

Proceeding
The First International Conference
Technology on Biosciences and Social

“Industry based on Knowledges”

17th-19th November 2016, Convention Hall, Andalas University

Organized by :
Animal Science Faculty of Andalas University
Co-organized by :
Alumni Center of Universiti Putra Malaysia

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Organized by:

Animal Science Faculty of Andalas University
and
Alumbi Center of Universiti Putra Malaysia

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Contents

	Page
Organizing Committee.....	ii
Content	iii
Preface	iv
List Paper of Oral Presentation	v
List Paper of Poster Presentation	xii
Keynote Lecturer	1
Papers of Oral Presentation	25
Animal Science.....	26
Agricultures.....	198
Medicines, Public Health, Technics and Natural Sciences	344
Economy and Social Sciences	425
Papers of Poster Presentation	491

Preface

List Paper of Oral Presentation

No.	Author's	Title	Page
ANIMAL SCIENCES			
1.	Jumatritikah Hadrawi, Asep Gunawan, Niken Ulupi, Sri Darwati and Cece Sumantri	Association Analysis of NRAMP1 Gene Related to Resistance Against <i>Salmonella pullorum</i> Infection in Kampung Chicken	27
2.	Ahmad Saleh Harahap, Cece Sumantri, Niken Ulupi, Sri Darwati, and Tike Sartika	Polymorphism Calpain-3 (CAPN3) Gene and Association with Carcass Traits and Meat Quality in Kampung Chicken	32
3.	Wahyuni, Niken Ulupi and Nahrowi	Physical Quality of Broiler Meat Fed Diets Containing Mealworm Protein Concentrate	40
4.	Mega Sofia, Cece Sumantri, Niken Ulupi and Asep Gunawan	Identification Polymorphisms of Inos Gene and Association with Body Resistance Trait in Kampung Chicken	46
5.	Risky Nauli Panjaitan, Niken Ulupi and Nahrowi	Investigation of Cadmium Contamination in Mealworm, Ration and Broilers's Feces	51
6.	Woki Bilyaro, Asep Gunawan, Tuti Suryati, Cece Sumantri, and Sri Darwati	Malonaldehyde and Fat Contents of Kampong-meat Type Crossbreed Chicken	55
7.	Devi Kumala Sari, Henny Nuraini and Tuti Suryati	Quality of Gelatin Processed from Chicken Legs (<i>Tarsometa tarsus</i>) Skin with Different Method	59
8.	Linda Suhartati, Asep Gunawan, Rukmiasih, Sri Darwati, Cece Sumantri, and Tuti Suryati	Physical and Chemical Characteristic of Chicken Meat from Kampung x Meat Type Crossbred Chicken	64
9.	Teguh Rafian, Jakaria, Niken Ulupi, Yosi Fenita, and Muhammad Andriansyah	Evaluated the Effect of Fermented Palm Sludge on Burgo Chicken Performance	69
10.	Donald John Calvien Hutabarat, Fransisca Rungkat Zakaria, Endang Yuli Purwani, and Maggy Thenawidjaja Suhartono	SCFA Profile of Rice RS Fermentation by Colonic Microbiota, <i>Clostridium butyricum</i> BCC B2571, or <i>Eubacterium rectale</i> DSM 17629	73

