BIBLIOGRAPHY

LANTAEN, GINA B.APRIL 2012. Microbiological Properties of Smoked Pork Using Alnus and Guava Wood as Smoking Material. Benguet State University, La Trinidad, Benguet.

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ABSTRACT

This study was conducted at the Animal Genetic Resources (TANGERE) Project Laboratory of Benguet State University in Bektey, Puguis, La Trinidad, Benguet to determined the bacterial contamination in the smoked product in terms of Staphylococcus aureus, E. coli, Fecal coliform and Total coliform, yeast and molds molds. Also to determine which is the best smoking material based on microbial properties of smoked pork.

Results of the microbial analysis by DOST-CAR Regional Standards and Testing Laboratory shows that the Total Coliform and Fecal Coliform Count showed that all samples were within in the standard limit set for food. Salmonella were not detected in both hot and cold smoked pork with alnus wood while negative in hot and cold smoked pork with guava wood as smoking material. Staphylococcus aureus is not also detected in hot smoked pork with alnus wood (T_1) but coagulase negative in cold smoked pork with alnus wood and in hot and cold smoked pork with guava wood as smoking material. In hot smoked pork with guava wood and cold smoked pork with guava wood the presence of

yeast are above the standard limit set for food. However, yeast can be eliminated by proper cooking at a high temperature (>50°C).

Smoked pork from hot smoking with guava wood (67.90) has the highest ROI. This is followed by the hot smoked pork with alnus wood (52.13) and cold smoked pork with guava wood (33.42). The lowest mean is realized cold smoked pork with alnus wood (30.72).

INTRODUCTION

Man started to preserve meat due to spoilage. The purpose of meat preservation is to prolong the time that meat is fresh, healthy, and bacteria-free for human consumption. Meat is preserved using many different processes (Adams, 2003). One method is smoking which is the process of flavoring, cooking, or preserving food by exposing it to the smoke from burning or smoldering plant materials, most often wood. Meats and fish are the most commonly smoked foods.

Cold smoking and hot smoking are two different methods for handling meat after it has been butchered. Hot smoking occurs within the range of 165°F (74°C) to 185°F (85°C). Within this temperature range, foods are fully cooked, moist and flavorful.

Smoke temperatures for cold smoking are below 100°F (38°C). In this temperature range, foods take on a smoked flavor, but remain relatively moist. Cold smoking does not cook foods. The principle of both methods is that the smoke infiltrates the outside layers of the product in order to develop flavor, color and a certain preservation effect.

Smoke occurs during the thermal decomposition of wood. The preferred wood for smoking is hard, fruit, or nut woods. All woods impart a slightly different flavor. The guava tree is a source of charcoal and also good fuel wood. They are cultivated in many tropical and subtropical countries for their edible and highly nutritious fruits. They are also grown as ornamental plants in the temperate regions (Maurice, 2011). Guava is used for smoking meat.

Scientists have identified the anti-bacterial properties of guava. The extracts from the leaves and barks of the guava tree have demonstrated vitro toxin exploits against

several bacteria. Again, during a number of studies, guava has demonstrated noteworthy anti-bacterial activities against bacteria such as Bacillus, Clostridium, E. coli, Shigella, Staphylococcus, Salmonella and Pseudomonas (Herbs. com., 2002).

The alnus tree is an important source of firewood. The wood is suitable for making furniture, tools, packaging and charcoal. Alnus japonica is one of the species found in the Philippines. The common name is Japanese alder in English and hannoki in Japan belong to the family of Betulaceae. The Betulaceae is closely related to the beech or oak family, Fagaceae (Orwa *et al*, 2009). Alnus japonica is one out of 32 species of alder trees.

Alder is the common name for any of the various deciduous trees and shrubs comprising the flowering plant genus Alnus of the birch family (family Betulaceae), characterized by alternate, simple leaves, scaly bark, and flowers as male and female catkins that appear on the same plant. Alder is commonly used for cooking, being traditionally for smoking fish and meat, with alder smoking especially common in the Pacific salmon industry in the Pacific Northwest (New World Encyclopedia, 2008).

The study was conducted to provide basic information to housewives and processor who are interested to preserve pork by hot and cold smoking for future consumption and additional source of their income. The result of the study was served as reference to the other researchers to come up with follow up research.

This study aimed to determined the bacterial contamination in the smoked product in terms of Staphylococcus aureus, E. coli, Fecal coliform and Total coliform, yeast and molds molds. Also to determine which is the best smoking material based on microbial properties of smoked pork.

