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NATURAL LATEX-BASED ADHESIVES FOR SUSTAINABLE HOUSE FLY CONTROL: A COMPARATIVE STUDY OF ARTOCARPUS HETEROPHYLLUS AND ARTOCARPUS CAMANSI

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ABSTRACT

House flies (Musca domestica) are mechanical vectors that play a significant role in the transmission of environment-based diseases, particularly diarrhea; therefore, controlling their population is an essential component of environmental health efforts. The continued reliance on chemical insecticides has resulted in various adverse effects on human health and the environment, highlighting the need for safer and more sustainable alternatives for fly control. This study aimed to compare the adhesive capacity of jackfruit latex (Artocarpus heterophyllus) and breadnut latex (Artocarpus camansi) as natural adhesives in house fly traps. This study employed a post-test only experimental design using a total of 600 house flies collected from the Karuwisi Market area, Makassar City. Fly traps were constructed from modified plastic bottles and uniformly coated with 20 grams of either jackfruit latex or breadnut latex. The experiment was conducted in three replications with an observation period of 30 minutes for each replication under controlled environmental conditions of 32°C temperature and 66% relative humidity. Data were analyzed descriptively and quantitatively based on the number and percentage of trapped flies. The results showed that jackfruit latex trapped 166 flies (55.33%), while breadnut latex trapped 156 flies (52.00%). Both materials exceeded the minimum effectiveness threshold of 50% for fly control. Although jackfruit latex demonstrated slightly higher adhesive performance, both types of latex were proven to be effective natural adhesives. Jackfruit latex and breadnut latex have strong potential to be developed as environmentally friendly adhesive materials for fly trap technology, supporting sustainable vector control strategies and the prevention of diarrheal diseases.

KEYWORDS: Breadnut Latex, Environmental Health, House Fly, Jackfruit Latex, Natural Adhesive.

1. INTRODUCTION

Health is a dynamic condition that reflects the ability of individuals and society to maintain physical, mental, and social balance and to adapt optimally to environmental changes (Salsabilla et al., 2022). From an environmental health perspective, environmental quality strongly influences public health, especially through environmental disease transmission mechanisms (Sungkono et al., 2025). One of the environmental health problems that remains a major challenge in developing countries is the high incidence of diarrheal diseases, largely triggered by poor sanitation and the presence of mechanical vectors, especially flies (Mastikana et al., 2025; Mustikawati et al., 2016).

House flies (*Musca domestica*) act as highly effective mechanical vectors in the spread of environmentally transmitted diseases (Iqbal et al., 2024). Diseases that can be transmitted by flies include gastrointestinal infections, dysentery, diarrhea, typhoid, cholera, and worm infections. In addition, these vectors can transmit pathogenic microorganisms that cause diarrhea, such as *Escherichia coli*, *Salmonella*, and *Shigella* (Piri et al., 2022). Globally, diarrhea is the leading cause of death among children under the age of five, with about 1.7 billion cases each year and more than 443,000 deaths. Although it is classified as a preventable disease through proper sanitation, clean water, and hygienic behavior, diarrhea remains the main cause of malnutrition in children (Hidayattullah et al., 2021; Rahayu et al., 2025; Zahara et al., 2023). The national prevalence of diarrhea among toddlers reached 26.4% in 2022, while the prevalence in South Sulawesi reached 26.1%. The highest prevalence of diarrhea among toddlers occurred in the 24-35-month age group, at 12.63% (Widowaty et al., 2022). According to data from the Makassar City Health Office, cases of diarrhea among toddlers in Makassar City remain high. In 2020, there were 4,306 cases; in 2021, 2,916 cases; and in 2022, 3,124 cases.

Flies breed in places rich in organic matter, such as garbage, feces, and food waste, so their bodies and legs are easily contaminated with pathogenic bacteria (Ahyanti et al., 2022). When flies land on human food or cutlery, the pathogen can be transferred and cause gastrointestinal infections (Wulansari & Windarso, 2018). Therefore, fly population control is a critical component of efforts to prevent diarrheal diseases and protect public health. Fly control efforts so far remain dominated by the use of chemical insecticides (Ahyanti et al., 2022). Although effective in the short term, the use of these chemicals has a variety of negative impacts, including insect resistance, environmental pollution, and potential toxic risks to humans and non-target animals (Fajriansyah, 2016). In addition, insecticide residues can pollute the air, soil, and water, ultimately degrading environmental quality. This condition demands an alternative fly control method that is safer, more environmentally friendly, and sustainable. (Scolari et al., 2021).

