



ATLANTIS  
PRESS

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Postgraduate School Universitas Airlangga :  
"Implementation of Climate Change Agreement to  
Meet Sustainable Development Goals"  
(ICPSUAS 2017)

at the Universitas Airlangga on August 1 - 2, 2017

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**Implementation of Climate Change  
Agreement to Meet Sustainable  
Development Goals**

**Advances in Social Science, Education and  
Humanities Research Volume 98**

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## **SESSION: GENDER EQUALITY**

<b>COULD THE EXISTENCE OF MICROFINANCE INSTITUTION FOR ALLEVIATION POVERTY IN RURAL AREA? A CASE STUDY IN WOMEN'S COOPERATIVE IN MAGERSARI VILLAGE, PLUMPANG SUB-DISTRICT, EAST JAVA, INDONESIA</b> .....	69
<i>Rustinsyah</i>	
<b>WOMEN EMPOWERMENT TO SUPPORT FAMILIES ECONOMY IN SUKAMUKTI CIAMIS INDONESIA</b> .....	76
<i>Nuning Kurniasih, Pawit M. Yusup, Engkus Kuswarno</i>	
<b>THE INFLUENCE OF EMOTIONAL INTELLIGENCE TO THE PERFORMANCE OF FEMALE LECTURERS AT SEVERAL PRIVATE COLLEGES IN BALIKPAPAN</b> .....	79
<i>Mardatillah</i>	

## **SESSION: RESPONSIBLE CONSUMPTION AND PRODUCTION**

<b>UTILIZATION OF DIGESTIBLE NUTRIENTS OF FEED RATIONS CONTAINING BLACK GLUTEN AND RED RICE BY MINI REX RABBIT</b> .....	83
<i>S. Romziah, K. Emy, H Sri</i>	
<b>PRODUCTION OF CARP IMMUNOGLOBULIN M EXPOSED WITH WHOLE PROTEIN FROM MYXOBOLUS KOI SPORE THROUGH FEED AS AN IMMUNOSTIMULANT</b> .....	87
<i>Moch. Saad, Gunanti Mahasri, Woro Hastuti Satyantini</i>	
<b>THE INFLUENCE OF THE DIFFERENT COMMERCIAL PROBIOTIC ON THE BIOFLOC NUTRITION</b> .....	94
<i>Endang Dewi Masithah, Fitri Anisha Kurniawati, Azhar Muhammad Helmi</i>	

## **SESSION: GOOD HEALTH AND WELL-BEING**

<b>ANTIGENIC PROTEIN OF LEUCOCYTOZOOM CAULLERYI SCHIZONT INDUCING CELLULAR IMMUNE RESPONSE: TLR-2 AND CD4 AS MARKER</b> .....	98
<i>Nunuk Dyah Retno Lastuti, Endang Suprihati, Dony Chrismanto, Anwar Ma'Ruf</i>	
<b>INFECTIOUS RESPIRATORY SUSPECT MALLEUS IN PONY HORSE AT SIDOARJO EAST JAVA INDONESIA</b> .....	102
<i>Arya Pradana Wicaksono, Romziah Sidik</i>	
<b>CONSUMER PROTECTION ON THE CIRCULATION OF COSMETIC ONLINE</b> .....	104
<i>Lilik Pudjiastuti, Emanuel Sujatmoko, Indrawati</i>	
<b>THE TRADITIONAL WAY IN PREVENTING AND OVERCOMING HEALTH PROBLEMS AMONG SULFUR MINERS IN THE CRATERS OF IJEN</b> .....	109
<i>Wisnu Setiadj, Myrtati D. Artaria</i>	
<b>SELF INDEPENDENCE OF FAMILY PLANNING IN URBAN AREA GRESIK DISTRICT</b> .....	114
<i>Yuly Sulistyorini, Nunik Puspitasari, Diah Indriani, Rachmah Indawati</i>	
<b>ANALYSIS OF THE EFFECT OF INDIVIDUAL, FAMILIAL AND ENVIRONMENTAL FACTORS ON FAMILY STIGMA OF LEPROSY IN JOMBANG REGENCY, EAST JAVA INDONESIA</b> .....	118
<i>Nasrudin, Tjipto Suwandi, Cholichul Hadi, A. Yusuf, R. Hargono</i>	
<b>THE FREQUENCY OF Y-PATTERN DENTAL TRAITS ON LOWER MOLAR OF JAVANESE DEUTROMALAYID</b> .....	123
<i>Aprian A. Prasty, Myrtati D. Artaria</i>	
<b>ANTIDIABETIC EFFECT ON TEA OF PLUCHEA INDICA LESS AS FUNCTIONAL BEVERAGE IN DIABETIC PATIENTS</b> .....	126
<i>Yesiana Dwi Wahyu Werdani, Paimi Sri Widayawati</i>	
<b>DESIGN OF A WIRELESS TELEMETRIC SENSOR SYSTEM FOR MONITORING THE DEVELOPMENT AND TREATMENT OF CHRONIC DIABETIC FOOT INJURIES</b> .....	130
<i>Suryani Dyah Astuti, Tri A. Prijo, Wirda A. Ridyananda, I. Suhariningsih</i>	
<b>ACTIVATION OF FAK EXPRESSION IN INFLUENCING BONE DENSITY BY EXERCISE TRAINING FOR DECREASIS OSTEOPOROTIC RISK</b> .....	133
<i>Nurul Mahmudati, Hawin Nurdiana</i>	
<b>ANTIMICROBIAL USAGE SURVEILLANCE OF CATTLE IN INDONESIA TO ADDRESS ANTIMICROBIAL RESISTANCE</b> .....	136
<i>Havan Yusuf, Syafrison Idris, Mathilde Paul, Theera Rukkwamsuk</i>	

