BIBLIOGRAPHY

OLI, DARLENE G. APRIL 2013. Carcass Yield and Quality of Cobb Broilers given activated Charcoal Containing Wood Vinegar. Benguet State University, La Trinidad, Benguet.

Adviser: Madeline S. Kingan, MSc.

ABSTRACT

This study was conducted to determine the effect of activated charcoal containing wood vinegar on the carcass yield and quality of Hubbard Cobb broilers in terms of slaughter weight, dressed weight, dressing recovery, weight and percentage of major cuts, weight and percentage of giblets; and to determine the effect of activated charcoal containing wood vinegar through an acceptability test in terms of appearance, aroma, tenderness, flavor and acceptability.

The result of the statistical analysis revealed no significant differences among treatments in terms of the different meat cuts as well as the organoleptic test of the different birds in each treatment. Significant differences were observed in T_2 the weight of legs, while T_0 is the best in the weight of neck and T_2 respectively is the best in the weight of the head.

It is therefore concluded that the yield and quality of carcass produced by broilers fed with 1% and 2% activated charcoal containing wood vinegar were comparable. Hence, further study is recommended on the usage of activated charcoal containing wood vinegar in raising broiler.

INTRODUCTION

Today, people are health conscious and they are particular on what they eat. As much as possible, the food they eat should be free from any toxic substance or chemical residues which are hazardous to man. Because of the above reason, organically produced products, meat or vegetable, is now popular. Consumers are even willing to pay higher price for it (Coma, 2000). He also mentioned that nutrition may have significant effect on certain attributes of meat quality, but we must not forget its interrelation with other elements of production process like genetics, handling and slaughter.

With this change in consumer trend, raisers are encouraged to try alternative feed additives which may help improve meat quality in their animals. One product being advocated by the Japan Agricultural Exchange Cooperation project is Nekka- Rich which is a mixture of activated charcoal and wood vinegar. Despite claims that this product has beneficial effects on plants and animals, very little scientific data has been published about its effects on carcass quality. This observation paved way for the inception of this study.

"Mokusaku" is a liquid produced from a composting mixture of wood, coconut shell, bamboo, grass and other plants. It is a pesticide, insecticide and soil conditioner all rolled into one. Also known as "wood vinegar", mokusaku is pyroligneous acid, a pesticide and insect repellant from the liquid that comes from water cooling wood smoke. It can also used to reduce chemicals in pesticides and fertilizers to as much as 1:1 ratio. Masaki Yokomori, who developed mokusaku, said agriculture in the Philippines is no longer that of a developing country but one that is for a developed one.

Pyroligneous acid (wood vinegar), is a dark liquid produced through the natural act of carbonization, which occurs when wood is heated in an airless container during charcoal

production. Its principal components are acetic acid and methanol. It was once used as a commercial source for acetic acid. In addition, the vinegar often contains 80-90% water along with some 200 organic compounds. Recently, it has been promoted as a natural aid for various uses including detoxification, mild pain relief, and to sterilize and promote healing of minor wounds.

To satisfy the demand of meat consumers today, broiler raisers are now searching the use of probiotics or organic products. The study provides information regarding the potential role of "Mokusaku" (Nekka-Rich) in wholesomeness of dressed poultry meat as well as consumer's protection.

Nekka-Rich has potential as poultry feed additive considering its effect on plants. This study is timely as it considers how the product may be used and how it may help improve the eating quality of broiler meat. Additionally, no local studies have been conducted to generate scientific data on this matter. If Nekka-Rich is to be used in poultry feeding programs, it is essential that its impact on the carcass quality be assessed to eliminate consumer apprehension.

Generally, the study was conducted to determine the effect of activated charcoal containing wood vinegar (Nekka-Rich) on the carcass yield and quality of Cobb broilers.

Specifically, the project aspired to achieve the following:

1. determine the effect of charcoal and mokusaku mixture to the carcass yield of broilers in terms of slaughter weight, dressed weight, dressing recovery, weight and percentage of major cuts, weight and percentage of giblets; and

2. determine the quality of carcass produced from broilers fed with charcoal and mokusaku through an acceptability test in terms of appearance, aroma, tenderness, flavor and acceptability.