One of the approaches that has developed is the use of fly traps (Fly Trap) based on mechanics that utilize adhesion as a means to trap flies (Hadi et al., 2022). *Fly* traps have the advantage of not using toxic ingredients, can be used repeatedly, are relatively inexpensive, and are easy to apply in household environments and food management places (Ahyanti et al., 2022). When Fly Trap is combined with natural adhesives, this technology is becoming increasingly relevant in the context of environmentally friendly vector control that is principled in sustainability (Soliman et al., 2024). The study of baits, including fish waste, rotten tempeh, vegetable waste, and fruit waste, in fly traps has a significant effect on the number of flies trapped in adhesive glue at Pabaeng Baeng Market, as shown by a One-Way ANOVA with $p = 0.006 < 0.05$. Fish waste baits have been shown to be the most effective at attracting flies, with the highest number of trapped flies compared to other baits. (Rasjid et al., 2025).

Plants such as *Artocarpus heterophyllus*And more (*Artocarpus camansi*) is an abundant tropical plant in Indonesia and belongs to the *Moraceae* family which is known to produce large amounts of sap (latex) (Hidayat et al., 2025). Jackfruit sap contains natural polymeric compounds, especially polyisoprene and polysaccharides. Polyisoprene is the main component of natural rubber, which has high elasticity and adhesion properties, while polysaccharides increase viscosity and adhesion. The combination of these two compounds makes jackfruit sap potentially a strong and stable natural adhesive. Meanwhile, *kluwih* is also a gummy plant, and almost all parts of the plant, ranging from flowers, fruits, leaves, twigs, to stems, can secrete latex (Hinkle & Hogsette, 2021). Traditionally, *kluwih* sap has been used as a bird adhesive because of its very sticky and durable properties. Although the potency of jackfruit sap and *kluwih* sap has been widely reported separately, studies that directly compare the adhesion ability and effectiveness of the two types of sap for fly control are still very limited (Khan et al., 2021). Most previous studies have focused only on one type of sap or on combining it with other ingredients, without evaluating the relative performance among plant latexes

(Kurniabudhi et al., 2024). In addition, studies that integrate plant sap use with environmental health perspectives and vector-borne disease prevention, especially for diarrhea, remain rare (Saurabh et al., 2021).

This research gap underscores the urgency of conducting a comparative study of the adhesive properties of jackfruit sap and *kluwih* sap as fly-trap materials. To date, there is no adequate scientific data on differences in adhesive characteristics, fly-entrapment efficiency, and the applicability of the two sap types in an environmentally oriented fly-trap system for vector control. In the absence of strong scientific evidence, the use of plant sap as a fly-control technology remains empirical and cannot be widely recommended. Given this background, this research is important for providing scientific evidence on the potential of jackfruit sap and *kluwih* sap as natural adhesives for house fly control. The results of this research are expected to serve as a basis for developing fly-trap technology that is cheap, biodegradable, safe for humans, and environmentally friendly. In addition, the findings of this study are expected to contribute to efforts to prevent diarrheal diseases through sustainable vector control, especially in areas with limited access to modern insect-control technology.

2. RESEARCH METHODOLOGY

This study used a post-test-only experimental design to evaluate the effectiveness of jackfruit sap (*Artocarpus heterophyllus*) and *kluwih* sap (*Artocarpus camansi*) as adhesives for controlling house flies (Musca domestica). The study included one untreated control group. A total of 600 flies were sampled from the Karuwisi Market area in Panakkukang District, Makassar City. Jackfruit and *kluwih* sap were collected from ripe fruit by cutting the fruit surface and collecting the latex, then filtering to remove impurities before use. Fly traps were made from modified plastic bottles and evenly coated with each type of sap according to the treatment group, while the control trap was not coated with sap.

The traps were labeled and placed at the same location under uniform environmental conditions. Temperature and air humidity were recorded before the test. Flies were allowed to enter the traps naturally during a 1-hour exposure period. After that period, the number of flies trapped on the adhesive surface was manually counted and recorded. This process was repeated until all 600 flies were observed. The data on the number of flies caught in each treatment were presented in a table and analyzed descriptively and quantitatively to compare the effectiveness of jackfruit and *kluwih* sap as natural adhesives in the fly control system.

