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ANALGESIC EFFECT OF GARLIC (*ALLIUM SATIVUM*) AS POTENTIAL HERBAL REMEDY FOR TOOTHACHE

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ABSTRACT. This study investigates the analgesic properties of garlic (Allium sativum) as a potential herbal remedy for toothache. With the rising interest in alternative and complementary medicine, exploring natural substances like garlic for their pain-relieving effects becomes imperative. The methods employed for extracting these mixtures were also utilized in a study conducted by (Somayyeh Loghmanifar, 2020). Data were presented as mean ± standard error mean (SEM). The results were analyzed using Statistical Package for the Social Sciences (SPSS) version 21. The results suggest that Aqueous Garlic Extract (AqGE) and Ethanolic Garlic Extract (EtGE), at specific concentrations and dosages, may have the potential for pain relief. However, commercially available over-the-counter pain relievers, such as Tooth-ache Drops, also demonstrated significant pain-relieving effects, with some being more pronounced than the garlic extracts. These findings hint at the potential of garlic extracts as natural pain management solutions, but further investigation is essential for practical applications.

Keywords:*analgesic, garlic, herbal remedy, toothache*

I.INTRODUCTION

Toothache is a common oral health problem experienced by individuals of all ages. It is often caused by various factors, including dental decay, gum disease, tooth fractures, and inflammation (JM., 2011). According to National Center for Biotechnology Information, the mouth is colonized by 200 to 300 bacterial species, but only a limited number of these species participate in dental decay (caries) or periodontal disease (Walter, 2006). Streptococcus mutans is the main pathogen which causes tooth decay that feed on the sugars and carbohydrates present in the food eaten by the consumers (Berkowitz, 2006). As a result, traditional remedies and over-the-counter medications are frequently used to alleviate the pain associated with toothaches.

However, despite application of medications, tooth problem is still on the rise. Hence, there is a strong suggestion for exploring natural and efficient substitutes for traditional approaches to managing pain. This is because conventional pain relievers often come with potential side effects, especially when used frequently. Several researches revealed that antibiotics such as penicillin and vancomycin are found to have good anticaries effect, yet make changes in the oral and intestinal flora, and their regular use can result in antibiotic resistance (Maheswarappa& Reddy, 2017). Natural medications to any dental issues especially toothache has led to the explorations of plant-based remedies (Christine, 2020).

Garlic (Allium sativum), a commonly available kitchen ingredient, is known for its potential medicinal properties due to its bioactive compounds, making it an intriguing candidate for investigating its effectiveness as a natural remedy for toothache ((Phytomed, 2014). This plant has been used for centuries in traditional medicine for its various health benefits, including pain relief. Its antimicrobial, anti-inflammatory, and analgesic properties have been acknowledged in different cultures. Garlic contains sulfur compounds such as allicin, which is known for its antibacterial and anti-inflammatory effects. (Sasi, Kumar, & Kumar, 2021). According to the study conducted by (Bongato, Chua, &Dacut, 2015) garlic, being a natural ingredient, might offer a safer alternative with fewer adverse effects, making it an appealing option for individuals seeking more natural solutions.

This study determined the potential pain-relieving effects of garlic when applied topically to aching teeth, comparing the relief it provides with that of traditional over-the-counter pain relievers.

Hypothesis:

$H_{a:}$ "If garlic extracts, specifically Aqueous Garlic Extract (AqGE) and Ethanolic Garlic Extract (EtGE), are applied at specific concentrations and dosages, then they will have a significant impact on reducing pain, as indicated by an increase in the response/latency period, compared to over-the-counter toothache drops.

Statement of the Problem

This study aimed to determine the potential pain-relieving effects of garlic extract when applied topically to aching teeth, comparing the relief it provides with that of traditional over-the-counter toothache pain relievers.

