

The population of buffalo is declining sharply in Indonesia during the last 20 years. The data show that by year 1990, there were 3.5 million heads, then drop to 2,5 million head within 10 years. It seems that the decrease of the populations is continuously and timescale gets narrow. Based on the year 2011 census, the buffalo population was 1.3 million head, while prediction for year 2013 according to agriculture census, the buffalo population is approaching 1 million heads. Therefore, it is important to develop strategies to overcome the problems. The conference recommends, as follows:

- To establish a communication forum for those who are interested in buffalo development.
- To establish the Center for Indonesian Buffalo Development in NTB.
- To establish Indonesian Buffalo Association (IBA) involving Academic, Businessmen, Government, Community, and International Buffalo Federation.
- The International Conference on Buffalo is recommended to be conducted every two years.
- All information that rose from this conference will be informed to all related stakeholders who are interested in buffalo development (Ministry of Agriculture, Ministry of Research and Technology, Ministry of Education and Culture, etc).
- For communication between scientists who are interested in buffalo development, the Indonesian Buffalo Association will publish a scientific journal.

These recommendations are made on occasion of the Buffalo International Conference 2013, in Makassar, 4-5 November 2013 and signed by the the following senior scientists. The recommendation is called MAKASSAR DECLARATION



Proceeding Buffalo International Conference 2013  
"Buffalo and Human Welfare"



PROCEEDING

# Buffalo International Conference 2013 "Buffalo and Human Welfare"

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Hasanuddin University

**PROCEEDING**  
**BUFFALO INTERNATIONAL CONFERENCE 2013**  
“Buffalo and Human Welfare”

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*Dear colleagues,*

I have the great honor of welcoming all delegates, speakers, and invited guests to the Buffalo International Conference 2013. The conference is hosted and by the Faculty of Animal Science, Hasanuddin University, Makassar, Indonesia with the theme “Buffalo and Human Welfare”. The theme covers a wide range of very interesting issues relating with the many roles that the buffalo hold in human welfare, the problems associated with that, and the developments or solutions to address the problems, locally, nationally, and internationally.

The buffalo plays an important role not only for fulling the need for red meat but also for cultural role in several communities. At the very heart of South Sulawesi, the district of Toraja is home to the endangered spotted buffalo. Despite endangerment, the spotted buffalo is in high demand for its pivotal role in Toraja’s traditional culture. I wish for delegates to actively engage in discussion on the role of buffalo in their own societies and countries and what developments have been implemented, and therefore we look forward to hear our distinguished colleagues report on their recent research developments.

We have with us today representatives from research institutions, universities, livestock practitioners, and the government. I hope that this two day conference, a multinational platform in the current issues of buffalo development, will challenge all delegates to think about the issues and responses to those matters, and in turn inspire novel and applicable solutions to the situation.

Let me use this opportunity to thank the Rector of Hasanuddin University for his fully support to the event. I would like also to thank the Minister of Agriculture, the governor of South Sulawesi, and to the all sponsors for their invaluable contribution to this event. A deep appreciation is presented to the organizing committee for their hard work and effort to make this event to happen. We hope that this International conference can be the first of many to come in the future.

Finally, I sincerely hope that you will benefit from the conference through learning from each other, meeting people and building up friendship between each other, and enjoying your time in our beautiful campus and city. I wish everyone a successful and fruitful conference.

With best wishes,

**Prof. Asmuddin Natsir**

President of Buffalo International Conference 2013

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# THE SENSORY PROPERTIES AND FLAVOR CHARACTERISTICS OF MEAT OF CATTLE AND BUFFALO FED PROTECTED LEMURU FISH (*Bali sardinella*) OIL AS DRIED CARBOXYLATE SALT MIXTURE (DCM) IN RATION

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## ABSTRACT

The aim of the study was to reveal the sensory and characteristic differences between cattle and buffalo meats. There were 6 swamp buffalo and 8 Ongole cross cattle used in the study which arranged as a factorial experiment 2x2, based on a completely randomized design: 2 species and 2 level of DCM (dried carboxylated salt mixture; 0 and 45 g per kg ration). The result indicated that DCM in ration was significantly ( $P < 0.05$ ) strengthen the odor of the meat compared with control meat. Buffalo meat was significantly ( $P < 0.05$ ) darker than of cattle.