The study was conducted at Benguet State University, Km.5, Balili, La Trinidad, Benguet at the DAS laboratory in December 2012.

REVIEW OF LITERATURE

Nekka-Rich

Nekka-Rich® (Miyazaki-Midori Pharmaceuticals Inc., Japan) is a product made by mixing activated charcoal and wood vinegar (mokusaku) liquid that contains organic acids. The activated charcoal and wood vinegar liquid of Nekka-Rich are both obtained from the bark of evergreen oak (Castanopis cuspidate and Quercusacuta) by carbonization.

Watarai *et al* (2008) found that activated charcoal from bark containing wood vinegar liquid (Nekka-Rich) is an effective treatment for Cryptosporidiosis in calves by reducing the viability and inhibiting adsorption of the C. parvum oocytes. Furthermore, the caves that were fed milk enriched with Nekka-Rich showed recovery from diarrhea one day after the start of treatment.

Mixture of charcoal and wood vinegar was proved to be useful as aqua feed (Yoo *et al*, 2007) while Samanya and Yamauchi (2001) found it a useful component in chicken feed.

Watarai and Tana (2004) studied the protective efficacy of activated carbon containing wood vinegar liquid (Nekka-Rich) against intestinal infection with Salmonella Enterica serovar Enteritidis in chicken and showed that S. Enteritidis was effectively adsorbed by activated charcoal. The wood vinegar included in Nekka-Rich inhibited the growth of S. Enteritidis whereas the growth of the normal bacteria flora in the intestine, Enterococcus faecum and Bifido bacterium thermophilu, was enhanced. These results suggest that Nekka-Rich would be a good product for eliminating the carriage of S. Enteritidis in domestic fowl.

Wood Vinegar (Mokusaku)

Mokusaku is liquid obtained from oil, juices, sap and other liquid contents of organic materials such as wood, coconut shell, bamboo, grass and other plants after being heated in a chamber. It is composed of a lot of organic chemical substances. Studies in Japan have shown that there could be more than 300 chemical substances. However, these substances are dependent on the materials to be heated as well as the burning / carbonization process and the timing collecting cooled steam from the tube: Further research are still needed to validate the chemical components since the data are based on few studies in Japan (Yokomori, 2009).

Wood vinegar is an all-natural deodorant derived from plant extracts. The skin friendly plant chemicals bind themselves to odor-causing agents on the animal's body and wastes, effectively breaking down, absorbing and transforming them into a natural acidic state – and destroying suppressing bacteria, viruses, and other odor-causing pathogens (ACE Pte Ltd, Singapore, 2012).

Sjostrom (1993), Godlstein (1983) and Frengel and Wegener (1984) as cited by Tiilikkala *et al.* (2010) claimed that the main organic components of wood vinegar are methanol and acetic acid. Other components are acetone, methyl acetone, acetaldehyde, allyl alcohol, furan and fromic, propionic and butyric acids.

Pyroligneous acid, also called wood vinegar, is a dark liquid produced through the natural act of carbonization, which occurs when wood is heated in an airless container during charcoal production. The principal components of pyroligneous acid are acetic acid, acetone and methanol. It was once used as a commercial source for acetic acid. In addition, the vinegar often contains 80-90% water along with some 200 organic compounds. Japanese farmers have been using wood vinegar to improve crop and livestock production.

They use it as: (1) foliar spray, particularly for fungus (grey molds), (2) insecticide when mixed with pepper, (3) enhancer for compost-making, (4) soil conditioner to improve the soil when mixed with charcoal, and (5) feed supplement or additive for livestock feeds (Yokomori, 2009).

Choi *et al.* (2009), reported that Apparent fecal digestibility of dry matter, gross energy and crude protein was significantly higher ($p<0.05$) in pigs fed the antibiotic diet when compared with pigs fed the control but comparable among pigs fed antibiotic, organic acid and wood vinegar diets. Higher populations of *Lactobacillus* ($p=0.004$) were noted in the ileum of pigs fed the wood vinegar diet, while the population of coliforms in the ileum and cecum was higher ($p<0.001$) in pigs fed the control diet when compared with pigs fed antibiotic, organic acid or wood vinegar diets. These results indicated that wood vinegar could improve the performance of weanling pigs by improving the nutrient digestibility and reducing harmful intestinal coliforms; moreover performance of pigs fed wood vinegar was superior to those fed organic acid.