This research was approved by the Health Research Ethics Committee of the Ministry of Health of Makassar (Approval Number: 0822/M/KEPK-PTKMS/V/2024). All experimental procedures were conducted in accordance with national and institutional ethical guidelines for research involving biological organisms, and no procedures involving human or vertebrate animal subjects were performed.

3. RESULTS AND DISCUSSION

3.1. Research Results

Based on research conducted on May 17, 2024, at Jl. Musyawarah no.15, Kec. Panakkukang, Makassar City, which was an experiment using a sample of 600 flies. The experiment used a fly cage with a fly trap device smeared with jackfruit sap or *kluwih* sap. The results are presented as follows:

Table 1. Results of Observation of the Ability of Jackfruit Sap and Kluwih Sap as Adhesive for House Flies (Musca Domestica).

No	Group Name	Observation Time	Rubber Weight	Number of Flies Replication			Total	Humidity Temperature
				I	II	III		
1.	*Artocarpus heterophyllus* (Jackfruit)	30 minutes	20 gr	56	53	57	166	32°C / 66% RH
2.	*Artocarpus camansi* (*Kluwih*)	30 minutes	20 gr	54	50	52	156	32°C / 66% RH
Total							**322**	

Based on Table 1, the results show that jackfruit sap and *kluwih* sap, used as adhesives for house flies (*Musca domestica*), differ in ensnarement ability across treatments. In the jackfruit sap treatment, with an observation time of 30 minutes and a sap weight of 20 grams, the number of flies trapped in replications I, II, and III was 56, 54, and 56, respectively, for a total of 166 flies successfully glued. Meanwhile, in the *kluwih* sap treatment, with the same time and sap weight, the number of flies trapped in replications I, II, and III was 50, 52, and 54, respectively, for a total of 156 flies successfully glued. All observations were made under relatively uniform environmental conditions, with an air temperature of 32°C and a relative humidity of 66%, so the difference in the number of trapped flies can be attributed to the

difference in adhesion of each type of sap. Overall, the total number of flies successfully glued by both types of sap in three replications was 322 individuals, which shows that both jackfruit sap and *kluwih* sap have the potential as natural adhesives in house fly control.

Table 2. Distribution of Flies Trapped in the Sap and Sap of Kluwih Fruit as Adhesive.

Adhesive Type	Remarks	Number of Flies (n)	Percentage (%)
Artocarpus heterophyllus (Jackfruit)	Non-stick	134	44
	Sticky	166	55
	Total	**300**	**100**
Artocarpus camansi (*Kluwih*)	Non-stick	144	48
	Sticky	156	52
	Total	**300**	**100**

According to Table 2, jackfruit sap glued 166 flies, or 55.33% of the 300 flies observed across three replications, while 44.67% were not attached. These results show that jackfruit sap meets the minimum standard for fly control effectiveness of 50%, so it can be considered effective as a natural adhesive. Meanwhile, *kluwih* sap glued 156 flies, or 52.00%, with 48.00% not attached. This percentage also exceeds the minimum effectiveness limit of 50%, indicating that *kluwih* sap is effective as a natural adhesive, although its adhesion is slightly lower than that of jackfruit sap. Overall, both types of sap show good potential as environmentally friendly alternatives in house fly control systems (*Musca domestica*).

3.2. Discussion

Based on the observational results, this study demonstrates that jackfruit sap (*Artocarpus heterophyllus*) and *kluwih* sap (*Artocarpus camansi*) are capable of functioning as natural adhesives for trapping house flies (*Musca domestica*), with effectiveness rates of 55.33% and 52.00%, respectively. Both values exceed the minimum effectiveness threshold of 50%, confirming that these plant-based materials hold genuine potential as alternatives to chemical insecticides in fly vector control. This finding aligns with the broader concern raised in the introduction regarding the negative consequences of chemical insecticide overuse, including insect resistance, environmental pollution, and toxic risks to non-target organisms (Fajriansyah, 2016), which has pushed researchers toward safer, more sustainable control strategies.

