Differences in the Decomposition Time of Brain and Lower Gastrointestinal Tract Male Wistar Rats (RATTUS NORVEGICUS) in Lowland and Highland Soil

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Abstract

Information in society, each person's body/corpse that is found can vary in condition, whether it is still fresh or has already rotted. Forensic science is needed to assist the investigative process, including determining the estimated time of death and the suspected cause of death. Thanatology is a branch of forensic science that studies the bodily changes that occur after death and provides definitive evidence of death. Decomposition of tissue is one of the sure signs of death caused by microorganisms both in the body and the environment. The objective of this research was to analyze the difference in decomposition time between the brain and the lower gastrointestinal tract in male Wistar rats buried in lowland soil and highland soil. This research is an experimental study with a repeated measures design. There are two treatment groups, each consisting of six male Wistar rats. Each group was euthanized using chloroform inhalation. The six rats in one group were buried in lowland soil, and the six in the other group were buried in highland soil. The brain and lower gastrointestinal tract organs were dissected. The Mann-Whitney test yielded p = 0.011, indicating significant differences in decomposition time between lowland and highland soil. Additionally, the decomposition time of the brain and lower gastrointestinal tract also showed significant differences, with p = 0.001. There are differences in the decomposition time between lowland and highland soils due to the distinct characteristics of these terrains. The lower gastrointestinal tract decomposes faster than the brain due to a higher population of bacteria in the gastrointestinal tract, which aids in the digestion process.

Keywords: Decomposition Time, Forensic Science, Thanatology.

INTRODUCTION

Every living organism undergoes a life cycle, beginning with the process of fertilization and ultimately ending in death. Death is an inevitable reality and cannot be predicted with certainty, including where, when, and how a living being will experience it. One possible cause of death is homicide.[1]

Decomposition is the process of the breakdown of body tissues caused by enzymatic activity from fungi and bacteria.[2] This process is driven by the activity of microorganisms originating either from the body's own microbiome or from the surrounding environment.[3] In relation to information circulating in the community, it has been reported that the bodies of homicide victims are often discovered in various locations, giving rise to cases where corpses are found abandoned without a clear cause. To uncover the mystery surrounding such remains, identification procedures are required.[4] Through identification, several important questions can be addressed, such as who the victim is, when the incident occurred, where the body was found, and how the death took place.[5] The identification of human remains is therefore crucial, both for law enforcement authorities handling the case and for providing explanations to the victim's family regarding the cause of death.[1]

Two main components can influence the process of human decomposition, namely internal and external factors. Internal factors include age, cause of death, body condition, sex, and the presence of injuries on the body. External factors include temperature, environmental conditions, atmospheric pressure, humidity, air exposure, the type of clothing worn by the victim, the medium in which the body is found, and the possible invasion of animals or insects. These factors play a role in either accelerating or delaying the decomposition process of the body.[6]

As this type of research remains relatively limited, the present study is considered important to conduct. In this study, Wistar strain rats were used as the research subjects. The decomposition of animal carcasses is a complex process in which various biotic and abiotic factors interact within the environment. One important aspect of this process is the rate of decomposition, which is influenced by several factors, including the soil conditions where the carcass is located.[7] Wistar rats (*Rattus norvegicus*) represent an interesting research subject as they are common rodents that are widely found and share certain biological similarities with humans. Rats possess biological and physiological systems that resemble those of humans and are frequently used in experimental studies because they are easy to maintain, readily available in large numbers, and able to provide reliable results.[8] Therefore, it is important to understand how environmental factors, such as soil type, may influence the decomposition time of Wistar rats.

METHODS

This study employed an experimental research design using a repeated measures design. The study measured the decomposition time of the brain and the lower gastrointestinal tract of Wistar rats that were buried in lowland soil and highland soil. The lowland site was located in Ledug Village, Banyumas, with an elevation of 69.15 meters above sea level, while the highland site was located in Bumisari Village, Purbalingga, with an elevation of 348.35 meters above sea level. The research was conducted in June 2024.