11.	Asep Gunawan, Ahmad Furqon, Kasita Listyarini, Jakaria, and Cece Sumantri	Growth and Carcass Characteristic in Kampong x Broiler Crossbred Divergently Selected for Unsaturated Fatty Acid	84
12.	Niken Ulupi, Cece Sumatri and Sri Darwati	Resistance against <i>Salmonella pullorum</i> in IPB-D1 Crossbreed, Kampong and Commercial Broiler Chicken	88
13.	Angelia Utari Harahap	Effects of Wheat Leaf Noni (<i>Morinda citrifolia</i>) on Carcass and Production Quail Eggs (<i>Coturnix Coturnix Javonica</i>) in the Different Level Concentrate	92
14.	Armein Lusi Zeswita, Vivi Fitriani and Nursyahra	Microbial Analysis on Freshwater Shell (<i>Corbicula sumatrana</i>) in Singkarak Lake Solok District West Sumatra	96
15.	Syaiful F. L, E. Purwati, Suardi, and T.Afriani	Analysis of Estradiol and Progesterone Hormone Levels Against Various Cell Culture in TCM- 199 Medium for Cattle <i>In vitro</i>	100
16.	Harissatria, Jaswandi, and Hendri	Acceleration Time Equilibration Cauda Epididymis Spermatozoa Buffalo with Addition of Antioxidant Glutathione	109
17.	Jhon Hendri and Harris Satria	Buffalo Embryo Maturation Optimization in Vitro with Addition Glutathione	113
18.	Khalil, Reswati, Y.F. kurnia, Indahwati and Yuherman	Blood Mineral Profiles of Simmental Breed Cattle with Different Feeding Systems and Reproduction Statues in Payakumbuh Region West Sumatra, Indonesia	118
19.	Lendrawati, A. Rahmat and J. M. Nur	Performance of Broiler Chicken Fed Turmeric and Zinc Mineral under Heat	122
20.	Muslim	Utilization of Plant <i>Tithonia</i> Flowers (<i>Tithonia diversifolia</i>) in The Ration on The Performans of Broiler	126
21.	Resolinda Harly, Almasdi and Sri Mulyani	Analysis of Factors Influence Palm Oil Farmers Personal Income Trough Buffalo's Breeding	132
22.	Retno Wilyani and Moch Hisyam Hermawan	Nutritional Value of Persimmon Yoghurt (<i>Diospyros kaki</i>) as Healthy Soft Drink to Make Healthy and Fitness: An Analysis	136

23.	Zulfa Elymaizar, Arnin, Salam N Aritonang, Mardiaty Zein, and Elly Roza	In-Vitro Rumen Digestibility of Goat Feed by Patikan Kerbau (<i>Euphorbia hirta</i> L.) Herbal Supplemented	145
24.	Salam N. Aritonang, Elly Roza and Lailya Rahma	The Adding of <i>Saccharomyces cerevisiae</i> on Moisture, Acidity and Lactic Acid Bacteria Colony Count of Yogurt from Goat's Milk	150
25.	Yuherman, Nur Asmaq and Endang Purwati	Characteristics and Antimicrobial Activity of Lactic Acid Bacteria Isolated from Dadih of Agam Regency	156
26.	Yunizardi Ade Rakhmadi, and Endang Purwati	Effect of Addition White Oyster Mushroom (<i>Pleurotus ostreatus</i>) and Carrot (<i>Daucus carota</i> L) In Probiotic Duck Nugget On Protein, Calcium and Organoleptic Value	161
27.	Yulianti Fitri Kurnia and Endang Purwati	The Potential Of Dadiah From 50 Kota District, West Sumatra as a Probiotic Food Based On Total of Lactic Acid Bacteria	170
28.	Tertia Delia Nova, Sabrina and trianawati	The Effect of level Flour turmeric (<i>Curcuma domestica</i> Val) ration toward carcass local duck	174
29.	T. Astuti, G. Yelni, Nurhaita, and Y. Amir	Effect of the Form Complete Feed With Basis Fermented Palm Oil Fronds on the Content of Moisture, Crude Lipid, and Crude Protein for Ruminants	185
AGRICULTURES			
30.	Azwar Rasyidn, Gusmini, Ade Fitriadi and Yulmira Yanti	Soil Microbes Diversity Between Hilly and Volcanic Physiography And Their Effect To Soil Fertility	190
31.	Dafni Mawar Tarigan, Bambang SAS, and Hasanul Arifin Marmen	Application of Green Manure and Rabbits Urine Affect Morphological Characters of Sweet Corn Plant (<i>Zea mays saccharata</i> Sturt) in Lowland of Deli Serdang District	200
32.	Dewi Rezki, Siska Efendi, and Herviyanti	Humic Substance Characterization of Lignite as a Source of Organic Material	205
33.	Jamilah, Sri Mulyani, and Juniarti	Nutritional Composition of Ruminant Forage Derived from Rice Crops (<i>Oryza Sativa</i> L.) that Applicated by <i>C.odorata</i> Compost	208
34.	Mega Andini, Riska, and Kuswandi	Effectiveness of Liquid Smoke to Control Mealybug on Papaya	216