**Key words:** Buffalo, Cattle, DCM, Sensory properties, Volatile component

## INTRODUCTION

Feeding system is an important factor in the intensive livestock production. Feeding should fulfill the requirements for maintenance, growth and reproduction. Dried Carbixilated Salt Mixture (DCM) is *Lemuru* (*Sardinellalongisepts*) fish oil used as feed supplement. This fish oil contains omega-3 such as *Eicosapentaenoic acid* (EPA) and *Docosahexaeonic acid* (DHA). Tasse (2010) reported that cattles fed with DCM in ration produced high content of omega-3 in milk.

Flavor is an important factor influencing choice and preference of consumers. High unsaturated fatty acid in meat is a source of free radicals of peroxide resulted from reaction of auto-oxidation which then produce a specific odors as volatile compound (Muika *et al*, 2005; Marquez-Ruiz *et al*. 2008; Rukmiasih *et al*. 2010).

This study aim to reveal meat sensory differences between breeds and DCM supplementation.

## MATERIALS AND METHODS

This study was performed at Field Laboratory Blok A, Faculty of Animal Science, Bogor Agricultural University (BAU). DCM was prepared at Ruminant Laboratory, Faculty of Animal Science and Teknopark SEAFast, Faculty of Agricultural Technology, BAU. Sensory Test was conducted at the Laboratory of Livestock Production Technology, BAU. Analysis of volatile component of meat was done at The Laboratory of Flavour BBPTP, Sukamandi.

Six cattle (bw 217.37±15.44 kg) and eight buffalo (bw 218.66±16.28 kg) were used, and their ages varied from 1.4 to 2 years old. Each animal was placed into an individual house. Length of fattening was 2.5 months. Adjustment period of 1 month.

Ration was formulated with forage and concentrate with ratio of 350 g kg<sup>-1</sup> and 650 g kg<sup>-1</sup> respectively in dry matter basis. Forage consisted of field grass and Napier grass with ratio of 50:50. Concentrate consisted of commercial concentrate and soya bean husk with ratio of 1:2. Commercial concentrate consisted of cassava waste (380 g kg<sup>-1</sup>), rice bran (250 g kg<sup>-1</sup>), corn meal (240 g kg<sup>-1</sup>), soya bean meal (80 g kg<sup>-1</sup>), Vitamin and Mineral (10 g kg<sup>-1</sup>), DCP (21.5 g kg<sup>-1</sup>), CaCO<sub>3</sub> (11.5 g kg<sup>-1</sup>), Methionin (3 g kg<sup>-1</sup>), NaCl (4 g kg<sup>-1</sup>).

There were two treatments of DCM supplementation, P<sub>0</sub> (forage and concentrate) and P<sub>1</sub> (forage, concentrate and DCM). DCM was added into concentrate (45 g per kg) and mixed manually. The chemical composition of ration can be seen in Table 1. Animal has free acces to water.

**Tabel 1.** The chemical composition of experimental ration (g kg<sup>-1</sup>).

Nutrient (g kg <sup>-1</sup> )	Treatment	
	P <sub>0</sub>	P <sub>1</sub>
Dry matter	333.3	335.8
Ash	74.2	72.5
Ether extract	22.5	29.1
Crude protein	136.5	138.2
Crude fibre	358.0	359.3
NFE*	408.7	400.9
TDN**	577.9	588.7

\*Calculation

\*\*TDN (Hartadiet *al.* 1980) =  $92.64 - 3.338 (CF) - 6.945 (EE) - 0.762(NFE) + 1.115 (CP) + 0.031(CF)^2 - 0.133(EE)^2 + 0.036(CF)(NFE) + 0.207(EE)(NFE) + 0.100(EE)(CP) - 0.022(EE)^2(CP)$ .

