BIBLIOGRAPHY

CORNELIO, MARLYN BANDIWAN. MARCH 2013. The Growth Performance of Growing-Finishing Pigs Fed with Commercial Feeds and Activated Charcoal Containing Wood Vinegar. Benguet State University, La Trinidad, Benguet.

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ABSTRACT

The study was conducted at the BSU experimental piggery, La Trinidad, Benguet from November to February 2013 to compare the growth performance of growing-finishing pigs fed with commercial feeds supplemented with activated charcoal containing wood vinegar to those fed with pure commercial feeds only.

A total of 60 days old crossbred (Landrace x Large white) pigs were used as experimental animals. The pigs were grouped into two treatments and were replicated four times following the completely randomized design (CRD). The two treatments were as follows: pure commercial feeds and commercial feeds + activated charcoal containing wood vinegar given at the level of 20g/ kg feed.

Statistical analysis revealed that the performance of pigs that were not given activated charcoal containing wood vinegar was similar to those pigs fed with activated charcoal containing wood vinegar. This result showed that activated charcoal containing wood vinegar at the rate of 20g/ kg feed did not significantly affect the final weight, total

and daily gains in weight, total and daily feed intake, feed conversion ratio and the returns on investment (ROI).

While there was no improvement on the growth performance of the pigs, it is interesting to note that during the experiment, lesser fecal odor was observed from the pigs given feeds with activated charcoal containing wood vinegar. It is then recommended that studies be conducted towards this effect and to include more treatments.

INTRODUCTION

The Swine Industry is one of the most important among the local animal industries in the country. It contributed about 98% of the country's total pork supply. Pork represents more than 50% of the total animal meat consumed by Filipinos (PCARRD, 2005).

Nutrition is very important in the improvement of swine production. It is required that supplemental feeds should be sufficiently appetizing to ensure an intake adequate for the purpose desired. Supplying feeds, as a source of nutrients, is a major concern in the profitability of animal production since feed cost accounts for 70-80% of the total production cost. Therefore, the nutrient composition of the diet will determine the performance of the animals or simply, the success or failure of the animal project.

Most individuals are very concerned about their health. They prefer to eat meat which has fewer chemicals added to avoid sickness. In order to meet this demand, one of organic feed additives which were approved by the Japanese Government is activated charcoal containing wood vinegar. It signifies thermo-chemistry which intended to convey message of "bringing prosperity through thermo-chemistry". Recently, some researchers found out that activated charcoal containing wood vinegar can be used for animal medication and feed mix. Therefore, it is being recommended to mix with swine diets.

Mixed activated charcoal and mokusaku (wood vinegar liquid) contains organic acids. The activated charcoal and mokusaku (wood vinegar liquid) are both obtained from the bark of evergreen oak by the process of carbonization. Activated charcoal is known as the universal adsorbent because it can bind with variety of molecules. It is also useful for the removal of bacteria and bacterial toxins, both in vivo and in vitro. Organic acids also inhibit the growth of enteropathogenic bacteria. These mixture compounds have a

significant impact on controlling contamination of the environment and potential waterborne spread of diseases (Watarai and Tana, 2008).

The result of the study if found feasible will contribute to the improvement of raising swine. Informations that will be obtained from the study can be used by the swine raisers to improve their production. It will serve also as a guide or additional knowledge to researchers and students who want to work on problems related to this study.

Generally, this study was conducted to determine the effect of activated charcoal containing wood vinegar on the growth performance of growing-finishing pigs. Specifically, it aimed to:

1. determine gain in weight, feed consumption, feed conversion ratio, and the morbidity and mortality rates of the growing-finishing pigs when given activated charcoal containing wood vinegar: and

2. determine the profitability of raising pigs when given activated charcoal containing wood vinegar as feed additives.

The study was conducted at the Benguet State University experimental piggery, La Trinidad, Benguet from October to February, 2013.

REVIEW OF LITERATURE

Feed Additives

Antimicrobial agents are commonly added to swine diets to improve the weight gains, feed conversion efficiency and reproduction. Recent findings show the danger of indiscriminate use of additives to animal or human health. Therefore, their use should be approved by the Food and Drug Administration (FDA) or any concerned agency (PCARRD, 2005). Currently, used additives include antibiotics, arsenicals and nitrofuran compounds, all of which have been shown to improve animal performance such as growth, feed utilization and some other production function (Pond and Pond, 2000).

Probiotics

The term probiotic was proposed for the very first time. The definition of probiotics has been modified several times over the intervening years, but was revised recently so as to indicate the necessity that the microbial cells be viable. Probiotics are live microorganisms that when administered the digestive route, are favorable to the host's health (Gulliot, 2000) as cited by Cayomba (2002).