## TABLE OF CONTENTS

### SESSION: INDUSTRY, INNOVATION AND INFRASTRUCTURE

<b>ANALYSIS OF FACTORS THAT INFLUENCE THE RISK OF OCCUPATIONAL ACCIDENTS IN TERMS OF BEHAVIORAL ASPECTS (STUDY ON AIRCRAFT PAINT REMOVAL WORKERS IN PT. X).....</b>	<b>1</b>
<i>Hesti Fiskalisa Purbayanti, Tri Martiana</i>	
<b>EARLY STUDY THE POTENCY OF TURMERIC (CURCUMA DOMESTICA VAL.) AS IMMUNOSTIMULATOR FOR LAYERS CHICKENS AGAINST AVIAN INFLUENZA (AI) VACCINE .....</b>	<b>7</b>
<i>Dyah Widhowati, Nurul Hidayah, Retina Yunani, Mijania Malia</i>	
<b>THE USE OF CELL FREE FETAL DNA [CFF-DNA] AS NON-INVASIVE TECHNIQUES ON PATERNITY TEST [FORENSIC IDENTIFICATION].....</b>	<b>10</b>
<i>Ahmad Yudianto</i>	
<b>LIBRARIAN : ANALYSIS FACTORS OF CAREER DEVELOPMENT .....</b>	<b>13</b>
<i>Dimas Agung Trisliatanto, Koko Srimulyo, Helmy Prasetyo Yuwinanto, Mirza Dewi Suntari, Lastika Kusumawardhani</i>	
<b>THE COMPETENCY DEVELOPMENT MODEL BASED ON PERFORMANCE .....</b>	<b>19</b>
<i>Dimas Agung Trisliatanto, Falih Suaedi, Fahmi Muhammad Az-Zuhri, Teguh Prasetyo, Rizka Pranatasari</i>	
<b>IDENTIFICATION HUMAN AND ANIMAL BLOOD MIXTURES USING HUMAN CYTOCHROME B GENE .....</b>	<b>26</b>
<i>Wimbuh Tri Widodo, Abdul Hadi Furqoni, Ahmad Yudianto, Sri Puji Astuti Wahyuningsih</i>	
<b>ANATOMICAL PATHOLOGY AND RADIOLOGY APPEARANCE OF BALLISTIC WOUND RESULT OF CAL. 177 AIR RIFLE WITH 4,5 MM PELLETS ON EXTRIMITY OF THE DOG (CANIS LUPUS FAMILIARIS) AT DIFFERENT SHOOTING DISTANCES.....</b>	<b>29</b>
<i>B. Putra, J. Rahmahani, E. Aksono, D. Legowo, B. Christoffel</i>	
<b>JOB SATISFACTION AND JOB MOTIVATION TOWARD PERFORMANCE THROUGH ORGANIZATIONAL COMMITMENT .....</b>	<b>33</b>
<i>Dimas Agung Trisliatanto, Tan Evan Tandiyono, Dimaz Ganjar Harry Pradana, Pristiandi Teguh Cahya, Nur Anilawati</i>	
<b>QUALITY AND QUANTITY TEST OF DNA FROM SPERM IN WATER IMMERSION .....</b>	<b>39</b>
<i>Abdul Hadi Furqoni, Wimbuh Tri Widodo, A. Yudianto</i>	
<b>IMMUNOMODULATION EFFECT OF MENIRAN (PHYLLANTHUS NIRURI LINN) ON BLOOD PROFILE OF BROILER CHICKENS INFECTED WITH ENTEROTOXIN OF ANTIBIOTIC-RESISTANT ESCHERICHIA COLI .....</b>	<b>42</b>
<i>Retno Sri Wahjuni, Emy Koestanti Sabdoningrum, Sri Hidanah, Diyantoro, R. Wahjuni</i>	

### SESSION: OPENING

<b>OBESITY IN PETS - ONE HEALTH AND ANIMAL WELFARE CONSIDERATIONS .....</b>	<b>45</b>
<i>Shane Ryan</i>	
<b>ENZOOTIC BOVINE LEUKOSIS: HOW TO PREVENT THE DISEASE AND CONTROL THE SPREAD OF BLV INFECTION.....</b>	<b>50</b>
<i>Takeshi Haga</i>	
<b>CARBON ACCOUNTING REFLECTION AS A RESPONSE TO FACE THE CLIMATE CHANGE.....</b>	<b>52</b>
<i>Sri Iswati</i>	
<b>DEVELOPMENT OF LEGAL THEORY FOR ENVIRONMENT PROTECTION AND REMEDY FOR VICTIMS IN JAPAN .....</b>	<b>56</b>
<i>Yuzuru Shimada</i>	
<b>AN OVERVIEW OF THE SEAWEED CULTIVATION IN SEVERAL COUNTRIES: TECHNOLOGY AND CHALLENGE .....</b>	<b>62</b>
<i>Mochammad Amin Alamsjah</i>	