The *Lemuru* fish oil was bought at traditional market Muncar village, Banyuwangi East Java. *Lemuru* fish oil was mixed with HCl then added with aquades. The mixture was heated at 60 °C for 30 minutes. The recovery mixture was added with KOH and shaken then added with CaCl<sub>2</sub>. This mixture was kept on room temperature of 25 °C (Hwang and Liang, 2001). This carboxilic salt produced was mixed with cassava waste with ration of 1:5 w/w. The mixture of cassava waste and DCM was dried in the oven at 32 °C (Hwang and Liang, 2001). DCM was preserved using *butylated-hidroksitoluen* (BHT) to prevent from oxidative rancidity. Fatty acid composition was analized using Gas Liquid Chromatography Flame Ionized Detector (GLCFID).

Two weeks adjustment period was applied to animals. At the end of the experiment all animals were slaughter, 14 strip loin meat samples were taken for volatile component analysis. Parameters measured were sensory analysis and volatile component analysis.

## Sensory analysis

Sensory analysis was conducted using Hedonic Quality Test (HQT). Raw cubic meat, sized 1.5, 1.5 and 1.5 for length, wide and height respectively, was tested by 15 testers. Testers freely marked samples and the results were converted to numeric scale (0-12). Parameter measured were meat colour, meat texture and fish odor.

## Volatile component analysis

The volatile component of meat samples were extracted using Simultaneous Distillation Extraction (SDE) Likens-Nickerson method according to Hustiany (2001). 100 grams of meat sample was put into a distillation tube. 500 ml distilled water was added and followed with internal standard, 0.5 ml of 1,4-dichlorobenzene (0.1 g in 100 ml diethyl ether). Sample was placed into SDE Likens-Nickerson then heated on 100 °C and extracted with 30 ml of diethyl ether solvent which heated in water heater at 40 °C for 1 hour after water boiled at 100 °C. Extraction was concentrated until the volume of 2 ml. Extraction was put into vial tube and added with Na<sub>2</sub>SO<sub>4</sub> to take water. Samples were kept in a freezer before injecting to the Gas Chromatograph-Mass Spectrometer (GC-MS) to determine volatile component.

Identification of volatile component was done using GC-MS (Agilent 7890A). Mass spectra of a volatile compound were compared with mass spectra standard according to National Institute Standard and Technology (NIST), NIST 12 and NIST 62 having more than 62,000 standards. Each peak detected by detector was recorded by integrator for each retention.

For gradient temperature program, it was calculated linear retention index (LRI). LRI value is the relationship between retention times of n-alkane standard (C<sub>5</sub>-C<sub>26</sub>) injected at the same condition with the condition of sample. The calculation of LRI of a component was compared with standard based on coulomb GC-MS used. The concentration of volatile component at each peak was calculated with the following formula:

$$\text{Component total} = \frac{\text{Component area}}{\text{Sample amount}} \times \frac{\text{The amount of internal standard}}{\text{internal standar area}}$$

Standard was prepared as 0.1 gram internal standard /100 ml diluent 0.1%. The volatile components found were compared with the reference to reveal the volatile component existing in buffalo and cattle meat.

## Experimental design

The research was arranged as a factorial experiment 2 x 2 based on a Completely Randomized Design; the first factor was DCM supplementation (0 and 45 gr/kg ration), the second factor was animal species (buffalo and cattle). Data were analysed in accordance with variance analysis followed with least square means.