This study was conducted at the Animal Genetic Resources (TANGERE) Project Laboratory of Benguet State University in Bektey, Puguis, La Trinidad, Benguet. Microbiological testing of smoked pork samples was done at DOST-CAR Regional Standards and Testing Laboratory in La Trinidad, Benguet.

REVIEW OF LITERATURE

Meat and other animal foods are better sources of protein than plant foods (except soy bean products). In the meat, the essential amino acids – the organic acids that are integral components of proteins and which not be synthesized in the human organism – are made available in well balanced proportions and concentrations. As well, plant food has no Vitamin B12; thus animal food is indispensable for children to establish B12 deposits. Animal food, in particular meat, is rich in iron, which is of utmost importance to prevent anemia, especially in children and pregnant women (Heinz and Hautzinger, 2007).

Heinz and Hautzinger (2007) stated that the greater demand for meat output will be met by a further shift away from pastoral systems to intensive livestock production system. As these systems cannot be expanded indefinitely due to limited feed availability and for environment reasons, other measures must be taken to meet growing demand. The only possible alternatives are making better use of the meat resources available and reducing waste of edible livestock parts to a minimum. This is where meat processing plays a prominent role. It fully utilizes meat resources, including nearly all edible livestock parts for human food consumption.

Smoking is a preservative because smoke contains chemical compounds that retard the growth of harmful bacteria. More than three hundred compounds of smoke have been identified. Carbonyl compounds in smoke contribute to the distinctive flavor and aroma of smoked meat, while the carbon dioxide and carbon monoxide help produce the bright red pigment. Phenolic compounds in smoke play a role in protecting fat from

oxidizing and turning rancid, which no doubt a major reason why fatty foods, such as herring or pork, so often smoked (Katz, 2003).

Smoking meat is exactly what name implies: flavoring meat with smoke. Using any kind of improvised device will do job as long as the smokehouse is made from environmentally safe material. As long as smoke contacts the meat surface it will impart its flavor to the meat. The strength of the flavor depends mainly on the time and density of the smoke. Smoke meats are usually eaten cold at later date. Many great recipes require that smoked products hang for a designated time to lose more weight to become drier. It is only then that they are ready for consumption (Marianski, 2007).

Smoking offers many improvements for meat. Besides enhancing the taste and look; it also increases its longevity, and helps preserve the meat by slowing down the spoilage of fat and growth of bacteria. Smoking meat longer leads more water loss, and results in a saltier and drier product, which naturally increases its shelf life. Man discovered that in addition to salting and curing meat with nitrates, smoking was a very effective tool in preserving meats (Marianski, 2007).

Smoke meats come almost always from cured parts of pork. The most popular large cuts used for smoking are ham, bacon, butt, loin, back fat and smaller parts as hocks and jowls.

Any hardwood is fine used in smoking of meat, but evergreen like fir, spruce, pine or others cause problems. All fruit and citrus trees have to medium sweet flavor and are excellent with poultry and ham. Other woods great for smoking of meat is alder light flavor that works well with fish and poultry. Contain a hint of sweetness, good with poultry and light–meat game birds (Marianski, 2007).

Harmful substances (e.g. benzpyrene which is carcinogenic) can be removed from the smoke by including water sprays or electrostatic precipitation between smoke generation and deposition on to product (Ranken, 2000).

Cold smoking is the traditional way of meat products and was primarily used for meat preservation. It serves more for flavor and color formation. The combination of cold smoking and drying/ripening can be applied to fermented sausages and salted or cured entire meat pieces, in particular many raw ham products. In long–term ripened and dried hams, apart from providing color and flavor, the cold smoking has an important preservative effect as it prevents the growth molds on the meat surfaces. Cold smoking is a long process which may take several days. It is not applied continuously, but in intervals of a few hours per day. Cold smoking is used for fermented meat products (raw–cured ham, raw fermented sausage) and precooked-cooked sausage (liver and blood sausages) (Heinz and Hautzinger, 2007).

Cold smoking is done at a low temperature and is not intended to actually cook the product. The meat or fish is held in an unheated chamber and smoke funneled through from a fire box. Wood dust or pellets work best for cold smoking, as they will, smolder and smoke at a lower temperature (CSP Information Group Inc., 2010).

