

## REDUCTION OF *BENZO (A) PYRENE* IN CHARCOAL GRILLED DUCK MEAT BY MARINATING WITH ANDALIMAN (*Zanthoxylum acanthopodium*, DC) FRUIT JUICE

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### ABSTRAK

Penelitian ini bertujuan untuk mengetahui pengaruh marinasi jus buah andaliman terhadap kandungan benzo (a) piren daging itik panggang. Rancangan acak lengkap digunakan untuk menentukan pengaruh 4 perlakuan jus buah andaliman (g buah andaliman/ml air). Sebanyak 24 sampel daging itik dibagi menjadi 4 perlakuan yaitu konsentrasi 0% (I), 10% (II), 20% (III) dan 30% jus buah andaliman (IV) dengan jumlah sampel 6 buah per perlakuan. Variabel yang diamati adalah total lemak, angka Tio Barbituric Acid (TBA) dan aktivitas antioksidan. Hasil penelitian menunjukkan bahwa perlakuan tidak berpengaruh nyata terhadap lemak daging itik. Aktivitas antioksidan daging itik dipengaruhi oleh konsentrasi jus buah andaliman. Aktivitas antioksidan sebesar 18,60%, 18,06%, 19,99% dan 7,54% masing-masing pada perlakuan II, III, IV dan I. Angka TBA masing-masing perlakuan adalah 1,03%, 0,89%, 0,09% dan 0,10% masing-masing pada perlakuan II, III, IV dan I. Hasil penelitian membuktikan bahwa antioksidan yang berasal dari jus buah andaliman menurunkan kandungan benzo (a) piren daging itik panggang. Kandungan benzo (a) piren daging itik tanpa dimarinasi jus buah andaliman adalah 787 ng, sedangkan daging itik hasil marinasi mengandung benzo (a) piren sebesar 295 ng.

*Kata kunci: itik, daging, andaliman, Benzo (a) pyrene, antioksidan*

### ABSTRACT

The effect of andaliman fruit juice marination on the amounts of benzo (a) pyrene in charcoal grilled duck meat were investigated in this research. Completely randomized design was used to determine the effect of 4 treatments of andaliman fruit juice concentration (w/v). Twenty four duck meat samples were divided into 4 treatment groups, those were 0% (I), 10% (II), 20% (III) and 30% (IV). Each group consisted of 6 samples. Total Fat, Tio Barbituric Acid (TBA) value and antioxidant activity were measured from all samples. The result showed there was no effect on total fat of duck meat. Antioxidant activity was 18.60 %, 18.06 %, 19.99 % and 7.54 % for andaliman fruit juice of 10%, 20%, 30% and 0%, respectively. TBA value was 1.03 %, 0.89 %, 0.09 % and 0.10 % for treatment II, III, IV and I, respectively. Antioxidant activity of andaliman fruit was decreased the amounts of Benzo (a) pyrene of duckmeat. Charcoal duck meat without andaliman fruit produced 787 ng, it was higher than charcoal duck meat with andaliman fruit (295 ng).

*Keywords : duck, meat, andaliman, Benzo (a) pyrene, antioxidant*

## INTRODUCTION

Meat are nutritional food that rich of fat and protein. There are many sources of meat in Indonesia, such as broiler, cow, goat, sheep and duck. Broiler is the most popular source of meat in Indonesia, but its production is easier attacked by disease. There is another source of meat alternative in Indonesia. Domestic duck is stronger than broiler in virus attacking. Data from Indonesia Statistical Center Agency showed that population of ducks in 2013 were about 46.313.000. Indonesia are tropical country that have many domestick ducks. One of the most popular ducks is named Tegal's duck.

Duck meat is diffrent than broiler meat in chemical compound. Ali *et al.* (2007) described that C18:0 content of duck meat is lower than broiler. There is specific aroma of duck meat which is different than that of broiler. It is good for some people but is not good for another. Duck meat are well known for its unique flavor and taste, high composition of essential amino acids and high percentage of polyunsaturated fatty acids (Pingel, 2009).

As the source of fat and protein, duck meat must be processed carefully. Heat treatment of duck meat influence the stability of fat and protein. Fat degradation can produce some unstability compounds that have reactive electron. Oxidation reaction is prevented by antioxidant activity. Reactive electron can be neutralized by antioxidant that the dangerous compounds are not formed.

Duck meat contain a little antioxidant compound which are not strong enough to prevent oxidation reaction. Antioxidant enrichment of duck meat can be done by adding some herbal ingredient. There are some herbal ingredients can be used to enrich antioxidant of duck meat. Andaliman fruit (*Zanthoxylum acanthopodium*) is domestic herbal ingredients from Indonesia which has good ability as antioxidant. It is very suitable added to duck meat as the source of antioxidant.