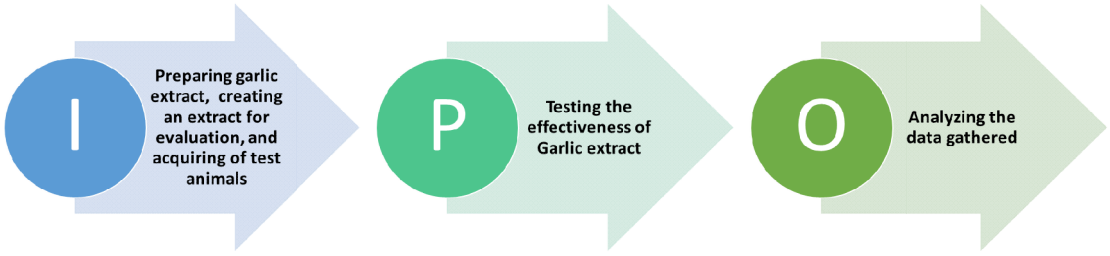
This study sought to address the following specific questions:

1. What mixture can be prepared from garlic that can relieve pain?
2. What are the optimal concentrations and dosages of garlic extracts that provide potential pain relief effects?
3. Is there a difference on the pain relief potential between the topical garlic solution with that of commercially available over-the-counter pain relievers?

II.METHODOLOGY

Materials:

70 g fresh garlic cloves	Garlic Grinder	Saline solution
Commercial toothache drops	50 Petri Dishes	1 Pan
Laboratory Oven	2 hot plates	Pipette
50% Ethanol	Sticky tape	Gavage
250 ml beaker	48 male mice	Mice cage
Blender	Mortar and Pestle	



Procedures

Garlic extract preparation

Fresh garlic bulbs were procured from the local market. Two distinct garlic mixtures were prepared for the sake of comparison. The methods employed for extracting these mixtures were also utilized in a study conducted by (Somayyeh Loghmanifar, 2020)

The first mixture, referred to as aqueous garlic extract (AGE), was prepared by adapting the method proposed by Swami et al, albeit with some modifications. In this process, garlic cloves were meticulously peeled, washed, and then crushed before being combined with distilled water in a ratio of 1:10 (weight to volume). The resulting mixture was subjected to an oven at 35°C for a duration of 24 hours. Following this, the solution was carefully filtered through Whatman Filter Paper No.1 and subsequently dried. The solid residue obtained was further desiccated under a hot-air dryer, resulting in a finely powdered crude extract.

The second mixture, referred to as ethanolic garlic extract (EGE), was prepared using a similar method to that of AGE, again with adaptations from Swami et al.'s 2008 approach. Garlic cloves were peeled, washed, and crushed, after which they were combined with 50% ethanol in a 1:10 (weight to volume) ratio. The mixture was exposed to an oven at 35°C for a period of 24 hours. The solution was then subjected to filtration using Whatman Filter Paper No.1, followed by drying. The solid residue obtained was further pounded to dryness under a hot-air dryer, resulting in a powdery crude ethanolic extract.

Preparation of Extracts for testing

The powdered aqueous garlic extract (AGE) was then prepared into three different concentrations, Aq 0.1 g/ml, Aq 0.2 g/ml, and Aq 0.5 g/ml. For Aq 0.1 g/ml, 10 grams of crushed garlic were added with enough solvent to make a 100 ml extract; the concentration of 10 g / 100 ml = 0.1 g/ml was obtained. Similarly, for Aq 0.2 g/ml, 20 grams of crushed garlic were added with enough solvent to make a 100 ml extract to achieve a 0.2 g/ml concentration, and for Aq 0.5 g/ml, 50 grams of crushed garlic were added with enough solvent to make a 100 ml extract used to prepare a 0.5 g/ml concentration. These different concentrations were carefully measured and prepared to ensure the accurate dosages required for the subsequent experiments. The solvent used in these preparations is typically distilled water, and the extracts were thoroughly mixed and filtered to obtain the desired concentrations. The resulting extracts were stored appropriately for further use in the research study. Similar method was used to prepare the ethanolic garlic extract (EGE) in three different concentrations, Et 0.1 g/ml, Et 0.2 g/ml, and Et 0.5 g/ml.