Activated Charcoal

In 2002, OMRI (Organic Materials Review Institute) updated a previous evaluation of activated charcoal as an animal feed supplement for the USDA. The panel is in complete agreement as to the unmatched efficacy of activated charcoal for the treatment of animal poisoning. However, it should be clear that charcoal is inert and thus it is neither digested nor assimilated by any animal.

Carcass Quality

According to Paris (1998) a poultry carcass should produce high yield of meat of good nutritional value and eating quality. As commodity, it has to meet the requirement of the customer in terms of attractive color and appearance of the product offered. Also, include the nutrient value, flavor and the smell and especially free from chemical residues.

Gill (2000) stated that to produce a good quality of meat, it is best to use organic feeds which are formulated ration without using synthetic chemicals.

MATERIALS AND METHODS

The study used a total of 24 heads 42-days-old straight-run broiler chicks, weighing scale, record book, slaughtering materials such as sticking knife, butchering knife, steamer, water basin, pot for boiling water, stove, water and a camera.

Pre-experimental phase. The pre-experimental phase of this study is a growth trial where 144 birds were fed with commercial feeds added with 1% and 2% Nekka-Rich to the ration, depending on the treatment they were assigned to for 42 days. Feeding and watering was done *ad libitum.* All necessary prophylactic and sanitary measures were observed to prevent diseases during the grow-out period. The following feeding regimes were followed in the growth trial:

TREATMENT NUMBER	TREATMENT
T_0	Control (commercial feeds with antibiotic premix)
T_1	Commercial feeds + 1% Nekka-Rich
T_2	Commercial feeds + 2% Nekka-Rich

Experimental Phase

Experimental design. The experiment was laid out in a Completely Randomized Design. There were three treatments replicated four times and each replicate was represented by ten birds.

Slaughtering and carcass yield evaluation. After the 42nd day of the grow-out period, two birds with comparable weights from each replicate were selected for slaughter. These birds were fasted for eight hours but water was provided *ad libitum.*

The following standard slaughtering procedures for poultry followed:

a. Sticking and bleeding. With the help of an assistant securing both shanks with one hand and both wings with the other hand to prevent struggling, sticking was done by severing the carotid vein in the neck with a sharp pointed knife. To allow complete bleeding, the birds were raised at a 45° angle, with the caudal part being higher than the head.

b. Scalding. After bleeding, the birds were immersed in hot water for one minute to loosen the feathers.

c. De-feathering/plucking. After scalding, the feathers were plucked manually. The birds were immersed for a second or third time when some feathers remain hard to pluck

d. Evisceration. Evisceration was done by laying the bird in dorsal recumbence. The esophagus and windpipe were pulled out from the base of the mandible. For easy insertion of the hand, a slit was made around the vent and then down to the tip of the keel. The entrails were then be pulled out from the abdominal area by severing the mesentery attachments.

e. Removal of head and feet. The head detached from the atlanto-occipital joint by cutting the skin, muscle and ligament with a sharp knife.

After slaughtering, the carcasses weighed and then prepared for fabrication. Each of the major cuts such as the whole breast, whole back, three-joint wing, and whole legs were separated from the whole carcass and then weighed individually. The weights of each cut recorded was deducted from the carcass weight.

Carcass quality evaluation. The quality of meat was judged by conducting an acceptability test. Twenty people with ages ranging from 18 to 40 were invited to serve as members of the taste panel. The breast portions were cooked for 45 minutes in a stainless steamer then cut into serving sizes (one-half matchbox size). The samples were offered to the panel in individual one ounce Dixie cups labeled appropriately. Sample score cards were given the each member of panel of tasters for their rating.