## RESULTS AND DISCUSSIONS

### Sensory properties of cattle and buffalo meat

#### Odor

Table 2 showed the effect of DCM in ration on meat odor. Odor is a factor influencing consumer in choosing a food product. The results showed that there was no interaction effect between treatment and animal species on meat odor. Supplementation of DCM in ration significantly ( $P < 0.05$ ) affected the meat odor. This is possible that the inclusions of DCM from *lemuru* fish in ration affected meat odor and therefore the meat would have the fishy odor. In contrast with Bratzler (1971), meat odor from cooked meat was stronger than those from the raw meat. This is affected by cooking method, type of meat and the treatment of meat before cooking. In addition, raw meat has flavor that is less liked as less odor and bloody taste. Volatile component affects on strong odor of meat as this might be from including of DCM in ration.

**Table 2.** Hedonic quality test of raw odor and buffalo meat supplementing with DCM

Items	Treatment	Animal species		Average
		Cattle	Buffalo	
Odor	DCM	5,50±0,70	6,50±2,12	6,00 <sup>a</sup> ±1,41
	Non DCM	3,00±1,41	2,75±1,25	2,83 <sup>b</sup> ±1,16
	Average	4,25±1,70	4,00±2,36	
Texture	DCM	2,00±0,00	8,20±3,34	7,16±3,92
	Non DCM	3,66±1,52	6,00±2,82	4,60±2,19
	Average	3,25±1,50	7,57±3,15	
Colour	DCM	3,00±1,41	8,00±0,00	4,66±3,05
	Non DCM	2,33±0,57	8,33±2,30	5,33±3,61
	Average	2,60 <sup>b</sup> ±0,89	8,25 <sup>a</sup> ±1,89	

Means with different superscript within the same column are significant ( $P < 0.05$ ), for DCM effect  
 Means with different superscript within the same row are significant ( $P < 0.05$ ), for animal species effect.  
 Odor scale 0,0-3,0 weakfish odor, 3,1-6,0 = medium fish odor, 6,1-9,0 = strong fish odor, 9,1-12,0 = strongest fish odor.

Texture scale 0,0-3,0 = soft, 3,1-6,0 = medium rough, 6,1-9,0 = rough, 9,1-12,0 = roughest

Colour scale : 0,0-3,0 = bright red, 3,1-6,0 = medium bright red, 6,1-9,0 = dark red, 9,1-12,0 = darkest red.

#### Texture

Texture is the characteristic of raw meat. Objectively it is difficult to evaluate. Muscle texture is classified into two categories such as rough texture with big fibre bound and soft texture with small soft fibre bound (Soeparno, 2005). These properties were visually measured and graded by consumer. Result showed that feed treatment, animal species and the interaction between feed treatment and animal species was not significant affect the meat texture. Meat texture mainly muscle fibre was influenced by animal species, animal breed, age and feed by animal (Soeparno 2005).

## Colour

Food colour is the light reflection on food surface that caught by eye and transmitted in nerve system. Colour affects the food acceptance as generally food is firstly interested by colour. Interesting colour will increase the product acceptance. Results showed that there is no significant effect of the interaction between ration treatment and animal species on colour. Supplementation of DCM did not significantly ( $P>0.05$ ) influence the colour of meat, while it occurred in different species.

The colour of buffalo meat had high score. The colour score of cattle and buffalo meat was around 3.1 to 6.0. It means that it was dark red. However, buffalo meat is darker than cattle meat. This might be due to the composition of buffalo meat contained more myoglobin than those of cattle meat. This result showed the buffalo and cattle meat score was 5 and 3 respectively. It means the buffalo meat was darker red than cattle meat. Suparno (2005) reported that consumers tend to choose the bright red raw meat.

## **Volatile component of the buffalo and cattle meat**

Meat flavor is originally from unfatty tissue and fatty tissue. Unfatty tissue is responsible on meat flavor while the fatty tissue contains volatile component that provide typical flavor from animal (Shahidi, 1998). Analysis of volatile component of buffalo and cattle meat was showed descriptively (Figure 1 and 2).