35.	M.Said Siregar, Arif Kurniawan, and Syakir Naim Siregar	Study on the Manufacture of Nuggets from Natural Rubber Seed (<i>Hevea Brasiliensis</i> Mull. Arg)	220
36.	Muhammad Thamrin, Desi Novita, Fitria Darma	Factors Affecting Farmers Decision to Convert Wetland	227
37.	Riry Prihatini, Yulia Irawati, Yosi Zendra Joni, and Sri Hadiati	The Occurrence of Somaclonal Variation on The Pineapple <i>In vitro</i> Culture as Detected by Molecular Markers	238
38.	Riska and Jumjunidang	Competitiveness of <i>Fusarium oxysporum</i> . sp <i>cubeense</i> VCGs 01213/16 (Tropical race 4) Among Several VCGs in Race 4 on Ambon Hijau Cultivar	244
39.	Fridarti and Sri Mulyani	Changes nutrients by microbial fermentation chocolate waste indigenous result of the additional mineral phosphor and sulphur in-vitro	252
40.	Sri Hadiati and Fitriana Nasution	Clustering and genetic distance some salak species (<i>Salacca</i> spp) based on morphological characters	256
41.	Asep Dedy Sutrisno, Yusman Taufik, and Jaka Rukmana	Optimalization Flour Composite Nutritiose as Basic Materials Processing for Food Products	264
42.	Sri Utami, Suryawati and Ermeli	KNO ₃ Concentration and Soaking Time Effect on Breaking Seed Dormancy and Seed Growth of Sour-Sop (<i>Annona muricata</i> L.)	272
43.	Susilawati, Dewi Sartika, and Mochamad Karel Saputra	Effect of Kepok Banana (<i>Musa paradisiaca</i> Linn) Peel Flour Addition as a Stabilizer on Chemical and Organoleptic Properties of Ice Cream	278
44.	Ubad Badrudin, Syakiroh Jazilah, and Budi Prakoso	The effect of soil submersion duration and ameliorant types on growth and yield of shallot at Brebes Regency	287
45.	Yulfi Desi, Trimurti Habazar, Ujang Khairul, and Agustian	Disease progress of Stewart's Wilt (<i>Pantoea stewartii</i> subsp. <i>stewartii</i>) on sweet corn	293
46.	Yusnawati	On growth response and results of upland rice due to the allotment of some a dose of compost bamboo leaves	300
47.	Fadriani Widya, Darmawan, and Adrinal	Rice husk biochar application in traditional paddy soil and its effect of nutrients vertical distribution	306

