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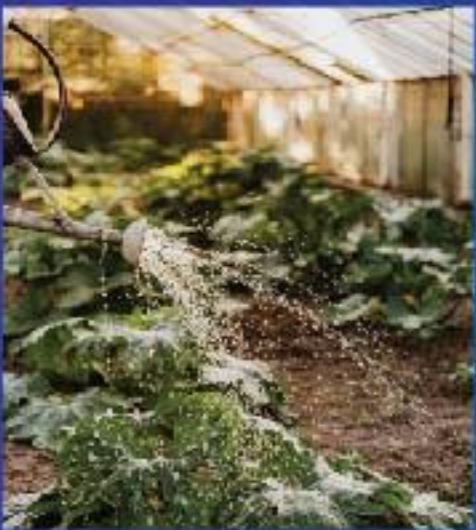

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DIGESTIVE MORPHOLOGY OF NATIVE PIG SUPPLEMENTED BY DIFFERENT LEVELS OF FERMENTED *Vigna radiata L.*

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ABSTRACT

Enhancing feed efficiency in converting feed mass into pig body mass is a critical phase for the profit in producing pig. To improve the metabolic utilization of dietary nutrients, it relies heavily on a healthy gut or gastrointestinal tract, and only a healthy digestive can result in better feed digestion and better nutrient absorption. Thus, the study investigates the growth performance, the response of the digestive morphology of native pigs, which treatment will stretch higher output and variations under different levels of fermented mungbean. The experimental research design was employed to determine the response of the three (3) pigs treated with mungbean for 70 days. The growth performance of pigs treated with different levels of fermented mungbean has a total gain weight of 7.50kg for Treatment 1; Treatment 2 is 9.00kg and, Treatment 3 is 6.50kg and is observed no significant difference on the final weight and the total weight with a p-value of > 0. 050; the response on digestive morphology such as small intestine, large intestine, heart, stomach, liver, lungs, esophagus, spleen, and kidney of pigs shows no variations on their length, width, and weight with a p-value of >0.050 under the different level of fermented mungbean; and resulted with high output treated with different level of fermented mungbean is observed on Treatment 2 with a lowest feed conversion efficiency of 3.89 for feeds and 1.39 for mungbean. Treatment 2 has the highest gain weight among the treated sample; the intestinal morphology of pigs was comparable under the three treatments; treatment 2 has the lowest feed conversion efficiency.

Keywords: Digestive morphology, growth performance, dietary treatment, fermentation, metabolic utilization

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INTRODUCTION

Feed efficiency represents the cumulative efficiency with which the pig utilizes dietary nutrients for maintenance, lean gain, and lipid accretion. The less efficient utilization of feed with a low protein diet in the modern pig husbandry will have to enhance the feeding diet to a plant-based diet containing complex protein and carbohydrates includes various antinutritional factors (Baguio, 2017). Weaning imposes tremendous stress on piglets and is accompanied by marked changes in gastrointestinal physiology, microbiology, and immunology. The period following weaning is characterized by a high incidence of intestinal disturbance with diarrhea and depression of growth performance of piglets. Poor growth performance associated with weaning in piglets is a result of multifactorial stressors including environmental, nutritional, physiological stressors. At weaning, pigs have to deal with the abrupt interruption in the established social interaction with sow and litter and the stress of adapting to a new environment. The piglet has to cope with the sudden withdrawal of sow milk and adapt to; less digestible, plant-based dry diets containing complex protein and carbohydrates including various antinutritional factors (Heo et al., 2012). In modern pig husbandry, piglets are forcibly weaned at 3 to 4 weeks of age, which is much shorter than that in the natural suckling habitat of approximately 8 to 12 weeks of nursing. Early weaning of pigs resulted in increased expression of genes related to oxidative stress and immune activation but decreased expression of genes related to macronutrient metabolism and cellular proliferation in the gut (Lee et al., 2016). Mungbean is a warm-season annual highly branched having trifoliate leaves like the other legumes. The plant upright and vine types of growth habit occur in it, with plants varying from one to five feet in length (Wu et al., 2019). Fermentation is the conversion of carbohydrates to alcohol and carbon dioxide or organic acids using yeast, bacteria, or a combination, under anaerobic conditions without net oxidation. It enhances nutrition, stabilization of the original raw materials, and detoxification and antinutritional factors. Fermentation can also increase the soluble phenolic content of legumes and consequently elevate their antioxidant activities (John and Olusegun, 2016). Lactic acid bacteria are a group of microorganisms were colonized in the intestine and exert beneficial health effects on human and animal bodies. The well- known; “generally recognized as safe” status and the probiotic role of the lactic acid bacteria has resulted; in an increased awareness of developing functional foods by using these strains. Apart from traditional fermented dairy products such as yogurt and cheese, specific lactic acid bacteria strains were also introduced to plant origin foodstuffs among which soy and soymilk were exploited most widely (Rui et al., 2015).