Animals

Male albino rats (Rattus norvegicus) (8 g–30 g), were obtained from the Laboratory Animal Units of the Cebu Roosevelt Memorial Colleges, were used for the experiment. The animals were housed under standard laboratory conditions at room temperature with relative humidity of 70–80%. They were fed with standard commercial diet and water ad libitum. Prior to the experiment, the animals were fasted for 12 h with water given ad libitum and weighed. All procedures described were reviewed and approved by the CRMC Research Animal Ethics Committee (REC).

Testing the effectiveness of Garlic extract

To test the efficacies of the extract, hot plate method was used and its effect was assessed by measuring the reaction time (in seconds) or latency period was determined as the time taken for the rats to react to the thermal pain by licking their paws or jumping. The reaction time was taken before and after the administration of the treatments. This method was done through these steps:

The rats were randomly assigned to 16 groups of three animals each for the different experimental models. The Aqueous extract (AqGE) and the Ethanolic extract (EtGE) of the garlic was given at a dose of 125 mg/kg and 250 mg/kg to the first to twelfth group. All treatments were administered orally. The thirteenthand fourteenth group served as negative control receiving water. The fifteenth and sixteenth groups served as positive control and were given standard drugs for toothache (0.5ml/0.5ml toothache drops).

Rats were placed on a hot-plate at 55°±5 ° C. The latency to lick the paw was the reaction time. A cut off time of 30 seconds was followed to avoid any thermal injury to the paws. GE was given in the doses of 125 mg/kg, and 250 mg/kg per orally. The reaction time of the rats was recorded before and 10 minutes after oral administration. The mean of the observed values was considered for statistical analysis.

Data Analysis

Data were presented as mean ± standard error mean (SEM). The results were analyzed using Statistical Package for the Social Sciences (SPSS) version 21. Statistical significance was determined by ANOVA and value less than 0.05 was considered as significant. Normality of data was established. To assess normality, a Shapiro-Wilk test was performed. The results indicated no evidence of non-normality. Additionally, a visual examination of the histogram and QQ plot supported this finding.

III.RESULTS

The results of the analgesic effect of the garlic extract using hot plate method are presented in Table 1.The table provides results related to the "Increase in Response/Latency Period" for various treatments at different concentrations and dosages. The data is presented as the mean percentage change in response/latency period along with the Standard Error of the Mean (SEM).

The treatments are categorized as Aqueous Garlic Extract (AqGE), Ethanolic Garlic Extract (EtGE), Control: Tooth-ache Drops and Water.In the Aqueous Garlic Extract (AqGE) with concentration of 0.1 g/ml, a dosage of 125 mg/kg, AqGE resulted in a 0.863% increase in the response/latency period, suggesting a potential for pain reduction. The SEM value of 0.069 indicates a relatively precise mean estimate.

When the dosage was increased to 250 mg/kg at the same concentration, the response/latency period increased to 1.034%, indicating a more substantial reduction in pain or increased pain tolerance. This effect is statistically significant compared to the control group ($P<0.05$).

Table 1

Increase in Response/Latency Period

Treatments	% Response/Latency Period (Mean±S.E.M.)	
	125mg/kg oral dose	250 mg/kg oral dose
AqGE		
0.1 g/ml	0.863 ±0.069	1.034±0.084 **
0.2 g/ml	0.626 ±0.336	0.634 ±0.057 **
0.5 g/ml	0.167 ±0.0133	0.048 ±0.009
EtGE		

0.1 g/ml	0.788 ± 0.209**	0.612 ±0.035 **
0.2 g/ml	0.262 ±0.040	1.073 ±0.230
0.5 g/ml	0.345 ±0.130	0.745 ±0.059
Control		
Tooth-ache Drops		
0.5/0.5 ml	1.087±0.154	2.843 ±0.268
Water		
	0.0108 ±0	0.021±0.021

**P<0.05 when compared to the control group. AqGE: EtGE:Response: SEM:

Meanwhile, at a concentration of 0.2 g/ml, the results at this concentration are similar to those of 0.1 g/ml, with a SEM value of 0.336 for the lower dosage. The mean percentage increase in the response/latency period remains relatively low. Moreover, at concentration of 0.5 g/ml, even at a higher dosage of 250 mg/kg, the effect on the response/latency period is modest (0.048%). This indicates that this concentration may have a weaker pain-relieving effect compared to the 0.1 g/ml concentration.