The adhesive performance of jackfruit sap can be attributed to its chemical composition. As noted by Indragiri et al. (2021) and Kasim et al. (2024), jackfruit sap contains polyisoprene and polysaccharides, polyisoprene provides natural elasticity and stickiness, while polysaccharides contribute to viscosity and enhanced adhesion. These properties explain why jackfruit sap was able to retain more flies (166 flies) across all three replications. The slight superiority of jackfruit sap over *kluwih* sap is consistent with its higher polymer density, though both materials share a similar mechanism of action. *Kluwih* sap, on the other hand, has been traditionally recognized for its strong adhesion which historically used as a bird adhesive and Baker et al. (2020) and Hinkle and Hogsette (2021) have noted the broader applicability of plant-derived adhesives in insect control systems, supporting the findings of this study.

Beyond physical adhesion, olfactory attraction appears to play an important role in luring flies toward the traps. The distinctive pungent odor emitted by both types of sap likely mimics the organic odor cues that flies associate with breeding and feeding sites, such as garbage and food waste (Mohamad et al., 2023). This is consistent with the study by Wulansari and Windarso (2018), which demonstrated that jackfruit-derived materials could serve as effective fly attractants in fly trap systems. Further, Rasjid et al. (2025) showed that bait type significantly influences the number of flies trapped on adhesive surfaces, reinforcing the idea that both the adhesive and olfactory properties of sap contribute jointly to entrapment success.

Environmental conditions recorded during this study which are temperature of 32°C and relative humidity of 66% were within the range that supports active fly behavior, though slightly above the optimal activity range of 21–30°C reported by Inayah and Sukendra (2019). Under these conditions, flies remained sufficiently active to approach and contact the adhesive surfaces, although the warmer temperature may have contributed to the faster drying of the sap, which in turn reduced adhesion over time and allowed some flies to escape after initial contact. This drying effect was more pronounced in jackfruit sap and may partly explain why its effectiveness, despite being higher, did not exceed 60%.

The slightly lower effectiveness of *kluwih* sap compared to jackfruit sap may also be attributed to uneven spatial distribution of flies within the cage,

with some individuals clustering near corners or netting rather than approaching the trap surface a behavioral observation consistent with findings reported by Musvitasari et al. (2023). Additionally, variations in sap viscosity between batches, which were not standardized in this study, could have introduced minor inconsistencies in adhesion performance across replications.

Despite these limitations, the overall results are encouraging. The use of fly traps as a mechanical, non-toxic control method has previously been established as a practical and reusable tool for managing fly populations in household and food-handling environments (Ahyanti et al., 2022; Hadi et al., 2022). When integrated with natural adhesives such as jackfruit and *kluwih* sap which are locally abundant, biodegradable, and free from the toxic residues associated with synthetic pesticides, this approach represents a meaningful contribution to sustainable vector control. As highlighted by Al-irsyad et al. (2025), community-based fly control using eco-friendly materials is not only feasible but actively promoted as part of environmental health education.

From a public health standpoint, the relevance of this study extends beyond fly control itself. House flies are established mechanical vectors for pathogens such as *Escherichia coli*, *Salmonella*, and *Shigella* (Iqbal et al., 2024; Piri et al., 2022), all of which are causative agents of diarrheal diseases that remain a significant burden in Indonesia, including in Makassar City where diarrhea cases among toddlers have consistently remained high across recent years. Reducing fly populations through safe, accessible tools directly supports diarrhea prevention efforts, particularly in communities with limited access to modern pest control technology.

Future research should address the limitations of this study by extending observation periods, testing a wider range of temperature and humidity conditions, and standardizing sap viscosity and application thickness. Field-based trials in household and market environments would further establish the practical applicability of jackfruit and *kluwih* sap as fly control materials. Exploring combinations of the two saps, or their integration with natural baits shown to be effective in previous studies such as fish waste (Rasjid et al., 2025), may also improve overall trap performance.

4. CONCLUSION

Based on the results of the research that has been carried out, it can be concluded that jackfruit sap and *kluwih* sap have the potential as natural adhesives for controlling house flies (Musca domestica). In three experiments with an observation time of 30 minutes each, a fly trap device smeared with jackfruit sap captured 166 flies, and *kluwih* sap captured 156 flies. Therefore, both ingredients are declared effective because they are able to capture more than 50% of the total samples used, even though jackfruit sap shows slightly higher effectiveness than *kluwih* sap. Based on these findings, the results of this study are expected to add academic insight in the field of environmental health, especially related to vector control; to become an alternative solution for the community in controlling flies using natural materials that are safer and more environmentally friendly; and to become the basis for further research to examine the influence of environmental factors such as temperature and humidity, as well as the development of rubber formulations so that their adhesion is more stable and applicable.

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