48.	Ragapadmi Purnamaningsih, Ika Roostika, and Sri Hutami	Embryogenic Callus Induction and Globular Embryo Formation of Kopyor Coconut (<i>Cocos nucifera</i> L.)	313
49.	A. Sparta, L. Octriana, Nofiarli, N. Marta, Kuswandi, M. Andini, and Y. Irawati	The Role of Cow Manure to Reduce The Need of Nutrient N Inorganic In Banana Plant Vegetative Growth	320
50.	Desi Ardilla, Herla Rusmarilin, and Adi Purnama	Study The Physical And Chemical Properties Of Bioethanol From Pineapple Skin (<i>Ananas comusus</i> L.Merr)	325
51	Masyhura MD, Budi Suarti, and Evan Ardyanto AS	Increase Moringa Leaf Powder and Long Roasting on Protein Content in the Making of Cookies from Mocaf (<i>Modified Cassava Flour</i>)	331
MEDICINES, PUBLIC HEALTH, ENGINEERING, AND NATURAL SCIENCES			
52.	Ayulia Fardila Sari ZA, Putri Nilam Sari, and Muthia Sari	Implementation of Hospital Information System in RSUP Dr. M. Djamil Padang 2016	336
53.	Dien GA Nursal, Rizanda Machmud, Eryati Darwin, Nana Mulyana	Implementation Patient Safety Standards in Basic Emergency Obstetric Care Community Health Center (BEOC_CHC) Padang	344
54.	Dewi Sartika, Susilawati, and Mumpuni Uji Kawedar	Survey of Salmonella Contaminated Vannamei Shrimps in Lampung	351
55.	Ferra Yanuar	Determinants of Birth Weight at Various Quantiles in West Sumatra	358
56.	Hardany Primarizky, Ira Sari Yudaniayanti, and Djoko Galijono	Detection Of Osteoporosis in Ovariohysterectomized Cats (<i>Felis Domesticus</i>) based on Serum Osteocalcin Levels	363
57.	Nefilinda	Influence of Education and Local Wisdom on Environment Villages in Minangkabau	368
58.	Masri, E., Asmira,S and Verawati	Local Food Development from Combination <i>Siarang</i> Variety Of Black Rice (<i>Oryza Sativa L.Indica</i>) And Yellow Pumpkin (<i>Cucurbita Moschata</i>) To Prevent Anemia For Pregnant Women	375
59.	Suryani, Zulmardi, Abdi Dharma, Yunazar Manjang, and Febria Elvy Susanti	Development of Antimicrobial Analysis of Lactic Acid Bacteria Isolated from VCO (Virgin Coconut Oil) Fermentation Process Against Bacteria in The Secretion of CSOM	380

60.	Suci Rahayu, Darmawan Saptadi, and Febi Reza Fitriani	The Influence of Dicamba in Combination with BAP on Callus Induction and Proliferation of <i>Centella</i> (<i>Centella asiatica</i> L.)	387
61.	Christina J. R. E. Lumbantobing, Endang Purwati, Sumaryati Syukur, and Eti Yerizel	Triglyceride lowering effect of <i>Garcinia atroviridis</i> leaf tea from Sijunjung - West Sumatra on obese subjects in Medan, North Sumatra	395
62.	Netty Suharti	Preparation and Characterization of Ethanol Extract of <i>Mychorryzae</i> Induced Ginger as Raw Matherial for Anti Breast cancer Nano suspension Formulation	404
63.	Misril Fuadi, Mahmud T.M. Mohamed, Mohd. Fauzi Ramlan, Yahya Awang	Effect of Benzyladenine (BA) and Duration of Shading onGrowth and Quality of <i>Dracaena sanderiana</i> and <i>Codiaeum variegatum</i>	408
ECONOMY AND SOCIAL SCI ENCES			
64.	Andri, Ida Indrayani and Rahmi Wati	Technical Efficiency Analysis of Poultry in District of 50 Kota (Stochastic Frontier Production Function Approach)	417
65.	Arif Fadhillah	Teaching Accounting in Business School: A Personal Reflection	422
66.	Wijaya Edo Rantou	Analysis Influence of Technical Competence on Company's Performance In Electrical Engineering Company In Bandung	427
67.	Ike Revita, R. Trioclarise, Inesti Printa Elisya	Reflections Of Social Reality In The Activities Of Women Trafficking In West Sumatera	435
68.	Ira Apriyanti, Desi Novita, and Pandhu Ahmad Pangestu	Efficiency of Marketing Distribution of Palm Oil in Sub District of Selesai Regency of Langkat	440
69.	Yeyep Natrio, Afdhal Rinsik, Gusmaizal Syandri	The Occurance Of Transitivity And Suicidal Motives On Famous Public Figure`S Suicide Letters	446
70.	Yusmarni	An analysis of Marketing Efficiency of Sapodilla in Nagari Sumpur sub district of Tanah Datar, West Sumatera	457