Data Gathered

The following data were gathered:

1. Slaughter weight (kg). The weight of the broiler after eight hours of fasting and just before slaughtering.
2. Dressed weight (kg). The weight of the carcass after it has been dressed with its head, feet off, feathers and viscera.
3. Weight of the major cuts (g). The weight of whole legs, three-joint wing, whole breast, and whole back.
4. Weight of giblets (g). The weight of heart, liver with spleen, weight of gizzard, feet, neck, and GIT.
5. Carcass quality parameters. These were obtained from the acceptability test and include the appearance, aroma, tenderness, flavor and acceptability.
6. Length of GIT (cm). This was obtained by measuring GIT in cm.
7. Other observations

Data Computed

1. Dressing percentage. This was obtained by dividing the dressed weight by the slaughter weight by 100.

2. Percentage of major cuts. This was computed by dividing the weight of major cut by the dressed weight then multiplied by 100. It includes the percent whole legs, percent wing, percent breast and percent back.

3. Percentage of giblets. This was computed by dividing the weight of giblet by the dressed weight then multiplied by 100. It includes the following: percent heart, percent gizzard, percent neck, percent head and percent GIT.

Data Analysis

All response variables were tested for significance through Analysis of Variance (ANOVA) appropriate for CRD. When significance is found, means were compared using Duncan's Multiple Range Test at 0.05 level.

RESULTS AND DISCUSSION

Weight at Slaughter, Dressed and Dressing Percentage

The birds were slaughtered after 8 hours of fasting. Table 1 presents the slaughter weights taken. Statistical analysis showed that there were no significance differences among means which confirms that the birds were selected to have more or less comparable weights during slaughter.

The dressed weight of birds were likewise homogenous in all three groups which may indicate that the carcass yield was not affected significantly by the addition of 10 to 20g activated charcoal containing wood vinegar.

The computed dressing percentage was found to be within the industry standard of 70%. Statistical analysis showed that there is no significant difference among means

Table 1. Slaughter weight, dressed weight and dressing percentage of 42 days old broilers

TREATMENT	SLAUGHTER WEIGHT (kg)	DRESSED WEIGHT (kg)	DRESSING PERCENTAGE
Commercial feeds only	1.657[a]	1.089[a]	65.694[a]
10g activated charcoal containing wood vinegar/kg CF	1.669[a]	1.093[a]	65.551[a]
20g activated charcoal containing wood vinegar/kg CF	1.635[a]	1.055[a]	64.468[a]

Means with the same superscript are not significantly different (P≥0.05) DMRT

The table shows the weight of major cuts recovered from the broiler carcasses. The control group had the highest numerical breast weight while birds given 20g of activated charcoal containing wood vinegar had the lowest. However, this numerical difference is statistically insignificant. This implies that the different levels of activated charcoal containing wood vinegar did not affect or increase the yield of weight of breast over birds given pure commercial feeds.

On the contrary, in terms of leg weight, the birds given plain commercial feeds had significantly lower mean compared to the birds given 10g and 20g activated charcoal containing wood vinegar. This may indicate that the addition of activated charcoal containing wood vinegar, may have enhanced leg muscle deposition.

The back and wing weights were homogenous across treatments which means that the inclusion of activated charcoal containing wood vinegar has no effect on the ability of the birds to produce carcass particularly the back and wings.

Table 2. Weight of major cuts

TREATMENTS	MAJOR CUTS			
	Breast	Legs	Back	Wings
Commercial feeds only	41.672[a]	29.461[b]	17.384[a]	11.437[a]
CF+10g activated charcoal containing wood vinegar	40.458[a]	31.316[a]	16.574[a]	11.585[a]
CF+20g activated charcoal containing wood vinegar	39.691[a]	31.739[a]	16.442[a]	12.059[a]

Means with the same superscript are not significantly different (P≥0.05) DMRT

Table 3 reflects that the birds given plain commercial feeds had heavier neck weights while the birds given 10g of activated charcoal containing wood vinegar had the lowest. In terms of weight of head, the birds given 20g activated charcoal with activated vinegar had a higher mean compared to the birds given 10g activated charcoal containing wood vinegar. The feet yield of all treatments was relatively homogenous.

Consistently, the birds given 10g activated charcoal per kg of commercial feed had lower weight of minor cuts compared to those given plain commercial feed and 20 g activated charcoal per kilogram feed.

This finding may show that 10g activated charcoal has a negative effect on the head and neck weight but this is reverted as the level of activated charcoal is increased. This may be a positive impact for producers as oftentimes these minor cuts are considered by-products and of little value in the market.