Pond and Pond (2000) said that probiotics are beneficial microorganism added to rations to improve the intestinal microbial of the animal. These microorganisms exert their beneficial effects through "competitive exclusion" and lactic acid production.

Effects of probiotic on the living body as reported by Koiwa and Watarai (2011) are as follows: (1) immunity is fortified (resistant to infections); (2) it can remove harmful substances produced by bad bacteria; (3) it inhibits propagation of pathogenic bacteria; (4) it normalize intestinal movement and prevent constipation. They also added that probiotics

can fortify animal health, reduce intestinal odor so it helps in improving meat quality and it enhance digestion to improve feeding efficiency.

PCARRD (2000) defined probiotic as live microbial supplements, these are beneficial microorganisms (mainly lactic acid producing bacteria and yeast combinations) added to rations to improve the intestinal microbial balance of the animal. Some of these microorganisms are the *Lactobacillus sp*. and *Bifidobacterium sp.*

Activated Charcoal

Activated charcoal has high adsorptive capacity although it tends to be non-selective. However, adsorptive capacity of activated charcoal depends on its pore size. *Salmonella enteritidis* was found to be more efficiently adsorbed by activated charcoal from the bark of evergreen oak than *Enterococcus faecium*. This is because the pores of activated charcoal which is used in the study has sufficient diameter for *S. enteritidis* but not for *E. faecium*. This findings suggests that activated charcoal from bark given orally could be able to function as an agent for reducing *S. enteritidis* carriage and to minimize the removal of normal bacterial flora in the intestinal tract (Watarai and Tana, 2005).

More recently, Watarai and Tana (2008) found that activated charcoal possessed pores of sufficient diameter for *C. parvum* oocysts. Therefore, they suggest that oral administration of activated charcoal could reduce *C. parvum* oocysts.

Wood Vinegar Liquid (Mokusaku)

Wood vinegar liquid is composed of a lot of organic chemical substances. Studies in Japan have shown that there could be more than 300 chemical substances that it contains.

Mokusaku is used for fertigation for it has two main effects, it controls pathogenic bacteria and it serves as food for useful microorganisms (Yokomori, 2011).

Watarai and Tana (2005) suggested that wood vinegar liquid would have two effects against intestinal bacteria: one would be an inhibitory effect on the growth of pathogenic bacteria, such as *S. enteritidis*, the other would be a stimulatory effect on the growth of bacterial flora, such as *E. faecium* and *B. thermolin*, in the intestines. Furthermore, Watarai and Tana (2008) proved that wood vinegar liquid from the bark of evergreen oak contains compounds with disinfectant activity against *C. parvum* oocysts.

Activated Charcoal & Mokusaku

Watarai (2011) stated that activated charcoal and mokusaku (wood vinegar liquid) was obtained from the evergreen broadleaf tree bark using "biomass transformation technology". Tree bark is full of energy. Mokusaku from the bark contains a number of useful substances. The product of activated charcoal containing wood vinegar can be used for animal medication, feed mix, and soil-mix fertilizer.

Activated charcoal containing wood vinegar has effects on microorganisms in intestinal organs. This improves the intestinal environment. Soft charcoal adsorp Pathogenic Microorganism (PthMio) and control also propagation of PthMio (Koiwa and Watarai, 2011).

Calgo and Walsi-en (2012) stated that the inclusion of activated charcoal containing wood vinegar didn't give effect to the gain in weights of pigs. After one hundred, sixty nine (169) days of feeding, they found that the fatteners under the control which was not given with activated charcoal containing wood vinegar have a mean gain in weight of 103kg, treatment 1 which was given with 10g activated charcoal containing wood vinegar

has a mean gain and weight of 97kg, and 99kg on treatment 2 which has given 50g activated charcoal containing wood vinegar. The difference among the treatment means are close, therefore it is not significant.

Bamboo Vinegar

Study on the effect of bamboo vinegar as an antibiotic alternative on the growth performance and fecal bacterial communities of weaned pigs was observed. One hundred and twenty weaned piglets (Duroc x Landrace x Yorkshire) were randomly assigned into three (3) treatments. At the end of the experiment, it was revealed that there was no significant difference observed in the feed intake and feed conversion ratio among different treatments (Wang *et. al*, 2011).

MATERIALS AND METHODS

Materials

The materials used in the study were eight 60 days old crossbred pigs (Largewhite x Landrace) belonging to the same litter and were more or less of the same weight, commercial feeds, activated charcoal containing wood vinegar (Fig. 1), weighing scale, pigpens, feeding troughs, water, disinfectants, stick broom, and recording materials.