71.	Jusuf Wahyudi, Hesti Nur'aini and Lina Widawati	Information Systems of Eradication Pests and Diseases Crops for Agriculture Extension Instructor	464
72.	Desi Novita and Ira Apriyanti	The Regional Investment Competitiveness In Binjai City	469
73.	Khairunnisa Rangkuti, Desi Novita, and Bima Mahdi	The Impact of Rising Soybean Prices to Tofu Industry Small Scale in Medan	474

List of Poster

No.	Author's	Title	Page
ANIMAL SCIENCES			
1.	Wahidin Teguh Sasongko, Teguh Wahyono, Shintia Nugrahini Wahyu Hardani, and Firsoni	Total Gas Production, Methane and Rumen Fermentation Characteristics of Rejected Soybean Meal Protected by Jackfruit Leaves	484
2.	Nita Yessirita, Tinda Afriani, and Sunadi	The Supplementation of Amino Acid Methionine-Lysine on the Protein Quality of <i>Leucaena</i> Leaf Meal Fermented with <i>Bacillus laterosporus</i>	492
AGRICULTURES			
3.	Willy Pranata Widjaja, Sumartini	Optimization Of Koji Concentration And Fermentation Time To Characteristics Of Modified Sorghum (<i>Sorghum Bicolor</i> L Monench) Flour	499
4.	Kuswandi, Makful, Sahlan, and Mega Andini	Evaluation Performance Of Some Hybrid Of Watermelon From Indonesian Tropical Fruit Research Institute	508
5.	A. Sparta, R, Triatminingsih, Y.Z. Joni, and Nofiarli	The Using of Thidiazuron to Induce the Mangoesteen Shoot (<i>Garcinia mangostana</i> L.) by Direct Organogenesis	513
6.	Ira Sari Yudaniayanti, Bambang Sektiari L., and Hardany Primarizky	Healing Quality Of Femoral Fractures In Ovariectomized Rats With Therapy Of <i>Cissus Quadrangularis</i> Extract Shown by The Expression Of Type I Collagen	517
7.	Sri Hadiati and Tri Budiyantri	Parameters Genetic of Fruit Component Characters on Snake Fruit (<i>Salacca</i> sp.)	525
8.	Riry Prihatini, Tri Budiyantri, and Noflindawati	Genetic Variability of Indonesian Papaya (<i>carica</i> spp.) as Revealed by RAPD (Rapid Amplified Polymorphic DNA)	530
9.	Regina Andayani and Fivi Yunianti	The Effects of Oxidation And Thermolysis Reaction on a-Mangostin Content in the Ethyl Acetate Extract of Mangosteen Rind (<i>Garcinia mangostana</i> L.) by High Performance Liquid Chromatography	538
10.	Nini Marta, Kuswandi, Liza Octriana, and Nofiarli	The effectiveness test of herbicides 2,4 D, glyphosate, paraquat on low dose as growth regulator on papaya seedling	545

Physical Quality of Broiler Meat Fed Diets Containing Mealworm Protein Concentrate