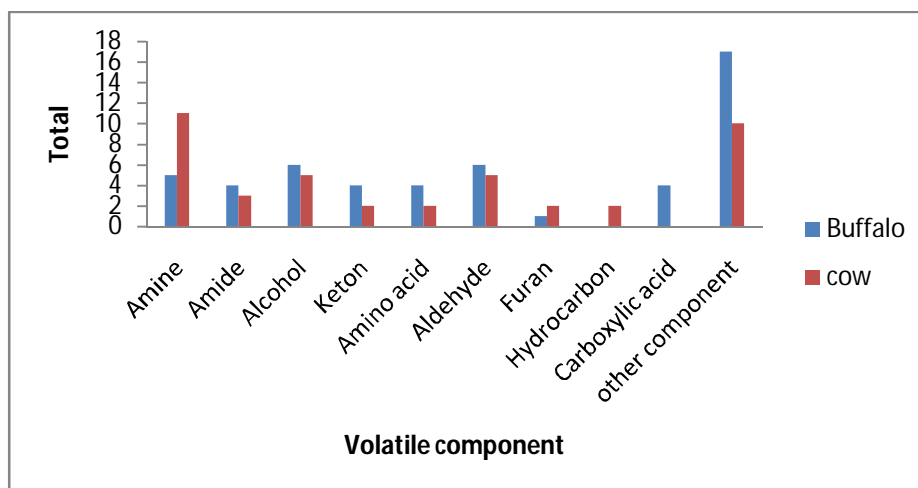
The amount of volatile component identified from cattle meat fed without DCM was 42 components including amine such as: *di(pent-4-enyl)amine*, *sec-butylamine*, *1,3-propanediamine*, *isobutylamine*, *1-heptadecanamine(4)*, *3,3'-Iminobispropylamine*, *1-Dodecanamine*, *2-Butenamide*, *N,2,3-trimethyl*; alcohol such as *2-Nonen-1-ol (2)*, *2,3-Butanediol (1)*, *Cyclobutanol (1)*, *1-Octen-3-ol (1)*; aldehyde such as *hexanal*, *nonanal*, *2-undecenal*, *2-tridecenal*, and *2,4-decadienal*, and 13 other components.

The amount of volatile component identified from buffalo meat fed without DCM was 50 components including amine such as: *1-hexamine*, *ethanamine*, *n-methyl*-, *1-octadecanamine*, *n-methyl*-, *2-butanamine*, *(s)-*, *1,4-butanediamine*, *n-(3-aminopropyl)* alcohol such as *2-hexanol*, *3-methyl*-, *ethanol*, *2-(vinylloxy)-*, *2,3-butanediol*, *1-octen-3-ol*, *cyclobutanol*, *2-nonen-1-o*; aldehyde such as *benzaldehyde (2)*, *hexanal*, *nonanal*, *2,4-decadienal*, *(e,e)- (2)*; amino acid such as ; carboxylic acid such as *butanoic acid*, *hexanoic acid*, *propanoic acid*, *2-hydroxy*-, *butanedioic acid*; and 18 other components.

