BIBLIOGRAPHY

PULACAN, JILLIAN KATE S. APRIL 2013. Carcass Characteristics of Growing-Finishing Pigs Given Commercial Feeds Supplemented with Activated Charcoal Containing Wood Vinegar. Benguet State University, La Trinidad, Benguet.

Adviser: Myrna B. Walsiyen, MSc.

ABSTRACT

The study was conducted to determine the effect of activated charcoal containing wood vinegar on the carcass characteristics of pigs namely slaughter weight, carcass weight, back fat thickness, carcass length, loin eye area, and weight of whole sale cuts and edible entrails; organoleptic test in terms of appearance, aroma, tenderness, juiciness, taste, and acceptability; and the proximate composition of the meat.

Six five months old pigs were randomly distributed in two treatments as follows: without activated charcoal containing wood vinegar (T_0) and activated charcoal containing wood vinegar at the level of 20g/kg feed (T_1).

Results showed that there were no significant differences on the slaughter weight, carcass length, weight of wholesale cuts, weight of edible entrails, and back fat thickness. The overall mean carcass length, back fat thickness, loin eye area obtained from the pigs was 67.67kg were 65.750cm, 2.266cm, and 5.877in^2, respectively. The percent shoulder, loin, belly, and ham were 30.146%, 24.443%, 19.261%, and 26.143%.

The percent edible entrails namely heart, liver, lungs, spleen, kidneys, pancreas, stomach, small intestine, and large intestine were 0.408%, 1.853%, 0.802%, 0.162%, 0.299%, 0.178%, 0.723%, 2.199%, and 2.490%, respectively.

In terms of organoleptic test, statistical analysis revealed no significant differences in all the parameters. The meat samples were desirable in appearance and aroma, moderately tender and juicy, good in taste, and liked very much in acceptability.

Finally in the proximate analysis, the meat obtained from the pigs given activated charcoal containing wood vinegar had a protein, ash and crude fat contents of 22.25%, 1.14%, and 2.60%, respectively. On the other hand, the protein, ash, and crude fat of the meat derived from the pigs that were not given activated charcoal containing wood vinegar were 18.61%, 1.23%, and 12.31%, respectively.

INTRODUCTION

Calabias (2012) cited that the prime agriculture purpose of pig is to provide human food. Meat consists of lean, fat, and bone. Lean is considered as the most important portion in relation to human nutrition, it comprises the bulk of the carcass which is about 50-65% of the carcass weight. Fat is also the most variable component of meat, it comprises about 5-30% of the carcass. Bone comprises 15-17% of the carcass. The demand for pork is very high yet the production is low. Only few farmers engage in commercial swine production because of high investment required. Many are still engaged in backyard swine raising as source of family protein and additional income.

Now a days, consumers are now starting to become conscious on the food they eat. They prefer to buy meat derived from organically produced animals or from animals that are at least free of antibiotics or chemical residues. Even though it's quite expensive, they keep on buying just to have a nutritious diet. Swine meat is preferred not only for their soft tender quality but also as source of protein.

One of the products that can be used as feed additives is Nekka-Rich. Nekka-Rich is made by mixing activated charcoal and wood vinegar liquid that contains organic acid. Activated charcoal is known as a universal adsorbent because it can bind with variety of molecules. It has been also reported that activated charcoal is useful for the removal of bacteria and bacterial toxins (Koiwa and Watarai, 2011).This feed additive from Japan is approved by Japanese Government.

This may help the swine raisers in increasing the production of animal products. It also serves as reference for students and other researchers. Furthermore, it hopes to promote the use of natural products such as Nekka-Rich in improving the carcass quality

and the general health of food animals such as swine. This will provide additional information and guide to swine raisers. Swine production plays a significant role in the economy and it is therefore, essential to study the performance of the swine industry to understand the present situation.

Generally, this study was conducted to determine the effect of activated charcoal containing wood vinegar (Nekka-Rich) as feed additives on the carcass characteristics of swine.

Specifically, it aimed to:

1. determine the dressing percentage of carcass of swine,

2. determine the effect of carcass measurements in terms of backfat thickness, carcass length and the loin eye area,

3. determine the carcass weight and weights of the wholesale cuts and the edible entrails,

4. organoleptic test in terms of appearance/color, aroma, tenderness, juiciness, taste, and acceptability; and

5. determine the proximate composition of the meat.