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Abstract

The research aimed to evaluate the physical quality of broiler meat fed with diets containing mealworm protein concentrate. Mealworms are beetle larvae of *Tenebriomolitor*, local insects that are potential to be used as feed material in Indonesia and expected to replace Meat and Bone Meal (MBM) that are still imported. Mealworm protein content were higher than the MBM, about 45.87% and 42.94%, respectively. The materials used for this research were 100 DOC (Day Old Chick) Lohman strain (MB 202) broiler male with average body weight of 46.72 ± 1.32 g/head. The broilers were reared for 35 days. The experimental design was Completely Randomized Design (CRD) with two treatments and five replications, and each replication consisted of ten broiler chickens. The treatments consisted of T0 and T1. T0 was feed containing mealworm protein concentrate 0% and 5% MBM as a control and the T1 was feed containing 5% mealworm protein concentrate and 0% MBM. Data were analyzed using T-test. The variables measured were pH, Tenderness, Water Holding Capacity (WHC), and cooking loss. The result showed that feed with mealworm protein concentrates had no significant effect ($P < 0.05$) on tenderness and cooking loss. While, T1 had higher pH and WHC value than T0. It can be concluded that the utilization of mealworms protein-containing feed can replace MBM and showed better influence on the physical quality of broiler meat (pH, tenderness, cooking loss, and WHC).

Keywords: mealworm, protein, physical quality of the meat, broiler

1. Introduction

Mealworm or yellow mealworm is beetle larvae of *Tenebriomolitor* [1]. In Indonesia, it is popular as -ulathongkong (hongkong caterpillar). Mealworm is one of the local insects that could potentially be used as feed material in Indonesia. Reference [2] reported that mealworm contains good nutrients including protein, fat, carbohydrates and vitamins. In addition to having a high nutrient, mealworm is also easily found, can

grow quickly, and the feed is not complicated.

It also requires a low input in breeding.

Some studies related to mealworm have been reported. Reference [3] found that mealworm contained complete essential amino acid composition. Mealworm has been industrially produced as feed for pets and animals at the zoo, including birds, reptiles, small mammals, amphibians and fish [4]. This caterpillar has proven to be a source of protein that can be accepted by the African catfish

[5], chicks [6], laying hens [7], and pork [6]. Reference [6] used mealworm as a substitute soybean meal in feed chicks. In Europe, the mealworm has been widely used not only as animal feed, but also human consumption [1].

Reference [9] showed that mealworm can be used as an alternative to imported feed materials in Indonesia, namely *Meat Bone Meal* (MBM) in broiler chicken feed. Substitution of MBM by mealworm is considerable since it has higher protein (45.87%) than MBM (42.94%). Mealworm in the form of extract and flour could increase its protein content. The use of mealworm intact in broiler chicken feed unaltered the performance, but no research has been done related to the quality of meat and protein extraction of mealworm [10]. The physical quality of the meat shows great effects on consumer acceptance. Physical or chemical quality of the meat were affected by the feed [11]. Therefore, this study was conducted to evaluate the use of the mealworm protein concentrates to the quality of broiler meat.

2. Material and Methods

The research was conducted at the cages of Animal Husbandry Faculty, Bogor Agricultural University in July-September 2016. The physical quality analysis was conducted at the Laboratory of the Department of Ruminant.

This study used 100 DOC (*Day Old Chick*) male broiler chickens with brands MB 202 (*Lohmanstrain*) that were divided into two treatments and five replications, and each replication consisted of 10 animals.

2.1. Feed Production

Mealworm protein was extracted using dry and rendering methods [12]. The composition of feed ingredients in the ration was exhibited in Table 1. Feed on starter and *finisher* phase was formulated according to [13]. Details of treatment were:
R0 : Feed containing mealworm protein concentrate 0%, MBM 5% (control)

R1 : Feed containing mealworm protein concentrate 5%, MBM 0%

2.2. Maintenance and Slaughter

Maintenance of broilers was conducted for 35 days. The feeding and drinking method was performed *ad libitum*, 3 times a day (at 07.00 (morning), 12.00 (noon) and 16.00 (afternoon)). At the end of the experiment, the chickens were slaughtered after fasting for 24 hours. Chicken samples were taken at random, respectively 10% in each plot. Samples were taken on the breast to test the quality of the meat.

2.3. Physical Quality of Broiler Meat

pH value [14]. Measurement was performed using pH meter (Hanna, USA). Cathode was calibrated, and then dipped in the sample to obtain constant pH value displayed in the pH meter. Cathode was rinsed with distilled water for next measurement.