Cold smoked meats prevent or slow down the spoilage of fats, which increases their shelf life. The product is drier and saltier with a more pronounced smoky flavor and very long shelf life. The color varies from yellow to dark brown on the surface and dark inside. Cold smoked products are not submitted to the cooking process. Using dry wood is of utmost importance when cold smoking. It is recommended to keep wood chips in a well-defined single pie as they will have less contact with air, thus will smoke better without

creating unnecessary flames and heat (Marianski, 2007). Cold smoking is done over a much longer period of time, e.g. 12-24 hours, over a smoldering fire (below 85°F). Since foods are held in the temperature danger zone, rapid microbial growth (40-140°F) could occur therefore, only those meat products that have been fermented, salted, or cured, should be cold – smoked. Most cold smoke product is treated this way (Andres and Nummer, 2002.).

Hot smoking is a technique where the meat is held directly above or in the same enclosure as the wood, so it cooks as it smokes. Hot–smoked items tend to have a firmer, drier texture, making temperature, timing and moisture control essential. Optimal temperature for hot smoking is around 212°F; remember low heat and slow are the keys to success. The low temperature gives the smoke enough time to sink in and naturally tenderize the meat. Slow cooking gives the natural fibers in meat time to break down and become tender. Hot smoke smoking occurs at 160°F to 225°F imparting flavor and coking the products (CSP Information Group Inc., 2010).

Hot smoking is carried out at temperature of +60 to 80°C, the thermal destruction of the wood used for the smoking is normally not sufficient to produce these temperatures in the smoking chamber. Hence, additional heat has to be applied in the smoking chamber. The relatively high temperatures, in hot smoking assure rapid color and flavor development the treatment period is kept relatively short in order to avoid excessive impact of the smoke (to strong smoke color and flavor).Hot smoking is used for a range of raw–cooked sausages, and cooked ham products (Heinz and Hautzinger, 2007).The guava is characterized by a strong, sweet odor (Foster, 2011). Guava wood is used for meat smoking in Hawaii and is being used at barbecue competitions across the United State. In Cuba the

leaves are also used in barbecues, providing a smoked flavor and scent to the meat (Maurice, 2011).

Guava wood has a subtle, semi-sweet aroma. Whether grilling or smoking fresh chicken, pork, fish, lamb or beef, guava wood will give complement flavor nicely. The leaves are fragrant, smooth, dark green, shiny. The leaves are aromatic when crushed (Guava Wood Farms, 2007).

Excellent source of vitamin C and potassium contains vitamin A and niacin. Traces phosphorus and calcium. Properties: astringent and laxative (Barron's Educational Series, Inc, 2001).

In the Philippines, the best wood materials used in smoking meat are guava trunk and ipil-ipil (Ibarra, 1983).

Alder is used for smoking because of natural sweetness and delicate flavor. Typically pairs well with fish, poultry and light meats. Alder has an inherent sweetness and delicate flavor that is beautifully suited for the slow cooking of fish, shellfish and pork. To further enhance the flavor alder chips can be soaked in wine or fruit juice as an alternative to water. Alder was used by American Indians for smoking, often in the form of alder planks. It provides the least heat of all natural woods.

Alder is preferred wood for charcoal making. Alder wood is commonly used for cooking. The wood is also traditionally used for smoking fish and meat, though this usage has often been replaced by other wood such as 0ak and hickory. An exception is the smoked Pacific salmon industry in the Pacific Northwest, where alder smoking is essentially universal. This is partly due to indigenous traditions of food preservation in the area, and partly because oak, hickory, mesquite and other woods favored for smoking meat

elsewhere are not locally available in any large quantities (New World Encyclopedia, 2008).

MATERIALS AND METHODS

Materials

The materials used for the experiment include of fresh pork, rock salt (NaCl), chopping boards, weighing scale, kitchen knives, stainless basin, guava and alnus wood.

Methods

Preparation of meat. A total of 16 kilograms of pork was obtained from a single carcass of a fasted commercial pig. The meat was cut into 1-inch strips and wash in water. After draining, the meat pieces were placed in a basin for curing (Figure 1).

Curing or salting. For each kilogram of pork, 180 grams of salt is enough. Meat and salt was mixed thoroughly in a container. Each meat slice was arranged in a plastic basin. The salted pork was allowed to stand for 120 hours or 5 days (Figure2). The cured meat is removed from the basin. The undissolved salt particles were brush off to prevent the appearance of objectionable white crust on the surfaces of meat.