<b>EFFECTS OF HEAT EXPOSURE DURATION ON SALIVA TRACES ON CIGARETTE BUTTS AS FORENSIC IDENTIFICATION TOOLS</b> .....	141
<i>Mely Purnadianti, Andika Alivameita, Diah Ayu Nur Rochmawati, Dian Amanovitasari</i>	
<b>THE USAGE OF VISUM ET REPERTUM (VER) AS A SCIENTIFIC EVIDENCE IN ANIMAL ABUSE ACCORDING TO THE PERSPECTIVE OF THE PENAL CODE (KUHP) AND THE LAW OF CRIMINAL PROCEDURE CODE (KUHAP) IN INDONESIA</b> .....	144
<i>A. Bilqisthi, N. Ignatius, H. Pudji, Haniyah, Sadjijono</i>	
<b>POLICY INSTRUMENTS ON REPRODUCTIVE HEALTH AS REALIZATION OF CIVIL RIGHTS IN GENDER EQUALITY AND JUSTICE</b> .....	148
<i>Lina Hastuti, Lilik Pudjiastuti, Sukardi</i>	
<b>MODEL OF ADOLESCENT REPRODUCTIVE HEALTH INFORMATION DISSEMINATION IN BANDUNG WEST JAVA INDONESIA</b> .....	153
<i>Nuning Kurniasih</i>	
<b>RELATION EFFECT OF VARIATION TIME STORAGE YAM TUBER (PACHYRRHIZUSEROZUS) TO CHOLESTEROL RATTUSNORVEGICUS</b> .....	157
<i>Anggi Khairina Hamum Hasibuan, Wa Ode Diana, Yosephin Anis Widiyanti</i>	
<b>PROTEIN SIGNAL TRANSDUCERS AND ACTIVATORS TRANSCRIPTION (STAT) AS GROWTH PROMOTER</b> .....	162
<i>Anwar Ma'Ruf, Ngakan Made Rv, M. Sukmanadi, Ratna Damayanti</i>	
<b>POTENTIAL PROTEIN GHRELIN ORIGIN OF PLANT AS ENERGY BALANCE SETTINGS FOR FEED EFFICIENCY</b> .....	166
<i>Nove Hidayati, Chairul Anwar, Ratna Damayanti</i>	
<b>ANTIOXIDANT ACTIVITY ASSAY OF ALPHA-MANGOSTIN FOR AMELIORATION OF KIDNEY STRUCTURE AND FUNCTION IN DIABETIC MICE</b> .....	170
<i>Saikhu Akhmad Husen, Firas Khaleyla, Arif Nur Muhammad Ansori, Raden Joko Kuncoroningrat Susilo, Dwi Winarni, Salamun</i>	
<b>RISK ANALYSIS OF OCCUPATIONAL DISEASES IN HARBOR COMMUNITY</b> .....	175
<i>Martiana Tri, N. Widajati</i>	
<b>THE VASCULAR DISTRIBUTION USING COLOR DOPPLER SONOGRAPHY IN AXILLARY NODES OF BREAST CANCER TO ASSES METASTASIS</b> .....	179
<i>Lailatul Muqmiroh, Lies Mardiyana, Heru Purwanto, Sri Agustiniingsih</i>	
<b>PHOTODYNAMIC INACTIVATION FOR PHATOGENIC BACTERIA: ADDING CHLOROPHYLL AND OXYGEN</b> .....	185
<i>Basitha Febrinda Hidayatulail, Moh. Yasin, Suryani Dyah Astuti</i>	
<b>THE EFFECT OF DAYAK ONION (ELEUTHERINE PALMIFOLIA) TUBER EXTRACT IN LIVER MALONDIALDEHYDE (MDA) LEVEL IN MALE WISTAR RATS INDUCED BY ALLOXAN</b> .....	189
<i>Risqia Damayanti, Anwar Ma'Ruf</i>	
<b>FISH PROTEIN PROFILE SUBMERGE ALUM SOLUTIONBASED ON SDS-PAGE</b> .....	192
<i>Akhmad Mubarak, S. Darmawati, T. Endang</i>	
<b>EFFECTIVENESS TEST OF AKAR KUCING PLANT EXTRACT (ACALYPHA INDICA LINN) TO LOWER TOTAL CHOLESTEROL LEVELS IN RATS (RATTUS NOVERGICUS) WHICH INDUCED HYPERCHOLESTEROLEMIA DIET</b> .....	195
<i>Retno Sri Wahyuni, Fitria Agung Nugrahaningtyas, Nove Hidayati, Rochmah Kurnijasanti</i>	