This was conducted at the Benguet State University Meat Laboratory, La Trinidad Benguet in February 2013.

REVIEW OF LITERATURE

Nekka-Rich

"Nekka" signifies thermo-chemistry, this word is intended to convey message of "bringing prosperity through thermo-chemistry". Nekka-Rich is obtained by combining charcoal and mokusaku (wood vinegar liquid) 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 Nekka-Rich can be use for animal medication, feed mix, and soil-mix fertilizer (Koiwa and Watarai, 2011).

Furthermore, Nekka-Rich 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).

Watarai and Tana (2008) stated that the activated charcoal is useful in the removal of verotoxin-producing Escherichia coli and verotoxin. Moreover, organic acids have an inhibitory affect on the growth of enteropathogenic bacteria.

Wood Vinegar Liquid (Mokusaku)

Wood vinegar liquid is a liquid obtained from oil, juices, sap, and other liquid contents of organic materials such as wood, coconut shell, bamboo, grass and other plants. Also it composed of a lot of organic chemical substances. In Japan, they studies more than 300 chemical substances (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.

Probiotics

Proboitics are living bacteria that may be added to diet in an attempt to control intestinalinfections in animals and enhance nutrient utilization. Recent interest in the use of probitics in livestock feeds is the result of concern about the use of antibiotics in the feed to improve animal performance. Commonly studied probiotics in poultry, swine, and cattle diets include members of the Lactobacillus genus, and streptococcus faecalis. Selected cultures of Lactobacilus species have been used control salmonellosis in poultry. Some reports indicate reduced mortality and increased growth in swine fed a mixture of Bacillus pseudolongum and L. acidophilus (Pond *et al*., 2005).

Watarai and Tana (2005) cited that the effects of proboitics on animal health are: (1) fortify animal health; (2) reduce intestinal odor, improve meat quality; (2) enhance digestion- improve feeding efficiency.

Probiotics are beneficial microorganism (mainlylactic acid producing bacteria) added to rations to improve the intestinal microbial balance of the animal. These bacteria exert their beneficial effects through “competitive exclusion and lactic acid production. In additional to competitive exclusion is reduction in gut pH, which makes the intestinal environment unfavourable for certain pathogenic bacteria (PCARRD, 2005).

Acidifiers

Acidifier is made of organic acid or mixture of organic acids when incorporated in the ration. They exert their affect on the gastrointestinal environment by lowering the stomach pH. Low stomach pH prevents the growth and proliferation of pathogenic pathogenic microorganisms, thus, promoting better feed efficiency (PCARRD, 2000).

Antibiotics

These are chemical products produced by microorganism, which are added in the mixed feed at subtherapeutic level. These materials may increase growth rate and feed conversion in animals, but are potentially harmful when improperly used. Examples of antibiotics are aureomycin, streptomycin, erythromycin, neomycin, virginiamycin, tylosin, and chorletracycline (PCARRD, 2000).

Baldo (2002) cited that, pigs lose live weight rapidly during transport at about 5% in 24 hours as the gut empties between 12 and 18 hours after the last meal, loss of carcass weight begins. When fasted pigs are also denied with water, additional weight loss occurs and can be as much as 1% for 24 hours. Thus, pigs can loss 2% carcass weight per day as a result of withdrawing their feed and water. The effect of dehydration on carcass weight comes about by shrinkage of the lean meat.

MATERIAL AND METHODS

Materials

The materials used in the study were six heads of finishing pigs that were five months old. Other materials used were weighing scale, measuring tape, knives, bolo, LPG, blow torch, chopping board, water, and basin.

Methodology

Experimental animals and treatments. The study made use of six finishing pigs obtained from pigs used in a previous feeding trial. Each treatment had three replications with one pig per replication. The study made use of the same treatments as the feeding trial so it followed that three pigs was taken from the pigs fed with commercial feeds only and the other three was obtained from those fed with commercial feeds supplemented with activated charcoal containing wood vinegar.