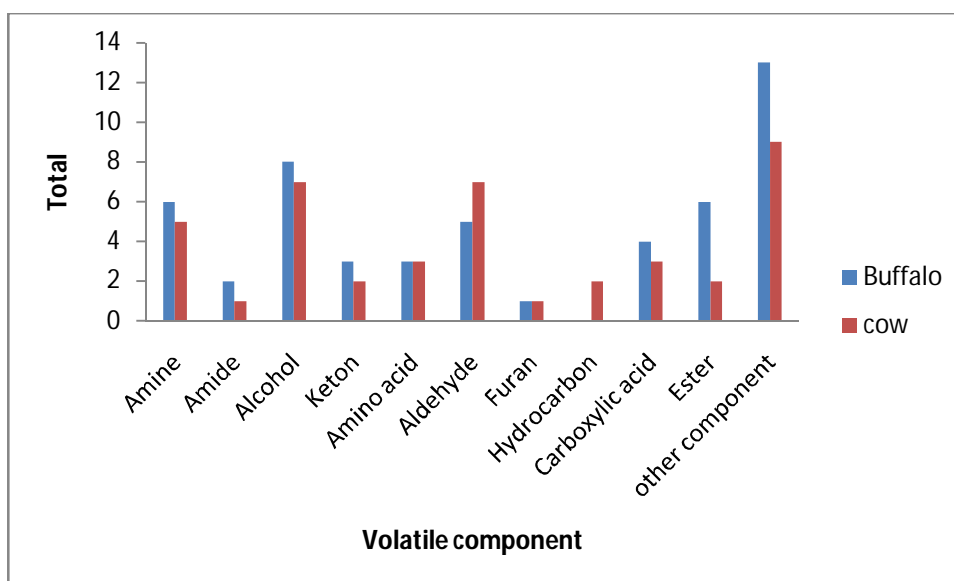
Buffalo meat without DCM had more component amide, alcohol, amino acid, keton, aldehyde and carboxylic acid than those in cattle meat. The amount of volatile component identified from meat of cattle fed with DCM were 42 components including alcohol such as: *ethanol*, *2-(vinylloxy)-*, *2-hexanol*, *3-methyl*-, *2-octanol*, *(s)-*, *1-butanol*, *3-(1-ethoxyethoxy)-2-methyl*, *cyclobutanol*, *1-octen-3-ol*, *2-nonen-1-ol*; ketonyaitu *2-butanone* dan *2-butanone*, *3-hydroxy*-; amno acid such as *dl-cysteine*, *glycine*, *n-acetyl*-, *alanine*; carboxylic acid such as *butanoic acid*, *propanoic acid*, *2-hydroxy*-, *oleic acid*, and 13 other components.

The amount of volatile component identified from meat of buffalo fed with DCM were 51 components including alcohol such as: *2-hexanol*, *3-methyl*-, *ethanol*, *2-(vinylloxy)-*, *1-pentanol*, *4-methoxy-4-methyl-2-pentanol*, *cyclobutanol*, *1-octen-3-ol*, *cyclohexanol*, *2-(methylaminomethyl)-*, *trans*-, *2-nonen-1-ol*; ester such as *formic acid*, *1-methylpropyl ester*, *propanoic acid*, *3-methoxy*-, *methyl ester*, *acetic acid*, *methoxy*-, *ethyl ester*,

3,7-dimethyl-6-nonen-1-ol acetate, 10-undecenoic acid, propyl ester, oxalic acid, allyl dodecyl ester;oxylic acid such as hexanoic acid, butanedioic acid, butanoic acid, propanoic acid, 2-hydroxy- and 17 other components.



**Figure 1.** Volatile component of meat of buffalo and cattle fed without DCM.



**Figure 2.** Volatile component of meat of buffalo and cattle fed with DCM

Generally, the amount of volatile component in buffalo meat was higher than those in cattle meat. Flavour was determined by amine, alcohol and aldehyde. This result was different from Suryaningsih (2005) that cattle meat flavor was influenced by octadecanoic acid and methyl ester. This might be due to animal was fed with different feed sources.

A part from the amine, alcohol and aldehyde, factors determining buffalo meat flavor were amide, keton, amino acid, carboxylic acid and ester. Alcohol had high flavor score but it plays little role in meat flavor (Mottram, 1991). Aldehyde also found

in meat of buffalo fed without DCM. Aldehyde also originally from lipid degradation then this could react with precursors produce from maillard reaction.

The main volatile odor when cooking meat was thermal oxidation induced from asil chain from lipid. Macleod (1998) mentioned that the decomposition of lipid started with oxidation and degradation of unsaturated fat and saturated fat. This reaction started with formatting of free radical. The formation of free radical produced peroxide that it was decomposed to produce aldehyde, alcohol, keton, lactone, furan and aromatic hydrocarbon contributing on the meat flavor. Volatile components, such as alcohol, aldehyde, hydrocarbon, furan, ester, alchyl, benzene and keton, degraded from lipid and oxidation reaction were the most important factors in determining meat flavor.