MATERIALS AND METHODS

Methodology

The experimental design was applied to determine the response of weaning impacts in digestive morphology fed with different levels of mungbean meal and fermented mungbean as a feed supplement. Completely Randomized Design was used; were in, in the experiment involves determining treatments; treatment 1, commercial feeds, Treatment 2 & 3 mungbean meal, fermented mungbean meal, and commercial feeds.

Population and Sample of the Study

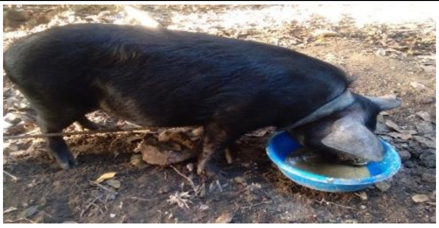
The population of the study were three native pigs (3 months old) randomly assigned to three dietary treatments.

Materials

The following materials and equipment were used in the identifying the morphology of pigs through experimental method: three (3) heads of native pigs (3 months old), commercial feeds (trigo), mungbean meal (cooked), fermented mungbean, distilled water, 1 tablespoon of salt for every cup of water, weighing scale, plastic jar, brine, measuring cups, morphometry / tape measure, caliper, record book and ballpen.

Experimental design

Completely randomized design was used in the experiment which involves three treatments with no replications using 3 heads of pigs. Every treatment was composed of 1 heads of experimental pig as represented by T1 commercial feeds; T2 and T3 mungbean meal, fermented mungbean meal and commercial feeds. Treatments-(levels of mungbean meals), Treatment 1 - control 1000 grams commercial feeds, Treatment 2 - 500 grams commercial feeds + 250 grams mungbean meal + 250 grams fermented mungbean, Treatment 3 - 500 grams commercial feeds + 300 grams mungbean meal + 200 grams fermented mungbean (Figure 1).

Treatments	Sex	Sample
T1- control 1000 grams trigo	1 (female)	 Native

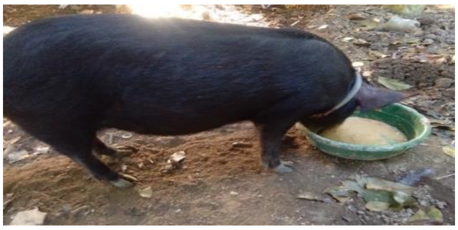
T2 - 500 grams trigo + 250 grams mungbean meal +250 grams fermented mungbean	1 (female)	 Native
T3- 500 grams trigo + 300 grams mungbean meal + 200 grams fermented mungbean	1 (male)	 Native
Total	3 Heads	

Figure 1 the distribution of treatments shown in the experimental layout.

Procedure

This includes the procedure in the conduct of the experimental study such as; construction of experimental cage, cleaning and disinfecting of the experimental area, selection and purchase of experimental animal, feeds/ biological and feed supplement, feed preparation, feeding and water management, dressing of pig, data collection and statistical treatment of data.

Data Gathering

The data was collected right after the slaughtering of experimental animals on the different level of treatments. The data gathered on the growth performance of pigs in terms of weight using the hanging scale while the intestinal morphology and digestive tract; small intestine, large intestine, spleen, stomach, Liver, lungs, esophagus and kidney was measured by its length, width and weight using the morphometric equipment/tape measure/caliper. After the data had been gathered it was recorded and described.

RESULTS AND DISCUSSION

Results shows Table 1, the coefficient of determination r-square (r2) of 0.182 using the linear regression implies that 18.20% of the variation in the gain in weight of pigs is explained by the different levels of treatment. Based on the different level of treatment it can be viewed that Treatment 2 obtained the highest final body weight of 30 kilos with a gain weight of 9 kilos with an initial body weight of 21 kilos feeding with 500 grams of commercial feeds, 250 grams of mungbean meal and 250 grams of fermented mungbean compared to Treatment 1 which has a final body weight of 28 kilos with a total gain weight of 7.50 kilos from the initial body weight of 20.50 feeding with 1000 grams of commercial feeds; while Treatment 3 has the lowest final body weight of 27 kilos with total gain weight of 6.50 kilos from the initial body weight of 20.50 kilos feed with 500 grams commercial feeds, 300 grams mungbean meal and 200 grams of fermented mungbean. The treatment was given to the pig's daily morning and afternoon. It can be said that Treatment 2 can be used as predictors of the growth performance of pigs. Further, the analysis shows that it is 95% confident that the slope of the true regression line is somewhere -20.924 and 19.424 on the total gain weight and -18.840 and 17.840 on the final gain weight. This means that for every treatment the pig's intake, the average estimated cost spent for every treatment increases somewhere between Php18.840 and Php17.840 and Php20.924 and Php19.424 respectively. At the 5% level of significance, it can be concluded that the gain in weight regression line with a computed F-value of .000 for initial body weight, .120 for final body weight and .223 for the total gain weight were shown by its p-value of > 0.050 has no significant difference. Hence, the result of the null hypothesis of the three treatments on the growth performance of pigs is accepted and therefore useful as a predictor of the weights of pigs. From the above coefficients, the regression equation can be computed as, final body weight = 29.333 - .500 (treatment) and the total gain weight is 20.667 + 0.000 (treatment) = 20.667. The result on the growth performance of native pigs may be attributed to the short experimental period and further morphological changes may occur over a more extended period. It can be noted that, there were only marked breed difference on the growth of pigs ranges from 1.50-2.50 kilos which supports the hypothesis that the growth performance is not significantly affected by the different levels of treatment. The potential of fermented liquid feed is an alternative to be use on growth promoting antibiotic in the pig diet (Missoten, 2015).