The treatments were as follows;

T_0= Without activated charcoal containing wood vinegar

T_1= With activated charcoal containing wood vinegar at the level of 20g/kg feeds

Slaughtering procedures. All experimental in the two treatments were subjected to the same slaughtering procedures as follows:

1.Sticking. Sticking is bleeding the animal using a sticking knife. The head is held with the left hand and sticking is done on the hollow portion above the tip of the breastbone (Figure 1).

Figure 1. Sticking and bleeding the animal

2.Singeing. It is the application of flame to a carcass for the purpose of burning the unscraped or unshaved hair and killing some microorganisms on the surface of the carcass (Figure 2).

3. Evisceration. Evisceration refers to the removal of the visceral organs from the opening of the carcass up to the complete removal of the internal organ from the body cavity (Figure 3).

4. Washing. The carcass is washed from the top down to remove any bone dust, blood, or bacterial contamination.

Figure 2. Dehairing and singeing the animal

Figure 3. Evisceration and gathering the edible entrails of the animals

5. Weighing the carcass. It is the process of weighing the pigs after slaughtering excluding the entrails, head, and feet.

6. Fabrication. This is cutting the carcass into whole sale cuts, namely: shoulder, ham, belly, and loin.

Organoleptic test. An organoleptic test was done for the sensory evaluation of the pork derived coming from the two treatments. Meat samples were obtained from the two treatments. These were steamed without salt or any seasonings. Steaming was done

separately or by treatments. After steaming for about 1hour, the meat samples were sliced into bite size and placed into containers which were previously coded. The meat samples

Figure 4. Evaluating the cooked meat

were then presented to panels of tasters composed of 20 persons. Each member of the panel was given a score sheet (Appendix Table 26) for him to put his own ratings (Figure 4). He was, however requested to drink water after each taste to rinse his mouth to minimize or remove any remains on the meat sample previously tasted that might have affected his taste.

Proximate analysis. From the carcasses of pigs in the two treatments, samples (250g of loin) were taken and were brought to the Department of Science and Technology (DOST), Km6, La Trinidad, Benguet for analysis.

Data Gathered

1. Slaughter and carcass data

a. Slaughter weight (kg). This was obtained by weighing the animals prior to slaughter using livestock scale after 24 hours of fasting (Figure 5).

b. Carcass weight (kg). This was the weight of the carcass without head, feet, and the entrails.

c. Weight of whole sale cuts (kg). This was obtained by weighing each of the wholesale cuts namely shoulder, loin, belly, and ham (Figure 6).

d. Weight of the edible entrails (kg). This refers to the weight of each of the edible entrails namely heart, liver, lungs, spleen, kidneys, pancreas and empty GIT.

2. Carcass Measurements

a. Backfat thickness (cm). This was measured from the first rib (P1), last rib (P2), and at the lumbar vertebra (P3) of the splitted carcass (Figure 7).

b. Carcass length (cm). This was taken by measuring from the first rib to the base of the tail on the suspended carcass in centimeters (Figure 8).

c. Loin eye area (in^2). This was measured in inches and was taken between the 10^{th} and 11^{th} rib (Figure 9).

