EFFECTS OF *COTYLELOBIUM LANCEOLATUM* AND *SHOREA TALURA* EXTRACT ON MICROORGANISMS AND STORAGE OF MEAT AT LOW TEMPERATURES

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Abstract

Water extract of *Cotylelobium lanceolatum* (Kiam) and *Shorea talura* (Phayom) wood were sprayed on pork and beef cut surfaces. The sprayed meats and control were placed on foam trays and wrapped with polyethylene cling wrap. Meat samples were kept at 4°C for a period of 10 days. Aerobic plate counts of the control and treated meat were significantly different ($P < 0.05$). Both Kiam and Phayom extract had relatively similar antimicrobial activities. The maximum reductions in microbial loads were about 1.35 and 1.24 log cycle for pork treated with Kiam and Phayom extract at day 7, respectively and about 1.15 and 1.21 log cycle for beef treated with Kiam and Phayom extract at days 4 and 3, respectively. Development of off-odors was observed. Control samples of both pork and beef became sour after 48 hrs while treated meat cuts stayed normal till day 5. Strong off-odors were detected at day 7 and were described as sour and ammoniacal odors. In addition, sulfidy odors were observed from control meats in the last two days of storage.

Key words : *Cotylelobium lanceolatum, Shorea talura,* Meat sanitizing, Meat microbiology, Meat storage.

The presence of microbial contamination on meat is undesirable as it may cause diseases, food poisoning or spoilage. Spoilage of the meat occurs when the number of microorganisms increase to a level sufficient to cause off-odors and slime formation (Silliker et al., 1980). Various methods have been employed to reduce the microbial level of carcass contamination, including hygienic handling (Rao and Ramesh, 1992), washing and/or spray washing with water (Ellerbroek et al., 1993; Crouse et al., 1988), chlorinated water (Kelly et al., 1982; Stevenson et al., 1978; Kotula et al., 1974), acetic acid (Dickson, 1992) and lactic acid (Prasai et al., 1992; Dixon et al., 1991). Selected compounds such as phosphate buffer, ethanol, sodium chloride, sodium hydroxide and potassium hydroxide were successfully used to reduce bacteria attached to meat surfaces (Dickson, 1988). Sprouts and extracts from organs of edible plants such as lotus, coffee, amaranth, rice and violet were also found to have

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antifungal activity (Matthews and Haas, 1993). Extracts of the bark of plants, *Saccoglottis gabonensis* and *Shorea disticha,* were found to have antimicrobial properties and employed to inhibit growth of microflora of palm wine and retarded the tendency of the wine to become sour. The chemical compunds of the bark responsible for inhibition of microbial growth were reported to be isocoumarin (lactone) and distichol (polyphenol), respectively (Uvais et al., 1987; Faparusi and Bassir, 1973; Ogan, 1971).

The bark of *Cotylelobium lanceolatum* (Kiam) and *Shorea talura* (Phayom) have been effectively employed in the central and the south of Thailand to retard the growth of microflora which cause spoilage of palm sap. The aim of this study was to investigate the possible inhibition of growth of microflora and time course of off-odor formation on meat surfaces stored at refrigerator temperatures by water extract from the bark of *Cotylelobium lanceolatum* and *Shorea tatura.*

Materials and Methods

Extraction of Active Principles

The *Cotylelobium lanceolatum* and *Shorea talura* wood were obtained from local market in form of wood chips. To isolate the active principles, the chips were ground. Three hundred grams of the the ground wood were extracted by direct immersion of the ground wood in 3 liters of water. Extraction was performed at 50°C for 24 hrs. The supernatant was filtered through muslin cloth. The filtrate was stored in a 4°C cold room for further uses.

Meat Sources and Extract Spraying

Meats (pork and beef) from forequarter and hindquarter were obtained from local market. The meats were cut into pieces of 200 - 250 g with 1 inch thick.

The cut of meat was placed onto a metal rack which was cleaned with 70% alcohol. The meat was aseptically sprayed with either *Cotylelobium lanceolatum* or *Shorea talura* extract. Spraying was performed by holding the sprayer about 15 cm from the meat surface for 2 min and drained for 2 min. Then, the sanitized meat was placed on a foam tray and wrapped with polyethylene cling wrap and kept in a 4°C cold room for further analyses. The extract spraying was repeated once with another set of meats.