Buffalo and cattle fed DCM produce strong fishy meat flavor as consisting volatile component of carboxylic acid especially butanoic acid, hexanoic acid and propanoic acid, 2-hydroxy-) and aldehyde such as (E)hexa-2-enal, decatrienal. Estiasih (2009) stated that aldehyde, benzene and carboxylic acid were the volatile component detected in fish oil and cause fish odor. The derivation of carboxylic acid with methyl chain such as ester and amide has strong odor. This caused stronger buffalo meat odor than cattle meat. This odor will affect the consumer in choising buffalo meat.

## CONCLUSSION

Meat from animal (cattle and buffalo) fed DCM supplementation had more specific fishy odor than those unsupplementation. Red colour of buffalo meat was darker than that of cattle meat; Buffalo meat contained more volatile components compared with cattle meat; Meat flavour was determined by aldehyde, alcohol and amine.

## REFERENCES

- Bratzler, L. J. 1971. Palatability Factors and Evaluation. in : J. F. Price dan B. S. Schweigert (Ed.). The Science of Meat and Meat Product. 2<sup>nd</sup> Edition. W. H. Freeman and Company, San Francisco.
- Estiasih, T. 2009. Fish Oil: Technology and Application to the Food and Health. Science Graha, Yogyakarta.
- Hartadi, H., S. Reksohadiprodjo, S. Lebdosukojo, A. Tillman, L. C. Kearl, L. E. Harris. 1980. Tabel-tabel dari Komposisi Bahan Makanan Ternak untuk Indonesia. International Feedstuffs Institute Utah Agricultural Experiment Station, Utah.
- Hustiany, R. 2001. Identifikasi dan karakterisasi komponen *off-odor* pada daging itik. Tesis. Fakultas Pascasarjana, Institut Pertanian Bogor, Bogor.
- Hwang, L. S. and J. H. Liang. 2001. Fractionation of urea-preteated squid visceral oil athyl esters. JAOCS, 78: 473-476.
- MacLeod, G. 1998. The Flavor of Beef, in Shahidi F, The Flavor of Meat, Meat Products and Seafood. Blackie Academic and Professional. Page 27-60

- Márquez-Ruiz, G., M.C. García-Martínez and F. Holgado. 2008. Changes and Effects of Dietary Oxidized Lipids in the Gastrointestinal Tract. *Lipid Insight*, 2:11-19.
- Mottram, D. S. 1991. Meat. in: *Volatile Compound in Food and Beverages*. Marcel Decker, Inc., New York.
- Muika, B., B. Lendl, A. Molina-Díaz, and M. J. Ayora-Canada. 2005. Direct monitoring of lipid oxidation in edible oils by fourier transform Raman spectroscopy. *Chem. Phys., Lipids* 134: 173–182
- Rukmiasih, P. S. Hardjosworo, W. G. Piliang, J. Hermanianto, and A. Apriyantono. 2010. Penampilan, kualitas kimia, dan off-odor daging Itik (*Anas platyrhynchos*) yang diberi pakan mengandung Beluntas (*Pluchea indica* L. Less). *Med. Pet.*, 33(2): 68-75.
- Shahidi, F. 1998. *Flavor of Meat, Meat Product and Seafood*. Blackie Academic & Professional, London-New York-Tokyo-Madras.
- Soeparno. 2005. *Ilmu dan Teknologi Daging*. Gadjah Mada University Press, Yogyakarta.
- Suryaningsih E. 2005. Pengaruh Jenis Daging, Penambahan Anti Denaturan, dan Natrium Tripolifosfat pada Nikumi terhadap Karakteristik Daging Olahan. Disertasi. IPB, Bogor.
- Tasse, A. M. 2010. Tampilan asam lemak dalam susu sapi hasil pemberian ransum mengandung campuran garam karboksilat atau metil ester kering. Disertasi. Institut Pertanian Bogor, Bogor.