Table 3. Weight of minor cuts

TREATMENT	NECK (g)	HEAD (g)	FEET (g)
Commercial feeds only	7.400[a]	3.724[ab]	6.078[a]
10g activated charcoal containing wood vinegar per kg CF	6.262[b]	3.554[b]	6.467[a]
20g activated charcoal containing wood vinegar per kg CF	7.167[ab]	3.968[a]	6.806[a]

Means with the same superscript are not significantly different ($P \geq 0.05$) DMRT

Table 4 reveals that there were no significant difference among treatment means of all giblets particularly the liver and spleen, gizzard, feet and GIT, meaning the giblet yield of all the birds regardless of treatment is comparable to each other. This signifies that varying levels of activated charcoal containing wood vinegar did not cause any change in the weight of the viscera of the broilers. This may be indicative of the safety of this feed additive as it did not produce any hypertrophy or atrophy in any of the organs considered.

Compared to the weight of minor cuts, the giblets recovered from the birds given 10g and 20g activated charcoal produced heavier giblets compared to the giblets produced by the birds fed plain commercial feeds.

Table 4. Weight of giblets

TREATMENT	GIBLETS (g)			
	LIVER & SPLEEN	GIZZARD	HEART	GIT
Commercial feeds only	4.108[a]	3.095[a]	0.976[a]	9.810[a]
10g activated charcoal containing wood vinegar per kg CF	4.200[a]	3.665[a]	1.038[a]	11.202[a]
20g activated charcoal containing wood vinegar per kg CF	4.151[a]	3.379[a]	1.006[a]	11.916[a]

Means with the same superscript are not significantly different ($P \geq 0.05$) DMRT

Table 5, the panel of tasters evaluated the cooked meat samples for five sensory traits specifically appearance, aroma, tenderness, flavor and overall acceptability. In terms of appearance, the meat sample from the broilers given 10g activated charcoal was adjudged dull while those that came from the birds fed with plain commercial feeds and 20g activated charcoal were found to be pleasing in appearance. As to aroma, the meat from the birds given 10g activated charcoal was fair while those that came from the birds fed with plain commercial feeds and 20g activated charcoal had poor aroma according to the tasters.

The birds fed plain commercial feeds and 10g activated charcoal per kg feed yield moderately tender meat while the broilers given 20g activated charcoal had tough meat. In terms of flavor, all the cooked samples were moderately desirable to the panel of tasters whereas in overall acceptability, all samples were liked moderately.

Table 5. Summary of the sensory evaluation of cooked meat samples

SENSORY TRAITS	MEAN	PARTICULARS
Appearance		
Commercial feeds only	2.412[a]	Pleasing
10g activated charcoal containing wood vinegar/CF	2.562[a]	Dull
20g activated charcoal containing wood vinegar/CF	2.375[a]	Pleasing
Aroma		
Commercial feeds only	2.512[a]	Poor
10g activated charcoal containing wood vinegar/CF	2.425[a]	Fair
20g activated charcoal containing wood vinegar/CF	2.500[a]	Poor
Tenderness		
Commercial feeds only	2.400[a]	Moderately Tender
10g activated charcoal containing wood vinegar/CF	2.325[a]	Moderately Tender
20g activated charcoal containing wood vinegar/CF	2.550[a]	Tough
Flavor		
Commercial feeds only	2.362[a]	Moderately Desirable
10g activated charcoal containing wood vinegar/CF	2.312[a]	Moderately Desirable
20g activated charcoal containing wood vinegar/CF	2.462[a]	Moderately Desirable
Acceptability		
Commercial feeds only	2.400[a]	Like Moderately
10g activated charcoal containing wood vinegar/CF	2.175[a]	Like Moderately
20g activated charcoal containing wood vinegar/CF	2.425[a]	Like Moderately

SUMMARY, CONCLUSION AND RECOMMENDATION

Summary

The study was conducted to determine the effect of the different levels of activated charcoal containing wood vinegar on the carcass yield and quality of broilers.

Specifically, the study aimed to determine the effect of activated charcoal containing wood vinegar on the slaughter and carcass weight, dressing percentage, the weights of the major and minor cuts as well as giblets of the birds. It likewise aimed tocompare the sensory evaluation of cooked meat samples from the different treatment groups.