Table 1. Growth performance of pigs treated with different level of fermented

	Body weight (N=3)		
Treatment	Initial body weight (in kg)	Final body weight (in kg)	Total gain weight (in kg)
T_1	20.50	28.00	7.50
T_2	21.00	30.00	9.00
T_3	20.50	27.00	6.50
R square	.000	.107	.182
p-value	1.000	.788	0.719
F	.000	.120	.223
Unstandardized coefficients:			
(Constant)	20.667	29.333	9.167
Treatment	.000	-.500	-.750

95.0% Confidence Interval for B:			
Lower Bound	-3.668	-18.840	-20.924
Upper Bound	3.668	17.840	19.424
Interpretation	Not Significant	Not Significant	Not Significant

The response of intestinal morphology of pigs (Table 2) in terms of small intestine treated with different level of feeding regimen. The result of analysis on the table shows that, the coefficient determination of r-square (r2) on the length (0.885), width (0.429) and weight (0.250) of pigs indicates that, 88.50% (length), 42.90% (width) and 25.00% (weight) of the variations in the small intestine of pigs is observed on the different levels of treatment. The 95% confidence interval states that the slope of the regression line is somewhere between -223.398 and 143.398 on the length, -1.567 and 1.367 on the width and -575.195 and 525.195 on the weight of small intestine. This implies that for every treatment the pig's intake to gain weight, their estimated average cost consumed increases somewhere in between Php575.195 and 525.195. At the significance level of 5%, it can be observed that the length (.220), width (.546) and weight (.667) of small intestine of pig regression line is shown by its p-value > 0.050. Thus, the length, width and weight of small intestine are significantly not different regardless of treatment. It can now conclude that the hypothesis is accepted and the different levels of treatment are useful predictors on the growth performance of pigs. From the above coefficients, the regression equation can be computed as, Length of small intestine = 1231.667 – 40.000 (Treatment) = 1191.667; width = 1.067 - 0.100 (treatment) = 0.967; and weight = 800.000 – 25.000 (treatment) = 775.000. It was observed on Treatment 2 that the small intestine has the highest kilograms of 800 treated with 500 grams of commercial feeds, 250 grams of mungbean meal and 250 grams fermented mungbean. Likewise, Treatment 1 and Treatment 3 has 50 kilograms decrease in weight which is 750 grams and 700 grams respectively treated with the same amount of commercial feeds but differ in mungbean meal and fermented mungbean intakes. The small intestine is the major site of nutrient digestion and absorption wherein the intestinal epithelium, gut associated lymphatic lymphoid tissues, and the gut microbiota play crucial roles in the prevention of pathogenic microorganisms, toxins, and allergenic macromolecules from entering the interior space of the body and the maintenance of the gastrointestinal tract (GIT) homeostasis (Gao 2013). That is why, the higher levels of Lactobacillus in the total bacteria population, the higher ratio of Lactobacillus to E. coli, the higher mRNA levels of tight junction proteins in the pigs with and without challenge. Therefore, it is assumed that the pigs may possess a better ability to maintain the intestinal physiology homeostasis.

Table 2. Response of intestinal morphology (small intestine) of pigs treated with different level of fermented mungbean in the diet

	Small Intestine		
Treatment	Length (in cm)	Width (in cm)	Weight (in kgs)
T_1	1200	0.9	750grams
T_2	1135	1	800grams
T_3	1120	0.7	700grams
R square	.885	.429	.250
p-value	.220	.546	.667
F	7.680	.750	.333
Unstandardized coefficients:			
(Constant)	1231.667	1.067	800.000
Treatment	-40.000	-.100	-25.000
95.0% Confidence Interval for B:			
Lower Bound	-223.398	-1.567	-575.195
Upper Bound	143.398	1.367	525.195
Interpretation	Not Significant	Not Significant	Not Significant

Represented on Table 3, the length, width and weight of the large intestine of pigs treated with different level of fermented mungbean in the diet. As observed on the table, the coefficient determination r-square (r2) of the intestinal morphology of pigs in terms of length (.824) and weight and width (.964) of the large intestine shows that, 82.4% of length and weight and 96.4% of width was influence by the different levels of treatment. The 95% confidence interval of the length is somewhere -137.375 and 97.375, width is somewhere -.517 and .217, and the weight of the large intestine is somewhere -3434.372 and 2434.372.