Microbial Analysis

Meat samples for microbial analysis were taken right after spraying of the extract and every day for 10 days. A sterilized core having surface area of 1 in^2 was employed. One 1 - in^2 surface section (3 - 5 mm thick) was excised with a sterile scalpel and forceps from the meat. The sample was placed into a sterilized bottle containing 99 ml of 0.1% peptone water. The bottle was shaken up and down for about 30 times. Series of dilutions were made with 0.1% peptone water. Duplicate pour plates of dilutions were prepared using Plate Count Agar (PCA). The plates were incubated at 37°C for 48 hrs.

Evaluation of Off-Odors

Evaluation of off-odors was performed on the meat samples right after taking microbial samples by smelling the odors of the meat. The odors were described as either normal or off-odors.

Statistical Analysis

The experiment was performed using a completely randomized design. Statistical analyses was made by the use of the IRRISTAT (1991). Significant differences among means were determined by Duncan's Multiple Range tests.

Results and Discussion

Bacterial Contamination

Washing or spraying with water, chlorinated water or acid is used extensively to reduce microbial loads of meat carcasses or cuts (Stevenson et al., 1978; Kelly et al., 1982; Crouse et al., 1988; Dickson, 1992). In present study, wood extract of *Cotylelobium lanceolatum* (Kiam) and *Shorea talura* (Phayom) also have effects of reduction of microbial loads on pork and beef cut surfaces as shown in Tables 1 and 2, respectively.

For the entire investigation, application of both wood extract on pork cuts resulted in lowering aerobic plate counts (Table 1). There were signifi-

Table 1. Mean aerobic plate counts (log_{10} cfu/in^2) of pork cuts sprayed with wood extract stored at 4°C

Day	Control	Kiam[1]	Phayom[2]
0	5.47 f[3]	5.43 b (0.04)[4]	5.01 d (0.46)
1	6.15 e	5.54 b (0.61)	5.27 cd (0.88)
2	6.23 de	5.43 b (0.80)	5.61 b (0.62)
3	6.51 bcd	5.90 a (0.61)	6.03 a (0.12)
4	6.60 bc	5.62 ab (0.98)	5.72 b (0.88)
5	6.85 ab	5.52 b (1.33)	5.69 b (1.16)
6	6.68 abc	5.41 b (1.27)	5.57 b (1.11)
7	6.96 a	5.61 ab (1.35)	5.72 b (1.24)
8	6.50 cd	5.59 ab (0.91)	5.67 b (0.83)
9	6.55 bcd	5.52 b (1.03)	5.51 bc (1.04)
10	6.57 bcd	5.40 b (1.17)	5.40 bc (1.17)

[1] *Cotylelobium lanceolatum*
[2] *Shorea talura*
[3] *Means followed by different letter are significantly different (P<0.05)*
[4] *Mean difference*

Table 2. Mean aerobic plate counts (log_{10} cfu/in^2) of beef cuts sprayed with wood extract stored at 4°C

Day	Control	Kiam[1]	Phayom[2]
0	4.93 b	4.97 f (-0.04)[4]	4.77 (0.16)
1	4.88 b	5.34 cdef (-0.46)	4.65 c (0.23)
2	6.53 a	5.42 cde (1.11)	5.53 ab (1.00)
3	6.72 a	5.19 ef (0.81)	5.51 ab (1.21)
4	6.47 a	5.32 def (1.15)	5.36 b (1.11)
5	6.48 a	5.48 bcde (1.00)	5.68 ab (0.80)
6	6.30 a	5.78 abc (0.52)	5.87 a (0.43)
7	6.43 a	5.67 bcd (0.76)	5.85 a (0.58)
8	6.41 a	5.64 bcd (0.77)	5.57 ab (0.84)
9	6.58 a	5.89 ab (0.69)	5.75 ab (0.83)
10	6.45 a	6.13 a (0.32)	5.88 a (0.57)