Andaliman is included in Rutaceae's family. It is suitable to grow at an altitude at 1000-2500 m above sea level. Analysis of essential oils using GC-MS by Moelyono *et al.* (2014) resulted in 29 chemical components with geranyl acetate as its major component (23.18%). According to Suryanto *et al.* (2005), andaliman fruit which was extracted by etanol produced high antioxidant compound. Andaliman fruit is suitable ingredient cause its antioxidant is stable in high temperature.

Tensiska *et al.* (2003) reported that antioxidant compounds of andaliman fruit was relatively stable in high temperature.

There are many cooking methods that usually practice in Indonesia, such as grilling and frying. Grilling method produce stronger aroma than frying. Many consumer interested in specific aroma of duck meat. Therefore, charcoal grilling is favourite cooking methods in duck meat processing. Several studies were reported that charcoal grilling at very high temperature caused formation of Polycyclic aromatic hydrocarbon (PAH).

According to Alomirah *et al.* (2011), PAH content was influenced by temperature and duration of heating. Benzo (a) pyrene is one of PAH compound that is very dangerous for human. Accumulation of it could become cancer in human body. For this reason, Indonesian government established maximum standard of availability Benzo (a) pyrene in food. According to National Agency of Drugs and Food Controls, the maximum amount of Benzo (a) pyrene in smoked meat is 5 µg. Antioxidant's compound of Andaliman fruit will be deposited into duck meat, so it will neutralize some Benzo (a) pyrene.

The aim of the research was to investigate the effect of andaliman fruit to reduce the amount of Benzo (a) pyrene in charcoal duck meat.

## MATERIALS AND METHODS

The research devided into 2 stages. The first stage was to determine the optimal concentration of andaliman fruit to deposite antioxidant into duck meat. The second stage was to investigate the effect of antioxidant enrichment on the amounts of Benzo (a) pyrene in charcoal duck meat.

Research material consist of Tegal's duck as domestic duck from Indonesia, Andaliman Fruit (*Zanthoxylum acanthopodium*) as local herbal from Indonesia, aquadest, blender, stove, grill. Tegal's duck 24 mounths old were slaughtered and leg part was preped as research samples. The duck meat was cooking at 90°C in 20 min Andaliman fruit juice were made by mixing andaliman fruit and aquades in g/mL. Andaliman fruit was weighed to obtain 100 g, 200 g, 300 g and it were blended in 1000 ml aquadest.

The mixed andaliman were filtered to obtain andaliman fruit juice. Duck meat samples were soaked in andaliman fruit juice for 60 minute. Duck meat samples were prepared for chemical

analysis after soaking process. Duck meat's fat was determined by soxhlet analysis. Rancidity were determined by Tio Barbituric Acid (TBA) value. Antioxidant activity were determined by antiradical scavenging method using *diphenyl picril hydrazil hydrate* (DPPH).

Benzo (a) pyrene content of duck meat was determined by High Performance Liquid Chromatography (HPLC). Cooked duck meat which marinated with andaliman fruit juice and without marination processed were grilled at 180°C for 15 minute.

## RESULT AND DISCUSSION

Antioxidant activity of duck meat which marinated with andaliman fruit in 0%, 10%, 20% and 30% concentration are presented on Table 1. There were significant differences between duckmeat without andaliman fruit juice (0%) and with andaliman fruit juice (10%, 20%, 30%) on antioxidant activity. Marination in 20% andaliman fruit concentration were chosen as the optimal concentration of marination.

Marination was one of meat processing method to give flavor into the meat. At the same time, it could deposite spesific bioactive compounds into the meat. Marination duck meat using andaliman fruit as marinade aimed to deposite antioxidant compounds into the duck meat. Miftakhurohmah and Suhirman (2009) reported that there were geraniol, sitronelal and limonene in raw andaliman fruit. The compounds had antioxidative ability and could inhibit oxidation in food.

Bianchi *et al.* (2009) concluded that both the ingredients and solution/meat ratio played a key role in determining the process yield with special

emphasis to the uptake of marinating solution and subsequent losses during cooking. Andaliman fruit is very suitable as ingredient for heat processing, because it is stable in high temperature.

TBA value was another reason why 20% become the optimal concentration. Andaliman fruit contain several antioxidant compounds, such as geraniol and limonene (Wijaya *et al.*, 2001). Antioxidant compounds of andaliman fruit were deposited to duck meat through marination process. The high amount of antioxidant compounds could delay oxidation process of duck meat. Fat content of duck meat which were marinated by andaliman fruit in 0%, 10%, 20% and 30% concentration are presented on Table 1. There were no significant difference between duck meat without andaliman and duckmeat with andaliman on fat content.