#### **SESSION: DECENT WORK AND ECONOMIC GROWTH**

<b>INDICATOR OF ZAKAT OVER MUZAKKI AN EXPLANATORY STUDY ON BAZNAS OF CENTRAL JAVA PROVINCE</b> .....	198
<i>Suraji, Sri Iswati</i>	
<b>KAILI WOMEN'S EMPOWERMENT IN INDONESIA</b> .....	202
<i>Indah Ahdiah, B. Suyanto, I. Wirawan</i>	
<b>THE ROLE OF MUHAMMADIYAH IN THE DEVELOPMENT OF SOCIAL CAPITAL COMMUNITY</b> .....	206
<i>Sri Iswati, Sri Herianingrum, Muslich Anshori, H. Effendie, Tika Widiastuti, Ririn Tri Ratnasari</i>	
<b>ROLE OF SOCIAL EUNTERPRENEURSHIP ON POVERTY REDUCTION AND ECONOMIC GROWTH IN INDONESIA</b> .....	211
<i>Risma Ayu Kinanti, Sri Iswati, Tjiptohadi Sawarjuwono, Ririn Tri Ratnasari</i>	
<b>WAFQ PRODUCTIVE EFFICIENCY: EVIDENCE FROM YAYASAN BADAN WAKAF SULTAN AGUNG, SEMARANG</b> .....	217
<i>Tika Widiastuti, Wahyuningasih</i>	

<b>EFFECT OF THE FINANCING OF SHARIA BANK ON THE INFLATION IN INDONESIA</b> .....	225
<i>Anas Alhifni, Rully Trihantana Rully, Maya Apriyana</i>	
<b>EMPOWERING COMMUNITY INFORMATION GROUP: STRATEGIC COMMUNICATION PLAN IN COMMUNICATION AND INFORMATICS OFFICE OF MALANG CITY</b> .....	230
<i>Dani Maroe Beni</i>	
<b>EVALUATION OF INVESTMENT POLICY IN THE FORM OF TAX HOLIDAY IN ORDER TO INCREASE INDONESIAN ECONOMIC GROWTH</b> .....	240
<i>Resha Dwiayu Pangesti Mulyono, Elia Mustikasari</i>	
<b>THE EXTERNAL AND INTERNAL FACTORS ON MICRO, SMALL AND MEDIUM ENTERPRISE (SME) FINANCING IN ISLAMIC BANK</b> .....	244
<i>Fira Nurafini, Raditya Sukmana, Sri Herianingrum</i>	
<b>ANALYSIS OF THE ROLE SHARIA FINANCING AND CHARACTERISTICS OF BUSINESS INSTITUTIONS TO MICRO, SMALL AND MEDIUM ENTERPRISE (MSMES) DEVELOPMENT IN SOLOK CITY OF WEST SUMATERA</b> .....	249
<i>Neng Kamarni, Muslich Anshori</i>	
<b>THE LINKAGE BETWEEN ECONOMIC GROWTH AND DEFORESTATION IN OIC (THE ORGANIZATION OF ISLAMIC COOPERATION) COUNTRIES</b> .....	253
<i>Rani Puspitaningrum, Raditya Sukmana, Imron Mawardi</i>	
<b>EMPLOYEES' COMMITMENT BUILDING THROUGH SOCIAL ESTEEM AT THE REMUNERATION'S INCREASEMENT OF RECOGNITION AN SELF-ACTUALIZATION NEED IN MASLOW THEORY</b> .....	259
<i>Djoko Soelistya</i>	
<b>THE DYNAMIC ANALYSIS ON IMPACTS OF EDUCATION AGAINST POVERTY REDUCTION</b> .....	262
<i>Sri Herianingrum, Sri Iswati, Muslich Anshori</i>	
<b>THIRD PARTY FUNDS, NUMBER OF CAPITAL, AND NON PERFORMING FINANCING TO THE NUMBER OF MUDHARABAH FINANCING IN INDONESIA'S SHARIA BANKING</b> .....	266
<i>Muhammad Iqbal Surya Pratikto, Ririn Tri Ratnasari</i>	
<b>ISLAMIC WORK ETHIC AND SATISFACTION WITH INTRINSIC MOTIVATION AS MEDIATOR VARIABLE</b> .....	272
<i>Rio Eriawan Putra Tohari, Ririn Tri Ratnasari</i>	
<b>BUILDING SOFT SKILLS AS THE PEOPLE-JOB FIT TO OVERCOME COUNTERPRODUCTIVE WORK BEHAVIOR IN CREDIT ASSESSMENT BANKING SECTOR: A LITERATURE REVIEW</b> .....	276
<i>Dewi Khrisna Sawitri</i>	

**SESSION: CLEAN WATER AND SANITATION**

<b>THE MANAGEMENT MODEL ON INTEGRATED SETTLEMENT WASTEWATER TREATMENT SYSTEM (SPAL) IN SUPPORTING HEALTH DEVELOPMENT</b> .....	281
<i>Lilik Pudjiastuti</i>	
<b>WATER TRADE IN ISLAMIC BUSINESS ETHICS PERSPECTIVE: EVIDENCE FROM INDONESIA</b> .....	285
<i>Bahrina Almas, Tjiptohadi Sawarjuwono, Sri Iswati</i>	