This implies that, for every treatment the pig's intake, the average estimated cost spent to gain a kilo of intestine is somewhere between Php3434.372 and Php2434.372. At the significance level of 5%, the large intestine is statistically no variations as shown by its p-value > 0.050 on length (.275), width (.121) and weight (.275). Therefore, the null hypothesis is accepted and the treatment is useful predictors on the weight of pigs. From the above coefficients, the regression equation can be computed as, length of large intestine = 464.667 – 20.000 (treatment) = 444.667, width = 2.167 - .150 = 2.017, and weight = 2866.667 – 500.000 (treatment) = 2366.667. As observed, Treatment 1 has the highest weight of 2500 grams treated with 100 percent of commercial feeds while the slight decrease on weight of Treatment 2 and Treatment 3 is due to the same amount of feeds intakes which is 500 grams commercial feeds and different grams of mungbean meal and fermented mungbean resulted to a total weight of 1600 and 1500 grams respectively. The weight variations of Treatment 1 ranges from 900 grams to 1000 grams is due to the waste materials found inside the large intestine. Relatively, the four diets fed such as basal corn-soybean meal (B), 15% oat hulls (OH), 15% soybean hulls (SH), and 20% alfalfa meal (AM) did not have major effects on performance in a 35-d feeding trial. Balance trials (7-d duration) were conducted 32 d (Trial 1) or 6 d (Trial 2) after completion of the feeding trials. Feed intakes were equalized at 8.7% (Trial 1) or 10.3% (Trial 2) of initial body weight kg.75 (Moore 1988). All fiber sources decreased apparent digestibility's of N, energy and dry matter ($P < .05$) with no effect on N retention. Hence, the fiber sources at the levels included in a corn-soybean meal diet fed in this study had only a minimal impact on performance and utilization of minerals and N and intestinal structure, although apparent energy utilization was decreased.

Table 3. Response of intestinal morphology (large intestine) of pigs treated with different level of fermented mungbean in the diet.

	Large Intestine		
Treatment	Length (in cm)	Width (in cm)	Weight (in kg)
T_1	450	2	2,500 g
T_2	414	1.9	1600 g
T_3	410	1.7	1500 g
R square	.824	.964	.824
p-value	.275	.121	.275
F	4.688	27.000	4.688
Unstandardized Coefficients:			
(Constant)	464.667	2.167	2866.667
Treatment	-20.00	-.150	-500.000
95.0% Confidence interval for B:			
Lower Bound	-137.375	-.517	-3434.372
Upper Bound	97.375	.217	2434.372
`Interpretation	Not Significant	Not Significant	Not Significant

Response of intestinal morphology (heart) of pigs (Table 4) treated with different level of fermented mungbean in the diet. As shown on the table, the coefficient determination r-square (r2) of the intestinal morphology of pigs in terms of the length of the heart (.750), width (.750) and weight (.250) shows that, 75% of length and width and 25% of weight was explained by the different levels of treatment. The 95% confidence interval in the length of the heart is somewhere -4.168 and 3.168, width is somewhere -3.334 and 2.534 and the weight is somewhere -575.195 and 525.195. This means that, for every treatment the pig's intake, the estimated average cost consumed to gain a kilo of the heart is somewhere in between Php575.195 and Php525.195. At the significance level of 5%, the large intestine is statistically no variations as shown by its p-value > 0.050 on length (.333), width (.333) and weight (.667). Therefore, the null hypothesis is accepted and the treatment is useful predictors on the growth performance of pigs. From the above coefficients, the regression equation can be computed as, length of heart = 9.333 – .500 (treatment) = 8.833, width = 5.567 - .400 (treatment) = 5.167, and weight = 200.000 – 25.000 (treatment) = 175.000. The analysis further indicates that, the 50 grams variations on weight among the three treatments is observed on Treatment 2 with a total weight of 200 grams treated with 500 grams commercial feeds, 250 grams mungbean meal and 250 grams fermented mungbean. Treatment 1 and Treatment 2 have the same weight of 150 grams which means that the feeds intakes having the same amount of commercial feeds but differ in mungbean meal and fermented mungbean implies no variations on the weight of the heart. In adding organic acids to piglet diets is known to be helpful in overcoming post-weaning syndrome, and butyric acid is the main energy source for the epithelial cells of the large intestine and the terminal ileum (Biagi et al, 2007). However, Sodium butyrate did not improve the animal growth performance. In the cecum, Sodium Butyrate increased pH and isobutyric acid concentration (linear, $P < 0.05$) and tended to increase ammonia concentration ($P = 0.056$). Intestinal counts of clostridia, Enterobacteriaceae, and lactic acid bacteria as well as intestinal mucosal morphology were not affected by feeding Sodium Butyrate.