Methodology

Preparation of the pens. Two weeks before the start of the study, the pens were prepared and cleaned thoroughly including the surrounding area. These were sprayed with disinfectant kill the microorganisms present.

Experimental design and treatments. At the start of the study, the eight pigs were distributed at random into two treatments following the Completely Randomized Design (CRD). Each treatment was replicated four times with one pig per replication. The individual weights of the experimental animals were taken first and were recorded before placing them into their respective pens.

The treatments were as follows:

T_0- without activated charcoal containing wood vinegar

T_1- with activated charcoal containing wood vinegar

Care and management of the pigs. All the experimental animals were subjected to the same care and management except in the ration offered to them. The control pigs were fed with pure commercial feeds (Fig. 2). The pigs under treatment two were fed with commercial feeds plus activated charcoal containing wood vinegar given at the level of 20g/kg feed (Fig. 3). Feeding was done two times a day from 7:00- 7:30 in the morning and 5:00-5:30 in the afternoon. The experimental animals were fed with starter feeds from the first four weeks of the study, grower feeds for the next four weeks and then finisher feeds for another four weeks or until the end of the study.

Clean and fresh water was always available for the experimental animals. To help maintain the good health of the animals, cleaning of the pens was done every day.

Figure 1. Activated charcoal containing wood vinegar

Figure 2. Commercial feeds only

Figure 3. Commercial feeds mixed with activated charcoal containing wood vinegar

Data Gathered

The data gathered were as follows:

1. Initial weight (kg). This was determined by weighing the pigs at the start of the study which was at 60 days old.

2. Final weight (kg). This was taken by weighing the pigs at the end of the experiment or after a feeding period of 12 weeks.

3. Amount of feed offered (kg). This was determined by weighing the feed offered to the swine from the start until the end of the experimental period.

4. Amount of feed leftover (kg). This was determined by weighing the spilled or refused feed.

5. Morbidity. This refers to the number of pigs that got sick during the experimental period.

6. Mortality. This refers to the numbers of pigs that died during the study.

7. Cost of inputs (Php). This was determined by recording all the expenses used in the study.

From the data above, the following parameters were computed:

1. Total gain in weight (kg). This was determined by subtracting the initial weight from the final weight.

2. Average daily gain in weight (kg). This was determined by dividing the total gain in weight by the number of days of feeding the pigs.

3. Total feed consumption (kg). This was determined by adding the amount of feed consumed by the pigs from the start to the end of the study.

4. Feed conversion ratio (FCR). This was determined by dividing the total feed consumption by the total gain in weight.

5. Feed cost/kg gain (kg). This was determined by multiplying FCR by the cost of one kilogram feed.

6. Morbidity rate (%). This was obtained by dividing the number of pigs that got sick by the total number of pigs at the start of the study multiplied by 100%.

7. Mortality rate (%). This was obtained by dividing the number of pigs that died by the total number of pigs at the start of the study multiplied by 100%.

8. Return on Investment. This was determined by using the following formula:

$$\text{ROI} = \frac{\text{Gross sales- Total Expenses}}{\text{Total Expenses}} \times 100\%$$

Data Analysis

All data gathered were consolidated, tabulated, and analyzed by using T-test.

RESULTS AND DISCUSSION

Body Weights

The initial and final weights of the pigs used in the study are shown in Table 1. In terms of initial weight, statistical analysis showed that there was no significant difference between the two treatment means. This indicates that the pigs were more or less of the same weights at the start of the study. The mean initial weight of pigs given activated charcoal containing wood vinegar was 13.469kg while the pigs given diets without activated charcoal containing wood vinegar additive was 13.500kg.

In terms of final weight, no significant difference was also observed between the two treatment means. This indicates that the final weights of the pigs in the two treatments were more or less the same. The mean final weight obtained from the pigs given diets with activated charcoal containing wood vinegar additive was 68.500kg and 69.250kg from the pigs fed diets without activated charcoal containing wood vinegar.

Table 1. Initial and final weights of the pigs

TREATMENT	INITIAL WEIGHT AT 60 DAYS OF AGE (kg)	FINAL WEIGHT AT 144 DAYS OF AGE (kg)
Without activated charcoal containing wood vinegar	13.500	69.250
With activated charcoal containing wood vinegar	13.438	68.500

Total And Average Daily
Gain (ADG) in Weight

The total and average daily gains in weight of the experimental pigs after a feeding period of 84 days are presented in Table 2. No significant difference between the two treatments was observed according to statistical analysis. This means that the gains in weight of the pigs were more or less the same. It is also reflected that the ability of the animals to gain weight has not been improved nor adversely affected by the addition of activated charcoal containing wood vinegar in their rations. The overall mean total gain in weight of the pigs in the two treatments was 55.405kg and the ADG was 0.6596kg.