[1] *Cotylelobium lanceolatum*
[2] *Shorea talura*
[3] *Means followed by different letter are significantly different (P < 0.05)*
[4] *Mean difference*

cant differences ($P < 0.05$) between treated and control samples. Significant differences were observed from initial counts (day 0) through day 4. Comparing with control pork, small reductions in microbial loads were observed at initial counts about 0.04 and 0.046 log cycle for pork cuts treated with Kiam and Phayom extract, respecively. The differences in microbial reduction were increased later to the maximum of about 1.35 and 1.24 log cycle for pork cuts treated with Kiam and Phayom extract, respectively at day 7. Then the differences in reduction were slightly decreased throughout the storage period. Figure 1 showed that antimicrobial activities of both wood extracts on pork cuts were relatively resemble. Faparusi and Bassir (1973) reported that *Saccoglottis gabonensis* bark significantly inhibited growth of microflora of palm wine particular of bacterial growth resulting in reduction in rate of souring of palm wine.

Data observed from the beef cuts (Table 2) were also significantly different ($P < 0.05$). The initial microbial counts at day 0 were relatively close for all treatments of about 4.77 - 4.97 $\log_{10}$cfu/in^2. The microbial counts of the control beef cuts increased rapidly from day 1 through day 2 from about 4.88 $\log_{10}$cfu/in^2 to 6.53 $\log_{10}$cfu/in^2 while the microbial counts of the treated beef cuts with either Kiam or Phayom extract increased gradually (Fig 2). It was observed that the microbial counts of beef treated with Phayom extract from day 2 through day 7 were slightly higher than that of beef treated with Kiam extract. However, throughout storage period (10 days) both Kiam and Phayom extract provided similar effects (Fig. 2). They were able to inhibit growth of microorganisms on beef cuts effectively. The maximum reductions in microbial loads were about 1.15 log cycle for Kiam extract treated beef at day 4 and 1.21 log cycle for Phayom extract treated beef at day 3. Afterwards, the differences in microbial loads were slightly decreased.