Figure 5. Weighing the animal at 144 days old

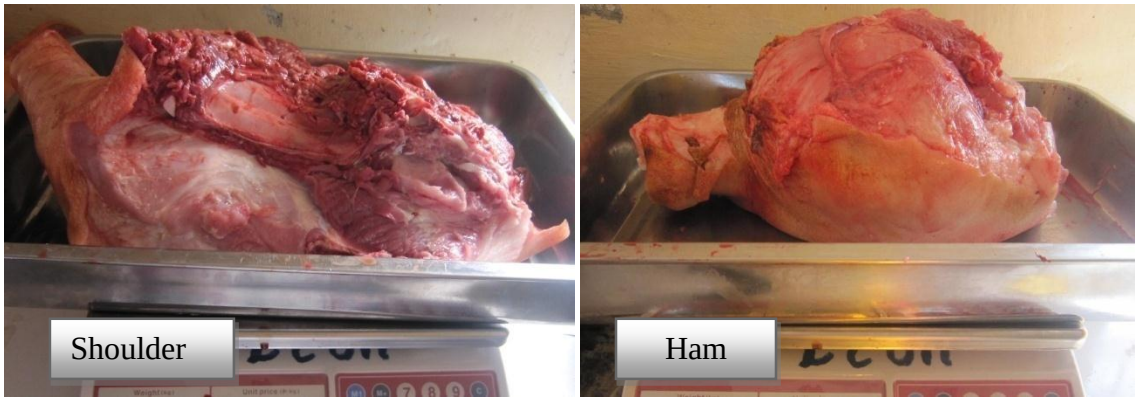

Figure 6. The wholesale cuts being weighed of the carcasses


Figure 7. Measuring the back fat thickness of hogs using a tape measure


Figure 8. Measuring the carcass length of splitted carcass using a tape measure

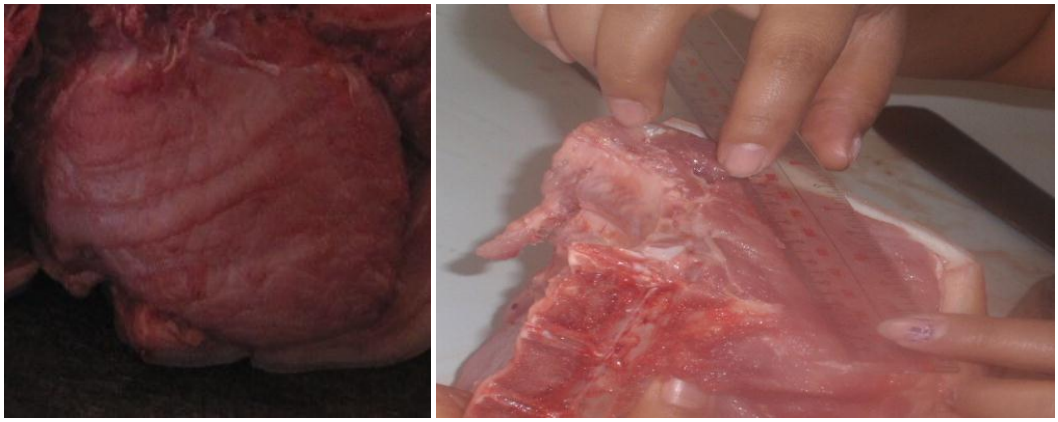

Figure 9. Measuring the loin eye area of slaughtered hogs using a ruler

3. Organoleptic test. The parameters used were as follows:

a. Appearance/Color. This was evaluated as follows:

Scale	Descriptive Rating
1	Desirable
2	Moderately Desirable
3	Undesirable

b. Aroma. This was evaluated as follows:

Scale	Descriptive Rating
1	Desirable
2	Moderate Desirable
3	Undesirable

c. Tenderness. This was evaluated as follows:

Scale	Descriptive Rating
1	Very Tender
2	Moderately Tender
3	Tough

d. Juiciness. This was evaluated as follows:

Scale	Descriptive Rating
1	Very juicy
2	Moderate juicy
3	Not juicy

e. Taste. This was evaluated as follows:

Scale	Descriptive Rating
1	Very Good
2	Good
3	Poor

f. Acceptability. This was evaluated as follows:

Scale	Descriptive Rating
1	Like Very Much
2	Like Moderately
3	Dislike

Data Computed

From the above data, the following parameters were computed:

1. Carcass yield. The carcass yield is expressed in terms of dressing percentage and this was obtained using the following formula:

$$\text{Dressing Percentage (head and feet off)} = \frac{\text{Carcass Weight}}{\text{Slaughter Weight}} \times 100\%$$

2. Percentage of wholesale cuts. This was computed using the formula:

$$\text{Percent of Wholesale Cuts} = \frac{\text{Cut Weight}}{\text{Carcass Weight}} \times 100\%$$

3. Percent of edible entrails. This was computed using the formula:

$$\text{Percent of Edible Entrails} = \frac{\text{Weight of edible entrails}}{\text{Slaughter weight}} \times 100\%$$

4. Back fat thickness. This was determined by taking the average of back fat thickness measurement taken at the opposite of first rib (P_1), last rib (P_2), and lumbar vertebra (P_3) of splitted carcass.

5. Loin eye area. This was computed using the following formula:

$$\text{Loin eye area} = \text{Length} \times \text{Width} \times 0.8$$

Data Analysis

Data gathered were tabulated and analyzed using T-test.