The above result is similar to the findings of Calgo and Walsi-en (2012). In their study, they found out that adding of activated charcoal containing wood vinegar at levels of 10 and 50 grams per kg of feed didn't give significant differences on the gains in weight of fattener pigs after 169 days of feeding. The pigs given diets with activated charcoal containing wood vinegar had a mean of 55. 06kg and 0.66kg for the total and daily gains in weight, respectively.

Table 2. Total and daily gains in weight of the pigs

TREATMENT	TOTAL GAIN IN WEIGHTS (kg)
Without activated charcoal containing wood vinegar	55.750
With activated charcoal containing wood vinegar	55.062

Feed Consumption

The feed consumptions of the experimental animals in the two treatments are shown in Table 3.

Statistical analysis revealed no significant difference was observed between the two treatment means. This implies that the addition of activated charcoal containing wood vinegar into the pig's diet did not reduce nor improve the appetite or feed consumptions of the animals. The mean feed consumption of the pigs after a feeding period of 84 days was 141.295kg for those given no activated charcoal and 139.705kg from those given activated charcoal.

The above result is similar with the study of Wang *et.al* (2011), though it is in bamboo, they found out that bamboo vinegar when given to weaned piglets did not give significant differences in the feed consumption and feed conversion ratio.

Table 3. Total feed consumptions of the pigs

TREATMENT	TOTAL FEED CONSUMPTION FOR 84 DAYS (kg
Without activated charcoal containing wood vinegar	141.295
With activated charcoal containing wood vinegar	139.705

Feed Conversion Ratio (FCR)

The efficiency of pigs in converting feeds consumed into meat is shown in Table 4. Results revealed that supplementing the diets of the pigs with activated charcoal containing wood vinegar at the level of 20g/ kg feed did not improve nor decrease the efficiency of the pigs to convert nutrients in the feeds into a unit gain in weight as revealed by the statistical analysis. This is consistent with the findings for both the gains in weight and feed consumptions of the animals where no significant differences were observed between the two treatments, meaning the pigs in all the treatments had more or less the same gain in weights and had consumed more or less the same amount of feeds. The mean feed conversion ratio of the pigs was 2.537.

Feed Cost per Kilogram Gain in Weight

Table 5 shows the cost of feed to produce a kilogram gain in weight. The cost of feeds per kilogram was based on the prevailing price during the conduct of the study.

Statistical analysis revealed that there was no significant difference between the two treatment means. The two treatments had almost the same feed cost to produce a kilogram gain in weight.

Table 4. Feed conversion ratio of pigs

TREATMENT	FEED CONVERSION RATIO
Without activated charcoal containing wood vinegar	2.536
With activated charcoal containing wood vinegar	2.538

The feed cost obtained from the pigs given activated charcoal containing wood vinegar was Php63.456 and those given no activated charcoal containing wood vinegar had a mean feed cost of Php63.446.

Returns on Investment (ROI)

The returns on investment (ROI) realized in the two treatments after the experiment are shown in Table 6 and the details of the cost production are presented in appendix Table 9. Though this parameter was not subjected to statistical analysis, results revealed that a higher ROI was obtained from the pigs fed with pure commercial feeds i.e. without activated charcoal with wood vinegar which had an ROI of 4.02% compared to the ROI realized from the pigs given commercial feeds with activated charcoal containing wood vinegar which was only -1.50%.

The difference was brought about by the additional expenses on activated charcoal with wood vinegar which was mixed into the diets of the pigs in one of the two treatments. No improvement had been observed on the gains in weight and feed conversion ratio, hence, the inclusion of the activated charcoal into the diets of the pigs turned out to be just an additional expense.

Table 5. Feed cost per kg gain in weight

TREATMENT	FEED COST/KG GAIN (Php)
Without activated charcoal containing wood vinegar	63.406
With activated charcoal containing wood vinegar	63.456

Table 6. Returns on investment (ROI)

TREATMENT	GROSS SALES (Php)	TOTAL EXPENSES (Php)	NET INCOME (Php)	ROI (%)
Without activated Charcoal containing Wood vinegar	33, 240.00	31, 952.562	1, 287.44	4.02
With activated charcoal containing wood vinegar	32, 880.00	33,379.39	-499.39	-1.50

Other Observations

While there was no improvement on the growth performance of the pigs, it is interesting to note that during the experiment, lesser fecal odor was observed from the pigs given feeds with activated charcoal containing wood vinegar.