Further, the Ethanolic Garlic Extract (EtGE), at 0.1 g/ml, EtGE resulted in a 0.788% increase in the response/latency period at a dosage of 125 mg/kg. This suggests a potential for pain reduction or increased pain tolerance, although the effect is moderate. The SEM of 0.209 indicates some variability in the data. When the dosage was increased to 250 mg/kg, the response/latency period increased by 0.612%, indicating a greater pain-relieving effect. This effect is statistically significant compared to the control group (P<0.05).

Meanwhile, at a concentration of 0.2 g/ml, the results for this concentration are mixed, with a significant increase in response/latency period at the higher dosage, suggesting potential pain relief. However, the SEM value of 0.230 indicates some variability in the data. Further, for the Concentration of 0.5 g/ml, EtGE shows a modest pain-relieving effect, with a response/latency period increase of 0.345% at a lower dosage and 0.745% at a higher dosage.

For the Tooth-ache Drops, serving as a commercially available over-the-counter pain reliever, demonstrated a significant pain-relieving effect with a mean percentage increase in the response/latency period of 1.087%. This effect is more pronounced than some of the garlic extract treatments. Subsequently, the control group, represented by the application of water, showed only a minimal mean percentage increase of 0.0108%, indicating minimal pain relief.

Therefore, the results suggest that Aqueous Garlic Extract (AqGE) and Ethanolic Garlic Extract (EtGE), at specific concentrations and dosages, may have the potential for pain relief. However, commercially available over-the-counter pain relievers, such as Tooth-ache Drops, also demonstrated significant pain-relieving effects, with some being more pronounced than the garlic extracts.