**SESSION: ZERO HUNGER**

<b>OPTIMIZATION OF FOOD ESTATE PROGRAM THROUGH CASH WAQF TO ACHIEVE FOOD SOVEREIGNTY OF INDONESIA</b> .....	290
<i>Denizar Abdurrahman Miraj, Ummi Muthia Fathy, Muhammad Nafik Hadi Ryandono, Tjiptohadi Sawarjuwono</i>	

**SESSION: CLIMATE ACTION**

<b>BLUE CARBON: ROLE OF SEA TO THE BALANCE OF CLIMATE WITHIN THE MITIGATION FRAME OF CLIMATE CHANGE</b> .....	294
<i>Suryowati Dina, Ria Tri Vinata</i>	

284



<b>LOCAL CONCERN ON PLASTIC BAG CHARGE IN INDONESIA: DO WE REALLY CARE?</b> .....	298
<i>Nuzulul Kusuma Putri</i>	
<b>MAKING MODEL OF VILLAGE REGULATION BASED ON GOOD VILLAGE GOVERNANCE IN INDONESIA</b> .....	302
<i>Suparto Wijoyo, Radian Salman, Bagus Oktafian Abrianto</i>	
<b>STRIP INTERCROPPING PRODUCTIVITY OF MODERN MAIZE HYBRID VARIETIES WITH PULSE CROPS ON A DRYLAND</b> .....	309
<i>I Komang Damar Jaya, Sudirman, Rosmilawati</i>	
<b>ANISAKIDAE AS A BIOINDICATOR CANDIDATE IN RESPONSE OF ENVIRONMENTAL DAMAGE</b> .....	313
<i>Hartanto M. Raharjo, Setiawan Koesdarto, Qabilah C. K. N. Sumarsono, Febrina D. Permatasari, Zafitri N. Wastomi, Nurul S. A. Sari</i>	
<b>ANALYSIS OF THE DISCLOSURE OF GREENHOUSE GAS EMISSIONS AND ENVIRONMENTAL PERFORMANCE IN LISTED FIRMS AT JAKARTA ISLAMIC INDEX (JII)</b> .....	316
<i>Dwi Swasana Ramadhan, Azizah Anshori, Sri Iswati, Sri Herianingrum</i>	
<b>MARINE ENVIRONMENT AND CLIMATE CHANGE : LEGAL ASPECTS OF PROTECTION AND PREVENTION AGAINST CORAL REEFS DEGRADATION IN INDONESIA</b> .....	321
<i>Dina Sunyowati, Amisa Firdhausy</i>	

**SESSION: ZERO POVERTY**

<b>ISLAMIC CONCEPTS AS EFFORT TO UTILIZE WASTELAND OF PUBLIC REVENUE DISTRIBUTION</b> .....	325
<i>Ridan Muhtadi, Sri Iswati, A. Rohman</i>	
<b>INFLUENCE OF INFLATION ON POVERTY IN SURABAYA AND ISLAMIC SOLUTIONS IN ERADICATING POVERTY</b> .....	331
<i>Amaliah Al Azmi, S. Iswati, R. Sukmana, R. Ratnasari</i>	
<b>ECONOMIC DEVELOPMENT IN INDONESIA: INTEGRATED MODEL OF ISLAMIC FINANCIAL INCLUSION</b> .....	335
<i>Laila Masruro Pimada, N. Firdaus</i>	
<b>POVERTY ALLEVIATION: AN ECONOMIC PRACTICE STUDY OF ISLAM IN CULTURE</b> .....	341
<i>Renny Oktafia, M. Anshori, I. Mawardi</i>	
<b>DETERMINANTS OF SUCCESS IN VENTURE CAPITAL ASSISTANCE RECIPIENTS IN YAYASAN DANA SOSIAL AL-FALAH (YDSF) SURABAYA</b> .....	345
<i>Doddy Koesnadhi, Tika Widiastuti, Sri Herianingrum</i>	
<b>OPTIMIZING FUND MANAGEMENT OF MOSQUE CASH FOR ECONOMIC EMPOWERMENT OF PEOPLE</b> .....	350
<i>Sri Wulandari, T. Sawarjuwow, S. Iswati</i>	
<b>ENHANCING FARMER'S INDEPENDENCE BY BAITUL MAAL WAT TAMWIL CONCEPT</b> .....	355
<i>Vina Septiana Permatasari, T. Sawarjuwono, S. Iswati</i>	
<b>THE MOVING OUT OF POVERTY OF MUSTAHIQ PRODUCTIVE ZAKAT IN INDONESIA</b> .....	359
<i>Imron Mawardi, Tika Widiastuti, Puji Sukmaningrum</i>	
<b>ISLAMIC FINANCIAL DEVELOPMENT AS EFFORTS TO ACCELERATE ECONOMIC DEVELOPMENT AND POVERTY ALLEVIATION</b> .....	365
<i>Elsi Mersilia Hanesti, Sri Herianingrum, Raditya Sukmana</i>	
<b>HADD AL- KIFAYAH (SUBSISTENCE CRITERIA) AS A MEASUREMENT OF ISLAMIC SOCIO-ECONOMIC SECURITY</b> .....	372
<i>Imron Mawardi, Sri Herianingrum, T. Widiastuti</i>	