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

The study aimed to compare the growth performance of growing-finishing pigs fed with commercial feeds and activated charcoal containing wood vinegar.

A total of 8 pigs that were about 60 days old were used in the experiment. These were grouped into two treatments with four (4) replications in each treatment following the completely randomized design (CRD). The two treatments were as follows: T_0 (pure commercial feeds), and T_1 (commercial feeds plus activated charcoal containing wood vinegar given at the level of 20g/ kg feed.

Statistical analysis revealed that there were no significant differences observed between the two treatments in all the parameters namely initial weight, final weight, gain in weight, feed consumption, feed conversion ratio and feed cost to produce a kilogram gain in body weight. The pigs in the two treatments had an overall mean initial weight of 13.47kg and a mean final weight of 68.875kg after 84 days of feeding.

In terms of gain in weight, the pigs in the control group had a mean of 55.75kg and an average daily feed intake of 1.68kg. Feed conversion ratio was 2.536; feed cost per kilogram gain in weight was Php63.41 and had a return on investment (ROI) of 4.02%.

On the other hand, pigs given diets with activated charcoal containing wood vinegar had a mean gain in weights of 55. 063kg and an average daily gain of 0.656kg. Their mean feed consumption was 139.705kg and an average daily feed consumption of 1.663kg, feed conversion ratio was 2.538, feed cost per kilogram gain in weight was Php63.456 and had a return on investment (ROI) of -1.50%.

Conclusion

Based on the results of the study, it is therefore concluded that the inclusion of activated charcoal containing wood vinegar into the pig's diet at the rate of 20g/ kg feed did not give effect in terms of their gains in weight, feed consumption, and feed conversion efficiency as well as for the return on investment (ROI).

Recommendations

From the results giving activated charcoal containing wood vinegar as feed additive of swine have no effect on the performance. However, further studies should be conducted using higher levels of activated charcoal and should involve more number of treatments. It is also recommended that studies should be conducted to include the digestibility trials and the effect of activated charcoal containing wood vinegar on waste management in animal production.

LITERATURE CITED

CAYOMBA, D. L. 2002. Performance of Broilers Given Probiotic Supplement during the Brooding and Growing Periods. BS Thesis (Unpub.) Benguet State University La Trinidad, Benguet. P. 3.

CALGO, E. P. and M. B. WALSI-EN. 2012. Performance of Piglets/Fatteners and Supplemented with Activated Charcoal Powder Wood Vinegar Compound. Verification Research. Sto. Nino, Ambassador, Tublay, Benguet. (Powerpoint presentation)

KOIWA, M. and H. WATARAI. 2011. Research Reports of Activated charcoal containing wood vinegar. Miyazaki Midori Pharms.Co., LTD, Miyazaki. (Powerpoint presentation)

PHILIPPINE COUNCIL FOR AGRICULTURE, FORESTRY AND NATURAL RESOURCES AND DEVELOPMENT. 2000. The Philippine Recommends for Livestock Feed Formulation. PCCARD/DOST.PFIZER INC., Los Banos, Laguna. Recommends Series no.65-A. P. 23.

PHILIPPINE COUNCIL FOR AGRICULTURE, FORESTRY AND NATURAL RESOURCES AND DEVELOPMENT. 2005. The Philippine Recommended for Animal Health Care. PCCARD/DOST. PFIZERINC., Los Banos,Laguna. Recommends Series No. 13-B Pp. iii & 37.

POND, K. R. and W. G. POND. 2000. Introduction to Animal Science. John Wiley and Sons, INC., United States of America. P. 687.

WATARAI, S. and K. TANA. 2005. Eliminating the carriage of *Salmonella enterica* serovar Enteritidis in domestic fowls by feeding activated charcoal from bark containing wood vinegar liquid. Poultry Science Association, Inc. 84:515-521.

WANG, H. F. *et.al.* 2011. Effect of Bamboo Vinegar as an Antibiotic Alternative on Growth Performance and Fecal Bacterial Communities of Weaned piglets. Livestock Science 144 (2012) 173-180. Journal homepage: www.elsevier.com.locate.livsci

WATARAI, S. and K. TANA.2008. Feeding activated charcoal from bark containing wood vinegar liquid (Nekka-Rich) is effective as treatment for *Cryptosporidiosis* in calves. American Dairy Science Association. 1458-1463.

WATARAI, H. 2011. Effective Uses of Charcoal and Mokusaku.Miyazaki Midori Pharms.Co., LTD, Miyazaki. (Powerpoint presentation).

YOKOMORI, M. 2011. Farmers in Benguet Practice Savers Technology. Rianella Printing Press. Baguio City, Philippines. Pp. 1-7.