Table 4. Response of intestinal morphology (heart) of pigs treated with different level of fermented mungbean in the diet.

	Heart		
Treatment	Length (in cm)	Width (in cm)	Weight (in kg)
T_1	8	4.5	150 grams
T_2	9	5.3	200 grams
T_3	8	4.5	150 grams
R square	.750	.750	.250
p-value	.333	.333	.667
F	3.000	3.00	.333
Unstandardized Coefficient:			
(Constant)	9.333	5.567	200.000
Treatment	-.500	-.400	-25.000
95.0% Confidence Interval for B:			
Lower Bound	-4.168	-3.334	-575.195
Upper Bound	3.168	2.534	525.195
Interpretation	Not Significant	Not Significant	Not Significant

It is observed on Table 5, the response of stomach of pigs treated with different level of fermented mungbean in the diet. The coefficient determination of r-square (r2) is 0.000 on the length, width and weight of stomach of pigs. This implies that, a dropped to zero of r2 means that, 0% indicates that there is no linear relation between the length of the stomach, width and weight of pigs under the different treatment. The 95% confidence interval in the length of the heart is somewhere + 7.336, width is + 4.402, and weight is somewhere + 733.593. This indicates that, for every treatment the pig's intake, the estimated average cost spent to gain the weight of the stomach is somewhere in between Php733.93. At the significance level of 5%, the length, width and weight of the stomach had no variations as shown by its p-value > 0.050 which is 1.000. Therefore, the null hypothesis is accepted. From the above coefficients, the regression equation can be computed as, length of stomach = 23.333 + 0.000 (treatment), width = 11.100 + 0.000 (treatment) and weight = 683.333 + 0.000 (treatment). The result of analysis further observed that Treatment 2 got the highest total weight of 750 grams treated with 500 grams commercial feeds, 250 grams mungbean meal and 250 grams fermented mungbean compared to Treatment 1 treated with 100 percent commercial feeds and Treatment 3 treated with 500 grams commercial feeds and 300 grams mungbean meal and 200 grams of fermented mungbean with a slight decrease in weight of 50 grams respectively. Piglets fed with Fermented Soybean Meal had a higher ($P<0.05$) villus height at three different locations of small intestine and had a lower ($P<0.05$) crypt depth in the duodenum compared to piglets fed SBM (Feng et al., 2007). The results showed that activities of total protease and trypsin at the duodenum and jejunum of piglets fed with Fermented Soybean Meal increased ($P<0.05$) compared with the control. The trypsin activity in the pancreas of piglets decreased ($P<0.05$) when they were fed with FSBM. The results showed that FSBM improved intestinal morphology and digestive enzyme activities in weaned piglets.

Table 5. Response of intestinal morphology (stomach) of pigs treated with different level of fermented mungbean in the diet.

	Stomach		
Treatment	Length (in cm)	Width (in cm)	Weight (in kg)
T_1	23	10.9	650 grams
T_2	24	11.5	750 grams
T_3	23	10.9	650 grams
R square	.000	.000	.000
p-value	1.000	1.000	1.000
F	.000	.000	.000
Unstandardized Coefficient:			

(Constant)	23.333	11.100	683.333
Treatment	.000	.000	.000
95.0% Confidence Interval for B:			
Lower bound	-7.336	-4.402	-733.593
Upper bound	7.336	4.402	733.593

Table 6 presents the response of intestinal morphology of pigs in relation to liver treated with different level of fermented mungbean in the diet. As observed on the table, the coefficient determination r-square of length (.250), width (.250) and weight (.107) of pigs implies that 25% of the variations of the length and width and 10.70% of the weight of liver are explained by the different level of treatment. The 95% confidence interval shows that, the length of the liver is somewhere – 5.752 and 5.252, width is somewhere – 5.752 and 5.252, and the weight is somewhere -376.797 and 356.797. This implies that, for every treatment the pigs consumed, the estimated average cost to be spent to gain a kilo of liver is somewhere in between Php376.797 and Php356.797. At the significance level of 5%, the length, width and weight of the liver had no variations as shown by its p-value > 0.050 which is .667 for length and width and .788 for weight. Thus, the null hypothesis is accepted. From the above coefficients, the regression equation can be computed as, length of liver = 26.500 - 0.250 (treatment), width = 19.100 - 0.250 (treatment) and weight = 746.667 - 10.000 (treatment). It is also implied on the table that Treatment 2 obtained the highest total weight of 760 grams treated with 500 grams commercial feeds, 250 grams of mungbean meal and fermented mungbean, followed by Treatment 1 with a total weight of 720 grams treated with 100 percent commercial feeds and the lowest total weight of 700 grams was observed on Treatment 3 which is treated with 500 grams commercial feeds and 300 grams and 200 grams of mungbean meal and fermented mungbean respectively. Thus, it only shows that the different level of treatment can be used as predictors of growth performance of pigs especially on Treatment 2. The effect of fiber source and concentration on morphological characteristics, mucin staining pattern, and mucosal enzyme activities in the gastrointestinal tract of pigs using 50 experimental 50 weaned pigs treated with 10 litters at 4 weeks of age (BW 8.6 ± 1.4 kg) and divided into 5 treatment groups with diets containing fiber of various physico-chemical properties and concentrations were formulated to contain 73, 104, or 145 g of dietary fiber/kg of DM (Hedemann et al., 2006). Feeding pigs high insoluble fiber diets improved gut morphology by increasing villi length and increased mucosal enzyme activity when compared with pigs fed pectin-containing diets. The mucin content as determined by staining characteristics suggests that pigs fed high insoluble fiber diets might be better protected against pathogenic bacteria than pigs fed diets high in soluble fiber.