Figure 1. Meat was cured by dry salting

Figure 2. Cured meat

Cold smoking. The smoker was prepared by placing 9 kg of guava trunk: 1 kg of guava leaves for 1 day or 8 hours inside the fire pit. Smoke goes into the smoke chamber by means of a pipe connecting it with the fire pit. A notch was made at the end of allowing for the insertion of an abaca cord, which was hooked to the wire. Meat slices will be hanged in a smoker. After curing or salting, the meat strips was suspended above the safety baffle of the smoking chamber (Figure 3). The piece of meat was not allowed to come in contact with one another in the smoking chamber to enable uniform penetration of smoke and even in color development. The temperatures were maintained at 34°C. Duration of cold smoking is 56 hours (7 days intermittent at 8:00 am to 4:00). At the end of the day the pork slices will be kept at room temperature in the meat preservation laboratory.

Figure 3. The cured meat hanged inside the cold smoking chamber

Hot smoking. The smoker was prepared by placing 9 kg of guava trunk: 1 kg of guava leaves inside the fire pit. Air intake was adjusted to regulate the fire and burning

wood. A notch was made at the end of meat allowing for the insertion of an abaca cord, which was hooked to the wire. Meat slices was hanged in a smoker. A safety baffle was placed over the fire over the fire pit to prevent flames from reaching the smoke chamber (Figure 4). The piece of meat was not allowed to come in contact with one another in the smoking chamber to enable uniform penetration of smoke and even in color development. The temperature was maintained at 75°C.Duration of hot smoking is 16 hours (2 days intermittent at 8:00 am to 4:00 pm). At the end of the day the pork slices were kept at room temperature in the meat preservation laboratory.

Figure 4. The cured meat hanged inside the hot smoking chamber

The smoking material served as experimental treatments which were replicated four times following completely randomized design. One kilogram of cured ham was considered as replicate. The treatments are as follows:

Treatment Smoking Material

T_1	Hot smoking with alnus wood
T_2	Cold smoking with alnus wood
T_3	Hot smoking with guava wood
T_4	Cold smoking with guava wood

The smoked hams in each treatment are shown in Figures 5 to 8.

Figure 5. Treatment 1 (Hot smoking of alnus wood)

Figure 6. Treatment 2(Cold smoking with alnus wood)

Figure 7. Treatment 3 (Hot smoking with guava wood)

Figure 8. Treatment 4 (Cold smoking with guava wood)

Microbial analysis. Samples of the meat product were brought to the DOST-CAR Regional Standards and Testing Laboratory for quantitative determination of bacterial contamination. Each sample weighing approximately 250 grams was tested for the presence of pathogenic bacteria. The samples was wrapped individually in aluminum foil, packed in a zip lock plastic bag and labeled accordingly.

Sanitation and hygiene. To prevent or minimize microbial contamination, good hygienic practices in meat processing and handling of smoked products as prescribed by the Department of Health (2004) were observed as follows:

1. Maintaining adequate personal cleanliness.

2. Wearing adequate garments, and hand gloves.

3. Washing hands before starting work and repeatedly during work.

4. No rings, watches and bracelets shall be worn during work.

5. Cleaning/disinfection of tools, knives, chopping boards, utensils and other materials for meat handling.

6. Taking any other necessary precautions to protect against contamination of meat and finished product.

Data to be Gathered

1. Microbial count. The number of microorganisms such as Staphylococcus, Salmonella, Fecal Coliform and Total Coliform Count was determined. The number of yeast and molds was counted

2. Cost. The cost of pork, curing ingredients, firewood and labor was determined.

3. Sales. All the smoked products was considered sold at Php 200/kg.

Data to be Computed

1. Total cost production (TCP). Computed by adding the cost of pork, curing ingredients, firewood and labor.

TCP= Cost of pork + cost of ingredient

2. Net income. These were calculated as:

NI= total sales-total cost of production

3. Return on investment (ROI). These were computed using the formula:

ROI= NI/TCP x 100

Statistical Analysis

The data rendered by the panel were recorded, tabulated and analyzed for difference using the analysis of variance. The Duncan's Multiple Range Test (DMRT) was used to determine significant differences between treatment means.

RESULTS AND DISCUSSION

Total Coliform Count and Fecal Count

Table 1 shows the Total Coliform Count (TCC) and Fecal Count (FC) of the smoked product. It shows that the total coliform count and fecal count on the smoked pork were within in the standard limit set for food which is <3.0 MPN/g.