RESULTS AND DISCUSSION

Slaughter Weight, Carcass Weight and Dressing Percentage of Swine

Table 1 shows the slaughter and carcass weights and dressing percentage of pigs slaughtered in the two treatments. Statistical analysis revealed that there were no significant differences in both the slaughter and carcass weights of pigs in the two treatments. This implies that the pigs in the study were more or less the same weight at the start of the study and carcass weight after slaughter. The overall mean slaughter weight was 67.67kg and the mean carcass weight was 47.636kg.

However in dressing percentage, statistical analysis revealed that the pigs given activated charcoal containing wood vinegar had higher dressing percentage with a mean of 71.79%, compared to the control pigs that were not given activated charcoal containing wood vinegar which had a mean dressing percentage of 69.09%.

Table 1. Dressing percentage of pigs as affected by supplementing activated charcoal containing wood vinegar

TREATMENT	SLAUGHTER WEIGHT (kg)	CARCASS WEIGHT (kg)	DRESSING PERCENTAGE (%)
Without Activated Charcoal containing Wood Vinegar	69.00[a]	47.65[a]	69.09[a]
With Activated Charcoal containing Wood Vinegar	66.33[a]	47.61[a]	71.79[b]

Means with common letters are not significant different

Weight of Wholesale Cuts

Table 2. Weights of wholesale cuts expressed as percent of carcass weight

TREATMENT	SHOUDER	LOIN	BELLY	HAM
Without Activated Charcoal containing Wood Vinegar	29.79[a]	23.80[a]	19.66[a]	26.75[a]
With Activated Charcoal containing Wood Vinegar	30.50[a]	25.18[a]	18.86[a]	25.52[a]

Means with common letters are not significant different

Table 2 shows the weights of shoulder, loin, belly, and ham expressed as percent of the slaughter weight of hogs. True to all the weights of the major cuts, statistical analysis showed no significant differences. This means that the percent weight of shoulder, loin, belly, and ham of the pigs not given activated charcoal containing wood vinegar at the level of 20g per kilogram of commercial feeds were more or less the same. The mean percent of shoulder, loin, belly, and ham were 30.15%, 24.44%, 19.26%, and 26.14%, respectively.

Weight of Edible Entrails

Table 3 shows the weights of edible entrails of swine expressed as percentage of slaughter weights, with an overall mean of 67.67kg. True to all the weight of the edible entrails obtained from the pigs. No significant differences were observed as revealed by the statistical analysis. This implies that the weights of the edible entrails obtained from the pigs given or not given activated charcoal containing wood vinegar were more or less similar. It also implies that giving activated charcoal containing wood vinegar to growing-finishing pigs at the level of 20g/kg feed did not affect the weight of the entrails.

Table 3. Edible entrails expressed as percentage of slaughter weight

EDIBLE ENTRAILS	TREATMENTS	
	Without Activated Charcoal Containing Wood Vinegar	With Activated Charcoal Containing Wood Vinegar
Heart	0.42[a]	0.39[a]
Liver	1.81[a]	1.89[a]
Lungs	0.83[a]	0.77[a]
Spleen	0.17[a]	0.14[a]
Kidneys	0.31[a]	028[a]
Pancreas	0.16[a]	0.19[a]
Stomach	0.86[a]	0.58[a]
Small Intestine	2.21[a]	2.18[a]
Large Intestine	2.49[a]	2.49[a]

Means with common letters are not significant different

The overall mean percent weight of the heart, liver, lungs, spleen, kidneys, pancreas, stomach, small intestine, and large intestine were 0.408%, 1.853%, 0.802%, 0.162%, 0.299%, 0.178%, 0.723%, 2.199%, and 2.490%, respectively.

Carcass Length, Back Fat Thickness, and Loin Eye Area

Table 4 shows the measurements of back fat thickness, loin eye area and carcass length obtained from the pigs in the two treatments.

Wide loin eye area in swine is indicative of high lean cut and low fat cut yields. It appears that the slaughter hogs with wide loin eye area are ideal for slaughtering. The loin eye area is highly correlated with all measures of meatiness including the ham, loin, and shoulder weights collectively. This trait has a high negative correlation with back fat thickness (Ibarra, 1983).