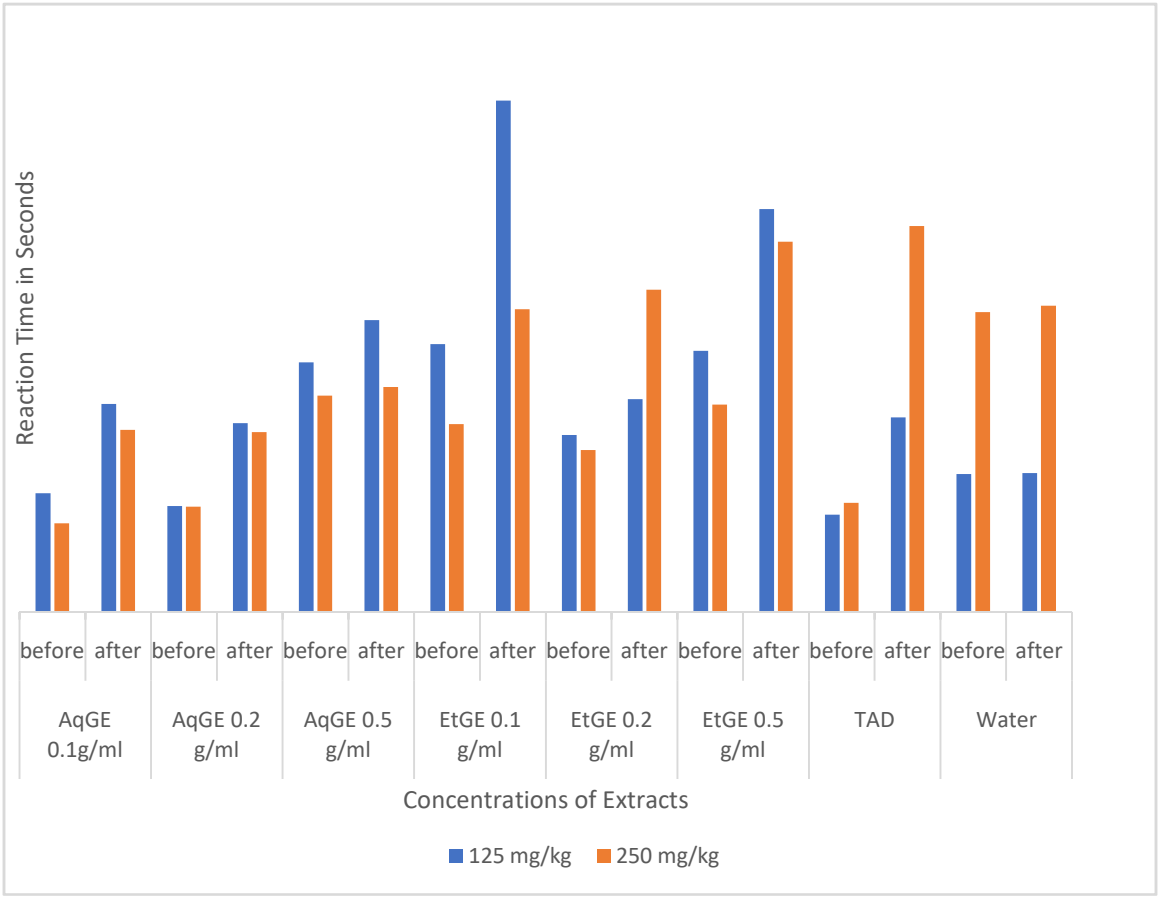
To precisely quantify the percentage reduction in pain and understand the mechanisms behind the pain-relieving effects, further research and clinical studies are warranted. These studies should also consider factors such as the duration of pain relief, safety, and side effects to

make a comprehensive assessment of their effectiveness. The Standard Error of the Mean (SEM) values provide confidence in the precision of the mean estimates, indicating the reliability of the results.

Figure 1 showed the comparison of the effects of varying extracts of AqGE and EtGE against the positive control, the toothache drops (TAD) and negative control, the Water. From the figure, it indicated that both AqGE and EtGE, at specific concentrations and dosages, showed significant increases in response/latency period, indicating potential pain reduction.Additionally, commercially available over-the-counter pain relievers, such as Tooth-ache Drops, also demonstrated a pain-reducing effect.The research revealed that Aqueous Garlic Extract (AqGE) at concentrations of 0.1 g/ml and 0.2 g/ml, when administered at a dosage of 250 mg/kg, displayed noticeable increases in the response/latency period, suggesting potential pain-relief effects. Similarly, Ethanolic Garlic Extract (EtGE) at a concentration of 0.1 g/ml and dosages of 125 mg/kg and 250 mg/kg also exhibited potential pain-relief properties.

Figure 1

Reaction Time across different treatment groups



Consequently, both AqGE (0.1 g/ml and 0.2 g/ml at 250 mg/kg) and EtGE (0.1 g/ml at 125 mg/kg and 250 mg/kg) showed statistically significant differences compared to a

commercially available over-the-counter pain reliever, Tooth-ache Drops, which yielded promising outcomes.

IV.DISCUSSIONS

This study investigated the potential pain-relieving properties of garlic extracts, specifically Aqueous Garlic Extract (AqGE) and Ethanolic Garlic Extract (EtGE). The researchers conducted experiments using different concentrations and dosages of these extracts to assess their impact on the response/latency period, which can be indicative of pain relief.

The study assessed the analgesic properties of garlic extracts using the hot plate method and presented the results in Table 1. The data indicates the "Increase in Response/Latency Period" for different treatments at various concentrations and dosages, along with the Standard Error of the Mean (SEM). The treatments were Aqueous Garlic Extract (AqGE), Ethanolic Garlic Extract (EtGE), Control: Tooth-ache Drops, and Water.