Coliform bacteria may not cause disease, but can be good indicators of the hygiene of the production environment and can be indicators of pathogen organisms that cause disease. It can cause intestinal infection, mastitis, hepatitis, typhoid fever, cholera and other illnesses. However, these illnesses are not limited to disease causing organisms in drinking water. Other factors not associated with drinking water may the cause (DOH, 2004).

Fecal coliform can usually be inhibited in growth by boiling water or by treating with chlorine.

Table 1. Result of coliform count in100 g samples

TREATMENT	TCC (MPN/g)	FC (MPN/g)	STANDARD (MPN/g)
Hot smoking with alnus wood	<3.0	<3.0	<3.0
Cold smoking with alnus wood	<3.0	<3.0	<3.0
Hot smoking with guava wood	<3.0	<3.0	<3.0
Cold smoking with guava wood	<3.0	<3.0	<3.0

Yeast and Mold Count

Table 2 shows the presence of yeast and mold colonies on 100 g sample. Sample from hot smoked pork with guava wood (T_3) and cold smoked pork with guava wood (T_4) showed that the test for yeast count exceeded the standard limit set for food with 53000 CFU/g and 152333 CFU/g. According to Quality Control Laboratory (1999), yeast does not result in food poisoning; it does cause food to spoil. Mold count showed that all treatments are within the standard limit set for food. If a mold develops and is not desired, it can be easily wiped off with a cloth saturated in vinegar. Because molds can grow only on the outside of the sausage, there is nothing wrong with the meat itself (Heinz and Hautzinger, 2007).

Hot and cold smoked pork with guava wood has the highest colonies of yeast because of higher water content in the smoked meat and yeast generally require a higher water activity for growth. Food borne molds of moisture requirement are relatively low

Table 2. Result of yeast and mold colonies per gram in 100 g sample

TREATMENT	YEAST (CFU/g)	MOLD (CFU/g)	STANDARD (CFU/g)
Hot smoking with alnus wood	67	100	10000
Cold smoking with alnus wood	467	433	10000
Hot smoking with guava wood	53000	100	10000
Cold smoking with guava wood	152333	167	10000

most species can grow at a water activity (a_w) of 0.85 or less. At temperatures 10-37°C yeast will grow and multiply, faster at higher temperatures with an optimal growth at 30-37°C (that depends on the species).

A temperature of 170°F will stop the yeast and mold spores from growing but 240°F is absolutely for meat, fish and low acid food such as vegetable.

Staphylococcus Aureus
and Salmonella

Table 3 shows the result of S. aureus and Salmonella detection in smoked pork sample. The report of analysis indicates hot smoking with alnus wood (T_1) is not detected for S. aureus while cold smoking with alnus wood (T_2) test yielded 13 CFU/g and hot smoking with guava wood (T_3) has 1993 CFU/g while cold smoking with guava wood (T_4) has the highest number of microorganism which is 2407 CFU/g but still it coagulase negative which means that the staphylococcal content is not pathogenic and will not cause food poisoning. Salmonella detection is not detected in hot smoking with alnus wood (T_1) and cold smoking with alnus wood (T_2) while negative in hot smoking with guava wood (T_3) and cold smoking with guava wood (T_4).

Comparing it from previous studies of students, the presence of S. aureus is above the standard limit set for foods due to microorganism with regard to meat hygiene include parasites, moulds, bacteria, and viruses. Within these group bacteria plays the most important role and depending on the slaughter hygiene, these bacteria find their way to the carcass or contaminate the meat during slaughterhouse operations. Proper hand washing, wearing adequate garments, cleaning of tools and maintaining adequate personal cleanliness is also important because it helps to avoid contamination. Human and animal wastes are a primary source of bacteria in water. These sources of bacterial contamination

include dog run, pastures, runoff from feedlots, and other land areas where animal waste deposited.

Staphylococcus aureus is destroyed by proper cooking and can be eliminated for 0.2 to 2.0 minutes in a 65°C temperature. Salmonella are readily destroyed by cooking to 165°F and do not grow at refrigerator or freezer temperatures.