Table 4. Other carcass measurements of the pigs

TREATMENTS	CARCASS LENGTH (cm)	BACKFAT THICNESS (cm)	LOIN EYE AREA (in^2)
Without Activated Charcoal Containing Wood Vinegar	66.00[a]	2.20[a]	5.548[a]
Without Activated Charcoal Containing Wood Vinegar	65.50[a]	2.33[a]	6.201[a]

Means with common letters are not significant different

Similar to the slaughter and carcass weights, statistical analysis revealed no significant differences in the two treatments in terms of carcass length, backfat thickness and loin eye area. The overall mean carcass length, back fat thickness, and loin eye area ware 65.750cm, 2.266cm, and 5.874in^2, respectively. The results reveal that giving activated charcoal containing wood vinegar to growing-finishing pigs at the level of 20g/kg feed did not have positive effects on the above parameters. The loin eye areas obtained in this study are slight lower than the loin eye area reported by Ibarra (1983) which was 6.61in^2. The higher the loin eye area, the better carcass characteristics of pigs.

Organoleptic Test

The Table 5 shows the verbal rating of the organoleptic test that was done by evaluating the meat. There were twenty panels of tasters that evaluate and make their own rating for each sample. Organoleptic evaluation consists in describing the attributes of food, in this special case of meat and meat products that can be perceived by the sense organ. The parameters are appearance, aroma, tenderness, juiciness, taste, and

acceptability. The means of the parameters were 1.417, 1.442 1.575, 1.743, 1.533, and 1.483, respectively.

Table 5. Result of organoleptic test

PARAMETERS	WITHOUT ACTIVATED CHARCOAL CONTAINING WOOD VINEGAR	WITH ACTIVATED CHARCOAL CONTAINING WOOD VINEGAR	DESCRIPTIVES RATING
Appearance	1.450[a]	1.383[b]	Desirable
Aroma	1.450[a]	1.433[a]	Desirable
Tenderness	1.533[a]	1.617[a]	Moderately tender
Juiciness	1.750[a]	1.733[a]	Moderately juicy
Taste	1.517[a]	1.550[a]	Good
Acceptability	1.467[a]	1.500[a]	Like very much

Means with common letters are not significant

Statistical analysis revealed no significant differences between the two treatments in aroma, tenderness, taste, juiciness, and acceptability. However, in terms of appearances statistical analysis shows that there is a significant difference between the two treatments.

ProximateAnalysis

Table 6 presents the proximate composition of the meat derived from the pigs in the two treatments as analyzed at the DOST-CAR, La Trinidad, Benguet. It is revealed in the Table that the pigs given activated charcoal containing wood vinegar had higher protein content which was 22.25%, compared to the meat obtained from the pigs that were gives activated charcoal containing wood vinegar which was 18.61%. In terms of ash contents, the meat obtained from the two treatments had more or less similar contents, 1.23% from those that were not given activated charcoal containing wood vinegar and 1.14% from those given activated charcoal containing wood vinegar.

However, in terms of crude fat, the meat obtained from the pigs given activated charcoal containing wood vinegar had content of 2.60% which is lower than the crude fat content of the meat obtained from the control pigs or those were not given activated charcoal containing wood vinegar which was 12.31%.

Table 6. Proximate analysis of meat samples as analyzed at the DOST-CAR, La Trinidad Benguet

COMPONENT	WITHOUT ACTIVATED CHARCOAL CONTAINING WOOD VINEGAR	WITH ACTIVATED CHARCOAL CONTAINING WOOD VINEGAR
Ash, % w/w	1.23	1.14
Carbohydrate, % w/w	2.96	0.35
Crude Fat, % w/w	12.31	2.60
Crude Protein, % w/w	18.61	22.25
Moisture, % w/w	64.88	73.66
Energy, kcal	197.50	52.56

SUMMARY, CONCLUSION AND RECOMMENDATION

Summary

The main objective of the study was to determine the effect of activated charcoal containing wood vinegar in terms of dressing percentage, weight of wholesale cuts, and edible entrails, back fat thickness, carcass length, loin eye area, The appearance, aroma, tenderness juiciness, taste, and acceptability in term of evaluating the meat through oganoleptic test and proximate composition of the meat.