In the case of AqGE, a concentration of 0.1 g/ml, administered at a dosage of 125 mg/kg, resulted in a 0.863% increase in the response/latency period, suggesting potential pain reduction. Increasing the dosage to 250 mg/kg at the same concentration led to a more substantial increase (1.034%) in pain tolerance. This effect was statistically significant compared to the control group ($P<0.05$). For a concentration of 0.2 g/ml, the results were similar to those of 0.1 g/ml but with a higher SEM value, indicating a modest effect. At 0.5 g/ml, even with a higher dosage of 250 mg/kg, the pain-relieving effect was modest (0.048%).

EtGE, at 0.1 g/ml and 125 mg/kg dosage, showed a 0.788% increase in the response/latency period, suggesting some potential for pain reduction. The effect became more significant when the dosage was increased to 250 mg/kg (0.612%). At a concentration of 0.2 g/ml, the results were mixed, with a significant increase in pain tolerance at higher dosages but some variability in the data (SEM = 0.230). For 0.5 g/ml, EtGE showed a modest pain-relieving effect.

Tooth-ache Drops, representing a commercially available over-the-counter pain reliever, demonstrated a significant pain-relieving effect (1.087%). This effect was more pronounced than some garlic extract treatments. The control group (Water) showed only minimal pain relief (0.0108%).

In essence, AqGE and EtGE at specific concentrations and dosages show potential for pain relief. However, commercially available over-the-counter pain relievers, like Tooth-ache Drops, also demonstrated significant pain relief, with some being more effective than garlic extracts. Further research and clinical studies are needed to precisely quantify pain reduction and understand the mechanisms of action. These studies should also consider factors such as the duration of pain relief, safety, and side effects to comprehensively assess their effectiveness. The SEM values provide confidence in the precision of the mean estimates, ensuring result reliability.

Figure 1 illustrates a comparison of the effects of different AqGE and EtGE extracts against the positive control, Tooth-ache Drops (TAD), and the negative control, Water. The figure shows that both AqGE and EtGE, at specific concentrations and dosages, significantly

increased the response/latency period, indicating potential pain reduction. Additionally, commercially available over-the-counter pain relievers, such as Tooth-ache Drops, also demonstrated pain-reducing effects. The study concludes that AqGE and EtGE have pain-relieving potential but should be further investigated alongside conventional pain relievers.

V.CONCLUSION

This study revealed that Aqueous Garlic Extract (AqGE) and Ethanolic Garlic Extract (EtGE) show promise as natural pain-relieving agents, particularly at specific concentrations and dosages. The research findings indicate significant increases in the response/latency period, suggesting potential pain reduction. Tooth-ache Drops, a commercial pain reliever, also demonstrated pain-reducing effects. Further research and comparative studies are needed to fully evaluate their efficacy and safety, as well as to explore potential mechanisms of action. These findings hint at the potential of garlic extracts as natural pain management solutions, but further investigation is essential for practical applications.

VI.FUNDING

The authors declare no funding in this study

VII.CONFLICT OF INTEREST

The authors declare no conflict of interest in this study

ETHICAL STATEMENT

This research has been declared to have received an ethical certificate from the Research Ethical Committee

AUTHOR CONTRIBUTION

All authors contributed equally to this study

VI.RECOMMENDATION

Based on the study's findings, it is recommended to conduct further research and clinical trials to better understand the effectiveness, safety, and mechanisms of action of Aqueous Garlic Extract (AqGE) and Ethanolic Garlic Extract (EtGE) in pain management. Comparative studies should be carried out to determine whether these garlic extracts offer advantages over existing over-the-counter pain relievers. Additionally, investigating the duration of pain relief and potential side effects is essential for a comprehensive assessment. These findings provide a foundation for exploring garlic extracts as potential natural alternatives for pain relief, but rigorous research is needed to validate their practical use.

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