**Author Index**

## **ANATOMICAL PATHOLOGY AND RADIOLOGY APPEARANCE OF BALLISTIC WOUND RESULT OF CAL. 177 AIR RIFLE WITH 4,5 MM PELLETS ON THE EXTRIMITY OF THE DOG (*Canis lupus familiaris*) AT DIFFERENT SHOOTING DISTANCES**

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**Abstract**— This study was undertaken to investigate the impact of several shooting distances of cal.177 (4,5 mm) air rifle toward the anatomical pathology changes of gunshot wounds (ballistic wounds in particular). This observational study used four domestic dogs (Non-SPF) obtained from a local dog breeder. The shooting distance were divided into 2 (two) different ranges at 0 cm as the contact range and 500 cm as the distance shooting range, respectively. Adequate anaesthesia was performed on the dogs prior to shooting. The use of experimental animals was approved by the Ethics Committee (Animal Care and Use Committee) Faculty of Veterinary Medicine, of the University of Airlangga. Ethical procedures were strictly followed in this research. The parameters were the depth of the gunshot wound and specific lesions at the site of the entry and exit wound. *Forensic Photomacrography* and x-rays were performed to observe the specific lesions of the gunshot wound. This study revealed that the average depth of gunshot wounds in the extremities at contact shooting distance is 57.5 mm and 55.5 mm for distant shooting. Each gunshot wound has a specific lesion in the context of both contact and distant shooting.

**Keywords**— Air rifle, Cal.177 Pellets, Shooting distance, gunshot wound, forensic photomacrography.

### I. INTRODUCTION

The crime of using an airgun/ air rifle against an animal is one of the most common crimes and becomes a legal case where and when the role of veterinarian is indispensable, both in investigation and inquiry. Airguns are often used to kill or maim domesticated and wild animals [1]. The occurrence of gunshot wounds caused by airguns is quite common in pets, including dogs and cats in both urban [2] and rural areas around the world.

The type of air rifle that is commonly found in the community is the type with a pneumatic multiple pump with 4,5mm pellet bullet (Diabolo pellet, hourglass-shaped, soft lead missile) because it is cheaper than the BB type [4].

The estimation of the shooting range can be determined by photography and x-rays to identify the presence of projectiles, and for the identification of shot and exit injuries [5][4]. The shooting range is divided into 4 categories namely, Touch (contact), Near (close), Medium (intermediate), and Far

(distant). Respectively, estimation data based on the appearance of the ballistic wound in animals rarely exists. In this research study, we tried to reveal the first information about gunshot wounds at contact and far/distant ranges in this context.

In the disclosure of animal crime cases with firearms, as well as with air rifles, a veterinarian who acts as a veterinary forensic expert needs to understand the science of Forensic Ballistics and Pathology as well. Forensic ballistics includes the type of weapon or rifle that is used, the state of the gun, the type of bullet, the distance and the direction of firing, as well as the wound figure (ballistic wound). Research on forensic ballistics in animals is still rarely done [3].

### MATERIAL AND METHODS

#### *Sample*

Two mongrel dogs were utilised for the study, after being given zolazepam-tiletamine (zoletil®) anaesthesia. The use of experimental animals was approved by the Ethics Committee (Animal Care and Use Committee) Faculty of Veterinary Medicine, of the University of Airlangga.

#### *Shooting Techniques*

An air rifle (Multi-pump), round shaped cal.177 pellets, gun scopes and lasers, a rifle tripod, and a wooden board with hole box were used to increase focus when shooting. The animals were placed on the stand position supported with a modified holder.

The shooting was done by 10 pumps on the gun with a perpendicular shooting angle to the dog's surface. The shooting distance was measured between the muzzle and the surface of the target [5].

The shot was directed at the exact point of the dog's humerus and femoral region [6]. The target shots were marked using a sterile and biological marker.

#### *Forensic Photography*

Photographs are taken in close-up (photomacrography) of the labelled gunshot wounds. The photo was taken after the measurement of the gunshot wound with an ABFO ruler [7] to give an interpretation of the size of the wound and the bullet

206

using a Digital Single-lens Reflex (DSLR) Camera and 50mm fixed lens [3].

**X-Ray**

X-Ray capture was done on the cranial extremities (os.humerus) and caudal (os.Femur) extremities. In the cranial extremities, the Central Ray (CR) was directed at the middle of the scapulo-humeri region with a lateral recumbency. In the caudal extremity, the Central Ray (CR) was directed to the sacro-femoral region (the link between the anterior femoral cap and the acetabulum) due to the position of the ventro-dorsal body (dorsal recumbency). [8]

**Post Operation**

Treatment using broad-spectrum antibiotics was essential as a prophylaxis against infectious agents that cause osteomyelitis and complications during recovery after surgery. The administration of ADONA (AC-17) ® (carbazochrome sodium sulfonate) was performed to stop the bleeding from the gunshot wounds. Bandaging was done using Modified Roberts Jones wrapping for 3 days to minimise swelling. Also administered was an intramuscular injection of Ampicillin 10-20 mg / kg with an interval of 8 hours for 5 days, a subcutaneous injection of caprofen® 4 mg / kg after surgery and an intramuscular injection Ketoprofen® 1 mg / kg for 3 days. The stitches were removed on day 14. Radiographic evaluation was performed 1 month after surgery with callus formation evident.