Result of the study revealed that there were no significant differences between the two treatment means in terms of slaughter and carcass weights, weights of wholesale cuts and edible entrails, and carcass measurements namely carcass length, back fat thickness and loin eye area. The overall mean slaughter weight was 67.67kg and 47.636kg for the carcass weight. The overall mean weight of shoulder, loin, belly, and ham expressed as percent of carcass weight were 30.15%, 24.44%, 19.26%, and 26.14%, respectively. For the weight of edible entrails, expressed as percent of slaughter weight, the overall means were as follows 0.408% for heart, 1.853% for liver, 0.802% for lungs, 0.162% for spleen, 0.299% for kidneys, 0.178% for pancreas, 0.723% for stomach, 2.199% for small intestines and 2.490% for large intestines. In terms of carcass measurements, the overall mean for the carcass length backfat thickness and loin eye area were 65.75cm, 2.266cm, and 5.874in^2, respectively.

The sensory evaluation of the meat which was done through organoleptic test, no significant differences were also observed in all the parameters used namely the appearance, aroma, tenderness, juiciness, taste and acceptability. The meat samples were

all desirable in appearance and aroma, moderately tender and juicy, good in taste and liked very much in acceptability by the panel of tasters.

Finally, in terms of proximate composition, the meat obtained from those that were given activated charcoal containing wood vinegar had protein, crude fat and ash content of 22.25%, 2.60% and 1.14%, respectively. On the other hand, protein, crude fat and ash contents of the meat obtained from the pigs that were not given activated charcoal containing wood vinegar were 18.61%, 12.31% and 1.23%, respectively

Conclusion

From the results of the study, it is therefore concluded that the addition of activated charcoal containing wood vinegar into the pigs diet at the level of 20g/kg feed did not have a positive effects on the carcass characteristics of the pigs.

Recommendation

Based on findings, it is recommended that further studies be conducted to include higher levels of the activated charcoal containing wood vinegar.

LITERATURE CITED

BALDO, E. A. 2002. Carcass yield and Characteristics of Hogs Slaughtered in Sagada, Mountain Province. BS Thesis.Benguet State University, La Trinidad Benguet. P.4.

CALABIAS, R. D. 2012. Effect of liquid yeast culture with plant herbal extract on some carcass characteristics of swine.BS Thesis. Benguet State University, La Trinidad Benguet.

IBARRA, P. I. 1983. Meat Processing for Small and Medium Scale Operations. Laguna. U.P. Los Banos. Pp. 18, 121,139-141.

KOIWA, M. and WATARAI, H. 2011.Effective Uses of Charcoal and Mokusaku. Miyazaki Midori Pharms Co., Ltd.

PHILIPPINE COUNCIL FOR AGRICULTURE, FORESTRY AND NATURALRESOURCES RESEARCH and DEVELOPMENT (PCARRD). 2005.The Philippine Recommended for Pork Production. PCCARD/DOST. PFIZER INC., Los Banos, Laguna. Philippine Recommends series no. 13-B. P. 35.

PHILIPPINE COUNCIL FOR AGRICULTURE, FORESTRY AND NATURAL RESOURCES RESEARCH and DEVELOPMENT (PCARRD). 2000. The Philippine Recommends for Livestock Feed Formulation. PCCARD/DOST. PFIZER INC., Los Banos, Laguna. Recommends series no. 65-A.

POND, W. G., D.C. CHURCH, K. R. POND, andP. A. SCHOKNECHT. 2005. Basic animal nutrition and feeding. 5th ed. USA: John Wiley and Sons.

WATARAI, S. and K. TANA.2005. Eliminating the Carraige of *Salmonella enteric* SerovarEnteritidis in Domestic Fowls by Feeding Activated charcoal from containing Wood Vinegar Liquid (NEKKA-RICH). Poult. Sci. Vol. 84. Pp 515-521.

WATARAI, S. and K. TANA.2008. Feeding Activated Charcoal from Bark ContainingWood Vinegar Liquid (NEKKA-RICH) is Effective as Treatment for Cryptosporidiosis in Calves. J. Dairy Sci. Vol. 91. Pp 1458-1463.

YOKOMORI, M. 2011. Farmers in Benguet practice savers technology. RianellaPrinting Press. Baguio City, Philippines. Pp. 1-3.