Tenderness [11]. The meat was boiled at 80 °C. The meat samples were drained and cooled for 1 hour to obtain constant weight. Samples were formed by following the directions *correr* meat fibers. Strips of flesh was measured by *Warner-Blatzer Shear Force* to determine the value of the power breakdown.

Cooking Loss [15]. Cooking loss represented the weight ratio of pre-cooked and post-cooked meat at 80 °C for 15 minutes.

WHC [15]. Hamm methods can be used to describe the WHC of meat. Samples (0.3 g) were set between filter papers and pressed with load 35 kg. After 5 minutes, the wet area surrounding the covered area was marked and measured.

Table 1. The composition of feedstuffs treatment (starter and finisher)

Material Composition	Starter		Finisher	
	R0 (%)	R1 (%)	R0 (%)	R1 (%)
Corn	54.18	54.09	63.77	64.70
Rice bran	3.50	4.00	3.50	3.50
Soybean meal	30.81	29.78	20.78	19.69
MBM	5	0	5	0
Mealworm protein concentrate	0	5	0	5
CPO	4.04	3.00	4.59	3.20
CaCO ₃	0.85	1.50	0.66	1.35
DCP	0.30	1.35	0.45	1.33
Salt	0.45	0.44	0.45	0.41
L-Lysine	0.08	0.18	0.09	0.19
DL-Methionine	0.28	0.22	0.21	0.13
Premix	0.50	0.50	0.50	0.50
Total	100	100	100	100
*Nutritional Content:				
Dry ingredients (%)	89.63	89.87	89.69	89.88
Metabolizable energy (kcal/kg)	3050	3050	3150	3150
Crude protein (%)	22	22	18	18
Fat (%)	6.94	6.43	7.79	6.96
Crude Fiber (%)	2.82	3.32	2.76	3.22
Calcium (%)	0.95	0.97	0.89	0.89
Phosphor (%)	0.68	0.66	0.67	0.61
Lysine (%)	1.30	1.30	1	1
Methionine (%)	0.65	0.57	0.52	0.43
Methionine+Cystine (%)	0.95	0.96	0.76	0.75

*The Result of Calculation

Table 2. Chicken carcass as result of mealworm protein concentrate addition

Parameters	Feed Containing	
	MBM	Mealworm
Final Body Weight (g)	1631 ± 62	1680 ± 72
Carcass weight (g)	1093 ± 53	1159 ± 60
Carcass percentage (%)	67	69

Table 3. Physical quality of broiler meat treated with addition of mealworm protein concentrate

Parameters	Feed Containing	
	MBM	Mealworm
pH	5.95 ± 0.04a	6.19 ± 0.12b
Tenderness	7.01 ± 0.48a	6.69 ± 0.61a
Cooking Loss (%)	35.66 ± 6.89a	32.96 ± 6.08a
WHC (%)	23.19 ± 2.74a	34.02 ± 3.21b

The different letters following the values in the same row indicate significant difference (P <0.05)

Wet area was outside of the circle, the circle area was measured using planimeter to obtain mgH₂O.

$$\text{mgH}_2\text{O} = \frac{\text{wet area (cm}^2\text{)}}{0.0948} \times 8.0$$

2.3. Statistical Analysis

Completely randomized design was selected for experimental design. The data were analyzed by t-test using SPSS software.

3. Result and Discussion

Percentage of broiler carcass with treatment of mealworm protein concentrate is presented in Table 2.

The results showed that final body weight of chicken was not different. However, the percentage of chicken carcass with treatment of mealworm protein concentrate has a higher value. Chicken carcass as result of mealworm protein concentrate addition were evaluated its meat quality.

Meat quality is attribute to high brightness and not stink. In addition, pH, tenderness, cooking loss and water holding capacity (WHC) of meat contributed to meat quality in term of consumer acceptance [11]. The physical quality of broiler chicken meat is displayed in Table 3.