Table 6. Response of intestinal morphology (liver) of pigs treated with different level of fermented mungbean in the diet.

	Liver		
Treatment	Length (in cm)	Width (in cm)	Weight (in kg)
T_1	26	18.5	720 grams
T_2	26.5	19	760 grams
T_3	25.5	18	700 grams
R square	.250	.250	.107
p-value	.667	.667	.788
F	.333	.333	.120
Unstandardized Coefficient:			
(constant)	26.500	19.000	746.667
Treatment	-.250	-.250	-10.000
95.0% Confidence interval for B:			
Lower bound	-5.752	-5.752	-376.797
Upper bound	5.252	5.252	356.797
Interpretation	Not Significant	Not Significant	Not Significant

It can be seen on Table 7, the response of intestinal morphology of pigs in terms of lungs treated with fermented mungbean in the diet. As shown on the table, the coefficient determination of r-square (r2) is 0.001 on the length, width (.107) and weight (.158) of lungs of pigs. This means that, 1.00% of the variations of length, 10.7% of the variations of width and 15.8% of weight of the lungs are explained by the different level of treatment. The 95% confidence interval in the length of the lungs is somewhere -79.428 and 79.028, width is -18.840 and 17.840, and weight is somewhere -303.437 and 283.437. This indicates that, for every treatment the pig's intake, the estimated average cost of the weight of the lungs spent is somewhere in between Php303.437 and Php283.437. At the significance level of 5%, the length, width and weight of the lungs has no significant difference as shown by its p-value > 0.050 wherein the p-value of length is .980, .788 for width and .740 for weight. Thus, the null hypothesis is accepted. From the above coefficients, the regression equation can be computed as, length of lungs = 19.800 - .200 (treatment), width = 10.333 - 0.500 (treatment) and weight = 343.333 - 10.000 (treatment). The result of analysis further indicates that, Treatment 2 obtained the highest total weight of 350 grams compared to Treatment 1 and Treatment 2 with a total weight of 320 grams and 300 grams respectively. The result emphasizes that the slight increase or decrease of weight in grams is due to the influence of different treatments given to pigs daily. Hence, it is observable that weight of pigs in terms of lungs can be predicted by the different level of mungbean intakes. Additional benefits from liquid feeding include an increase in nutrient digestibility, improved intestinal morphology, a reduction in the content of various anti-nutritional factors in feeds and a reduction in dust levels in swine barns (Missoten et al., 2015).

Table 7. Response of intestinal morphology (lungs) of pigs treated with different level of fermented mungbean in the diet.

	Lungs		
Treatment	Length (in cm)	Width (in cm)	Weight (in kg)
T_1	16	9	320 grams
T_2	26.6	11	350 grams
T_3	15.6	8	300 grams
R square	.001	.107	.158
p-value	.980	.788	.740
F	.001	.120	.188
Unstandardized Coefficients:			
(Constant)	19.800	10.333	343.333
Treatment	-.200	-.500	-10.000
95.0% Confidence interval for B:			
Lower bound	-79.428	-18.840	-303.437
Upper bound	79.028	17.840	283.437
Interpretation	Not Significant	Not Significant	Not Significant

Gleaned on Table 8, the response of intestinal morphology of pigs in relation to esophagus treated with different level of fermented mungbean in the diet. As seen on the table, the coefficient determination of r-square (r2) is 0.107 on length, width is 0.000 and weight of esophagus is 0.077. This states that a dropped to zero of r2 on the width of the esophagus means that 0% indicates no linear relation under the different treatment. However, 10.7% of the variations on the length and 7.7% on the weight of the esophagus are expressed on the different level of treatment. The 95% confidence interval in the length of the esophagus is somewhere -9.420 and 8.920 on length, width is +7.336 and weight is somewhere -450.156 and 430.156. This indicates that, for every treatment the pig's intake, the estimated average cost of the weight of the esophagus spent is somewhere in between Php450.156 and 430.156. At the significance level of 5%, the length, width and weight of the esophagus had no variations as shown by its p-value > 0.050. Therefore, the null hypothesis is accepted. From the above coefficients, the regression equation can be computed as, length of esophagus = 16.667 - 0.250 (treatment), width = 6.333 + 0.000 (treatment) and weight = 230.000 - 10.000