**Data Analysis**

All of the data obtained from this observational study was analysed descriptively.

**RESULT AND DISCUSSION**

The firing using maximum pump at a contact and distant shooting distance showed different results (Table 1). Both shooting distances can penetrate the extremity at contact, and are able to form an exit wound (Fig. 1).

Tabel.1 : Mean of depth<sup>2</sup> of gunshot assisted x-ray virtual trajectory wound.

Distance (cm)	Mean (mm)
0 (Contact)	57,5
500 (Distant)	55,5

The results of anatomical pathology observations on gunshot wounds using forensic photography methods shows different appearance at each shooting range. The entry wound and exit wound were differentiated based on the edge of the wound, the wound diameter, scuffed skin and subcutaneous bleeding (contusion ring).

The observation results show that at 0 cm distance (contact), there is an entry wound and exit wound. In the incoming wound (entry wound), there is a compression area that occurs around the wound (Figure.2). Compression can also be known through the hair pattern around the wound. The penetration of projectiles in to the muscle causes active

bleeding. Extravasation and minor blood spatter can also be observed in the gunshot wounds. (Figure 2)

The contusions on the entry and exit wound appear different. The contusions on the outbound wound are larger and firmer than the incoming wound. Further observation showed that the entry wound and exit wound appear to have acute subcutaneous bleeding. Contusions in the entry wound have an average diameter of 5.49 mm. The average wound diameter is 4.60 mm. The the exit wound also appears to have a contusion with an average diameter of 9.71 mm. The average diameter of the exit wound is 4.65 mm. The mean diameter of the contusions on the outflow was 9.71 mm and the average diameter of the wound was 4.65 mm. (Table.2)

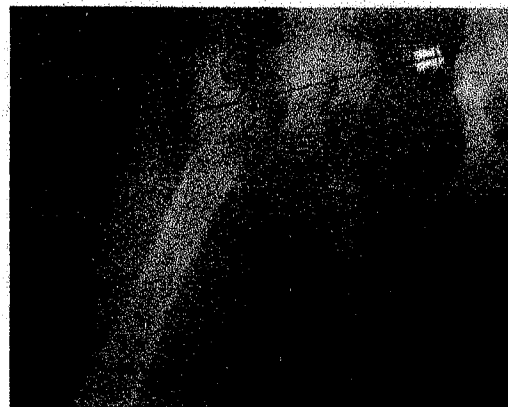
Blisters can be seen on the inside edge of the wound. Abrasions at the edge of the gunshot wound appear in the entry wound. The grease collar on the edges of the wound appear to be blackish. (Figure.3)

A follow-up observation at 500cm indicates that the entry wound and exit wound appears to have acute subcutaneous bleeding around the wound (Figure 4.10). Contusions in the entry wound have an average diameter of 8.50 mm. The average diameter of the entry wound is 4.44 mm. The exit wound also appears to have contusions with an average diameter of 9.71 mm. The average diameter of the exit wound is 5.50 mm (Table.2). The description of the contusions of the entry wounds and exit wounds appear different. The contusions of the entry wound are firmer and smaller than that of the exit wound. Blisters can be seen on the inside edge of the wound. Abrasions at the edge of the gunshot wound appear in the entry wound. The grease collar on the wound edges are not visible.

Table.2:

Distance	Type of Wound	Diameter (mm)	
		contusion	wound
0 cm ( <i>contact</i> )	entry	5,49	4,60
	exit	9,71	4,65
500 cm ( <i>distant</i> )	entry	8,50	4,44
	exit	8,68	5,50

Figure. 1: Estimation of trajectory wound from x-ray.



282

Figure.2: Comparison of the contusion ring between the entry and exit wound at contact (0 cm) shooting.

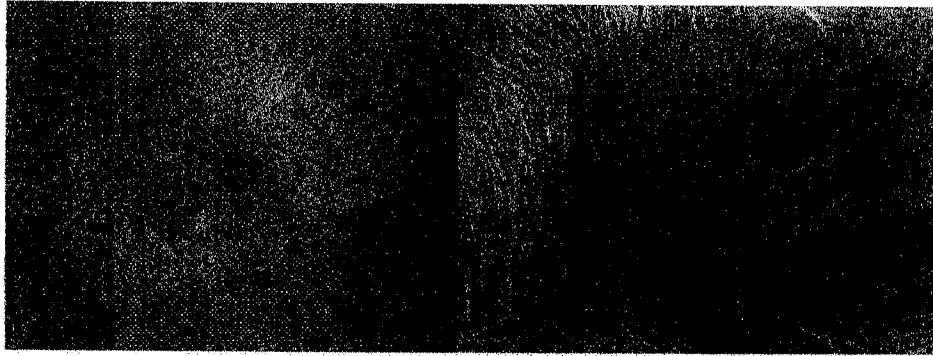


Figure.3: (A) The blisters at the edge of the entry of the contact shooting wound (0 cm). (B) Grease collar/ring

