DISCRIMINATION BETWEEN CAT AND DOG HAIRS USING NUMERICAL MORPHOLOGY

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Specially dedicated to my parents

Mahani Idrus & Azhar Bahaman

and my beloved siblings

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ABSTRACT

Cats and dogs are universal pets that can be easily found in Malaysia. Due to the constant hair loss, a lot of cat and dog hairs are encountered in the household, their surroundings and adhere onto clothing or the body of the owner or anyone came into contact without being noticed. These hairs are sometimes the only available evidence found at crime scene. In this study, hair samples from seven types of cats and thirteen types of dog breeds were collected. Difference between two species was analyzed using three types of microscope; compound microscope, stereomicroscope, and scanning electron microscope. Numerical morphology employ six measurements on hair samples which are (length, (Len), maximum width (MaxWid), medulla width (MedWid), width at 1/3 of proximal hair shaft (proWid), medullary index (MI) and hair width index (HWI). The statistical tests of *t*-test and *f*-test show significant differences between cat and dog hairs based on Len, MaxWid and MI. In this study, morphology features examination between several other animals from different animal species found in Malaysia were also carried out. Result of the study showed unique morphologies based on cuticle pattern and medulla characteristics. Outcome of this research has provides a standard reference of morphology features that could help forensic scientist to identify the species origin of unknown hair samples frequently obtained as exhibit in the Malaysian Forensic Laboratory.

ABSTRAK

Kucing dan anjing merupakan haiwan peliharaan yang universal di Malaysia. Bulu ini akan mengalami keguguran pada sela waktu tertentu. Sampel bulu haiwan ini, mudah dijumpai di persekitaran kawasan rumah.atau terlekat pada pakaian atau badan pemilik dan sesiapa yang bersentuhan dengan haiwan ini tanpa disedari. Dalam sesetengah kes forensik bulu haiwan berkemungkinan besar menjadi bukti utama yang diperolehi di tempat kejadian jenayah. Dalam kajian ini, sampel rambut dari tujuh jenis kucing dan tigabelas jenis baka anjing diperolehi sebagai sampel kajian. Perbezaan antara dua spesies in dikaji menggunakan kaedah mikroskopik iaitu kompaun mikroskop, stereomikroskop dan imbasan elektron mikroskop. Pengiraan morfologi menggunakan enam ukuran ke atas bulu iaitu panjang (Len), lebar maximum (MaxWid), lebar medulla (MedWid), lebar bahagian 1/3 proximal (proWid), indeks medulla (MI) dan indeks ketebalan rambut (HWI) diukur. Analisis statistik menggunakan ujian-*t* dan ujian-*f*, menunjukkan terdapat perbezaan yang nyata antara kucing dan anjing berdasarkan pada ukuran Len, MaxWid dan MI. Selain itu hasil pemerhatian ke atas ciri morfologi dan perbandingan antara haiwan yang berlainan spesies yang terdapat di Malaysia menunjukkan corak kutikel dan susunan medula bagi sampel bulu adalah unik. Kajian ini dapat menghasilkan rujukan piawai bagi ciri morfologi yang dapat membantu ahli forensik mengenal pasti spesies rambut yang tidak diketahui asal-usulnya.

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LIST OF ABBREVIATIONS

ANOVA	-	Analysis of Variance
Len	-	Length
MaxWid	-	Maximum width
MedWid	-	Medulla width
proWid	-	Width at the one third of proximal hair shaft
HWI	-	Hair width index
MI	-	Medullary index
SEM	-	Scanning electron microscope
DSH	-	Domestic short hair cat
ASH	-	American short hair cat
AWC	-	African wild cat
TA	-	Turkish angora
NWF	-	Norwegian forest cat
PB	-	Pit bull dog
BT	-	Bull terrier
ACS	-	American cocker spaniel dog
SH	-	Siberian husky dog
GR	-	Golden retriever dog
DC		Dachshund Cross

LIST OF SYMBOLS

p	-	Significant confidence level
®	-	Registered mark
≤	-	Less than or equal to

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CHAPTER 1

INTRODUCTION

1.1 Background of Study

Numerous types of physical evidence are encountered during criminal investigation. Hair is one of the most familiar evidence being submitted to a forensic laboratory. In some forensic cases, animal hair can be the only available evidence found at a crime scene (Katz, 2005). Cats and dogs are universal pets which can be easily found in some homes in Malaysia. Due to the constant hair loss, a lot of cat's and dog's guard hairs can be found in the household, their surroundings and adhered onto clothing or the body of the owner or anyone who came into contact (Muller *et al*., 2008). This associative evidence is particularly useful in crimes of burglary or armed robbery and other cases which typically involve the recovery of animal hair. It can also provide information of the suspects/victims workplace. The numerical features of hairs samples were observed, four measurements (length (Len), maximum width (MaxWid), hair width at proximal one third of hair shaft (proWid), medulla width (MedWid)) and two indices (hair width index (HWI) and medulla index (MI)) were examined. Based on statistical comparison of the numerical morphology features, the cat and dog guard hairs can be differentiated. This study also investigated the morphological features; color, root appearance, medulla structure, scale/cuticle pattern, and tip appearance were examined. Comparative studies were made between cat, dog, and several others types of animal guard hair based on their morphology features.

1.2 Problem Statement

Cats and dogs are the most popular domestic animals that many people keep as pets and can easily be found anywhere even by the roadside, stall, streets and markets. The animals continuously lose their hairs especially their guard hairs which can spread out fast in their surroundings, household and entangled to clothing unintentionally without being noticed by the owner (Muller *et al.*, 2008). These hairs could be used by a forensic laboratory as evidence, linking a suspect with a crime. However to date, there are limited studies that provide information on the discrimination between cats and dogs guard hair using statistical comparison of numerical morphology. In Malaysia, such studies have not been reported.

1.3 Scope of Study

This research emphasized on the forensic comparison between domestic cat and dog guard hairs from various breed commonly found in Malaysia. Observation of morphology features; numerical features (measurements and indices) were conducted by using stereomicroscope, compound microscope and scanning electron microscope. The morphology characteristic and numerical features were statistically compared using *t*-test and ANOVA in order to discriminate between various breed of cats and dogs. Comparison of morphological features among cats, dogs and other animal hairs were also conducted to improve the discrimination between the hair samples.

1.4 Objectives of Research

The aims of this study are:

i. To discriminate between cats and dogs guard hairs using statistical comparison of their numerical morphology features.

ii. To compare morphology features among cats, dogs and other animals' hair.

1.5 Significance of The Study

Cats and dogs hairs could be evidently discriminated statistically based on their numerical features. Morphological examination among other animals can also distinguish the species of either dogs or cats from the unknown hair samples. This information is useful for forensic scientists in crime laboratories such as Jabatan Kimia Malaysia (JKM) and private organization such as Society for the Prevention of Cruelty to Animals (SPCA) in the identification of unknown hair samples submitted for evidence in court cases.

1.6 Hypothesis Statement

The numerical feature differences can be used to discriminate between cat and dog guard hair. The morphological features of other animal hair widened up the scope of the study. This in turn will provide extra information in the identification of a particular species which can link the animal hair with the victim, the suspect or the crime scene.