(treatment). The result of analysis on the different treatment emphasize that, Treatment 2 obtained the highest weight of 250 grams treated with 500 grams of commercial feeds and 250 grams of mungbean meal and fermented mungbean while a light decrease of 20 grams was found on Treatment 1 and Treatment 2 with a total weight of 200 grams and 180 grams respectively. This only shows that Treatment 2 is good predictors of the growth performance of pigs. The slight difference in the weight of esophagus is attributed to the shortest treatment of native pigs. The effects of Bacillus subtilis fermented soybean meal (FSBM) on intestinal morphology and digestive enzyme activities in piglets had a higher (P<0.05) villus height at three different locations of small intestine and had a lower (P<0.05) crypt depth in the duodenum compared to piglets fed Soybean Meal (Feng et al.,2007). The results showed that activities of total protease and trypsin at the duodenum and jejunum of piglets fed with Fermented Soybean Meal increased (P<0.05) compared with the control. The trypsin activity in the pancreas of piglets decreased (P<0.05) when they were fed with fermented soybean meal.

Table 8. Response of intestinal morphology (esophagus) of pigs treated with different level of fermented mungbean in the diet.

	Esophagus		
Treatment	Length (in cm)	Width (in cm)	Weight (in kg)
T_1	16	6	200 grams
T_2	17	7	250 grams
T_3	15.5	6	180 grams
R square	.107	.000	.077
p-value	.788	1.000	.821
F	.120	.000	.083
Unstandardized Coefficients:			
(constant)	16.667	6.333	230.000
Treatment	-.250	.000	-10.000
95.0% Confidence interval for B:			
Lower bound	-9.420	-7.336	-450.156
Upper bound	8.920	7.336	430.156
Interpretation	Not Significant	Not significant	Not Significant

It is represented on Table 9, the response of intestinal morphology of pigs in terms of spleen treated with different level of fermented mungbean in the diet. As gleaned on the table, the coefficient determination of r-square (r2) is 0.250 on the length, width is 0.000 and weight of spleen of pigs is 0.058. This indicates that 25% of the variation of length and 5.8% of the weight of the pigs is explained by the different level of treatment, while a dropped to zero of r2 indicates that there is no linear relation on the width of the spleen under the different level of treatment. The 95% confidence interval in the length of the spleen is somewhere -11.504 and 10504, the width is + 7.336, and weight is somewhere -261.758 and 251.758. This indicates that, for every treatment the pig's intake, the estimated average cost of the weight of the spleen spent is somewhere in between Php261.758 and Php251.578. At the significance level of 5%, the length (p-value = .667), width (p-value = 1.000) and weight (p-value = .846) of the spleen has no variations as shown by its p-value > 0.050. Therefore, the null hypothesis is accepted. From the above coefficients, the regression equation can be computed as, length of spleen = 19.000 - 0.500 (treatment), width = 5.333 + 0.000 (treatment) and weight = 86.667 - 5.000 (treatment). The result of treatment further observed that, Treatment 2 has the highest spleen weight of 100 grams which is treated with 500 grams commercial feeds and 250 grams of both mungbean meal and fermented mungbean, while Treatment 1 and 3 using 100% commercial feeds and 500 grams commercial feeds, 300 grams mungben meal and 200 grams fermented mungbean respectively, have the same total spleen weight of 70 grams. This only shows that Treatment 2 despite of the slight variations on the spleen weight is good predictors of the pig's growth performance. Feeding diets containing 19%-23% crude protein could help meet the growth needs of weaning piglets (Wu et al., 2015). It is important therefore to determine whether the performance and intestinal health would be affected in piglets if dietary crude protein is increased from 17.3% without in-feed antibiotics. In addition, weaned piglets fed animal protein sources appear to have a superior feeding value than plant sources, which partly due to the plant proteins are less digestible than animal proteins.

Table 9. Response of intestinal morphology (spleen) of pigs treated with different level of fermented mungbean in the diet.