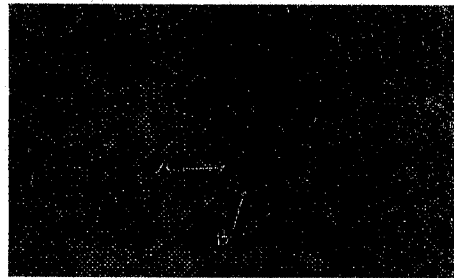
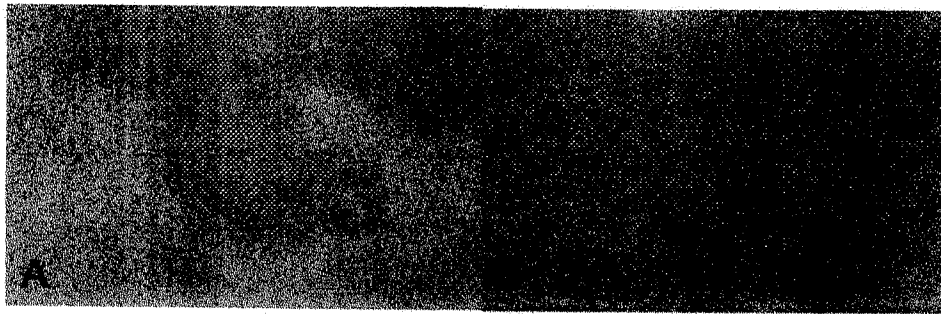


Figure.4: Comparison of the entry and exit wound at distance shooting (500 cm).



The pellet used was of the round shape type and had an average weight of 0.54 g. The 10x pumping result based on the specification of the air rifle used in this research showed that the muzzle velocity (projectile speed as it leaves the barrel) is 715 fps or 218m / s if it is equalised up to 784.8 km / h. The energy generated by the rifle used in this study belongs to the low energy bracket i.e <400J [9].

The kinetic energy at the time of the projectile leaving the barrel can be known through the following formulation:

$$E_0 = 1 / 2.M.V_0^2$$

$E_0$  = Kinetic energy (J)

$M$  = Mass (g)

$V_0$  = The speed of the projectile when leaving the barrel (m / s) [10]

The kinetic energy of the projectile upon leaving the barrel is 12.83 J or equivalent to 9.42 fpe. It also means that  $E_0$  is the kinetic energy of the projectile at a distance of 0 cm (contact wound). Kinetic energy at the 500 cm range can be known after the projectile velocity is calculated when touching skin ( $V_1$ ):

$$V_1 = V_0 - (Br) \times L$$

$V_1$  = The speed of the projectile at a distance of 500 cm (m / s)

$V_0$  = Projectile velocity when leaving the barrel (m / s)

$Br$  = Constants derived free flight table

$L$  = Distance Shoot

288

[10]

The speed of the projectile at the time before touching the skin or at a distance of 500 cm is 208 m / s or 682.4 fps if equalised at 748.8 km / h. The kinetic energy before the projectile touches the skin or at 500 cm range can be calculated through the following formulation:

$$E_1 = 1 / 2.M.V_1^2$$

E0 = Kinetic energy (J)

M = Mass (g)

V<sub>0</sub> = The speed of the projectile when leaving the barrel (m / s)

[10]

The kinetic energy before the projectile touches the skin or at a distance of 500 cm is 11.66 J.

The penetrating wound at contact and distant shooting indicates that the kinetic energy loaded by the mass and speed of the projectile is still relatively capable of penetrating all extremities except bone. The speed of the projectile required to penetrate the bone is 250 cm / s or equivalent to 900 km / j. [10].

The difference in the average of depth of the wound at the range of 0 cm (contact) and 500 cm (distant) is due to the loss of kinetic energy of the projectile at the time it is in flight. The kinetic energy lost during the flight at 500 cm distant range can be detected through the following formulation:

$$\Delta E = E_0 - E_1$$

ΔE = Missing kinetic energy

E<sub>1</sub> = Initial energy (muzzle energy)

E<sub>0</sub> = Energy at a distance of 500 cm (distant)

The energy lost during the air at a 5 cm range is 1.17 J.

#### CONCLUSION

The following conclusions can be drawn from this study; the average depth of the ballistic wound on the dog's extremity due to a air rifle using a cal.177 pellet projectile at a range of 0 cm (*contact*) is deeper than at 500 cm (*distant*). Based on the description of the anatomical pathology of the ballistic wound, there is a distinctly different appearance of the entry wound and exit wound at the different shooting distances.

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# CERTIFICATE

Awarded to :

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DIUSULKAN, MAKA DENGAN INI MENYATAKAN BAHWA :**

**PENELITIAN BERJUDUL** : Gambaran Luka Tembak (*Ballsitic Wound*) Senapan Angin Menggunakan Proyektil Pellet Pada Anjing (*Canis lupus familiaris*) Pada Jarak Tembak Yang Berbeda

**PENELITI UTAMA** : Bilqisthi Ari Putra

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