This study involved two groups: the lowland group and the highland group, with six Wistar rats in each group. All rats were euthanized using chloroform inhalation. Subsequently, six rats were buried in lowland soil and the other six in highland soil. The brain and lower gastrointestinal tract were surgically removed, wrapped in aluminum foil, and then buried in the soil at a depth of 50 cm. After burial, the sites were excavated every 12 hours to identify and observe the decomposition of the brain and lower gastrointestinal tract.

Inclusion Criteria: male Wistar rats; healthy and without physical deformities; and body weight between 250 and 300 grams. Exclusion Criteria: Rats that were ill or had physical deformities.

The data obtained from the study were analyzed using the Mann–Whitney test to assess the difference in decomposition time between lowland and highland soils. And also the comparison of decomposition time between the brain and the lower gastrointestinal tract was analyzed.

In case p-values are less than 0.05, it can be concluded that there is a statistically significant difference in the decomposition time of the brain and the lower gastrointestinal tract between lowland soil and highland soil.[9]

RESULTS AND DISCUSSION

Table 1. Decomposition Time (Hours)

	Mean	Minimum	Maximum
Brain	34	24	48
Lower Gastrointestinal Tract	18	12	36
Lowland area	20	12	36
Highland area	32	12	48

Based on Table 1, the mean decomposition time of the brain was 34 hours, with the fastest decomposition occurring at 24 hours and the longest at 48 hours. Meanwhile, the mean decomposition time of the lower gastrointestinal tract was 18 hours, with the fastest decomposition observed at 12 hours and the longest at 36 hours.

The mean decomposition time in the lowland area was 20 hours, with the fastest decomposition occurring at 12 hours and the longest at 36 hours. In contrast, the mean decomposition time in the highland area was 32 hours, with the fastest decomposition observed at 12 hours and the longest at 48 hours.

Table 2. Data Normality Test

	Result	p
Shapiro-Wilk	0.836	0.001

Based on Table 2, the results of the normality test showed a p-value of 0.001, indicating that the data distribution is not normally distributed. Therefore, the hypothesis testing was conducted using the Mann–Whitney test.

Table 3. The Differences in Decomposition Time Between the Brain and the Lower Gastrointestinal Tract

	Result	p
Time	125.000	< .001

Based on Table 3, the p-value obtained was < 0.001, indicating a statistically significant difference in decomposition time between the brain and the lower gastrointestinal tract. The hypothesis test shows that the decomposition time of the brain is longer than that of the lower gastrointestinal tract.

Table 4. The Differences in Decomposition Time Between Lowland and Highland Areas

	Result	p
Time	34.000	0.011

Based on Table 4, the p-value obtained was 0.011, indicating a statistically significant difference in decomposition time between the lowland and highland areas. The hypothesis test shows that the decomposition process occurs faster in the lowland area compared to the highland area.

The results of this study demonstrate a significant difference in decomposition time. Among the six rats buried in the lowland area, the latest occurrence of brain decomposition was observed at 36 hours, whereas in rats buried in the highland area, the latest decomposition occurred at 48 hours. Similarly, in the lower gastrointestinal tract, decomposition in the lowland area occurred simultaneously at 12 hours, while in the highland area, the latest decomposition occurred at 36 hours. These findings are consistent with the previously formulated hypothesis that there are differences in the decomposition time of the brain and the lower gastrointestinal tract of male Wistar rats buried in lowland and highland soil.[10]

This finding is consistent with existing theory, which states that the decomposition process generally occurs faster in lowland areas compared to highland areas due to higher temperatures, higher humidity, and greater oxygen availability. Lowland environments provide more favorable conditions for decomposing microorganisms to efficiently break down organic matter. In contrast, highland areas tend to have lower temperatures, drier conditions, and reduced oxygen availability, which slow down the decomposition process by inhibiting microbial activity and the degradation of organic materials.[6]