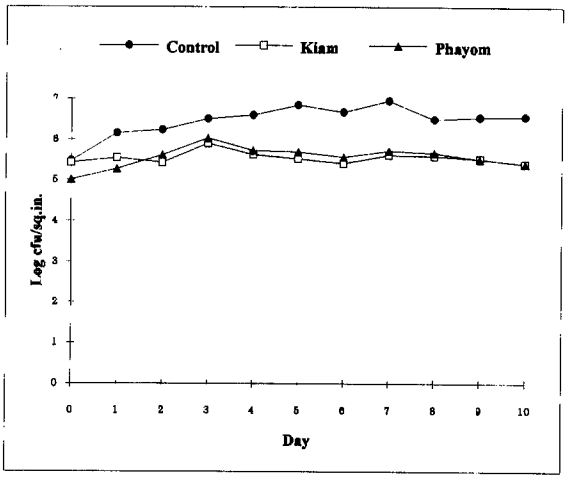

Figure 1. Effect of wood extract on microbial counts of pork cut surfaces

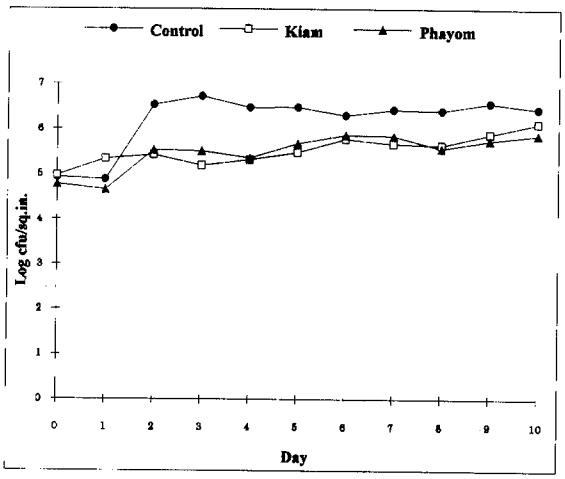

Figure 2. Effect of wood extract on microbial counts of beef cut surfaces

Evaluation of Off-Odors

After a lapse of time, the metabolic activities of microorganisms become detectable to human senses. In this study, development of spoilage odor of meat samples were obviously observed. The efficacy of Kiam and Phayom extract in retarding growth of microorganisms and, in turn, delaying off-odor development is shown in Tables 3 and 4. Control samples of both pork and beef cuts became sour after 48 hrs (day 3) of storage while treated samples stayed normal till day 5, then, souring of meat cuts was observed. Faparusi and Bassir (1973) reported similar effects of bark of *Saccoglotiis gabonenis* on reducing rate of souring of palm wine due to its inhibition of the rate of growth of bacteria. Sour/acid off-odors of stored meat were reported to be caused by the production of both straight (C_2 - C_6) and branched chain (C_4 and C_5) fatty acids arising from carbohydrate fermentation of spoilage microorganisms (Dainty, 1982).

Strong off-odors were detected at day 7 and, afterwards, stronger throughout storage period. The

Table 3. Effect of application of wood extract on odor of pork cuts stored at 4°C.

Day	Control	Kiam[1]	Phayom[2]
0	Normal	Normal	Normal
1	Normal	Normal	Normal
2	Normal	Normal	Normal
3	Slightly Sour	Normal	Normal
4	Sour	Normal	Normal
5	Sour	Slight Sour	Slightly Sour
6	Very Sour	Sour	Very Sour
7	Sour, Slightly Ammoniacal	Sour Ammoniacal	Very Sour
8	Sour, Slightly Ammoniacal	Sour, Ammoniacal	Sour, Ammoniacal
9	Sour, Ammoniacal, Slightly sulfidy	Sour, Ammoniacal	Sour, Ammoniacal
10	Sour, Ammoniacal, sulfidy	Sour, Ammoniacal	Sour, Ammoniacal

[1] *Cotylelobium lanceolatum*
[2] *Shorea talura*

Table 4. Effect of application of wood extract on odor of pork cuts stored at 4°C.

Day	Control	Kiam[1]	Phayom[2]
0	Normal	Normal	Normal
1	Normal	Normal	Normal
2	Normal	Normal	Normal
3	Slightly Sour	Normal	Normal
4	Sour	Normal	Normal
5	Very Sour	Slight Sour	Slight Sour
6	Very Sour	Sour	
7	Sour, Slightly Ammoniacal	Sour Slightly Ammoniacal	Very Sour Very Sour
8	Sour, Ammoniacal, Sulfidy	Sour, Ammoniacal	Sour, Ammoniacal
9	Sour, Ammoniacal, Sulfidy	Sour, Ammoniacal	Sour, Ammoniacal
10	Sour, Ammoniacal, Sulfidy	Sour, Ammoniacal	Sour, Ammoniacal

[1] *Cotylelobium lanceolatum*
[2] *Shorea talura*

intensity of off-odors of control meat samples were observed to be stronger than that of treated samples. Strong off-odors were described to compose dominantly of ammoniacal and sulfidy odors. Ammoniacal odors are associated with amounts of amines and ammonia. These compounds normally become significant during post-spoilage processes of meat and fish arising from amino acid, carbohydrate or lipid metabolism via decarboxylation and transamination (Dainty, 1982). Sulfidy odors were observed from control meat in the last 2 days of storage. Combinations of hydrogen sulfide, dimethyl sulfide, and methyl mercaptan are responsible for the sulfidy smell develop on spoiled meat (Stutz, 1978). The sources of compounds are shown to be cysteine and methionine (Herbert et al., 1975).

In conclusion, the investigation demonstrated that wood extract of *Cotylelobium lanceolatum* (Kiam) and *Shorea talura* (Phayom) had significant effects on reducing microbial contamination on meat surfaces stored at low temperatures. Spoliage of fresh meat treated with either extract was delayed at least 4 days. There were no differences in antimicrobial activities of either wood extract. Utilization of any kind of sanitizing agents in washing meat carcasses and fabricated subprimal cuts for decontamination of microorganisms and prolonging shelf-life is very interesting and useful in the meat product industry. Therefore, further studies on chemical and antimicrobial properties of *Cotylelobium lanceolatum* and *Shorea talura* extract and other wood should be investigated.

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