	Spleen		
Treatment	Length (in cm)	Width (in cm)	Weight (in kg)
T_1	17	5	70 grams
T_2	18	6	100 grams
T_3	17	5	70 grams
R square	.250	.000	.058
p-value	.667	1.000	.846
F	.333	.000	.061
Unstandardized Coefficients:			
(Constant)	19.000	5.333	86.667
Treatment	-.500	.000	-5.000

95.0% confidence Interval for B:			
Lower bound	-11.504	-7.336	-261.758
Upper bound	10.504	7.336	251.758
Interpretation	Not Significant	Not Significant	Not Significant

It is presented on Table 10, the response of intestinal morphology of pigs in terms of kidney treated with different level of fermented mungbean in the diet. As shown on the table, the coefficient determination of r-square (r^2) is 0.000 on the length, width and weight of kidney of the pigs. A dropped to zero of r^2 indicates that there is no linear relation on the length, width and weight of kidney under the different level of treatment. The 95% confidence interval in the length of the heart is somewhere $\pm$ 7.336, width is $\pm$ 7.336, and weight is somewhere $\pm$ 733.593. This indicates that, for every treatment the pig's intake, the estimated average cost of the weight of the kidney spent is somewhere Php733.593. At the significance level of 5%, the length, width and weight of the kidney had no variations as shown by its p-value > 0.050 which is 1.000. Therefore, the null hypothesis is accepted. From the above coefficients, the regression equation can be computed as, length of kidney = 10.333 + 0.000 (treatment), width = 6.333 + 0.000 (treatment) and weight = 183.333 + 0.000 (treatment). As a result of the analysis it is observed that using 500 grams of commercial feeds, 250 grams mungbean meal and 250 grams of fermented mungbean for Treatment 2 can obtained a total weight of 250 grams for kidney while using Treatment 1 and 3 can only have a weight of 150 grams. This shows that, Treatment 2 greatly affect the growth performance of pig. According to Lee et al, 2016, with the slight difference on the weight advantage of using polyphenol content as a feed supplement, mungbean coat needs to be treated to release its antioxidant compound. Moreover, the number of antioxidants should be sufficient to promote the immune capabilities of pigs, as in natural form, it has no extra value as roughage. It has suggested that antioxidant and anti-inflammatory properties of mungbean coats can be greatly increased once fermented with fungi.

Table 10. Response of intestinal morphology (kidney) of pigs treated with different level of fermented mungbean in the diet.

Treatment	Kidney Length (in cm)	Width (in cm)	Weight (in kg)
T_1	10	6	150 grams
T_2	11	7	250 grams
T_3	10	6	150 grams
R square	.000	.000	.000
p-value	1.000	1.000	1.000

F	.000	.000	.000
Unstandardized Coefficients:			
(Constant)	10.333	6.333	183.333
Treatment	.000	.000	.000
95.0% Confidence interval for B:			
Lower bound	-7.336	-7.336	-733.593
Upper bound	7.336	7.336	733.593
Interpretation	Not Significant	Not Significant	Not Significant

Table 11 represents the treatment that gives good output to the growth performance of pigs treated with different levels of fermented mungbean in the diet using feed conversion efficiency. As shown on the table, the lowest feed conversion efficiency is obtained by Treatment 2 with food conversion efficiency of 3.89 on feeds and 1.39 on mungbean. This means that, it took 3.89 kilos of feeds and 1.39 kilos of mungbean to produce one (1) kilo of meat. However, Treatment 1 has the highest feed conversion efficiency of 9.33 on feeds and zero on mungbean. This indicates that, it took 9.33 kilos of feeds to produce one (1) kilo of meat. The result of analysis shows that Treatment 2 gives good output to the growth performance of pigs. Thus, the lower the feed conversion efficiency, the lower the cost of rearing pigs the greater the income. [3]Growth of pigs, protein source is very important factor for nursery pig's growth, because poor amino acid and protein nutrition have a profound effect on physiology health status and growth factor of pigs. Diets with high crude protein content are commonly used for early-weaned pigs. This kind of diet can improve growth performance of piglets, but is always associated with incidence of diarrhea. Proteins are composed of amino acids, and it is actually the amino acids that are the essential nutrients.

Table 11. Feed conversion efficiency of pigs treated with different levels of feeding regimen

Treatment	Body weight			Feed Consumption		Feed Conversion Efficiency (FC/TGW)	
	Initial body weight (in kg)	Final body weight (in kg)	Total gain weight (in kg)	Feeds	Mungbean	Feeds	Mungbean
T_1	20.50	28.00	7.50	70	-	9.33	-
T_2	21.00	30.00	9.00	35	12.50	3.89	1.39
T_3	20.50	27.00	6.00	35	12.50	5.83	2.08

CONCLUSIONS

From the summary of findings, the researcher concluded that: Treatment 2 has the highest gain weight among the treated sample. The intestinal morphology of pigs was comparably observed under the three treatments. Hence, the null hypothesis is accepted. Treatment 2 with the lowest feed conversion efficiency is a good output.

RECOMMENDATIONS

Highly application of systematic Treatment 2 could be adopted to improve the growth performance of pigs, gut morphology, meat qualities, better feed conversion efficiency and profit. The no variations in the study could be used to develop other treatment on mungbean coat to release its antioxidant compound to promote the immune capabilities of pigs. Fermentation of mungbean is recommended to promote the healthy bacteria in the intestinal tract of pigs. This study may be conducted by other researchers in educational institutions and government agencies public or private by conducting researches related to the study.

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