The lower gastrointestinal tract typically decomposes faster than the brain after death. The primary reason is the extremely large bacterial population present in the large intestine. These bacteria, which normally function in the digestion of food during life, become directly involved in the decomposition of organic material after death.[5] This process occurs more rapidly due to the warm internal temperature and the abundant availability of organic

substrates, which support the growth and activity of putrefactive bacteria.[11] In contrast, the skull provides physical protection for the brain, limiting its direct exposure to decomposing bacteria and the external environment. Furthermore, the natural bacterial population in the brain is considerably smaller than that in the gastrointestinal tract, resulting in a slower decomposition process in the brain.[9]

CONCLUSION

Based on the results of the study on the Differences in Decomposition Time of the Brain and Lower Gastrointestinal Tract in Male Wistar Rats (*Rattus norvegicus*) Buried in Lowland and Highland Soil, the following conclusions can be drawn:

1. There is a significant difference in decomposition time between lowland and highland soil environments.
2. The lower gastrointestinal tract decomposes faster than the brain, primarily due to the larger bacterial population in the gastrointestinal tract, which plays a major role in the digestive process and accelerates postmortem decomposition.

REFERENCES

1. Saputra, A. I., Isramilda, I., & Tsaury, S. A. Pengaruh Beda Suhu Peletakan Bangkai terhadap Pertumbuhan Larva Lalat Chrysomya Megacephala Pada Tikus Wistar (*Rattus norvegicus*). *Zona Kedokteran: Program Studi Pendidikan Dokter Universitas Batam*, 2022; 12(2): 79-86.
2. Apuranto, H.. Buku Ajar Ilmu Kedokteran Forensik dan Medikolegal, edisi ketujuh. *Surabaya: Departemen Ilmu Kedokteran Forensik Dan Medikolegal Fakultas Kedokteran Universitas Airlangga*. 2010. Hal. 86-94.
3. Sunniyyah, D. Judul Artikel Dalam Bahasa Indonesia: Perubahan Kadar Nitrogen Total pada Tanah sebagai Alternatif Estimasi *Post Mortem Interval*. Jurnal Biosains Pascasarjana. 2021; 23(1): 1-5
4. Atmoko, W. D., & Mahila, N. A. D. Suicide in Adult Man: A Case Report and Forensic Medical Aspects. *Jurnal Ilmiah Simantek*. 2023; *7*(1): 1-6.
5. Di Maio, V. J., & Dana, S. E. *Handbook of Forensic Pathology*. USA: CRC Press. 2006.
6. Upayogi, I. N. Kajian Eksplanasi Taru Menyan Penetral Bau Mayat. *Jurnal Filsafat Indonesia*. 2019; 2(1): 37- 4.
7. Al-Mekhlafi, F. A. Decomposition Process for Buried rat (*Rattus norvegicus*, Berkenhout 1769) Carcasses in Riyadh City, Saudi Arabia: A Preliminary Study. *Saudi Journal of Biological Sciences.* 2021; 28(7): 3745-3750.
8. Lahamendu, B., Bodhi, W. & Siampa, J. P. Uji Efek Analgetik Ekstrak Etanol Rimpang Jahe Putih (Zingiber officinale Rosc. var. Amarum) pada tikus putih jantan galur wistar (*Rattus norvegicus*). *Pharmacon*. 2019; 8(4): 927-935.
9. Saukko P., Knight B. *Knight's Forensic Pathology Fourth Edition*. Boca Raton: CRC Press. 2016.
10. James J. P., Jones R., Karch S. B., Manlove J. *Simpson's Forensic Medicine*. 13th ed. UK: Hodder & Stoughton. 2011; p. 47.
11. Pangaila, S. K. Gambaran Kecepatan Pembusukan Hewan Coba di Daerah Pesisir Pantai Manado. *E Clinic*. 2014; 2(2).