3.1. Potential Hydrogen (pH)

Table 3 indicates that the administration of feed containing mealworm protein concentrate shows significant differences ($P < 0.05$) in pH values of male broiler chicken breast meat. After cutting process, the pH value of broiler meat was 6.31, and then decreases [16]. The pH in this study was measured at three hours after cutting. Therefore, the pH value is not extremely decreased. The absence of blood after the slaughtering discontinues oxygen supply to the brain, and causes glycogen scarcity in the muscles. Consequently, some changes are observed in the muscle including temperature, pH, and process of

rigormortis. The decrease in pH value was associated with high acidity due to production of lactic acid. This condition led to formation of open structure of the meat and lowered the WHC [17]

3.2. Tenderness

Table 3 showed that the treatments (MBM and Mealworm protein concentrate) had no significant effects ($P > 0.05$) on the meat tenderness (7.01 ± 0.48 and 6.69 ± 0.61 , respectively). Tenderness represented the pressure needed to cut a product per unit area (kg cm^{-2}), suggesting that the smaller value showed more tenderness of the meat [11]. The higher value of *Warner Blatzler* means more force required to break the fibers of the meat square percentimeter. This means high meat tenderness [18]. The level of meat tenderness was determined by the extent of connective tissue proteins, namely collagen, miofibril, actomyosin and elastin [16].

In the study, we tested breast meat to produce relatively equal tenderness. The breast muscle is considered to have low activity, thus the breast muscle is less structured. In addition, less myofibril protein meat lead to lower water holding capacity, contributing to higher meat tenderness. This is in accordance with [19] that the high activity muscles have greater myofibril fibers, and proteins in the muscle meat as liaisons have an important effect on the value of meat tenderness. The higher the protein content of meat, the meat tenderness is lower.

3.3. Cooking Loss

T-test showed that the treatments showed no significant effects on percentage of cooking loss ($P > 0.05$). Cooking loss is affected by the protein content of feed. The feed has similar protein content, 22% in the starter phase and 18% in the finisher phase (food prepared in iso protein), resulting in similar cooking loss. However, Table 3 indicated that feed containing mealworm

protein concentrate tend to produce lower cooking loss. Reference [11] reported that desirable meat had low cooking loss due to less nutritional disintegration. This figure relates to the binding power of water by protein meat. Low WHC of meat is attributed to high fluid loss, resulting in decreased meat weight. In this study, the cooking loss is in acceptable value. Acceptable values of cooking shrinkage of chicken meat was 15-40% [16].

3.4. Water Holding Capacity (WHC)

Water holding Capacity (WHC) is the ability of the meat protein to bind water. Thus, WHC, expressed as percent, represents the level of meat protein damage. The ability to bind water is an important factor, especially in the meat to be used in the food industry. Administration of mealworm protein concentrate in the feed showed significant differences ($P < 0.05$) as exhibited in Table 3. Reference [19] found that the decrease rate of pH in *postmortem* meat is a key determinant for water holding capacity. The pH value and the value of WHC was inversely correlated in this study. This is consistent with the statement [11] that the pH value of meat is directly proportional to the water holding capacity. The higher the pH value of the meat, the greater the ability of meat to bind water, vice versa. Furthermore, reference [20] suggests that changes in water holding capacity of meat due to the change ions are bound by protein meat. The decline in water holding capacity is due to the increasing number of lactic acid that accumulates as a result of damaged miofibriler proteins. Thus the ability of protein to bind water is reduced. High protein content of meat is attributed to higher water binding power. The expansion of the network of proteins or protein miofibril development (particularly myosin) was due to the weakening of hydrogen bonds or hydrophobic bonds that cause more mobilized

between miofibril, resulting in higher water holding capacity [20].

Conclusion

Feed supplementation by meal worm protein concentrates was considerable to substitute MBM, and exhibited better effects on physical properties of broiler meat.

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