It was found that slaughter parameters such as slaughter weight, carcass weight and dressing percentage was not enhanced by the utilization of activated charcoal containing wood vinegar as feed additive. Furthermore, the weight of major cuts did not vary to a significant extent across treatments. The giblets yield was comparable across levels of activated charcoal in the diet. On the contrary, the birds given 10 g and 20 g activated charcoal containing wood vinegar had higher leg but lower neck and head yield.

Sensory evaluation by 20 tasters revealed the following results: (a) the meat from broilers fed plain commercial feeds had a pleasing appearance, poor aroma, and moderately tender; (b) the meat from broilers given 10g activated charcoal containing wood vinegar had dull appearance, fair aroma, and moderately tender; (c) the meat from broilers given 20g activated charcoal with wood vinegar had pleasing appearance, poor aroma, and tough. All the cooked samples had moderately desirable flavor and in terms of overall acceptability, was liked moderately by the panel.

Conclusion

Based from the result of the study it is therefore concluded that the different levels of activated charcoal containing wood vinegar at a level of 10g per kg commercial feedmay increase the leg yield and decrease the weight of head and neck of broilers. The sensory traits of meat from broilers given 10g activated charcoal was closely comparable to that of those fed plain commercial feeds.

Recommendation

Further study is recommended to verify the results of this study and evaluate further the usage of activated charcoal containing wood vinegar on broilers and other poultry species.

LITERATURE CITED

ACE Pte Ltd. 2012. Wood Vinegar. Retrieved from the World Wide Web on June 11, 2012.http://www.ace-agro.com/wood-vinegar.html.

BACANI, F. 2010. Carcass yield and quality of Hubbard broilers given different levels of Palm Kernel Meal.

BAYACSAN, R. 2008. Carcass yield and quality of Cobb and Hubbard broilers fed with varying levels of OKARA (Soybean Pulp).

CHOI, J.H., P.L. SHINDE, I.K. KWON, Y.H. SONG, and B.J. CHAE, 2009. Effect of wood vinegar on the performance, nutrient digestibility and intestinal microflora in weanling pigs. Asian Aust Journal of Animal Science; 22(2):267-274.

COMA, V. 2000. Feeding Guidelines for Meat and pig Progress 16 (10):16-17. Retrieved from undergraduate thesis: Carcass yield and quality of cob and Hubbard broilers fed with varying levels okara # (soybean pulp).P. #5.

GILL, C. 2000. Originally Dutch, Feed International 21 (4):63 Retrieved from BS Thesis. Carcass yield and quality of cobb and hubbard broilers fed with varying levels of okara (soybean pulp),p.6.

PARIS, C. G. 1998. Correlation Analysis between Live Weight and some related Dressed Carcass and Turkey. BS thesis Benguet State University La Trinidad, Benguet P. #5.

SAMANYA,M. and K. YAMAUCHI, 2001. Morphological changes of the intestinal villi of chickens fed the dietary charcoal powder including wood vinegar compounds. Journal of Poultry Science; 38:289-301.

TIILIKKALA, K., L. FAGERNAS and J. TIILIKKALA, 2010. History and use of woo pyrolysis liquid as biocide and plant protection product. The Open Agriculture Journal; 4:111-118

WATARAI, S., TANA and M. KOIWA, 2007. Feeding activated charcoal from bark containing wood vinegar liquid (Nekka-Rich) is effective as treatment for cryptosporidiosis in calves. Journal of Dairy Science. 91:1458-1463.

WATARAI, S. and TANA. 2004. Eliminating the carriage of *Salmonella enteric* serovar enteritidis in domestic fowls by feeding activated charcoal from bark containing wood vinegar liquid (Nekka-Rich). Graduate School Agriculture and Biological Sciences. Osaka Prefecture University, Japan.

YOKOMORI, W. 2009. Manual: Organic Farming Technology in Japan. Koibuchi College of Agriculture and Nutrition.

YOO, J.H, JI, S.C and G.S. JEONG, 2007. Effect of dietary charcoal and wood vinegar mixture (CV82) on body composition of Olive Flounder *Paralichthy salivaceus*. Journal of World Aquaculture Society; 36 (2):203-208