Net Income and Return on Investment

Table 4 shows the details of the sales, expenses, and net income and return on investment. Cold smoked pork with alnus wood (T_2) and cold smoked pork with guava wood (T_4) had the highest total expenses which was Php 2,956. This was expected because of the cost of firewood and wages of the person a day is higher than the two treatments. Meanwhile, the hot smoked pork with alnus wood (T_1) and hot smoked pork with guava wood (T_3) had expense of Php 2,156. The processed products produced in a

Table 3. Result of Staphylococcus enumeration and Salmonella detection in smoked pork

TREATMENT	S.AUREUS (CFU/g)	STANDARD (CFU/g)	SALMONELLA (CFU/g)	STANDARD (CFU/g)
Hot smoking with alnus wood	0	100	0	0 in 25 grams
Cold smoking with alnus wood	13	100	0	0 in 25 grams
Hot smoking with guava wood	1993	100	negative	negative
Cold smoking with guava wood	2407	100	negative	negative

30 kg of commercial pork meat were 36.77 kg of smoked meat after the duration of smoking was finish. The commercial smoked meat had a computed of Php 400 per kilogram. The return on investment shows that meat from hot smoking with guava wood (T_3) had the highest ROI of 67.90%. This is followed by hot smoked pork with alnus wood (T_1) of 52.13% and cold smoked pork with guava wood (T_4) 33.42%. Cold smoked pork with alnus wood (T_2) has the lowest ROI of 30.72%.

Table 4. Return on Investment

ITEM	T_1	T_2	T_3	T_4
A. SALES from 10 kg of smoked pork @ 400 Php/kg	3,280	3,864	3,620	3,944
B. EXPENSES				
1. Commercial Pork (P180/kg)	1,800	1,800	1,800	1,800
2. Salt (P20/kg)	36	36	36	36
3. Firewood	20	70	20	70
Labor	300	1,050	300	1,050
SUB TOTAL	2,156	2,956	2,156	2,956
C. NET INCOME	1,124	908	1,464	988
D. ROI%	52.13	30.72	67.90	33.42

1. A total of 12.77 kg of smoked pork was produced as follows

   For T_1=8.20 kg

   T_2=9.66 kg

   T_3=9.05 kg

   T_4=9.86 kg

SUMMARY, CONCLUSION AND RECOMMENDATION

Summary

The study was conducted at the TANGERE Project Laboratory of Benguet State University in Bektey, Puguis, La Trinidad Benguet from December 26 to February 14, 2012.

Following the Completely Randomized Design (CRD), the 16 kilogram of pork from a single carcass of a fasted commercial pig was equally allotted into four treatments. Each treatment has for replication with 1 kilogram of pork per replication. For every kilogram of pork, 180 grams of salt was used for curing. The curing time for the meat is 120 hours or 5 days to let the salt penetrate into the meat. The treatments were exposed to hot and cold smoking chamber for several days depending on the treatments. For treatment one, hot smoking with alnus wood; treatment two, cold smoking with alnus wood; treatment three, hot smoking with guava wood; and treatment four, cold smoking with guava wood.

The study was conducted to determine the bacterial contamination of the smoked product in terms of S. aureus, E. coli, Fecal Coliform, Total Coliform, Yeast and Molds. It also aimed to determine which is best smoking material based on microbial properties of the smoked product.

The Total Coliform and Fecal Coliform Count showed that all samples were within in the standard limit set for food. Salmonella were not detected in both hot and cold smoked pork with alnus wood while negative in hot and cold smoked pork with guava wood as smoking material. Staphylococcus aureus is not also detected in hot smoked pork with alnus wood (T_1) but coagulase negative in cold smoked pork with alnus wood and in hot

and cold smoked pork with guava wood as smoking material. In hot smoked pork with guava wood and cold smoked pork with guava wood the presence of yeast are above the standard limit set for food. However, yeast can be eliminated by proper cooking at a high temperature (>50°C).

Smoked pork from hot smoking with guava wood (67.90) has the highest ROI. This is followed by the hot smoked pork with alnus wood (52.13) and cold smoked pork with guava wood (33.42). The lowest mean is realized cold smoked pork with alnus wood (30.72).

Conclusion

Based on the result of the microbial analysis showed only the test for yeast count exceeded the standard limit set for food using guava wood as smoking material. All result is negative and within the standard limit set for food by BFAD. The use of alnus wood as smoking material is the most desirable for smoking based on the microbial properties of the smoked product.

Recommendation

Since the alnus wood is most desirable based on microbial properties of the smoked meat, it is recommended to use for smoking material. Moreover, strict hygienic handling and processing techniques are necessary to prevent contamination with microorganism.

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