body weight gain at day 42. Molnár et al. (2011) also stated that there was a significant lower feed conversion ratio in the groups consuming *B. subtilis* supplemented diets, compared with the control group. This study have same finding with the result describe above as well as (Santoso et al., 1995, 2001; Jin et al., 1996) where diets supplemented with 0.5% dried *B. subtilis* fermented product improve feed efficiency as well as body weight compared to control.

The feed conversion ratio is an indicator that is commonly used in all types of farming or in the field of research. It can provide a good indication of how efficient a feed or a feeding strategy can be. The lower the FCR, the higher the weight gain obtained from the feed. The significantly improve of FCR in birds supplemented with the probiotic possibly due to the ability of the probiotic change the microflora in the digestive tract (Shabani, 2012). In contrast, Chen et al. (2009) reported that fermented feed with probiotics did not improve in weight gain, feed consumption and feed conversion because the experiment added about 23% of water in fermentation which could not acidify the diet efficiently to preserve the feed. Therefore, it results to produce putrefied feed that decreased growth performance of the birds.

ANOVA analysis revealed that feed intake showed significant difference between the treatment group and control ($p < 0.05$). Control group consume high feed in week 3 and week 4, however they cannot perform well compared to other treatment especially treatment 2. This study have same finding with Cavazzoni et al. (1998) and Zulkifli et al. (2000).This may be due to microbial population in gastrointestinal from the probiotic help to enhance their digestibility of the quails. Tabidi et al. (2013) reported that probiotic capable to stimulate intestinal microflora, thus result in beneficial bacteria and improving the growth performance and feed efficiency of broilers. Dhingra (1993) also stated that probiotic also can help to regulate the microbial environment of intestine by inhibit the pathogenic intestinal microorganism, thus improve the feed conversion ratio. The other reason might be due to probiotic helps in improving gastrointestinal morphology in birds. Based on Sen et al. (2012) supplementation of *Bacillus subtilis* in broiler diets resulted in increased villus height and villus height to crypt depth ratio in duodenum and ileum. This result also agreed with Samanya and Yamauchi (2002), who reported increased villus height and villus height to crypt depth ratio of duodenum in birds supplemented with *B. subtilis var. natto*. Other than that, increasing of the villus height will increase surface area which lead to capable of greater absorption of available nutrients (Caspary, 1992). Therefore, feed enriched with probiotic in birds diet can improved nutrient absorption and increased the growth performances (Xu et al., 2003).

Hepatosomatic index (HSI) is defined as the ratio of liver weight to body weight. It provide an indication to compare between treatment group and control whether it give negative effect on the liver of animals or vice-versa. According to Gurdersen (2002), HSI is a reliable indicator of hepatic growth and development according to age and physiological or physiochemical status of the liver. In this study, there was no significant different shown among treatment and control group ($P > 0.05$). It showed that different concentration of *Bacillus subtilis natto* has no adverse effect on liver of quails. This indicate that the liver maintain in normal size without effect the function of the amino acid catabolism.

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