TBA value of duck meat which were marinated by andaliman fruit in 0%, 10%, 20% and 30% concentration are presented in Table 1. There were significant difference between duckmeat without andaliman and duckmeat with andaliman in TBA value. Duck meat which marinated in 20 and 30 % andaliman fruit juice had TBA value lower than duck meat without andaliman fruit juice marination.

Soeparno (2011) explained that oxidation could begin from free radical formation as the result of several factor such as light, heat, enzyme, hydroperoxyde. Heat treatment can lead to undesirable change, such as a reduction in the nutritional value, alteration in fatty acid composition and production of toxic compounds mainly due to lipid oxidation and losses of vitamins and minerals (Danowska, 2009; Gerber *et al.*, 2009; Cox *et al.*, 2012)

Table 1. Antioxidant Activity, Total Fat and TBA Value of Duck Meat Marinated by Andaliman Fruit Juice

Marination	Antioxidant Activity (%)	Fat (%)	TBA value (mg malonaldehyd/100 g)
Andaliman 0%	7.54±3.29 <sup>a</sup>	10.46±3.88	1.03±0.63 <sup>a</sup>
Andaliman 10%	18.60±1.13 <sup>b</sup>	11.16±0.49	0.89±0.81 <sup>a</sup>
Andaliman 20%	18.06±0.95 <sup>b</sup>	10.39±0.48	0.09±0.03 <sup>b</sup>
Andaliman 30%	19.99±0.74 <sup>b</sup>	10.40±0.55	0.10±0.08 <sup>b</sup>

Average with different superscript indicates significantly different (P<0.05)

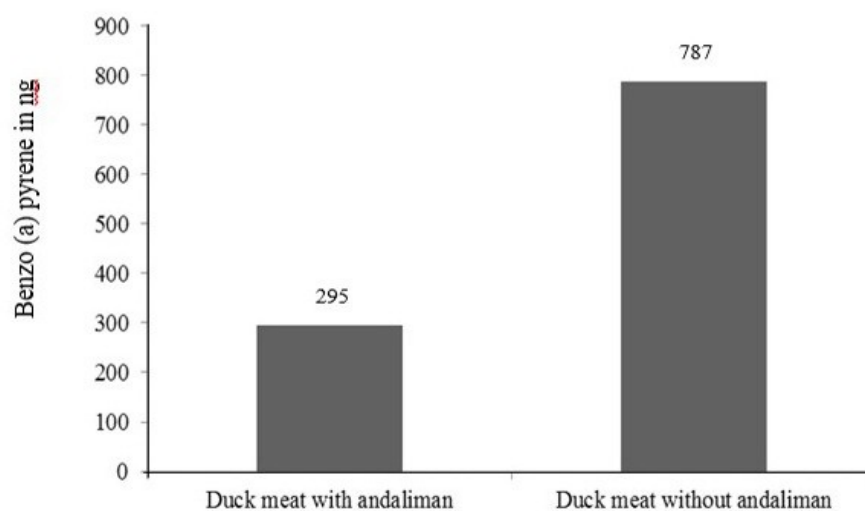


Figure 1. Benzo (a) pyrene Content of Charcoal Grilled Duck Meat

Lipid oxidation could be reduced by using natural antioxidants in food products, so free radical formation was not happen. Natural antioxidants exert their action through various mechanisms: preventing chain initiation by scavenging radicals, inhibiting the propagation of radical chain reactions, metal chelating, decreasing localized oxygen concentration and decomposing peroxides (Niki, 1997).

The present study shows that marination of duck meat in andaliman fruit juice could reduce the amounts of Benzo (a) pyrene. Antioxidant compounds of andaliman fruit were able to reduce oxidation process of duck meat. The amount of Benzo (a) pyrene of charcoal duck meat is presented on Figure 1. Alomirah *et al.* (2011) indicated that there was strong influence of type of heat source, grilling duration, geometry of the grill and the use of marinating sauces and fat content on PAHs formation.

Fat oxidation could result dangerous compounds formation such as Benzo (a) pyrene. Figure 1 shows that andaliman fruit juice addition could reduce Benzo (a) pyrene content of charcoal duck meat.

Geraniol and limonene played important role in electron exchange so free radical compounds could be netrailized. Chiralt *et al.* (2002) described that limonen could be used as cancer chemotrathy. According to Badry (2010), natural spices addition into the meat could reduce the amount of PAH.

## CONCLUSION

Marination in 20% concentration of andaliman fruit juice could reduce Benzo (a) pyrene of charcoal duckmeat. Antioxidant activity of duckmeat increased significantly as the result of marination in andaliman fruit juice. Benzo (a) pyrene of charcoal duck meat could be reduced by marination in andaliman fruit juice.

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